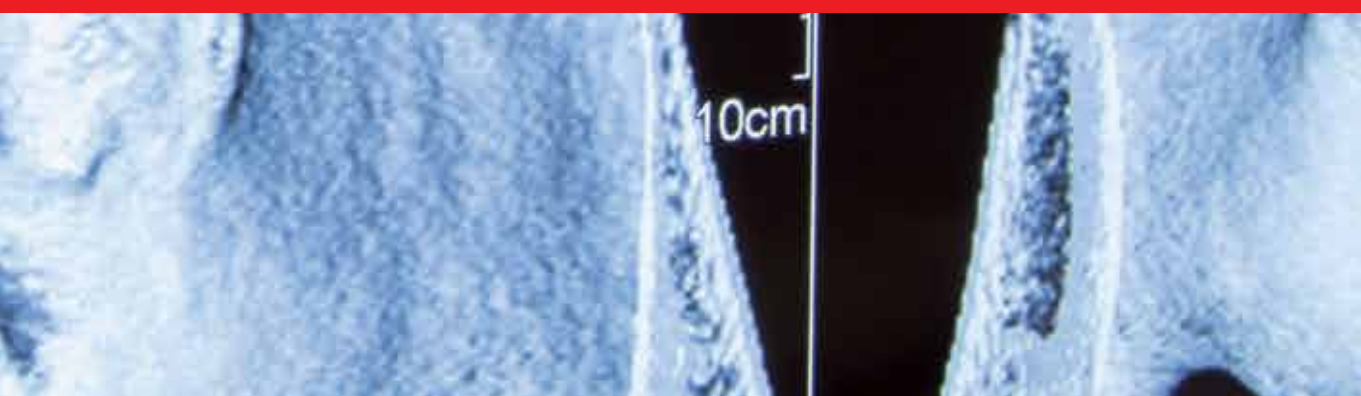
IntechOpen

Hernia Surgery and Recent Developments

Edited by Arshad M. Malik



HERNIA SURGERY AND RECENT DEVELOPMENTS

Edited by **Arshad M. Malik**

Hernia Surgery and Recent Developments
http://dx.doi.org/10.5772/intechopen.72463
Edited by Arshad M. Malik

Contributors

Florina Popa, Ahmed A Nugud, Abdulrahman Al Awadhi, Shomous Nugud, Assmaa Nugud, Manish Kumar Gupta, Angelo Guttadauro, Matteo Maternini, Nicoletta Pecora, Valentina Riggio, Francesco Gabrielli, Marco Chiarelli, Fatih Altintoprak, Emrah Akin, Kemal Gundogdu, Enis Dikicier, Monika Romanowska, Jacek Pawlak, Arshad Malik

Notice

First published in London, United Kingdom, 2018 by IntechOpen
eBook (PDF) Published by IntechOpen, 2019
IntechOpen is the global imprint of INTECHOPEN LIMITED, registered in England and Wales, registration number: 11086078, The Shard, 25th floor, 32 London Bridge Street
London, SE19SG – United Kingdom
Printed in Croatia

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Additional hard and PDF copies can be obtained from orders@intechopen.com

Hernia Surgery and Recent Developments
Edited by Arshad M. Malik

p. cm.

Print ISBN 978-1-78923-446-6

Online ISBN 978-1-78923-447-3

eBook (PDF) ISBN 978-1-83881-687-2

Meet the editor

Dr. Arshad Malik graduated from the Liaquat Medical College, Jamshoro, Pakistan, in 1985. After many years of academic struggle, he has finally chosen his career in General Surgery. He joined the surgical training under the dynamic supervision of Professor Jan Muhammad Memon (FRCS) and did his fellowship in General Surgery from the College of Physicians and Surgeons, Pakistan, in 1997. He also started doing laparoscopic surgery and developed an especial interest in medical writing. He has authored 48 scientific publications in various national and international journals. He has presented his scientific work in general and laparoscopic surgical meetings all over the world. His scientific contribution has always been praised and well-received by the experts in this field. He is presently working as an Associate Professor of Surgery at the College of Medicine, Qassim University, Saudi Arabia wherein he is supervising student research projects as a guide and mentor. He is a reviewer of many reputed journals and an Editor of the International Journal of Health Sciences. He is also associated with Intech publishers as an author as well as an editor. He has edited four books so far and contributed four chapters of very significant impact. His main interests are hernia, biliary surgery, thyroid surgery, and abdominal and chest trauma.

This book is intended for the undergraduates and postgraduates alike who are inspiring hernia surgeons. The book contains the recent advances in the operative techniques in hernia surgery and is likely to benefit the laparoscopic surgeons all around.

Contents

Preface

Hernia is one of the most ancient surgical problems affecting the mankind. Since the earliest time, various operative and nonoperative modes of treatment for the correction of hernias were introduced and practiced by surgeons. There were various strange surgical operative approaches in practice ranging from excision of the testicles to various noninterventional methods like bleeding the patients and keeping them sedated so as to reduce the obstructed hernias. A number of eminent surgeons of their time tried different strategies for the careful management of hernia. The hernia surgery has passed through a long phase of evolution from the very basic repair by Dr. Edoardo Bassini (1844–1924), who was an Italian surgeon. He presented his technique based purely on the anatomy of the inguinal region and suggested a repair procedure by using a suture repair to strengthen the posterior wall of inguinal canal. Dr. Edward Earle Shouldice (1890–1965) introduced the concept of reinforcing the inguinal canal by applying the mesh to repair inguinal hernias. There were many complications associated with these traditional procedures for the repair of inguinal and other hernias of which the most dreaded and common complication was the recurrence of the hernia. The surgeons were in a continuous struggle to find an optimal procedure that will offer the best possible surgical procedure to the hernia patients. In 1987, Dr. Irving Lichtenstein reported the consequences of 6321 patients showing a substantially low rate of recurrence after surgery with Marlex (polypropylene) prosthetic material. His strategy bearing his name was termed "tensionless" repair, and after some time, this has turned into a mainstay of hernia repair. The tensionless repair continued and even today is practiced all over the world. The introduction of laparoscopic repair of hernia repair has changed the outlook of hernia patients globally. The current laparoscopic technique involves applying the mesh either through a totally extra-peritoneal approach or through a trans-peritoneal approach.

This book gives a very deep insight into the rapidly changing field of hernia surgery. The eminent surgeons involved in the field have contributed their respective experiences regarding the most recent patterns and specialized adjustments for both normal and complex hernias. The readers will certainly gain a lot of knowledge regarding the basic anatomical concepts and the various advancements in the different techniques offered for the correction of different hernias. Positive critical observations and suggestions will be highly appreciated.

Dr. Arshad M. Malik
Associate Professor of Surgery
College of Medicine
Qassim University
Kingdom of Saudi Arabia

A Brief Note on Hernia Surgery

Chapter 1

Introductory Chapter: Hernia Surgery and the Developing World

Arshad M. Malik

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.77977

1. Introduction

Hernias are as old as history of mankind. The history of hernia dates back to 400 BC when Ancient Greeks diagnosed and proposed various modes of treatment. The word hernia has its origin from the Greek word hernios, a bud or a shoot. Despite the fact that the common course of the hernia was not sudden and the progress was typically slow, it eventually grows to an enormous size at times and could make the life of the patient difficult as far as the routine work was concerned. This coupled with an impending danger of complications made it mandatory for the physicians to find out some remedy.

For many years, different surgical and nonsurgical options were practiced and offered to patients experiencing complicated hernias such as obstructed and strangulated hernias. One of the common strategy included surgery with castration as a component to get rid of the complicated hernia. Nonsurgical strategies comprised principally of applying pressure belts to keep the hernia contents from descending into scrotum. This was done after reducing the contents of the hernia sac and then applying firm pressure of the belt especially on to the deep inguinal ring to keep the passage of hernia completely blocked. The other methods included phlebotomy, tobacco douches, and exceptional eating methodologies. Curiously, trusses (pressure gadget) were additionally portrayed and utilized for noncomplicated hernias and that option continues even today.

1.1. Evolution of hernia surgery

Hernia surgery has made a tremendous improvement in the surgical treatment over many decades from basic repair to the present laparoscopic repair. Various pioneer specialists presented different techniques for the surgical correction and repair of hernia. Among all, the

one who merits specific acknowledgment is Edoardo Bassini (1844–1924) who was an Italian specialist who proposed the idea of restoring the distorted anatomy of the inguinal region to achieve an optimal cure of hernia. His ultimate doctrine was that only complete restoration of the anatomy and reinforcement of the stretched out tissues could produce complete cure. Each and every subsequent strategy for inguinal hernia surgery until introduction of fabricated materials was in actuality varieties of Bassini's doctrine.

It was not until 1984 when Irvin Lichtenstein proposed the idea of a tension-free repair by applying a mesh to strengthen the weak spot without rendering any tension on the tissues. This led to a significant change in the overall outlook of hernia patients especially with reference to the recurrence of hernia. Subsequently, a large number of different prosthetic materials and changes in the technique were introduced until the advent of laparoscopic repair of hernias.

2. Laparoscopic hernia repair

Laparoscopic surgery has brought a phenomenal change in the surgical practice all over the world. Laparoscopic inguinal hernia repair has been presented after the achievement of laparoscopic cholecystectomy on the preface that there would be less postoperative pain and agony, the repair of recurrent hernias would be less demanding, and the bilateral hernias could be dealt simultaneously with enhanced cosmetic results. It has not taken a long time to become the most popular mode of surgical treatment for all types of hernia, especially the groin and ventral abdominal hernias. It is completely different from conventional surgery in which the surgeon enjoys wide exposure, tissue contact, binocular vision, and the use of traditional equipment [1]. A tremendous effort has been made to spread and popularize this new technique especially in the developing countries [2]. However, there is still a major gap in the implementation of modern surgical methods in underdeveloped countries due to various reasons including financial constraints, lack of equipment, and lack of proper training of surgeons. Despite gaining a worldwide popularity, the open surgery is still practiced in the world and more so in the developing countries due to financial constraints [3]. Although the impact of laparoscopic surgery is the same in developing world, the acceptance of laparoscopic surgery is not as much as in the developed world.

Laparoscopic inguinal hernia repair is a current global change in the treatment of this basic surgical issue. Various reports assert its predominance over open repair of hernia in terms of lesser postoperative pain, early return to normal life and a substantial decrease in recurrence rate [4–6]. There are basically two laparoscopic approaches in inguinal hernia surgery which are in common practice globally.

A. The totally extraperitoneal (TEP) repair, albeit actually troublesome, is a type of laparoscopic hernia repair which is picking up popularity and acknowledgment all around the world. It has a unique feature that it does not puncture the peritoneum. In spite of known confinements and dangers, the TEP is getting an overall acceptance and ubiquity as an ever-increasing number of specialists are adopting this technique. It is, however, necessary to have an adequate experience and be clear about the groin anatomy before one should attempt this technique.

Surgical technique: The TEP involves the regularly utilized procedure with a 10-mm infraumbilical port. Through this port, a balloon is advanced after cutting the anterior rectus sheath for insufflating and dissecting out the additional peritoneal space as recommended by many experts in this field [7]. A 100-cc saline or air is insufflated and that very effectively produces a sufficient space for further dissection. The balloon is then pulled out and further insufflation is achieved by way of using an insufflator attached to the trocar. A 10-mm telescope is then inserted and retained followed by insertion of a 5-mm trocar 2 cm above pubic symphysis. A third 5-mm trocar is placed in between these two trocars. Sidelong space made by continuous dissection using traction and countertraction method. The cord is very gently separated from the sac. A polypropylene mesh is then moved onto a grasper and pushed through 10-mm port subsequent to guaranteeing that adequate space is as of now made to lay the mesh. Once in the additional peritoneal space, mesh is unrolled with the assistance of graspers and afterward spreading it on a level plane from midline to lateral ward to cover the hernia orifices adequately. The mesh is fixed by applying few tackers.

B. Transabdominal preperitoneal (TAPP) repair of inguinal hernia. In this technique, the hernia repair is essentially done transabdominally and a mesh is applied after having explored the whole abdomen and excluding any coexisting pathology. This technique basically involves creation of an infraumbilical 5-mm port through which a 5-mm trocar is introduced for insufflation to place other ports under direct vision to ensure safety. A 5-mm scope is passed to take a tour of the abdomen and then two 5-mm trocars are placed lateral to and at the level of umbilicus on each side. After having created the ports, the peritoneum is incised and bluntly dissected from abdominal wall taking care of the triangle of doom. The hernia is reduced by careful dissection and the mesh is applied in the room created by initial dissection. The mesh is then fixed in proper position by applying tackers. The peritoneal flaps are also sutured over the mesh.

Both of the laparoscopic techniques have their advocates comparing the techniques in terms of ease of the procedure, duration of the operation, operative, and postoperative complications.

3. Conclusion

The hernia surgery is in a continuous state of amendment and improvement. So far, there has been a lot of change from the conventional open repair to the present laparoscopic approach. There is a lot to do to make this laparoscopic approach to be taken up by surgeons in the developing world by way of training options and making it economically acceptable to the poor community where the disease is much more common as compared to the affluent society.

Author details

Arshad M. Malik

Address all correspondence to: arshadhamzapk@yahoo.com

College of Medicine, Qassim University, KSA

References

[1] Tehemton E. Udwadia guidelines for laparoscopic surgery. Indian Journal of Medical Ethics. 1997;**5**(2):40

[2] Udwadia TE. Navigating laparoscopic surgery into the next decade in developing countries—A personal perspective. Langenbeck's Archives of Surgery

[3] Basu S, Giri PS, Roy D. Feasibility of same day discharge after mini-laparotomy cholecystectomy—A simulation study in a rural teaching hospital. Canadian Journal of Rural Medicine. 2006;**11**(2):93-98

[4] Wright DM, Kennedy A, Baxter JN. Early outcome after open versus extra peritoneal endoscopic tension free hernioplasty. Surgery. 1996;**119**:552-557

[5] Brooks DC. A prospective comparison of laparoscopic and tension-free open hernioplasty. Archives of Surgery. 1994;**129**:361-366

[6] Liem MSL, Van Duyn EB, van der Graaf Y, van Vroonhove TJMV. Recurrences after conventional anterior and laparoscopic inguinal hernia repair. A randomized comparison. Annals of Surgery. 2003;**237**(1):136-141

[7] Chowbey PK, Khullar R, Sharma A, Soni V, Baijal M. Totally extra peritoneal repair of inguinal hernia: Sir Ganga Ram Hospital technique. Journal of Minimal Access Surgery. 2006;(3):160-164

Section 2

Global Collaboration

Chapter 2

International Surgical Collaboration in Hernia Repair for the Benefit of the Patients: Things We Must Do

Florina Popa

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76906

Abstract

All surgeons must remember the main purpose for which they choose to practice this specialty: to help people. In all books about hernia, the debates are focused on the new surgical techniques developed, the discovery of new materials that can be used for the repair, and the presentation of the particular hernia cases. I believe that progress in this field comes by organizing training programs, visiting fellowships, common clinical studies, sharing knowledge, and medical support for the benefit of the patient. The idea of organizing an international collaboration should be mentioned in this book because ultimately a hernia repair will be made depending on the experience of the surgeon, the particularities of the patient, and the hospital resources.

Keywords: hernia center, international collaboration, surgery, certified hernia center, benefit of the patient

1. Introduction

Medical and scientific researches in the last few years have become increasingly global, cross-national, cross-cultural, and collaborative. This reality is a reflection of the globalization of modern day life and easy communications and movement of health professionals and patients [1].

Acting on principle is better to give than to receive on the following pages I want to highlight the importance of the surgeon in the society, the need for international collaboration, and the key element—teamworking.

A team is made up of individuals with different opinions. That is why it is good to leave aside the personal interests and carefully watch those that are in the interest of the project. Sharing the workload within the team is an important milestone in the evolution of the project. Teamwork is based on that—each member does what he/she is best at. Surgery is teamworking. Through international collaboration, surgeons learn how to improve the performance and accelerate progress. A vast majority of surgical practitioners come into diversified career paths that enable them to use their various abilities in a wide variety of workplace environments. Surgeons have a demanding life but they have to realize that this profession allows them to put their skills to good use and will get more satisfaction as they will get even more involved in providing services for all people in need. Getting engaged in difficult situations and trying to find the best solution to resolve them reflect two great qualities: responsibility and leadership. There are seven major settings in which surgeons can put their education, training, and skills to valuable use: private practice, academic medicine, institutional practice, hospitals, ambulatory surgery settings, government service programs, and the uniformed services. Nevertheless, the primary responsibilities of a surgeon are to serve as a leader in their profession by diagnosing a patient's condition, performing the associated surgery, and following up with the patient to ensure continued proper care and treatment.

Many publications are available on the best surgical techniques and treatment of incisional hernias with reports of experiences and randomized clinical studies at the two extremes of the evidence scale.

Recent medical advancements have allowed hernia to be repaired through a minimally invasive approach using a robotic surgery platform. The existing robotic surgery platform features a 3D-HD visualization system that will guide the surgeon's movement and small surgical instruments with the capabilities of moving with greater vision, precision, dexterity, and control than the human hand.

The ultimate proof of the best operative technique has, however, not yet been achieved. In practically no other field of surgery are the variability and the resulting potential aims of surgery so great [2].

There is a great imbalance in hernia care: in some regions, the science of prosthetic material continues to develop, being supported by the largest supply chain standards system in the world and focusing on laparoscopic or robotic technique repair, while in other countries they do not even have the basic materials to perform an open surgery. Therefore, we need to focus on raising the quality of hernia care and to maintain a balance for hernia repair in all regions bringing greater value to all patients.

All the effort of a surgeon lies in the benefit of the patient. We can achieve better outcomes for this purpose by creating an international network, specialized programs and centers which are stable and internationally recognized. Understanding and targeting the needs identified by the surgical community has cultivated a critical working environment that has had a profound effect on expanding surgical care in UE and non-UE countries.

Access to surgery is being increasingly recognized as a global health issue, as the poorest countries in the world—representing a third of the global population—only account for a small percentage of operations performed annually [3, 4].

Humanitarian surgical missions can provide the much needed care for those who are otherwise unable to receive such care because of limited local health-care resources and cost. When most people think about volunteering, they think about going to a foreign country and doing something they've never done before. One of the great benefits for volunteers is the possibility to combine "to be useful" with to visit and to live temporarily in a foreign country, to learn a few of things about its culture, and to meet people of different nationalities. The participation in such missions requires dedicating time and resources but offers you a new experience with a new cycle of knowledge gained. For those within a medical profession are very beneficial as they allow for diverse communication and a transfer of knowledge that can vastly help those with a primary specialization.

Successful humanitarian surgical mission requires careful planning and coordination and can be challenging for those tasked with the responsibilities to organize and lead these missions. Surgeons who go on humanitarian missions are definitely engaged in a noble cause. However, not infrequently, despite the best of intentions, errors are made in attempting to help others [5].

Usually, the mission must be planned long before they can be achieved. A pre-mission plan is critical prior to arrival and a contingency plan must be in place for missing mission-critical items. Majority of these collaborations are still disorganized efforts, and they vary according to the centers and universities they are originating from. There are no coherent international collaborations, and many failures have been reported [6]. Necessary conditions and limitations of these actions are reflected in the "Seven sins of humanitarian medicine" [5] to which others can be added:

1. most missions are deployed in disadvantaged countries, most of them being non-European Union (EU);
2. time-limited missions: the activity of a mission lasts several days, and periodicity consists in two to three missions by year;
3. local doctors do not have enough time to be trained or the medical supplies that have been brought cover the hospital's needs for short periods of time;
4. involves a small number of staff that often change due to availability, depending on the period and the country in which the mission will take place;
5. recognition of the medical licenses to practice in that country (involves administrative problems and takes a long time);
6. gathering the patients and the preparation for surgery and most importantly the follow-up of patients after surgery, because the surgeons who performed the surgery must return to their country and all complications must be handled by local surgeons;
7. sometimes, the medical resources, which are donated do not have the best quality or the medical devices, need specific legislation to be put into practice in local hospitals.

Care or service should be provided to the patient in the right way consistent with scientific knowledge and the highest-quality services.

Millions of hernia operations are performed each year, making hernia the world's most common of all surgical operations. The increased number of patients with hernias led to the need for a specialized surgical field. In adults, the only treatment for a hernia is surgical, and there are several different approaches with different results. The aim consists on patients getting access to the care or service they need, no matter where they are, regardless of their material situation.

When deciding which surgical service to offer facility capabilities and infrastructure must be considered. A well-equipped facility is necessary to support a strong education program in undeserved areas. According to the World Health Organization Safe Surgery Initiative, operating theaters must be of adequate size, have appropriate lighting, and have dependable electricity and water to a minimum [7].

Advancements in health-care always come down to collaboration. It benefits both the health-care system and the population as it may provide new treatments which are probably not already available in that country [6].

By focusing on collaboration with institutions around the world rather than the simple provision of short-term services, hope is to promote a culture of training and investigation to be shared equally among all partners.

There are no data in the study on the integration of surgical services within a health system or as a component of health system strengthening. Conceptual models should be proposed based on the international meetings, knowledge gained across the international collaboration, infrastructure or patient population, resources and materials, and knowledge transfer tools to facilitate communication. A preliminary model presenting a concept of surgical care integration within a health system is being presented in association with various medical literature resources that further the World Health Organizations vision of a health-care system model [8].

What if dedicated hernia experts would collaborate through hospital networks (hernia centers) committed to providing surgical excellence and best patient outcome. The opportunity to develop this hernia center networks would provide a hernia international collaboration:

1. sharing knowledge and repair strategies among surgeons;
2. if a surgeon has doubts about a case, he may ask for guidance;
3. if one of the hospitals has certain shortcomings, the patient can be referred to another hospital;
4. practice will attentively guide the patient and caringly support him;
5. before surgery, the patient will be guided through the process and provided all of the information required to make informed decisions and plan for the procedure;
6. after surgery, follow-up by telephone or coming directly to the center will make sure that the patients are happy, healthy, and completely satisfied as returning to their normal activities;

7. academic publications, papers, presentations, textbooks, and letters will be issued by this hernia centers;
8. will enable access to part-time or temporary full-time experienced Research & Clinical Trials;
9. discussing cases will be done by videoconference or will be the possibility of forming an international commission composed of one member of each country, to meet twice a month to discuss all types of complex cases and to individualize patient care.

Whether the condition of one of the patients requires care from one specialist or an entire team, the surgeons work side by side with the patient explaining to him/her the entire treatment to develop a personalized care plan to treat his/her condition. In some cases, such as complex reconstructions, collaboration will be needed by working with surgeons from the Division of Plastic and Reconstructive Surgery to perform procedures and help coordinate the most appropriate course of care for the patient.

2. International hernia centers and surgical care

I want to reinforce the statement made by Dr. Halfdan Mahler: that surgery has a key role in health-care, and unfortunately although medicine has evolved so much lately by getting to work with robotics, body parts transplants, the appearance of new different surgical materials, the majority of the world's population has no access whatsoever to skilled surgical care because of the poverty. Much more can be done if we share common goals meet in working, learning, practice, all for the benefit of the patients.

Conventional solutions are not likely to be very satisfactory. So what should the international surgical community do?

The magnitude and importance of achieving solidarity and cooperation in an interdependent world calls for a major program and considerable support. For decades, hernias have been managed by all general surgeons, but now top-tier medical systems are recognizing the value of standalone hernia centers, staffed with physicians equally adept at open surgery and minimally invasive techniques.

Hernia literature is more and more focusing on developing surgery techniques, discussion focused mostly on surgical meshes, mesh repair versus tissue repair, robotic surgery, robotic-assisted procedure versus the laparoscopic approach and so on. What about hernia health-care system? A commitment to patient care and success necessitates that the requirements be comprehensive, research-based, and verified through a rigorous site inspection?

Even if private institutions began to greatly develop the terminology of "hernia center" as not yet well understood, that is why it is more used as a marketing instrument. Google has approximately 6,560,000 links associated to "hernia center" from a single search inquiry. There are very few scientific articles in which the term "hernia center" is explained as a model of how surgical care might be integrated within a health system. As a result of this lack of

factual content related to "hernia center," it is clear that this term is being used loosely as a potential trigger to mislead patients into believing that they are getting proper treatment from certified private institutions [9].

I propose a new model for integrating modern surgical hernia centers network to continue pioneering independent efforts to further expand modern surgical care for patients with hernias. Many hospitals and surgery centers offer hernia repair—but most of the patients would not receive the same results and level of personal care everywhere. Hernia centers will offer a hernia repair from a leading surgeon who provides unmatched expertise and state-of-the-art treatment options. For patients, this means a positive and happy experience, a swift return to normal life, and a lower risk of discomfort and complications.

The first strategy would be the creation of hernia departments within the major hospitals in the university cities by accessing European funds or charity. The departments should be run by a team of specialized surgeons and nurses who will take charge of the patient. A platform for improving health-care delivery around the world should be created. One way to manage these expectations is to create a strategic plan that clearly outlines goals for the future and how to reach them. In every country, there are less equipped hospitals and hospitals with a high level of training and equipment. The consultants will assume the responsibility in keeping contact with all hospitals, to take charge of patients, to attend conferences, and to participate in clinical trials to collaborate for the benefit of the patients. The idea is that depending on the hospital conditions and the particularities of the case, the patient is referred to a specialist in the country or in another country. The most important is that the patient will be staying in contact with his/her surgeon.

The second suggestion would be to create specialized centers: hernia centers in each country which gather surgeons focusing on hernias. As thousands of new cases are being added each year, centers are able to offer the best possible treatment options available in all hernia-based cases. This project will provide opportunities for patients to be treated by true experts in hernia field, but also for surgeons to maintain a record of operated patients, the type of surgery performed, the complications that occurred, and the complexity of the cases with their particularities. The analysis of this information will lead to improved surgical services by creating a relevant statistic which will help us to make hernia protocols. A "hernia center" is capable of continuous improvement focused on a magnitude of experience.

Surgeons who will work in these centers will be experienced in treating primary and recurrent hernias using both open and laparoscopic methods. The hernia center will be equipped with the newest techniques and materials in hernia repair. The center should be available to patients for consultation, surgical treatment, follow-up, or just for questions, and should provide appointments and international collaboration. Hernia center should provide assistance also for emergency situations.

3. Hernia physicians

Abdominal wall reconstruction, proper care of recurring hernias, pain prevention, treating hernias with enterocutaneous fistulas, complex mesh-associated infections, and mesh reconstructions require specialized treatment plans that can be established by team members using laparoscopic and modern hernia repair techniques.

The fear of patients and inexperienced surgeons is mainly focused on how to deal with the complications that occur after surgery. Recurrence after primary hernia repair or the complexity of the case due to its particularities highlights the need for hernia experts. A surgeon has many qualities but being patient and calm can be reflected in the way patient is treated: to be listened and understood, to receive all the required answers, and to understand the treatment options they have so that they will fulfill all the recommendations received.

Multidisciplinary experts work in a team environment to serve each patient's unique needs with an individualized care plan. The physicians not only treat patients but conduct scientific research and teach the next generation of medical professionals.

The aim of these departments/centers will be focused on finding personalized solution to help the patient to return to an active, pain-free life. The surgeons are particularly skilled in assessing hernias and determining their appropriateness for open or laparoscopic surgery.

The hernia center will offer the full range of surgical options to repair hernias. Most hernia repairs are, by surgeons' standards, relatively straightforward and uncomplicated. Some, however, are more complex because of their size or because they occur at the site of a previous surgical incision that has not healed adequately. The hernia team will repair all types of hernias, including inguinal hernia, femoral hernia, umbilical hernia, incisional hernia, spigelian hernia, obturator hernia, epigastric hernia, hiatal hernia, and diaphragmatic hernia. Minimally invasive surgery such as laparoscopy is generally better for patients—less pain, faster recovery—but it demands additional training for the surgeon. Open inguinal hernia repairs will be possible to perform as an outpatient procedure under local anesthesia.

