

“Amyand’s Hernia” – Pathophysiology, Role of Investigations and Treatment

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ABSTRACT

Background: *In the present era, appendicitis and hernia are common problems but their presentations in different positions are rare to be seen. It is difficult to make diagnose pre-operatively of contents as appendicitis in obstructed hernia. The term “Amyand’s hernia” was lost in the literature and we are describing its pathophysiology and management. The aggravating factors are: complex injuries related to hernia (size, degree of sliding, multiplicity, etc.), patient characteristics (age, activity, respiratory disease, dysuria, obesity, constipation). If not treated in the earliest stages then it can lead to significant morbidity and mortality. Existing literature describes almost exclusively its pathophysiology, investigations and treatment.*

Material and Methods: *We have focused on clinical presentation, radiological investigations and management of “Amyand’s hernia”. In literature, there is still confusion regarding investigations and treatment. We are presenting such rare entity managed in time without encountering any post-operative complications.*

Results: *Ultrasonography and Computed Tomography are useful tests but clinical correlation is necessary in incarcerated appendix. Regarding treatment, it is clear that if appendix is inflamed then it should be removed, but we concluded that if appendix is found to be normal in obstructed hernia then it should also be removed due to possible later inflammation.*

Conclusion: *If the appendix found in the hernial sac is inflamed then chances of mortality increase. Although emergency surgery is indicated in all obstructed hernias, morbidity and mortality can be decreased if operated on time. Early recognition and its awareness, along with good surgical technique in such cases are keys to success when dealing with this problem.*

Keywords: ultrasonography, inguinal, hernia, investigations, management

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INTRODUCTION

An incarcerated or strangulated hernia is a hernia complication. The incidence of appendicitis within an inguinal hernia is rare, estimated at 0.07% to 0.13% (1-3). Acute appendicitis is the most common cause of pain in right iliac fossa. The eponym "Amyand hernia" was first suggested by Creese in 1953, then by Hiatt and Hiatt in 1988, followed by Hutchinson in 1993, in recognition of Claudius Amyand. Claudius Amyand (1680-1740) was a French Huguenot in exile in Britain, a military surgeon, Sergeant in the British Army and a Surgeon to King George II, Fellow of the Royal Society, first Principal Surgeon to the Westminster Hospital, and the founder and first Principal Surgeon to St. George's Hospital. He performed the first successful appendicectomy on a 11-years old boy named Hanvil Anderson on the 6th of December 1735, initially diagnosed as a fistula discharging faeces in the groin (4-7). It is very rare to find an inflamed appendix in the obstructed inguinal hernia on Ultrasonog-

raphy (USG) alone pre-operatively, as diagnosed by Singal R et al in his study (8). They have used the term incarcerated appendix and hernia which were defined as inflamed/gangrenous appendix found in the hernial sac either incisional or inguinal (8).

Fernando and Leelaratna defined Amyand hernia as an inguinal hernia containing (a) a non-inflamed appendix, (b) an inflamed appendix, or (c) a perforated appendix (2, 7, and 9). In 1991, the Nyhus classification emphasizes the anatomic criteria including the size of the internal ring and status of the posterior wall (Table 2) (10). Losanoff and Basson (11) further developed this classification into 4 subtypes, adding the situation of complicating intra-abdominal pathology such as an appendiceal tumor or incidental abdominal mass (Table 2). Bendavid had proposed the T.S.D. (Type, Staging, and Dimension) system which includes five types of groin hernia and three stages for each type. In this classification Bendavid emphasizes the extension (sliding) of the hernia which may lead to destruction of important functional structures, e.g., lacunar ligament, inguinal ligament (Table 3) (12). Acute appendicitis within an "Amyand's hernia" could be a life threatening condition unless tackled immediately. □

CASE REPORT

A 68 years old male reported to the emergency with pain and swelling in the right inguinal region that had persisted for the two days. A history of vomiting, and fever was present for 4 days. The patient was a known chronic smoker and was taking treatment from outside on and off. The swelling was reducible manually, for the last 1 year.

