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Review Article

Hernia repair techniques - a comparative analysis of mesh types

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ABSTRACT

A hernia is a condition characterized by the protrusion of an internal organ, often part of the intestine, through a weakened area in the surrounding muscle and tissue. Surgical intervention is the primary treatment option for most hernias, with procedures known as herniorrhaphy or hernioplasty. Traditional open surgery involves a sizable abdominal incision, granting direct access to the herniated tissue. Alternatively, minimally invasive laparoscopic surgery utilizes small incisions and specialized instruments, including a camera, for repair. Synthetic or biological mesh is frequently employed to reinforce weakened muscle or tissue, reducing hernia recurrence risk. Mesh is integral to hernia treatment, providing critical reinforcement and enabling tension-free closure. This article's rationale lies in the necessity for a comprehensive comparative analysis of hernia repair techniques, with a particular focus on the influence of different mesh types in abdominal hernia surgery. This research, initiated on 17 October 2023, involved an exhaustive review of existing literature via databases like PubMed, Web of Science, and Cochrane, employing a broad range of medical terminology combinations. The management of hernias has evolved significantly, and open hernia repair, especially using the Shouldice technique, remains valuable when the mesh is unavailable or undesired. Modern tension-free repair techniques, such as Lichtenstein and plug and patch, provide similar outcomes. Laparoscopic hernia repair, despite the longer surgery duration, offers advantages in terms of recurrence, recovery, and postoperative discomfort. Mesh selection is vital, with options like polypropylene, polyester, composite, biological, and 3D offering tailored attributes. The choice should consider patient history, hernia type, and surgeon expertise, necessitating awareness of evolving techniques and materials for optimal outcomes in hernia repair.

Keywords: Hernia, Open hernia repair, Laparoscopic repair, Polypropylene mesh, Polyester mesh, Biological mesh, Composite mesh, 3D mesh

INTRODUCTION

A hernia is a condition characterized by the protrusion of an internal organ, such as part of the intestine, pushing through a weakened area in the surrounding muscle and tissue. This typically occurs due to factors like muscle weakness or excessive strain.[1] While hernias can develop in various parts of the body, they are most commonly seen in the abdominal region. The type of hernia can be classified based on its location, and some of the most prevalent types include inguinal hernias, umbilical hernias, femoral hernias, and hiatus hernias.[1] In many cases, hernias do not manifest noticeable symptoms and may be initially asymptomatic. This situation often calls for a watchful waiting approach, where patients and healthcare providers monitor the hernia's progress. However, it's important to recognize that hernias have the potential to cause significant complications, especially if they become incarcerated or strangulated. In these scenarios, surgical intervention becomes a critical and immediate requirement.[2] The first step in the effective management of a hernia is to seek professional medical evaluation and diagnosis. Typically, this evaluation is conducted by a healthcare provider, often a general surgeon. The process involves a thorough physical examination to identify the hernia's location and extent. In some cases, imaging tests like ultrasound or MRI may be employed to confirm the presence of a hernia and assess its severity.[2] Lifestyle modifications play a crucial role in the overall treatment and management of hernias. Patients diagnosed with a hernia should take certain measures to ensure their well-being and reduce the risk of complications.[3] However, it's important to recognize that while lifestyle modifications can help alleviate symptoms and prevent further deterioration, they are not a definitive or curative solution for hernias. Surgical intervention is typically the primary treatment option for most types of hernias.

