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Abdominal Wall Hernias in Adults: Diagnosis and Management

Each year, in the United States alone, hundreds of thousands of patients undergo various types of abdominal wall hernia surgery. Many of these patients initially present to the emergency department (ED) with complaints referable to their hernia — pain, worry about the appearance of their hernia, or more urgent or emergent concerns related to hernia incarceration or strangulation. Scar is never as strong as original tissue, so patients who have had surgery for abdominal wall hernias continue to have a lifetime risk for recurrence. These recurrent hernia patients may present to the ED as well.

Patients having undergone hernia surgery also present to the ED with complications in the immediate postoperative period. These surgical complications include infection, seroma, wound ischemia, and dehiscence. Patients with certain risk factors, such as smoking, obesity, poor glycemic control, malnutrition, surgical site contamination, and others, are at increased risk for these complications, and are often first seen in the ED.

Finally, while the diagnosis of a "simple" inguinal hernia may be straightforward, rare and uncommon or complicated abdominal wall hernias occur. Many patients with these unusual hernias have very nonspecific symptoms (fever; buttock, back, thigh, or hip pain; vomiting; vague abdominal discomfort or complaints; and so forth) and represent a diagnostic and therapeutic challenge.

This article will help emergency practitioners appreciate the full range of adult abdominal wall hernias. It will also alert them to the perils, pitfalls, signs, and symptoms associated with a variety of abdominal wall hernia presentations. Finally, this article will attempt to present an up-to-date summary of the rapidly advancing science of "herniology" (particularly focused on laparoscopy, mesh-based, and tension-free hernia repairs) relevant to emergency practitioners.

Definitions and Classifications

Simply put, "a hernia is a protrusion of any viscus from its proper cavity."¹ More specifically for abdominal wall hernias, "Hernias emerge through pre-formed or acquired defects or weak areas of the abdominal wall unprotected by muscle or aponeurosis."² There are literally dozens of types and subtypes of abdominal wall hernias, ranging from the previously-considered-simple hernia to the incredibly complex and rare.

Recently, in an effort to allow comparison of scientific studies in the burgeoning field of "herniology," the European Hernia Society formulated a classification matrix for primary and incisional abdominal wall hernias. The dizzying array of factors considered in the matrix is beyond the scope of this article and beyond the scope of the knowledge base needed by most emergency practitioners. However, the primary branch point in this scheme is to consider primary ventral hernias distinct from incisional hernias due to their different etiologies. Primary ventral hernias are multifactorial, generally resulting from several congenital or acquired conditions, whereas incisional hernias, as the name implies, result from surgical incision failure.³ (See Table 1.)

Executive Summary

- Some hernias self-reduce. Patients who present with an incarcerated hernia and no signs of strangulation can be reduced in the ED. Provide pain medication, mild sedation, and muscle relaxation, place the patient in Trendelenburg, put an ice pack on the area, and wait.
- Manual reduction is performed if self reduction does not occur within 15-30 minutes. Gently apply pressure on the distal aspect while guiding the proximal area into the defect.
- Strangulated hernias should not be reduced. Signs of strangulation include increased tenderness, leukocytosis, fever, red or ecchymotic skin, and elevated lactate.
- Mesh is often used in hernia repairs and may become infected. It may be difficult to distinguish mesh infection from cellulitis. Signs of mesh infection include fever, erythema, pain, purulent drainage, and an elevated sed rate.

Parastomal hernias are considered a separate category by the European Hernia Society.⁴ Traditionally, these are hernias around the stoma such as a colostomy or ileostomy. Related to both stoma and incisional hernias are port-site hernias that occur after laparoscopic surgery. There is growing interest in this particular hernia category since an increasing number of abdominal surgeries are performed laparoscopically and the abdominal wall entry points for these procedures predispose to hernia formation and resultant complications.

A great deal is written about the optimal definitive surgical management of all the hernia types listed below. This knowledge clearly goes beyond what an emergency practitioner needs to know. However, a general recognition that hernias can and do occur in unusual or infrequently encountered locations may cause one to consider the symptomatic abdominal wall bulge or irregularity in a different manner. Similarly, certain acute or chronic symptoms — however vague — possibly arising from the abdomen, may be due to hernia formation.

The emergency practitioner should know the following abdominal wall hernia types.

- Groin. Groin hernias include inguinal hernias — both indirect and direct — and femoral hernias.⁵
- Inguinal (indirect and direct hernias). Indirect: Hernia protrudes at the internal inguinal ring. In males, this is the abdominal exit point for the spermatic cord. In females, the internal inguinal ring is the

abdominal exit point for the round ligament.

Direct: Hernia protrudes medial to the inferior epigastric vessels within Hesselbach's triangle. Hesselbach's triangle is bounded by the inguinal ligament inferiorly, laterally by the inferior epigastric vessels, and medially by the rectus abdominus muscle.⁵

- Femoral. Hernia protrudes through the femoral ring inferior to the inguinal ligament and medial to the femoral vessels.⁵

The management of inguinal and femoral hernias from an emergency provider perspective is the same. However, distinguishing between them can impress your surgical colleagues. Femoral hernias appear below the crease of the inguinal ligament, while the inguinal hernias appear above. Femoral hernias are more common in women. Direct inguinal hernias are nearly always acquired. Indirect hernias traverse a much smaller canal and are therefore more prone to strangulation. Direct hernias hit the side of the examiner's finger during a cough; the indirect ones hit the tip of the finger. Also, the bulge of a direct hernia appears promptly when the patient stands.

