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Case Report

Amyand's Hernia diagnosed preoperatively via a CT scan: A case report [☆]

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ABSTRACT

Amyand's hernia is a rare type of inguinal hernia characterized by the presence of the vermiform appendix within the hernia sac. It was named after Claudius Amyand who performed the world's first successful appendectomy on an 11-year-old boy with a right inguinal hernia in 1735 and discovered a herniated appendix during surgery.

This condition warrants urgent surgical treatment, with the type of surgical intervention depending on the appendix's condition. However, the nonspecific clinical presentation often complicates the preoperative diagnosis, emphasizing the critical role of imaging in surgical planning.

Herein, we present the case of a 74-year-old male who presented with fever, inguinal swelling, and discomfort. Clinical suspicion of inguinal and scrotal inflammation prompted us to perform a prompt CT scan. This radiological evaluation led to a preoperative diagnosis of a Type 3 Amyand's hernia.

This case highlights the significance of CT scans in the accurate and timely diagnosis of Amyand's hernia. Distinguishing between various types of Amyand's hernia is pivotal as it profoundly influences surgical decision-making and postoperative outcomes. By sharing this case, we contribute to current knowledge about Amyand's hernia, increase clinical awareness of the condition, and emphasize the crucial role of imaging in its management.

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Introduction

In 1735, the surgeon known as Claudius Amyand successfully performed surgery on an 11-year-old boy with a right inguinal hernia and discovered that the appendix had herniated into the inguinal hernia sac. This marked the first successful appendectomy and subsequently gave rise to the name "Amyand's hernia" for inguinal hernias that include the appendix, regardless of the presence of inflammation [1,2].

Although inguinal hernias are common pathological entities, Amyand's hernia remains infrequently encountered in clinical practice. The preoperative clinical diagnosis of the condition is challenging due to the absence of pathognomonic clinical features. Therefore, imaging modalities (especially CT) play a pivotal role in establishing the diagnosis and determining the appropriate surgical approach.

Case presentation

The patient was a 74-year-old male who presented with a fever. His past medical history includes old myocardial infarction, chronic kidney disease, hypertension, and pollen allergies. His family history was unremarkable. He had been experiencing swelling in the right inguinal area and discomfort in the scrotum for over a year but did not seek medical care because there were no other symptoms. Approximately 2 weeks ago, he developed a persistent fever, which prompted him to seek medical attention at our hospital. Upon admission, he was alert and oriented, with a blood pressure of 178/81 mmHg, a pulse rate of 115 beats per minute, a body temperature of 36.9°C, SpO₂ of 100% on room air, clear breath sounds, and normal heart sounds. His abdomen was flat and soft, while his scrotum was enlarged (measuring approximately 20 × 10 cm). Scrotal tissue was remarkably firm, accompanied by erythema and warmth, extending from the right inguinal region to the right scrotum, with no pain. Blood test results showed a white

blood cell count of $18.5 \times 10^3/\mu\text{L}$ and a C-reactive protein level of 16.85 mg/dL. There were no other significant abnormalities in his blood test results.

A CT scan revealed a right inguinal hernia with the appendix inside the hernia sac (Fig. 1). The appendix appeared enlarged, and the continuity of its wall was unclear, especially at its tip. The surrounding adipose tissue exhibited haziness, and a multilocular fluid collection with a capsule-like appearance indicated the presence of an abscess extending from the right inguinal canal into the scrotum (Fig. 2). With the protrusion of the appendix, the patient had developed gangrenous appendicitis, leading to the formation of an abscess within the hernia sac. Manual reduction was not feasible because of the gangrene, and there was a risk of infection spreading into the abdominal cavity. Therefore, emergency surgery (appendectomy and radical inguinal hernia repair) was performed. During surgery, it was evident that the enlarged appendix had strongly adhered to the hernia sac, and much greenish-white pus was present within the abscess. Intraoperatively, notable signs of infection were observed in the upper part of the testis. Consequently, we performed a high orchiectomy.

