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Case Report

Acute Appendicitis within Incarcerated Hernia Sac: A Case Report and Literature Review

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**Abstract:** *Background:* Localization of acute appendicitis in a hernia sac is a rare phenomenon with a frequency of around 0.08 - 1 %. Even fewer cases of postoperative hernias with a vermiform appendix in the hernia sac have been described. We selected 23 cases in the English literature describing this phenomenon and analyzed diagnostic and treatment options. *Case presentation:* We present a 72-year-old woman who was complaining of a painful, rigid mass in the anterior abdomen wall for two days. After performing an ultrasound, incarcerated ventral hernia was diagnosed and emergency surgery was performed. During the surgery, gangrenous appendicitis was found in the hernia sac. It was decided to do an appendectomy and primal hernioplasty. Postoperative period was uneventful. *Conclusion:* Appendicitis within incisional hernia is an extremely rare phenomenon. Diagnosis may be challenging because of dominating incarcerated hernia symptoms. However, computed tomography might play a crucial role, by differentiating causes of acute abdomen. Appendectomy is the standard option for appendicitis treatment, however, there is no consensus on how abdominal wall integrity should be restored.

**Keywords:** appendicitis; vermiform appendix; incisional hernia; postoperative hernia; appendectomy; hernioplasty

1. Introduction

A postoperative hernia is one of the most common late complications after surgical interventions in the abdominal area. The incidence of this complication can vary on average from 10 % to 15 %, depending on the surgery performed. [1] The highest risk of postoperative hernia is after midline laparotomy, with a 2-year risk of up to 35.6 %. [2] During surgery, it is common to find omentum, large or small intestine, or preperitoneal fat in the hernia sac. In sporadic cases – a vermiform appendix is included. [3]

After reviewing the available English literature, twenty-three publications on this topic were selected. Of these, twenty-one cases describe acute appendicitis found in a postoperative ventral hernia. [4–24] Another two publications refer to the appendix without inflammatory changes. [25,26] (Table 1)

The purpose of this publication is to present a unique clinical case describing appendicitis incarcerated in a postoperative hernia and share our hospital experience and review the literature.

Table 1. Previous cases of appendix within the incisional hernia.

| No | Author                 | Previous operation  | Location of the hernia  | Appendix   | Diagnostic method | Surgery performed                         |
|----|------------------------|---------------------|-------------------------|------------|-------------------|-------------------------------------------|
| 1. | Abu Ghazaleh et al [4] | C-section           | Para-umbilical incision | Inflamed   | CT                | Right hemicolectomy, primary hernioplasty |
| 2. | Agada et al [27]       | Multiple C-sections | Previous incision site  | Perforated | During surgery    | Appendectomy, primary hernioplasty        |