- Hiatal (Hiatus). Herniation of intra-abdominal contents through the diaphragm's esophageal hiatus.⁷ These are not considered in this review.
- Spigelian (spontaneous lateral ventral hernia). Hernia protrudes between the rectus abdominis muscle and the semilunar line. This type is often interparietal, meaning that the

Table 1: Classification of Hernias

Midline
<ul style="list-style-type: none"> • Epigastric • Umbilical
Lateral
<ul style="list-style-type: none"> • Spigelian • Groin <p style="text-align: center;">Inguinal: Direct, Indirect Femoral</p>
Incisional
Parastomal
Adapted from the European Hernia Society

hernia occurs between the abdominal wall musculature comprised of the transversus abdominis and internal obliques posteriorly and the external obliques anteriorly. Subcutaneous (through the external oblique musculature) Spigelian hernias occur as well.^{9,20}

- Ventral. The general term for an abnormal protrusion of normally intra-abdominal contents through the anterior abdominal wall fascia.¹⁰
- Epigastric. As the name implies, these hernias occur in the epigastric region between the xiphoid process and the umbilicus.¹⁰
- Subxiphoid. Abnormal protrusions (generally in the area of prior incisions) in the immediate subxiphoid region. Often clinically unapparent/asymptomatic because the liver prevents herniation of

intra-abdominal contents.¹¹

- Umbilical (often considered alongside paraumbilical). Hernia protrudes through an opening in the linea alba in the umbilical region.^{6,9}
- Suprapubic (also termed parapubic). Hernia protrudes through an abdominal wall defect just superior to the pubic symphysis.¹¹
- Incisional. Hernia protrudes at the site of a surgical incision.
- Parastomal. A type of incisional hernia with hernia protrusion at or near a stoma site.
- Flank (Lumbar) (rare). Hernia protrudes through a defect in the posterolateral abdominal wall.¹²
- Obturator (rare). Hernia protrudes through the obturator foramen.¹⁷
- Traumatic. Blunt force trauma may cause muscle or fascial weakness with resultant herniation. Diaphragmatic hernias are common after truncal trauma, but traumatic inguinal (rare) and traumatic anterior abdominal wall hernias (rare) occur as well.^{13,14} Trauma-induced hernias occur in other locations as well.
- Supravesical (rare). Occurs at the supravesical fossa between urachal remnants and either umbilical artery.¹⁵
- Perineal (variety of types, rare). Results from pelvic floor muscle and fascial laxity.¹⁶
- Sciatic (rare). Protrusion of the hernia through either the greater or lesser sciatic foramen.¹⁸
- Internal. Not covered in this review.

Multiple other hernia descriptors also appear in the medical and lay literature. The so-called “Swiss cheese hernia” occurs when multiple hernia sites occur in a localized area of the abdominal wall. The pantaloons hernia describes the appearance of a direct and indirect groin hernia occurring on the same side. However, these terms, and others like them, add little to the basic understanding of hernias since they are variants of the hernia types listed above.

Other Useful Definitions, Classifications, and Clarifications

- Reducible. A hernia that can be returned, spontaneously or manually, to its normal body cavity.¹⁹
- Incarcerated (Irreducible). A hernia that cannot be returned to its normal body cavity. An incarcerated hernia may become strangulated or cause a bowel obstruction but does not necessarily do so.¹⁹
- Strangulated. A hernia in which blood supply to its contents is compromised.¹⁹
- Richter (Richter’s). A hernia in which only a portion of the bowel’s circumference — usually the bowel’s antimesenteric border — herniates. Therefore, bowel obstruction with resultant vomiting may not occur. This may be the case even if the hernia is incarcerated or strangulated.¹
- Sliding. A hernia in which part of the hernia’s sac is formed by a viscus.²¹
- Diastasis Recti. Not truly a hernia but a supra-umbilical bulging of intra-abdominal contents through a weakened and splayed linea alba. Generally asymptomatic and seen most commonly in obese middle-aged and poorly conditioned individuals, especially when they raise their heads while laying supine.
- Loss of Domain. This term refers to massive hernias, usually of long standing, which can no longer be replaced within the abdominal cavity.¹⁰
- External vs. Internal. External Hernia. What most think of when considering a “hernia,” that is, protrusion of normally intra-abdominal contents through an abdominopelvic wall defect.³⁹
- Internal Hernia (far less common). Viscus protrusion through a normal or abnormal peritoneal or mesenteric opening within the peritoneal cavity itself. Note that the opening through which the hernia protrudes may be either acquired (post-surgical, for example) or congenital.^{39,42,43}

Definition of the Problem

Hernia repair and related complications, often including cycles of repair, recurrence, and re-repair, represent a time-consuming and expensive portion of the U.S. health care system. Patients suffer pain, lost work days, concern over cosmesis, medical and surgical complications, both pre- and post-operatively, and decreased ability to function at full physical capacity. Physicians are consumed with diagnosis and treatment of hernias of various types. Many hernias are difficult to diagnose and cause chronic symptoms for years before they are discovered and repaired. Even relatively straightforward and easily diagnosed hernias present problems. When is the optimal time for repair? What is the optimal method of repair? How can complications be minimized, or resolved? Research into many aspects of hernia repair and management are beginning to answer some of these questions, but many remain incompletely addressed.

Relevance of the Problem to the Adult Population

The number of hernia repairs escalates annually in the United States, and hernia recurrences remain fairly constant. These facts, coupled with an aging, ever-expanding population and the frequency of abdominal operations, mean that hernia-associated costs and the societal burden imposed by hernia-related issues will continue to mount.²²

At the individual patient level, hernias cause pain and other symptoms, lost work days, lost physical functionality, significant additional morbidity, and occasionally mortality due to hernia-related complications (i.e., incarceration leading to bowel perforation, sepsis, and death).

