

Case Report

## Incarcerated Amyand's Hernia

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A 76-year-old Japanese man was transferred to our hospital to undergo rehabilitation after traffic accident-related injuries. Seven days post-admission, he presented with abdominal pain and an 8-cm lump in the right inguinal region. He was diagnosed with an incarcerated inguinal hernia and underwent elective surgery the day after manual reduction. He had a normal vermiform appendix which was observed to have adhered to the right indirect hernia sac. An appendectomy and hernia repair using lightweight mesh were performed. We discuss the surgical management of this rare incarcerated Amyand's hernia and the relevant literature.

**Key words:** Amyand's hernia, incarcerated inguinal hernia, appendectomy

Inguinal hernias are common, and various organs and tissues have been reported to be included within inguinal hernia sacs [1]. Amyand's hernia is a type of inguinal hernia in which the hernia sac contains the vermiform appendix [2]. A normal appendix is found in the inguinal hernia sac in 0.5-1% of cases; thus, this finding is extremely rare [1]. Due to the rarity of this condition and the lack of a randomized controlled study or an evidence-based standardized approach to treatment, there is some debate as to whether prosthetic mesh use and a prophylactic appendectomy should be routinely performed to treat Amyand's hernias [3], especially incarcerated Amyand's hernias. We report a rare case in which an incarcerated inguinal hernia contained a normal-appearing appendix.

### Case Report

A 76-year-old Japanese man had been diagnosed with talar and calcaneal and malleolar fractures after being involved in a traffic accident and was treated via cast immobilization at another hospital. He was trans-

ferred to our hospital for rehabilitation. Before admission, he had a right inguinal hernia with no history of incarceration, and a computed tomography (CT) scan indicated that the appendix was not present within the hernia sac. Seven days after his admission, he presented with abdominal pain and a physical examination detected an 8-cm lump in the right inguinal region. An abdominal CT scan revealed a right inguinal hernia that contained the intestines of the ileocecal section (Fig. 1).

The patient was diagnosed with an incarcerated inguinal hernia, and a manual reduction was performed. After the manual reduction, the abdominal pain was eased and a physical examination did not indicate appendicitis. A preoperative laboratory examination demonstrated a white blood cell count of 3,500/ $\mu$ L. The patient underwent elective surgery the next day. An intraoperative examination showed that the vermiform appendix and the cecum were located in and had adhered to the right indirect hernia sac (Fig. 2). When the hernia sac was opened, a fibrous connection between the vermiform appendix and the hernia orifice was observed, and it was dissected carefully. An appendectomy was performed, and hernia repair was

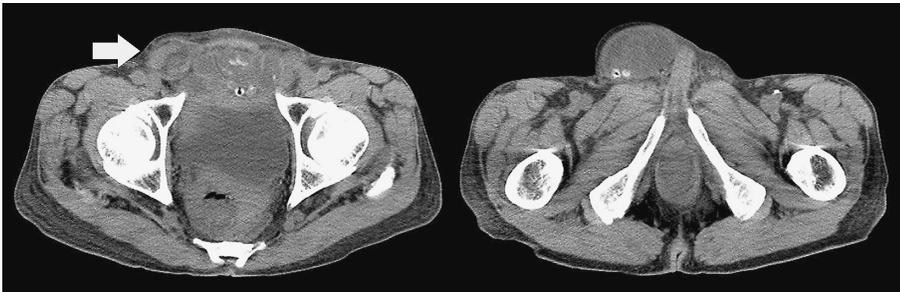


Fig. 1 Computed tomography findings. A computed tomography scan showed that the sac of the right inguinal hernia contained the vermiform appendix (white arrow).

