Laparoscopic Repair of Incisional Hernia

An Essay
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Master Degree of General Surgery

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The ancients:

Hernia (Greek hernios, bud) is barely mentioned in the writings of Hippocrates (٥٠٠ B.C.), the Farther of Medicine. Nevertheless, the condition, then a social stigma, is portrayed in Greek and Phoenician statuary. An Egyptian papyrus (Ebers, ١٥٥٠ B.C.) describing bandaging (trussing); the abdominal cavity was not opened for strangulation, cathartics and hot poultices being used instead of an operation. The encyclopedist Celsus, a Greek emigrant to Rome, documented in A.D. ٢٥ (in the seventh of eight books, De Medicinia) the use of transillumination to distinguish hydroceles and described taxis for strangulation. **(Nyhus et Condon, ١٩٨٩).**

The concept of rupture came from Galen (A.D. ٢٠٠) who without dissecting the human body, conceived that herniation was produced by rupture of the peritoneum with

stretching of the overlying fasciae and muscles. **(Nyhus et Condon, ١٩٨٩).**

The barber-Surgeons:

After the fall of Rome both Islam and Christian churches interdicted surgery (ecclesia abhorret a sanguine). Operations were relegated to barbers, hangmen, and irritant "incisors." Self-taught with secrets handed down within families, such people generally were unable to read or write Latin or Greek, and thus were prevented from developing a profession. Many of the ancient texts had been lost and were recovered only by retranslation from Arabic after the Crusades. Thus Celsus's work was reprinted in A.D. ١٤٧٨ in its original Latin. In Avignon, France, Guy de Chauliac (A.D. ١٣٦٣), in his text "Chirugia Magna," distinguished for the first time between inguinal and femoral herniation; he considered the operations doubtful and dangerous, consonant with the Arab physician Albucasis, and, like him, preferred chemical cauterization (coutere potential) with escharotics such as arsenic to burning of the skin, fasciae, and pubic bone. De Chauliac also prescribed ٦ weeks or more of bed rest. Another important medieval contribution was that of Roland of Parma, an exponent of the Salerno school, who, in a treatise in A.D. ١٣٨٣, recommended the use of what is now called the Trendelenburg (١٨٤٤-١٩٢٤) position in the management of hernias. **(Nyhus et Condon, ١٩٨٩).**

The Surgeon-Anatomists:

After the Renaissance, autopsy and anatomic dissection (started in Bolonga, A.D. ١٢٠٠) spread

throughout Europe. Knowledge about herniation accumulated rapidly. In ١٧٠٠ Littre reported a Mechel diverticulum in a hernial sac. Heister, in his monograph (١٧٢٤), described successful resection of gangrenous intestine with diversion and distinguished indirect from indirect inguinal defects. It is of interest that this distinction had been clearly demonstrated in ١٥٥٩ by Casper Stromayer, a little known German "incisor." He pointed out the futility of sacrificing the testis in direct inguinal herniation. Unfortunately his beautifully illustrated book on hernia was not published until ١٩٢٥, the manuscript only being discovered in ١٩٠٩. Ronsil (١٧٢٤) reported obturator hernias (De Garengeot, ١٧٣١). De Garengeot, in ١٧٣١, described lumber herniation as well as herniated appendix. Richter (١٧٨٥) described partial enterocoele. **(Nyhus et Condon, ١٩٨٩).**

Despite these important advances and the introduction of anesthesia in ١٨٤٦, surgical repair made little progress because any attempt to open the inguinal canal was followed by sepsis. Extraordinary efforts were made to reduce strangulated hernias nonoperatively. These included taxis, ice or warm baths, enemas, mercury by mouth, purgatives, and venisection. **(Nyhus et Condon, ١٩٨٩).**

<u>Historical background of incisional hernia:</u>

Historically, incisional hernias have been repaired with either primary suture techniques or placement of a variety of (and sometimes novel!) prosthetic materials. Surgeons recognized early that inert products would be the best materials to use when placed in contact with living tissue. For many years surgeons reported intricate maneuvers in

order to use the patient's own tissue for abdominal wall closure. William J. Mayo reported using overlapping tissue techniques in a large series of umbilical hernia repairs at the meeting of the American Surgical Association in ١٩٠١. The report by Mayo generated the term "pants-over-vest", although Mayo described that most of his operations were closed in side-to-side fashion. The concept of creating a relaxing incision dates from the early ١٩٠٠'s and still may be utilized in a certain condition where a prosthetic mesh may be contraindicated. Charles Gibson, Professor of Surgery at Cornell, reported "an operation for cure of large ventral hernia" at the American Surgical Association meeting in the early ١٩٠٠'s and advocated the creation of relaxing incisions to permit the closure of large mid-line ventral hernias. Although Gibson reported his concern regarding the opportunity for herniation through the relaxation areas, no such hernias actually occurred in his series. **(Frederick Greene, ٢٠٠٠).**