Epidemiology

Taken as a group, herniorrhaphies (groin, umbilical, and epigastric) are the most common operations performed by general surgeons. The annual health care expenditure in

the United States for herniorrhaphy totals billions of dollars.

Surprisingly, though, exact data on the numbers and types of hernia repairs are not currently available in the United States. Federal budgetary constraints and the vast movement from hospital-based surgeries to outpatient surgery centers and other factors are responsible for this knowledge gap. For a sense of scale, however, estimates of abdominal wall hernia repairs in 2003 in the United States are as follows: inguinal 770,000; umbilical 175,000; incisional 105,000; epigastric, Spigelian, and other 80,000; femoral 30,000.

It is well known that, beginning in the 1980s and continuing today in an accelerating fashion, groin hernia repair has evolved from sutured repairs (so-called tension-based procedures creating tension on the suture line) to tension-free, mesh-based techniques. It is hoped that this evolution will reduce complications, decrease patient discomfort and disability, speed postoperative rehabilitation, and reduce hernia recurrence rates. There is some evolving evidence that this hope is being realized.⁸

Etiology and Pathophysiology

As previously noted, in the broadest sense, hernias can be subdivided into incisional (related to some form of operative procedure) and primary (occurring due to a factor or factors — congenital or acquired — related to the individual patient but unrelated to an operation). However, even in the case of incisional hernias, this clean separation is blurred by the interplay of patient-related, surgical, and postoperative factors that influence normal wound healing and the risk of hernia development.

Incisional Hernias

Incisional hernias are more common in those who have had major surgery such as an open aortic aneurysm repair. As one might expect, those with particular connective tissue diseases — Marfan syndrome, osteogenesis imperfecta, and Ehlers-Danlos syndrome — more

commonly develop incisional hernias. Other patient-related risks (either proven or posited in medical literature) for the development of incisional hernias include: age older than 65 years, male gender (possible), atherosclerosis, diabetes mellitus, obesity, renal failure, protein deficiency, vitamin C deficiency, immunosuppression, smoking, and a variety of medications and medical treatments (corticosteroids, chemotherapeutic agents, radiotherapy, warfarin).²³

Any type of laparotomy incision may lead to the development of an incisional hernia, but midline and transverse incisions seem particularly prone to this complication. This finding, however, is based on older literature derived from operative techniques prevalent in the 1980s and 1990s. Newer closure techniques may diminish this complication.²³ Recently, the use of prophylactic mesh repair of midline laparotomies has been investigated to determine if this technology will decrease the incidence of incisional hernias in certain high-risk groups.²⁴ Long-term results are currently lacking. Similarly, suturing techniques of various types are being studied to determine their effect on incisional hernia incidence.²⁵ Similarly, long-term results are pending. It also remains to be seen which sub-populations of laparotomy patients will benefit from these newer techniques.

Post-operative factors also increase the risk of incisional hernia formation. Post-op infection (the risk of which is, in itself, multifactorial) is the single most important risk factor for incisional hernia formation. Other related factors are those that increase intra-abdominal pressure shortly after operation, such as ileus, repeated bladder catheterizations, coughing, vomiting, and mechanical ventilation.²³

Parastomal. Although several complex classification schemes exist for parastomal hernias⁴ (none universally accepted), in the broadest sense, a parastomal hernia is a specific type of incisional hernia wherein normally intra-abdominal contents protrude adjacent to a stoma “through the abdominal wall defect created during

ostomy formation.”²⁹ Parastomal hernia rates vary widely with the type of enterostomy performed, and most occur within two years of stoma creation.²⁹ Multiple risk factors for parastomal hernia formation are known, including advanced age, technical failure, increased intra-abdominal pressure, emphysema, obesity, malnutrition, corticosteroid use, malignancy, and wound infection.^{29,30}

Many parastomal hernias can be managed non-operatively, but a significant fraction require repair due to bowel obstruction or incarceration, prolapse, formation of a giant hernia, pain, bleeding, and appliance leakage or discomfort due to ill fit.²⁹ Management decisions are best left to an expert in parastomal hernias since optimal methods for repair and prevention of parastomal hernias are currently in flux.

Primary Hernias

A variety of risk factors predispose to hernia development. Each hernia review article seems to present a slightly different risk factor list, with references to match, but some of the more commonly listed risks include any history of hernia or hernia repair, older age, male gender, Caucasian race, chronic cough, chronic constipation, other factors that cause increased intra-abdominal pressure (pregnancy, ascites), abdominal aortic aneurysm history, abdominal wall injury, smoking, and family history of hernia.⁵

That noted, however, a more specific profile could be developed for patients more likely to develop each hernia type.

Groin Hernias. The most common hernia type across both genders is the indirect inguinal hernia. These are properly considered congenital hernias — although often clinically unapparent in early life — due to incomplete or weakened closure of the processus vaginalis. Age-associated decreased muscle tone, in concert with other factors like increased intra-abdominal pressure or connective tissue abnormalities, forces abdominal organs through the weakened and widened internal

inguinal ring into the inguinal canal. A clinically apparent hernia is the result. This occurs most commonly on the right in both males and females.⁵

Weakness of the floor of the inguinal canal results in a direct inguinal hernia. Muscle weakness from a variety of factors, perhaps coupled with connective tissue abnormalities, leads to the development of a direct hernia.⁵

Injury or age-associated changes in the femoral ring lead to widening and the development of femoral hernias. These are the least common type of groin hernia and occur most often in females. Although an uncommon groin hernia, the femoral hernia is the one most likely to present incarcerated or strangulated. Therefore, even asymptomatic femoral hernias should be repaired upon detection.⁵

Spigelian (spontaneous lateral ventral wall) Hernia. This unusual hernia is generally considered an acquired condition in adults. Risk factors for the development of a Spigelian hernia (based on limited evidence) include: morbid obesity, multiparity, rapid weight loss, COPD, chronic constipation, prostatic enlargement, ascites, trauma, and previous surgery affecting the integrity of the semilunar line.