The surgical procedures involved are known as herniorrhaphy or hernioplasty.[4] During hernia surgery, the surgeon aims to reposition the herniated tissue and repair the weakened area of the muscle or tissue wall. Several techniques can be employed, and the choice depends on factors such as the type and size of the hernia, the patient's overall health, and the surgeon's preference.[5] The traditional open surgery approach involves making a large incision in the abdominal area to access and repair the hernia. This method provides the surgeon with direct visibility and access to the herniated tissue.[5] Another approach is Laparoscopic or minimally invasive surgery which involves making small incisions and using specialized instruments, including a camera, to repair the hernia. Laparoscopic surgery typically results in smaller scars, less postoperative pain, and a shorter recovery period.[5] In many cases, surgeons also use a synthetic or biological mesh to reinforce the weakened area of the muscle or tissue wall. This mesh can help prevent a recurrence of the hernia. Some patients may require a combination of stitches and mesh for added reinforcement.[6] Mesh repair plays a crucial role in the treatment of abdominal hernias for several reasons. It significantly lowers the risk of hernia recurrence compared to non-mesh repair methods.[7] Mesh provides reinforcement to the weakened abdominal wall, reducing the likelihood of the hernia reoccurring at the same site. In addition to that, the use of mesh in hernia repair allows for a tension-free closure, which means the tissues around the hernia are not pulled together tightly. This reduces the risk of wound complications and postoperative pain.[8] Patients can return to their regular activities sooner than with tension-based repair methods. Due to its versatility, the mesh repair technique can be applied to various types of abdominal hernias, including inguinal, ventral, umbilical, and incisional hernias. Different mesh types and sizes can be chosen to suit the specific needs of each patient and hernia type.[3] It is important to note that while mesh repair offers many advantages, it is not without risks. Potential complications include infection, pain, mesh migration, and adhesions. The choice of mesh material and surgical technique should be carefully considered based on the patient's specific condition and the surgeon's expertise. Ultimately, the importance of mesh repair in abdominal hernias lies in its ability to provide durable and effective solutions for hernia management, resulting in improved patient outcomes and a reduced risk of recurrence.

The study's rationale is to provide a comprehensive comparative analysis of various hernia repair techniques, focusing on the role and impact of different mesh types in the surgical management of abdominal hernias. Given the array of available hernia repair techniques and mesh materials, this research aims to address the critical need for evidence-based guidance in clinical decision-making. The study will additionally evaluate the efficacy, safety, and long-term outcomes associated with different mesh types within diverse hernia repair methods, including open hernia repair and laparoscopic techniques. By comparing the advantages and disadvantages of mesh materials such as polypropylene, polyester, composite, biologic, and 3D meshes, the study seeks to provide surgeons and healthcare professionals with valuable insights into the optimal mesh selection for various patient profiles, hernia types, and clinical scenarios. Ultimately, this research contributes to improving the quality of hernia repair procedures, reducing recurrence rates, minimizing postoperative complications, and enhancing patients' overall well-being, making it of paramount significance in the field of hernia surgery and patient care.

METHODOLOGY

The research, which began on 17 October 2023, was initiated after an extensive examination of existing literature. Various databases, including PubMed, Web of Science, and Cochrane, were utilized to conduct this literature review. The search process involved the use of a wide range of medical terminology combinations. Additionally, we conducted manual searches on Google Scholar to find relevant research terms. The primary aim of this literature review encompassed several critical areas,

which included evaluating hernias, their various types, and strategies for managing them. We also included keywords related to hernia repair techniques and the types of mesh materials used. It is important to highlight that the selection of articles for inclusion in this study was based on multiple criteria, ensuring a thorough and robust review process.

DISCUSSION

Hernia repair techniques

The management of hernias has evolved over the years, encompassing various techniques aimed at effectively repairing the hernia while minimizing postoperative complications. This article will delve into the two primary categories of hernia repair techniques: open hernia repair and laparoscopic hernia repair. Each of these techniques offers distinct advantages and considerations, providing patients and surgeons with options tailored to individual needs.