|     |                            |                                                                                               |                                                                                                                           |                                                                                            |                                                                                       |                                                                                                                     |
|-----|----------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 3.  | Kabir et al [6]            | N/A                                                                                           | Paramedial                                                                                                                | Perforated                                                                                 | During surgery                                                                        | Right hemicolectomy, primary hernioplasty                                                                           |
| 4.  | Pufoš et al [7]            | Laparoscopic bilateral inguinal hernia                                                        | Supraumbilical port site                                                                                                  | Inflamed                                                                                   | During surgery                                                                        | Appendectomy, primary hernioplasty                                                                                  |
| 5.  | West et al [28]            | 1 <sup>st</sup> – abdominal aortic aneurysm repair<br>2 <sup>nd</sup> – laparoscopic surgery  | 1 <sup>st</sup> – laparotomy incision<br>2 <sup>nd</sup> – port site incision                                             | 1 <sup>st</sup> – inflamed.<br>2 <sup>nd</sup> – inflamed                                  | 1 <sup>st</sup> – CT<br>2 <sup>nd</sup> – CT                                          | 1 <sup>st</sup> – appendectomy, hernioplasty with mesh<br>2 <sup>nd</sup> – appendectomy, hernioplasty with mesh    |
| 6.  | E.d et al [10]             | Multiple C-sections                                                                           | Previous incision site                                                                                                    | Inflamed                                                                                   | During surgery                                                                        | Appendectomy, laparoscopic hernioplasty                                                                             |
| 7.  | Ortiz-Contreras et al [9]  | Laparoscopic cholecystectomy                                                                  | Right lower quadrant port site hernia                                                                                     | Inflamed with abscess                                                                      | CT                                                                                    | Appendectomy, primal hernioplasty                                                                                   |
| 8.  | R. Singal et al [11]       | 1 <sup>st</sup> – N/A<br>2 <sup>nd</sup> – N/A<br>3 <sup>rd</sup> – N/A                       | 1 <sup>st</sup> - right iliac fossa previous incision<br>2 <sup>nd</sup> - groin hernia<br>3 <sup>rd</sup> – groin hernia | 1 <sup>st</sup> – perforated<br>2 <sup>nd</sup> – gangrenous<br>3 <sup>rd</sup> - inflamed | 1 <sup>st</sup> – CT<br>2 <sup>nd</sup> – US, during surgery<br>3 <sup>rd</sup> – N/A | 1 <sup>st</sup> – appendectomy<br>2 <sup>nd</sup> – appendectomy<br>3 <sup>rd</sup> – appendectomy                  |
| 9.  | Al-Hadithy et al [12]      | Radical nephrectomy                                                                           | Previous incision site                                                                                                    | Inflamed                                                                                   | CT                                                                                    | Appendectomy, hernioplasty with mech                                                                                |
| 10. | Bak et al [29]             | Loop ileostomy reversal surgery                                                               | Right lower quadrant incisional hernia                                                                                    | Inflamed                                                                                   | CT                                                                                    | Laparoscopic appendectomy, primal hernioplasty                                                                      |
| 11. | Cerná et al [14]           | Laparoscopic surgery                                                                          | N/A                                                                                                                       | Gangrenous perforated                                                                      | During surgery                                                                        | N/A                                                                                                                 |
| 12. | Dittmar et al [30]         | Kidney transplantation                                                                        | Right lower quadrant incisional hernia                                                                                    | N/A                                                                                        | N/A                                                                                   | Laparoscopic appendectomy, primal hernioplasty                                                                      |
| 13. | Galiñanes et al [31]       | Total hysterectomy with right-sided oophorectomy                                              | Pfannenstiel                                                                                                              | Inflamed                                                                                   | CT                                                                                    | Laparoscopic appendectomy, primal hernioplasty                                                                      |
| 14. | Issa et al [17]            | Hysterectomy                                                                                  | Pfannenstiel                                                                                                              | Gangrenous                                                                                 | US, CT                                                                                | Appendectomy, primal hernioplasty                                                                                   |
| 15. | Kler et al [25]            | Hysterectomy                                                                                  | Pfannenstiel                                                                                                              | Not inflamed                                                                               | CT                                                                                    | Appendectomy                                                                                                        |
| 16. | Lakhani et al [18]         | Nephrectomy and kidney transplantation                                                        | Right lower quadrant incisional hernia                                                                                    | Perforated                                                                                 | CT                                                                                    | N/A                                                                                                                 |
| 17. | Lam et al [32]             | Laparoscopic sterilization                                                                    | Umbilical laparoscopic port site incision                                                                                 | Inflamed                                                                                   | CT                                                                                    | Appendectomy, hernioplasty with mesh                                                                                |
| 18. | Marcinkeviciute et al [26] | Laparoscopic sigmoid colon resection                                                          | Right lower quadrant port site hernia                                                                                     | Not inflamed                                                                               | CT                                                                                    | Laparoscopic hernioplasty                                                                                           |
| 19. | Molina et al [20]          | Open cholecystectomy                                                                          | Kocher incision                                                                                                           | Inflamed                                                                                   | US, CT                                                                                | Appendectomy, primal hernioplasty                                                                                   |
| 20. | Paudyal et al [33]         | Laparotomy with right-sided salpingectomy                                                     | Pfannenstiel                                                                                                              | Inflamed                                                                                   | US                                                                                    | Appendectomy, primal hernioplasty                                                                                   |
| 21. | Skelhorne-Gross et al [34] | Multiple laparotomies                                                                         | Previous incision site                                                                                                    | Perforated                                                                                 | CT                                                                                    | Medications, delayed appendectomy, and hernioplasty with mesh                                                       |
| 22. | Cantay et al [23]          | Laparoscopic total hysterectomy with both-sided oophorectomy                                  | Right lower quadrant port site hernia                                                                                     | Inflamed                                                                                   | Rx, US, during surgery                                                                | Appendectomy and hernioplasty with mesh                                                                             |
| 23. | Sugrue et al [24]          | 1 <sup>st</sup> – open cholecystectomy<br>2 <sup>nd</sup> – diagnostic laparoscopy and lavage | 1 <sup>st</sup> – upper midline incisional hernia<br>2 <sup>nd</sup> – right iliac fossa port site incision               | 1 <sup>st</sup> – inflamed<br>2 <sup>nd</sup> - inflamed                                   | 1 <sup>st</sup> – Rx, during surgery<br>2 <sup>nd</sup> – US, during surgery          | 1 <sup>st</sup> – appendectomy and hernioplasty with mesh<br>2 <sup>nd</sup> – appendectomy and primal hernioplasty |

C-section – Cesarean section; N/A – not available; CT – computed tomography; US – ultrasound; Rx – X-ray.