At that same meeting where Dr. Mayo described the "pantsover- vest" method, A.J. McCosh, a surgeon from the College of Physicians and Surgeons in New York, reported an operation on a woman who most likely had a desmoid removed from the abdominal wall. She was left with a large defect so he reported that "I filled up the gap with a celluoid plate inserting it between the peritoneum and the external oblique muscle, tucking it under the edges of the latter. The plate was perforated by twenty five or thirty perforations made with a ticket punch, although this was nearly three years ago, the woman is still perfectly comfortable." Until the late ١٩٥٠'s when a moresuitable synthetic material was developed, surgeons tended to use

silver or stainless steel wire or tantalum mesh because of the inert qualities of these products. In more recent times, close observational studies have supported the concept that even in small defects (٣ to ٤ centimeters in diameter) a prosthetic material should be used in order to avoid the tension created by primary fascial closure. Theodore Bilroth wrote in ١٨٥٧, "if we could artificially produce tissue of the density and toughness of fascia and tendon, the secret of the radical cure of the hernia would be discovered".

Prior attempts to use autogenous tissue (musculofascial) had been complicated by unacceptably high recurrence rates. Hence, the development of synthetic prosthetic materials to repair abdominal wall incisional hernias began at the end of the ١٩th century. Unfortunately, the synthetic prostheses developed and used in the first half of the ٢٠th century were prone to complications and failure.

The first prostheses were metallic. Silver wire mesh, introduced in Germany (١٩٠٠) and adopted in the United States (١٩٠٣) was limited by its weak tensile strength and susceptibility to oxidize, corrode and fragment. Tantalum mesh, first reported in the United States in ١٩٤٨, but introduced in Canada in ١٩٤٠, was resistant to corrosion, but tended to fragment (metal fatigue) from repeated flexion of the abdominal wall. If the silver wire mesh or tantalum mesh fragmented, the metal fragments could erode into the abdominal cavity causing abscesses, chronic sinus tracts, or intestinal fistulae. Stainless steel wire mesh, also introduced in ١٩٤٠'s, did not oxidize and infrequently fragmented. However, the metal's rigidity limited a

patient's ability to flex the abdominal wall and re-operation required the removal of the stainless steel mesh secondary to tremendous tissue ingrowth. A variety of synthetic polymeric meshes were developed in the second half of the ٢٠th century and revolutionized abdominal wall incisional hernia repair. With these meshes, abdominal wall defects could be repaired without undue tension on the sutured tissue, decreasing the high recurrence rates of abdominal wall incisional hernia repair reported ١٠٠ years earlier. Sir Francis Usher introduced woven monofilament polypropylene mesh in ١٩٥٨. It was modified to a knitted mesh in ١٩٦٢ so that the mesh would not unravel when it was cut. Polypropylene mesh gained widespread popularity over the next ٣٠ years and several types of polypropylene mesh are commercially available today. Polyester mesh was also introduced in the ١٩٥٠'s in Europe. Rives and Stoppa employed polyester mesh in their landmark article describing a preperitoneal technique for abdominal wall incisional hernia repair in ١٩٨٩. The technique described by Rives and Stoppa has become the standard by which all abdominal wall incisional hernia repairs are measured. Polypropylene mesh and polyester mesh revolutionized abdominal wall incisional hernia repair because the meshes did not deteriorate with age, were pliable, and would stretch, allowing for more even load distribution. Nevertheless, the large interstices in polypropylene and polyester mesh promoted adhesion formation when the mesh came into contact with the visceral abdominal cavity. Reported complications included small bowel obstruction, erosion, and fistulization. Expanded polytetrafluoroethylene (ePTFE), initially used as a

vascular prosthesis, was adapted for abdominal wall incisional hernia repair in ١٩٨٣ by W.L. Gore & Associates and modified several times in the ١٩٩٠'s. Unlike the polypropylene and polyester meshes that preceded it, ePTFE is microporous and select products are uniquely designed with pores measuring ٣ microns on the visceral side (facing the abdominal cavity) and ٢٢ microns on the other side (facing the abdominal wall). This design promotes fibroblastic and vascular ingrowth from the abdominal wall (٢٢ micron side), but inhibits tissue attachment to the material (٣ micron side) when exposed to the intra-abdominal cavity. There are no reports of fistulization or small bowel obstructions due to adhesions from ePTFE material. Using sound scientific principles and improving surgical techniques, the approaches to abdominal wall hernia will continue to advance during the ٢١st Century. **(Frederick Greene, ٢٠٠٠).**

Anatomy of The Anterior Abdominal Wall

Embryology of the anterior abdominal wall

A new anatomical description of the anterior abdominal wall has been given recently. It describes each abdominal aponeurosis as bilaminar and each wall of the rectus sheath as trilaminar.

