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HISTORICAL REVIEW OF SURGICAL TECHNIQUES FOR OPERATIVE TREATMENT OF INGUINAL HERNIA

POVIJESNI PREGLED KIRURŠKIH TEHNIKA OPERATIVNOG LIJEČENJA PREPONSKE KILE

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SUMMARY

Hernia is characterized as the protrusion of the peritoneum with or without an organ or a portion of an organ through the defect of the abdominal wall. It is likely that inguinal hernias have been a problem since the beginning of human history. Many doctors have had challenges in the past when treating them. Although they are no longer recognized as a fatal illness, they are nevertheless very common in the general population and they can be clinically complicated. There have been advancements in hernia repair throughout history. The most significant advancement was in the late 1800s when Eduardo Bassini published his method of triple sewing fascia and muscle tissues to reinforce the posterior wall of the inguinal canal. The use of prosthetic materials in the repair of the inguinal canal marked the next major development. Irving Lichtenstein is credited with being a pioneer in the use of prolene mesh for tension-free repair. The last remarkable development was the introduction of laparoscopic techniques in surgery, which are nowadays very commonly used in laparoscopic procedures.

***Keywords**: history, inguinal hernia, surgical technique*

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Introduction

One of the most frequently performed operations by general surgeons worldwide is the repair of an abdominal wall hernia. Inguinal hernias constitute approximately 75% of abdominal wall hernias, with femoral hernias accounting for 5%. (Mulholland et al., 2017) An inguinal hernia is a result of protrusion of the contents of the abdomen through a weak spot in the lower abdominal wall. There are two places in the lower abdominal wall, one on either side of the groin, where inguinal hernias can develop. Nowadays, and looking throughout history, one can see a high level of incidence and the development of many surgical techniques that will lead to the best results with different approaches. Today's treatment methods are very advanced and do not present an exceptional problem, and they are usually elective procedures. Advances in anesthesia and operative techniques have led to the fact that this is an operation with a low number of recurrences and an extremely low mortality rate. Given this success, the quality of life and avoidance of chronic pain became paramount in deciding which technique to use for the hernia repair itself. The choice of technique itself still remains a decision of the operator, and most will decide on a technique they are familiar with and have learned well. However, it is extremely important to emphasize that regardless of the choice of technique, each operation is a serious procedure and carries a possible risk of complications.

Historical review

Ancient times

The history of inguinal hernia treatment is the history of surgery. Descriptive anatomy of the anterior abdominal wall dates more than 6000 years back, to the beginning of civilization, the Nile Valley, and the Ancient Egyptian papyrus. These books, many of which were written by unidentified authors, date back to a time when magic and religion were the mainstays of medicine. Ebers Papyrus, dating back to 1500 BC and most closely resembling a modern surgical textbook of that period, was found in the Theban tomb in 1862 by Professor George Ebers. It provides the first descriptions of the anterior abdominal wall (Sanders & Kingsnorth, 2012). Interestingly, the last section deals with abdominal swellings and tumors. Although there is no specific mention of inguinal hernia, we can clearly see the root of all future developments in methods over the years. The observation about hernias was stated: "When you judge a swelling on the surface of a belly.., what comes out.., caused by coughing" (Lau, 2002.). Egyptian specialists considered all hernias, besides the inguinal-scrotal assortment, to be treated nonsurgically. The Ebers Papyrus suggested eating less and making outside compression of the hernia with gauze and liniments (palm oil). The

surgical approach to the inguinal-scrotal hernia contained an extraction of the hernia together with an orchiectomy. An illustrated sculpture of an operator seemingly completing a circumcision and possibly reducing an inguinal hernia can be found in the Egyptian tomb of Ankh-ma-Hor at Saqqara, which dates back to approximately 2500 BC. The role of the Egyptian pharaoh's inner circle of doctors was to maintain the monarch's health. These medical professionals had a thorough understanding of the human anatomy and had created several cutting-edge surgical methods for treating hernias in addition to other ailments. The mummy of Pharaoh Merneptah (1215 BC) showed a large wound in the groin, and the scrotum was separated from the body, from which it was concluded that an inguinal-scrotal hernia operation was performed (Kingsorth & Sanders, 2018).