Macroscopic examination of the resected specimen revealed that the appendix and its surrounding mesentery, which are considered the contents of the hernia, measured 109 × 81 × 19 mm when opened. The mesentery between the appendix, from the center to the near tip, was dark brownish, and there was some tissue loss. Scattered areas of brownish hemorrhage were noted on the serosal surface (Fig. 3A). We observed a coarse, dark brownish structure that is partially covered with a membranous grayish-white material within the hernia sac. The tunica vaginalis of the testis remained intact, with no continuity observed with the hernia sac (Fig. 3B).

Histologically, in the appendix, the wall structure from the mucosa to the muscularis propria was generally preserved. In the mesentery of the appendix, extensive fibrosis alongside abundant inflammatory cell infiltration and hemorrhagic necrosis (Fig. 4). These findings were consistent with hemorrhagic necrosis due to circulatory disturbance associated with hernia sac incarceration.

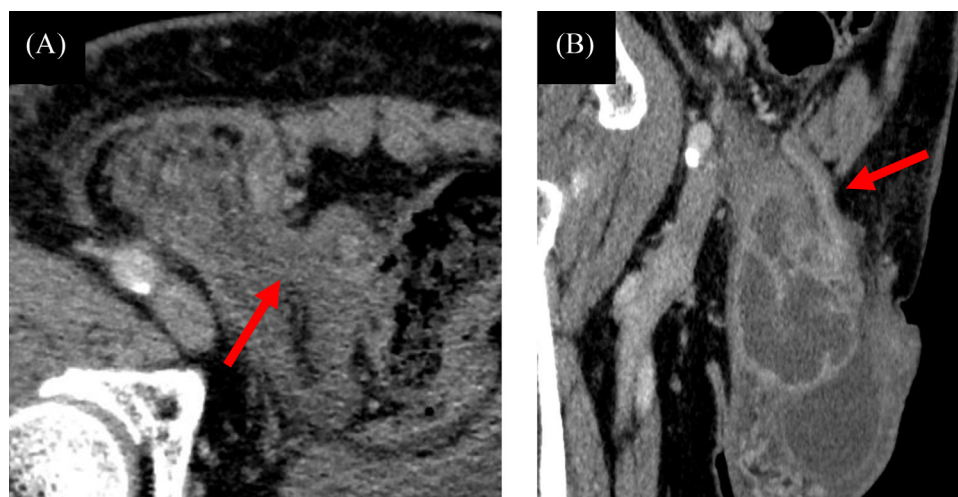


Fig. 1 – The axial (A) and sagittal oblique (B) contrast enhanced CT scan showed the appendix (arrow) inside the hernia sac and the continuity of its wall was unclear especially at its tip.

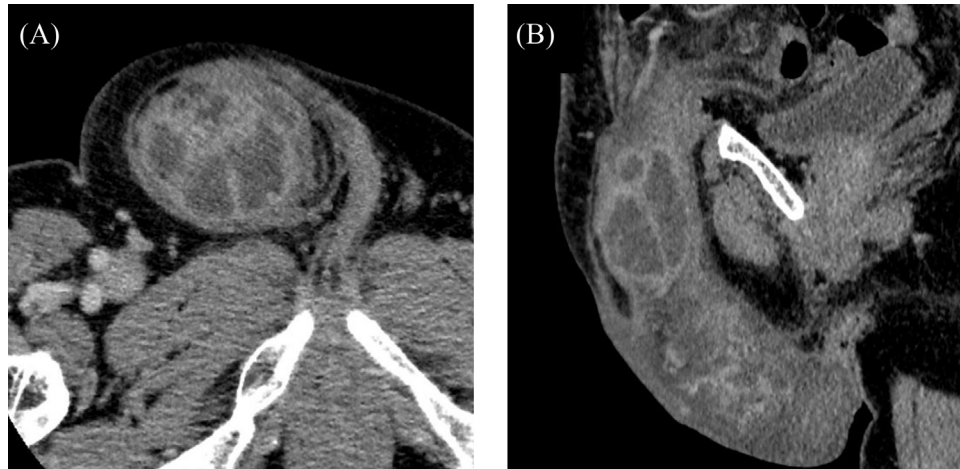


Fig. 2 – The axial (A) and sagittal oblique (B) contrast enhanced CT showed an abscess extending from the right inguinal canal into the scrotum.