Surgical team should include general surgeons and plastic surgeons, as well as clinical and support professionals collaborating to provide a comprehensive care to patients. Surgeons will carefully plan surgery for each patient depending on the characteristics of the hernia and the comorbidities of the patient. Specialists are mastering the laparoscopy technique and are prepared to manage complications: hernia recurrence, pain after previous repair, hernias with enterocutaneous fistulas, mesh reconstruction, and complicated mesh-related infections.

Complex or not, all patients wish their hernia to be treated by practitioners who perform more than 200 such procedures a year, instead of, say, 20 or 30? It is this type of experience that gives to patients a greater likelihood of an uncomplicated operation and a successful outcome.

4. Things we must do for patients

Providing care for poor people, persons who are not insured, undocumented immigrants is an issue, particularly in developing countries or very poor neighborhoods from different countries. Physicians can also volunteer their time to care for these patients, and how a physician handles a situation may depend on the specific case, and the most important thing is to focus on the international collaboration.

We should place greater importance on providing preventive care: teaching patients to eat right and exercise, and compensating health-care professionals for providing that care. It is important for physicians to remove their personal agenda or bias when helping patients

understand their options and make good health-care decisions. In other words, we cannot only rely on old-fashioned forms of caring for patients. It is increasingly important that we care for patients in new ways and pay health-care professionals to do so. Surgeons should place value of care as a priority, thus creating a patient-centered approach which would place a priority on the quality of care rather than volume. Safe surgery involves avoiding complications or adverse events that can arise before, during, and after surgical procedures and most importantly avoid any danger of exposure to disease while they are in a vulnerable, postoperative state. Thus, safety measures are implemented before anesthesia, before incision, during surgery, and in the provision of postoperative care.

The need for a greater regionalization of care, the use of telemedicine, and providing incentives to relocate where patient needs is the greatest merit that requires further exploration.

Existing guidelines, which often reflect the values and practices of a particular region, have not yet achieved this goal. Accurate assessment of quality in hernia repair also will require a better long-term follow-up worldwide.

The network will aim to promote a systematic guideline development and implementation which "seeks to improve the quality of health-care by promoting systematic development of clinical practice guidelines." Professionals from all countries should join together to form networks for the rapid exchange of information on outbreaks. Networks, focusing on a wide particularity of the case, the possibility of repair, availability of medical supplies, medical strategies, and so on such as the European Working Group for Legionella Infections (EWGLI) or the European Influenza Surveillance Scheme (EISS), form the basis of international cooperation on communicable diseases within the European Union [10]. A specific example comes from New York City about how social media, specifically the International Hernia Collaborative, has changed the way surgeons communicate and collaborate with one another to help patients [11]. The start can be given the EHS-GREPA which has representative members from each country, including the International Hernia Collaboration (IHC) (more than 2500 members) created by panelist Brian Jacob, MD. The creation of these social media communities is invaluable for sharing knowledge and varied perspectives, social/professional support, rapid communication dissemination, and advancement of innovative solutions and improved patient care. The thing is that in one country, there are multiple centers which must communicate, and when a situation goes beyond their country should be able to get in touch with a hospital from other country for the benefit of the patient. International Patient Program should provide advanced diagnostic, medical, surgical, and rehabilitative specialty care to patients from around the world. The health-care providers will work together as a team—with each patient at its center—to provide the most effective and compassionate care, always.

5. Surgery and poverty

Surgery in low-income and middle-income countries faces implementation challenges. Compared with vaccination or antiretroviral treatment, surgery needs more infrastructures—for example, clean operating rooms, anesthesia, electrical power for monitoring equipment, and ancillary laboratory services. The infrastructure investment and the recurring cost of its

maintenance might be a financial obstacle to implementation, especially when compared with complex public health interventions. The high cost, infrastructure demands, and complexity of implementing surgery compared with other public health interventions are challenges, but they are not insurmountable. In addition to providing common surgical items, medical device manufacturers could make a real impact by developing high-quality easily serviceable devices for all aspects for surgical care, instrument sterilization equipment, and monitoring machines.

Funding is a big issue which needs to be considered seriously. Every recurring incident of a hernia-related operation places a significant financial weight on the health-care system and it may even lead to further problems for the patient. Cost-benefit analysis will always report that by correctly treating the patients with proper conditions, complications will be avoided. Economic losses can be reduced by quantifying the risks, especially in groups of patients who may be more prone to complications and by applying prophylactic measures. Typical forms of economic analysis include cost analysis per individual procedure, efficient spending related to the financial values of standardized medical outcomes, and the associated social benefit that involves the reductions of cost to an individual who has undergone an operation and society as a whole. Fundamental knowledge of the financial value of health interventions is crucial for policy makers to make proper decisions related to the allocation of resources.

Although there are increasing funding opportunities, mainly via philanthropic organizations, some nongovernmental organizations (NGOs), and even governmental organizations, the sheer problem is so huge that more is continually needed. There are many different policy options to ensure the successful development of these chains of specialized centers, but what works for one country may not work for another. The EU provides funding for a broad range of projects and programs covering areas such as research & innovation or humanitarian aid. The EU has been providing humanitarian aid since 1992 in over 140 countries. EU-funded humanitarian assistance is implemented through humanitarian organizations. These are European NGOs, UN agencies, and International organizations. Because in each country the national governments manage the funding, a proposal would be that, through the European hernia society, unanimously obtain funds for each member country and form a network between centers. A project based on the work of an international team aiming to help the society has more chance to succeed.

Special attention should be paid to internationally collaborated work identified based on the creation of centers or specialized departments. With the involvement of various international organizations, policy makers, health-care managers, and other stakeholders, a collaborative approach can be achieved in order to accelerate progress toward an improved and sustainable surgical care. It can often be found that various charitable groups are primarily responsible for the proper delivery of medical and surgical care in both less developed and developing countries. Lately, many surgical organizations have appeared but who keeps track of them and their results, who monitors their outcomes, who controls them to ensure the quality of the materials used in the mission, and most of the volunteers are not hernia experts. In the published literature, we find immediate results of the mission in question, and almost all missions have very good results without complications. To determine their real collective contribution, a comprehensive database of these groups is needed.

6. Improving research

Hernia centers can improve research. Through hernia centers, surgeons will be able to record all their activity from the type of interventions, whether mesh was used or not, patient comorbidities, postoperative complications, long-term follow-up of patients, in other words, a high-quality databases. Hernia centers will be an ongoing initiative to motivate all surgeons to report their operations in order to increase the national reports. It is critical to ensure quality databases by maintaining a high registration rate. All data can be published every year or a multicentric study can be carried out which will provide scientific evidence to generate further recommendations, unanimous protocols, and guidelines. A dedication to continuous improvement and higher levels of excellence sets forth that requirements be research focused, proven through extensive site inspections and reviews.

7. Certification processes

Treating patients by nongovernmental organizations, performing surgery procedures that are not in conformance with the guidelines of the hernia societies, and by different volunteers, who are not properly trained sometimes under conditions not so favorable can lead to considerable complications for the patient and therefore additional costs for the society.

A primary necessity for valid certification of hernia centers includes a clear explanation of associated regulations and requirements and verification through either hernia societies and/or nonprofit organizations to ensure the optimal quality for hernia surgery. In addition, treatment quality must be verified through a certified center and it must be acquired through mandatory participation within a quality guarantee program or registry that includes a follow-up with patients.

Certified Center of Excellence in Hernia Surgery (COEHS) means a rigorous center of excellence program based on the effectiveness of the experts—well-trained hernia surgeon members of hernia societies fully committed to hernia field and properly equipped to ensure efficiency of technical care worldwide. Hernia centers will improve the follow-up of the patients gathering data through which we can create an international database. Health-care system is changed by international protocols which are deliberated after a long research with significant impact. That is why we need hernia centers to support us by facilitating our work and especially to ensure quality treatment to all patients.

Hernia centers should be certified by the European Hernia Society (EHS)/Americas Hernia Society (AHS)/Asia Pacific Hernia Society (APHS) depending on the country in which the center will be built. Member representation and participation in these committees is of critical value and can serve as a stepping stone for senior leadership roles within the society.

German Hernia Society presents a model on how hernia centers should become certified through a Certified Hernia Center program which is very well explained in an article [9] published in 2014. We can also take the model of cancer institutes, which focuses only on cancer pathology. There are not many definitive consensuses in hernia field concerning prevention,

which surgical technique is best, non-mesh repair versus mesh repair, robotic versus laparoscopic approach for ventral hernias, and the possibilities of repairing hernia recurrences. That is why an individualized, patient-centered approach is needed, and how can you achieve it better than by setting up hernia centers. These initiatives based on collaboration and globalization must become our future target focused on improving care for all hernia patients.

8. Next step for hernia

Although surgery requires more specialized human resources and infrastructure than many traditional public health interventions, when these challenges are met, surgery can produce health benefits with similar cost-effectiveness ratios [12].

There are surgeons who dedicate the majority of their surgical practice to abdominal reconstructive surgery and others who perform ventral hernia repair infrequently or refer the more complicated patient to another surgeon. No matter the patient, surgeon, or acute care facility, all HealthCare Systems need to provide value to patients for all surgical care episodes, promote collaboration across the health-care system, stimulate sharing of best practices, and initiate changes in the health management. Professional cooperation is needed. The professionals involved in its inception all share a passion for global health in addition to hernia surgery.

An important step in taking action for hernia collaboration was made by Dr. Brian Jacob, the founder of The International Hernia Collaboration Facebook™ Group being the new example of a professional-to-professional-to-industry group where exchange of information is centered on the concept of improving patient outcomes. Members, either surgeons or members of an academic institution, from all over the world, UE and non-UE, join this group, and their number is growing every day.

International Hernia Collaboration Facebook™ group demonstrates that social media can be used professionally as an extremely effective educational tool that provides rapid global collaboration with limitless possibilities, all designed to optimize patient care.

Research demonstrates that a high-volume experience results in improved patient outcomes. Task-sharing is greatly needed to grow the global surgical workforce, to enhance international collaboration, leverage technology, and optimize health systems. The challenge includes all surgeons and hospitals in a concerted effort to improve the quality of care across the board.

Creation of these institutional partnerships and trainee exchanges can enrich training, stimulate commitment to patient care, and promote the equal exchange of ideas and expertise.

9. Conclusion

I want to emphasize the role of these centers in providing a welcoming physical environment, respect for their values, empowerment and collaboration, coordination and integration of care, comfort and support, and access and navigation skills to patients and their families.

The concept is designed to help organizations deliver a consistent, safe, and high-quality approach to care—that is, an approach that reduces the risk of error and improves outcomes and customer satisfaction—by providing the following:

1. integrated, coordinated, patient-centered care—starting with the hernia consultation and continuing through the hernia surgeon follow-up visit;
2. comprehensive education of, and shared decision making with occurring along the continuum of care from hernia consultation to care of the patient (preoperative, intraoperative, and postoperative) to discharge to follow-up visit with the hernia surgeon;
3. consistent communication and collaboration with all health-care providers involved in the patient's care and transitions of care—including providers on the interdisciplinary team (as well as those who are not on the team) from the hernia consultation through the follow-up visit with the surgeon;
4. ongoing quality improvement processes—involving the implementation of improvements to the program from the hernia consultation to the hernia follow-up visit.

The surgeon's role is to continue to be the patient's "provider of choice" in hernia treatment and be a global leader in hernia education and research. To align the objectives of clinicians, patients, and providers, "a greater emphasis on value is key, and achieving high-value care for patients must become the goal of health-care delivery, thereby reducing costs" [13].

Successful change must be locally driven by local leaders, supported by global partners through true accompaniment, global collaboration, and an emphasis on systems, not silos. Only in this way will we be able to do some action.

There is work being undertaken to have work-based assessments and a curriculum to officially recognize the benefits and learning opportunities of work abroad.

I conclude by discussing hernia surgery and hernia centers as a global health priority and possible solutions to improving surgical care globally.

Conflict of interest

No conflict of interest.

Notes/thanks/other declarations

God bless all my family members who have shown so much of faith in me throughout my challenging situation in life.

Author details

Florina Popa

Address all correspondence to: florinapopa11@yahoo.com

Department of Surgery, Iuliu Haţieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania

References

[1] Butrous G. International cooperation to promote advances in medicine. Annals of Thoracic Medicine. 2008;**3**(3):79-81

[2] Dietz UA, Muysoms FE, Germer CT, Wiegering A. Technical principles of incisional hernia surgery. Der Chirurg. 2016;**87**(4):355-365. quiz 366-7

[3] Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: A modelling strategy based on available data. Lancet. 2008;**372**(9633):139-144

[4] Agarwal-Harding KJ, von Keudell A, Zirkle LG, Meara JG, Dyer GS. Understanding and addressing the global need for orthopaedic trauma care. The Journal of Bone and Joint Surgery – American Volume. 2016;**98**(21):1844-1853

[5] Welling DR, Ryan JM, Burris DG, Rich NM. Seven sins of humanitarian medicine. World Journal of Surgery. 2010;**34**(3):466-470

[6] Smeby JC, Trondal J. Globalisation or europeanisation? International contact among university staff. Higher Education. 2005;**49**:449-466

[7] World Alliance for Patient Safety. Second Global Patient Safety Challenge: Safe Surgery Save Lives. Geneva: WHO Press; 2008

[8] Spiegel DA, Misra M, Bendix P, Hagander L, Bickler SW, et al. Surgical care and health systems. World Journal of Surgery. 2015;**39**(9):2132-2139

[9] Köckerling F, Berger D, Jost JO. What is a certified hernia center? The example of the German Hernia Society and German Society of General and Visceral Surgery. Frontiers in Surgery. 2014;**1**:26

[10] Chen TJ, Chen YC, Hwang SJ, Chou LF. International collaboration of clinical medicine research in Taiwan, 1990-2004: A bibliometric analysis. Journal of the Chinese Medical Association. 2007;**70**:110-116

[11] Felix E. Social media and the surgeon: Collaborating globally in real time. General Surgery News. Video. June 8, 2015

[12] Chao TE, Sharma K, Mandigo M, Hagander L, Resch SC, et al. Cost-effectiveness of surgery and its policy implications for global health: A systematic review and analysis. The Lancet Global Health. 2014;**2**(6):e334-e345

[13] Rosenthal T. Controversial approach to health care: Nix 'low-value' surgical interventions. General Surgery News. January 30, 2018

Section 3

Recent Advances

Chapter 3

"555 Manish Technique" for Mini TEP Repair

Manish Kumar Gupta

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76356

Abstract

TEP repair of inguinal hernia has gained popularity in last two decades. TEP repair has steep learning curve due to limited working space. The current Hasson trocar approach is the only technique known among laparoscopic surgeons. Creating pre-peritoneal space without injuring the peritoneum is again a challenging task in the initial part of surgery. Accidental pneumoperitoneum can further compromise the pre-peritoneal space which leads to difficult dissection and prolongation of operative time. Larger infra-umbilical incision for large cone of Hasson trocar has its own complications in terms of more pain, more SSI, incisional hernia, increased cost for morbidity management and suboptimal cosmetic result due to large scar below the belly button. We have innovated a "555 Manish Technique" which addresses the shortcomings of conventional TEP repair. We complete Mini TEP repair by all three 5 mm ports using "555 Manish Technique" with the help of an indigenous "Manish Retractor" which plays a key role. We have also innovated a simple technique to insert an adequate size light weight polypropylene mesh through 5 mm port using "Tail pull" technique. "555 Manish Technique" is simple, less invasive, less morbid, time saving, cost effective and having better cosmetic results and increased patient satisfaction.

Keywords: 555 Manish technique, Mini TEP repair, Manish retractor, TEP by all 5 mm ports, innovative technique for TEP repair

1. Background

Over the past 30 years, hernia surgery has become increasingly complex due to introduction of novel endoscopic, but also conventional techniques. The "Tailored Approach" is now used to describe the differentiated use of different techniques to decrease the risks in management of hernia [1]. The first revolution of open tension-free Lichtenstein Repair in 1989 significantly reduced the recurrence rate while the second revolution was the application of Laparoscopic

inguinal hernia repair in 1992. Laparoscopic inguinal hernia repair can be done either by trans abdominal pre-peritoneal (TAPP) or totally extra-peritoneal (TEP) approach. Laparoscopic inguinal hernia shows advantage over tension-free Liechtenstein repair in terms of less pain, early return to work, smaller scars and low recurrence rates. TEP repair of inguinal hernia has gained popularity in last two decades since 1st introduced by Dulucq in 1992 [2]. TEP repair of inguinal hernia is now a standard surgical technique [3]. It also avoids the chances of missing femoral, obturator and contralateral inguinal hernia and simultaneously give the operating surgeon an opportunity to repair at the same time [2, 4]. Fixing a mesh over the myopectineal orifice at the time of TEP or TAPP repair prophylactically prevents femoral or obturator hernia formation.

2. Current scenario of TEP repair

This technique requires specialized anatomical knowledge and good two hand dexterity for dissecting hernia sac and placement of mesh. Therefore, the acceptance and implementation of TEP have been slow in comparison to other laparoscopic procedures such as cholecystectomy. Laparoscopic inguinal hernia repair has steep learning curve especially in TEP repair and due to limited working space [5, 6]. Increased operative time and complication rates during the early learning curve are other drawbacks. Creating a pre-peritoneal space without injuring the peritoneum is again a challenging task in the initial part of surgery. Accidental pneumoperitoneum can further compromise the pre-peritoneal space which leads to difficult dissection and prolongation of surgical time [6]. The current Hasson trocar approach is the only way to create pre-peritoneal space and the only technique known among laparoscopic surgeons. There is always dependence over the wide Hasson trocar and its broader cone to create pre-peritoneal space. A larger infra-umbilical incision is required for dissecting up to the anterior rectus sheath with the help of "S Retractor" to fix the Hasson trocar with the anchoring sutures. The insertion of Hasson trocar is a relatively blind surgical step of TEP repair of inguinal hernia [7]. Cases of port site incisional hernia were also reported at the site of 12 mm port site used for insertion of mesh [2]. Exclusive use of Hasson trocar for TEP repair in current scenario ultimately reflects in surgical cost. Management of morbidities due to larger port site wound also adds to the financial burden over the patient. Large scar below the belly button is cosmetically suboptimal especially to females. Bigger wound not only leave scar on the body but over the mind & soul as well [6, 7].

3. Innovative approach of Mini TEP by "555 Manish Technique"

We have innovated a "555 Manish Technique" which addresses the shortcomings of the conventional TEP repair of inguinal hernia. In our technique, we complete Mini TEP repair by all three 5 mm ports. We do not use Hasson trocar to create pre-peritoneal space and innovated

a technique to access pre-peritoneal space by 5 mm Visiport using indigenously made simple retractor device. This retractor device was given the name "Manish Retractor" made by 2 ml sterile plastic syringe. This approach gives the advantage to insert the first trocar under complete vision which prevents any accidental injury to peritoneum at this stage. We have also innovated a simple technique to insert an adequate size light weight polypropylene mesh through 5 mm port using "Tail pull" technique.

4. Surgical steps of Mini TEP repair by "555 Manish Technique"

4.1. Instruments used in "555" technique

Three 5 mm Visiport (Endopath XCEL bladders trocar: Ethicon) (**Figure 1**).

Two milliliters plastic syringe to make "Manish Retractor".

Five millimeters 0 or 30-degree telescope.

Laparoscopic instruments (Maryland dissector, Grasper, scissors).

Silk thread No 1-0 on needle.

15 × 10 cm size, light weight polypropylene mesh (Ultrapro Mesh; Ethicon).

Tacker for mesh fixation.

Figure 1. Instruments used in "555 Manish Technique".

5. Steps of "555 Manish Technique" for Mini TEP repair of inguinal hernia

1. Preparing the "Manish Retractor".
2. Pre-peritoneal space access by "555 Manish Technique."
3. Dissection of pre-peritoneal space and placement of working ports.
4. Dissection the hernia sac.
5. Insertion & placement of mesh by "Tail Pull" technique through 5 mm port.
6. Closure of all the infra-umbilical port site wounds.

5.1. Preparing the "Manish Retractor"

"Manish Retractor" is prepared using a 2 ml disposable plastic syringe. The hub of the syringe is divided to obtain a 4 cm length of the retractor. It is further slit along its full length with the help of a scissor and the resultant device is named "Manish Retractor" (**Figures 2** and **3**). Manish retractor replaces the use of large "S" retractor (need 12 mm skin incision) and provide the clear view of ARS through 5 mm skin incision. It retracts skin and subcutaneous fat up to the ARS. This being a cylindrical retraction device is less invasive & less traumatic. This indigenous retractor device plays the key role in accessing the PPS by 5 mm Visiport. This avoids the dependence over wide bore Hasson trocar which is must for current surgical technique [6].

Figure 2. 2mL Syringe hub is divided to make "Manish Retractor".

http://dx.doi.org/10.5772/intechopen.76356

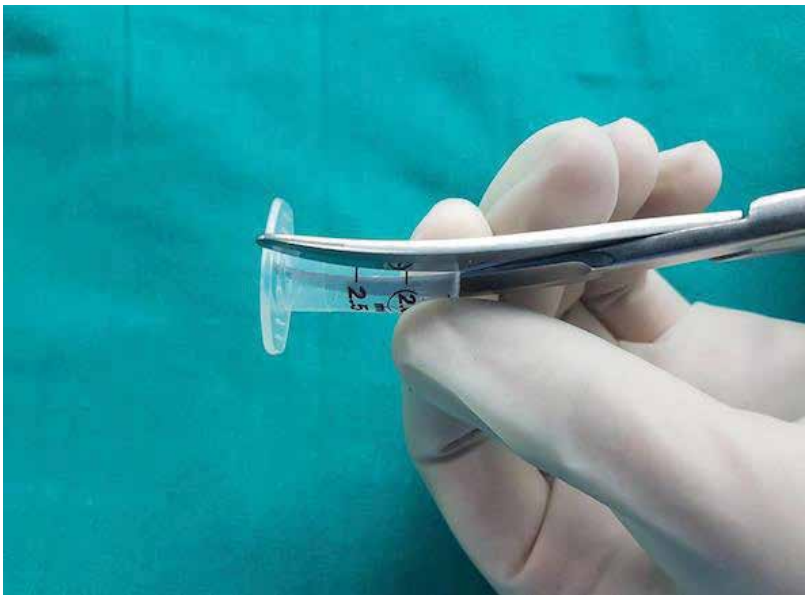


Figure 3. Divided syringe hub is slit along its full length to make "Manish Retractor"

5.2. Pre-peritoneal space access by "555 Manish Technique"

In order to reach the ARS, A 5 mm incision is made in the infra-umbilical region just lateral to midline (**Figure 4**). It is then deepened in the subcutaneous fat and the Manish retractor is inserted. The circumference of the 2 ml syringe is such that it snugly fits in the 5 mm incision. It aids in displacing the fat outwards so that the glistening ARS is clearly visible (**Figure 5**). Excess subcutaneous fat may be cleared by suction.

Next, using a No. 11 blade, a 5 mm transverse incision is made in the ARS and the underlying longitudinal muscle fibers of rectus muscle are seen (**Figures 6** and **7**). The 5 mm Visiport is mounted over a 5 mm, zero-degree telescope so as to enter into the pre-peritoneal space under vision (**Figure 8**). As the Visiport is progressed into the incision, one can appreciate the upper and the lower lip of the slit in ARS (**Figure 9**) followed by rectus muscle fibers laterally and linea alba medially (**Figure 10**). On further advancement of the trocar the arcuate line gets visible beyond which the posterior rectus sheath is deficient. Finally, after crossing the arcuate line the loose areolar tissue of the pre-peritoneal space gets visible (**Figures 11** and **12**). Then the Manish retractor is pulled out gently from the incision by sliding over the trocar. The slit in the retractor helps its easy and complete removal from the 5 mm trocar (**Figure 13**). CO_2 insufflation at 14 mm pressure is achieved after removing the telescope and leaving the cannula of trocar at its site. The trocar is snugly held by the skin, soft tissue and ARS without any need for anchoring sutures and chances of CO_2 leak.

Hasson trocar insertion in current technique of TEP repair is a relatively blind step because only the insertion of Hasson trocar in to the ARS is under vision while rest of the trocar

Figure 4. A 5 mm incision is made in the infra-umbilical region just lateral to midline.

Figure 5. "Manish Retractor" provides a clear view of anterior rectus sheath by displacing fat outwards.

advancement up to the PPS is blind which can lead to accidental injury to peritoneum. The injury to peritoneum can lead to pneumoperitoneum. Pneumoperitoneum at this stage of surgery leads to difficult dissection and also prolongs the duration of surgery [8]. This is avoidable in our technique as one can see the track of the trocar up to the PPS. It also negates the need for

http://dx.doi.org/10.5772/intechopen.76356

Figure 6. No. 11 blade is used to incise ARS.

Figure 7. Longitudinal rectus muscle fibres are visible through the slit in ARS.

anchoring sutures over the anterior rectus sheath which is required to fix the large cone of the Hasson trocar [9]. The cone of the Hasson trocar further tears the fibers of ARS at the time of fixation to get a leak proof fixation of cone which needs to be repaired by absorbable sutures at the end of the procedure. Finally, the financial impact of using a Hasson's trocar is also

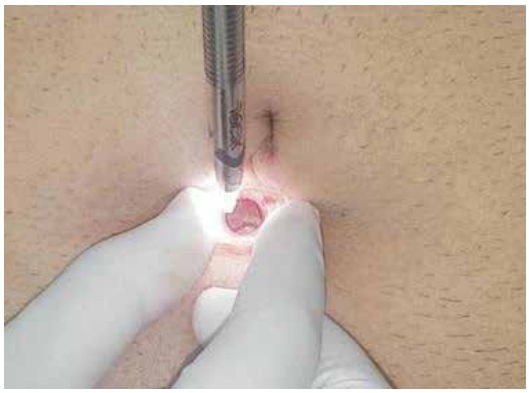


Figure 8. Visiport is mounted over 5 mm, zero-degree telescope and introduced through "Manish retractor" to reach PPS under vision.

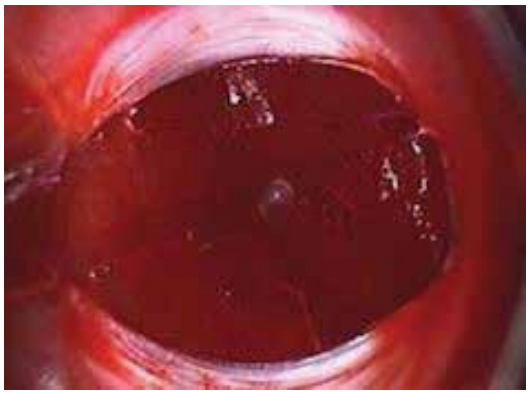


Figure 9. Upper and lower lips of slit in ARS.

Figure 10. Linea alba is visible on the left side while rectus muscle fibre on the right side of figure.

http://dx.doi.org/10.5772/intechopen.76356

Figure 11. Pre-peritoneal fat becomes visible through visiport on reaching the PPS.

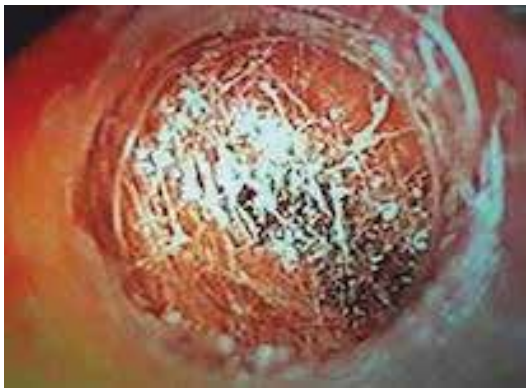


Figure 12. Loose areolar tissue in pre-peritoneal space.

alleviated. The placement of 1st trocar by "555 Manish Technique" takes 2.5 min of surgical time which is far less than average 7–10 min of time taken in placement of Hasson trocar. This technique of accessing the PPS is time saving, less traumatic and less invasive than Hasson trocar technique [5, 6].

