



Paediatric inguinal hernia anatomical classifications – new perspectives for study design

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Abstract

Introduction and Objective. Inguinal hernia is a common congenital surgical problem in children. There are many techniques for surgical treatment. Due to the fact that so many solutions exist to the problem of inguinal hernia in children, the best choice of surgical technique for a particular patient seems crucial. In the literature, there are many studies designed to compare the results of surgical treatment. It is probable that different types of hernia can be related to different results when a particular technique is used. The laparoscopic approach gives a new perspective to classifying paediatric inguinal hernia. The review aims to summarize the classification systems used in the description of paediatric inguinal hernias.

Review methods. The review is based on academic literature and scientific publications available in PubMed and NCBI – National Library of Medicine databases. After evaluation of abstracts, articles were selected and analyzed, considering the references cited.

Brief description of the state of knowledge. Apart from classical anatomical classifications, the review indicates promising new classifications. Shehata et al. proposed a paediatric hernia classification and tailored treatment modified from the original Nyhus classification for adults, with suggested tailored treatment for each subtype. Toki et al. proposed the ultrasonographic classification for paediatric inguinal hernia. Tanaka et al. assessed the size of the hernia orifice during laparoscopy and used the classification by the European Hernia Society (EHS) for adult patients.

Summary. A unified paediatric inguinal hernia classification would be useful not only for pre- or intra-operative descriptions of the anatomy and size of a hernia. The unification of the classification system of a paediatric inguinal hernia could also be helpful in the study design.

Key words

children, surgery, classification, inguinal hernia

INTRODUCTION

Inguinal hernia is a common surgical problem in children [1]. Thus, the procedure of inguinal hernia repair is very often performed by paediatric surgeons [2]. There are many techniques for surgical treatment. Nowadays, it cannot be simply divided into open and laparoscopic approaches (intraperitoneal and extraperitoneal) because many different solutions to the problem are possible. The choice of the appropriate technique for a particular patient depends on many factors, for example, the age, body mass of the child, concomitant diseases, the centre's experience in performing particular procedures, and the surgeon's preference. The laparoscopic approach gains acceptance due to better cosmetic results and the possibility to avoid a metachronous hernia. Among possible laparoscopic approaches, herniotomy (intracorporeal pursue string suture with dissociation of the peritoneum) and herniorrhaphy (percutaneous stitches, percutaneous pursue string suture, and incorporeal Z-stitch without dissociation of the peritoneum) can be distinguished [2]. In the literature, there are many studies designed to compare the results of the treatment and compare, for example, the prevalence of recurrence, metachronous

hernia, wound infection, cosmesis, testicular atrophy, and vas deferens damage.

Due to the fact that there are so many solutions to the problem of inguinal hernia in children, the best choice of surgical technique for a particular patient seems crucial [1]. There are many studies designed to compare the results of particular techniques. However, the disadvantage is that in most of the studies there are no unified classification systems used to classify the hernia pre-operatively. This seems crucial, because thanks to the laparoscopic approach, it is easier to notice that there are different types of paediatric hernias. The laparoscopic approach gives a new perspective to classifying paediatric inguinal hernia. Different types of hernia can probably be related to different results when a particular technique is used.

The review aims to summarize the classification systems used in the description of paediatric inguinal hernias, based on academic literature and scientific publications available in PubMed and NCBI – National Library of Medicine databases. After evaluation of abstracts, articles were selected and analyzed, considering the references cited.

Classifications of inguinal hernia. Anatomically, an inguinal hernia is a protrusion of a parietal peritoneum and viscera through the opening of the abdominal cavity. The opening can be normal or abnormal. Two major categories of hernia are: direct and indirect [3]. Indirect hernias (previously also

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known as ‘congenital’) are more common in children. The predisposing factor is the patency of processus vaginalis. In this type of hernia, herniating bowel (or other structure, e.g. ovary) passes from lateral to the inferior epigastric vessels to enter the deep inguinal ring. The direct hernias (called also ‘acquired’) appear in correlation with weakness of the anterior abdominal wall in the inguinal triangle and are more common in adults [3]. However, this type of hernia can sometimes be observed in teenagers. In direct (so-called ‘acquired’) hernia, the herniating bowel passes from medial to the inferior epigastric vessels pushing through the peritoneum and transversalis fascia in the inguinal triangle (known as the ‘Hesselbach’s triangle’) to enter the inguinal canal [3; 4]. The inguinal canal is formed concerning the relocation of the testis during foetal development or labia formation in girls [3].

