

REVIEWS

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Challenges in strategies for Amyand hernia in children: literature review with clinical illustrations

Sergey Klyuev^{1*} and Mustafa Azizoğlu²

Abstract

Introduction Amyand hernia (AH) is a rare disease, so there are no standard strategies and there are many different aspects at each stage of its management. Based on our own experience, we encountered these differences even in a small number of cases and therefore sought to review the literature to highlight the diversity of approaches to this pathology. This review of the literature was not intended to describe the statistical findings found in the clinical case series, but rather to highlight the clinical and surgical difficulties of AH in children. Nevertheless, we conducted an introductory statistical study based on data from PubMed and Google Scholar to understand the global prevalence of AH.

Materials and methods The search for the key terms Amyand hernia, Amyand's hernia, and "children" between 2003 and 2023 resulted in 52 PubMed and 548 Google Scholar articles.

Results After the exclusion of irrelevant studies, 101 articles were found. A total of 83 case reports describing 182 pediatric patients were used to understand the demographic distribution of this pathology. Given the impossibility of further comprehensive statistical analysis (due to heterogeneous data), a narrative design was used to describe the remaining aspects of AH management. Finally, three clinical cases demonstrated the mentioned aspects.

Discussion As a result of the search, conclusions were drawn about the main difficulties in the management of AH in children, which were discussed.

Keywords Amyand hernia, Appendicitis, Children, Malrotation, Appendectomy, Inguinal hernia repair

Introduction

The abdominal wall hernias usually contain an omentum or small intestine, but it is extremely rare to find unusual contents such as a Meckel's diverticulum (Litre's hernia), part of the bowel wall (Richter's hernia), or an appendix (Amyand's hernia). These hernias have not only eponymous names but also a common feature—they

are difficult to diagnose before surgical examination. The story of the first appendectomy and Amyand hernia (AH) is very popular among surgeons [1]. However, there are still no strict criteria for the diagnosis of that eponymous diagnosis, as well as little knowledge about the clinical and surgical features of this pathology. The current review of the literature gives the impression that there are many underreported cases and there is, probably, a mismatch in terminology that makes the count moot. For example, there is data that from the original case published in 1736 to 2017 [2, 3], there are only 228 documented cases of AH. A search for the current review has identified 182 only pediatric cases in only the last 20 years, not counting adults and all cases up to 2003.

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Due to the rare occurrence of AH, it is rarely taken into account in differential diagnosis and is mainly an accidental intraoperative finding due to various clinical manifestations or complications. In addition, during the operation, the presence of the appendix with or without the caecum in the hernial sac can lead to a difficult technical situation and controversial actions of a surgeon. The lack of classification systems and standards in pediatric practice brings about different and unreasonable decisions in individual cases. We have encountered several types of AH, which manifested as surgical emergencies and required non-standard approaches. In this study, we represent the literature review with personal clinical illustrations, aiming to focus on clinical and surgical difficulties in children with AH.

Material and methods

Using the databases PubMed and Google Scholar, we carried out a meticulous literature search over a period between 2003 and 2023, using the key terms Amyand hernia, Amyand's hernia and "Children" and synonyms, together with the Boolean operator AND/OR. The search resulted in 52 articles in PubMed and 548 results in Google Scholar-600 in total (Fig. 1). Eventually after the exclusion of irrelevant studies and duplications 83

pediatric case reports, 10 statistically significant case series, 8 reviews were found.

Definition

Rigorous terminology is needed for the correct evaluation of technical features, results, and understanding that the authors are on the same page. Found that at the beginning of the analysed period, there was a slight difference in the definition of AH in different sources. Most sources declare AH as simply the presence of an appendix [4–6]—herniation, harboring, or protrusion of an appendix; and few suggest mandatory incarceration of the appendix [7]. The presence of the caecum with the appendix in the hernial sac is also called Amyand sliding hernia by some [8], but most authors do not distinguish this symptom from other cases of AH. Moreover, a hernia containing the ileum, appendix, caecum, and ascending colon in adults has been described as a giant Amyand hernia [9]. Similar to incarceration, the degree of inflammation of the appendix does not change the definition [10].