5.3. Dissection of pre-peritoneal space and placement of working ports

Blunt dissection of loose areolar tissue is done by 5 mm, zero-degree telescope. CO_2 pneumo-insufflation at 14 mm Hg pressure and on high flow rate helps in creating the Space of Bogros & Space of Retzius. The dissection in PPS is beginning by dissecting the relatively avascular loose areolar tissue in midline till the pubic bone as the first landmark. Then the dissection is carried out laterally on the contralateral side to make the 5 mm working ports. We are trained in performing TEP repair via lateral approach. The first working port is placed just above and medial to ASIS and second one, 5 cm cranial to it. Lateral working port approach is not the part of "555 Manish Technique" and so the procedure can be done using midline working ports as well after insertion of 1st 5 mm infra-umbilical camera port.

Figure 13. Slit in "Manish retractor" helps in its complete removal without taking out the 5 mm trocar.

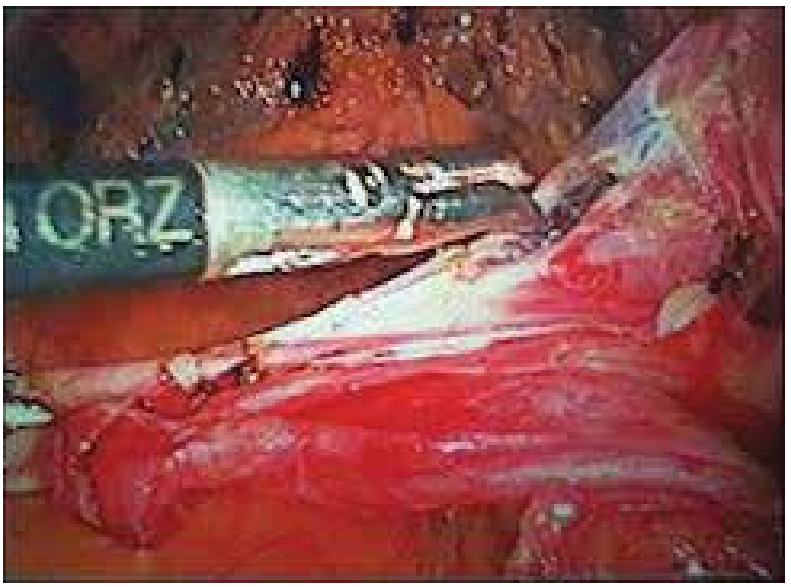


Figure 14. Indirect inguinal hernia sac is dissected from cord structures.

5.4. Dissection of hernia sac

Maryland dissector and a blunt grasper are used to reach up to the hernia sac and cord structures by gentle dissection. The sac is reduced and dissected off from the cord structure and

http://dx.doi.org/10.5772/intechopen.76356

vas deferens using blunt and sharp dissection. Catgut loop is then tied at the base of the sac after complete parietalization of cord structures and vas deferens. 5 mm telescope provides a good vision and does not cause any problem in dissection (**Figure 14**).

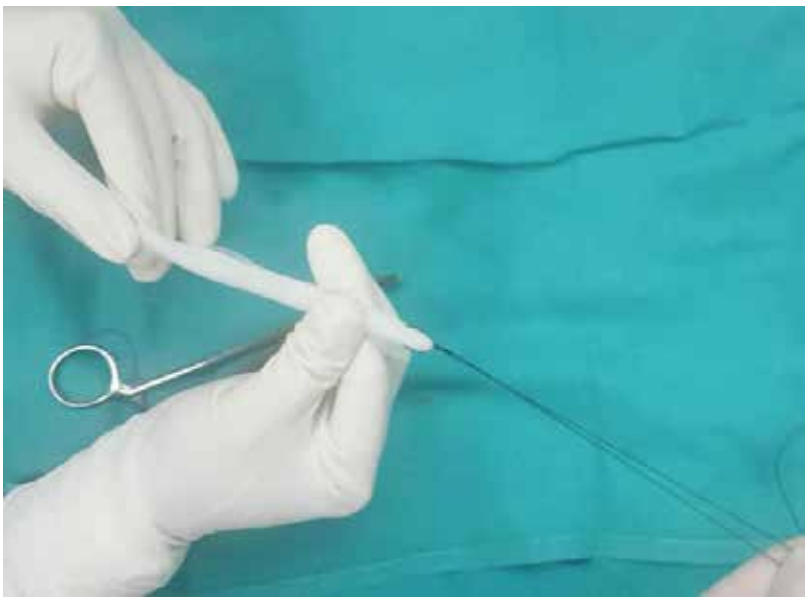


Figure 15. No. 1 silk thread is tied at one end of rolled mesh with 20 cm long tail.

Figure 16. Silk thread tail is inserted through 5 mm trocar in to PPS.

Figure 17. The end of long tail of silk thread is left inside the PPS.

Figure 18. Light weight polypropylene mesh is pulled inside through 5 mm port.

Figure 19. Rolled mesh is then pulled inside by holding and pulling the silk thread inside with grasper from another port.

http://dx.doi.org/10.5772/intechopen.76356

Figure 20. Adequate size light weight polypropylene mesh is unfolded over myopectineal orifices and fixed at cooper's ligament.

6. Insertion and placement of mesh by "Tail Pull" technique through 5 mm port

The "Tail Pull" technique is also innovated and used to insert the adequate size mesh. A light weight polypropylene mesh of 15 × 12 cm size is rolled to the thinnest possible thickness along its width. A No. 1 silk thread of 20 cm length is tied at one end of the rolled mesh (**Figure 15**). The long silk thread tail is grasped with Maryland dissector and then inserted through a 5 mm working port. Maryland dissector is then taken out leaving the end of the tail in the PPS (**Figures 16** and **17**). This end of tail is then grasped by inserting Maryland dissector through other working port. The tail is then pulled inside which facilitate the insertion of mesh in PPS through 5 mm port (**Figures 18** and **19**). The mesh is then unrolled inside after cutting the thread and placed over the myopectineal orifice (**Figure 20**). It is fixed with tackers over the cooper's ligament. This "Tail Pull" technique facilitate the insertion of mesh as only the mesh is traversing through the trocar cannula while conventionally the mesh is introduced along with a grasping instrument which need a bigger lumen to insert mesh, as mesh and instrument both occupy the space of lumen. The use of a lightweight mesh reduces complications of chronic pain, seroma formation, etc. [10].

7. Closure of all the infra-umbilical port site wounds

All 5 mm trocars are taken out after deflating the space. The small 5 mm size of the infra-umbilical ports does not need any repair of ARS or subcutaneous fat. Skin is stapled as all the wounds are of 5 mm in size. The 12 mm infra-umbilical skin incision in Hasson trocar technique ultimately gets wider due to fixation of the large cone and ultimately becomes a size of 2.5–3.0 cm. Even the ARS fibers got teared because of the tight fixation of the tip of the cone and needs to be repaired along with subcutaneous fat with Vicryl. Larger incisions are always more prone for SSI and more pain [11]. All these complications are prevented in "555 Manish Technique" as it is done by all three 5 mm ports without deviating from the principles of TEP repair.

8. Our experience

Since October 2014 we have operated 108 inguinal, 1 femoral & 1 obturator hernias. 109/110 cases were successfully completed by our technique. The average duration of first 5 mm port placement to access PPS was 2.5 min in comparison to Hasson trocar technique which takes 7–10 min on an average.

Pneumoperitoneum occurred in 23% cases that were managed by putting Veress needle. In all cases pneumoperitoneum occurred in later stages of surgery except one which was converted to TAPP because of adhesions due to past history of contralateral repair TEP repair of inguinal hernia. Thirteen cases of unilateral indirect inguinal hernias were irreducible and reduced during surgery by opening the sac. Ten cases of inguinal hernia patients underwent inguinal hernia repair of contralateral side. Three patients had recurrent inguinal hernia which were operated earlier by open mesh hernioplasty and subsequently repaired successfully by our innovative technique.

One patient had history of TEP repair for recurrent open inguinal hernia repair on the right side. This patient first presented in our outpatient department (OPD) with enterocutaneous fistula and mesh infection after TEP repair. Mesh removal along with disconnection of enterocutaneous fistula and laparoscopic repair of enterotomy after refreshing the margins was done. After complete healing of the wound by secondary intention, he was again subjected to TEP repair after 2 months and was successfully operated by our innovative technique.

One patient developed right side inguinal hernia 2 years after bilateral orchidopexy, which was successfully repaired by our technique.

In our technique pain was less in comparison to Hasson trocar technique as all the ports are of 5 mm size. We reported no, SSI, chronic pain, hernia recurrence, incisional hernia or any other complications other than seroma on 6 months follow up. Smaller scars are cosmetically better and always more acceptable to patients.

9. Conclusion

“555 Manish Technique” is simple, less invasive, less morbid, time saving, cost effective and having better cosmetic results with patient satisfaction. There is no dependence on Hasson Trocar & this technique does not compromise on the principles of current surgical procedure. “Manish Retractor” plays a key role in successful completion of surgery.

Acknowledgements

I am thankful to my teachers, my colleagues and my students who supported this work and guided me in need. I am grateful to my wife who is always there wherever I lack and to my son for always making me feel special.

Author details

Manish Kumar Gupta

Address all correspondence to: drmanishgupta2002@yahoo.com

Department of General and Laparoscopic Surgery, Sir Ganga Ram Hospital, New Delhi, India

References

[1] Kockerling F, Schug-Pass C. Tailored approach in inguinal hernia repair—Decision tree based on the guidelines. Frontiers in Surgery. 2014;**1**:Article 20. DOI: 10.3389/fsurg.2014.00020

[2] Dulucq JL, Wintringer P, Mahajna A. Laparoscopic totally extraperitoneal inguinal hernia repair: Lesson learned from 3,100 hernia repairs over 15 years. Surgical Endoscopy. 2009;**23**:482-486

[3] Rajapandian S, Senthilan P, Gupta A, Gupta PD, Praveenraj P, Vaitheeswaran V, Palanivelu C. Laparoscopic totally extraperitoneal repair of inguinal hernia using two-hand approach—A gold standard alternative to open repair. Journal of the Indian Medical Association. 2010;**108**:652-654

[4] Barrat C, Surlin V, etal BA. Management of recurrent inguinal hernias: A prospective study of 163 cases. Hernia. 2003;**7**:125-129

[5] Hasbahceci M, Basak F, Acar A, Alimoglu O. A new proposal for learning curve of TEP inguinal hernia repair: Ability to complete operation endoscopically as a first phase of learning curve. Minimally Invasive Surgery. 2014;**2014**:528517

[6] Gupta MK, Muley KK, Bethanbhatla MK, Nanavati JD, Manish K, Sarangi R. Mini totally extra-peritoneal repair of inguinal hernia with all 5 mm ports: An innovative "555 Technique". Journal of Laparoendoscopic & Advanced Surgical Techniques. 2017 Mar;**27**(3):295-303

[7] Gupta MK, Bethanbhatla MK, Nanavati JD, Kumar M, Agarwal BB, Sarangi R. An innovative "555 Technique" for totally extra-peritoneal repair of inguinal hernia using all 5 mm ports. Journal of Laparoendoscopic & Advanced Surgical Techniques Part B, Videoscopy. 2016;**26**(4)

[8] Lomanto D, Katara AN. Managing intra-operative complications during totally extra-peritoneal repair of inguinal hernia. Journal of Minimal Access Surgery. 2006;**2**:165-170

[9] Hasson HM. Laparoscopic cannula cone with means for cannula stabilization and wound closure. The Journal of the American Association of Gynecologic Laparoscopists. 1998;**5**:183-185

[10] Bittner R, Arregui ME, Bisgaard T, et al. Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia [International Endohernia Society (IEHS)]. Surgical Endoscopy. 2011;**25**:2773-2743

[11] Karthik S, Augustine AJ, Shibhumon MM, Pai MV. Analysis of laparoscopic port site complications: A descriptive study. Journal of Minimal Access Surgery. 2013;**9**:59-64

Chapter 4

All-in-One Mesh Hernioplasty: A New Procedure for Inguinal Hernia Repair

Angelo Guttadauro, Matteo Maternini,
Nicoletta Pecora, Marco Chiarelli,
Valentina Riggio and Francesco Gabrielli

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.75387

Abstract

Since the 1970s, when biocompatible meshes were introduced with the consequent decrease of recurrence, one of the priorities in inguinal hernia surgery was that of minimizing postoperative chronic pain. All technical variations, proposed during the past years in order to improve patient's comfort, reported a variable incidence of chronic neuralgia. The procedure we describe, applicable to all cases of primary inguinal hernia, employs a smaller pre-cut single mesh that covers all weak areas of the inguinal canal and is enveloped in a fibro-cremasteric sheath, avoiding contact of the prosthesis with neural structures. The new procedure, already performed on 250 patients, aims to improve patients' comfort and to reduce the incidence of chronic neuralgia.

Keywords: inguinal hernioplasty, tension-free hernia repair, hernioplasty technique, mesh for groin hernia, neuralgia posthernioplasty

1. Introduction

A major goal of modern surgery is to achieve better outcomes with less invasive techniques while sparing functional tissue and reducing pain and long-term complications. Pain and restriction of daily activity rank high among patient concerns. The variety of surgical procedures for inguinal hernia repair might arouse suspicion that, because none to date has proven effective, old techniques need to be refined and new ones developed.

In 1974, Lichtenstein revolutionized hernia surgery with the use of tension-free mesh repair that would eventually supplant sutured procedures (Bassini, Shouldice) in which the area of weakness is strengthened by overlapping and suturing the musculoaponeurotic structures of the inguinal canal. Placement of an easy-to-use, biocompatible mesh prosthesis allowed for inguinal hernia repair was tension-free and so could potentially reduce its recurrence [1]. In the Lichtenstein procedure, a prosthetic mesh is placed under the external oblique muscle fascia (**Figure 1**) and fixed without tension to the surrounding musculoaponeurotic structures, thus reducing the rate of hernia recurrence. Later, Trabucco developed a pre-shaped monofilament polypropylene mesh that is inserted under the aponeurosis of the external oblique muscle where it is held in place by intra-abdominal pressure. This sutureless, tension-free technique also entails the placement of a "plug" prosthesis to reinforce the area of weakness of the floor of the inguinal canal after the hernia sac has been reduced in the abdominal cavity (**Figure 1**) [2]. Fibroblastic proliferation through the mesh and formation of fibrin already hours after prosthesis implantation, together with precipitation of collagen, provide for a natural seal of the mesh and tension-free hernioplasty.

Several problems remain, however:

- Persistent postoperative pain that may progress to chronic neuropathic or somatic pain

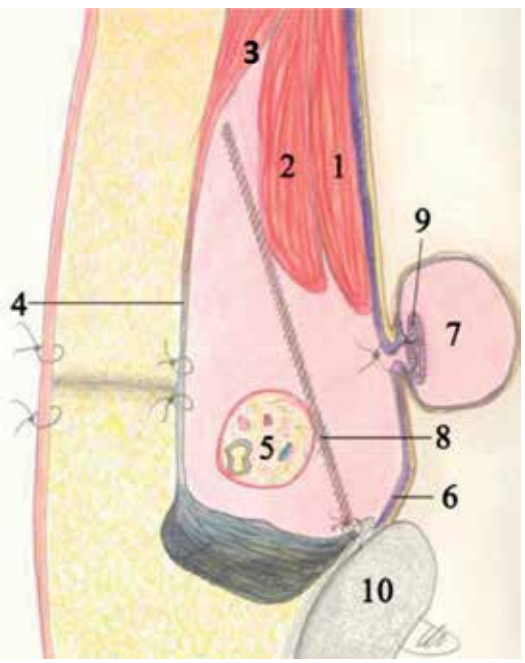


Figure 1. (1) Transverse muscle, (2) internal oblique muscle, (3) external oblique muscle, (4) aponeurosis of external oblique muscle, (5) spermatic cord, (6) transversalis fascia, (7) reduced direct inguinal hernia and sutured transversalis fascia, (8) prosthetic mesh placed according to Lichtenstein procedure, (9) prosthetic plug inserted into point of weakness according to Trabucco repair, (10) pubic tubercle.

http://dx.doi.org/10.5772/intechopen.75387

- Severe complications, albeit rare, due to plug migration
- Long-term risk of recurrence

Postoperative pain is usually transient and subjective and varies from one patient to another. Somatic pain arises from the presence of a foreign body (prosthetic mesh) which, owing to its size and implantation site, may affect muscles. Chronic neuropathic pain is often debilitating and generally caused by nerve entrapment in the subaponeurotic layer [3, 4], which is why some authors have underlined the need to isolate or transect nerves to prevent the development of chronic pain [5, 6]. Nerve resection is known to alter sensation of the skin area where the nerve has been resected and may induce a neuralgic effect, with the formation of a neuroma that causes chronic pain. Over the years, a variety of "plugs and patches," as well as surgical techniques (e.g., laparoscopy), have been developed without substantially changing the situation [7–10].

In 2012 a newly designed surgical technique began to be standardized for the placement of a pre-cut mesh prosthesis that would reinforce the areas of weakness of the inguinal canal without affecting the nerve structures of the inguinal canal. To better illustrate this system, a brief anatomic review is given below.

2. Anatomy of the inguinal region

The inguinal canal is located at the midpoint of the inguinal ligament that runs between the anterior superior iliac spine (ASIS) and the pubic tubercle. It is about 5 cm long and passes obliquely downward and inward. It is bounded by four walls: anteriorly, the aponeurosis of the external oblique muscle; posteriorly, the transversalis fascia; superiorly (roof), the fascia of the internal oblique and transverse abdominal muscles (joined by the conjoint tendon in 5% of cases); and inferiorly (floor), the rolled up portion (lacunar ligament) of the inguinal ligament. The deep inguinal ring is an opening in the transversalis fascia; it is located between the epigastric vessels and the fascia of the internal oblique and the transverse muscles and reinforced by Hesselbach's ligament. The superficial inguinal ring is a triangular opening formed by the external oblique where it inserts on the pubic crest and the pubic tubercle. It is bounded on either side by the margins of the opening in the aponeurosis, the crura of the ring. Lying superficial to the inguinal aponeurosis and deep to the superficial abdominal ring is Colles' ligament (reflected inguinal ligament), a triangular fibrous connective tissue band running from the pubic bone and lacunar ligament medially and upward to the linea alba [11–13].

The posterior wall of the inguinal canal is reinforced laterally by Hesselbach's (interfoveolar) ligament, medially by the conjoint tendon, and the reflected part of Colles' ligament at the distal end of Henle's ligament (formed by the union of the inferior terminal fibers of the aponeurosis of the transverse muscle and the iliopubic band) and is present only in the central part of the transversalis fascia. This oval area is particularly weak between the lower edge of the aponeurosis of the transverse muscle superiorly, the iliopubic band (thickening of the transversalis fascia near the inguinal ligament) inferiorly, Henle's ligament at the medial end, the junction of the inferior edge of the transverse muscle, and the iliopubic band at the lateral end (**Figure 2**) [11–13].

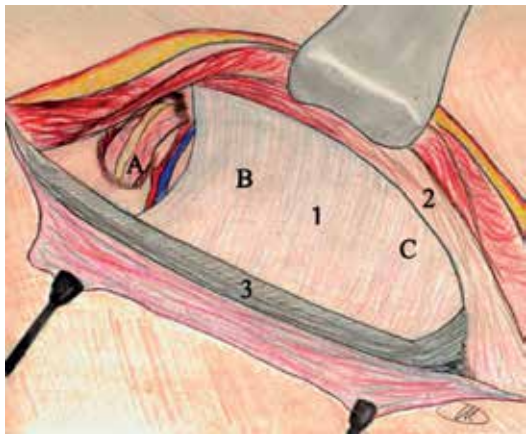


Figure 2. (1) Transversalis fascia (inguinal hiatus), (2) falx inguinalis, (3) inguinal ligament (iliopubic band), (A) lateral fossa (origin of external oblique inguinal hernia), (B) middle fossa (origin of direct inguinal hernia), (C) medial fossa (origin of internal oblique inguinal hernia.

This area of weakness comprises the deep inguinal ring, the site of indirect hernias, the area underlying it, and the site of direct hernias. Topographically, beneath the transversalis fascia, the inferior epigastric vessels run vertically and medially to the deep inguinal ring. Medial to the epigastric vessels and passing outward and downward is the remnant of the umbilical artery. Based on their relationship with the epigastric vessels and the remnant of the umbilical artery (**Figure 3**), three types of hernia can be distinguished:

1. External oblique hernia originates from the deep inguinal ring in an area of weakness termed the lateral fossa.
2. Direct hernia originates from an aperture in the posterior wall of the inguinal canal between the epigastric vessels and the remnant umbilical artery in an area of weakness termed the middle fossa.
3. Internal oblique hernia protrudes medially to the site of direct hernia in an area of weakness between the remnant of the umbilical artery and the urachus, termed the medial fossa. This type of hernia occurs rarely owing to the protective effect of the conjoint tendon, Colles' ligament, and Henle's ligament.

This universally recognized classification of inguinal hernia was recently simplified by the European Hernia Society into two areas of weakness of the inguinal canal floor: the medial area (direct hernias) and the lateral area (indirect hernias) [14].

Detailed anatomic study of the inguinal region shows how the transversalis fascia, together with the aponeurosis of the oblique internal and transverse abdominal muscles, by virtue of their anatomic structure and function, works to retain the content of the abdominal cavity. The aponeurosis of the external oblique muscle appears to have two roles: to cover and to oppose intra-abdominal pressure. In 1884 Edoardo Bassini conceived of a method to reinforce

http://dx.doi.org/10.5772/intechopen.75387

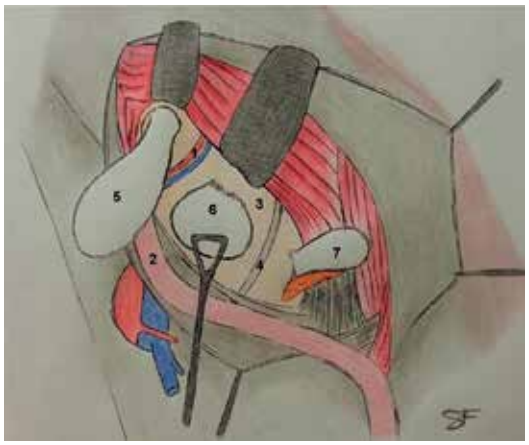


Figure 3. (1) Epigastric vessels, (2) spermatic cord, (3) transversalis fascia, (4) remnant of umbilical artery, (5) external oblique inguinal hernia, (6) direct inguinal hernia, (7) internal oblique inguinal hernia.

the wall using a triple layer in which the transversalis fascia, along with the internal oblique and the transverse muscles, was sutured to the posterior border of the inguinal (Poupart's) ligament. The drawback to this technique was that tension on the sutures led to high rates of hernia recurrence. To demonstrate the retainment capability of the transversalis fascia, Bassini showed that incidence of recurrence was higher when a double layer comprising only the internal oblique and the transverse muscles was employed to repair the defect. Later, Lichtenstein and Trabucco independently understood the need to reinforce the wall weakness using instead of sutures a mesh prosthesis with or without placing a "plug" in the weak point of the transversalis fascia. The drastic reduction in recurrence rates with the use of these techniques has made prosthesis hernioplasty the gold standard in inguinal hernia repair [1, 2].

Observing the anatomy of the transversalis fascia, we can imagine it as a thin layer lining the abdominal cavity, contracting relationships with the muscles and aponeurotic and bony structures. Cephalad fuses with the diaphragmatic fascia, in contact with the lower ribs, the first lumbar vertebrae, and the lumbodorsal fascia. Inferolaterally, it is continuous with the psoas fascia and the quadratus lumborum muscles and anteriorly with the rectus abdominis muscles and the aponeurosis of the transverse muscle. The image is that of a sac hung on the musculoaponeurotic and bony structures of the upper abdomen, with posterior and lateral connections in which the only area of passage is the semicircular arch of Douglas. The transversalis fascia then thickens medially (Henle's ligament) at the lateral concave edge (he called it the falx inguinalis) which inserts at its base in Cooper's ligament and anteriorly attaches to the conjoint tendon [11–13].

More lateral to the arch of Douglas is a thickening that continues to Hesselbach's (interfoveolar) ligament and inserts between the two fossas, the superficial inguinal ring and the medial fossa. It then inserts in the inguinal ligament after having circled the deep inguinal ring inferiorly. More laterally, the transversalis fascia forms a U-shaped sling around the ring and is continuous with the internal spermatic fascia. The so-called transversalis fascial sling, on contraction of the transverse muscle due to increased intra-abdominal pressure, is flattened at

its base, producing partial closure of the ring. The transversalis fascia performs a containing function by virtue of its bony and musculoaponeurotic attachments, particularly in the upper abdomen, attachment of Henle's ligament to Cooper's ligament and Hesselbach's ligament, and its attachment to the transverse muscle (transversalis fascial sling) and valve mechanism.

Other structures that assist in this function include:

- The internal oblique muscle surrounding the deep inguinal ring superiorly and then forming the medial wall of the inguinal canal. Contraction of the transversus abdominis causes this structure to move down toward the inguinal (Keith) ligament in a kind of protective shutter mechanism, which reinforces the weakest area of the groin on elevation of intra-abdominal pressure.
- The transverse muscle, which forms the medial wall of the inguinal canal and, together with the internal oblique muscle, unites in the conjoint tendon. The conjoint tendon then forms a lateral concavity and inserts on the pubic symphysis, the pubic tubercle, and Cooper's ligament. Posteriorly, it fuses with Henle's ligament (falx inguinalis). When the transverse muscle contracts, the deep inguinal ring narrows via the action of Hesselbach's ligament (Lytle's sling), another protective mechanism.
- Colles' ligament is made of fibers of the aponeurosis of the contralateral external oblique muscle that crosses at the midline.

The falx inguinalis, together with the inguinal ligament, forms the curved upper edge of the inguinal hiatus; its base is formed by the inguinal ligament (**Figure 2**). In healthy conditions, the falx inguinalis and the transversalis fascia contribute synergistically to retainment of the walls of the inguinal canal [11–13].

Three principal nerve structures pass through the inguinal canal:

1. The iliohypogastric nerve (anterior branch) runs along the internal oblique muscle, parallel and cranial to the spermatic cord; it exits the inguinal canal through a small aperture above the superficial inguinal ring.
2. The ilioinguinal nerve runs along the anterosuperior border of the spermatic cord between the cremasteric fibers.
3. The genital branch of the genitofemoral nerve enters the inguinal canal medial to the deep inguinal ring and runs along the posterolateral cremasteric fascia together with the external spermatic vessels [11–13].

2.1. Pathophysiological aspects

Changes in strength and resistance of anatomical structures, often associated with congenital or acquired degenerative disorders, and remodeling of collagen and elastic fibers can lead to widening of the deep inguinal ring and weakening of the posterior wall of the inguinal canal

by increased intra-abdominal pressure. The abdominal cavity can be compared to a container holding a dense, viscous content. Since its walls are subject to the laws of plasticity, the content of the abdominal cavity exerts a force per unit area perpendicularly to a surface, commonly defined as pressure. An imbalance between the force of intra-abdominal pressure and resistance of the inguinal wall at an area of weakness of the inguinal canal can result in plastic deformation that will increase even when the pressure remains unchanged [15]. It is this deformation at the points of weakness of the transversalis fascia that leads to its weakening.