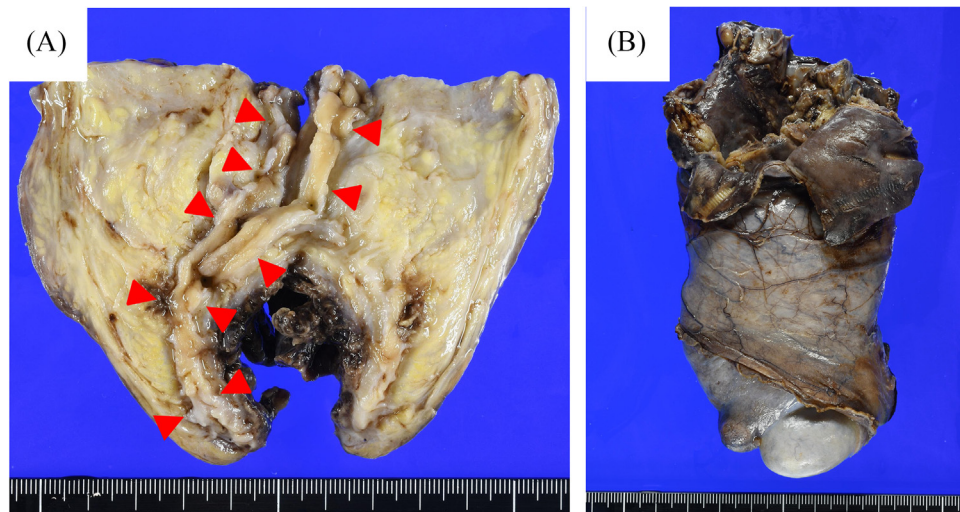


Fig. 3 – Macroscopic image of the resected specimen. The appendix (arrowhead) has been incised. A portion of the mesentery between the appendix showed dark brownish color, and there was some tissue loss. The tunica vaginalis of the testis remained intact (B).

The postoperative clinical course was uneventful, and the patient was discharged on the ninth postoperative day. As of the current date, approximately 1 year and 5 months post-discharge, there have been no reports of wound infections or hernia recurrences.

Discussion

Amyand's hernia has been reported in a wide range of age groups, from newborns to the elderly. Its incidence is relatively low as it accounts for 0.19%–1.7% of all inguinal hernias [3,4]. The occurrence of appendicitis within Amyand's hernia is even less common, with its prevalence being estimated to

be between 0.07% and 0.13% and appendiceal perforation occurring in only 0.1% of those cases [4]. Amyand's hernia complicated by appendicitis is reported to account for 0.1% of all cases of appendicitis [9].

The ages of patients reported to have Amyand's hernia vary widely, from 3 weeks to 88 years [8]. The condition is approximately thrice as common in children as it is in adults due to the higher prevalence of a patent processus vaginalis in children [4,9]. Nevertheless, due to concerns about radiation exposure, CT scans are less commonly performed in children than in adults. This poses a challenge in preoperative diagnosis, especially in pediatric cases where imaging modalities are generally used less frequently.

Amyand's hernia typically occurs on the right side because the anatomically normal position of the appendix is on the