Spigelian hernias have a slight female-to-male predominance and typically present in patients in their 60s and 70s. Spigelian hernias incarcerate frequently.⁹

Ventral. Ventral wall hernia subtypes and their etiologies, predisposing conditions, risk factors, and associated illnesses, are discussed below.

It is important to note that the rise of laparoscopic ventral hernia repair has led to the realization that many ventral hernia defects are occult until direct visualization at the time of operation reveals them. In one series, nearly half of the patients undergoing laparoscopic ventral hernia repair were found to have occult hernia defects not found on pre-operative physical examination.²⁸

Subxiphoid. Most subxiphoid hernias occur due to prior surgery

and are classified as incisional rather than primary hernias. Specific risks for subxiphoid hernia formation include upper midline laparotomy, median sternotomy, mediastinal drainage tube incision, and laparoscopic procedure. Sternotomy confers the largest risk.

Notably, although a subxiphoid hernia defect may exist, herniation of intra-abdominal content may not occur because of the liver's presence underlying the defect.¹¹

Subxiphoid hernia repair is difficult due to the hernia's proximity to bony structures.²⁶

Epigastric. Primary (non-incisional) epigastric hernias are theorized to occur due to either vascular lacunae penetrating the linea alba and causing weaknesses or lack of so-called triple lines of musculofascial decussation. Both factors may play a role. As with many hernias, collagen disorders and conditions causing increased intra-abdominal pressure contribute to hernia formation as well.²⁷

An epigastric hernia is almost always an acquired, not congenital, condition. It commonly presents in middle age with a three-to-one male-to-female predominance. A sizeable percentage of epigastric hernias are multiple.⁶

Umbilical. Infantile umbilical hernias are distinct from adult umbilical hernias, have different causes, and are not further considered in this article.

Adult umbilical hernias protrude through the umbilical canal and are most often acquired conditions from gradual weakening — due to increased intra-abdominal pressure — of the scar tissue sealing the umbilical ring. Risk factors for the development of adult umbilical hernias include obesity, multiparity, ascites, and large abdominal masses.

Adult umbilical hernias exhibit a female-to-male predominance and occur most commonly in those aged 50 to 70. Few complications occur, although small hernias are significantly more likely to incarcerate than large hernias. In those with ascites, overlying skin breakdown may lead

to chronic fluid leak and peritonitis.⁹

Infraumbilical. The same general risk factors that contribute to hernia formation elsewhere on the ventral wall (collagen deficits and increased intra-abdominal pressure, with or without prior surgery) contribute to hernia formation in this region.

Suprapubic (also called Parapubic). Most suprapubic hernias occur due to prior surgery and are classified as incisional rather than primary hernias. Low midline and Pfannenstiel incisions (often used for gynecologic, colorectal, and urologic surgeries) place patients at particular risk.¹¹

Suprapubic hernia repair is difficult due to the hernia's proximity to bony structures.²⁶

Flank (Lumbar). Flank hernias occur in the posterior abdominal wall. Most hernias in this region protrude through two distinct locations, known as the inferior and superior lumbar triangles. Most are acquired conditions (rather than congenital) due to either particular risk factors or prior surgery (often urologic, i.e., nephrectomy). Known or suspected risks include advanced age, obesity, extreme thinness or weight loss, chronic debilitation, muscular atrophy, chronic bronchitis, and vigorous physical activity.^{9,12}

These hernias are rare; therefore, a typical patient profile cannot be established. However, include lumbar hernia in your differential diagnosis of flank mass, realizing that a variety of normally intra-abdominal contents can enter the hernia, which may incarcerate, producing bowel obstruction symptomatology.

Obturator. This is another rare hernia type, seen almost exclusively in very elderly, frail females, many of whom have a history of bowel obstruction that resolved without surgery. They are more likely to occur on the right side.⁹

The hernia protrudes through the obturator foramen, a deep structure, so no external bulge will be seen or felt, although a pelvic or rectal examination may reveal the hernia bulge. Patients may present with only medial thigh pain (which

may be misinterpreted as arthritic pain) with radiation to the knee, or, less commonly, the hip due to pressure of the hernia on the obturator nerve. Hip flexion often relieves the pain. Hip extension, abduction, and medial rotation frequently worsen the pain.^{9,17,31,32} Loss of the adductor reflex with preservation of the patellar reflex may be seen as well, again due to obturator nerve impingement. The adductor reflex is rarely assessed but can be elicited by placing the examiner's index finger across the thigh's adductor muscles about two inches above the femur's medial epicondyle and striking that digit firmly with a reflex hammer. Under non-pathologic circumstances, the adductor muscles will be seen and felt to contract.^{31,32}

Small bowel obstruction is seen in a high percentage of patients with obturator hernia and usually presents with typical symptoms.⁹

Traumatic. A variety of traumatic abdominal wall hernias (lumbar, ventral, and inguinal, likely others) have been the subject of several case reports and small case series.^{33,34,35} Although these hernias are rarely reported in the medical literature, there is interest in establishing a uniform classification scheme for them to facilitate clinical trials and compare management outcomes. Currently, no universally accepted classification scheme exists. Hints in the recent medical literature attempting a classification scheme include elements like: no pre-existent hernia, force sufficient to cause the hernia, sudden intra-abdominal pressure increase, and acceleration-deceleration shear and compressive force (usually of a seat belt, but other mechanisms are possible, i.e., bicycle handlebars).^{36,37,38}