The work by Wegh and Read showed that the fascia of hernia patients had low hydroxyproline content [16]. Histology demonstrated in many cases degeneration of collagen and elastic fibers in the musculoaponeurosis of the transverse muscle, like that seen in patients with Marfan syndrome [17, 18], apparently due to collagen catabolism because of a metabolic defect [18]. The use of prosthetic material that can promote rapid fibroblast proliferation is therefore required for reinforcing the inguinal wall and renders its resistance enough to ensure mesh stability after the patient has left the operating table, assumes the upright position, and begins to go about his daily activities.

Lichtenstein procedures are performed in part directly on the transversalis fascia since the mesh is placed in the subaponeurotic space (anterior wall of the inguinal canal) [1], and Trabucco procedures involve the floor of the inguinal canal through the application of plugs. The use of isolated plugs does not reduce the risk of recurrence at the site of insertion nor recurrence at other sites due to differences in the distribution of pressure. Hence, there is a need to apply also a prosthetic mesh to reinforce the aponeurosis of the external oblique muscle [2]. The support mechanism is similar to that provided by hernia support garments that apply targeted compression to prevent failure of the inguinal canal floor due to elevation of intra-abdominal pressure.

The absence of tension on the musculoaponeurotic layer after application of a prosthetic mesh under the anterior wall of the inguinal canal has reduced hernia recurrence rates; however, this type of mesh can cause pain due to contact with the musculoaponeurotic and nerve structures or induce a foreign body sensation due to wrinkling of the mesh. Analysis of hernia recurrence causes shows that they always occur in an area beneath a subaponeurotic mesh that has become well integrated with the anterior wall of the inguinal canal. In a review of 1276 patients operated on for hernia recurrence, Lichtenstein found a hernia defect near the pubic tubercle in 47% of cases, at the deep inguinal ring in 40%, and involving the entire suture in 13% [1].

This gave rise to the idea of a tension-free mesh prosthesis designed to provide direct reinforcement of the entire area of weakness of the inguinal canal floor, thus restoring its normal function. In addition, a technique was developed to apply a mesh that would not interfere with nerves and muscles in the area. Mesh shape and size were derived from repeated measurement of the inguinal canal floor for targeted application. No isolated plugs or subaponeurotic patches are needed. The mesh conforms to anatomy, with the less use of foreign body material, thus reducing the risk of pain and increasing patient comfort.

Furthermore, the presence of a missed hernia sac, which may be the cause of early hernia recurrence after a Lichtenstein or Trabucco procedure, is no longer possible. The areas of

weakness of the transversalis fascia at the floor of the inguinal canal are contemporaneously reinforced by apposition of a single prosthetic mesh designed to conform to the anatomy and function of the inguinal canal. The resulting rapid integration of fibroblasts into the mesh and the transversalis fascia strengthens the new wall, rendering the entire area of weakness of the inguinal canal floor more resistant to weakening under elevated intra-abdominal pressure.

3. Surgical technique

A skin incision is made, the aponeurosis of the external oblique muscle is opened, and the spermatic cord is identified. The subaponeurotic nerves (iliohypogastric and ilioinguinal nerves) need not be identified. Using a diathermy coagulator, a longitudinal medial incision is made along the cremasteric muscle and external spermatic cord fascia (fibrous cremasteric sheath); these are then separated from the spermatic cord to the inguinal ligament. The cremaster muscle, a continuation of the internal oblique abdominal muscle, arises at the pubic tubercle and the inguinal ligament. It forms the middle covering layer of the spermatic cord between the external and internal spermatic fascias, as it passes through the inguinal canal and distally to the common tunica vaginalis, an extroflexion of the transverse fascia.

The medial borders of the cremasteric sheath are grasped with Klemmer clamps (**Figure 4**), and the hernia sac is identified and separated from the spermatic cord. In direct or internal oblique inguinal hernia, the sac should be isolated from the surrounding anatomical structures and the transversalis fascia up to its neck when present. The area of weakness is then flattened by plicating the transversalis fascia. The deep internal inguinal ring is then prepared for applying section A of the mesh (**Figure 5**). In external oblique inguinal hernia, the hernia sac should be freed from the deep inguinal ring so that it can be completely reduced in the abdominal cavity. If present, a

Figure 4. (1) Cremasteric sheath, (2) transversalis fascia, (3) spermatic cord, (4) external oblique inguinal hernia.

http://dx.doi.org/10.5772/intechopen.75387

voluminous prehernia lipoma can be resected or reduced in the abdominal cavity together with the hernia sac. If necessary, the deep inguinal ring is then narrowed with resorbable interrupted sutures. In all cases, the posterior wall is reinforced with the prosthetic mesh, as shown in **Figure 5**.

This innovative, semiresorbable pre-cut mesh (70% polyglycolic acid and 30% polypropylene) is designed to reinforce the entire floor of the inguinal canal. It is shaped to conform to anatomy without the risk of wrinkling or need to trim it. Polypropylene is noted for its ability to induce an inflammatory fibrous reaction that promotes rapid, firm adhesion of the mesh onto tissues [19]. The mesh is available as a large-pore woven mesh that promotes infiltration and integration of connective tissue [16, 20, 21]. Less susceptible to bacterial colonization, the mesh can be left in place in case of infection [20, 22, 23].

Section A of the mesh is applied to surround the spermatic cord contents and form a cone around them by overlapping the two tails (A1 and A2). The length of the tails can be shortened to adjust the opening of the cone apex to the diameter of the spermatic cord. If present, diffuse lipomatosis

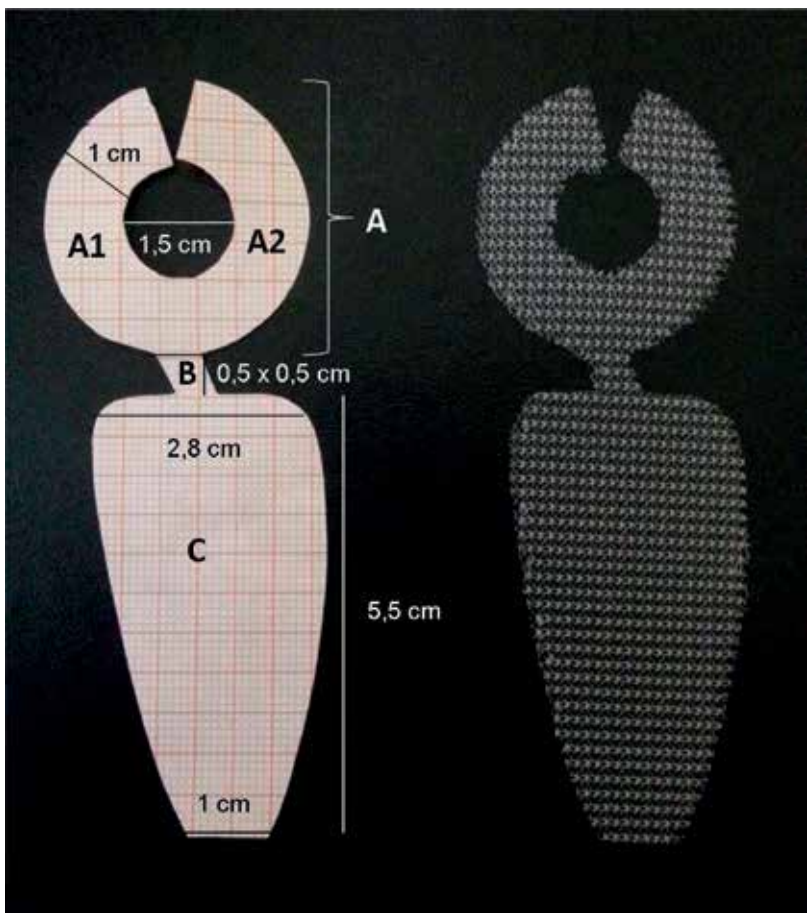


Figure 5. "All-in-one mesh" device.

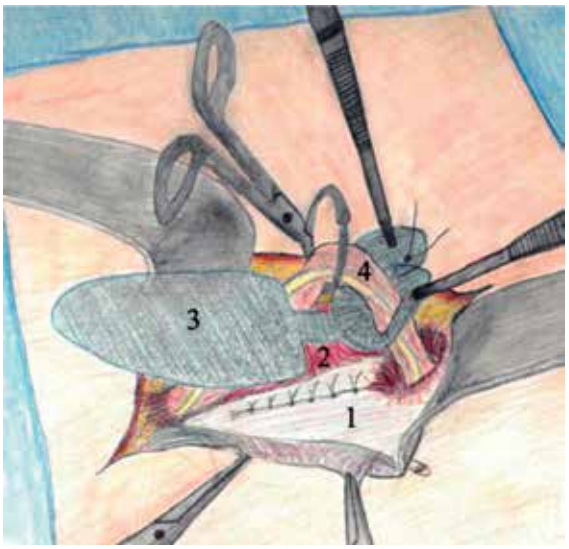


Figure 6. (1) Transversalis fascia after flattening the direct inguinal hernia, (2) isolation of the cremasteric sheath, (3) prosthetic mesh reinforcing the inguinal hiatus, (4) spermatic cord.

of the spermatic cord can be resected. The cone is closed with a suture tying the overlapping tails. While the assistant elevates the spermatic cord with Bottini forceps, the surgeon inserts the prosthetic ring into the deep inguinal ring using two anatomic forceps (**Figure 6**).

The cone serves to strengthen the area of weakness at the deep inguinal ring. When inserted into the ring, the cone depth is such that the implant does not interfere with or compromise the many underlying vessels, including the iliac vein medial to the artery and collateral vessels. Bendavid reported that the distance between the iliac vein and the transversalis fascia at the deep inguinal ring is between 0.8 and 1.2 cm [24]. A plug inserted any deeper would certainly comprise vessel function.

Sections B and C of the mesh are placed on the transversalis fascia. Section B connects section A in a medial angle to section C, which covers the entire floor of the inguinal canal and reinforces the middle and the medial fossa. So applied, the mesh sits laterally with its lesser convexity abutting the concavity of the inguinal ligament and extends medially to the conjoint tendon or above it, depending on the length of the canal, so as to avoid mesh wrinkling. A smooth mesh surface prevents the formation of dead spaces that delay fibroblast infiltration to the site and increase the risk of mesh-related infection and hernia recurrence. The distal end of section C (about 1 cm) is fixed to the pubic tubercle (not the periosteum) using resorbable suture (**Figure 7**). The shape of the mesh is configured so that it can be used for left- and right-sided inguinal hernia repair.

The medial edge of the previously identified cremasteric muscle is retrieved and sutured to the musculoaponeurotic structures using a running resorbable suture to cover the mesh (**Figure 8**). The cremaster serves only as a cover to prevent contact between the spermatic cord and the underlying mesh. If the muscle is injured during dissection, it can be repaired with

http://dx.doi.org/10.5772/intechopen.75387

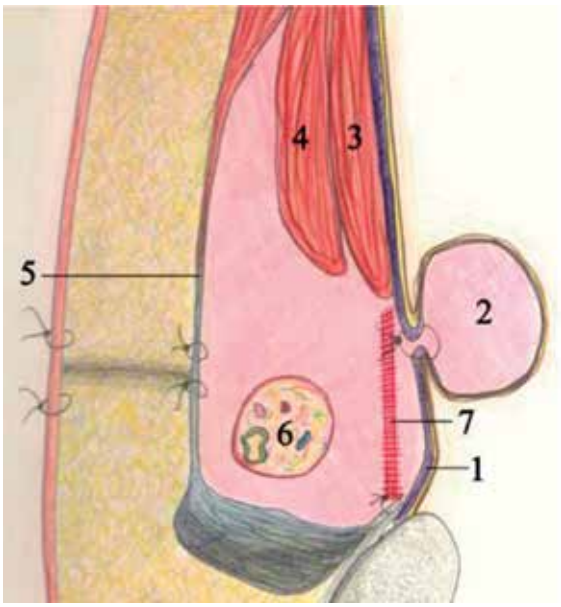


Figure 7. (1) Transversalis fascia, (2) reduced direct inguinal hernia flattened by suturing the transversalis fascia, (3) transverse muscle, (4) internal oblique muscle, (5) aponeurosis of the external oblique muscle, (6) spermatic cord, (7) all-in-one mesh placed as described in the text. The special mesh configuration allows for deployment in left and right hernioplasty.

a resorbable suture. The spermatic cord is returned to its natural position, and the external oblique aponeurosis is closed over the cord with interrupted resorbable sutures, as are the superficial layers.

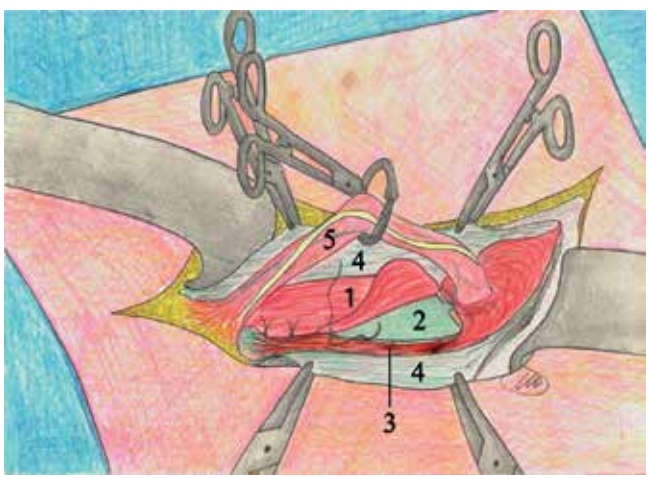


Figure 8. (1) Cremaster, (2) prosthetic mesh, (3) musculoaponeurotic layer, (4) external oblique muscle fascia, (5) spermatic cord.

Fixed between the deep inguinal ring and the pubic tubercle, the mesh reinforces the posterior inguinal wall as it extends between the cremaster muscle and the transversalis fascia. The spermatic cord, subaponeurotic structures, and pressure exerted by the tissues compress it. Rapid fibroblast infiltration of the prosthesis incorporates it into the tissues to form a triple retaining layer, without the formation of dead space which could lead to the development of hematoma and/or seroma or nerve entrapment, all of which are causes of chronic pain that is notoriously difficult to treat. Surgery is performed with local anesthesia [25].

3.1. Advantages

Compared with other techniques currently in use, this novel procedure has the following advantages:

1. A relatively simple procedure with a short learning curve.
2. Shorter operating time and greater ease of execution, without the need to isolate nerves, prepare the site for subaponeurotic placement, trim the mesh, fix it to the surrounding musculoaponeurotic structures, or apply one or more plugs.

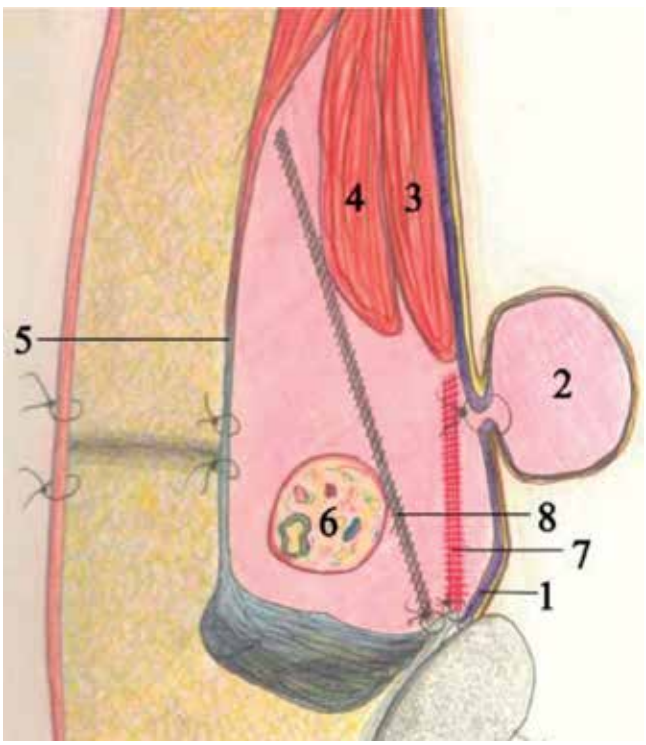


Figure 9. (1) Transversalis fascia, (2) reduced direct inguinal hernia flattened by suturing the transversalis fascia, (3) transverse muscle, (4) internal oblique muscle, (5) aponeurosis of the external oblique muscle, (6) spermatic cord, (7) all-in-one mesh placed as described in the text, (8) mesh prosthesis placed according to Lichtenstein procedure or modifications thereof.

3. Reduced surgical trauma, with no or minimal postoperative pain and rapid return to activities of daily living.
4. Minimal use of mesh material and elimination of problems related to mesh wrinkling.
5. Early hospital discharge.
6. Reduced risk of chronic neuropathic or somatic pain caused by contact of mesh prosthesis with nerves and surrounding musculoaponeurotic structures.
7. No plugs used; no risk of plug migration.
8. Potential reduction of hernia recurrence since the mesh covers the entire area of weakness of the floor of the inguinal canal and does not come into contact with the overlying layer, as occurs with the Lichtenstein and Trabucco procedures (**Figure 9**).

4. Personal case

4.1. Population

We considered a cohort of patients suffering from primary unilateral inguinal hernia that underwent the "all-in-one" mesh hernioplasty technique consecutively, at our institution. Hernias were divided according to the European Hernia Society criteria (**Table 1**). The work described has been carried out in accordance with the code of ethics of the World Medical Association. Written informed consent was obtained from each patient included in the study. All data of the cohort were registered in a specific database. Spinal anesthesia was adopted, and 2.0 g cefazolin was administrated intravenously over 30 minutes before the incision for all patients, and the procedure was performed on a 1-day surgery basis. From September 2012 to August 2015, we treated 250 adult patients for primary inguinal hernia, 241 males and 9 females with an average age of 61.7 years (range, 22–90).

4.2. Follow-up

Postoperative pain was gauged on the ward by a surgeon of the team. At discharge, all patients received a data sheet designed for the evaluation of postoperative pain using visual analogue scale (VAS) score, quantity of pain medication, and any postoperative discomfort. The patient's discomfort was assessed in terms of limitation of daily activities during the postoperative period, and return to work, and sports. Patients were asked for an overall opinion on the operation, on the postoperative period, and on the final result. These data were recorded by patients themselves on data sheet after 1, 2, and 3 weeks from discharge. The first clinical evaluation was made 7 days after surgery by a member of the surgical team. The second and third week interviews were made on the phone. The postoperative data registered by patients were collected. Follow-up, made to evaluate local signs, any kind of chronic pain, any sensation of foreign body, and recurrence, took place at 3, 6, 12, 18, and 24 months after surgery in the outpatient clinic by a surgeon of the team. All patient data were collected in a database of our institution.

Type	No. of patients
P L1M0F0	53
P L2M0F0	53
P L3M0F0	33
P L2M2F0	24
P L1M1F0	20
P L0M2F0	16
P L0M1F0	12
P L3M3F0	12
P L1M2F0	12
P L0M3F0	8
P L1M3F0	3
P L2M1F0	2
P L2M3F0	1
P L3M2F0	1

Table 1. Hernias were divided according to the European hernia society classification.

4.3. Results

Three (1.2%) patients complained of urinary retention, 2 (0.8%) of orchitis, and 14 (5.6%) showed bruising of the external genitalia. No other early complications were reported. Pain reported by patients in the immediate postoperative period was slight (mean VAS score = 2.1). A total of 79 (31.6%) patients required no pain medication, while the remaining 171 (68.4%) were given nonnarcotic analgesics. Average VAS score during the first postoperative week 171 was 1.2, and 119 (47.6) patients took no medication (**Table 2**). During the second postoperative week, 8 (3.2%) subjects still complained of slight pain referred to the wound

VAS 0	46.8% (117 pts)
VAS 1	17.6% (44 pts)
VAS 2	17.6% (44 pts)
VAS 3	10.8% (27 pts)
VAS 4	3.2% (8 pts)
VAS 5	3.2% (8 pts)
VAS 6	0.8% (2 pts)
Average pain VAS 1.2; SD 1.5.	

Table 2. Postoperative pain in the first week.

VAS 0	96.8% (242 pts)
VAS 1	0.8% (2 pts)
VAS 2	1.2% (3 pts)
VAS 3	1.2% (3 pts)
Average pain VAS 0.06; SD 0.4.	

Table 3. Postoperative pain in the second week.

(average VAS score = 0.06). None of the patients took medication (**Table 3**). During the third postoperative week, only 0.4% (1) of patients complained of slight pain (average VAS score 0.01) which needed no medication (**Table 4**). Only 23 (9.2%) subjects experienced slight limitations of normal activities during the first week (**Table 5**). Thirty (20.1%) patients were able to engage in sports as early as 1 week from surgery, while 46 (30.9%) started between 7 and 21 days after surgery. Patients underwent to planned follow-up at 3 months (50 patients), 6 months (35 patients), 12 months (25 patients), 18 months (35 patients +1 patient lost), and 24 months (104 patients). Average follow-up is 15 months. None of our patients suffered from postoperative neuralgia, sensation of foreign bodies, or even simply discomfort. One recurrence was seen. All patients seemed satisfied with the operation, the recovery, and the final result [25].

4.4. Discussion

Tension-free techniques dramatically reduced recurrence rates making them the standard in hernia surgery. A not negligible incidence of postoperative chronic neuralgia [8, 26, 27] brought the attention of surgeons to new precautions even with the use of meshes [28].

Postoperative pain is temporary, usually controlled by medication. When persistent after 3–6 months from surgery, pain becomes disabling and may compromise the patient's quality of life. Pain may be related to the presence of the mesh that, because of size and location, takes contact with muscular structures or caused by fibrotic entrapment of nerves by a subfascial prosthesis [4, 13]. Studies conducted on animals also showed perineural alterations with myelinic degeneration due to contact between nervous structures and mesh [29]. Therefore, there is a necessity of identifying and dissecting subfascial nerves [30] and even of dividing them to avoid chronic pain [5, 6]. New surgical techniques and numerous kinds of meshes were proposed in the past years in the attempt to reduce postoperative neuralgia; nevertheless, the results of these new procedures were not completely satisfactory [7–10].

VAS 0	99.6% (249 pts)
VAS 1	0.4% (1 pt)
Average pain VAS 1.2; SD 1.5.	

Table 4. Postoperative pain in the third week.

	First week n. pt	Second week n. pt	Third week n. pt
No restriction	227	246	250
Slight restriction	23	4	0
Severe restriction	0	0	0

Table 5. Restriction in daily activities.

This led to the setting of guidelines for prevention and treatment of this situation [31].

If we consider the areas of weakness within the inguinal canal from which the three types of hernia arise, we see an oval-shaped surface surrounded by known muscular and fascial structures on the canal's floor and a further weak zone in proximity to the deep inguinal ring (**Figure 2**).

The transversalis fascia is an important restraining element for both structure and functionality in a region lacking overlying muscular structures. Then, the idea of a prosthesis specifically shaped to obtain containment by acting directly on the weak areas of the transversalis fascia without involving muscular or nervous structures avoiding to place a subaponeurotic mesh. This allows the procedure more anatomical with minimal foreign body implantation.

The prosthesis size, defined after numerous measurements of the inguinal canal made at the operating table, is notably smaller than the ones used as of now, allowing a precise and smooth positioning in a different plane to where the nerves lie.

The weak areas along the transversalis fascia are strengthened, all at once, by the prosthesis (all-in-one mesh), so that losing a hernia sac can no longer happen [2].

Polypropylene was chosen because of its capacity of inducing a lively inflammatory and fibrotic response with quick and strong adhesion to adjacent tissues. A prompt fibroblastic reaction between transversalis fascia and mesh immediately takes place because of the absence of any dead space and quickly forms a new wall.

This new technique is simple to perform and guarantees quick discharge and return to normal activities without any long-term discomfort. The average operative time was 25 min. The surgeon needs not dissect the cremaster, which may cause damage to the nerves, nor create a subfascial "nest," because no mesh is inserted at that level.

Furthermore, no plugs nor mesh trimming are necessary, and the prosthesis does not have to be sutured to adjacent structures. The use of a smaller quantity of prosthetic material allows the envelopment of the mesh by the fibro-cremasteric sheath, avoiding contact with surrounding nerves. Because of its shape, the mesh is placed in a deeper site directly over the weak areas of the floor of the inguinal, canal and, although smaller, it seems not to increase rate of recurrence.

The most common technique of Lichtenstein provides a prosthesis which, to remain on the transversalis fascia, must be fixed to the sides and becomes necessarily under aponeurotic in the upper third.

In our technique, the prosthesis is positioned and remains on the transversalis fascia because it is coated with the fibro-cremasteric sheath and it remains anchored on the inguinal floor with a single fixing point at the pubic level and with the prosthetic conical ring on the deep inguinal ring. It is not directly under-aponeurotic at any point, and it stays in place and therefore does not require lateral fixation.

In addition, the prosthesis is not in contact with the ilioinguinal and iliohypogastric nerves. Our paper is an observational cohort study with only midterm (2 years) follow-up. Clinical trials comparing the "all-in-one mesh" hernioplasty to the most common surgical techniques are required to obtain a validation of our procedure. Indeed, a much longer follow-up could highlight the actual recurrence rate of the new procedure.

5. Conclusion

This new procedure claims many technical advantages and helps the less experienced surgeon to avoid pitfalls in dealing with nerves. According to our series, "all-in-one mesh" hernioplasty presents a low rate of long-term complications. Employing a smaller amount of prosthetic material, placed where no contact with nerves occurs, avoids neuralgia and sensation of foreign body.

A multicenter study is underway to compare this new procedure with the most common techniques.