Incidence

The exact incidence of AH varies greatly by geographic area and appears to be undetermined, as most cases

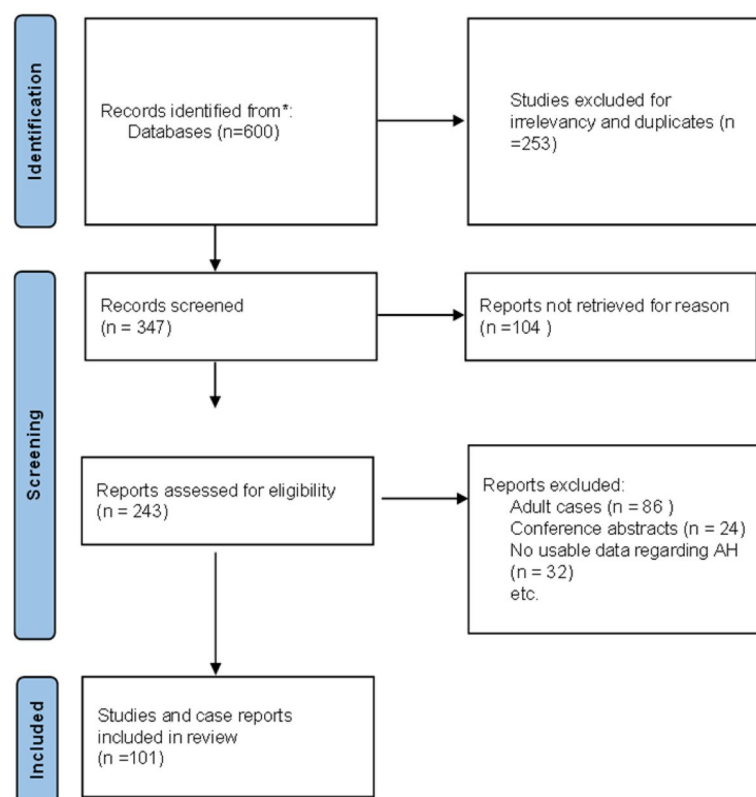


Fig. 1 PRISMA flow diagram of study selection. No legend

occur in developing countries without further reporting. The analysis of 83 pediatric case reports ($n=182$) provided an approximate overview of the worldwide reports of AH (Fig. 2). The distribution of cases of AH by parts of the world is contradictory evidence of its predominance in Asia and Africa, but there is not enough data to refute a simple correlation between the incidences of AH and inguinal hernia in general. This seems logical given the population sizes and possible underreporting of AH.

Despite varying numbers of cases, most authors report similar AH rates. The incidence of Amyand hernia rarely ranges from 0.09 [10] to 1.7% [7, 8, 11, 12]. Thus, a pediatric surgeon can expect to find an appendix in 1–1.6 out of every 1000 hernia sacs [13]. A clinical serial study involving 21 cases in Turkey, where the highest number

of AHs have been registered in the last 20 years, showed that the incidence of AH is also 0.97% [14]. Therefore, there is still no convincing population data on the demographic prevalence of AH. However, there are some reports pointing to a possible genetic predisposition. For example, Baldassarre et al. [15] reported two 32-day premature twins with simultaneous right-sided AHs, where a congenital band extending from the appendix into the scrotum to the right testicle in neonates has been suggested as a possible explanation.

There are also not many sources indicating on associated conditions, as undescended testis [16]. More rarely, an unusual left-sided AH may be associated with situs viscerus inversus, intestinal malrotation, or a cecum mobile [4, 17]. There is a suggestion that the caecum and