Open hernia repair

In the past, tension repair was the standard technique, where the surgeon would suture the edges of the hernia defect together without using a mesh. This approach is associated with a higher risk of recurrence and postoperative pain.[9] However, in cases of the non-availability of mesh due to low resource setting or refusal to use mesh from the patient, the Shouldice technique (Figure 1) was recommended by the Hernia Surge Group guidelines, since it has the lowest risk of recurrence and postoperative complications among other open repair non mesh procedures.[2,10] Modern approaches involving the use of mesh materials are primarily known as tension-free repair techniques.[11] This involves using a mesh to bridge and reinforce the hernia defect without putting tension on the surrounding tissues. There are two main types of tension-free repair: Lichtenstein repair, and plug and patch repair. The Lichtenstein repair method involves using a flat, heavyweight polypropylene mesh placed over the hernia defect and sutured into place. On the other hand, in the plug and patch technique, a preformed mesh plug is placed into the hernia sac, and a patch is placed over the defect.[11] Both techniques were similar in terms of healing, postoperative pain, complications, and hernia recurrence.[12,13] However, the hernia surge group guidelines strongly suggest that the plug and patch technique should be avoided due to excessive use of foreign or synthetic material.[2]

Laparoscopic hernia repair

Laparoscopic hernia repair takes precedence over open hernia repair in multiple meta-analyses.[14-16] Although the surgery duration for laparoscopic repair was longer, with an increased risk of rare postoperative complications, there is still significant evidence available for less recurrence, faster healing, and less persisting pain.[17] There are two most used laparoscopic hernial repair methods: transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP), as illustrated in Figure 2. TAPP is a minimally invasive procedure where a mesh is placed behind the abdominal wall, and it is particularly useful for inguinal hernias.[17] On the contrary, TEP does not enter the abdominal cavity but rather does the work externally, making it a good choice for patients with prior abdominal surgeries. Both TAPP and TEP are superior treatment options to open repair methods; however, the evidence regarding the superiority between TAPP and TEP is insufficient.[18]

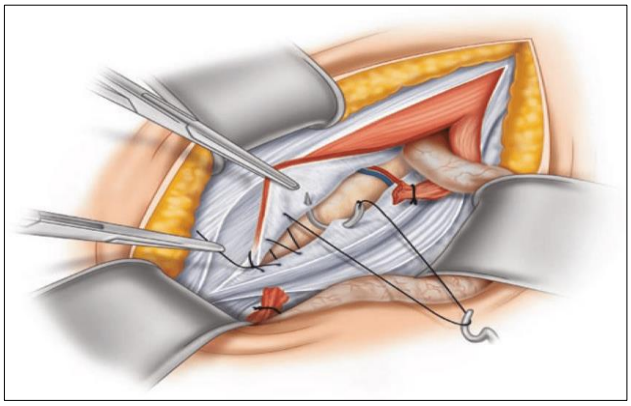

Figure 1: Shouldice technique of hernia repair.[24]

The choice between open and laparoscopic hernia repair techniques depends on several factors, including the type of hernia, the patient's overall health, the surgeon's expertise, and patient preferences.[6] Both approaches offer advantages, but it is crucial to weigh the benefits and potential risks carefully. Patients should engage in comprehensive discussions with their healthcare providers to determine the most suitable hernia repair technique for their specific circumstances. Moreover, ongoing advancements in surgical procedures and materials continually shape the landscape of hernia repair, enhancing outcomes and patient satisfaction.[10]

Comparative analysis of mesh types

Before selecting a mesh for an individual patient, a surgeon must consider patient characteristics and mesh properties to determine the appropriate treatment. The mechanical compatibility between the hernia meshes and the abdominal wall layers plays an important role in avoiding postoperative complications and recurrences. Factors such as filament type, tensile strength, and porosity are important to determine the type of mesh material suitable for the specific surgical setting.[19] In an ideal setting, the mesh should be made up of monofilament, and hence, the most preferred types are either polypropylene or polyester mesh types.[20] The polypropylene mesh is the most used mesh material and is well known for its durability. However, it can be associated with postoperative pain and a risk of adhesion formation, which is when the mesh sticks to surrounding tissues. Adhesion formation usually occurs in hernia present in the peritoneal cavity.[19] Polyester