Author details

Angelo Guttadauro[1]*, Matteo Maternini[1], Nicoletta Pecora[1], Marco Chiarelli[2], Valentina Riggio[3] and Francesco Gabrielli[1]

*Address all correspondence to: angelo.guttadauro@unimib.it

1 Department of Medicine and Surgery, General Surgery Unit, Istituti Clinici Zucchi, University of Milano-Bicocca, Monza, Italy

2 General Surgery Unit, Ospedale di Lecco, Italy

3 Department of Medicine and Surgery, University of Milano-Bicocca, Italy

References

[1] Lichtenstein IL. Herniorrhaphy. A personal experience with 6321 cases. American Journal of Surgery. 1987;**153**(6):553-559

[2] Trabucco E, Trabucco A, Rollino R, et al. L'ernioplastica inguinale tension-free con rete presagomata senza suture secondo Trabucco. Chirurgia. 1998;**11**:142-148

[3] Canzani M, Frattini F, Cavalli, et al. Trattamento chirurgico nel dolore cronico posterniorrhaphy? Journal of the American College of Surgeons. 1998;**187**:514-518

[4] Heise CP, Starling JR. Mesh inguinodynia: A new clinical syndrome after inguinal herni-

[5] Karakayali F, Oksuz E, Turk E, et al. Effectiveness of multiple neurectomies to prevent chronic groin pain after tension-free hernia repair. International Surgery. 2010;**95**:40-48

[6] Mui WL, Ng CS, Fung TM, et al. Prophylactic ilioinguinal neurectomy in open inguinal hernia repair: A double-blind randomized controlled trial. Annals of Surgery. 2006;**244**:27-33

[7] Amid PK. Groin hernia repair: Open techniques. World Journal of Surgery. 2005;**29**: 1046-1051

[8] Valenti G, Baldassarre E, Testa A, et al. Dynamic self-regulating prosthesis (protesi autoregolantesi dinamica): The long-term results in the treatment of primary inguinal hernias. The American Surgeon. 2006;**72**:244-248

[9] Koeninger J, Redecke J, Butters M. Chronic pain after hernia repair: A randomized trial comparing Shouldice, Lichtenstein and TAPP. Langenbeck's Archives of Surgery. 2004;**389**:361-365

[10] Birk D, Hess S, Garcia-Pardo C. Low recurrence rate and low chronic pain associated with inguinal hernia repair by laparoscopic placement of Parietex ProGrip™ mesh: Clinical outcomes of 220 hernias 340 with mean follow-up at 23 months. Hernia. 2013;**17**:313-320

[11] Testut L, Jacob O. Trattato di Anatomia Topografica. In: UTET, editor. Torino. 1967. Vol. II 405-431, Vol. III 568-576

[12] Terranova O, Battocchio F. La chirurgia delle ernie della regione inguinale e crurale. Anatomia. Padova: La Garangola; 1988

[13] Pellissier E. Tecniche Chirurgiche Addominali. Anatomia Chirurgica Dell'inguine. Elsevier; 40-105. DOI: 10.1016/S1283-0798(07)49266-X

[14] Miserez M, Alexandre JH, Campanelli G, et al. The European hernia society groin hernia classification: Simple and easy to remember. Hernia. 2007;**11**:113-116

[15] Hoffman CH, Vinton Traverso A. Preperitoneal prosthetic herniorrhaphy. One surgeon's successful technique. Archives of Surgery. 1993;**128**(9):964-969

[16] Campanelli G, Bottero L, Leopaldi E, et al. Cosa sta cambiando nella chirurgia dell'ernia inguinale. Chir Arch Trim. 1993;**17**:13-17

[17] Campanelli G, Bottero L, Campagnoli P, et al. L'approccio pre-peritoneale in anestesia locale nella chirurgia delle recidive di ernia inguinale. Atti SPIGC; 1992

[18] Nyhus LM, Pollak R, Bombeck CT, et al. The pre-peritoneal approach and prosthetic buttress repair for recurrent hernia. The evolution of a technique. Annals of Surgery. 1988;**208**(6):733-737

[19] Bendavid R. L'intervento di Shouldice. Una tecnica per la riparazione dell'ernia inguinale. In: Terranova O, Battocchio F, editors. La chirurgia delle ernie della regione inguinale e crurale. La Garangola; 1988. pp. 76-83

[20] Shulman AG, Amid PK, Lichtenstein IL. The "plug" repair of 1402 recurrent inguinal hernias. 20-year experience. Archives of Surgery. 1990;**125**(2):265-267

[21] Shulman AG, Amid PK, Lichtenstein IL. Prosthetic mesh plug repair of femoral and recurrent inguinal hernias: The American experience. Annals of the Royal College of Surgeons of England. 1992;**74**(2):97-99

[22] Gilbert A. Sutureless repair of inguinal hernia. American Journal of Surgery. 1992;**163** (3):331-335

[23] Barnes JP Jr. Inguinal hernia repair with routine use of Marlex mesh. Surgery, Gyne cology & Obstetrics. 1987;**165**(1):33-37

[24] Bendavid R. The space of Bogros and the deep inguinal iliac circulation. Surgery, Gynecology & Obstetrics. 1992;**174**(5):356-357

[25] Guttadauro A, Maternini M, Frassani S, et al. "All-in-one mesh" hernioplasty: A new procedure for primary inguinal hernia open repair. Asian Journal of Surgery. 2017; Aug 26. pii: S1015-9584(17)30162-8. DOI: 10.1016/j.PMID:28851612

[26] Campanelli G, Sfeclan C, Cavalli M, et al. Reducing postoperative pain: The use of Tisseel for mesh fixation in inguinal hernia repair. Surgical Technology International. 2012;**22**:134-139

[27] Bueno J, Serralta A, Planells M, et al. Inguinodynia after two inguinal herniorrhaphy methods. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques. 2004;**14**:210-214

[28] Lionetti R, Neola B, Dilillo S, et al. Sutureless hernioplasty with light-weight mesh and fibrin glue versus Lichtenstein procedure: A comparison of outcomes focusing on chronic postoperative pain. Hernia. 2012;**16**:127-131

[29] Demirer S, Kepenekci I, Evirgen O, et al. The effect of polypropylene mesh on ilioinguinal nerve in open mesh repair of groin hernia. The Journal of Surgical Research. 2006;**131**:175-181

[30] Alfieri S, Rotondi F, Di Miceli D, et al. Chronic pain after inguinal hernia mesh repair: Possible role of surgical manipulation of the inguinal nerves. A prospective multicentre study of 973 cases. Chirurgia Italiana. 2006;**58**:23-31

[31] Alfieri S, Amid PK, Campanelli G, et al. International guidelines for prevention and management of post-operative chronic pain following inguinal hernia surgery. Hernia. 2011;**15**:239-249

Chapter 5

Hybrid Technique for Incisional Hernias

Monika Romanowska and Jacek Pawlak

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76941

Abstract

Hernia is one of the most common complications post any laparotomy. Various techniques are used for the repair of incisional hernias. Hernioplasty with synthetic materials is worldwide standard, and indications to the simple suture methods are rare. Minimally invasive techniques for hernia repair have become popular since 1990 and carry many advantages. Some incisional hernias have a very large hernia sac with large loss of fascia, which makes an exclusive laparoscopic approach challenging. Moreover, some patients are found to have very dense adhesions, which makes laparoscopic approach unsafe, and almost impossible necessitating conversion from laparoscopic to open surgery. Then, the process is carried on until the safe implantation of mesh into abdominal cavity becomes possible. This has led to the birth of what is known as the hybrid technique for incisional hernia repair (laparoscopy, conversion, laparotomy, laparoscopy). Patients with large, complicated, and recurrent incisional hernias should primarily be qualified to hernioplasty with the hybrid technique, which combines the conventional open repairs (safe adhesiolysis, safe placement of laparoscopic tools into the abdominal cavity, closing the defect) with laparoscopic repair (intraperitoneal mesh placing).

Keywords: incisional hernia, hybrid techniques, synthetic materials

1. Introduction

Postoperative hernia is the most common complication of abdominal surgery and a big problem in clinical practice. Incisional hernias complicate in 2–20% of laparotomies and depend on wound complications during the postoperative period, the type of surgical technique, the method used to close the abdomen, and many factors connected with the patient (age, elevated body mass index, general condition) [1, 2]. High rate of recurrence in 20–50% of patients after the primary repair of a defect is another problem [3, 4]. Many complications after open

operation and technical progress, associated with innovations in synthetic materials which are covered by anti-adhesive substance of the ventral side, lead to the development of laparoscopic surgery [5, 6]. This method offers many advantages: minimal pain, shorter stay in the hospital, quicker return to activities, and the ability to identify additional defects in abdominal wall [7, 8]. However, the problem of recurrence after incisional hernia repair still exists, and its incidence rate ranges between 1.8 and 10% [9].

As the hernias have become more complex, the management strategy has evolved as well. In some difficult cases, defects are very large, and then even after laparoscopic repair, patients are unhappy because of cosmetic appearance of their wound. Moreover, sometimes mini-invasive repair of complicated postoperative hernia is not so easy to perform due to massive adhesions after the primary operations which are especially dangerous during placing laparoscopic tools into abdominal cavity. Some surgeons are convinced that it is worth to combine the two techniques, open and laparoscopic, to maximize benefits of both methods.

2. Surgical technique

Hybrid incisional repair can be performed by two techniques.

2.1. Standard combined laparoscopic technique

Fascial defect is exposed via incision over the previous surgical scar and hernia sac incised to access into the abdomen (**Figures 1** and **2**). Afterward during the next step of laparotomy, extensive and safe adhesiolysis can be ensured; reduction of the hernia sac (**Figure 3**) and proper placement of the laparoscopic trocars under direct vision are the other steps. Finally, the mesh can be laid into the peritoneal cavity (under the fascia defect) (**Figure 4**). Some researchers use Prolene sutures to fixate the mesh [10]. Then, mesh material is left in the abdomen, and fascial defect was primarily closed.

Figure 1. Recurrent hernia with thin overlying skin after laparotomy and the primary suture repair complicated by wound infection.

http://dx.doi.org/10.5772/intechopen.76941

Figure 2. Removal of surgical scar.

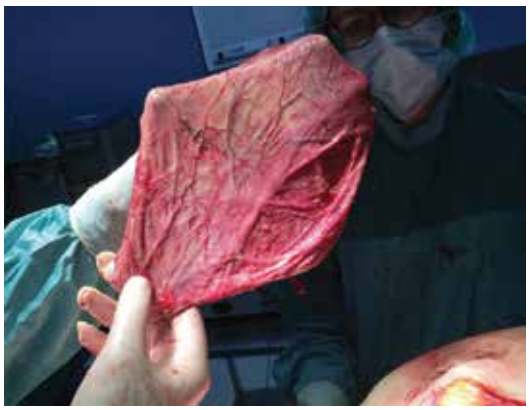


Figure 3. Prepared hernia sac.

Figure 4. The mesh placed into abdominal cavity.

The next step is the laparoscopic part of the procedure, intraperitoneal placement of the mesh after the reduction of the intraperitoneal pressure to 7–8 mm Hg. The mesh should have appropriate size, covering the actual hernia size edges for at least 5–7 cm, and then it is laparoscopically fixed with transfascial stay stitches (Protac, AbsorbaTack, or CapSure) (**Figure 5**). Desufflation and skin sutures finish the procedure (**Figure 6**).

In case of large incisional hernia where primary closure of fascial defect is impossible, authors enlarge the abdominal wall surface by modified component separation technique. The dissection of adhesions between the peritoneum and small bowels is needed until rectus muscles are entirely exposed. The skin is elevated and dissected from the anterior surface of the rectus sheath to the exposure of external abdominal oblique muscles by 5 cm (**Figure 7**). At 2 cm, lateral from rectus sheath, the aponeurosis of the external abdominal oblique muscle is longitudinally

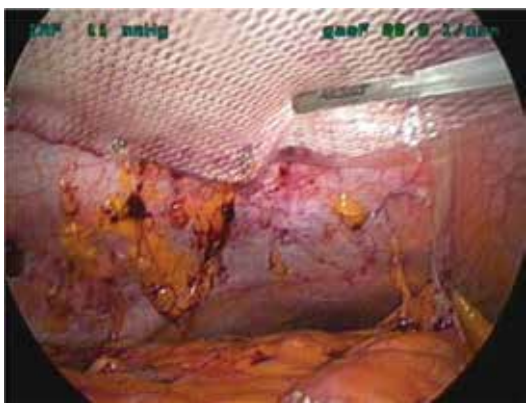


Figure 5. The mesh fixated laparoscopically.

Figure 6. Early postoperative view.

http://dx.doi.org/10.5772/intechopen.76941

Figure 7. Dissection of the skin from anterior surface of rectus sheath.

transected (**Figure 8**), superiorly to the level of costal margin and inferiorly to the symphysis pubis. By releasing bilateral external abdominal oblique muscle attachment, a gap of 7–10 cm between rectus abdominis muscles could be bridged at the waistline [11]. Closure of abdominal wall defect can be achieved using continuous running sutures. Suction drains placed at the subcutaneous space are necessary. The laparoscopic part is the same as mentioned above.

2.2. Combined technique with early conversion

The procedure starts with entering the peritoneal cavity by using a Veress needle, an open Hasson method, or an optical trocar allowing the view of the abdominal wall layers during penetration. The authors prefer the Veress needle entered under the left costal margin—the left upper quadrant as space where the least adhesions are expected. Three trocars are used, one 10 mm trocar and two 5 mm trocars, which are placed as laterally as possible on the abdominal wall, so they are at an adequate distance from the hernia orifice. The next step

Figure 8. The transection of the aponeurosis of external abdominal oblique muscle.

Causes of conversion	n-237 (%)
Massive adhesions	4.6
Injury of small bowel during adhesiolysis	3
Injury of small bowel during trocar placement	1.3
Size of defect (too large to repair during laparoscopy)	1.3
Lack of progression of operation	0.9
Intraoperative bleeding	0.4

Table 1. Causes of conversion during IPOM procedure based on 237 cases.

of the operation is adhesiolysis. The adhesions in the abdomen are lysed using an electrocautery, an ultrasonic scalpel, or scissors. No cauterization should be done that may injure the bowel wall. Perforation of the intestine is the most serious injury associated with laparoscopic ventral hernia repair [12]. Thus, in selected cases, if extensive adhesiolysis is deemed to be particularly hazardous for enterotomy, the conversion should be done and division of omental and bowel adhesions to the anterior abdominal wall is performed through laparotomy. Other causes of conversion are bigger size of the fascial defect than it was primary expected but which was impossible to repair during laparoscopic procedure only, lack of progression of operation, and intraoperative bleeding. The authors analyzed the causes of conversion based on 237 patients primarily qualified to hernia repair with the IPOM procedure in our department between 2008 and 2016. In case of 27 patients (11.4%) from a group of 237 patients, it was necessary to change surgical approach from laparoscopic to open surgical approach. Respective causes of conversion are presented in **Table 1**.

Performance of open, safe adhesiolysis or repair of injuries is essential for graduating to another step of the procedure. Placement of the mesh into the abdominal cavity, closing the fascial defect and laparoscopic fixation of the mesh, should progress the same as in case of standard combined laparoscopic technique.

3. Indications for the hybrid technique

There are no objectively defined selection criteria of treatment of incisional hernias, but we selected some rules which may find helpful in making treatment decisions.

In our concept, hybrid surgical approach can be dedicated to patients with large, difficult incisional hernias, where extensive, dense adhesions are expected (e.g., patients with two or more recurrences of hernia, patients with history of successful treatment of gastrointestinal-cutaneous fistulas, patients after many laparotomies—three or more). Moreover, it may be prudent to offer hybrid repair for particularly large incisional hernias, where transverse separation of the fascial edges is >8–10 cm.

4. Contraindications for the hybrid technique

Obese patients (with BMI > 35 kg/m^2) should be primarily qualified to laparoscopic hernia repair which gives them more benefits than the hybrid technique (e.g., less infection complications, earlier recovery).

Patients with giant incisional hernia with loss of abdominal domain are the most challenging ones and require an individual preoperative treatment. Loss of domain (LOD) occurs when an abdominal wall defect progresses to a size at which it may no longer accommodate the viscera, leading to protrusion outside of the abdominal wall and into the hernia sac [13]. Hernia defect area can be calculated from cross-sectional imaging using computed tomography (CT), and hernia sac volume (HSV) and peritoneal cavity volume (CV) are obtained from preoperative CT measurements. If the calculated volume ratio (VR = HSV/CV) is larger than 25%, loss of domain is observed [14]. In these cases the individual preoperative treatment includes pulmonary training, an installation of a pneumoperitoneum, or an implantation of an expander system to achieve a relaxation and stretching of the skin and muscles as well [15].

5. Postoperative complications

Complications after hybrid approaches to incisional hernia repair span a wide range of severities. To do it more comprehensibly, they were divided into early and long-term complications.

5.1. Early postoperative complications

Early postoperative complications are revealed during the operation or not longer than 30 days after the operation. Some of postoperative complications are composed of those common to all general surgery, for example, thromboembolism and superficial surgical site infection, and are typically managed no differently [16]. Unique to recovery from hernia surgery however can be increased pain after mesh placement, seroma related to large dissection planes, infections of the mesh, as well as pulmonary insufficiency due to changes or loss in abdominal domain.

An inadvertent enterotomy is a serious complication of adhesiolysis. Adhesions to the abdominal scar represent a significant problem during hybrid repair, with the risk of bowel injury around the neck of the hernia during dissection. Rudmik et al. [17] in their review calculated an overall risk of enterotomy of 2.1% when the laparoscopic approach is the first step of hybrid repair. Injury of a hollow organ is a very serious event and should be recognized and treated immediately. An incidental enterotomy may occur during initial trocar placement or may result from adhesiolysis. Two strategies are available to deal with such a situation. One option, which is particularly attractive when there is no enteric spillage, is to suture the perforation and proceed with hybrid repair, in conjunction with copious saline lavage of the peritoneal cavity and intravenous antibiotics. The second option is to complete adhesiolysis and repair the bowel

injury but to delay mesh placement (i.e., perform a "staged repair," within a fairly short interval), in order to optimize bacterial clearance and minimize the risk of infection [18]. Colonic injury is a more serious concern; there is no substantial evidence base to guide decision-making. The optimal strategy in case of enteric injury needs to be decided on a case-by-case basis. A safe option, particularly if laparotomy has been undertaken because of the bowel injury, is to perform simply a suture repair of the hernia and accept that the risk of mesh infection has been exchanged for a higher risk of hernia recurrence. If the enterotomy remains unnoticed, it may result in an acute abdominal condition and sepsis within a few hours after surgery.

Authors have experiences based on 61 patients who underwent hybrid hernia repair in our department between 2008 and 2016. They were divided into two groups. Group 1 (n = 34) identifies patients operated with standard combined laparoscopic technique, whereas group 2 (n = 27) labels combined technique with early conversion. Both groups were compared in terms of early complications and shown in **Table 2**.

Serious complications include mesh infections and enterocutaneous fistula involving mesh, as well as the rare, but highly morbid mesh. Complications such as these likely require revisional surgery for resolution. Then, in our opinion, complete removal of the mesh is required, as well as drainage of subcutaneous surface and intravenous antibiotics.

Early postoperative abdominal pain is a fairly regular feature of the hybrid repair. In our concept, it is usual to anticipate a comfortable patient at 24–72 h after operation and remain within 6–7 on the Visual Analogue Scale. Mesh fixation with titanium tacks plays a key role in the development of acute postoperative pain. Conceptually, a 4-mm-long tack would be expected to penetrate only 2 mm into the abdominal wall, after allowing 1 mm for the thickness of the mesh and another 1 mm for the tack profile that projects on the surface of the mesh. Thus, in obese patients, the tack may be restricted to the extraperitoneal fat without purchase

Postoperative early complications	**Group 1 (n = 34)**	**Group 2 (n = 27)**
Enterotomy during initial trocar or Veress needle placement	0	3
Enterotomy during laparotomy	1	1
Enterotomy during adhesiolysis	5	7
Injury of the bladder	1	0
Acute postoperative pain	6	8
Surgical site infection	6	8
Enterocutaneous fistula	2	0
Mesh infection	2	1
Small bowel tied up into 12 mm trocar defect	1	0
Left part of mesh fixing system	1	0
Total	25	28

Table 2. Postoperative early complications in both groups.

into the muscle. This theory explains why acute postoperative pain is the most frequently observed in young, slim females. Furthermore, some studies show that the use of multiple transparietal sutures is largely related to a perceived association with increased postoperative pain, perhaps due to muscular ischemia or entrapment neuropathy [19].

Patients with acute pain are initially treated with anti-inflammatory medications and continuous infusion of opioids during 24–48 h after hernia repair.

5.2. Long-term postoperative complications

Long-term complications are revealed more than 30 days after the operation and include chronic pain, chronic mesh infections, and enterocutaneous fistula involving mesh and hernia recurrence.

Chronic pain is defined as pain lasting more than 3 months. Evidence reveals that chronic pain is most likely multifactorial with an incidence ranging from 1 to 7% [20]. Major factors that have been identified as possible etiologies include the technique of mesh fixation. The authors' group noted severe postoperative pain with the use of a large number of tacks. Initial nonoperative management of chronic pain with oral analgesics and anti-inflammatory medications is the most conservative approach, but local injection of anesthetic and even mesh excision may be required.

Patients with complications carry a higher risk of developing a hernia recurrence. Most recurrences occur after mesh removal for postoperative infection. Some researchers found significant associations between recurrence and larger hernias, longer operative times, previous hernia repairs, morbid obesity, and higher complication rates [21]. Several studies compare open and laparoscopic approach in incisional hernia repair. These studies have not shown significant differences in recurrence rates for laparoscopic and open incisional hernia repair. Contrary to previous studies that reported recurrence rates up to 20% with mesh repair, there are some studies showing exceptionally low recurrence rates varying between 0 and 5% [22–24]. Only single-center reports show results of hybrid technique of incisional hernia repair based on a small group of patients and with a short follow-up periods (from 12 to 63 months). During these follow-up periods, no hernia recurrences occurred [25, 26]. Our results, although from a single institution, are based on average follow-up period of 27 months (3–96 months). Recurrence revealed in four patients including one case after biologic mesh implantation.

Long-term postoperative complications in authors' studied groups are shown in **Table 3**.

Long-term complications	Group 1 (n = 34)	Group 2 (n = 27)
Hernia recurrence	2	2
Chronic pain	2	4
Total	4	6

Table 3. Long-term complications in both groups.

The surgical treatment of incisional hernia has changed rapidly during the last decade with the increasing use of mesh technique and the introduction of laparoscopy. However, many questions concerning mesh type, mesh positioning, fixation method, and operation type still remain unanswered. Patients with incisional hernia are a heterogeneous population with patient-specific comorbidity and innate differences (e.g., collagen formation quality). This makes the choice of the technique most suitable for each patient even if it is more difficult.

The authors' retrospective study including 61 patients with large incisional hernias treated with hybrid technique has shown that the hybrid technique is an effective method confirmed by a low rate of recurrence. However, the hybrid technique is a complicated surgical method. Perfect knowledge of anatomy of the abdominal wall is required from a surgeon as well as expertly employed of open and laparoscopic surgical approach. Moreover, long-term multicenter studies comparing the results of hybrid technique are needed to establish its efficacy. For the time being, it is considered a good alternative to its open-only counterpart, at least in experienced hands.

Author details

Monika Romanowska* and Jacek Pawlak

*Address all correspondence to: monika.meszka@gmail.com

Department of General Surgery, Specialist Western Hospital of Saint John Paul II in Grodzisk Mazowiecki, Poland

References

[1] Mackiewicz Z. The Modern Treatment of Ventral Hernias. Warsow: PZWL; 2006. pp. 152-159

[2] Jankins E, Yom V, Melman L, et al. Clinical predictors of operative complexity in laparoscopic ventral hernia repair: A prospective study. Surgical Endoscopy. 2010;**24**(8):1872-1877

[3] Lee Y, Iqubal A, Vitamvas M, et al. Is it safe to perform laparoscopic ventral hernia repair with mesh in elderly patients? Hernia. 2008;**12**:239-242

[4] Romańczuk M, Mitura K, Wróblewski T. A comparison of methods and results of ventral incisional hernia repair. Videosurgery and Other Miniivasive Techniques. 2006; **1**(3):95-100

[5] Wysocki A, Budzyński P. Implants in surgery of hernias. Medycyna Praktyczna. 2010;**1**:9

[6] Janczak D, Litarski A, Merenda M. Use of synthetic mesh in abdominal wall hernias repair. Polimery w Medycynie. 2011;**41**(3):13-18

[7] Carlson MA, Frantzides CT, Shostrom VK, et al. Minimally invasive ventral herniorrhaphy: An analysis of 6,266 published cases. Hernia. 2008;**12**:9-22

[8] Sajid MS, Bokhari SA, Mallick AS, et al. Laparoscopic versus open repair of incisional/ventral hernia: A meta-analysis. The American Journal of Surgery. 2009;**197**:64-72

[9] Millikan KW. Incisional hernia repair. The Surgical Clinics of North America. 2003; **83**:1223-12234

[10] Ozturk G, Malya FU, Ersavas C, et al. A novel reconstruction method for giant incisional hernia: Hybrid laparoscopic technique. Journal of Minimal Access Surgery. 2015; **11**:267-270

[11] Kim Z, Kim YJ. Components separation technique for large abdominal wall defects. Journal of the Korean Statistical Society. 2011;**80**(Suppl 1):S63-S66. DOI: 10.4174/jkss.2011.80.Suppl1.S63 PubMed

[12] LeBlanc KA. Incisional hernia repair: Laparoscopic techniques. World Journal of Surgery. 2005;**29**:1073-1079

[13] Azar FK, Crawford TC, Poruk KE, et al. Ventral hernia repair in patients with abdominal loss of domain: An observational study of one institution's experience. Hernia. 2017;**21**(2):245-252. DOI: 10.1007/s10029-017-1576-0

[14] Tanaka EY, JH Y, Rodrigues AJ Jr, et al. A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain. Hernia. 2010;**14**:63-69

[15] Fortelny R. Loss of domain incisional hernia. Chirurgische Praxis. 2015;**79**(1):11-18

[16] Bleier JIS, Resnick AR. Complications of incisional hernia repair. Seminars in Colon and Rectal Surgery. 2009;**20**(3):125-130

[17] Rudmik LR, Schieman C, Dixon E. Laparoscopic incisional hernia repair: A review of the literature. Hernia. 2006;**10**:110-119

[18] Sarela A. Controversies in laparoscopic repair of incisional hernia. Journal of Minimal Access Surgery. 2006;**2**(1):7-11

[19] van't Riet M, de Vos van Steenwijk PJ, Kleinrensink GJ, et al. Tensile strength of mesh fixation methods in laparoscopic incisional hernia repair. Surgical Endoscopy. 2002;**16**: 1713-1716

[20] Snyder CW, Graham LA, Vick CC, et al. Patient satisfaction, chronic pain, and quality of life after elective incisional hernia repair: Effects of recurrence and repair technique. Hernia. 2010;**15**:123-129

[21] Anthony T, Bergen P, Kim L, et al. Factors affecting recurrence following incisional herniorrhaphy. World Journal of Surgery. 2000;**24**:95-10

[22] Eker HH, Hansson BME, et al. Laparoscopic vs open incisional hernia repair: A randomized clinical trial. JAMA Surgery. 2013;**148**(3):259-263. DOI: 10.1001/jamasurg.2013.1466

[23] Awaiz A, Rahman F, Hossain MB, et al. Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Hernia. 2015;**19**(3):449-463

[24] Al Chalabi H, Larkin J, Mehigan B, et al. A systematic review of laparoscopic versus open abdominal incisional hernia repair, with meta-analysis of randomized controlled trials. The International Journal of Surgery. 2015;**20**:65-74

[25] Stoikes N, Quasebarth M, Burnt LM. Hybrid ventral hernia repair: Technique and results. Hernia. 2013;**17**:627-632

[26] Ji Y, Zhan X, Wang Y, Zhu J. Combined laparoscopic and open technique for the repair of large complicated incisional hernias. Surgical Endoscopy. 2013;**27**(5):1778-1783

Chapter 6

Laparoscopic Inguinal Hernia Repair: Technical Details, Pitfalls and Current Results

Fatih Altintoprak, Emrah Akin,
Kemal Gundogdu and Enis Dikicier

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76942

Abstract

Expanding view of minimal invasive surgery horizon reveals new practice areas for surgeons and patients. Laparoscopic inguinal hernia repair is an example in progress wondered by many patients and surgeons. Advantages in laparoscopic repair motivate surgeons to discover this popular field. In addition, patients search the most convenient surgical method for themselves today. Laparoscopic approaches to inguinal hernia surgery have become popular as a result of the development of experience about different laparoscopic interventions, and these techniques are increasingly used these days. As other laparoscopic surgical methods, experience is the most important point in order to obtain good results. This chapter aims to show technical details, pitfalls and the literature results about two methods that are commonly used in laparoscopic inguinal hernia repair.

Keywords: laparoscopy, inguinal hernia, TAPP, TEP

1. Introduction

For centuries, the inguinal hernias have played an important role in the surgical literature and continue to preserve this feature today. With many procedures, inguinal hernia interventions continue to be the most common general surgery operations worldwide and approximately 2 million people are operated for inguinal hernia every year. There are many techniques described on the surgical treatment of inguinal hernias. There is no other example of disease preoccupied in the surgical literature. Existence of the postoperative complications suggests that we have not found the ideal treatment option yet because a wide variety of techniques

have been described and most of the surgeons engaged in this procedure have completed learning curves a long time ago. In 1984, about hernia, Sir Astley Paston Cooper says: "No disease from the human body, belonging to the surgeon, demands in its treatment, a better mixture of precise, anatomical knowledge along with surgical skill, compared to hernia in most of its variations". In this chapter, the details and results of two laparoscopic techniques, which have become common in inguinal hernia treatment today, are evaluated in detail.