## 2. Case Report

Here we present a case of gangrenous perforated appendicitis in the incisional hernia.

A 72-year-old woman presented with abdominal pain lasting for two days. The pain increased gradually, the most intense around the ventral hernia. The patient also complained of nausea and vomiting. No other complaints, such as fever, diarrhea, or changes in urination were reported. Her past medical history included ventral hernioplasty with a mesh 9 years prior. An objective examination revealed a distend abdomen, painful when palpated around the hernia, without signs of peritonitis. Hernia was irreparable, painful while palpating, and rigid.

After performing routine imaging tests – abdominal ultrasound (US) – incarcerated hernia of the abdominal wall was observed, with the 4 cm gate. Blood flow in the tissues of the hernia sac was registered, and a small amount of free fluid was visible in the abdominal cavity. In laboratory blood tests increased inflammatory indicators were seen - leukocytosis -  $14.31 \times 10^9/l$ , C-reactive protein - 117 mg/l.

An urgent surgical treatment was indicated. During the surgery, a laparotomy incision was made above the hernia. The hernia sac then separated from the surrounding tissues. The hernia sac was composed of multiple chambers. In one of them, a gangrenous and perforated appendicitis was found with a small amount of purulent fluid. The appendectomy was then performed. Since the purulent process prevailed, primary hernioplasty was performed. The abdominal cavity was drained with two drains, and one drain with an active suction system was left.

After the surgery, the patient received conservative treatment. The postoperative course proceeded without any complications and the drains were removed three days post-operation. Subsequently, the patient was discharged following an eight postoperative day. The patient had no complications on day 30.

## 3. Discussion

A postoperative hernia is a common complication following abdominal surgery interventions. Studies have shown that the most significant risk was associated with an incision in the midline of the abdominal wall. [35] Occasionally, postoperative hernias form in other areas, such as paramedian, subcostal, McBurney, Pfannenstiel, or former trocar incisions. The risk is increased by factors like the patient's age, gender, obesity, other comorbidities (for example, connective tissue diseases, type 1 and type 2 diabetes), immunosuppression, surgical site infection, and smoking. [36] Postoperative hernias may be asymptomatic, but some patients experience non-specific symptoms, such as intermittent abdominal pain, feeling of fullness, and aesthetic dissatisfaction. The main complication of untreated postoperative hernia is the incarceration of the hernia sac and intestinal obstruction. This is one of the acute abdominal conditions that require prompt diagnosis and immediate surgical attention. The frequency of such complications is from 6 to 15 % of cases. [37]

Acute appendicitis is one of the most common causes of acute abdomen that require intensive surgical treatment. Every year, 96-100/100,000 people in the world are diagnosed with appendicitis. [38] Although this is an extremely common pathology in surgeon practice, diagnosis can be complicated and challenging. In suspicion of acute appendicitis, the symptoms, and the medical anamnesis are the primary focus. Scales have been developed to assess the risk of appendicitis. One of the most widely used is the Alvarado scale. If the score is 5 or more, the probability of the patient suffering from appendicitis increases significantly. [39] In case of typical symptoms: Kocher's symptoms, nausea, vomiting, it is appropriate to perform an abdomen ultrasound. This instrumental examination method is cheap, fast, and widely available. [39,40] In exceptional cases, computed tomography of the abdomen and pelvis or magnetic resonance imaging may be appropriate for diagnosis. Diagnosing appendicitis can be challenging due to its atypical position, the patient's old age, severe obesity, and other comorbidities. [41–43] In the presence of several acute abdominal pathologies, the symptoms may overlap, thus leading to a worse prognosis and the choice of treatment tactics. Currently, the standard way of treating uncomplicated appendicitis is appendectomy. However, according to *De Almeida Leite et al* 2022 published a systematic review with a meta-analysis, antibiotic therapy is a possible alternative in the treatment of uncomplicated

appendicitis, although it should be emphasized that longer hospitalization time and the risk of recurrence are possible. [44] Untreated appendicitis can perforate and cause a potentially life-threatening condition - acute peritonitis.