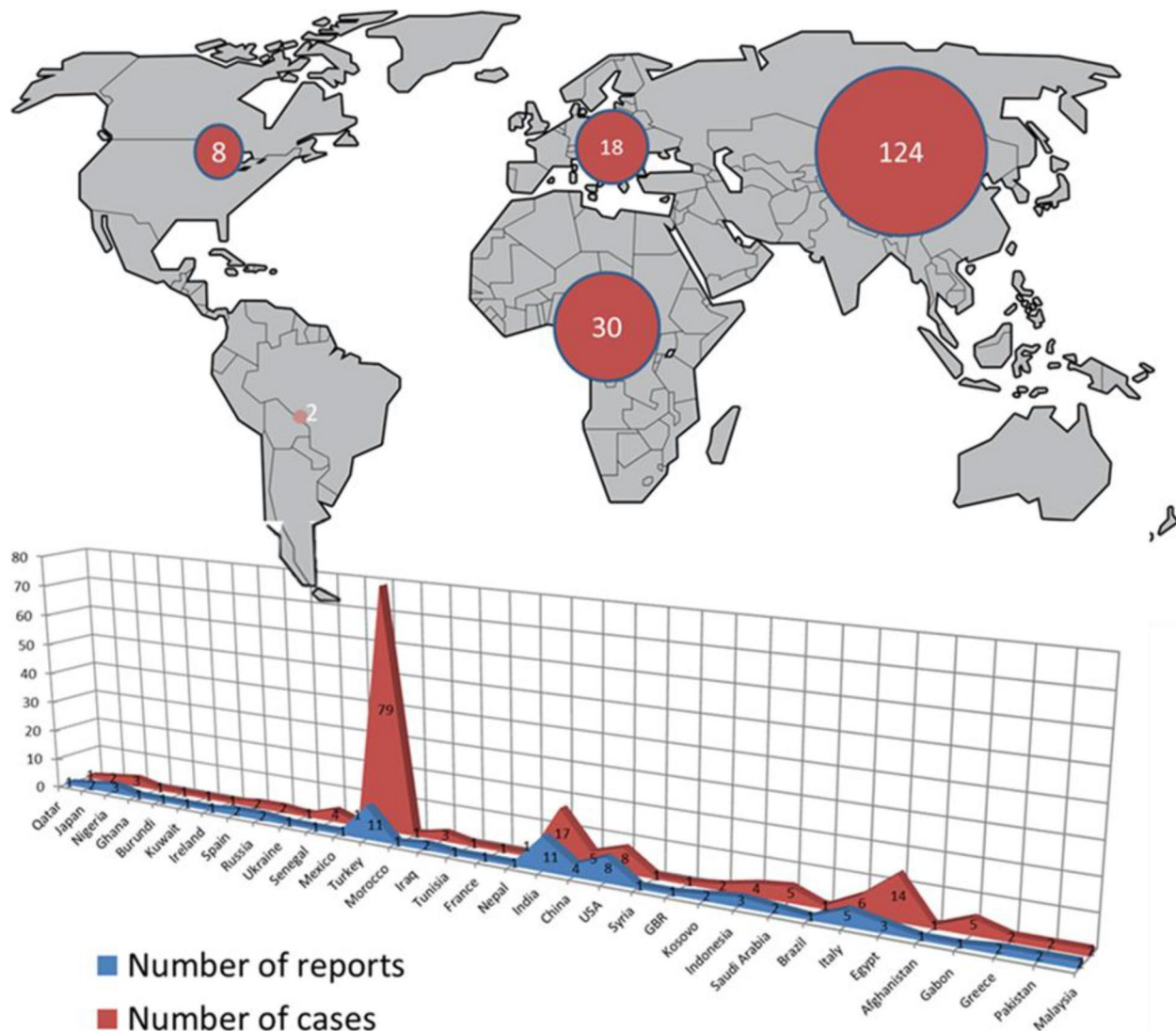


Fig. 2 Global pediatric Amyand hernia case reporting over 2003–2023. No legend

appendix protrude through the left inguinal canal, either due to high caecal mobility, in these cases [5]. Therefore, the higher mobility of an appendix with or without caecum is one of the more popular etiologic theories rather a genetic predisposition [18].

The frequency of right-sided AH is so high that some authors state exclusively right-sided [5], however, there are many reports of cases of left-sided AH with previously noted associations [4, 5, 17, 18]. Moreover, some authors have found that the rate of left-sided AHs is between 4.3% [19] and 10% [20]. The distribution of AH between males and females varied significantly (Table 1) from reports of findings exclusively in boys [11, 19, 21, 22] to 16–25% of female AH in some case series [3, 6].

Despite the fact that AH is recorded in all age groups [1], it is diagnosed three times more often in childhood, when it is associated with patency of the vaginal process and, therefore, more often indirect [25, 26]. Most cases of AH have been registered in premature newborns and young children [20]. According to the literature, the average age at which surgical correction of AH is performed ranges from 5 days after birth to 16 months [27]. In a series of cases in adults, the second peak of AH at about 70 years of age [28, 29] was found with a predominance of direct hernias.

The etiopathogenesis

The etiopathogenesis of AH is still disputable, as well as the role of compressive trauma to the appendix inside the hernial sac in the development of acute appendicitis [3]. It is noticed [30] that the appendix can be herniated in any abdominal wall hernias—inguinal, incisional, Spigelian, or umbilical. On the one hand, there is no evidence of a higher incidence of acute appendicitis

associated with AH patients, on the other hand, there are relatively fewer cases of obstructive appendicitis in these patients [3].

