



Amyand's Hernia - Appendix as a Hernia Content

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Abstract

Amyand's hernia is defined as when the appendix is trapped within an inguinal hernia. While the incidence of this type of hernia is rare, the appendix may become incarcerated within Amyand's hernia and lead to further complications such as strangulation and perforation. Incarceration of the appendix most commonly occurs within inguinal and femoral hernias but may arise to a lesser extent in incisional and umbilical hernias. Incarcerated appendix has been reported in a variety of ventral abdominal and inguinal locations, yet its in- distinct clinical presentation represents a diagnostic challenge. This paper reviews the literature on incarceration of the appendix within inguinal hernias and discusses current approaches to diagnosis and treatment of Amyand's hernia and complications that may arise from incarceration of the appendix within the hernia.

Keywords: Appendicitis; Incarceration; Hernia; Inguinal; Appendix as a Hernia Content

Background

A hernia is the protrusion of an organ or its fascia through the wall of a containing cavity [1]. When an organ is contained within a non-reducible hernia, it is termed an incarcerated hernia. A strangulated hernia may result if the blood supply to the edematous, incarcerated bowel is compromised secondary to venous and lymphatic obstruction. Strangulated bowel is susceptible to necrosis, which can lead to perforation, rupture, and spillage of bowel contents, and eventually, catastrophic peritonitis. Ventral abdominal and inguinal hernias typically contain bowel or omentum only rarely is the appendix discovered, often incidentally, within the herniated region [1]. A thorough literature review indicates that only about 1% of all hernias contain portions of the appendix. Incarceration of the appendix within an inguinal hernia is termed Amyand's hernia (Figure 1). An Amyand's hernia may

become inflamed, infected, or perforated. The appendix may also be incarcerated and entirely healthy [2-4]. Definitive preoperative diagnosis presents a clinical challenge due to indistinct clinical signs and symptoms and a lack of clear radiological diagnostic features. Incarcerated appendix or appendicitis, for example, is often misdiagnosed as a strangulated hernia [5]. Diagnosis of Amyand's hernia remains primarily an incidental finding during surgery, and there remains no true consensus on the optimal operative management approach. Surgeons and residents need to become familiar with incarcerated appendixes within hernias, and the scant literature makes it a rather time-consuming process for physicians to educate themselves on Amyand's hernia and incarcerated appendixes. Thus, this paper aims to review the literature with regards to Amyand's hernia and provide new insight into the diagnosis and treatment of Amyand's hernia and its complications.

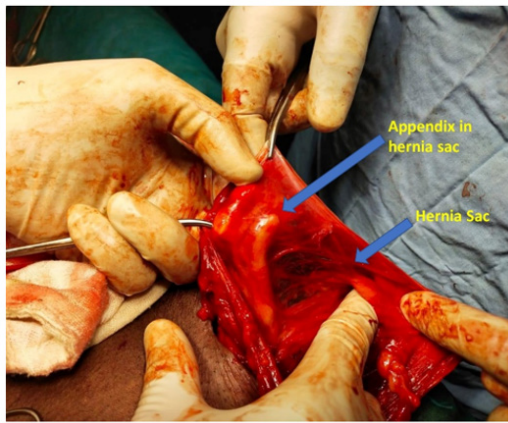
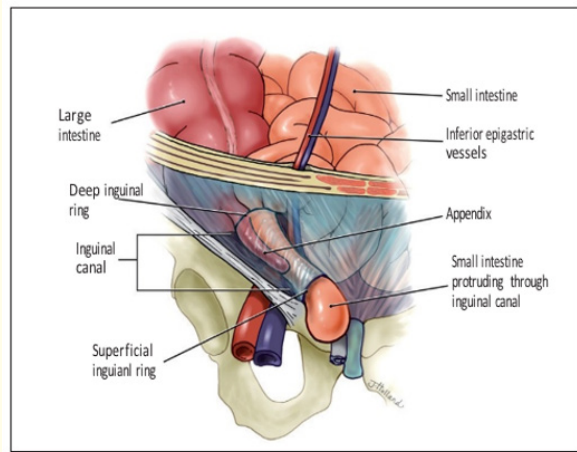


Figure 1

This illustration depicts an Amyand's hernia. The appendix is shown within an indirect inguinal hernia, passing through both the deep and superficial inguinal rings and passing laterally to the inferior epigastric vessels.

