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REVIEW

Crucial steps in the evolution of the preperitoneal approaches to the groin: an historical review

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Abstract Preperitoneal approaches to the repair of primary, bilateral, recurrent, inguinal, and femoral herniae, the most common abdominal protrusions, now dominate techniques of repair. The purpose of this review is to outline crucial steps which have led to this result. Abernethy (Surgical cases and remarks. Of the operation for the aneurysm. Cadell and Davies (Strand), London, pp. 149–176, 1797) introduced an operation to treat aneurysms of the external iliac artery, which was endorsed by Cooper (The anatomy and surgical treatment of abdominal hernia. Longman and Co, London, 1804). Bogros (Essai sur l'anatomie chirurgical de la region iliac et description d'un nouveau procede pour faire la ligature des arteries epigastric et iliaque externe. Th. Paris, no. 153. A Paris, de l'imprimerie de Didot le Jeune, imprimeur de la Faculte de Medicine, rue des Macons, Sorbonne no. 13, 1823) described his preperitoneal space which continues into the suprapubic space of Retzius. Annandale (Edinb Med J 21:1087–1091, 1876) initiated anterior preperitoneal repair. Cheatle (Br Med J 2:68–69, 1920, Br Med J 2:1025–1026, 1921) demonstrated the median posterior preperitoneal approach, resurrected by Henry (Lancet 1:531–533, 1936). McEvedy (Ann R Coll Surg Engl 7:484–496, 1950) modified the Cheatle–Henry procedure by using a unilateral oblique incision in the rectus sheath and underlying transversalis fascia with medial retraction of the rectus muscle. Estrin et al. (Surg Gynecol Obstet 116:547–550, 1963) reinforced this repair with prostheses attached to Cooper's ligament, thereby, eliminating tension. Anterior prosthetic preperitoneal repair was introduced by Usher et al. (Am Surg 24:969–974, 1958) using polyethylene and, later, polypropylene meshes which were not slit, since the spermatic cord was lateralized. Stoppa et al., beginning in 1965, performed giant prosthetic reinforcement of the visceral sac, covering Fruchaud's myopectineal orifice preperitoneally with extensive overlap. They used a posterior approach to avoid scarring in recurrent cases and to allow the exposure of large, bilateral, inguinal, and femoral sacs (Rev Med Picardie 1:46–46, 1972). Wantz (Surg Gynecol Obstet, 169:408–417, 1989) proposed a unilateral version. Gilbert (Am J Surg 163:331–335, 1992) described the anterior preperitoneal sutureless repair of groin herniation. He employed a two-layered prosthesis, the upper resting on the transversalis fascia, the lower in the space of Bogros. They were connected by a plug passed through the internal inguinal ring. Kugel (Am J Surg 178:298–302, 1999) described his anterior preperitoneal prosthetic repair of groin herniation through an abdominal gridiron incision. Laparoscopic repair of groin protrusions began in 1982 (Ger; Ann R Coll Surg Engl 64:342–344, 1982). In 1992, Arregui et al. (Surg Laparosc Endosc 2:53–58, 1992) and Dion and Morin (Can J Surg 35:209–212, 1992) reported on their transabdominal preperitoneal (TAPP) approach. To avoid intraperitoneal complications, Dulucq (Cahiers Chir 79:15–16, 1991) recommended a totally extraperitoneal (TEP) approach. These techniques incur fewer recurrences than open techniques and diminish postoperative pain. However, the operating time is longer, they are more expensive, and special skills are needed. In addition, general anesthesia is required. Thus, late in the 18th century, surgeons began incising the groin to treat aneurysms there. This experience led to the discovery of the preperitoneal space of Bogros, which, in the 1870s, was employed for the anterior repair of groin herniation. The posterior preperitoneal approach became established in the 1920s–1960s, along with the use

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of prostheses. Laparoscopy was applied near the end of the century.

Keywords Anterior · Posterior · Preperitoneal repair

Introduction

Most abdominal hernias present in the groin. Up until late in the 19th century, treatment consisted of reducing protrusions through the external inguinal ring or femoral canal, and applying a truss for maintenance. Surgery was attempted only in a few cases of incarceration or strangulation. Bassini's repair or its corruption, which failed to divide the transversalis fascial floor of the inguinal canal, became the standard of care in the 1890s for inguinal herniae. Preperitoneal approaches to the groin began a century earlier with a new operation to manage aneurysm of the external iliac artery. Crucial steps eventually resulted in extraperitoneal repair of primary and recurrent inguinal and femoral herniae becoming the preferred technique. The purpose of this review is to outline the contributions which led to this result.