Classification of AH

Losanoff and Basson proposed a classification of AH in 2007 [3, 8, 31], where AH without or with appendicitis is presented in the following subtypes:

- Type 1 includes a normal appendix within the inguinal hernia
- Type 2 includes acute appendicitis without inflammation
- Type 3 includes acute appendicitis with inflammation of the abdominal wall or peritoneum
- Type 4 includes appendicitis with concomitant abdominal pathology.

This classification was created to provide rationale for the further surgical technique in adults, mainly focused on the possibility of using a mesh depending on the degree of regional septic inflammation. However, some pediatric cases have been described using this classification [3, 8, 18]. The fact that almost all pediatric AH are indirect and require a different approach than in adults, in addition to the presence of a different spectrum of comorbidities, dictates the need for a different classification and strategy in pediatric surgery. Classification of AH in children according to presenting symptoms and inflammatory status of the appendix could help determine whether an appendectomy should be performed [19] and how to manage left-sided AH.

Table 1 Case series of Amyand hernia in children over the 2003–2023 period

Source	Number of cases	Median age	Female	U–urgent, E–elective	Appendectomy	Primary hernia repair
Gupta B, et al. 2019 [3]	6 (4 children)	NA* (2 adults)	1 (25%)	U	1 (25%)	In all children
Almetaher H.A. et al. 2020 [6]	12	7 months (range 15 days to 5 years)	2 (16%)	U	1 (8%)	12
Okur M.H., et al. 2013 [14]	21	20.3 months (ranging from 2 months to 10 years)	1 (4.7%)	U	9 (42.8%)	21
Cigsar E. B., et al. 2016 [19]	46 (2 left)	16.7 months (range 15 days–8 years)	0	9 – U; 37 – E	18 (39%)	46
Kaymakci A, et al. 2009, [20]	30	1.5 years (range 19 days to 8 years)	2 (6%)	NA	5 (16.6%)	30
Cankorkmaz L., et al. 2010 [22]	12	40 days (range, 15 days–14 months)	0	U	10 (83%)	12
Tartar T., et al. 2022 [23]	47	3 months	6 (12.7%)	U	11 (23.4%)	47
Malikov MKh, et al. 2021 [24]	9	11 (4 to 14 years)	NA	E	9 (100%)	9

NA* not applicable

Difficulties before surgery

The rarity, abnormal and unexpected location of the vermiform appendix, and late admission with septic complications make the diagnosis and treatment of AH difficult. The clinical picture varies widely, but all cases can be divided into two groups: uncomplicated with a non-inflamed appendix—the majority of the cases [8] and complicated. Complications usually arise from late hospitalization and a pronounced inflammatory condition of the appendix within the hernial sac.

Uncomplicated AH has no defining features and initially manifests itself as an incarcerated or strangulated hernia without any additional features. Preoperative diagnosis of AH is very difficult and, as a rule, is an incidental finding during surgery due to various clinical manifestations and features [7, 21, 32]. However, while in some studies [20] none of the patients was diagnosed before surgery, other authors indicate that a thorough clinical examination and various instrumental studies made it possible to establish a preoperative diagnosis in a large percentage of cases, especially in children older than one year [6, 14, 32]. Preoperative diagnostics provide information to parents of patients about AH and preoperatively prepare the surgeon for precise treatment [14].

Ultrasonography is considered the most effective and justified instrumental method. First, inguinoscrotal ultrasonography can detect the appendix within the hernial sac as an incarcerated tubular structure [6, 33]. Some authors [6, 14] point to the relatively high sensitivity of ultrasound in the preoperative diagnosis of AH. So, M. Okur et al. [14] report that AH can be detected by ultrasound in 42.8% of patients before surgery if the sonographer is aware of this condition. Secondly, ultrasound is useful for differential diagnosis and can detect other acute conditions testicular torsion [27] and acute epididymitis [34], which in the early stages can mimic AH.

Less commonly, CT was used to diagnose AH. Rather in complicated cases than routinely [7, 14, 20], due to exposition to radiation and extra cost. It is considered more justified in left-sided AH, but in most cases, it is performed after surgery to exclude malrotational abnormalities or situs viscerus inversus. An abdominal X-ray can be used to demonstrate the presence of gas in the groin area in the case of a strangulated hernia, signs of intestinal obstruction, or perforation of a hollow organ in the case of severe ischemia [27]. There are also sporadic data on the use of upper gastrointestinal contrast to confirm normal bowel rotation in left-sided AH [5].