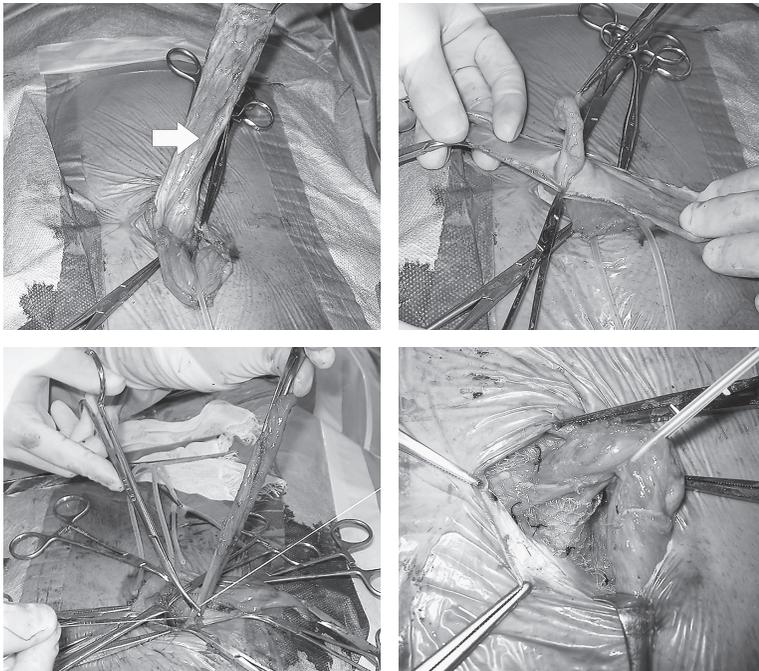


Fig. 2 Intraoperative findings. **A**, The hernia sac was dissected and separated from the cord. The vermiform appendix was identified in the hernia sac (white arrow); **B**, After opening the sac, the appendix was dissected and separated from the sac; **C**, Appendectomy was performed; **D**, A prosthetic polypropylene mesh was inserted using the Lichtenstein method.

A	B
C	D

then carried out using lightweight mesh by the Lichtenstein method. The patient's postoperative course was uneventful. A pathological examination showed no evidence of the appendiceal inflammation or appendicitis.

### Discussion

Various organs and tissues have been found within inguinal hernias, including fat, the bowel, the omentum, an ovary, the bladder, Meckel diverticulum, and the appendix [4, 5]. Amyand's hernia was first reported in 1735, in a case in which a perforated appendix was found in a hernia sac, and an appendectomy was performed successfully [6]. Amyand's hernia is considered to be rare; it has a prevalence of about 1% among incarcerated inguinal hernias, and most cases are iden-

tified incidentally during surgery [2]. The term 'Amyand's hernia' has been used to describe various clinical conditions, including (a) the occurrence of an inflamed appendix with an inguinal hernia, (b) the presence of a perforated appendix within an inguinal hernia, and (c) the presence of a non-inflamed appendix within an irreducible inguinal hernia [1, 7].

The incidence of appendicitis within an inguinal hernia is rare at 0.07-0.13% and the incidence of perforated appendix incarcerated within an inguinal hernia is also rare at 0.1% of all cases of appendicitis [8]. The majority of cases of Amyand's hernia involve men with right-sided inguinal hernias, most of which present with groin pain [2]. Amyand's hernia does not exhibit a predilection for any particular age group and has been reported to occur in patients ranging in age from neonates to 92 years old [8].

Definitive preoperative diagnoses of Amyand's hernia are rare. Instead, such diagnoses are generally made incidentally during hernia surgery [2,8]. Computed tomography is considered to be the best available imaging tool for the evaluation of acute abdomen and abdominal hernias [5]. Inguinal hernias have typically been diagnosed clinically or during surgery, and therefore imaging tools are not always helpful for the differential diagnosis in such cases [8]. In fact, obtaining a preoperative clinical diagnosis was reported to be practically impossible [9], although ultrasonography, or CT might be of some assistance [10,11]. In addition, previous reports about diagnostic methods did not include sensitivity and specificity data [9].

Regarding the treatment of Amyand's hernias, surgeons are faced with the 2 conditions, *i.e.*, the hernia and the appendicitis, and if the appendix is not inflamed, questions arise about the necessity of a prophylactic appendectomy and prosthetic mesh repair [12]. Several researchers have suggested that prophylactic appendectomy is not necessary when the appendix does not exhibit signs of inflammation [2]. On the other hand, Ofili reported 2 cases in which acute appendicitis occurred after inguinal hernia repair was performed without incidental appendectomy and 11 cases in which no wound infection or hernia recurrence was seen after herniorrhaphy was carried out in combination with incidental appendectomy [13]. It has been suggested that manipulating the appendix without removing it during herniorrhaphy might lead to appendicitis [14], and it was proposed that incidental appendectomy is necessary in such cases [13]. Whether a normal appendix should be removed remains a clinical dilemma because there is no evidence-based information about this topic [1].