Supravesical. These are extremely rare hernia types, and protrusion is through the supravesical fossa.^{9,15} There are four supravesical hernia subtypes, which can be either internal or external, occasionally presenting as a groin hernia would. If a characteristic presentation was described for this hernia type it would be an elderly malnourished male with an intestinal obstruction *and* urinary complaints.⁹

Perineal. These are hernias — occasionally quite large — through the pelvic diaphragm/floor and they occur in a variety of locations there.⁹ Primary perineal hernias are extremely rare, with most occurring following pelvic trauma or surgery. The “classic” perineal hernia patient is multiparous and “older.” If a hernia bulge is visible, it will appear in the labial, gluteal, or perineal area, perhaps best seen with the patient standing or straining. It may also be felt during the bimanual rectovaginal examination. Patients with perineal hernias may have vague pelvic complaints (“fullness,” for example) for variable time periods.^{9,16}

Sciatic. Some authors consider this extremely rare hernia to be a type of pelvic floor hernia, lumping them with — in decreasing order of frequency — obturator, perineal, and finally, sciatic hernias.⁴⁰ Protrusion is through either the greater or lesser sciatic foramen.¹⁹ Most are acquired, and increased intra-abdominal pressure is thought to be the cause. No classic description of a sciatic hernia presentation is possible since the range of signs and symptoms includes none, abdominal pain, a palpable buttock mass, sciatica, vague pelvic pain, intestinal obstruction, and gluteal abscess formation.^{9,19,40,41}

General Clinical and Historical Features

The majority of ED patients with hernia-related concerns present with either a bulge in the area of their hernia or pain, either localized to the hernia area or diffusely throughout the abdomen. Bowel and/or fat are the most common hernia contents and account for these common signs and symptoms. Realize, however, that virtually any solid intra-abdominal organ (including, but not limited to, the spleen, ovary, and liver) and virtually any hollow structure (ureter, bladder, stomach, blood vessels) may be contained within a hernia sac as well. This accounts for some unusual and unexpected hernia presentations.^{21,44,45}

Based not on controlled clinical trials but on an abundance of

clinical experience, most experts recommend that patients with possible hernia-related complaints be examined supine and standing and perhaps in the position in which the hernia is most apparent.^{5,10} Especially for groin hernias, having the patient cough or strain may facilitate hernia identification.¹⁰ Sometimes having the patient walk or stand for a time has a similar effect.¹⁰

When considering less common hernia types (Spigelian, obturator, and others), particular focused examinations (described below) must be done.

Remember that hernias of various types may self-reduce in certain positions. Therefore, it is possible to miss them during physical examination or even during diagnostic imaging with ultrasound or computed tomography. Again, having the patient Valsalva or assume particular positions may facilitate hernia identification in these unusual circumstances.

Specific Clinical and Historical Features

Incisional Hernias. These hernias occur only in the area of prior abdominal wall surgical scars. However, certain risk factors make them more likely to occur. In particular, ask about prior abdominal aortic aneurysm surgery, connective tissue diseases, post-operative complications (especially wound infection and/or dehiscence), atherosclerosis, diabetes, renal failure, protein deficiency, immunosuppression, and smoking. Obtain a thorough medication/medical intervention history since some place patients at risk for incisional hernias (corticosteroids, chemotherapeutic agents, radiotherapy, and warfarin).²³ Other incisional hernia risk factors include age greater than 65 years, male gender, and obesity.

Physical Examination

Palpate for a bulge in the area of the patient's surgical incision(s). Feel also for the edges of the fascial defect(s). Remember that incisional hernias are often multiple (the “Swiss cheese hernia”) and many hernia sites are missed on physical

examination.^{23,28} Check for skin and muscle thinning. These changes are associated with large and long-standing hernias.²³

An evidence-based approach for most hernia-related physical examination findings is lacking. But, the constellation of overlying skin erythema, exquisite local tenderness, increased hernia size, and irreducibility, especially in a patient's hernia that was previously minimally symptomatic and easily reducible, should lead you to strongly consider hernia incarceration and possibly strangulation.

Primary Hernias. *Groin (inguinal, direct and indirect, and femoral).* When evaluating a patient with a known or suspected groin hernia, ask about other hernias, hernia repairs, especially those complicated by infection, chronic cough, or constipation, and other factors that increase intra-abdominal pressure, abdominal aortic aneurysm history with or without repair, abdominal wall injury, and a family history of hernia.

Inguinal hernias occur more often in older male Caucasians.⁵ Femoral hernias are more common in females and more often present incarcerated or strangulated. They are also harder to detect (or actually impossible to detect) on physical examination.

A hernia bulge, which may involve the scrotum, felt above the inguinal ligament usually represents an inguinal hernia. However, distinguishing direct from indirect hernias is immaterial since the surgical approach is the same.

A hernia bulge below the inguinal ligament and medial to the femoral vessels is usually a femoral hernia. Notably, these are generally repaired at the time of discovery, even if asymptomatic, due to their high risk of incarceration and strangulation.¹⁰

Hernia Reduction

The decision to reduce a symptomatic hernia should be guided by local practice and clinical judgment. Medical literature on the subject offers considered opinion but not studies or evidence-based conclusions. Surgical opinion holds that

an obviously strangulated hernia should not be reduced, since doing so returns dead or poorly vascularized bowel to the peritoneal cavity, converting a localized process into generalized peritonitis. Also, this necessitates a laparotomy or laparoscopy to evaluate bowel viability when a local exploration might have been adequate.