Localization of acute appendicitis in a hernia sac is a rare phenomenon. The literature states that the frequency varies around 0.08 - 1 %. Even fewer cases of postoperative hernias with a vermiform appendix in the hernia sac have been described. (Table 1) [31] Diagnosis is the primary challenge encountered by surgeons. In the article, *Meinke et al* demonstrated that in the case of a hernia combined with appendicitis, the symptoms of an incarcerated hernia usually predominate. The main symptom is a rigid painful mass around the hernia. Meanwhile, typical early symptoms of appendicitis, such as pain in the epigastrium, descending to the lower abdomen, nausea, and vomiting, are not that typical. This leads to late diagnosis, which usually occurs while undergoing surgery. Moreover, it increases the risk of complications (such as perforation (41 %) or gangrene of the appendix (26 %)). [45] After reviewing the collected literature, it is observed that in the presence of clinical signs of incarcerated hernia, a computed tomography (CT) scan with contrast is usually chosen. In 14 out of 23 described cases, a CT scan was the primary diagnostic choice. As a result, there was a more precise diagnosis during the preoperative phase. A faster, cheaper, and more accessible method of examination is the ultrasound. However, based on several clinical cases, it has been shown that the UG exam is not a dependable diagnostic test when it comes to distinguishing the contents of the hernia sac with accuracy. [11,17,20,23,24] In the clinical case report, *Issa et al* documented the use of abdominal ultrasound as a primary choice for the diagnosis of postoperative hernia obstruction. The ultrasound revealed an inflammatory fatty mass (omentum) that was adhered to, but no evidence of distal intestinal dilatation was observed. Notably, the examination did not visualize the cecum. After performing a CT scan, it was seen that there is an incarcerated appendicitis in the hernia sac. [17]

The primary treatment for an inflamed appendix vermiform is surgery, as previously stated. However, there is a contentious discussion regarding the suitability of removing the intact appendix. Specific authors argue for the removal of the vermiform appendix to prevent disease recurrence, regardless of inflammation. [31] Alternatively, some experts recommend retaining the appendix in the absence of evidence of inflammation or other relevant indications. This avoids postoperative complications – surgical site infection, bleeding, formation of adhesions, and ileus. Additionally, it is believed that the appendix serves as an essential component by stimulating immunity through B- and T-lymphocyte-mediated response. [46] *Marcinkeviciute et al* reported an inadvertent discovery of an appendix located within a postoperative hernia in their case study. During the surgery, the appendix was easily separated from the hernia sac and left in the abdominal cavity while laparoscopic hernioplasty was performed. [26] *Kler et al* also advocate the preservation of the vermiform appendix, but in the described clinical case, macroscopic changes in the tip of the appendix were observed. To avoid complications, the appendix was removed. [25] A unique treatment strategy for acute appendicitis in hernia was chosen by *Skelhorne-Gross et al*. The patient's anamnesis includes morbid obesity, an extensive list of co-morbidities, several laparotomies in the past, and a gigantic postoperative hernia. The patient's dominant complaint was pain in the right side of the abdomen. CT scan revealed acute appendicitis in the hernia sac. After assessing the patient's condition and co-morbidities, it was decided to start conservative treatment with antibiotics. After her condition improved, the patient was discharged home. Five weeks later, a delayed hernioplasty and appendectomy were performed. The postoperative course was smooth, and no complications were observed. [34]

Over the years, discussion arises when deciding on the method of postoperative hernia treatment after appendectomy. Once the source of infection has been removed, there are several options to restore abdominal wall integrity depending on surgery time and technique – primary hernioplasty, mesh hernioplasty, or delayed mesh hernioplasty. It can be performed as an open surgery or laparoscopically. Currently, there is no established specific algorithm. Treatment tactics are chosen individually, considering the doctor's abilities, the hospital's sources, and the characteristics of the patient. [47] When evaluating the selected articles, it was observed that most

surgeons prefer primary hernioplasty. This was also done in our case. Meanwhile, author *West C.* described two cases of appendicitis within a postoperative hernia. In both cases, acute ischemic appendicitis was removed during surgery. In the first case, hernioplasty was performed using collagen bridging mesh, the postoperative course was uneventful, and the patient was discharged home for further treatment. In the second case, a proline mesh was used for hernioplasty, and a suction system was formed. The patient developed a wound infection that was controlled with antibiotics. The further course of treatment was uneventful, the patient was discharged home. [28]

#### 4. Conclusions

In conclusion, appendicitis in a postoperative hernia is an unique case. Symptoms of an incarcerated hernia often predominate. For diagnosis, it is most appropriate to choose computed tomography. This diagnostic method of examination allows a more accurate assessment of the contents of the hernia sac. In the presence of this pathology, urgent surgical treatment is indicated – appendectomy and hernioplasty. The choice of hernia treatment method depends on the doctor's experience, the hospital's capabilities, and the individual case. The purpose of this work is to introduce rare cases and individual treatment options.

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