Most of the complications of AH are septic in nature and in the advanced stage cannot indicate AH itself as the root cause. The primary cause of these changes in most cases is appendicitis within the hernial sac, which is not typical for AH and, according to literature develops

in 0.07–0.13% [6, 28, 35]. However, some studies [14, 20] demonstrate a higher incidence of up to 16.6% of inflamed appendixes among patients with incarcerated AH. This fact fuels controversy about the relationship between the strangulation of the appendix in the inguinal canal and the development of its inflammation [36]. Some authors [14] believe that once the appendix enters the sac, it becomes vulnerable to injury, which, in turn, results in blood supply interruption or significant reduction, leading to inflammation and appendiceal obstruction.

The indirect course of the hernia makes it possible to communicate with the inguinal canal and scrotal cavities. That explains many cases of abdominal wall abscesses or scrotal pyoceles (scrotal abscess) [23, 26, 37–40], scrotal [41] or right groin entero-cutaneous fistula [42], pneumohernios due to the rupture of the caecum [43]. Cases with varying degrees of septic lesions of the spermatic cord and testis have also been published, ranging from ischemic inflammation [34] to necrosis followed by removal of the structures [44, 45]. The AH manifestation as acute scrotum without hernia bulge is possible in neonates [46] and should be included in differential diagnosis among infants. The spread of the septic process into the abdominal cavity can lead to the formation of an abscess of the abdominal cavity on the background of the perforation of the appendix into the inguinal hernia [47, 48]. There are also many reports of necrotizing fasciitis of the anterior abdominal wall secondary to caecal perforation or appendicitis in AH patients [45, 49–51]. In cases of caecal involvement, signs of intestinal obstruction are also present [18].

Difficulties during the surgery

Surgical treatment of AH can be challenging if it presents as an incidental finding or complicated. The best strategy is debatable and, according to the literature [14, 20, 52–54], varies depending on many factors, such as the presence of a preoperative diagnosis, the generally accepted approach for pediatric inguinal hernia in a particular hospital (use of reduction, open or laparoscopic surgery), urgency of the case (strangulation). Although the most common cases of AH were reported as urgent [6, 20, 23], there are also case series where all [24] or most cases [19] were operated on as elective. Statistical analysis of appendectomies in published singular clinical cases was not possible due to the fact that complicated cases were registered more often, and the samples were not representative. The explanation of the appendectomies discussed in the case series seems to be more actual (Table 1).

Most surgeries were performed under general anesthesia [14, 20] and only in exceptional case, with concomitant

hemodynamically significant cardiac abnormalities, spinal anesthesia was used [54]. The surgical approach was initially focused on the repair of strangulated inguinal hernia, especially in cases without a preoperative diagnosis, and the inguinal transverse incision was noted as the most common [6, 14, 19, 20, 23, 34, 37, 54–57]. Appendectomies in these cases were performed via herniotomy with followed primary hernia repair. When perforation or abscess in the pelvis was suspected, a lower median laparotomy was performed without simultaneous hernia repair [28]. Khan R.A. et al. [58] considered midline laparotomy followed by herniorrhaphy indicated in the case of left-sided AH due to possible malrotation.

Laparoscopic appendectomy for AH with appendicitis was first described in 1999 [52]. Later, reports about laparoscopic assistance in the diagnosis and treatment of AH became more frequent after 2010, when it became widely popular for the treatment of inguinal hernias, including the initial approach for strangulated hernias [57]. Most authors consider the laparoscopic method to be safe and effective in these cases with good outcomes and worthy of application [53, 59, 60], regardless of the inflammatory status of the appendix. In these cases, the normally looked appendix was reduced into the abdomen [20] under video control or pulled back into the abdominal cavity without subsequent appendicitis [53, 59, 60]. Some studies have shown that modern laparoscopic procedures involving mechanical manipulation of the appendix do not increase the incidence of appendicitis [28]. However, in the case of Esposito et al. [33], after opening the hernial sac and returning the unchanged appendix to the abdominal cavity, appendicitis developed on the second postoperative day and required surgical intervention. The main conversion factor for laparotomy was considered to be the presence of a necrotic process with inflamed loops in the form of an appendicular infiltrate or abscess, as well as severe ischemic lesions of the abdominal structures, such as intestinal loops, required resection [56].