meshes are more pliable and lightweight compared to polypropylene. They are less likely to cause postoperative pain but may have a higher risk of infection.[20] Polyester meshes were also preferred in TAPP due to their ability to produce less foreign body reactions and lower postsurgical pain.[21] In cases where the mesh placement is done such that it is in contact with any visceral organ, a mesh with an absorbable surface should be chosen. A hybrid mesh, such as composite mesh, is the best choice in this scenario.[20] These meshes combine different materials, such as a polypropylene core with a collagen or absorbable layer. They aim to combine the strength of synthetic meshes with reduced inflammatory response and adhesion formation.[19] In infected cases, where either a bacterial compromised environment is expected or the strangulation of the hernia is present, an absorbable material for the mesh is recommended by the literature.[20] These meshes are usually known as biological meshes and are made from human or animal tissue. They are used in contaminated or infected hernia repairs, as they do not leave permanent foreign material behind. However, they are typically not as strong as synthetic meshes.[22] Another advancement in the mesh industry has been the development of 3D meshes. These innovative meshes have three-dimensional structures to promote tissue integration, minimize the risk of adhesions, and improve outcomes.[23] Evidence suggests that these meshes are efficient and safe and propose many advantages, such as less surgical time and less postoperative pain.[23] When comparing mesh types, it's important to consider factors such as the patient's medical history, the type and location of the hernia, the surgeon's experience, and the potential risks and benefits associated with each mesh type. The choice of mesh should be individualized for each patient and their specific clinical circumstances. Additionally, advances in hernia repair techniques and materials continue to evolve, so it's essential for both patients and surgeons to stay informed about the latest developments in the field.

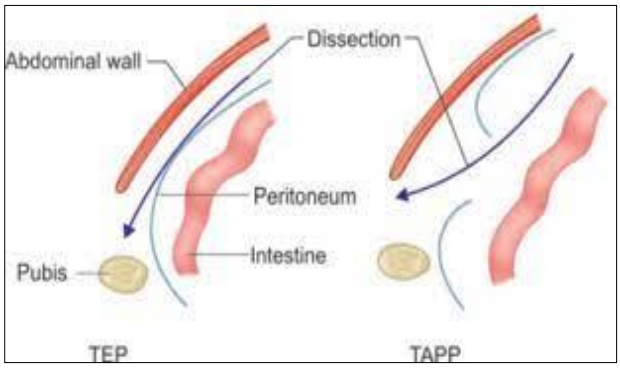

Figure 2: Totally extraperitoneal (TEP) versus transabdominal preperitoneal (TAPP) hernia repair.[25]

CONCLUSION

In conclusion, the management of hernias has witnessed a significant evolution with the development of various techniques aimed at ensuring effective repair while minimizing postoperative complications. Open hernia repair with the Shouldice technique is a viable option when mesh is unavailable or undesirable due to resource constraints or patient preferences. However, modern tension-free repair techniques have become the norm, with options like the Lichtenstein and plug and patch methods offering comparable outcomes. On the other hand, laparoscopic hernia repair has gained prominence due to its lower recurrence rates, faster recovery, and reduced postoperative pain, despite the longer surgical duration. In the realm of hernia repair, the choice of mesh material plays a pivotal role in ensuring successful outcomes. Various mesh types, such as polypropylene, polyester, composite, biological, and 3D, offer different attributes that can be tailored to individual patient needs. The choice of mesh material must consider the patient's medical history, hernia type, and surgeon's experience. Staying informed about evolving techniques and materials is paramount for both patients and surgeons in achieving optimal hernia repair outcomes.