History

Amyand's hernia is named after Claudius Amyand, who, on December 6, 1735, performed the first successful appendectomy during the treatment of an 11-year-old boy who presented with a right inguinal hernia. During the surgery, Amyand found a pin within the appendix, which was encrusted with stone; the appendix was found within the inguinal hernia sac [6]. The term Amyand's hernia, therefore, refers to an incarcerated hernia containing the appendix, which may be normal or inflamed [1]. Because of the rarity of the condition, the term "Amyand's hernia" has been

recently adopted as an eponymous description of an incarcerated appendix within an inguinal hernia [7].

Epidemiology

Amyand's hernia has been reported in patients ranging in age from 3 weeks to 92 years [4,8]. The incidence of Amyand's hernia has varied in the literature, ranging from 0.19% to 1.7% of reported hernia cases. Amyand's hernia is 3 times more likely to be diagnosed in children than in adults, due to the patency of the processus vaginalis in the pediatric population [9].

The incidence of appendicitis within an inguinal hernia is even rarer; with an estimated rate of 0.07-0.13% [10]. The incidence of perforated appendix incarcerated within an inguinal hernia is rare as well, at 0.1% of all cases of appendicitis [11,12]. A 2003 study by D'Alia, *et al.* examined 1341 inguinal hernias and determined the incidence of Amyand's hernia to be 0.6%, always on the right side, and exclusively in males [4]. Sharma, *et al.* reported that according to their study when cases of hernial appendicitis were found in females, they tended to be found in postmenopausal women [10].

Mortality of Amyand's hernia has been reported to range from 14-30% and was linked to the peritoneal spread of sepsis [4]. Sharma, *et al.* reported a postoperative wound infection rate of only 5.5% following their surgeries [10]. However, they reported discovering infection rates as high as 50% in the literature [10]. They also reported a mortality rate of only 5.5%, in comparison to the 14-30% range noted in the literature. They attributed this too early appropriate treatment and good postoperative care [10].

Clinical presentation

An appendix incarcerated within an inguinal hernia may become inflamed, infected, or perforated. Although incarcerated, the appendix may also present as being entirely healthy [2,4]. Inguinal herniations are found superior to the inguinal ligament, and superolateral to the pubic tubercle. They may be either direct or indirect. Direct inguinal hernias are found anteromedial and inferior to the inferior epigastric vessels; whereas indirect hernias protrude posterolateral and are superior to the vessels [13]. The appendix may be found in either of these as an Amyand's hernia.

Preoperative diagnosis of Amyand's hernia is not straightforward and is generally an incidental finding during surgery [1,10,14,15]. Abdominal exam, physical signs, lab results, and imaging are

not always helpful in differential diagnosis [14,16]. Common complaints include sudden-onset epigastric or periumbilical pain with localized tenderness in the right lower quadrant, combined with a tender irreducible mass in the inguinal or inguinoscrotal region [10,17]. This presentation, however, often gives the clinical impression of a strangulated hernia, making the clinical diagnosis of Amyand's hernia difficult [10,15].

Although incarceration of the appendix within an inguinal hernia does not always lead to appendicitis, this is not an uncommon finding. Ash, *et al.* suggested a relationship between the incarceration of the appendix in the inguinal canal and the development of inflammation [18]. They provided an account of appendiceal migration into the inguinal canal, leading to increased vulnerability to trauma and compromised blood supply, followed by generalized inflammation and bacterial overgrowth. Various complications of Amyand's hernia have been reported in the literature.

Preoperative diagnosis

Cases of definitive preoperative diagnosis are rare, and diagnosis is generally made during surgery [1,10,14,15,19]. Abdominal exam, physical signs, lab results, and imaging are not always helpful in differential diagnosis [14,16,19].

Computed tomography (CT) is the most commonly used imaging modality for evaluation of acute abdomen and abdominal hernias [13]. However, inguinal hernias are typically diagnosed clinically. The lack of distinct presenting signs and symptoms in Amyand's hernia, even when complicated, means that imaging is commonly not ordered if a simpler diagnosis is made clinically. When imaging is ordered, it is often to rule out more serious pathology.

Although CT scanning may help reach a correct diagnosis, it is usually not part of the standard diagnostic work-up when a simple inguinal hernia is suspected. Sonography has been reported to be valuable in the preoperative diagnosis of Amyand's hernia [21,22]. Coulier, *et al.* presented the first known case of Amyand's hernia successfully diagnosed using sonography [21]. They confirmed the diagnosis using CT, which was also performed to rule out potential intraabdominal complications. Sonography could be a useful imaging modality for Amyand's hernia, as it is often a cheaper and safer option, and positive findings can be confirmed using

CT if necessary [21]. However, preoperative diagnosis based on ultrasound alone is heavily dependent upon the technical skill of the operator, and as such remains a relatively unreliable modality [23].