The Greco-Roman period

The currently used term "hernia" comes directly from ancient Greece (*kele*/*hernios* in Greek means bud or offshoot) (Kingsorth & Sanders, 2018). Although the natural course of the disease is relatively slow, it eventually reaches a size that severely impairs patients' ability to perform daily activities. Early Greek medical texts such as The Corpus Hippocraticum, which are closely linked to the physician Hippocrates and his teachings, also mention hernias (Sanders & Kingsnorth, 2012). However, there was no description or hint of any possible surgical treatment in the books of the Hippocratic School. However, the anatomical studies in the Hellenistic period appear to have highly contributed to our understanding of the etiology and improved surgical management of hernias when necrotomies were permitted. A few centuries later, a Roman named Aulus Cornelius Celsus first described the importance of surgical closure of the abdominal wall. Cornelius Celsus states that when groin hernias first appear in small children, bandaging and poultices should be applied before considering surgery. A strip of linen is used for the bandaging; one end of the strip is rolled into a ball and applied to the prolapse to push the intestines back. After that, the remaining linen strip is securely tied all around. In this manner, the intestines are pushed back inside, and the tunics quickly adhere. The author also advises against surgery in older patients with very large or strangulated hernias. Celsus also provided a thorough surgical method for sparing the testicles. A century later, Aelius Galenus, undoubtedly the most prominent physician of the Greco-Roman period, provides a detailed description of how a hernia is the result of a rupture of the peritoneum and stretching of the adjacent fascia and muscles. Galen classifies hernias as bubonocele (when located in the groin), enterocele (scrotal hernia), and omphalocele (umbilical hernia). He provides a precise definition of the hernia, stating that it is a tumor that contains the intestines, peritoneum, liquids, dilated vessels, omentum, and similar sub-

stances. He further divides them into categories according to their contents; for example, enterocele - if containing intestines (entera in Greek), hydrocele - if containing water (hydor in Greek), epiplocele - if containing omentum (epiploon in Greek). The treatment process included ligature of the hernial sac and spermatic cord and testicular resection. Galen's principle of treatment was used as the treatment of choice for centuries afterward. (Lascaratos, Tsiamis & Kostakis, 2003).

The Middle ages

During the fall of the Western Roman Empire in 476, the Greco-Roman medical tradition was taken over by Byzantine medicine, with an emphasis on Galen's treatment. The notable techniques of Greco-Roman surgery were largely lost. Then came the long, dark Middle Ages, a period described as one of medical decline in the civilized world, marked by stagnation, the eclipse of surgery, centuries of ignorance, and the widespread abandonment of the use of the knife. This was an age of faith and scholasticism. Abdominal wall hernias of different types were rarely distinguished during this time. On the other hand, French physician and surgeon Arnauld de Villeneuve described an epigastric hernia in the year 1285, and Guy de Chauliac, 1363 wrote *Chirurgia Magna,* where he described six surgical techniques for inguinal hernia surgery and classification of various hernia types. He developed taxis for incarceration, recommending the head-down, Trendelenburg position (Sanders & Kingsnorth, 2012). His six surgical techniques were:

1. After the skin incision, the hernia sac is transfixed, and the distal spermatic cord with the testicle is amputated a (method of Galen).
2. Cauterization of the external swelling with the red-hot iron (a method of Albucasis).
3. Scar formation by using a 'cauteriumpotentiale,' a plaster with escharotic capacity, for instance, arsenic (a method of Theodoric of Cervia).
4. Applying a transcutaneous suture around the spermatic cord and tying it on an external wooden slat until the cord becomes sectioned (a method of Roger of Salerno).
5. Incising the suprapubic area and introducing a hot iron cautery directly on the spermatic cord (a method of Lanfranchi of Milan).
6. After incision, applying a golden thread around the spermatic cord to tie it just enough to ensure closure of the hernia sac but without compromising the vascularization and function of the testis (method of Guy de Chauliac) (A. Marte, A. A. Caldamone and L. M. Aguiar, 2021.) At the time, he was the authoritative expert on hernia, and his methods were in use, with a progressive predominance for de Chauliac's technique with the so-called "Golden Thread."