2. Incidence and general information

The incidence of inguinal hernia varies according to age and sex. There is a bi-modal distribution in males and it increases in the first year of life and in older ages. The rate of 15% in the second decade increases with age and reaches 47% in the seventh decade. In females, this rate is 3% for life. There is a significant difference between the male/female ratio and is reported as 1:15. Although the majority of the inguinal hernia patients do not face great problems in resuscitating their lives, the incidence of general incidence and emergency case incidence (incarceration-strangulation) increases with age [1].

Inguinal hernias are classified as direct or indirect inguinal hernia according to their mechanism and anatomical characteristics. Indirect inguinal hernias are the most common subtype and the risk of strangulation is much higher compared to direct hernias. In the case of strangulation, it is also necessary to mention that the femoral hernias head to this issue. Femoral hernias, which are found in 70% of women and generally settled in the principle of "should be fixed when they are detected", due to the risk of strangulation, have not been included in this section [2].

When the side is concerned, it is a fact that all inguinal hernias are seen more on the right side. One of the theories developed to explain this is that there is anatomically protective effect of the sigmoid colon present on the left side and delayed atrophy of the processus vaginalis due to the slower descent of the scrotum on the right side during embryological development.

3. History

The word "hernia" came from the Latin word "rupture" and was described as a disease in the first fifteenth century in papyrus. The idea of repairing surgery came out between fifteenth and seventeenth centuries although the inguinal region anatomy has been described in detail by Hesselbach, Cooper, Camper, Scarpa and Gimbernat during eighteenth and nineteenth centuries. In the twentieth century, "tension-free repairs" started to be proposed and in the last 25 years, parallel to technological developments, videoscopic repairs became widespread. As a result of this development, surgical procedures have now become the standard procedure for "strengthening the abdominal wall in the transverse fascia plan" and are accepted all over the world [3].

The idea of laparoscopic repair was first alleged by Ger in 1982 by the collapse of the internal loop. In 1990, Schultz used transperitoneal plugs and developed the intraperitoneal onlay mesh (IPOM) technique, which was performed in the same year by patching the Fitzgibbons

peritoneum. Transabdominal preperitoneal (TAPP) patch application was first performed by Leroy in 1990. Then in 1991 Dulucq and in 1992 McKernan introduced total extraperitoneal (TEP) intervention [4].

4. Anatomy

In the inguinal region, four different types of hernia—indirect, direct, femoral and obturator—can develop. One of the most important advantages of the posterior approach is the ability to reveal the entirety of hernia types. There are median, medial and lateral ligaments in the anterior wall of the abdomen after fetal period, followed by urachus obliteration, umbilical artery obliteration and inferior epigastric vessels, respectively. In addition, there are iliopubic tractus, pectineal ligament (Cooper) and lacunar ligament in pubic region, pubic tubercule, spina iliaca anterior superior (SIAS) and superior pubic ramus bones [5].

There are two potential gaps in the preperitoneum. The "Bogros gap" is located between the transverse fascia and the peritoneum. Preperitoneal fatty tissue and porous connective tissue fill this area. The medial part of the preperitoneal cavity on the bladder is known as the "Retzius cavity". The posterior view angle allows examination of the myofektineal orifice, which is a relatively weak part of the abdominal wall and is divided by the inguinal ligament [6].

The external iliac vessels are anastomosed with the inferior epigastric vessels and the superior epigastric vessels. They supply the abdominal wall and penetrate the rectus abdominus through the cranial route within the vagina musculature rectus. Posteriorly inspected anulus inguinalis profundus will reveal the deep location of inferior epigastric vessels. In addition, the aberrant obturator arteries formed by the anastomosis of the pubic ramus of the epigastric artery with the obturator artery, known as "Corona Mortis", constitute the basis of the death triangle. The medial side of this triangle is vas deferens, the lateral side is the spermatic cord and the posterior border is the peritoneal margin.

The inferolateral border of the iliopubic tract, the superomedial border of the gonadal vessels and the lateral border of the peritoneal catheter is defined as the area of the pain triangle and the intermediate cutaneous branches of the lateral femoral cutaneous nerve, the femoral branch of the genitofemoral nerve and the anterior branch of the femoral nerve contain posterior anatomical approach.

5. Material and methods

We performed laparoscopic inguinal hernia surgery in 163 patients between January 2017 and 2018 in our clinic. Laparoscopic hernia repair was recommended to patients who are suitable for general anesthesia, had no previous abdominal surgery or incarceration or strangulated hernia or without acute mechanical intestinal obstruction. In terms of learning curve, TAPP was performed on first 50 cases and TEP on the following cases. A total of 155 (95%) patients were male and 8 (5%) were female. A total of 51 patients received TAPP (31.2%) and 112 patients (68.7%) received TEP. Eight patients who underwent TAPP (15.6%) were operated

for recurrence. Thirteen patients (25.4%) underwent bilateral repair while three (5.8%) patients underwent the same session umbilical hernia repair. The groups were evaluated in terms of operation time, pain scores, recurrence rates, duration of hospitalization and return to daily activity and complication rates. TAPP average operation time is 58 min while in bilateral cases this duration is 72 min. The duration of operation of recurrent cases was 59 min average and there was no significant difference between these patients and the primary cases. A total of 112 patients were treated with TEP technique. Nineteen patients (16.9%) were operated for recurrent hernia, and 14 patients (12.5%) underwent bilateral repair. In three patients (2.6%), the same session umbilical hernia repair was also performed. Average duration of TEP is 47 min while in bilateral cases this duration is observed as elongated, 56 min. The duration of operation in recurrent cases was 56 min and there was no significant difference between these patients and the primary cases. The hospital stay was measured as 1.2 days for TAPP and 1.1 days for TEP, and no significant difference was found between the groups. It was also found that the pain scores between the two groups were similar as 3.2 and 2.9 for TAPP and TEP, respectively. The time to return to the daily activity for TAPP was 5.6 days and for TEP was 5.3 days and no significant difference was found between the two groups. As a complication, seroma in four patients (2.4%), recurrent hernia in two patients (1.2%) and chronic persistent pain in six patients (3.6%) occurred. Patients with recurrence were reoperated. Five patients with chronic persistent pain were treated with medical therapy within 6 months, and one patient with osteitis pubis was detected and curettage was performed by orthopedics clinic. In our study, no significant difference in recurrence, return duration to work, pain score, duration of hospitalization and postoperative complication were detected between the groups.

6. Technical points

The use of laparoscopic methods for inguinal hernia surgery is advanced minimal invasive surgery with less tissue trauma, less postoperative pain, lower postoperative infection risk and faster postoperative recovery. It is possible to combine positive effects such as faster return to work and better cosmetic results. As with all surgical techniques, minimally invasive techniques also have advantages. Compared to open surgery, some disadvantages of inguinal hernia surgery are the initial operation time and the long learning curve. Also, the cost is relatively high. In addition, unlike open surgery, the lack of sense of depth in the image, that is, the operation with the 2D image requires the surgeon to dominate the inguinal region anatomy at a high level. Instead of cost problem, by time, the integration of the learning curve and the increase in the experience reduce most of the problems.

There are two main techniques when laparoscopic inguinal hernia repair is concerned. These are defined as transabdominal preperitoneal approach (TAPP) and total extraperitoneal approach (TEP). According to the International Endohernia Group's 2011 Guidelines, revised in 2015, TAPP and TEP have become the preferred repair techniques for the Lichtenstein technique, especially after hernia recurs by open pre-repair [7].

http://dx.doi.org/10.5772/intechopen.76942

7. Laparoscopic transabdominal preperitoneal approach

It is stated that TAPP is the first method to be learned because it is applicable in all inguinal region hernia types. As an advantage of the intraabdominal approach, the posterior wall anatomy can be better dominated, so proper and adequate parietalization can be made more comfortable. Compared to TEP, the cost is lower and the learning curve is shorter. TAPP is a highly successful method for both incarcerated and scrotal hernias. Due to intraabdominal vision, providing a wide field of view study is one of its greatest advantages and is a method that can be used in laparoscopically repaired recurrent hernias.

8. Technical details

8.1. Operating room layout

The opposite side of the surgical field and both legs are in closed position. In bilateral hernia repair, both arms are in closed position. The videomonitor laparoscopy tower is placed on the patient's foot, on the side to be operated. The operator can be placed on the opposite side of the area to be operated and the camera assistant can be placed on the same side or opposite side of the surgeon depending on the experience and habits of the team. We prefer the camera assistant to sit on the same side of the surgeon (**Figure 1**).

8.2. Surgical instruments

- Standard laparoscopic equipment consisting of camera, monitor, light and bag
- 10 mm diameter and 30° angle camera
- One 10 mm and two 5 mm in diameter totally 3 trocars
- Veress needle
- Endoinstruments (Atraumatic pens, dissector, scissors, hook, acutenaculum, aspirator)
- 5 mm diameter vessel sealing device
- 15 × 15 cm polypropylene or polyester special shaped patch
- Fixing material for mesh detection and peritoneal closure (mechanical stapler, tissue adhesive or non-absorbable suture material) (**Figure 2**).

8.3. Preparation of the patient and treatment of trocars

A single dose of 1 g second-generation cephalosporin as prophylactic antibiotic is injected half an hour before the onset of operation. The patient should urinate before operation and preoperative fluid resuscitation should be kept to a minimum. Before the operation, the patient

Figure 1. Operating room: The surgeon and camera assistant placed on the opposite side of the surgical area.

Figure 2. Surgical instruments for TAPP procedure.

is scrubbed and covered in the supine position for sterility. Under general anesthesia, by Hasson technique or with Veress needle which is placed in the infraumbilical region, produces caphno pneumoperitoneum. General intraabdominal exploration is completed with a 10 mm trocar inserted in the infraumbilical region. The operating table position is kept (30° Trendelenburg and 15°–20°opposite to the operating area). Two operating ports (5 mms) are placed on the umbilical level transverse line, with the lateral sides of both rectus muscles localized and placed under direct vision. The trocars on the operative side are placed on infraumbilical transverse line, while the opposite trocar is placed 4–5 cm caudal side on this line (**Figure 3**). In bilateral hernias, it is suggested that both trocars to be placed on the transverse line at the same level.

8.4. Intraabdominal inguinal exploration

As the trocar placements are complete, the inguinal area is examined with care. The hernia type is detected and the content—if present—of the hernia is carefully reduced to origin with atraumatic clamp. If there are elements such as intestine or omentum in the hernia sac, the vitability of intestine or omentum is checked after reducement.

http://dx.doi.org/10.5772/intechopen.76942

Figure 3. Trocar placement for TAPP procedure.

8.5. Peritoneal incision, dissection and preparation of preperitoneal area

The preparation of the peritoneal flap starts on approximately 5 cm above the hernia canal at the level of the anterior superior crista iliaca on the upper outer side of the annulus inguinalis. The incision is advanced to the medial side of the transverse plane through the upper 5 cm of the inguinal canal's inner ring and terminated at approximately 2 cm to median ligament.

The peritoneal incision can be done with endoscissors or hooks. Rest of the peritoneal flap on the inguinal canal inner ring can be easily disrupted with the help of intraabdominal CO_2 pressure, stretched with endograsper. Peritoneal dissection, below the inguinal canal inner ring, is a little more difficult. The lower peritoneal flap is liberated until lateral visualization of the iliopubic tract, and medial visualization of the Cooper ligament. The hernia sac is carefully dissected from the spermatic cord and elements that are attached through the lower peritoneal membrane (**Figure 4**). The peritoneal upper and lower flaps are dissected in each direction to provide large parietalization and vision of myopectineal orifice. Thus, enough space is available to lay a mesh on probable direct, indirect and femoral herniation defect sources. If bilateral hernias are present, the peritoneal incision can be extended from one side of the crista iliaca to the other side of the crista iliaca, but in the literature it is suggested that a single incision should be made and a peritoneal bridge could be released in the midline.

8.6. Preparation, placement and detection of the mesh patch

Special shaped polypropylene or polyester patches prepared in size appropriate to the anatomical characteristics of the hernia of the patient are used. The patch is rolled from the outside to the inside and from top to bottom in the form of a roll with limb or without limb (**Figure 5**). It is placed into the abdomen through a 10 mm trocar. With the help of two endograspers, placed in the working ports, the roll is unfolded in the opposite direction and is laid to cover

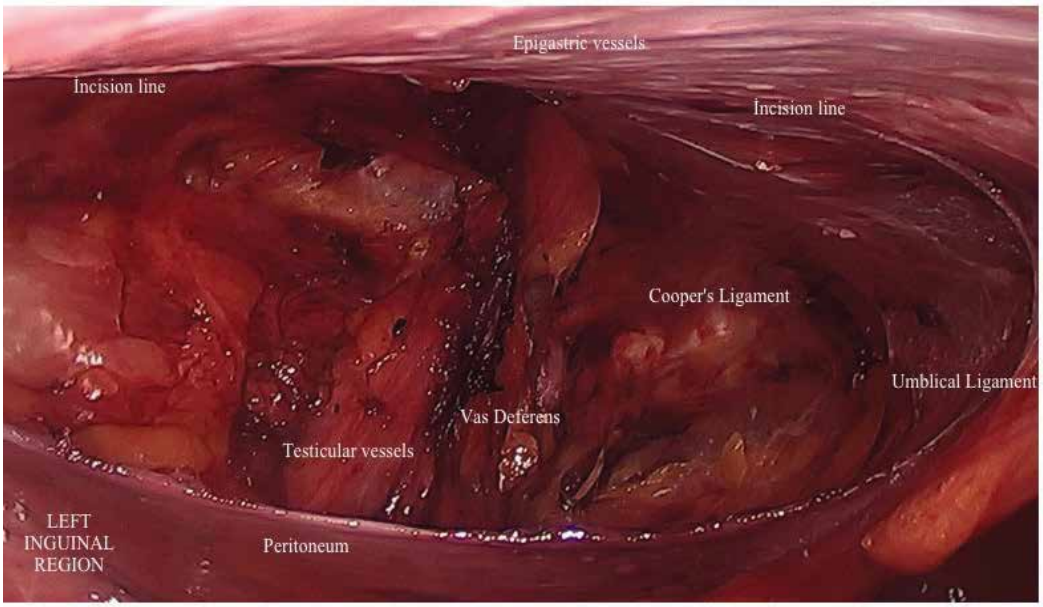


Figure 4. Anatomic details of left inguinal region after peritoneal flap preparation.

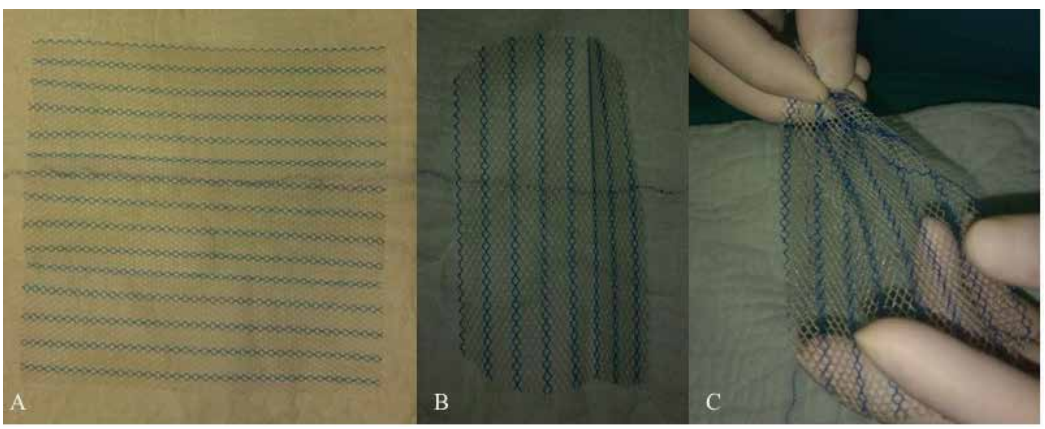


Figure 5. Mesh preparation.

the existing hernia defect and potential hernia sources. Also, it must be ensured that the patch is placed with a proper tension. When a limb patch is applied the lower limb is passed under the spermatic cord and it is wrapped in a tie and is joined laterally with the upper limb again. The location and number of staples is very important for the immobilization of the mesh patch. The basic rule—with different suggestions about this—is that the staples must be placed on the ileo-pubic tract. We prefer to fix it with two absorbable staples totally, one medially to the Cooper ligament and one to the back of the transverse fascia (**Figure 6**). Tissue adhesives or absorbable suture materials may also be used for detection.

http://dx.doi.org/10.5772/intechopen.76942

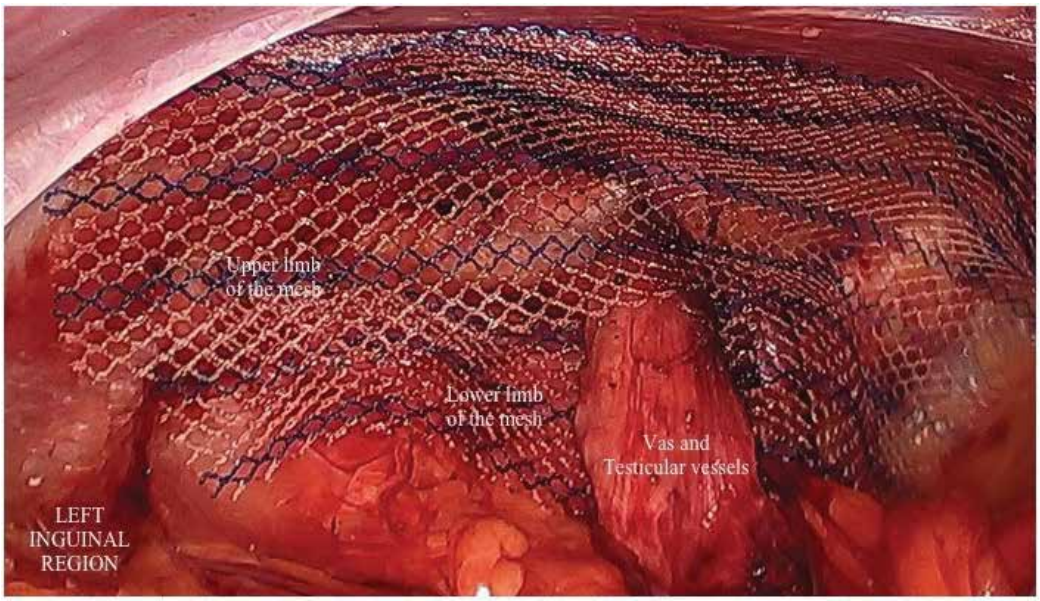


Figure 6. After mesh fixation in TAPP procedure.

8.7. Closure of peritoneum over mesh

After the integration of fixation, the upper and lower leaves of the peritoneum are covered on the patch and the opposite edges are closed with either continuous stitches or with clips. Closing the peritoneum with stitches is more convenient but requires more time and experience. The hernia sac, which is usually left in the lower peritoneal sheet and reduced into the peritoneum, can be left if it is small, also the larger sacs can be partially resected before closing the peritoneal leaves. According to experience and preference, a drain can be placed behind the peritoneal flap. After the peritoneum is closed, 5 mm ports are removed under direct vision and the operation is terminated.

8.8. Postoperative care

Oral intake can be started a few hours after surgery and the patient is mobilized the same evening. The following day the patient can be discharged by removal of the drain. There is no need to regulate postoperative medical treatment other than oral analgesics.

9. Laparoscopic total extraperitonal approach

Despite discussions about the use of laparoscopy in the repair of primary unilateral groin hernias, the superiority of TEP in bilateral or recurrent hernias is accepted. The major advantages of this method are that it is extraperitoneal and there is no break in peritoneum. The

dominance of the anatomy of the posterior wall is not as good as TAPP, but sufficient parietalization is possible with TEP. Nowadays it becomes the first choice especially for athletes both men and women.

9.1. Operating room layout

The opposite side of the surgical field and both legs are in closed position. In bilateral hernia repair, both arms are in closed position. The videomonitor laparoscopy tower is placed on the patient's foot, on the side to be operated. The operator can be placed on the opposite side of the area to be operated and the camera assistant can be placed on the same side or opposite side of the surgeon depending on the experience and habits of the team. We prefer the camera assistant to sit on the same side of the surgeon.

9.2. Surgical supplies

Standard laparoscopic equipment consisting of a camera, a monitor, a light and an insuflator

- 10 mm diameter balloon trocar
- Laparoscope with a diameter of 10 mm and a 30° angle
- A 10 mm, two 5 mm diameter, totally 3 trocars
- Atraumatic clamps, endodissectors, endoscissors, endohooks, endoclapms, endoaspirators
- 5 mm diameter vessel sealing device
- 15 × 15 cm polypropylene or polyester special shaped patch
- Fixation material (mechanical staple or tissue adhesive)

9.3. Preparation of the patient, application of extraperitoneal trocars

A single dose of 1 g second-generation cephalosporin as prophylactic antibiotic is injected half an hour before the onset of operation. The patient should urinate before operation and pre-operatory fluid resuscitation should be kept to a minimum. With general anesthesia, the operation starts in supine position. In method of TEP, the patient should be wider painted than the TAPP technique, from the nipple to the perineum. Infraumbilical, slightly lateralized incision is made on the hernia side and then the rectus sheath is opened by transverse incision. Rectus fibers are removed with Farabeuf retractor and blunt dissection is performed to reach the Bogros area. A tunnel is made between umbilicus to pubis. In front of this tunnel, there is a parietal peritoneum from the back of the rectus muscle and from the end of this fascia to the transverse course of the linea semilunaris. After blunt dissection and cannula is completely inserted from the preperitoneal tunnel to the pubis, it is removed from the trocar cannula and replaced with a telescope, and the cannula is inflated with a balloon attached to the mandrel. Air is discharged 20–25 times with puar after waiting for 30 s and this process is repeated three times. With some balloons, it is possible to view inside with scope as it inflates. It can also be monitored whether the definite surgical area is viewed during this observation. Upper view of rectus fibrils and lower view of parietal peritoneum indicates the

right position. A 10 mm trocar is placed in the infraumbilical incision to prevent gas leakage and the telescope is placed. The preperitoneal space is inflated with 10–12 mmHg CO_2. Two 5 mm ports are placed at a distance of 5 cm from the midline in direct view (**Figure 7**).

9.4. The dissection of extraperitoneal area and herniated sac

After the 30° camera is inserted, the inferior epigastric artery and vein are observed along the bottom of the rectus muscle. The parietal peritoneum is dissected in the medial and lateral directions to remain underneath. The Cooper ligament is visible in the inferomedial area and it is removed. The lateral aspect of the rectus is up to the border of the crista iliaca and the fascia transversalis is opened with blunt and sharp dissections posteriorly. The potential hernia areas are examined and the hernia type is determined (**Figure 8**). In the indirect inguinal hernia, the hernia sac is found adhered to the spermatic cord. The hernia sac should be dissected from the pubic tuberculum to the level of the external iliac vein. Large scrotal or indirect hernia may be released by Zig technique if it is confirmed that the hernia sac does not contain omentum or intestinal contents. The anatomic regions described as Femoral and Hasselbach triangles should be examined in terms of direct and femoral hernia that may be accompanied. The ililopubic tract must be detected not to injure the femoral and lateral femoral cutaneous nerves of the underlying genitofemoral nerve. The lateral dissection does not need to be as wide as the TAPP technique. The hernia sac should be gently released and reduced from the spermatic cord and cremaster fibers. If the peritoneum is wounded during the dissection procedure, the defect can be closed with a clip. If gas insufflation flows through the gap to the peritoneal defect, the enlarged abdomen will restrict the area of dissection. In order to prevent this, intraperitoneal air could be taken out from the upper left quadrant of the midclavicular line through the abdominal cavity (Palmer's point) with Veress needle. The valve is left open, the evacuation of the gas is provided and the operation can be continued.

9.5. Preparation, placement and detection of the mesh patch

Special shaped 15 × 15 cm polypropylene or polyester patch can be used according to the anatomy of the patient. The patch can be prepared with limb or without limb. It is rolled up

Figure 7. Trocar placement for TEP procedure.

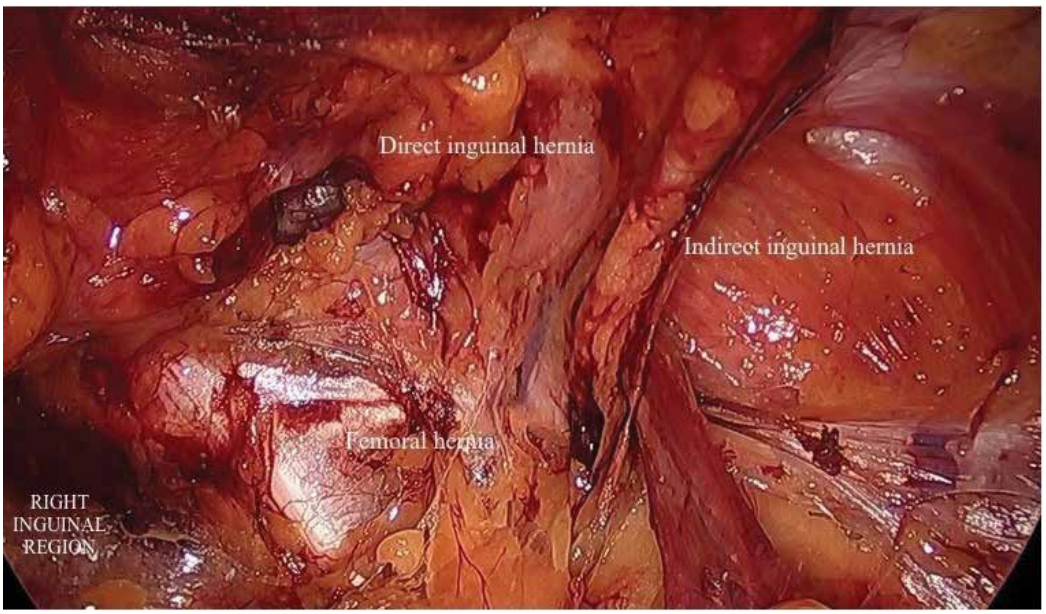


Figure 8. Potential hernia areas for TEP procedure.

from the top and laid to the extraperitoneal space by the 10 mm camera trocars. With the help of two endograspers placed in the working ports, the patch is unfolded in the opposite direction and is laid to cover the existing hernia defect and potential hernia areas. It should be ensured that the area where the patch is applied covers it with a proper tension. When a limb patch is applied, the lower limb is passed under the spermatic cord and it is wrapped in a tie and is laterally joined to the lower limb (**Figure 9**). The lower edge of the patch is placed so that it remains at least 2 cm above the released hernia sheath. The locations and numbers are very important if the absorbable staple is preferred for the detection of the mesh. The basic rule, with different suggestions about this, is that the mesh must be placed on the ileo-pubic tract. We prefer to fix it with a total of two absorptive staples, one medially to the Cooper ligament and one to the back of the transverse fascia laterally. On the lateral edge of the spermatic cord there are anatomical areas defined as the triangle of pain mentioned above and the death triangle at the medial border. Staples must be avoided in these areas. Tissue adhesives have also been used today as fixing material. The use of drains varies according to experience and habits. We routinely use aspirative drain after TEP.