A point of controversy to be settled is the mesodermal origin of the abdominal muscles. Some authors describe the thoracic myotomes as extending ventrally to form the ventrolateral muscles of the thorax and the abdomen (Bardeen & Lewis, ١٩٠١; Patten, ١٩٦٤; Arey, ١٩٦٥; Hamilton, Boyd & Mossmanw ١٩٧٢). However, more recently Snell (١٩٧٥) stated that the abdominal muscles differentiate locally from the mesenchyme of the somatopleure. The further course of development of the abdominal mesoderm is a point of agreement between some investigators (Hamilton et al. ١٩٧٢; Snell, ١٩٧٥), but the literature seems to be deficient in embryological reports that could be related to the new anatomical description. the dense paraxial mesoderm could be differentiated from the

loose mesenchyme of the lateral plate. Then the the thoracic myotomes were seen to invade the loose tissues of the lateral body wall. Then the invading bud had divided into a small ventral portion, oval in cross section, and a dorsal segment that was split into three ill-defined layers. The migrating myotomal mesoderm, which was relatively more advanced caudal to the umbilicus, reached the middle line in the inguinal region. The splitting of the dorsal segment of the migrating mesoderm into three layers became more apparent. They could be arranged according to their relative thickness as: internal oblique (middle layer), external oblique (outer layer) then transversus abdominis (inner layer). The ventral portion of the migrating mesoderm remained unlamellated as a thick mass oval in cross section, the 'rectus abdominis'. Histogenesis started at this age when some elongation of the cells was seen, but a definite direction of fibres for each layer was still difficult to identify. Further subdivision of each of the three muscular strata into two thinner laminae appeared, first in the transversus abdominis and the internal oblique muscle, then, slightly later in the external oblique muscle. Re-fusion of the two laminae of each of the three muscles occurred in the same sequence. A similar tangential splitting of the cranial third of the rectus abdominis occurred, to form two laminae, superficial and deep. The superficial wall of the rectus sheath became well defined, and crossed the middle line to continue into its fellow of the opposite side. During this day, the further histogenesis of the cells was apparent in their elongation and orientation so that a definite direction could be identified for the cells of each layer. The cells of the outer and inner layers were

parallel to each other, but those of the middle layer were perpendicular to those of both the others (plywood arrangement). The medial extension of the ventral wall of the rectus sheath progressed. Thus, apart from the umbilicus, which remained as a small foramen, continuity between the two sheaths of the two sides became complete throughout the linea alba. A ventral and thin aponeurotic part could be differentiated from a thicker, dorsal and fleshy one. However, the aponeuroses were not yet collagenized. A condensation of fine collagenous fibres was visible around the three muscle layers, especially ventral to the external oblique, and formed the deep fascia. Tendinous intersections were seen only in postnatal specimens; they were attached to the ventral, but not to the dorsal, rectus sheath. The tendinous intersections were thickened, and collagenous fibres were present as endomysium and epimysium around the muscular fibres and bundles. From this age on, the development was just a gradual increase in size and in degree of differentiation of the various structures.

Anatomy of the anterior abdominal wall
Surgical anatomy

The purpose of this chapter is to set the stage for the operative descriptions that follow. To repair the hernias that will be discussed, a requisite knowledge of the anatomy is essential. Therefore we will illustrate the salient anatomy as it specifically affects surgical decision making in the repair of abdominal wall hernias. The abdomen represents the portion of the trunk between the thorax and pelvis. For the purpose of the hernia repairs to be described in this issue, only the anterior abdominal wall is of interest. The abdominal wall structure will be described from the most superficial layer to the peritoneum. **(Ahluwalia et al., ٢٠٠٤).**

SUPERFICIAL FASCIA, VESSELS, AND NERVES

The abdominal wall consists of skin, superficial fascia, fat, muscles, transversalis fascia, and the parietal