The anatomical era

Surgical operation on a fully anatomical basis only began to be performed after 'modern anatomy' was established during the sixteenth century, as autopsy and anatomic dissection spread throughout Europe. The superior pubic ligament, transversalis fascia, and cremasteric fascia were first described by Sir Astley Paston Cooper, an English surgeon and anatomist. In 1804, Astley Cooper stated, "No disease of the human body, belonging to the province of the surgeon, requires in its treatment a greater combination of accurate anatomical knowledge with surgical skill than hernia in all its varieties" (Hori & Yasukawa, 2021). The earliest method used was to cause inflammation to strengthen the hernial opening, which was achieved by cauterization with a red-hot iron, which is the forerunner of today's electrocautery device. Another used method was injecting acidic chemicals. In this way, the formation of a solid scar was induced in the area of the front wall of the inguinal canal. After the hernia was repositioned, a purse-string ligation was tied around the hernial sack at the level of the external inguinal ring. The hernial sack and spermatic cord were often tied with a golden thread, the so-called golden stitch (Sachs, Damm & Encke, 1997). A major contribution was made in 1817 when Cloquet dissected and examined about 340 hernia cases for his thesis, *Recherches Anatomiques sur les Hernies de l'Abdomen*. These cases came from five thousand cadavers that he had dissected over the course of three years at the University of Paris, along with Pierre-Augustin Béclard, a colleague and friend. The revolutionary aspect of Cloquet's thesis was that it was an extensive anatomical study that included a thorough description, dissection, and drawing. The thesis described the locations where inguinal and crural hernias are more likely to occur in terms of the cremaster muscle, the peritoneum, and the spermatic vessels (Loukas et al., 2007). Marios Jules Cloquet provided a crucial anatomical structure used in numerous sutured inguinal hernia repairs. Even with these significant advancements in anatomy knowledge and the discovery of anesthesia in 1846, hernia surgery did not advance much in the first half of the 19th century because attempts to open the inguinal canal often led to severe sepsis and hernia recurrence.

New trends from the XIX century

The first operation to narrow the hernial opening of the inguinal canal was performed by Vinzenz von Czerny, a German surgeon (1877). He surgically strengthened the abdominal aponeurosis by fascial duplicature without opening the aponeurosis (Czerny suture), which led to the narrowing of the external inguinal ring. Unfortunately, this operative augmentation of the anterior wall led to a high recurrence rate (>30%), even when performed by skilled surgeons such as

Billroth. Therefore, the procedure was considered insufficient (Sachs, Damm & Encke, 1997; Hori & Yasukawa, 2021). The Parisian surgeon Just Lucas-Championniere was the first to indicate that a high ligature of the hernial sac on the internal inguinal ring is necessary after splitting the abdominal aponeurosis. Most significant inguinal hernia repair techniques, still in use today, were made possible by this reinforcement of the posterior wall of the inguinal canal (Sachs, Damm & Encke, 1997).

For most of the 19th century, groin hernia surgery was performed largely in accordance with the procedures that Celsus had performed nearly 2,000 years earlier in Rome. The primary indications remained pain, incarceration, and strangulation, unresponsive to taxis. The age of tension hernia repair (19th to mid-20th century) was recognized as the beginning of contemporary hernia surgery, highlighting of anesthetic and sterile methods. Three key guidelines for hernia repair were established: high ligation of the hernia sac, internal inguinal ring narrowing, and aseptic and antiseptic techniques. Even with this improvement, the treatment was not very effective because the postoperative mortality rate was 7%, and the recurrence rate was significant. Only with Bassini's help did the outcomes noticeably improve (Marte, Caldamone & Aguiar, 2021).

Bassini began his work on inguinal herniation in 1883. He gave up on the idea of making a scar under the external oblique aponeurosis and hoping it would close the internal abdominal ring inside out, leaving the inguinal canal open for the spermatic cord to pass through. He made the decision to reconstruct the canal physiologically, companioned with new inguinal rings, and restored the valvular obliquity of the canal. Bassini sutured the conjoint transversalis abdominis and obliquus internus to the inguinal ligament, and his "triple layer" included the fascia verticalis Cooperi (transversalis fascia) (Rad, 1999). He focused attention on the valve-like mechanism, which must be restored by closing the floor from below upward. Many unique elements of his procedure included the use of interrupted nonabsorbable (silk) sutures, bilateral repairs, the management of cryptorchidism, the restoration of obliquity, and the placement of transversalis fascia and the rectus sheath. Additionally, he was the first person to deliver such a big success with thorough aftercare. He stopped using postoperative trusses and seldom used drains (Lau, 2002). The Bassini techniques were unfairly criticized in the interwar period since the outcomes of the many changes did not live up to initial reports. It was also shown that the muscle would not repair to the aponeurosis. Repairs of the deep, transverse layer resulted from a renewed focus on transversalis fascia deterioration and an increased incidence of direct defects with aging and smoking (Read, 1987). However, although Bassini's procedure was adopted widely, modifications (corruptions) to his methods were rapidly introduced. At about the same