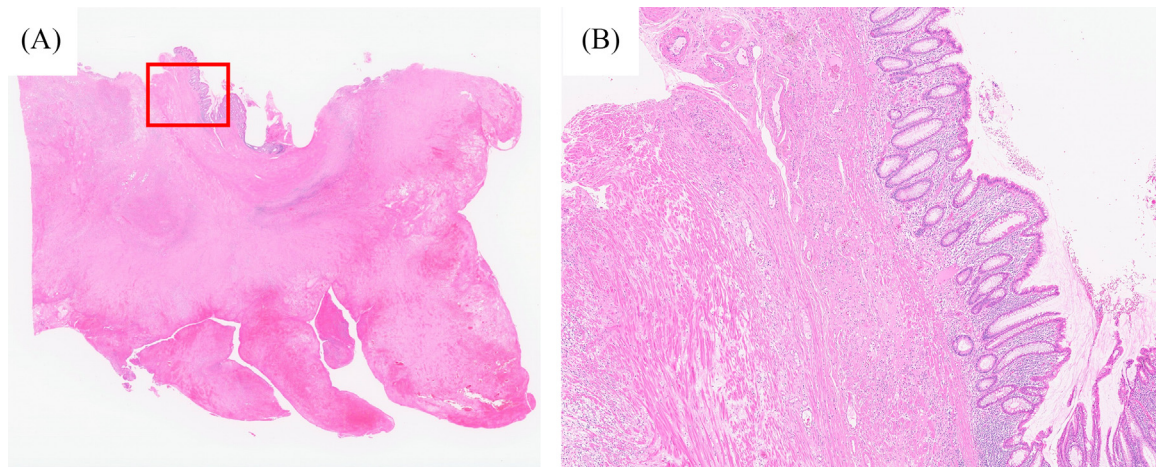


Fig. 4 – Histologic findings. Hematoxylin and eosin stain. (A) Hemorrhage and fibrosis was seen in the mesentery of the appendix. (B) Magnification of the boxed region in (A). The appendiceal wall structure was preserved. There was little infiltration of inflammatory cells from the mucosa to the muscularis propria.

right. However, there have been reported cases in which the condition occurs on the left side due to factors such as cecal mobility, situs inversus, intestinal malrotation, and other anatomical variations [5,7,9,11].

Patients with Amyand's hernia may only be minimally aware of their symptoms, especially if the protrusion of the appendix does not result in appendicitis. Apart from inguinal swelling, these patients may exhibit only a few other clinical manifestations. Furthermore, it is noted that the incarceration of the appendix alone does not typically lead to ileus [8].

In patients with Amyand's hernia, it is also common not to observe fever or elevated white blood cell counts [11,12]. Even when abdominal pain is present, it is considered non-specific, making it difficult to differentiate from various abdominal conditions, including acute appendicitis [12].

In the differential diagnosis of Amyand's hernia, several conditions should be considered, including hernia incarceration, orchitis/epididymitis, undescended testis, tumors involving the testis with vascular structures, hydrocele, Richter's hernia, enlarged inguinal lymph nodes, torsion of the testis or ovary, and herniation of intra-abdominal floating organs such as the intestines. Inflammatory conditions such as enteritis should also be considered [8–10].

Therefore, conducting imaging studies is crucial in making the diagnosis of Amyand's hernia. If a tubular structure with a blind end is visualized protruding into the inguinal region on imaging, it can aid in diagnosing Amyand's hernia. Regarding the presence of appendicitis, findings such as thickening of the wall of the appendix, congestion, and increased peri-cecal fat density can provide additional clues [8,10].

In the past, the preoperative diagnosis of Amyand's hernia was considered challenging through imaging studies; however, nowadays, there have been increasing reports of successful preoperative diagnosis due to advancements in imaging techniques. Nevertheless, the success rate of preoperative diagnosis remains relatively low (around 17.2%). In most cases, the diagnosis is still made during surgery [7,8].

The primary treatment for Amyand's hernia involves early appendectomy and hernia repair. If there is no concurrent appendicitis, hernia repair alone may be considered enough therapy. The choice of treatment depends on the specific clinical presentation and intraoperative findings, and it is important to address both the hernia and the appendix as appropriate during surgery.

The exact mechanism by which appendicitis occurs in conjunction with inguinal hernias like Amyand's hernia is not fully understood. However, several proposed mechanisms include:

- Inflammation due to incarceration.
- Adhesions were formed as the appendix remained within the hernia sac for long, increasing the risk of injury.
- Increased intra-abdominal pressure resulting from the contraction of abdominal muscles, leading to the compression and functional obstruction of the escaped appendix.
- Swelling of the escaped appendix due to venous stasis, causing microcirculatory disturbances in the wall of the tubular organ, which can promote bacterial overgrowth and translocation.

These are some of the theories regarding the pathogenesis of appendicitis in inguinal hernias [13].

While these mechanisms are considered, it is important to note that the precise cause of appendicitis in Amyand's hernia may vary among individual cases, and further research is needed to fully elucidate the underlying causative factors.