Vascular surgery in the groin

In 1797, Abernethy [1], a leading English surgeon who had been a student of John Hunter, the inventor of femoral arterial ligation in the adductor canal for popliteal aneurysm, introduced an operation to treat aneurysms of the external iliac artery. A skin incision was made overlaying the vessel close to the inguinal ligament, thereby, avoiding penetration of the peritoneal cavity. A proximal ligature was encircled and tied. His procedure was endorsed by Sir Astley Cooper (1804) [2], who used a semilunar incision along the external oblique aponeurosis. Closer to the anterior superior iliac spine, it ended above the medial aspect of the deep inguinal ring, thus, allowing for ligation of the inferior epigastric artery to reduce hematomata.

The space of Bogros

The surgical anatomist Bogros (1823) [3] obtained a doctorate in medicine by defending his thesis regarding "the iliac region and a new procedure for ligation of the inferior epigastric and external iliac arteries". His 5-cm incision, above the inguinal ligament, was transverse, midway between the anterior superior iliac spine and the pubic tubercle. The external oblique aponeurosis was split in the line of its fibers. The spermatic cord and cremaster were retracted medially and the inferior epigastric artery was tracked to its origin, allowing for proximal ligation of the external iliac 2.5 cm above the inguinal ligament. He stated, "the peritoneum, as it reflects from the anterior abdominal wall to the iliac fossa, leaves a space in front 13.5–15.5 mm wide where the external iliac artery ends and the inferior epigastric begins." Further, "a loose layer of cellular tissue separates the inferior epigastric artery from the transversalis fascia anteriorly. Posteriorly, a thicker layer of the same tissue separates it from the peritoneum." Rouvièrè (1912) [4] used the term "preperitoneal space of Bogros" continuing medially into the suprapubic space of Retzius.

Anterior preperitoneal repair of inguinal and femoral herniation

Annandale (1876) [5], treating a patient with large inguinal and femoral protrusions, made a transverse incision an inch above the inguinal ligament. He cut through the roof and floor of the inguinal canal, severing the inferior epigastric artery. The necks of the inguinal hernial sacs were ligated close to the peritoneum, after their content had been returned to the abdominal cavity. Excised hernia sacs were used to plug the femoral canal. His procedure was employed by Ruggi (1892) [6], who sutured the inguinal ligament down to Cooper's ligament. Lotheissen (1898) [7] brought the conjoint tendon down instead. Moschowitz (1907) [8] added an anterior herniorrhaphy to prevent recurrence. In 1887, McGill initiated suprapubic prostatectomy through the space of Bogros.

Posterior preperitoneal approach to the groin

Cheatle (1920) [9] introduced the transabdominal paramedian approach to the space of Bogros. The following year, he switched to a median incision [10]. His operation was ignored until Henry (1936) [11], a urologist, used it to treat a femoral hernia, while operating extraperitoneally on the pelvic ureter for stones. In 1942, Jennings et al. [12] revived the Cheatle–Henry approach for the repair of groin herniae.

Lateral transverse incision

To avoid postoperative incisional herniation, McEvedy (1950) [13] made an oblique lateral incision, dividing both the rectus sheath and transversalis fascia with medial retraction of the rectus muscle. McNaught (1956) [14] agreed. In 1956, Reay-Young [15] cut transversely.

Popularization of the Cheatle–Henry approach

Nyhus et al. (1959) [16] presented their experience using a median incision. Visiting Professor John Bruce of Edinburgh advised them to use a transverse incision. Their 1960

report [17] encouraged posterior preperitoneal herniorrhaphy in the groin. Boley and Kleinhaus (1966) [18] employed this technique in children with incarceration, recurrence, and cryptorchidism.

Use of prostheses

Nyhus et al. used the iliopubic tract for distal fixation. Others who followed reported having high recurrence rates. McVay (1966) [19] cogently pointed out that this tract was but a fragment of failed transversalis fascia. Further, the transversus muscle arch cannot be brought down without tension. The problem was solved by Estrin et al. (1963) [20], who used prostheses attached to Cooper's ligament.

Anterior prosthetic preperitoneal repair

This procedure was introduced by Usher et al. (1958) [21] using polyethylene mesh (later polypropylene), which was not slit since the spermatic cord was lateralized. Mahorner and Goss (1962) [22], in two patients with recurrent herniation, following the destruction of both Poupart's and Cooper's ligaments, used anterior preperitoneal grafts to support the overlying weakened transversalis fascia. Rives (1967) [23] led the way in France with both anterior and posterior preperitoneal prosthetic repairs of groin hernias using Mersilene mesh.