Intraoperative findings in children with AH often determine further surgical actions, however, there is no single universal strategy regarding an appendix found. While some advocate appendectomy only if the appendix is inflamed [6, 8, 14, 17, 61, 62], others support appendectomy even when it is not inflamed [17, 63] to avoid future complications. Hutchinson R. [61] considered appendectomy contraindicated in non-inflammatory AH, since violation of surgical cleanliness can increase morbidity and mortality from surgical infection. The frequency of an unchanged appendix within the hernia sac ranges from 0.5 to 1%, while the presence of an inflamed appendix is only 0.1% of all hernia cases [20]. Although most authors do not opt for appendectomy in children with AH, it has been performed in the majority

of published clinical cases due to various reasons. In the case series of the same institutions, appendectomies were performed within a wide range from 8 to 100% (Table 1). In the few existing clinical series [6, 14], where the tactics of actions for a non-inflamed appendix were determined, it is obvious that appendectomy should be avoided not only for saving a functional organ but also for possible subsequent use of the appendix in case of reconstruction of the biliary tract, urinary diversion procedures, Malone operations, etc. [14, 29].

In addition to the inflammatory status of the appendix, there are other less common indications for appendectomy suggested by many authors. The next common reason for an appendectomy is the deformation of the appendix and its dense adhesions to the hernial sac [8, 14, 21]. Shazia Jalil [21] reports that adhesions are as important a cause of appendectomy as inflammation. In a study by M. Okur et al. [14] in 21 patients, surgical findings were twelve normal appendixes, six inflamed appendixes, including one perforated, and three hernias, where the appendix was adherent to the hernial sac. In another study [19], a pronounced adhesive process, which made the hernia irreducible, was found in 6% of AHs. Many surgeons also suggest the removal of a normal appendix if it is found in the left inguinal canal, since malrotation or caecum mobile increase the likelihood of a later atypical appendicitis [25, 58, 64].

Primary hernia repair was performed in the most of published cases and case series [6, 14, 19, 20, 23, 34, 37, 54–57], (Table 1). Delayed operations due to septic complications of AH were less common than in adults [65] and were the exception rather than the rule in advanced purulent processes only [23, 26, 37–41, 43]. Appendicitis was not considered an obstacle to the ligation of processus vaginalis in most cases (Table 1). Hernia ligation was performed in all cases of appendicitis regardless of the extent of the inflammation and the presence of purulent exudate nearby [19, 23].

As already mentioned before high ligation of processus vaginalis was a method of choice in most of the cases with rare variations, like the Ferguson method [54]. Only in one case serial study [24], the Lichtenstein method was reported in 2 out of 9 AHs and the other 7 patients required strengthening of the posterior wall of the inguinal canal. However, these surgeries were done by general surgeons with different approaches to inguinal hernias. These authors also used semi-absorbable mesh in adolescents with significant posterior wall defects.

Open hernia repair sometimes requires an extended incision due to technical difficulties [20] or an incision of the internal inguinal ring due to an irreducible hernia. General surgeons reported [24] the need for incision of the internal inguinal ring in 6 out of 9 cases. Laparoscopic

herniorrhaphy seemed to have no features in case of possible treatment of AH.

Difficulties after surgery

Most authors state the absence of complications in the early and late postoperative period of treated AH [6, 14, 20, 23]. The greatest concern is the possibility of developing acute appendicitis after organ-preserving operations, which is not confirmed by most surgeons [14, 19, 20, 23]. However, the case of Esposito [57] does not exclude the absolute possibility of not missing an inflamed appendix at an early stage. Therefore, intensive short-term postoperative monitoring may be useful. The recurrence rate of hernias is the same as in operations for conventional inguinal hernias. In the literature, no septic complications were found in the inguinal canal or scrotum after appendectomy for an inflamed appendix in

AH patients. The frequency of postoperative wound infection practically does not differ from other operations and is no more than 5.5% [14, 28].

Case series

In this series, we report three cases of AH with different features but requesting appendectomy due to different reasons.

Case 1

A male patient, one year six months, was admitted with a strangulated inguinal-scrotal hernia. The intraoperatively found abdominal sac contained a caecum mobile and appendix (Fig. 3). The latter was deformed, flattened, and attached by adhesions of the peritoneum to the dome of the caecum. An appendectomy, with the inverted stump and purse suture, and high ligation of the hernia sac were performed. The reduction required the opening of the