9.6. Postoperative care

Oral intake can be started a few hours after surgery and the patient is mobilized the same evening. The following day the patient can be discharged by removal of the drain. There is no need to regulate postoperative medical treatment other than oral analgesics.

http://dx.doi.org/10.5772/intechopen.76942

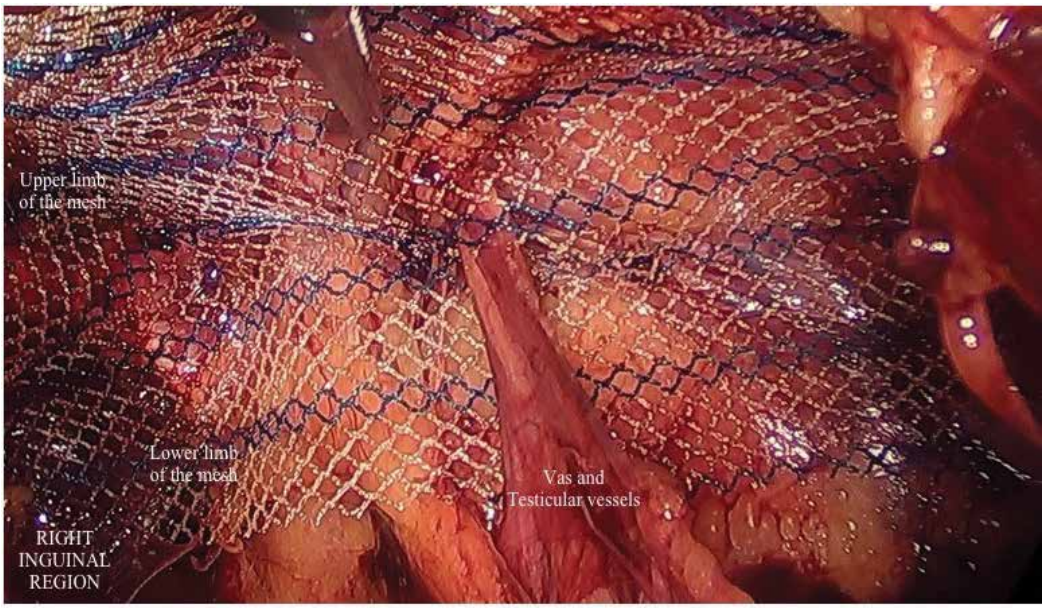


Figure 9. After mesh fixation.

10. Pitfalls

In this chapter, details take place as noted; details in current practice are given while applying the laparoscopic hernia repair. The points to be considered are evaluated for both techniques. In addition, the difficulties faced by the surgeon are itemized.

10.1. TAPP

- As all laparoscopic operations, the first point to note in laparoscopic hernia surgery is trocar entry sites. Correct positioning of the appropriate points will prevent intestinal injuries that may occur at the time of first entry and bleeding which may be caused by the injury of the abdominal wall, especially the epigastric vessels.
- A complete exploration should be done in terms of hernia type, size, presence of accompanying incarceration and other pathologies in intraabdominal exploration.
- Taking enough width for dissection during the preparation of the peritoneal flap will ensure that the exploration area is convenient. Working on a sufficient width of dissection will facilitate the spread of the patch, the adequate closure of the hernia defect and the operator's work during the detection of the patch.
- A very careful dissection should be performed in order to avoid damage to the spermatic cord structures, especially in the presence of indirect hernia, when the hernia incision is

dissected, as interference with the anatomical planes may result in attempts made for recurrent hernia.

- Should be very careful not to hold Vas Deferens by endo-devices so as to not disturb.
- The dissection should be performed at an adequate width of the myopectinale opening, but should be avoided from the extreme dissection in front of the psoas site in the lateral direction. There is an anatomic area defined as triangular pain in this region and it should be especially noted that the cutaneous femoral lateralis and femoral branches of genitofemoral nerves are not damaged. Postoperative chronic pain syndromes can be encountered in the event of a possible nerve injury.
- Death triangle is defined as the anastomotic area between the external iliac vein and the obturator vein and should be avoided from the extreme dissection. Because, in the event of a possible vascular injury in this region, catastrophic consequences may be encountered.
- The staples used for patch detection due to the same reasons should never be used under the iliopubic tract.
- Should be sure to place the staples on the medial side, especially on the Cooper ligament, so that postoperative osteitis pubis is avoided.
- It is generally advised to use the least amount of other materials that can be used for stapling or patch fixation.
- Wide laying of the mesh will reduce the recurrence rate by covering the three hernia areas.
- Reducing the intraabdominal CO_2 pressure during the peritoneal flap closure and correcting the patient's position will facilitate closure because it will reduce tension. The effective closing of the flap is important to prevent postoperative intestinal adhesions.

10.2. TEP

- The infraumbilical incision should be made from slightly left or right lateral. What should be noted here is to be on the rectus front sheath. If the linea alba is opened by mistake, the gas will flow to the intraabdominal region and strengthen the technique at the start.
- It is important to notice the bright white color of the rectus posterior sheath, and it is important that the balloon is inflated by advancing the balloon trocar in this space. The balloon dissection between the fibers of the rectus will cause bleeding between the muscle fibers, disturbing the dissection plans and preventing the vision.
- If gas flows into the abdomen during possible peritoneal injuries in the TEP technique, as mentioned in the techniques section, the gas must be evacuated with the Veress needle, which will be entered from the Palmer point.
- Large peritoneal defects may cause postoperative patchy contact with the intestines and lead to postoperative intestinal adhesion development. For this reason, large peritoneal defects should be closed with endoclips.

http://dx.doi.org/10.5772/intechopen.76942

11. Complications and management

In this section, complications related to laparoscopic inguinal hernia surgery, literature information about management of these complications and suggestions based on our own experience are included.

11.1. Local complications

The most common complications are serous fluid deposits (seroma) and bleeding(hematoma) which may develop during operation. Patients should be informed in the preoperative period about these complications. Postoperative seromas usually resorb spontaneously within 2 weeks and do not require treatment. Therapeutic drainage needs arise in the presence of seroma persistent for longer than 6–8 weeks or in the presence of seroma causing clinical symptoms. The use of peroperative aspirative drains in risky patients of who may be predicted seroma and hematoma development may prevent the development of these complications. Scrotal elevation is recommended in the postoperative period. If abdominal wall ecchymosis occur, mechanical compression, cold application and medical treatment can be tried. Subcutaneous emphysema is often untreated and spontaneous. In rare occasional hydrocele cases, it will be more appropriate to consult with a urologist.

11.2. Neurological complications

The treatment of chronic pain syndromes after laparoscopic hernia surgery is often long and difficult. Chronic postoperative pain has been reported in up to 63% of all groin repairs and significantly affects clinical outcomes. The pain following laparoscopic surgery is usually neuropathic pain. The cause is usually the damage or trapping of the lateral femoral cutaneous or femoral branch of the genitofemoral nerve. Clinically it occurs as acute burning and/or crushing pain in a particular dermatome. Mareljia parestetika is the name of a pain clinic that develops after a lateral femoral cutaneous nerve injury and persistent paresthesia lateral of the femoral area. It is recommended to apply corticosteroids or anesthetic injections which can be applied at rest, cold application, NSAIDs, physical therapy, locally. Osteitis pubis is; the name of the pain clinic that occurs due to public inflammation and arises especially on the middle of the groin or on the pubis, especially with femoral adduction. Diagnosis can be made by excluding recurrent hernia diagnosis radiographically and performing bone imaging. The treatment approach is the same as neuropathic pain. Often, 6 months are required to respond to treatment. However, if the cure is not available, the orthopedic consultation may be needed to consider possible bone resection or curettage options.

11.3. Cord and testicular injury

Ischemic orchitis should be considered in the complaints of hardened, enlarged and painful testicles that appear about 10 days after the repair of the inguinal hernia. It is often self-limiting. It is usually the result of a possible damage to the pampiniform plexus, not the testicular artery. Ultrasound can distinguish necrosis or ischemia. If testicular necrosis is detected,

urgent orchiectomy may be necessary. Treatment includes IV hydration and NSAIDs. If testicular artery is damaged, it can be caused testicular atrophy after long periods of operation. Vas deferens may not be manipulated during surgery and maximum effort to avoid disturbing their nutrition may help to avoid these complications.

11.4. Recurrents

Postoperative pain, swelling and the presence of a mass in the inguinal region should be considered. Diagnosis can be made by radiological examinations. Technical factors that play a role in the development of recurrence include inappropriate patch size, inadequate patch, stress or inaccurate detection, lack of experience, tissue ischemia and infections. Factors related to the patient include malnutrition, obesity, wound healing disorders and uncontrolled diabetes mellitus. Surgical intervention should be considered in the treatment.

Other complications include urinary retention, which can be prevented by the patient's urination before surgery or by peroperative urinary catheterization. Paralytic ileus, visceral injuries, vascular injuries, intestinal obstruction, hypercapnia, pneumothorax and gas embolism are also uncommon complications.

12. Literature review

The results of laparoscopic and open inguinal hernia surgeries are now being compared very much. Postoperative pain complications, recurrence rates, patient satisfaction, cost analysis are frequently discussed. Papachariston and colleagues in their postoperative evaluation of pain study [8], even though it was reported to require more analgesic in the first 6 h in the TAPP group, pain was reported in 2–11% of the open surgery group and reported as 1–4.2% in the laparoscopic group. In the same study, persistent pain lasting from seventh day to 1 year in the open surgical group was associated with postoperative fibrosis, while point pain in the laparoscopic group was associated with scar tissue rupture. In a meta-analysis evaluating persistent pain [9], patch repair has been shown to reduce persistent pain as opposed to pain relief, and it has also been found that chronic pain is less in the laparoscopic method.

In a study in which approximately 10,000 patient outcomes were assessed in the United States and patients were followed for 3 years [10], the recurrence rate of the laparoscopic method was found to be 0.4%, and it was emphasized that the most important difference between open and laparoscopic operations was the achievement of sufficient experimentation, the number of operations performed. According to this recommendation, a randomized controlled trial conducted by the Veterans Affairs Cooperative Study and reporting of 2-year follow-ups [11], recurrence rates were reported as 10% for laparoscopic repair and 5% for open repair, but after 250 laparoscopic cases techniques, results were improved. In a more recent study, Lal et al. [12] has shown that surgeons have reduced recurrence rates from 9 to 2.9% after 100 operations. In different studies, it has been reported that the laparoscopic techniques are spreading and the time to assess the competence of the surgeons is between 50 and

100 cases. A meta-analysis by Köckerling et al. [13] evaluating the relationship between patch fixation and recurrence, cases that patch fixation was performed and in cases not performed, there was no difference in the duration of operation, patch-related complications, recurrence and duration of hospital stay.

In a randomized controlled meta-analysis in which Wei and colleagues evaluated the outcomes of 1000 patients published in 2015, there was no difference between the two surgeries, pain score, operation time, return to daily activity, hospitalization time, complication and cost between the two surgeries. In conclusion, TEP was found to be more complicated than TAPP and advised to start laparoscopic surgery with TAPP to inexperienced surgeons [14]. In a study published by Köckerling et al. [15] there was no difference between two surgeries in terms of intraoperative complications and reoperation rates. However, after TAPP surgery, complication rates were found to be higher due to possible large complications, more scrotal hernia, elderly patient selection.

In a study conducted by Payne et al. [16] to measure postoperative quality of life, it has been shown that patients' compliance with straight leg exercises is better after laparoscopic surgery. Designed in the same way and studied by Lawrence et al. [17], this difference was more evident in bilateral hernia repair.

The problem of cost is still an important problem, with the fact that it has been removed from the big picture compared to the past. In the study conducted by Stylopoulos et al. [18] in 2003 and the results of 1.5 million patients evaluated, laparoscopic operations have been claimed to reduce costs compared to long-term open surgery when salary, health insurance costs, reduced job quality, delayed work shifts and the salary of the worker looking after the patient are taken into consideration. Farinas et al. [19] showed that 60% reduction in indirect costs could be achieved despite the 40% increase in the direct costs of using non-disposable devices and shortening of the operation time.

When TEP and TAPP were compared, there was no difference between the two techniques in terms of hospitalization time, recovery time and short term recurrence rates. The duration of the TEP technique is shorter than that of the TAPP technique [20]. However, according to the International Endohernia Association, it has been suggested that surgeons should apply the TEP technique after learning the TAPP technique and acquiring a certain experience in the learning curve [21].

In our study, we have found that there is only a minimal difference between TAPP and TEP techniques, in terms of operative time. There was no difference in both techniques when recurrence, return to work, pain score, duration of hospitalization and complications were evaluated. Particularly, we observed that bilateral and recurrent hernia had high patient satisfaction. Also we observed that TAPP surgery in the early stages of surgery, shortened the learning curve.

In conclusion, laparoscopic inguinal hernia surgery takes place in daily practice as an increasingly widespread up-to-date treatment method in which training and experience gained over time and patient satisfaction of clinical outcomes are very good.

Conflict of interest

The authors declare that they have no conflict of interest.

Author details

Fatih Altintoprak[1]*, Emrah Akin[2], Kemal Gundogdu[2] and Enis Dikicier[1]

*Address all correspondence to: fatihaltintoprak@yahoo.com

1 Istinye University Faculty of Medicine, Department of General Surgery, Istanbul, Turkey

2 Sakarya University Research and Educational Hospital, Department of General Surgery, Sakarya, Turkey

References

[1] Wagner JP, Brunicardi CF, Amid PK. İnguinal Hernias Schwartz's Princeples of Surgery. 10th ed. In: Brunicardi CF, editor. New York: In chief. McGraw Hill publishing; 2016. pp. 1510-1517

[2] Mark A, Malangomi and Michael J. Dosen Hernias Sabiston Textbook of Surgery: The biological basis of modern surgical practice 19th ed. In: Townsend CM, Beauchamp RD, Evers BM, Matteox KL, editors. London: Saunders publishing; 2012. pp. 1114-1141

[3] Van Hee R. History of inguinal hernia repair. Turnalul de Chirurgie. 2011;**73**:301-314

[4] Sachs M, Damm M, Enche A. Historical evaluation of inguinal hernia repair. World Journal of Surgery. 1997;**21**(2):218-223

[5] Bianutto SN, Repetto E, Aliendo MM, Borginho VW. İnguinal canal development: The muscular wall and the role of the gubernaculum. Clinical Anatomy. 2009;**22**(5):614-618. DOI: 10.1002/ca.20820

[6] Rosenberger RT, Loewneck H, Meyer G. The cutaneous nerves encountered during laparoscopic repair of inguinal hernia: New anatomical findings for the surgeon. Surgical Endoscopy. 2000;**14**(8):731-735

[7] Brittner R, Montgomery MA, Arregui, et al. Erratum to: Update of guidelines on laparoscopic(TAPP) and endoscopic (TEP) treatment of inguinal hernia (İnternational Endehernia society). Surgical Endoscopy. 2015;**29**(6):1655-1656. DOI: 10.1007/s00464-015-4156-3

[8] Papachariston EA, Mitselou MF, Finokaliotis ND. Surgical outcome and hospital cost analysis of laparoscopic and open tension free hernia repair hernia. 2002;**6**(2):68-72. PMID:12152642

[9] EU Hernia trialists Colloboration. Repair of groin hernia with synthetic mesh: Meta analysis of randomized controlled trials. Annals of Surgery. 2002;**235**(3):322-332.PMID:11882753

[10] Felix EL, Harbestson N, Vartanian S. Laparoscopic hernioplasty; significant complications. Surgical Endoscopy. 1998 Apr;**13**(4):328-331. PMID:10094740

[11] Neumayer L, Giobbie-Hurder A, Jonasson A, et al. Veterans cooperative studies program 456 investigators. Open mesh versus laparoscopic mesh repair of inguinal hernia. The New England Journal of Medicine. 2004;**350**(18):1819-1827. DOI: 10.1056/NEJMoa040093

[12] Lal P, Kajla RK, Chander J, et al. Laparoscopic total extraperitoneal (TEP) inguinal hernia repair: Overcoming the learning curve. Surgical Endoscopy. 2004;**18**(4):642-645. Epub 2004. DOI: 10.1007/s00464-002-8649-5

[13] Köckerling F, Jacob DA, Chowbey P, et al. A meta-anlysis examining the use of tucker fixation versus no-fixation of mesh in laparoscopic inguinal hernia repair. International Journal of Surgery. 2012;**10**(6):325. DOI: 10.1016/J.ijsu. 2012.04.014

[14] Fx W, Zhang YC, Han W, et al. Transabdominal preperitoneal (TAPP) versus totally extraperitoneal (TEP) for laparoscopic hernia repair: A meta-analysis. Surgical Laparoscopy, Endoscopy and Percutaneous Techniques. 2015;**25**(5):375-383. DOI: 10.1097/SLE.0000000000000123

[15] Köckerling F, Bittner R, Jacob DA. TEP versus TAPP: Comparision of the perioperative outcome in 17.587 patients with a primary inguinal hernia. Surgical Endoscopy. 2015;**39**(12):3750-3760. DOI: 10.1007/s00464-015-4150-9

[16] Payne JH, Grininger LM, Izawa WT, et al. Laparoscopic or open inguinal hernioraphy? A randomized prospective trial. Archives of Surgery. 1994;**129**(9):973-979. PMID:8080380

[17] Lawrence K, Mc Whinnie D, Goodwin A, et al. Randomized controlled trial of laparoscopic versus open repair of inguinal hernia: Early results, BMJ. 1995;**311**(701):981-985. PMID:7583639

[18] Stylopoulos N, Gazelle GS, Rattner DW, et al. A cost-utility analysis of treatment options for inguinal hernia in 1,513,008 adult patients, Surgical Endoscopy. 2003;**17**:180-189. DOI: 10.1007/900464-002-8849-z

[19] Farinas LP, Griffin FD. Cost containment and totally extraperitoneal laparoscopic herniorraphy. Surgical Endoscopy. 2000;**14**(1):37-40. PMID:10653233

[20] Qıu K, Ma J. Comments on TAPP versus TEP for laparoscopic hernia repair: A meta-analysis. Surgical Laparoscopy Endoscopy and Percutaneous Techniques. 2016;**26**(2):171. DOI: 10.1097/SLE.0000000000000251

[21] Bittner R, Köckerling F. Endorsement of the hernia surgical guidelines by the International Endohernia Society. Hernia. 2018;**22**(1):179. DOI: 10.1007/s10029-017-1674-z

Chapter 7

Worst Case Scenarios! Complications Related to Hernial Disease

Ahmed Alwahab, Abdulrahman AlAwadhi,
Asmaa Abd Alwahab Nugud and
Shomous Abd Elwahab Nugud

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76079

Abstract

Incarceration, obstruction and strangulation are well recognized common complications of hernias. Several risk factors determine patients' morbidity and mortality. Hernia surgery complications encompass infections, fascial dehiscence, recurrence, neuralgia, visceral injury, and mesh erosion or migration predetermined by many risk factors. The types and criteria for surgical site infections are defined by the extent of the infection. Whether the open or laparoscopic approaches are attempted, the rates of the respective complications depend on the approach. Post-operative hernias are appreciated because of their prevalence and complications. The criteria for enhanced recovery after surgery depend on whether patient is in the pre-operative, intra-operative or post-operative phase. Within the pediatric population, the risk of developing umbilical and inguinal is variable.

Keywords: hernia, surgical complications, hernia surgery complications, recovery after hernia surgery, post-surgical complications, watchful waiting, recurrence, endoscopic approach, open approach

1. Introduction

Weakness or defects of the body wall, mainly the fibro-muscular tissue is known as hernia. The hernial disease is among the oldest diseases described in the medical literature with reports as old as 1500BC. It was not until the nineteenth century for the surgical approach to be recognized as a treatment modality when Bassini published novel approach and primary outcomes. Since

then, the improvements in surgical approach emphasized intended to reduce the long-term hernia recurrence and complications. The use of synthetic material for support was introduced in the early 1900s by Handly by using silk for prosthetic support, but soon after it was found to increase the incidence of wound infection [1]. Risk factors for hernia include, but are not limited to, previous operations, physical stress, constipation, smoking, aging, trauma, family history, systemic disease, and obesity. Hernia repair is among the most common surgeries performed worldwide today, in which more than 75% found to be in the groin region, mainly inguinal canal hernias [2, 3]. The overall risk of developing hernia in a lifespan is around 15% in males and 5% in females, with proportionate increase in risk as the age increases. Inguinal hernias affect around 3–4% of the general population worldwide [4]. Differential diagnoses encompass any pathology that could lead to pain or mass formation in the groin area in particular. Such diagnoses include, but not limited to, soft tissue, lymphoid tissue, associated vessels, bony structures, and reproductive organs [5, 6]. Even though hernias, in general, are associated with overall promising short and long-term outcomes, there are still some complications to be recognized [7].

2. Complications of an untreated hernia

2.1. Incarceration and strangulation

Incarceration is the process by which hernia contents are trapped within a hernial sac in which reducing them is not possible. This result in decreased venous and lymphatic flow thus edema of incarcerated tissue. As a result, normal gut flora start flourishing and gas accumulates due to bacterial fermentation. As the swelling enlarges, the arterial blood flow to the hernial sac contents is compromised leading to ischemia and tissue necrosis, which is known as hernia strangulation [8]. These two entities are complications of hernia itself and are associated with increased rates of mortality and morbidity. The risk of incarceration and subsequent strangulation tend to be higher in the first few months to years and decrease with time. Gallegos et al. [9] estimated the probability of incarceration to be around 2.8% at 3 months and 4.8% at 2 years, which might be partially due to weakening of the abdominal wall and decreased pressure on the sac and its contents [9, 10]. Some of the risk factors for incarceration and subsequent strangulation include advanced age at the time of presentation, femoral hernia, and recurrent hernia [8]. Morbidity and mortality are determined by many factors including the patient age, comorbidities, and duration of the strangulation, the longer the duration, the greater the strangulation risk. For the reasons mentioned above along with an increased risk of perforation, a strangulated hernia is considered a surgical emergency that mandates surgical intervention with possible bowel resection. If the strangulation lasts longer than 4–6 hours on average bowel resection may be warranted. In such scenarios, placement of prosthetic mesh is usually not advised, as there will be a higher chance of bacterial translocation and wound infection [11, 12].

3. Complications of hernia surgery

3.1. Surgical complications

The incidence of complications associated with laparoscopic surgery is low on average when compared with an open approach. Most of the serious complications occur during access

to the abdominal cavity or while ports are created [13, 14]. Chandler et al. [15] reported the incidence of complications after laparoscopic surgery to be around 30 per 10,000, with half of the complications present in the first 24 hours post-surgery. Most common injuries were to the small bowel, iliac artery, and colon; while the least injured organs were the bladder and liver [15]. There is an increased risk of complications in patients with a history of previous abdominal surgery for any intra-abdominal pathology such as diverticulitis, history of extensive bowel resection, diaphragmatic hernia, and in patients with multiple cardiopulmonary risks [16].

3.2. Infection (wound, UTI, pneumonia)

Despite the fact that in the modern era advanced aseptic measures have decreased the incidence of post-operative infection; it is still a leading cause and a well-known complication of hernia surgery. Infections could be from multiple sources including the suture used and/or mesh. It is reported that infection incidences are as low as 1%, or even less, in multidisciplinary specialized hernia practice [17]. The most common underlying organisms are gram-positive skin flora. It was found that there is a slightly increased risk of infection with groin herniorrhaphy. Usually, it is hard to determine the extent of infection, whether skin and soft tissue are only involved, or deeper infection involving the mesh is there. Either way, should be treated with aggressive antibiotics and drainage, especially in the setting of a foreign body such as mesh [18].

From a broader perspective, surgical site infections are seen in around 1% of clean wounds and around 35% of contaminated wounds. **Table 1** lists different types of surgical wound infections. Clinical features include erythema, induration, warmth, and frothy discharge later in the course [19, 20]. The incidence of surgical wound infections can be reduced by following simple measures. For example, avoiding surgery in the setting of an active infection, antibiotic prophylaxis, proper skin preparation, maintaining sterile conditions throughout the surgery, and proper wound dressing [21].

3.3. Fascial dehiscence

Dehiscence is usually due to abdominal wall tension that exceeds the tissue and suture strength. It can be seen early in the post-operative period, and it could also happen as a late complication that might involve the full length of the surgical suture or part of it. Its incidence is estimated to be around 1–3% depending on the type of abdominal surgery. Despite of the improvement in the surgical techniques and wound management, the overall risk of fascial dehiscence remains unchanged [23–25].

Risk factors for wound dehiscence can be sub-classified into patient risk factors and those related to surgical site and surgeons' techniques. Patient risk factors include age, male gender, ascites, chronic pulmonary disease, post-operative cough, obesity, malnutrition, and chronic glucocorticoid therapy [19, 26]. Surgical technique risk factors include the length of the surgical wound if bigger than 18 cm or not. Suture failure is a major cause of fascial dehiscence, and it is said that in around 95% of cases knots are intact, but they have been pulled through the fascia resulting in fascial edge necrosis [27, 28].

Depth of infection	Comments
Superficial incisional	Infection occurs within 30 days after the surgery and involves skin and subcutaneous tissue of the incision and encompasses the following criteria: • Purulent discharge • Isolated organism • Acute inflammatory reaction with pain, swelling, redness, and heat
Deep incisional	Infection occurs within 30 days after the operation if there are no implants or within 1 year from the surgery if there are implants. Infections are related to implanted prosthetic material and involves deep fascial layers and muscle tissue, and encompass the following criteria: • Purulent discharge from deep tissue layer • Deep incisional spontaneous dehiscence • Deep tissue infection or abscess found by direct examination • Diagnosis made by an experienced surgeon
Organ space	Infection occurs within 30 days after the operation if there are no implants or within 1 year from the surgery if there are implants. Infections are related to implanted prosthetic and involve organs or anatomical spaces that were manipulated during surgery, and encompass the following criteria: • Purulent discharge from a drain • Organisms isolated from suspected area • Deep tissue infection or abscess found by direct examination • Diagnosis made by an experienced surgeon

Table 1. Types and criteria for the diagnosis of surgical wound infection [22].

4. Hernia surgery complications

4.1. Recurrence

Recurrence of hernia is usually seen as a late complication of hernia surgery. When it occurs, it is generally due to deep infection or due to the excessive tension of the repaired tissues and tissue ischemia. Early over-activity is a principal causative agent of recurrent hernia, as it results in inadequate fibrous tissue formation around the mesh or suture used to approximate the hernia sac. O'Reilly et al. [29] found that patients who underwent a laparoscopic repair for an inguinal hernia had a higher chance of having a recurrence in comparison to those who underwent open repair. Recurrence should be differentiated from other etiologies that could have similar clinical presentations such as seromas in the obliterated hernia sac [30]. Seroma can be defined as fluid-filled dead space in the distal remnants of hernial sac, seromas are usually seen after laparoscopic repair and are sometimes termed as a pseudo-hernia. Other etiologies include hematomas that could be seen in anti-coagulated patients. They could be of a concern if they were of large volume, as they could provide an optimal environment for bacterial

http://dx.doi.org/10.5772/intechopen.76079

growth and infection. Overall hematomas are far more common than seromas and both could be prevented with a careful hemostasis during surgery [31]. One of the primary causes of hernia recurrence is wound tension; excessive tension could lead to tissues pulling apart thus recurrence at an early stage post-operatively. Excessive tension can also lead to tissue ischemia leading to sutures pulling apart or even falling off. Henceforth new modalities of tension free and suture-free hernia repairs are being promoted by experts such as Lichtenstein [7, 32].

Another factor to consider is the size of the initial hernia defect which is proposed proportional to the risk of developing recurrence in the aftermath of hernia repair. This fact might be explained by the quality of the tissue and fascia surrounding the defect area. As the defect grows bigger it affects the surrounding fascial plans making them weaker and relatively more ischemic in comparison to smaller sized defects. Isik et al. [33] found that higher levels of matrix metalloproteinase s-1-2-9-13, in addition to decreased levels of tissue inhibitors of metalloproteinases-1-2-3 played an integral role in the formation of inguinal hernia, leading to dysfunction of collagen fibers, which will result in weakening of fascia, indicating that a hernia is not only a local issue, but rather a reflection of systemic disease [33]. Other etiologies for hernia recurrence include complicated hernia at presentation such as incarceration or strangulation, in which the tissue will be inflamed and edematous providing a good medium for recurrence as the tissue is unhealthy, to begin with. Another causative agent for recurrence is smoking which is said to increase proteolytic enzymes and decrease protective factors involved in tissue healing [11].