Midline posterior preperitoneal approach to the prosthetic repair of large, bilateral, and recurrent groin herniation

Stoppa et al. (1972) [24] reported on their giant prosthetic reinforcement of the visceral sac (GPRVS), beginning in 1965. Large bilateral Dacron meshes were inserted deep into the weakened transversalis fascia, covering Fruchaud's myopectineal orifice with extensive overlap. Their operation provided an alternative to the anterior preperitoneal approach which, in cases of recurrent herniation, encounters scarring, possibly leading to damage of the spermatic cord, nerves, and blood vessels. Wantz (1989) [25] proposed a unilateral version. It reached the preperitoneal spaces of Bogros and Retzius using a transverse incision extending laterally 9 cm from the linea alba, 3 cm below the anterior superior iliac spine.

Anterior preperitoneal sutureless repair of groin herniation

Gilbert (1992) [26] described a two-layered prosthesis, the superficial portion resting on the transversalis fascial floor of the inguinal canal, while the lower lay beneath, in the anterior preperitoneal space. The patches were connected by a plug which passed through the internal inguinal ring. A slit in the onlay allowed for passage of the spermatic cord to beneath the external oblique aponeurosis. Widespread release of the device from its manufacturer (1998) led to the technique being called the Prolene Hernia System (PHS).

Anterior preperitoneal prosthetic repair of groin herniae through an abdominal gridiron incision

Kugel (1999) [27] employed this approach using a fortified patch to reinforce the overlying damaged transversalis fascial floor of the inguinal and femoral canals.

Posterior preperitoneal approach to the groin using laparoscopy

This technique quickly followed laparoscopic success with cholecystectomy, with Ger (1982) [28] being the first to report its application to herniology. Inguinal hernia sacs were plugged with mesh and ligated intraperitoneally. In 1992, Arregui et al. [29] and Dion and Morin [30] reported on a transabdominal posterior preperitoneal (TAPP) approach using large meshes to completely cover Fruchaud's myopectineal orifice with overlap. Fixation was to the transversus abdominis arch above and Cooper's ligament below. Dulucq (1991) [31], McKernan and Laws (1992) [32], and Phillips et al. (1993) [33] recommended a totally extraperitoneal (TEP) approach to avoid intraperitoneal complications. Femoral and bilateral defects were taken care of in a similar fashion.

Discussion

The virtue of the preperitoneal approach to the repair of groin herniation is that it facilitates entry into the retro-fascial transversalis space, thereby, providing direct access to the posterior inguinal structures. Hernial protrusions are exposed along with the myopectineal orifice of Fruchaud. Placement of a large prosthesis, with adequate overlap, wraps the peritoneal sac, rendering it inextensible. Thus, recurrent herniae can be eliminated. The mesh forms a barrier against intra-abdominal pressure further damaging the defective transversalis fascial floor of the inguinal canal. The prosthesis, pressed by intra-abdominal pressure against the parietes, replaces the damaged floor of the inguinal canal to which it quickly becomes attached as connective tissue infiltrates its pores. The need for fixation devices, which can cause postoperative pain, is reduced, as abdominal pressure, according to Pascal's hydrostatic principles, stabilizes the prosthesis.

Preperitoneal repair can be conducted anteriorly through the groin or posteriorly after dissecting the abdominal wall. Which is better? The time-honored anterior approach can be performed under local anesthesia. It is particularly

suitable for primary repairs, since dissection within a scarred inguinal canal, encountered in recurrent herniation, can cause damage to the spermatic cord contents, nerves, and blood vessels. In addition, internal and external inguinal rings are both easily accessed. The posterior preperitoneal approach is available for difficult herniae, i.e., enormous, bilateral, recurrent, and some direct. Better exposure of defects facilitates high ligation of hernia sacs. Herniated intestine, omentum, or fat can be pulled away rather than pushed back. Incarcerated or strangulated bowel may be taken care of by entering the adjacent peritoneal sac. The inguinal canal is not disturbed and parietalization of the spermatic cord avoids slitting of the prosthesis to allow its passage. Postoperative pain is less, prompting an earlier return to work. Disadvantages of this approach include the need for regional or general anesthesia, along with potential injury to the bowel.

Laparoscopic herniorrhaphy incurs less recurrences or complications than open techniques [34], as well as diminished postoperative pain. However, it is more expensive, the operating time is longer, and there are increased demands on surgical skills. The TEP approach does not violate the abdominal cavity, thereby, incurring the risk of bowel injury, and has a lower recurrence rate. Return to normal activities is quicker. However, it is more difficult to learn and, like TAPP, requires general anesthesia.

Finally, it is interesting that the preperitoneal approach to herniae of the groin was a sequel to the use of this technique in vascular surgery. Read et al. (2000) [35] found that, as happened in herniology, modern experience with arterial bypass in the groin for leg ischemia indicates that better results are obtained if it is accomplished through the space of Bogros rather than subcutaneously. Many urologists have chosen a similar route to suprapubic prostatectomy.

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