Patient vitals were stable except for tachycardia. On local examination, a tender irreducible swelling was present in the right inguinal region. Cough impulse was not present. Scrotum examination was normal and testis could be felt separately. Bowel sounds were absent. We diagnosed a right sided irreducible obstructed inguinal hernia. Total leukocyte cell count, blood urea and serum creatinine were raised. Chest X-ray was suggestive of bronchitis.

Emergency surgery was planned. Incision was given over the right inguinal region in the line of crease. The deep fascia and external oblique aponeurosis were opened. The hernial sac was identified; the cord was adherent to

Type 1	Indirect inguinal hernia with a normal ring Sac in the canal
Type 2	Indirect hernia with an enlarged internal ring but the posterior wall is intact; inferior deep epigastric vessels not displaced, sac not in scrotum
Type 3a	Direct hernia with a posterior floor defect only
Type 3b	Indirect hernia with enlargement of internal ring and posterior floor defect
Type 3c	Femoral hernia
Type 4	Recurrent hernia A direct B indirect C femoral D combinations of A-B-C

TABLE 1. Nyhus classification - 1993

Classification	Description	Surgical management
Type 1	Normal appendix within an inguinal hernia	Hernia reduction, mesh repair, appendicectomy in young patients
Type 2	Acute appendicitis within an inguinal hernia, no abdominal sepsis	Appendicectomy through hernia, primary repair of hernia, no mesh
Type 3	Acute appendicitis within an inguinal hernia, abdominal wall, or peritoneal sepsis	Laparotomy, appendicectomy, primary repair of hernia, no mesh
Type 4	Acute appendicitis within an inguinal hernia, related or unrelated abdominal pathology	Manage as types 1 to 3 hernia, investigate or treat second pathology as appropriate

TABLE 2. Classification of Amyand Hernias, after Losanoff and Basson¹⁰

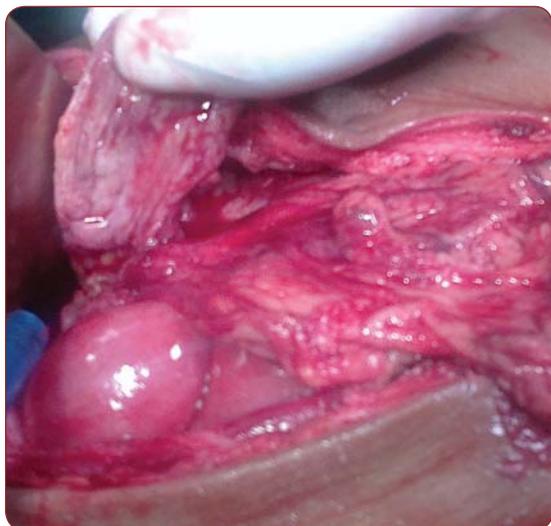


FIGURE 1. Operative picture revealed hernial sac and inflamed appendix



FIGURE 2. Showed part of the inflamed appendix holding with instrument

the sac, which was isolated. On opening the hernial sac, normal caecum and the inflamed appendix were found lying within, along with adhesions to the sac (Figure 1, 2). Serosanguinous fluid was present in the sac. Appendicectomy was performed through the inguinal incision only. A thorough wash was given by normal saline and Bassini's repair without using mesh. The sheath was closed with prolene 1-0 (Ethicon). The patient was put on third generation antibiotics (2 gm twice per day), metronidazole, and analgesics. The patient recovered very well in the post-operative period. In follow-up of 8 months, the patient is doing well. □

DISCUSSION

The presence of a vermiform appendix within an inguinal hernia sac was first described

by Claudius Amyand in 1735 hence the entity takes its name (5). Solecki et al. observed that acute appendicitis was found in 0.62% of groin hernia sac (13,14). The appendix was found in 0.51 % and acute appendicitis was found in 0.1 % of groin hernia sac as reported by Gurer et al. (15). Amyand hernia usually occurs on the right side, probably as a consequence of normal anatomic position of the appendix. However, "Amyand's hernia" has also been reported on the left side which may be associated with situs inversus, intestinal malrotation or mobile caecum (6). Acute appendicitis occurs much less frequently, and perforated appendix and peri-appendicular abscess formation within an inguinal hernia sac is an extremely rare clinical entity (8,16). □