Losanoff et al. classify Amyand's hernia into 4 types, ranging from Type 1 to Type 4, based on the severity of the cases [6]:

- Type 1: When there is no inflammation in the appendix.
- Type 2: When inflammation occurs in the appendix but is confined within the hernia sac.
- Type 3: When inflammation in the appendix spreads outside the hernia sac.
- Type 4: When there are complications such as mucous cystadenoma or cancer in the appendix.

In Type 2 cases, the use of artificial materials (such as mesh) during hernia surgery is considered to come with a higher risk of infection. Therefore, it is recommended to use a technique that involves suturing biological tissues. This classification serves as a useful guideline to tailor the diagnosis and treatment approach to specific characteristics of each case.

In our patient, inflammatory marker levels were elevated and there was a fever. However, there were no typical signs of appendicitis in the clinical course and physical examination findings. This made it challenging to differentiate it from other conditions such as orchitis, epididymitis, or testicular torsion. However, the emergency contrast-enhanced CT scan revealed the presence of the appendix protruding into the inguinal hernia, along with signs of appendicitis and the presence of an abscess, all of which were identified before initiating treatment. This case underscores the utility of imaging diagnosis in supporting both emergency surgery and preoperative diagnosis.

Furthermore, in distinguishing the herniated appendix from the contents of the hernia sac or from the cecum into the scrotum, the creation of not only axial images but also sagittal and coronal images, and, in some cases, oblique images, proved to be valuable in the imaging diagnostic process.

Losanoff et al. suggest that for Type 3 cases, treatment may involve not only appendectomy and hernia repair but also more extensive surgical procedures such as high orchiectomy, right hemicolectomy, and debridement for necrotizing fasciitis, depending on the individual case. In this particular case, in addition to appendectomy and inguinal hernia repair, performing a more extensive procedure like high orchiectomy resulted in a favorable outcome without exacerbations of inflammation or postoperative complications [6].

Type 3 cases tend to have more extensive inflammation that can spread to the scrotum and the lateral abdominal area compared to other types. While imaging diagnosis can be somewhat challenging in these cases [5], when a preoperative diagnosis is achieved through imaging studies, it can provide crucial information.

Regarding the CT findings in this case, the preoperative CT scan revealed appendix enlargement; however, there was no significant contrast enhancement, and the continuity of the appendix wall was interrupted. Therefore, the diagnosis was that the patient had developed gangrenous appendicitis. Histopathologically, there was noticeable hemorrhagic necrosis in the mesentery of the appendix. The appendix likely became enlarged and inflamed due to external compression of the organ within the hernia sac, resulting in impaired blood flow from the serosal side as suggested by the findings of pathology.

The use of imaging studies such as CT and ultrasonography is of great value in diagnosing Amyand's hernia, as it can be challenging to differentiate this condition from other diseases based solely on chief complaints and clinical findings. Preoperative imaging diagnosis plays a crucial role in determining the surgical approach. This case underscores the importance of imaging modalities in guiding treatment decisions.

It is expected that the accuracy of preoperative diagnosis will continue to improve with advancements in imaging diagnostics. As a result, the importance of imaging modalities in clinical practice is likely to increase further in the future.

Conclusion

We experienced a case in which a patient with an external inguinal hernia had his appendix protruding into the hernia sac, forming an abscess within the hernia sac with significant surrounding inflammation. This was preoperatively diagnosed using CT imaging. This was preoperatively diagnosed using CT imaging, leading to an appendectomy, hernia repair, and high orchiectomy.

While Amyand's hernia has historically been predominantly diagnosed during surgery, it is now conceivable that advancements in imaging diagnostics allow for the preoperative assessment of hernia contents and the extent of inflammation spread.

For patients with hernia incarceration or those experiencing symptoms such as abdominal pain due to the inflammation of the herniated appendix, imaging diagnosis is highly valuable not only for distinguishing this condition from other differential diagnoses but also for determining the necessity of emergency surgery and selecting the appropriate surgical approach. It plays a crucial role in guiding treatment decisions.

Patient consent

Written informed consent was obtained from the patients for this case report.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.radcr.2024.04.031](https://doi.org/10.1016/j.radcr.2024.04.031).

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