Acutely incarcerated hernias can be gently reduced in the proper clinical setting. Avoid forceful and/or repeated reduction attempts.

Bear in mind that a Richter's hernia may present without signs of bowel obstruction and produce limited local signs and symptoms. It is difficult, if not impossible, to distinguish a devascularized Richter's hernia from the far more benign simple incarcerated hernia. Clues to strangulated versus incarcerated bowel (none infallible or well-studied) include: increased tenderness, elevated white blood cell count, elevated serum lactate/lactic acid level. (*See Table 2.*) Hernias incarcerated for a short time period may be easier (and more reasonable) to reduce. Even so, surgeons may delay operating on a patient whose incarcerated hernia has been reduced in an attempt to identify those whose non-viable bowel has been returned to the peritoneal cavity.¹⁹

General Hernia Reduction Technique (all steps may not be required). Provide your patient adequate pain relief, anxiolysis, and muscle relaxation. Remember that pain, associated anxiety, muscle tension — with resultant increased intra-abdominal pressure — will spike during the actual hernia reduction attempt. Place the patient in Trendelenburg position. Apply a padded ice pack to the area overlying the hernia and wait. The hernia may spontaneously reduce. The patient may also be able to aid reduction if he or she is familiar with self-reduction maneuvers that have proven successful. If necessary, slowly and gently apply pressure to the hernia's distal portion while guiding its proximal portion through the fascial

Table 2: Signs of Bowel Strangulation

- Increased tenderness
- Leukocytosis
- Fever
- Skin changes (erythema, ecchymotic)
- Elevated lactate

defect. Reducing the most proximal portion of the hernia first will avoid the problem of “ballooning” of the hernia around the fascial defect. Manual reduction may take up to 15 minutes. Repeated forceful reduction attempts are not advised.⁴⁶

Ultrasound-guided reduction has been advocated and may be available at your institution.

Spigelian Hernia. Historical features associated with Spigelian hernias include obesity, increased intra-abdominal pressure from various causes, trauma, and prior surgery. The only physical examination finding may be a hernia bulge lateral to the rectus abdominis muscle below the level of the umbilicus. Even this finding may be lacking or difficult to appreciate if the hernia is interparietal (which it often is) or the patient is obese.^{19,20} Point tenderness may be the only finding in this case.¹⁹ Spigelian hernias are at high risk of incarceration with resultant bowel obstruction, so repair is performed at the time of detection.^{19,20}

Ventral Hernias. From cephalad to caudad, ventral wall hernias occur in the following locations: subxiphoid, epigastric, umbilical, infra-umbilical, and suprapubic.

Common historical features predisposing to these hernias include collagen disorders and increased intra-abdominal pressure. Surgery with scar in the herniated region is another risk factor.

On physical examination, assess for midline and/or paramedian hernia bulges. Assess the patient supine, standing, and during dynamic maneuvers to best see and feel the hernia. Remember that multiple ventral wall hernias can occur in an individual patient. Assess for multiple

fascial defects, especially in the case of epigastric hernias.⁶

Flank, Obturator, Supravesical, Perineal, and Sciatic Hernias. See the “Etiology and Pathophysiology” section for risk factors and typical patient profiles (if known) for these rare hernias. Physical examination findings associated with each have been covered as well.

Traumatic Hernias. Major trauma affecting the abdominal wall may lead to sudden hernia formation of various types. Evaluation of patients thought to have acute trauma-induced hernias should be guided by trauma management principles and are not further covered in this article.

Additional Considerations. Although fat and bowel are most often contained within hernias, virtually any intra-abdominal structure may herniate. Therefore, a wide variety of odd, seemingly unrelated complaints, physical findings, and imaging abnormalities may accompany what seems to be just another straightforward hernia presentation. Two case reports (many more exist) illustrate this point. The first involves a male who presented with left flank pain and a reducible left inguinal hernia. An ultrasound showed left hydronephrosis. A CT scan showed a loop of the left ureter protruding into the hernia sac.²¹ The second case involves an elderly male who presented with an irreducible left inguinal hernia, acute severe lower abdominal pain, and inability to void. His work-up ultimately revealed a near-total incarcerated scrotal cystocele, or bladder herniation into an inguinal hernia sac.⁴⁴

Diagnostic Studies

Many patients with inguinal hernias, especially those with known disease, do not require diagnostic work-up per se. They may simply need to be readied for operation as guided by local standards — EKG, chest radiograph, laboratory studies, NPO, intravenous line, and the like.

Those whose diagnosis is in doubt may need additional work-up, most of which hinges on imaging. Ultrasonography provides some

value in the evaluation of certain hernia types, and can diagnose Spigelian and inguinal hernias.^{47,48,51} However, CT remains the test of choice in most cases when the diagnosis is in doubt or high-resolution pre-operative anatomic evaluation is required. CT can show the contents of the hernia and may show signs of strangulation. MRI has been put forth as “the best valid diagnostic tool for differentiating the causes of uncertain groin pain.”⁵² This may well be true, but seems to be a minority opinion based on limited clinical experience. Additionally, MRI is costly, time-consuming, infrequently necessary, and unavailable in many practice settings.

When caring for an ill patient whose presentation screams strangulation: resuscitate, resolve symptoms, and reach a surgeon. Imaging is likely not required.

The perfect pre-operative test to diagnose ischemic bowel remains the holy grail of hernia evaluation. That perfect test does not exist, nor is it likely to, near term. Serum lactic acid/lactate is the best test currently available, but offers sensitivity and specificity for non-viable bowel, at best, of approximately 85%.⁴⁹ A pre-operative D-dimer level performs less well in ischemic bowel detection.⁵⁰ Other serum markers studied to date provide no diagnostic or prognostic value.^{49,50} The bottom line is: Consider obtaining a lactic acid level in those hernia patients you’re evaluating for bowel ischemia. However, a normal level *does not* exclude the condition.