PATHOPHYSIOLOGY

Acute appendicitis in "Amyand's hernia" is still controversial. It is usually caused by extra luminal obstruction due to pressure on the hernia neck rather than intraluminal obstruction of the appendix (8, 14, and 17). Abu-Dalu and Urca have suggested that the appendix becomes more vulnerable to trauma in "Amyand's hernia" and is ultimately retained by adhesions when it enters the sac (18). Contraction of the abdominal muscles and other sudden increases in intra abdominal pressure may cause compression of the appendix, resulting in further inflammation (14). Its blood supply may subsequently be cut off or significantly reduced, resulting in inflammation and bacterial overgrowth (18-20).

Reviewing the existing literature, Ibrahim Barut and Omer Ridvan Tarhan (17) found 188 cases of vermiform appendix in the hernia sac (Table 4). The Aachen classification has introduced the diameter measurement of the hernia orifice to the lateral, medial, combined and femoral hernia (Table 5) (21). Ryan reported only 11 (0.13%) of 8692 cases of acute appendicitis occurring in external hernias (22). Thomas et al (23) reviewed seven cases of acute appendicitis in a series of external hernia (three inguinal) collected in 8 years.

Priego et al described 4,752 cases of appendicitis, and in 6 cases the appendix was inside the hernia sac (0.126%). He studied 6 cases of incarcerated crural hernia and appendix was present, which represented 1.6% amongst 372 incarcerated crural hernias operated upon (24).

Type 1	Anterolateral or indirect
Stage 1	Extends from the deep inguinal ring to the superficial ring
Stage 2	Goes beyond the superficial ring but not unto the scrotum
Stage 3	Reaches the scrotum
Type 2	Anteromedial or direct
Stage 1	Remains within the confines of the inguinal canal
Stage 2	Goes beyond the superficial ring but not into the scrotum
Stage 3	Reaches the scrotum
Type 3	Posteromedial or femoral
Stage 1	Occupies a portion of the distance between the femoral vein and the lacunar ligament
Stage 2	Goes the entire distance between the femoral vein and the lacunar ligament
Stage 3	Extends from the femoral vein to the pubic tubercle (recurrences, destruction of the lacunar ligament)
Type 4	Posterolateral or prevascular
Stage 1	Located medial to the femoral vein: Cloquet and Laugier hernia
Stage 2	Located at the level of the femoral vessels: Velpeau and Serafini hernias
Stage 3	Located lateral to the femoral vessels: Hesselbach and Partridge hernias
Type 5	Anteroposterior or inguinofemoral
Stage 1	Has lifted or destroyed a portion of the inguinal ligament between the pubic crest and the femoral vein
Stage 2	Has lifted or destroyed the inguinal ligament from the pubic crest to the femoral vein
Stage 3	Has destroyed the inguinal ligament from the pubic crest to a point lateral to the femoral vein

TABLE 3. Bendavid classification 1994 (From Rutkow and Robbins 1994)

Hernia type	n
Incarcerated inguinal hernia	113
Strangulated inguinal hernia	11
Incarcerated femoral hernia	30
Strangulated femoral hernia	11
Umbilical hernia	4
Strangulated obturator hernia	3
Incarcerated Spiegel hernia	3
Strangulated diaphragmatic hernia	7
Incisional hernia	2
Epigastric hernia	2
Strangulated internal hernia	1
Strangulated paraduodenal hernia	1
Total	188

TABLE 4. Hernia types that were included vermiform appendix (17)

Singal R et al. (8) reported three cases of “Amyand’s hernia” as incarcerated appendix with rare presentations. They have reported the first case, as contents ascending and part of the transverse colon in the inguinal hernial sac and scrotum with tip of the appendix was lying in the sac. In another case, they have reported the incisional hernia with contents as appendicitis over the inguinal region. It is necessary to avoid complications by early surgical repair for definitive treatment. Singal R (8) added new term

in Amyands hernia classification After Losanoff and Basson (Table 6). They included appendix in the incisional hernial sac and management remains same. □