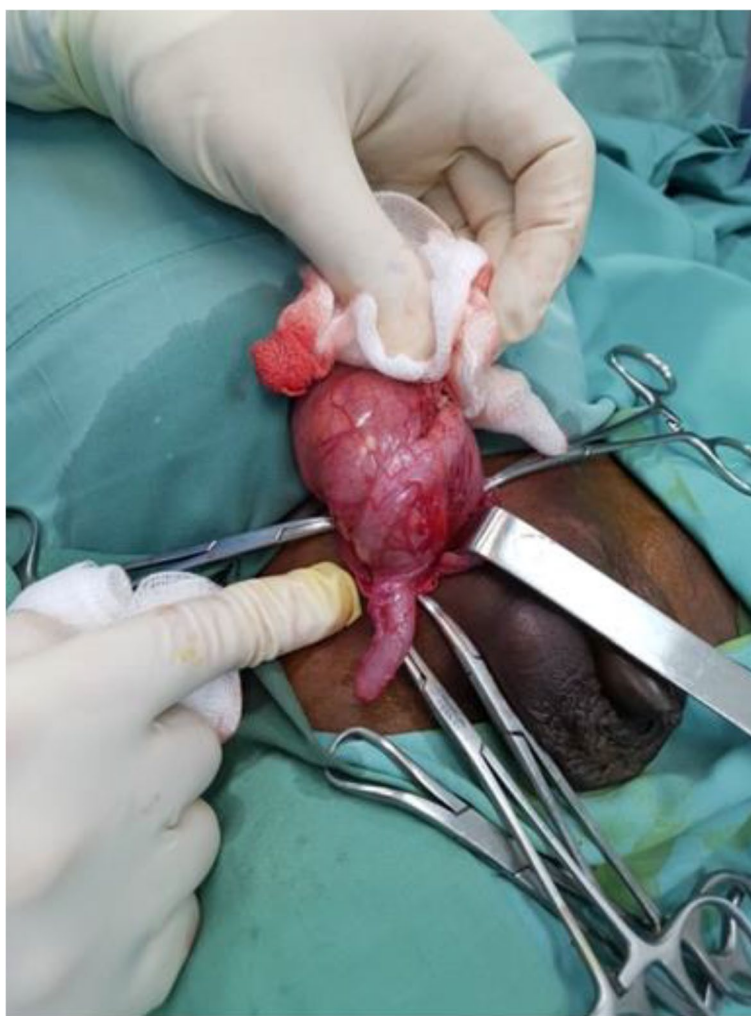


Fig. 3 Case 1. Legend: Intraoperative findings demonstrate AH with an adherent non-inflamed appendix

inguinal canal with extension through the interior inguinal ring. The postoperative course was uneventful.

Case 2

One year and 3 months male was brought by his parents to the emergency room with complaints of vomiting, accompanied by a protrusion in the right inguinal region to the left scrotum. From the anamnesis, the left inguinal lump had been noted periodically since birth. The intraoperatively found appendix was visually normal (Fig. 4). In this case, we decided to perform an appendectomy due to the remote place of living and a very low-income background. The postoperative course was uneventful.

Case 3

A 9-month-old boy with a huge inguinoscrotal hernia was brought by his grandmother. The parents did not seek medical attention for the left inguinoscrotal bulge in the size of the head of the child during the previous 9 months (Fig. 5). According to the grandmother, there

were no signs of intestinal obstruction or incarceration before and at admission also, his physical development was normal for his age. The reduction was possible, but not successful due to the big size of hernial defect. Intraoperative findings include three loops of ileum and caecum with appendix. There were multiple indications for appendectomy in this case—malrotation of the caecum and atypical position of the appendix, risk of further neglect, and absence of the possibility of follow-up in a rural area. The peritoneal and aponeurotic defects were sutured. The postoperative course was uneventful.

In all cases, perioperative antimicrobial prophylaxis was performed.

Discussion

The incidence of AH, registered in different countries, corresponds to the total number of inguinal hernias in children in a particular area and is almost the same over the world. In all countries, it is still considered a rare pathology, but an active pediatric surgeon should expect



Fig. 4 Case 2. Legend: Intraoperative findings demonstrate AH



Fig. 5 Case 3. Legend: Gigantic left-side inguinal hernia, the local status. Intraoperative findings demonstrate malrotated caecum with appendix and a few intestinal loops retrieved from the hernia sac

to encounter this pathology in almost 1–2 cases per 1000 children with inguinal hernia [6, 14]. This literature review and clinical cases demonstrate the possible difficulties in diagnosis, surgical treatment, and complication management of AH, which could be expected by pediatric surgeon. The absence of a unified algorithm for children with AH makes the following questions important.