time when Bassini brought his changes, Williams S. Halsted developed an independent operation for the treatment of inguinal hernia (Halsted I procedure) that differed from Bassini's technique by transposition of the cord in a position above the aponeurosis of the external oblique muscle (Read, 1984). By 1891, Halsted had performed this operation twenty-one times. In his paper, he gave a historical review of the operations for inguinal hernia and then described his operation. "'Bassini's operation and mine are so nearly identical that I might quote his results in support of my operation. Instead of trying to repair the old canal and the internal abdominal ring, as McEwen had tried to do, I make a new canal and a new ring" (Summers, 1947). Both Bassini and Halsted established the fourth principle of inguinal herniorrhaphy: reconstruction of the posterior inguinal floor. Georg Lotheissen developed a significant modification to Bassini's procedure in 1898. He suggested that the internal oblique abdominal muscle and the transverse abdominal muscle for radical hernia surgery should be attached to Cooper's ligament, which is typically more developed than the inguinal ligament. The American surgeon Chester B. McVay re-described this technique in 1942, and it was later published in the literature under the name McVay repair (Sachs, Damm & Encke, 1997). The original Bassini method has also been revived as the Shouldice operation in modern times. The classic open repair culminated in the 1940s with a new approach based on Bassini's technique, which involved using local anesthesia to apply an extension suture for a four-layer posterior wall closure. Shouldice made duplicates of the external obliques' aponeurosis, the internal spermatic fascia, and the cremaster fascia. Years later, the recurrence rate significantly decreased, and that approach became the norm. The three key components in the Shouldice repair method that contribute to its safety, effectiveness, and cost-effectiveness are local anesthesia, technical aspects of the repair, and early mobility (Shearburn & Myers, 1969). Later on, the tension-free method appears. In 1980, Irving Lichtenstein performed and introduced a more advanced tension-free hernia operation with mesh placed anteriorly to the transversalis fascia, and his method of repair became accepted as the standard easy-to-perform hernia operation and is still performed today (Komorowski, 2014). In his own words: „There is evidence that to incise a strong posterior layer and, then, to reconstruct it as in the Bassini, Shouldice, or McVay repair is inappropriate, disruptive, and even meddlesome. The application of a wide sheet of harmless prosthetic mesh, one which serves only to strengthen such a floor, is harmless and should reduce the incidence of recurrences" (Lichtenstein & Shulman, 1986). And indeed, his results were and still are exceptional.

With the progress of medicine, there is further development of minimally invasive techniques where inguinal hernias are repaired with a laparoscopic ap-

proach. The two most commonly used techniques are the total extraperitoneal approach (TEP) and the transabdominal preperitoneal approach (TAPP).

The Shouldice repair, the Lichtenstein repair, and the laparoscopic techniques of transabdominal preperitoneal repair and total extraperitoneal repair are currently still the most common surgeries performed. The unique benefits of Shouldice and Lichtenstein repairs include the ability to perform the procedure under local anesthesia, as well as their low rates of long-term recurrence and postoperative complications. The Lichtenstein repair has the added advantage of a simpler operation with a shorter learning curve than the Shouldice repair. The benefits of laparoscopic surgeries include reduced pain and quicker return to normal daily activities. General anesthesia and much higher surgical costs are two drawbacks of the laparoscopic approach.

Conclusion

Many years ago, inguinal hernia repair lured the interest of skilled surgeons. Various techniques have been established throughout history and have evolved over the years. Each surgeon, whether using a similar or completely different approach, has contributed to key guidelines still in use today. While one cannot affirm which method is ideal and should be used, it is important to consider each patient individually.

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SAŽETAK

Kila je izbočenje peritoneuma sa ili bez organa kroz otvor trbušne stijenke. Vrlo je vjerojatno da su ingvinalne kile problem od početka ljudske povijesti. Mnogim kirurzima u prošlosti bio je izazov kako kirurški liječiti hernije. Iako se više ne prepoznaju kao smrtonosna bolest, česte su u općoj populaciji, a mogu se klinički i komplicirati. Tijekom povijesti došlo je do napretka u kirurškom popravku kila. Najveći napredak postignut je u kasnim 1800-ima kada je Eduardo Bassini objavio svoju metodu trostrukog šivanja fascije i mišićnog tkiva za pojačavanje stražnje stijenke ingvinalnog kanala. Korištenje protetskih materijala u popravku ingvinalnog kanala označilo je sljedeći veliki razvoj. Irving Lichtenstein zaslužan je za korištenje prolenske mrežice za popravak bez napetosti. Posljednji je značajan razvoj uvođenje laparoskopskih tehnika u kirurgiju, koje se danas vrlo često koriste u laparoskopiji.

***Ključne riječi**: povijest, preponska kila, kirurške tehnike*