Differential Diagnosis

A discussion of the full differential diagnosis for every abdominal wall bulge or symptom possibly due to a hernia of any type would require several articles the length of this one. However, the differential diagnosis for groin and scrotal masses includes: inguinal hernia, hydrocele, varicocele, ectopic testis, epididymitis, testicular torsion, retracted or undescended testicle, malignancy, spermatocele, venous varix, lipoma, hematoma, sebaceous cyst, hidradenitis

suppurativa, lymphadenopathy, lymphoma, metastatic cancer, abscess, lymphogranuloma venereum, femoral hernia, aneurysm/pseudoaneurysm, and tracking of intra-peritoneal process (blood, infection).^{10,46}

Management and Disposition

Many hernia patients with minimal or no symptoms, or a concern with cosmesis, may need only symptomatic relief, good return precautions, and a surgical referral.

Others, with perhaps more worrisome signs and symptoms (i.e., somewhat increased hernia site pain), may be discharged from the ED after a reassuring work-up, and symptom management and resolution. Provide close follow-up and good return precautions to these patients.

Ill patients, those with abnormal vital signs, metabolic derangements, evidence of bowel obstruction, ischemia or necrosis, or other concerning symptoms (i.e., exquisite local hernia pain/tenderness) should be adequately fluid resuscitated, expeditiously worked-up, treated for infectious complications if present, and readied for operation. Antibiotics are indicated for ischemic/necrotic bowel and should cover intestinal flora. Zosyn 4.5 g (piperacillin/tazobactam) IV is a reasonable choice. Multiple other antibiotics can be used in this setting.

Definitive therapy, however, remains surgery with evaluation of bowel viability. Consult a surgeon early for those with bowel obstruction or ischemia, ischemia or compromise of other organs contained within the hernia sac, and symptomatic incarcerated hernias.

Consider hernia reduction (see earlier discussion of this topic).

For patients with certain hernia types (notably epigastric and femoral), many surgeons opt to operate at the time of diagnosis due to the high risk of hernia incarceration and/or strangulation. This may be true even if the patient displays limited or no symptoms.

For men with minimally symptomatic inguinal hernias, do not be

surprised if your surgeons advocate watchful waiting over immediate repair. This approach is based largely on a pivotal and oft-cited paper that appeared in the *Journal of the American Medical Association* in 2006. The study randomized men with minimally symptomatic inguinal hernias to either watchful waiting or repair. Follow-up was conducted out to 4.5 years. Although 23% of patients assigned to watchful waiting crossed over to repair (mostly due to increased hernia pain), there were very few serious hernia-related complications (bowel obstruction or incarceration) and no strangulated hernias. Of note, 17% of patients originally assigned to repair crossed over to watchful waiting.⁵³

A more recent study (2011) attempted to “risk stratify” those patients in the watchful waiting group most likely to cross over to repair. A variety of factors were found that predicted cross over, including pain with strenuous activity, chronic constipation, prostatism, being married, and being healthy. It is thought that these refined factors may help surgeons and patients decide who is best served by repair or by watchful waiting.⁵⁴

Additional Aspects

Within the past several decades, hernia repairs have undergone three significant transitions. These changes include the use of mesh, laparoscopy for hernia surgery, and the move from tension-based to tension-free closures. Literally thousands of medical articles have appeared in that time frame covering various aspects of these newer techniques and technologies. A brief summary, relevant to EM practice, follows.

A substantial percentage of abdominal surgery patients develop incisional hernias. Hernia recurrence also occurs after initial and subsequent hernia repairs. The risk for recurrence is progressive.⁵⁵ That is, hernia recurrence rates rise with each subsequent repair attempt. Newer hernia repair techniques (mesh, laparoscopy, tension-free closure) have been developed in an attempt to address these issues.

Mesh comes in two basic forms: biological and synthetic. Many variations of these two forms exist. All are intended to promote tissue in-growth while providing sufficient strength to meet the functional needs of the location into which they are inserted.⁵⁶ Mesh may be placed over, under, or interposed between layers of tissue being surgically repaired. The optimal mesh placement location, optimal mesh type to use in a given clinical circumstance, and many other aspects of mesh use are currently undergoing investigation. Little consensus exists on many of these important issues.⁵⁶ Mesh can be used during open or laparoscopic procedures.

Mesh complications include infection, migration, erosion into surrounding structures, fistula formation, and chronic pain or sensation of implant presence.⁶⁰

Mesh infection is considered a catastrophic complication. It may present in the immediate post-operative period, but is more likely to present months to years after mesh insertion. Early mesh infection may be difficult to distinguish from superficial/incisional cellulitis. Clues include fever, pain, local erythema, infected drainage, leukocytosis, elevated erythrocyte sedimentation rate, and signs of sepsis. Imaging may show a fluid collection, but this can be a normal post-operative finding. Gas in the fluid may represent an anaerobic infection or communication with the bowel. Definitive diagnosis depends on positive deep cultures of the fluid surrounding the mesh.⁵⁷ Treatment is on a case-by-case basis depending on the patient’s clinical status, with antibiotics, supportive care, drainage, and mesh explantation all part of the surgeon’s armamentarium. Mesh explantation is highly associated with hernia recurrence and other complications.⁵⁷

Risk factors for mesh explantation are long operative times, surgical site infections, wound complications, and the performance of other intra-abdominal surgery at the time of incisional hernia repair.⁵⁹