INVESTIGATION

Ultrasonography (USG) and Contrast enhanced computed tomography (CECT) are the helpful investigations to diagnose the abdominal injuries. Multidetector computed tomography (MDCT) is the new imaging modality in blunt traumatic abdominal and pelvis cases. It helps in identifying the solid organs injuries and associated bowel/mesenteric injury which decreases the morbidity and mortality. But challenges still remain in the abdominal and pelvic CT images in trauma cases. Advance CT features of the bowel or mesenteric injuries have been recognized with the help of the latest equipment such as MDCT (25). One of the latest features of the mesenteric tear is beading and termination of mesenteric vessels on MDCT, indicating requirement of surgery. MDCT also detects small or trace amounts of isolated intraperitoneal fluid in trauma cases, although the management is still controversial. This pictorial essay illustrates the spectrum of typical, atypical, and newly reported MDCT features of bowel and mesenteric injuries due to blunt trauma (25).

The presence of extraluminal air or fluid on MDCT is significantly correlated with blunt hollow viscus injury. Extraluminal air had the highest specificity (98.1%) but low sensitivity (62.5%), extraluminal fluid had the highest sensitivity (95.8%) but low specificity (36.2%). By comparison, unexplained fluid in the absence of solid organ injury had a higher specificity than unspecified extraluminal fluid (73.3% vs 36.2%) (26).

From 1959 through 1999, Weber et al (27) reviewed a total of 60 cases of acute appendicitis as Amyand’s hernias in adults. The value of coronal and sagittal reformats was shown in 2007 by Gillion et al. (28) who diagnosed a type - 2 hernia, and Maizlin et al (29) who reported type - 1 and type - 2 hernia diagnosed using multislice CT scanning.

Differential diagnosis should include strangulated hernia, strangulated omentocele, Richter’s hernia, testicular tumor with hemorrhage, acute hydrocele, inguinal adenitis, and epididimitis.

Some authors, including Logan MTBS and Weber et al. (27,30) raised the question regarding ethiopathogenesis - why does the appendix inflame in Amyand's hernia. Is Amyand's hernia with acute appendicitis an incidental finding, or is there a relationship between incarceration and inflammation?

We agreed with most of the authors that the most plausible hypothesis was the second quoted, where an ischemic phenomenon may result from compression at the neck of the sac, thus developing a secondary appendicitis. To this we want to add the important role of USG and CT scan in diagnosing appendix in the sac pre-operatively. Singal R et al. (8) confirmed acute appendicitis in inguinal hernia preoperatively on USG and recommended that USG is a very helpful investigation at lower costs. Usually such diagnosis is made by demonstration of blind-ending tubular structure with thickened walls, in connection to the caecum within the hernia sac.

Losanoff proposed in his classification (type I), that where no inflammation is encountered, no appendectomy should be performed and hernioplasty. The type-3 Amyand hernia can be more difficult to diagnose as extensive inflammatory changes may obscure the appendix within the inguinal canal. The inflammatory changes may be intra-abdominal or, in the cases of a large hernia or long appendix, may affect the scrotum or flank (31,32). □

MANAGEMENT

There are different surgical modalities for Amyand's hernia. Appendectomy is recommended in inflamed appendix without using mesh. The use of mesh for hernia repair in contaminated wound is advocated by some surgeon but is strongly opposed by others due to high possibility of post operative wound infection. It is generally accepted that mesh should not be used in infected cases because prosthetic material can increase the inflammatory response and result in an increased incidence of wound infection (4,25,33).