Surgical approach

Incision

The most common choice of treatment for Amyand's hernia is appendectomy via herniotomy, with primary hernia repair [15,18,19]. Lower midline laparotomy is recommended for cases of suspected perforation or pelvic abscess, as this approach provides excellent control and technical ease [10,26]. Solecki, *et al.* recommended midline inferior laparotomy, and Shouldice's herniorrhaphy in cases of gangrenous acute appendicitis in Amyand's hernia [26].

Recently, more varied methods have begun to appear in the literature. Vermillion, *et al.* reported the first instance of laparoscopic appendectomy in a case of Amyand's hernia with appendicitis [17]. Reports now indicate that the incidence of laparoscopic surgery is on the rise [22,25,27,29]. However, discovery of complications may necessitate a transition from laparoscopic to open hernia repair. Salemis, *et al.* reported a case in which a laparoscopic approach on an indirect inguinal hernia repair revealed a gangrenous perforated appendix with peritonitis, necessitating a midline laparotomy [24].

More recently, extraperitoneal management of Amyand's hernia has become more common [16]. Sagar, *et al.* reported total extraperitoneal management, including appendectomy and hernioplasty using synthetic mesh [30]. Burgess, *et al.* reported that the surgical approach should be guided by suspected diagnosis, such as laparotomy for suspected bowel obstruction or appendicitis, and anterior groin incision for suspected incarcerated inguinal hernia [20]. This may seem intuitive, yet techniques vary because preoperative diagnosis remains a challenge.

State of the appendix

There is no consensus in the literature regarding the best course of action in treating an appendix in Amyand's hernia. Acute appendicitis is the most frequent cause of acute right iliac fossa pain. However, such pain does not necessitate the presence of an inflamed appendix [23]. This often leaves an intra-operative

decision of whether or not to remove the appendix. While some argue for appendectomy only if the appendix is inflamed [20,23], others support appendectomy even when the appendix is noninflamed, to avoid future complications [20,23,33]. A potential pathophysiological process was proposed by Ofili, *et al.*, who suggested that mere manipulation of a healthy appendix during surgery may incite inflammation and may provoke secondary appendicitis [33]. However, studies have shown that current laparoscopic procedures involving manipulation of the appendix do not increase the incidence of appendicitis [10].

Repair of hernia

Most often, hernia repair is completed during primary surgery. In a few cases, hernia repair is delayed due to complications and inflammation [15]. Hernia repair with prosthetic mesh has been shown to decrease the incidence of recurrence when compared to deficit reinforcement using native tissue, but there are contraindications for its use in some cases [20]. Because prosthetic mesh material can elicit an increased inflammatory response, it is generally contraindicated in the closure of contaminated abdominal wall defects [10]. Prosthetic mesh is typically contraindicated in patients with an inflamed or perforated appendix, due to the risk of wound and mesh infection [10]. The treatment of choice in these cases is appendectomy using Bassini's repair, along with thorough abdominal and pelvic washouts to reduce septic complications [10]. A lower midline laparotomy is an excellent choice when there are clear signs of peritonitis but the diagnosis is in doubt [10].

In contrast, reported that synthetic mesh may be used successfully in cases of Amyand's hernia, even when inflamed or perforated, with no postoperative complications, and that a septic environment is not an absolute contraindication for use of prosthetic mesh [34]. The use of synthetic mesh if the inguinal area is adequately irrigated with antibiotics intraoperatively; a drain is placed under the aponeurosis, and the procedure is followed by a post-operative course of antibiotics [33].

Losanoff, *et al.* proposed a classification of Amyand's hernia to improve treatment. Type I is a normal appendix: perform reduction or appendectomy with mesh hernioplasty [35]. Type II is acute appendicitis localized in a hernial sac: perform appendectomy through the hernia, with mesh hernia repair; associated with a higher risk of mesh infection. Type III is acute appendicitis complicated by peritonitis: perform appendectomy through

laparotomy; hernioplasty decision should be made based upon the spread of sepsis. Type IV is acute appendicitis accompanied by other abnormal pathology: hernioplasty may be contraindicated if the damage is too extensive.

Conclusions

Amyand's hernia is a rare presentation of inguinal hernia, in which the appendix is incarcerated within the hernia sac. Amyand's hernia is a diagnostic challenge due to its low incidence, indistinct clinical presentation, and ambiguous appearance on imaging such as CT. Surgery is therefore frequently diagnostic as well as therapeutic. Since the appendix may be noninflamed when found within the inguinal hernia sac, removal is not always necessary; this is a decision currently dictated primarily by the surgeon's preference. Due to the rarity of Amyand's hernia, and the wide variance of its presentation, each case study and review article brings new and useful information to light regarding its treatment and diagnosis.

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