Does preoperative diagnosis make sense? And what instrumental methods should be applied? Preoperative diagnosis of AH is difficult, and most authors do not strive to achieve it [7, 20, 21], since this does not change the tactics of treating AH much. Ultrasound is not always sensitive—the highest percentage of confirmed AH is reported as 42.8%, and CT is also exposed to radiation [14]. However, some authors [6, 14, 32] suggest the importance of making a diagnosis before surgery to provide information to the surgeon in order to exclude complications or other pathologies and prepare for a more accurate approach. We tend to think that in left-sided and all complicated cases (including long-term hernia protrusion and local septic inflammation with or without necrosis), ultrasound and MRI are necessary. These instrumental findings reveal malrotational anomalies or abscesses within the anterior abdominal wall, inguinal canal, or abdominal cavity, and the surgeon may change the standard approach. In addition, these methods do not carry radiation exposure to the child.

Should we remove the appendix when it is not inflamed?

All pediatric surgeons do not advocate for appendectomy, if it is clear that the appendix is not inflamed [6, 8, 14, 17, 61, 62]. AH is more common in children, but rarely requires appendectomy—on average in about 15% of all cases, while in adults it is required in 65% [66]. Morphologically confirmed complicated appendicitis

was also more common in adults, while normal appendix was found more often in children.

Is there any risk of secondary appendicitis after incarceration?

The most difficult diagnostic challenge is to recognize inflammation of the appendix during surgery when the decision to perform or not to perform an appendectomy must be based on the appearance of the appendix [29]. Sometimes the inflammatory status of the appendix in AH is difficult to determine intraoperatively, therefore, in the clinical series Cigsar et al. [19] three of 18 removed appendixes were morphologically normal. The normal appendix may appear inflamed after incarceration, especially in neonates [29, 37, 46]. Vague subjective criteria in visual assessment of the inflammatory status may result in a negative appendectomy or missed appendicitis. Acute appendicitis did not develop during the follow-up period after reduction in most case series [14, 20, 23, 32], however, there are extremely rare reports when it was observed for unknown reasons [33].

What are the indications for appendectomy in patients with AH?

According to the analyzed literature, only acute appendicitis in hypertensive patients was considered an absolute indication for appendectomy [6, 8, 14, 17, 61, 62]. Relative indications varied and caused differences in the incidence of appendectomies in different institutions. Malrotation and appendicular adhesions are the most common indications after appendicitis [4, 17, 23, 58]. We also personally believe that the patient's social background plays a role in appendectomy, such as living in a remote rural area without access to medical care. The correlation between the onset of incarceration and the frequency of

appendicitis has not been described, so it cannot be considered as a relative indication for appendectomy.

Should we perform primary hernia repair if appendicitis is present, in the presence of purulent discharge?

The contamination of the inguinal canal is not highlighted as a contraindication for closure of the processus vaginalis by most authors [6, 14, 19, 20, 23, 34, 54–57]. There are no reports about specific septic complications within the inguinal canal or scrotal cavities after appendectomies in the case of AH.

What are the possible complications and tactics in complicated AH?

Soft tissue infection, such as scrotal abscess, inguinal abscess [23, 26, 37–40], and fistulas [42], is the most common possible complication. There are no cases describing peritonitis on the background of hypertension. Necrotizing fasciitis of the groin and anterior abdominal wall is the most severe complication of advanced AH with appendicitis. Tactics for septic and necrotic complications vary, but have several common features. In most cases, extensive debridement and appendectomy were performed initially [49, 50], and only occasionally patients required segmental resection of the caecum with anastomosis [50]. There is no accepted strategy regarding hernia repair in such cases. Antimicrobial therapy included an empiric combination of 2–3 broad-spectrum antibiotics (clindamycin, ciprofloxacin, metronidazole, meropenem) followed by replacement with vancomycin, piperacillin-tazobactam according to test results [49, 51, 65, 67].

Overall, the review of the literature and the cases described above did not suggest the best approach to AH. However, modern world experience allows us to more clearly define some aspects of the management of AH in children. In the future, it is necessary to develop a classification for the pediatric population with clarification of the criteria for specific surgical treatment.

Abbreviation

AH Amyand hernia

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Authors' contributions

Research concept and design: SK. Data analysis and interpretation: MA. Collection and/or assembly of data: SK. Writing the article: SK. Critical revision of the article: MA. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Consent to publish is taken in all cases and included in the medical history document of the patient.

Competing interests

The authors declare that they have no competing interests.

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