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REFERENCES

1. UK National Health Service. Hernia. 2023. Available at: https://www.nhs.uk/conditions/hernia/. Accessed on 09 August 2023.
2. HerniaSurge Group. International guidelines for groin hernia management. Hernia. 2018;22(1):1-165.
3. M. The Art and Science of Abdominal Hernia. BoD–Books on Demand. 2022.
4. Marcy HO. The anatomy and surgical treatment of hernia. Ann Surg. 1893;18:678-81.
5. Bittner R, Köckerling F, Fitzgibbons Jr RJ, LeBlanc KA, Mittal SK, Chowbey P. Laparo-endoscopic hernia surgery: evidence based clinical practice. Springer. 2018.
6. LeBlanc KA, Kingsnorth A, Sanders DL. Management of abdominal hernias. Springer. 2018.
7. LeBlanc K. Proper mesh overlap is a key determinant in hernia recurrence following laparoscopic ventral and incisional hernia repair. Hernia. 2016;20(1):85-99.
8. Vatansev C, Belviranli M, Aksoy F, Tuncer S, Sahin M, Karahan O. The Effects of Different Hernia Repair Methods on Postoperative Pain Medication and CRP Levels. Surg Laparosc Endosc Percutaneous Techniques. 2002;12(4):243-6.
9. Amato B, Moja L, Panico S, Persico G, Rispoli C, Rocco N, Moschetti I. Shouldice technique versus other open techniques for inguinal hernia repair. Cochrane Database Syst Rev. 2012;4:CD001543.
10. AlMarzooqi R, Tish S, Huang LC, Prabhu A, Rosen M. Review of inguinal hernia repair techniques within the Americas Hernia Society Quality Collaborative. Hernia. 2019;23(3):429-38.

11. Köckerling F, Simons MP. Current Concepts of Inguinal Hernia Repair. Visceral Med. 2018;34(2):145-50.
12. Zhao G, Gao P, Ma B, Tian J, Yang K. Open mesh techniques for inguinal hernia repair: a meta-analysis of randomized controlled trials. Ann Surg. 2009;250(1):35-42.
13. Li J, Ji Z, Li Y. Comparison of mesh-plug and Lichtenstein for inguinal hernia repair: a meta-analysis of randomized controlled trials. Hernia. 2012;16:541-8.
14. Chung R, Rowland D. Meta-analyses of randomized controlled trials of laparoscopic vs conventional inguinal hernia repairs. Surg Endosc. 1999;13:689-94.
15. O'Reilly EA, Burke JP, O'Connell PR. A meta-analysis of surgical morbidity and recurrence after laparoscopic and open repair of primary unilateral inguinal hernia. Ann Surg. 2012;255(5):846-53.
16. Schmedt C, Sauerland S, Bittner R. Comparison of endoscopic procedures vs Lichtenstein and other open mesh techniques for inguinal hernia repair: a meta-analysis of randomized controlled trials. Surg Endosc Other Intervent Techniques. 2005;19:188-99.
17. McCormack K, Scott N, Go PM, Ross SJ, Grant A. Laparoscopic techniques versus open techniques for inguinal hernia repair. Cochrane Database Syst Rev. 2003;1.
18. Bittner R, Schwarz J. Inguinal hernia repair: current surgical techniques. Langenbeck's Arch Surg. 2012;397(2):271-82.
19. Brown C, Finch J. Which mesh for hernia repair? Ann Royal Coll Surgeons Engl. 2010;92(4):272-8.
20. Bilsel Y, Abci I. The search for ideal hernia repair; mesh materials and types. Int J Surg. 2012;10(6):317-21.
21. Langenbach MR, Sauerland S. Polypropylene versus Polyester Mesh for Laparoscopic Inguinal Hernia Repair: Short-Term Results of a Comparative Study. Surg Sci. 2013;4(1):6.
22. Majumder A, Winder JS, Wen Y, Pauli EM, Belyansky I, Novitsky YW. Comparative analysis of biologic versus synthetic mesh outcomes in contaminated hernia repairs. Surgery. 2016;160(4):828-38.
23. Rashid T, Reshi FA, Mir IS. A comparative study of three-dimensional mesh (3D mesh) and polypropylene mesh in laparoscopic inguinal hernia repairs in adults. Int Surg J. 2018;5(1):174-80.
24. Lorenz R, Arlt, Conze J. Shouldice standard 2020: review of the current literature and results of an international consensus meeting. Hernia. 2021;25:3.
25. Mishra R. Laparoscopic repair of inguinal hernia. Laparoscopy Hospital, New Delhi, India. 2003. Available at: http://www laparoscopyhospital com. Accessed on 09 August 2023.

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