4.2. Neuralgia

Nerve injury could be a terrible consequence of an otherwise successful surgery presenting with pain, loss of sensation or muscular weakness. Neuralgia, commonly known as post-operative pain, is a rather common complication with varying degrees of pain after herniorrhaphy and follows nerve distribution. While some degree of post-operative pain is expected after surgery, for the diagnosis of post-herniorrhaphy neuralgia to be made, pain should persist for more than 3 months, not to be attributed to any other cause and interfere with patient social and/or sexual life [34, 35]. The differential diagnosis for post-herniorrhaphy neuralgia includes hernia recurrence, mesh infection or displacement, osteitis pubis, and fluid collection. Open approach injuries usually affects the ilioinguinal nerve, iliohypogastric nerve, genital branch of the genitofemoral nerve, while injuries to the lateral femorocutaneous nerve is more common with laparoscopic approach, see **Table 2** [1, 36].Most of the time, the mechanism of injury is attributed to nerve entrapment within the mesh or the suture line. This can be prevented with careful handling of the tissue and preventing over manipulation of the nerves. In laparoscopic approach staple placement below the iliopubic tract decreases the risk of nerve entrapment [37].

Ilioinguinal and iliohypogastric nerves are mostly injured during elevation of the external oblique fascia. The genitofemoral nerve is thought to be injured following cord isolation for cremasteric muscle fibers stripping. As soon as the nerves are identified, they are retracted out of the field by encircling them with a vessel loop and retraction. While injury happens with

Nerve	Area affected
Ilioinguinal nerve	• Proximal and medial thigh • Mons pubis and Labia majora • The root of the penis and upper scrotum
Iliohypogastric nerve	• Skin of the hypogastric area • Skin of the gluteal area
Genitofemoral nerve	• Mons pubis and scrotum/labia • Anterior lateral thigh area
Later femoral cutaneous nerve	Anterior lateral thigh area
Femoral nerve	• Motor nerve to quadriceps femoris • Anterior thigh area

Table 2. Commonly injured nerves post-herniorrhaphy [1].

mesh tacking in the laparoscopic approach, which can be side stepped by avoiding tacking in known areas of nerves distribution [1]. O'Reilly et al. [29] found that the risk for post-herniorrhaphy neuralgia and/or numbness was significantly lower with laparoscopic approach when compared with open approach [28].

The first line in the management of neuralgia is usually conservative, mainly by local anesthesia injections in the affected groin. When this modality fails, surgical re-exploration is advocated to identify the affected nerve and excise it. On rare cases of patients presenting with pain not matching the distribution of a single nerve, surgical re-exploration is not advised as it usually will fail improving the pain and may result in damaging more structures [15, 38].

4.3. Visceral injury

Bladder, testicular, and vas deferens injuries are among the commonly injured visceral organs with groin herniorrhaphy procedures Among the least injured structures are the ureters which are more often seen with the laparoscopic approach- the most common type of injury is incomplete transection of the ureter and ureteral perforation [39–41]. Bladder injuries are frequently reported with direct inguinal hernias, and in rare cases could result in a sliding hernia, in which part of the bladder adheres to the hernia sac. Thus, direct sacs are usually inverted back into the peritoneal cavity to avoid unnecessary dissection [42, 43].

Testicular swelling and atrophy could develop after inguinal hernia repair. Swelling and edema of the scrotum are due to hematoma or edema of the inguinal canal that progress inferiorly to the scrotum with gravity. On one hand, testicular atrophy is associated with blood supply injury during the process of dissection and isolation of the cord and usually is a painless complication. On the other hand, testicular pain post-operatively could be a result of torsion or abscess and ruling out such suspicion is done by ultrasound imaging. In the pediatric

population cord traction might cause testicular migration into the inguinal canal. Therefore, before the end of the surgery testes are palpated to ensure the right placement [1, 44].

Vas Deferens injury is considered a rare complication yet the most feared. However, if such an injury was to happen, it requires an urgent urological consultation; injuries range from as severe as transection to a mild laceration. Untreated injuries can result in the formation of anti-sperm antibodies and infertility. Avoiding such dreaded complications is possible by gentle traction of the vas and avoiding grasping or squeezing the Vas Deferens [21].

4.4. Mesh erosion\migration

Mesh migration or erosion may occur after femoral or inguinal hernias and depends on the extent of the symptoms; hence mesh removal might be advised. Mesh migration can be categorized into primary and secondary. Primary, also known as mechanical, is when the mesh dislodges along the path with least resistance as a result of inadequate fixation or external forces. While secondary, is the slow movement of the mesh through nearby anatomical structures due to body response to a foreign body. The result is an erosion of adjacent structures such as the urinary bladder leading to urinary tract infections or hematuria, bowel injury and subsequent fistula formation, and spermatic cord erosion causing vessel obstruction [45, 46].

Ott et al. [47] reported a case of late intestinal fistula formation as a consequence of an incisional hernia repair using an inter-peritoneal mesh. Animal studies showed that micro-erosions and mesh migration and consequent fistulae formation is decreased when mesh covered with biological material such as collagen [48]. In addition, Leber [49] reported a higher incidence entero-cutaneous fistula formation with the use of Mersilene mesh.

5. Post-operative hernia

Also known as an incisional hernia, post-operative hernias occur as a direct result of fascial tissue failure to heal post laparotomy. Although incisional hernias are frequently seen either post mid line and/or transverse incisions, it can, in theory, happen after any surgical incisions like paramedian and McBurney incisions, and are also seen post laparoscopic surgeries [50]. Such hernias can grow to huge sizes and contain a significant amount of small and large bowel. Previously, the incidence was believed to be around 20%, but recent epidemiological studies estimate the number to be 11%. Around two-thirds of cases may present within the first 12 months after the operation, while the other -third present as a late complication after 5–10 years [51–53]. Risk factors of incisional hernias are increased with advanced patient age, malnutrition, immune-compromised state, smoking, and obesity [12, 15, 54, 55]. Other factors that play an important role include emergency surgery and post-operative wound infection. One major complication of incisional hernia repair surgery is a high recurrence rate, which might reach up to 50%. In some cases this risk is related to the type of surgical approach, whether suture repair or mesh supported repair, and also to the amount of tension applied on the wound edges. Recurrence in this type of hernia is also related to the appearance of unrecognized hernia sites [56]. Another set of complications is related to the empty hernia cavity that is left

behind post reduction of hernia sac, such as hematomas and seromas. Henceforth, experts recommend placement of closed suction drainage; which by itself along with mesh will increase the risk of infection post-operatively [57, 58].

6. Enhanced recovery after hernia surgery

The aim of enhanced recovery after surgery protocols is to improve outcomes, lower health cost, while harnessing the benefits by standardizing the medical care [59, 60]. Such protocols are evidence-based guidelines that include minimizing surgical trauma, post-operative pain, reduce complications, and improve outcomes by decreasing the expected length of hospital stay and fasten the patient recovery [61]. Such approach to patient care should be a multi-disciplinary approach including surgeon, anesthesiologists or pain specialists, nursing staff, physical rehabilitation service, and most importantly patient cooperation [62, 63]. Patients who are followed with an enhanced recovery protocol will have the same discharge criteria but will reach these milestones sooner. This approach will usually contain 15–20 elements and will span through the full patient hospital stay; preoperatively, intra-operatively, and post-operatively (**Table 3**) [64]. Before surgery, patient education and counseling about current treatment options and best approach should be discussed. After that, a meticulous overview of the patient general health condition and management of any comorbidities such as renal, cardiac, or respiratory should be done. Intra-operatively prophylactic antibiotics are recommended

Period	Criteria
Pre-operative	• Patient education • Medical comorbidities optimization • Bowel preparation
Intra-operative	• Thromboprophylaxis • Antibiotic prophylaxis • Thermal regulation • Fluid maintenance • Avoid drains and nasogastric tube
Post-operative	• Enteral nutrition from day one post-operative • Multimodal analgesia • Antiemetic prophylaxis • Early removal of urinary catheter • Early mobilization

Table 3. Main criteria for enhanced recovery after surgery protocol [66].

before surgery, and fluids should be managed judiciously along with continuous monitoring of the patient vital status [65–67]. While post-operative period is mainly concerned with pain management, fluid and diet, avoidance of nasogastric tube and early urinary catheter removal, early mobilization, and finally early discharge [68, 69].

7. Hernia and the pediatric population

7.1. Umbilical hernia

An umbilical hernia is usually seen in the pediatric population with an incidence of 10–30% at birth in infants of Caucasian ethnicity and higher in those of African-American ethnicity, for unknown reasons [1]. It is also more common in premature infants of all races, and some report a tendency for familial inheritance. While the cause is yet to be identified in most of the cases, an umbilical hernia usually will regress and close on its own by 2–3 years of age with less than 10% needing surgical intervention.

Meanwhile, umbilical hernias in adults have a different clinical presentation, most being acquired not congenital with a male to female ratio of 3:1. The adult-type umbilical hernia usually will need surgical intervention for it to close and usually are symptomatic at time of presentation. A typical presentation will be of an exquisitely tender peri-umbilical mass overlying the skin; long-standing untreated umbilical hernia might result in thinning of covering skin and ulceration due to pressure necrosis of the adjacent skin. While small umbilical hernias could pass unnoticed and discovered incidentally. This type of hernia is associated usually with recurrence in the setting of high intra-abdominal pressure. For this reason, surgical repair is offered for incarcerated hernia or a progressively symptomatic type [3, 11, 70].

7.2. Inguinal hernias

Although the overall incidence of inguinal hernia in the pediatric population is low when compared with adults, the complication that might arise is almost the same. In the age group, bowel incarceration is incidence is low, but should this be the case, bowel infarction would happen within 2–3 hours. With bowel infarction, it is not uncommon to get testicular blood supply compromise leading to ischemic necrosis and testicular atrophy with an incidence around 9% according to some studies [71–73]. While in girls, ovarian torsion is reported to happen with inguinal hernia strangulation in about third of patients with incarcerated hernia that contain an irreducible ovary. For this reason, some experts recommend not to delay surgical intervention in this population [74].

7.3. Congenital diaphragmatic hernia

The congenital diaphragmatic hernia is caused by a diaphragmatic defect resulting abdominal viscera herniating to the chest. It usually presents in the first few hours of life with respiratory distress so severe that it could be incompatible with life [75]. In many cases, this condition

can be diagnosed in utero via ultrasound, and for those not diagnosed prenatally, this condition should be suspected in neonates with respiratory distress and absent breath sounds soon after delivery and can be easily diagnosed by chest X-ray [76]. Congenital diaphragmatic hernia complications are categorized into acute, and late-onset complications, the most serious acute complication is persistent pulmonary hypertension of the new born other complications include chylothorax, hemorrhage, and recurrent infection. Furthermore, the spectrum of late complications includes chronic respiratory disease, recurrent hernia, spinal/chest wall abnormalities, neurological, and gastrointestinal complications [77, 78].

8. Watchful waiting vs. intervention in hernial disease

The complication of hernia surgery is low; but it could have a significant impact on the patient life, should it happen. Thus, many patients with asymptomatic hernias prefer to delay surgical intervention until needed. As the natural history of an untreated hernia is generally unknown, many practitioners recommend an elective surgery to treat the hernia. Fitzgibbons et al. [79] followed 720 men, half of which had a surgical intervention and half underwent watchful waiting and were followed up to 4.5 years. The authors concluded that watchful waiting was a suitable option to manage a minimally symptomatic inguinal hernia as the overall risk of complication is low [80].

Author details

Ahmed Alwahab[1,2*], Abdulrahman AlAwadhi[1], Asmaa Abd Alwahab Nugud[3] and Shomous Abd Elwahab Nugud[4]

*Address all correspondence to: a7md13@gmail.com

1 Dubai Health Authority, Dubai, UAE

2 Sharjah Institute for Medical Research, Sharjah, UAE

3 RAK Medical and Health Sciences University, RAK, UAE

4 Community and Family Medicine department, College of Medicine, University of Sharjah, Sharjah, UAE

References

[1] Zinner M. Maingot's Abdominal Operations. [S.l.]: Mcgraw-Hill Education; 2018

[2] Rutkow I, Robbins A. Demographic, classificatory, and socioeconomic aspects of hernia repair in the United States. Surgical Clinics of North America. 1993;**73**(3):413-426

[3] Rutkow I. Demographic and socioeconomic aspects of hernia repair in the United States in 2003. Surgical Clinics of North America. 2003;**83**(5):1045-1051

[4] Caglayan F, Caglayan O, Cakmak M, Saygun O, Somuncu S, Ulusoy S, et al. Investigation of OH-proline contents of hernia sacs in children and comparison with adults. European Journal of Pediatric Surgery. 2005;**15**(4):258-261

[5] Dent B, Al Samaraee A, Coyne P, Nice C, Katory M. Varices of the round ligament mimicking an inguinal hernia: An important differential diagnosis during pregnancy. The Annals of the Royal College of Surgeons of England. 2010;**92**(7):e10-e11

[6] Ijpma F, Boddeus K, de Haan H, van Geldere D. Bilateral round ligament varicosities mimicking inguinal hernia during pregnancy. Hernia. 2008;**13**(1):85-88

[7] Schumpelick P. Inguinal hernia repair in adults. The Lancet. 1994;**344**(8919):375-379

[8] O'Dwyer P, Norrie J, Alani A, Walker A, Duffy F, Horgan P. Observation or operation for patients with an asymptomatic inguinal hernia. Annals of Surgery. 2006;**244**(2):167-173

[9] Gallegos N, Dawson J, Jarvis M, Hobsley M. Risk of strangulation in groin hernias. British Journal of Surgery. 1991;**78**(10):1171-1173

[10] Ścierski A. Duration of groin hernias and accompanied symptoms before beginning of treatment of hernias. Polish Journal of Surgery. 2008;**80**(12)

[11] Srinath S, Prashanth H, Suma K. Complicated groin hernias: Risk factors, conservative management and timing of surgical management. Journal of Evolution of Medical and Dental Sciences. 2013;**2**(34):6502-6508

[12] Ge B, Huang Q, Liu L, Bian H, Fan Y. Risk factors for bowel resection and outcome in patients with incarcerated groin hernias. Hernia. 2009;**14**(3):259-264

[13] Molloy D, Kaloo P, Cooper M, Nguyen T. Laparoscopic entry: A literature review and analysis of techniques and complications of primary port entry. The Australian and New Zealand Journal of Obstetrics and Gynaecology. 2002;**42**(3):246-254

[14] Ahmad G, Gent D, Henderson D, O'Flynn H, Phillips K. Laparoscopic entry techniques. Cochrane Database of Systematic Reviews. 2015;**31**(8):6583

[15] Chandler JG, Corson SL, Way LW. Three spectra of laparoscopic entry access injuries. Journal of the American College of Surgeons. 2001;**192**:478

[16] McGoldrick K. Surgeon volume and operative mortality in the United States. Survey of Anesthesiology. 2004;**48**(2):111-112

[17] Samee A, Adjepong S, Pattar, J. Late-onset mesh infection following laparoscopic inguinal hernia repair. Case Reports, 2011(nov 11 1), bcr0920114863-bcr0920114863

[18] Delikoukos S, Tzovaras G, Liakou P, Mantzos F, Hatzitheofilou C. Late-onset deep mesh infection after inguinal hernia repair. Hernia. 2006;**11**(1):15-17

[19] Ovington L. Hanging wet-to-dry dressings out to dry. Advances in Skin and Wound Care. 2002;**15**(2):79-84

[20] Madhok B, Vowden K, Vowden P. New techniques for wound debridement. International Wound Journal. 2013;**10**(3):247-251

[21] Cruse P, Foord R. The epidemiology of wound infection: A 10-year prospective study of 62,939 wounds. Surgical Clinics of North America. 1980;**60**(1):27-40

[22] Mangram A, Horan T, Pearson M, Silver L, Jarvis W. Guideline for prevention of surgical site infection. Infection Control and Hospital Epidemiology. 1999;**20**(04):247-280

[23] Carlson M. Acute wound failure. Surgical Clinics of North America. 1997;**77**(3):607-636

[24] van Ramshorst G, Nieuwenhuizen J, Hop W, Arends P, Boom J, Jeekel J, Lange J. Abdominal wound dehiscence in adults: Development and validation of a risk model. World Journal of Surgery. 2009;**34**(1):20-27

[25] Harris R, Dodson M. Surgical wound infection and management of extrafascial wound disruption. Postgraduate Obstetrics and Gynecology. 1996;**16**(7):1

[26] Pollock A. Commentary on complete dehiscence of the abdominal wound and incriminating factors by Pavlidis TE et al. The European Journal of Surgery. 2001;**167**(5):355-355

[27] Greenall M, Evans M, Pollock A. Midline or transverse laparotomy? A random controlled clinical trial. Part I: Influence on healing. British Journal of Surgery. 1980;**67**(3):188-190

[28] Ellis H, Coleridge-Smith P, Joyce A. Abdominal incisions: Vertical or transverse? Postgraduate Medical Journal. 1984;**60**(704):407-410

[29] O'Reilly E, Burke J, O'Connell P. A meta-analysis of surgical morbidity and recurrence after laparoscopic and open repair of primary unilateral inguinal hernia. Annals of Surgery. 2012;**255**(5):846-853

[30] Mayo W. An operation for the radical cure of umbilical hernia. Annals of Surgery. 1901;**34**(1):276-280

[31] Zaid T, Herring W, Meeks G. A randomized trial of secondary closure of superficial wound dehiscence by surgical tape or suture. Female Pelvic Medicine and Reconstructive Surgery. 2010;**16**(4):246-248

[32] Glassow F. Recurrent inguinal and femoral hernia. British Medical Journal. 1970;**1** (5690):215-216

[33] Isik A, Gursul C, Peker K, Aydın M, Fırat D, Yılmaz İ. Metalloproteinases and their inhibitors in patients with inguinal hernia. World Journal of Surgery. 2017;**41**(5):1259-1266

[34] Bay-Nielsen M, Perkins F, Kehlet H. Pain and functional impairment 1 year after inguinal Herniorrhaphy: A Nationwide questionnaire study. Annals of Surgery. 2001;**233**(1):1-7

[35] Kehlet H, Jensen T, Woolf C. Persistent postsurgical pain: Risk factors and prevention. The Lancet. 2006;**367**(9522):1618-1625

[36] Tverskoy M, Cozacov C, Ayache M, Bradley E, Kissin I. Postoperative pain after inguinal Herniorrhaphy with different types of anesthesia. Anesthesia and Analgesia. 1990;**70**(1):29-35

[37] Klein S, Greengrass R, Warner D. Paravertebral somatic nerve block for outpatient inguinal herniorraphy. Regional Anesthesia and Pain Medicine. 1998;**23**(Sup 1):54

[38] Mirdehghan M, Yazdanjo M, Sadri B, Akhavantafti E, Ghaei E. Postoperative analgesia in inguinal Herniorrhaphy: Infiltration of 0.25% bupivacaine before incision vs before repair of incision. Regional Anesthesia and Pain Medicine. 2008;**33**(1):e152

[39] Al-Awadi K, Kehinde E, Al-Hunayan A, Al-Khayat A. Latrogenic ureteric injuries: Incidence, aetiological factors and the effect of early management on subsequent outcome. International Urology and Nephrology. 2005;**37**(2):235-241

[40] Basic D, Ignjatovic I, Potic M. Latrogenic ureteral trauma: A 16-year single tertiary center experience. Srpski Arhiv za Celokupno Lekarstvo. 2015;**143**(3-4):162-168

[41] Marcelissen T, Den Hollander P, Tuytten T, Sosef M. The incidence of Iatrogenic ureteral injury during open and laparoscopic colorectal surgery. Surgical Laparoscopy, Endoscopy and Percutaneous Techniques. 2016;**26**(6):513-515

[42] Edye M. Complications of endoscopic and laparoscopic surgery: Prevention and management. Archives of Surgery. 1998;**133**(4):464-464

[43] Das D. Meta-analysis of randomized clinical trials comparing open and laparoscopic inguinal hernia repair. British Journal of Surgery. 2004;**91**(5):647-647, 91: 253

[44] Amid P. A strategy for circumventing the problem of prostate surgery subsequent to preperitoneal inguinal hernia repair. Hernia. 2004;**8**(3)

[45] ocot A, Gerharz E, Riedmiller H. Urological complications of laparoscopic inguinal hernia repair: A case series. Hernia. 2010;**15**(5):583-586

[46] Agrawal A, Avill R. Mesh migration following repair of inguinal hernia: A case report and review of the literature. Hernia. 2005;**10**(1):79-82

[47] Ott V, Groebli Y, Schneider R. Late intestinal fistula formation after incisional hernia using intraperitoneal mesh. Hernia. 2004;**9**(1):103-104

[48] Aubé C, Pessaux P, Tuech J, du Plessis R, Becker P, Caron C, Arnaud J. Detection of peritoneal adhesions using ultrasound examination for the evaluation of an innovative intraperitoneal mesh. Surgical Endoscopy and Other Interventional Techniques. 2003;**18**(1):131-135

[49] Leber G. Long-term complications associated with prosthetic repair of incisional hernias. Archives of Surgery. 1998;**133**(4):378

[50] Bucknall T, Cox P, Ellis H. Burst abdomen and incisional hernia: A prospective study of 1129 major laparotomies. BMJ. 1982;**284**(6320):931-933

[51] LeBlanc K. Laparoscopic incisional and ventral hernia repair: Complications?How to avoid and handle. Hernia. 2004;**8**(4):323-331

[52] Mudge M, Hughes L. Incisional hernia: A 10 year prospective study of incidence and attitudes. British Journal of Surgery. 1985;**72**(1):70-71

[53] Read R. Recent trends in the management of incisional herniation. Archives of Surgery. 1989;**124**(4):485

[54] Rosin D. Prevention of incisional hernia in midline laparotomy with Onlay mesh: A randomized clinical trial. World Journal of Surgery. 2014;**38**(9):2231-2232

[55] Meena K, Ali S, Chawla A, Aggarwal L, Suhani S, Kumar S, Khan R. A prospective study of factors influencing wound dehiscence after midline laparotomy. Surgical Science. 2013;**04**(08):354-358

[56] Mäkelä J, Kiviniemi H, Juvonen T, Laitinen S. Factors influencing wound dehiscence after midline laparotomy. The American Journal of Surgery. 1995;**170**(4):387-390

[57] Cobb W, Kercher K, Heniford B. Laparoscopic repair of incisional hernias. Surgical Clinics of North America. 2005;**85**(1):91-103

[58] Awaiz A, Rahman F, Hossain M, Yunus R, Khan S, Memon B, Memon M. Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Hernia. 2015;**19**(3):449-463

[59] Kehlet H, Wilmore D. Evidence-based surgical care and the evolution of fast-track surgery. Annals of Surgery. 2008;**248**(2):189-198

[60] Ljungqvist O, Scott M, Fearon K. Enhanced recovery after surgery. JAMA Surgery. 2017;**152**(3):292

[61] Delaney C, Fazio V, Senagore A, Robinson B, Halverson A, Remzi F.'Fast track' postoperative management protocol for patients with high co-morbidity undergoing complex abdominal and pelvic colorectal surgery. British Journal of Surgery. 2001;**88**(11):1533-1538

[62] Gustafsson U, Scott M, Schwenk W, Demartines N, Roulin D, Francis N, et al. Guidelines for perioperative care in elective colonic surgery: Enhanced recovery after surgery (ERAS®) society recommendations. Clinical Nutrition. 2012;**31**(6):783-800

[63] Slim K, Joris J. The egg-and-chicken situation in postoperative enhanced recovery programmes. British Journal of Anaesthesia. 2017;**118**(1):5-6

[64] Kehlet H, Joshi G. Enhanced recovery after surgery. Anesthesia and Analgesia. 2017;**125**(6):2154-2155

[65] Feldheiser A, Aziz O, Baldini G, Cox B, Fearon K, Feldman L, et al. Enhanced recovery after surgery (ERAS) for gastrointestinal surgery, part 2: Consensus statement for anaesthesia practice. Acta Anaesthesiologica Scandinavica. 2015;**60**(3):289-334

[66] Maurice-Szamburski A, Auquier P, Viarre-Oreal V, Cuvillon P, Carles M, Ripart J, et al. Effect of sedative premedication on patient experience after general anesthesia. Journal of the American Medical Association. 2015;**313**(9):916

[67] Rollins K, Lobo D. Intraoperative goal-directed fluid therapy in elective major abdominal surgery. Annals of Surgery. 2016;**263**(3):465-476

[68] Kamel H, Iqbal M, Mogallapu R, Maas D, Hoffmann R. Time to ambulation after hip fracture surgery: Relation to hospitalization outcomes. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2003;**58**(11):M1042-M1045

[69] Muller S, Zalunardo M, Hubner M, Clavien P, Demartines N. A fast-track program reduces complications and length of hospital stay after open colonic surgery. Gastroenterology. 2009;**136**(3):842-847.e1

[70] Darling J. Radical operation for the cure of umbilical hernia. The Dublin Journal of Medical Science. 1910;**129**(6):428-430

[71] Puri P, Guiney E, O'Donnell B. Inguinal hernia in infants: The fate of the testis following incarceration. The Journal of Urology. 1984;**132**(2):425

[72] Rowe M. Incarcerated and strangulated hernias in children. Archives of Surgery. 1970;**101**(2):136

[73] Walc L, Bass J, Rubin S, Walton M. Testicular fate after incarcerated hernia repair and/or orchiopexy performed in patients under 6 months of age. Journal of Pediatric Surgery. 1995;**30**(8):1195-1197

[74] Boley S, Cahn D, Lauer T, Weinberg G, Kleinhaus S. The irreducible ovary: A true emergency. Journal of Pediatric Surgery. 1991;**26**(9):1035-1038

[75] Wiener E. Congenital diaphragmatic hernia: Pathophysiology and pharmacologic support. Journal of Pediatric Surgery. 1981;**16**(6):1043

[76] Sakurai M, Donnelly L, Klosterman L, Strife J. Congenital diaphragmatic hernia in neonates: Variations in umbilical catheter and enteric tube position. Radiology. 2000;**216**(1):112-116

[77] Dillon P, Cilley R, Mauger D, Zachary C, Meier A. The relationship of pulmonary artery pressure and survival in congenital diaphragmatic hernia. Journal of Pediatric Surgery. 2004;**39**(3):307-312

[78] Jancelewicz T, Chiang M, Oliveira C, Chiu P. Late surgical outcomes among congenital diaphragmatic hernia (CDH) patients: Why long-term follow-up with surgeons overall. Journal of Pediatric Surgery. 2013;**48**(5):935-941

[79] Fitzgibbons R, Giobbie-Hurder A, Gibbs J, Dunlop D, Reda D, McCarthy M, et al. Watchful waiting vs repair of inguinal hernia in minimally symptomatic men. The Journal of the American Medical Association. 2006;**295**(3):285

[80] Nugud A, Nugud S. Long-standing asymptomatic Inguinoscrotal hernia. Sultan Qaboos University Medical Journal. 2017:e250-e251

Edited by Arshad M. Malik

Dr. Arshad Malik is an Associate Professor of Surgery and is affiliated with the College of Medicine, Qassim University, Saudi Arabia. He graduated from the Liaquat Medical College, Jamshoro, Pakistan, and is a fellow of the College of Physicians and Surgeons of Pakistan. He has authored many national and international scientific publications in the field of general and laparoscopic surgery. He has presented his work in many national and international scientific sessions all over the world. He has also contributed to several chapters in different books on surgery and edited three books.

This book highlights the hernia as an ancient disease that has affected the mankind all over the world with a very high frequency. The book contains a brief introductory chapter followed by various chapters emphasizing the evolution of hernia surgery from the very basic operations to the present highly advanced technique use in present era to treat this surgical problem. Hopefully, this book will be of significant benefit to the trainee and practicing surgeons alike.

Published in London, UK

IntechOpen

ISBN 978-1-83881-687-2