On the positive side, some have found that mesh repair of incisional hernias (vs. standard suture repair)

is associated with a lower hernia recurrence rate and less abdominal pain.^{58,62} This remains a subject of some debate, however.⁵⁶

Currently, abdominal wall closure after hernia repair is done in a “tension-free” manner. The older style, of simply reapproximating tissue and closing — with sutures (and tissue) under tension — has fallen out of favor. This is because of the unacceptably high incidence of hernia recurrence with this approach. So-called “component separation” and closure (often with interposed mesh) is the new standard. Component separation involves abdominal wall muscle separation and fascial release. This allows tissue to be advanced toward incision edges and closed, tension-free. As of 2013, the American Hernia Society considers this approach to be the gold standard technique for open ventral hernia repair.⁶¹

Laparoscopic hernia repair (for a variety of hernia types) has become the norm in many centers.^{16,63,64,65} The proposed advantages of a laparoscopic approach include: fewer wound infections and complications, faster recovery to normal activity, lower recurrence rates, and shorter hospital stays. Operative times equivalent to open procedures were hoped for as well. These positives seem to have been realized.^{63,64,65} A laparoscopic approach is frequently combined with a mesh-based repair.^{63,64}

Summary

“No disease of the human body, belonging to the province of the surgeon, requires in its treatment a greater combination of accurate anatomic knowledge, with surgical skill, than hernia in all its varieties.” (Sir Astley Paston Cooper, 1804) True then, true now; relevant for emergency physicians as well.

“Herniology” is a rapidly advancing field. A quick PubMed screen for “abdominal wall hernia” articles published within the last decade returned more than 4,000 hits. As progress in the many aspects of this common condition advances, emergency physicians must be up-to-date on the myriad hernia-related perils,

pitfalls, presentations, and problems. Also, in our role as stewards of the health care system, it behooves us to be aware of the enormous costs — human and financial — associated with hernias of various types. Finally, while almost anyone can recognize a groin “rupture,” rare and atypical hernia presentations lurk. Emergency physicians must be able to recognize these unusual hernia manifestations.

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CME Questions

1. Hip or thigh pain is characteristic of which hernia type?
 - A. direct hernia
 - B. indirect hernia
 - C. obturator hernia

D. Spigelian hernia

2. Which one of the following is considered a "surgical site occurrence"?
 - A. hernia recurrence
 - B. hernia strangulation
 - C. seroma
 - D. mesh migration
3. Which one of following statements is correct?
 - A. Another term for primary ventral hernia is "incisional hernia."
 - B. A parastomal hernia always forms in the area of a previous surgically created opening.
 - C. It is important to distinguish between direct and indirect hernias, as their treatment is different.
 - D. The best way to feel a femoral hernia is to examine the patient supine.
4. Which one of the following hernia types is correctly described?
 - A. Spigelian — also known as a flank or lumbar hernia
 - B. Umbilical — only occurs in children
 - C. Traumatic — involves the diaphragm
 - D. Internal — occurs *only* within the peritoneal cavity
5. Which one of the following statements is correct?
 - A. A previously reducible hernia never transforms into an irreducible hernia.
 - B. An irreducible hernia generally just involves fat and is of no concern.
 - C. A strangulated hernia involves ischemic hernia sac contents.
 - D. Richter's hernia is the same as a sliding hernia.
6. A variety of proven or suspected risk factors exist for the development of incisional hernias. Which one of the following is a proven risk factor for incisional hernia formation?
 - A. spina bifida
 - B. abdominal aortic aneurysm repair
 - C. alcoholism
 - D. liver disease
7. Which statement is correct about femoral hernias?
 - A. Femoral hernias are more common than direct hernias but less common than indirect hernias.
 - B. Of the groin hernias, the least likely to present is incarcerated.
 - C. A watchful waiting strategy for the management of femoral hernias is always advised.
 - D. Femoral hernias occur most commonly in females.
8. The past several decades have seen an explosion in the performance of laparoscopic hernia repair. Which one of the statements about hernia laparoscopy is correct?
 - A. Physical examination is equivalent to laparoscopy for the detection of ventral hernia defects.

- B. Laparoscopic hernia repair precludes biologic mesh use.
- C. Laparoscopic hernia repair times generally approximate open hernia repair times.
- D. When compared to an open procedure, the downside of laparoscopic hernia repair is a prolonged recovery time.

9. Which statement about rare hernias is true?
 - A. A lumbar hernia may present as a bulge in the gluteal region.
 - B. Obturator hernias are most commonly seen in obese middle-aged men and nearly always are on the left.
 - C. Patients with perineal hernias may present with chronic vague pelvic discomfort.
 - D. Obturator hernias rarely cause bowel obstructions.
10. Regarding hernia reduction, which one of the statements below is correct?
 - A. "Time is tissue," therefore reduce all hernias expeditiously.
 - B. The knee-chest position aids the reduction of most groin hernias.
 - C. Strangulated hernias always present with high fever and signs of sepsis.
 - D. Some incarcerated hernias may spontaneously reduce rather than require manual manipulation.

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Abdominal Wall Hernias in Adults: Diagnosis and Management

Classification of Hernias

<p>Midline</p> <ul style="list-style-type: none"> • Epigastric • Umbilical
<p>Lateral</p> <ul style="list-style-type: none"> • Spigelian • Groin <ul style="list-style-type: none"> Inguinal: Direct, Indirect Femoral
<p>Incisional</p>
<p>Parastomal</p>
<p>Adapted from the European Hernia Society</p>

Signs of Bowel Strangulation

- Increased tenderness
- Leukocytosis
- Fever
- Skin changes (erythema, ecchymotic)
- Elevated lactate