Lonsanoff *et al.* reported a classification system for Amyand's hernias which is very helpful for intraoperative decision-making [15]. According to their criteria, our patient's case is type I, in which a normal appendix is found in an inguinal hernia sac. Hernia reduction with mesh replacement is recommended for such cases. However, this diagnosis was not considered to be strictly accurate, as an incarcerated hernia that exhibits peri-appendiceal adhesion to the hernia sac (as seen in our patient) is difficult to place in the above-mentioned classification system. Holms *et al.* reported a similar case of peri-appendiceal adhesion to the hernia sac which was complicated by difficulties with the reduction

of the hernia and in which the above-mentioned classification was used [16]. However, that case did not involve an incarcerated hernia.

It was reported that appendices located within inguinal sacs are more frequently inflamed than appendices within the abdominal cavity normally [2]. One possible explanation for this finding is that when an appendix is located within a hernia sac inside the inguinal canal, it is more vulnerable to injury and secondary inflammation [2,8,11]. In addition, contractions of the abdominal muscles can cause the intermittent compression of the appendix, which can lead to appendiceal ischemia, infection and severe inflammation [2]. Kose *et al.* reported a series of 5 cases of Amyand's hernia in which hernia repair with mesh replacement was performed, and the normal appendices were subjected to appendectomy. They suggested that the presence of fibrous connections between the vermiform appendix and the surrounding hernia sac, and the manipulation and surgical maneuvers involved in dissecting the appendix might cause increased inflammation, provoking secondary appendicitis [17]. On the other hand, localization of the appendix within the hernia canal does not always lead to appendicitis [2]. Practically, preoperatively determining whether the appendix has adhered to the hernia sac is impossible. Although the surgical management strategy largely depends on the surgeon's experience, decisions regarding whether a prophylactic appendectomy is performed should be based on common sense after taking into account the benefits and risks [1].

Conducting inguinal hernia repair with prosthetic mesh as a tension-free repair method under elective conditions is the gold standard procedure for reducing the risk of recurrence compared to deficit reinforcement using native tissue [8]. Inguinal hernia repair is a form of clean surgery, but the addition of a prophylactic appendectomy changes it to clean-contaminated surgery [12]. In such conditions, the use of prosthetic mesh is generally avoided to prevent mesh infections. However, there is still considerable debate regarding the use of prosthetic mesh to repair incarcerated hernias. Lie *et al.* reported that surgical site infections did not lead to mesh infections, and as long as the wound was kept clean and contamination-free, the use of mesh was not contraindicated [18]. In our patient's case, manual reduction had already been performed and the operation was conducted in an elective setting. In addition,

the fibrous connection between the hernia sac and the appendix was dissected without injuries occurring; in addition, during the appendiceal resection procedure, the stump was inverted and buried in the cecum using purse-string sutures, and we took great care to prevent the contaminated portion from coming into contact with the surrounding tissues. We considered that prosthetic mesh use is not contraindicated in the elective setting for patients without appendicitis or a strangulated hernia.

The most common choice of surgical approach for an Amyand's hernia is appendectomy via a herniotomy, with primary hernia repair [8]. Recently, the incidence of laparoscopic surgery is on the rise [8], and Vermillion *et al.* reported the first instance of a laparoscopic appendectomy for the treatment of an Amyand's hernia with appendicitis [19]. Laparoscopy for dealing with an Amyand's hernia is frequently diagnostic as well as therapeutic, and has the advantage of detecting the type and nature of the hernia and the status of the appendix [20]. However, no true consensus has been achieved regarding the best possible management approach [20], and we did not choose laparoscopic surgery for this reason.

The major complications of Amyand's hernia include perforation of the appendix, necrotizing fasciitis of abdominal wall and secondary intestinal perforation [2]. Amyand's hernias have a high mortality rate ranging from 14% to 30%, and they are closely linked to the peritoneal spread of sepsis [21]. In the present case, we considered that early surgery was necessary to treat the incarcerated Amyand's hernia--even though manual reduction had been performed successfully--in order to prevent secondary appendicitis [11].

In conclusion, Amyand's hernia is a rare entity and its preoperative diagnosis and surgical management are difficult. Although manual reduction of the incarcerated inguinal hernia was successfully achieved in our patient's case, we recommend an early operation, involving safe prosthetic mesh use in consideration of the risk of appendicitis.

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