Priego et al. (24) made diagnosis of incarcerated crural hernia with vermiform appendix inside, and performed appendectomy via the hernia sac and used mesh in three cases (24). Postoperative course of five of their cases was uneventful, but one patient developed wound

Classification	Type
L	Lateral hernia
M	Medial hernia
Mc	Combined hernia
F	Femoral hernia
I	Hernia orifice < 1.5 cm
II	Hernia orifice 3 cm
III	Hernia orifice >3 cm

TABLE 5. Aachen classification (Schumpelick and Arlt 1995)²⁰

Classification	Description	Surgical management
Type 1	Normal appendix within an inguinal hernia	Hernia reduction, mesh repair, appendectomy in young patients
Type 2	Acute appendicitis within an inguinal hernia, no abdominal sepsis	Appendectomy through hernia, primary repair of hernia, no mesh
Type 3	Acute appendicitis within an inguinal hernia, abdominal wall, or peritoneal sepsis	Laparotomy, appendectomy, primary repair of hernia, no mesh
Type 4	Acute appendicitis within an inguinal hernia, related or unrelated abdominal pathology	Manage as types 1 to 3 hernia, investigate or treat second pathology as appropriate
Type - 5 a	Normal appendix within an incisional hernia	Appendectomy through hernia, primary repair of hernia including mesh
Type - 5 b	Acute appendicitis within an incisional hernia, no abdominal sepsis	Appendectomy through hernia, primary repair of hernia
Type - 5 c	Acute appendicitis within an incisional hernia, abdominal wall, or peritoneal sepsis or in relation to previous surgery	Mange as type - 4

TABLE 6. Classification of Amyand Hernias, After Losanoff and Basson, modified by Rikki (8) as Rikki's classification of Amyand Hernias

infection in which a prosthetic material was used. However, Saggar et al reported that they used a mesh in their case with a right-sided incarcerated inguinal hernia without any untoward sequel (33). Laparoscopic reduction of "Amyand's hernia" had been described previously.

Reijnen et al, in 2003, found that diminished fibrin degradation is a common pathway for the formation of adhesions (34). Other factors which can cause adhesions are like inflammatory reaction, high friction and ischemic tissue. Singal R et al. (35) reported three cases diagnosed as traumatic abdominal wall hernia and managed successfully with the help of the USG and CECT scan. CECT scan is the modal-

ity of choice in evaluation of blunt trauma abdomen cases and to evaluate the associated intra-abdominal injuries (36). It is also useful for identification of the associated injuries. Extensive dissection to free the sac from the cord or the adjacent tissue, especially in patients with large sliding inguinal hernias, may be demanding and there is an increased risk for complications. The significance of aggravating factors – complex injuries related to the hernia (size, degree of sliding, multiplicity, etc.), patient characteristics (age, activity, respiratory disease, dysuria, obesity, constipation) or special surgical circumstances (technical difficulties, infection risk) have been demonstrated by Stoppa in 1998 (9).

A retrospective study of elderly patients with groin hernias over 65 years of age identified incarceration in almost 13% of inguinal hernias (37). A Kaplan-Meier estimate used to calculate the cumulative probability of irreducibility found the probability of an inguinal hernia becoming irreducible increased with time from 6.5% at 12 months to 30% at ten years.

Four to five per cent of all groin hernias will present and be operated on acutely (38,39). Gallegos et al. (40) studied the presentation of inguinal hernias with a 'working diagnosis of strangulation'. Their results demonstrated a cumulative probability of strangulation for ingui-

nal hernias to be 2.8% after having the hernia for three months, increasing to 4.5% after two years. Their study calculated that, from the rate at which the cumulative probability of strangulation in groin hernias increased, the greatest was during the first three months of developing a hernia. However, the term strangulation in this study was misleadingly used to describe an acute presentation of an inguinal hernia rather than the finding of compromised bowel at operation. Fourteen of their 22 patients (64%) with an acute hernia had evidence of compromised tissue at operation with only one out of 439 patients requiring a bowel resection (40). Another study estimated the lifetime risk of strangulation to be 0.272% (1 in 368) for an 18-year-old man and 0.034% (1 in 2941) for a 72-year-old man with an inguinal hernia (41).

□

CONCLUSIONS

"Amyand's hernia" is a rare entity which is hard to diagnose preoperatively. Once the appendix is the content of the hernia sac, chances of complications are higher. USG and MDCT are the useful modalities. Treatment involves appendectomy in inflamed appendix through the herniotomy incision itself with meticulous hernia repair.



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