In paediatric patients, most cases of inguinal hernia are congenital. However, acquired paediatric inguinal hernias are also possible, for example, in cases of recurrent inguinal hernia after ligation of a congenital defect during primary repair, or metachronous contralateral inguinal hernia after identifying closed open processus vaginalis in males/open canal of Nuck in females [5]. This means that in children the acquired type of inguinal hernia can also be an indirect hernia.

It is possible to see unilateral (right-sided) hernias are more common than left-sided hernias) and bilateral hernias [4]. Sometimes, they can appear in a metachronous way. Clinically, inguinal hernias can be symptomatic and asymptomatic. From a surgical point of view, it is important to establish if the patient has a reducible or non-reducible inguinal hernia [4]. Incarceration is the situation in which the hernia cannot be reduced by manipulation. It is necessary to decide if the patient requires urgent surgical treatment. In incarcerated hernias, the sac can contain the bowel, the omentum, or the ovary/fallopian tube in girls [2]. In incarcerated hernia, there is a risk of strangulation (vascular compromise of the contents of an incarcerated hernia). The distinction between strangulated and non-strangulated hernia is crucial because a strangulated hernia is a surgical emergency that can lead to intestinal obstruction, ischemia, necrosis, and perforation or testicular damage (testicular atrophy) in boys and ovarian damage in girls [4].

In adult patients with inguinal hernias, the use of the European Hernia Society classification systems is suggested to perform research, tailor treatments, and perform quality treatment [6].

Shehata et al. proposed a paediatric hernia classification and tailored treatment modified from the original Nyhus classification for adults, with suggested tailored treatment for each subtype [7]. This approach to the problem of a paediatric inguinal hernia would improve the possibility compare the different techniques with a group of patients treated by classical herniotomy [7]. According to this classification, Paediatric Nyhus type 0 (PN0) is patent processus vaginalis detected by ultrasonography or during laparoscopy, but where there is no clinical hernia [7]. The Paediatric Nyhus type I (PNI) is the clinical situation when the hernia is not detected at examination and diagnosed by reliable history and silk glove sign or during laparoscopy [7]. Similarly to the PN0, there is no clinical hernia [7]. When it takes time for the hernia to appear after repeated straining for more than 30s and the manipulations are necessary for the Paediatric Nyhus type II (PNII) to be recognized [7]. It is worth noting

that irreducible hernia is also classified as type II. Paediatric Nyhus type III (PNIII) is recognized in patients whose hernia appears immediately on minor straining or spontaneously and reduces very easily with minimum manipulation [7].

When considering Paediatric Nyhus type 0 it must be underlined that ultrasound has a role in the diagnosis and even treatment of paediatric inguinal hernia [8]. However, ultrasonographic criteria to accurately detect patent processus vaginalis are not homogeneous [9]. There is still little educational material relevant to the field of ultrasound treatment [10]. Moreover, because patent processus vaginalis can be very small, direct visualization can be challenging [11]. The experience of the person performing the examination is also important.

Toki et al. proposed an ultrasonographic classification for paediatric inguinal hernia. In 1995, they proposed that ultrasonograms were divided into four types [12]. Type I was recognized when the intestine was observed in the inguinal canal; type II was recognized when the cystic pattern was seen at the internal ring of the inguinal canal; type III was recognized when the patent processus vaginalis enlarged with the increased abdominal pressure [12]. Type IV was recognized when the patent processus vaginalis contained moving material without enlargement [12].

In 2003, they proposed six types of inguinal hernia [13, 14]. Type I – the intra-abdominal organ was observed in the inguinal canal; type II – PPV was seen as a cyst at the internal ring of the inguinal canal; type III – PPV was widened with increases in abdominal pressure (the length of the PPV was longer than 20 mm); type IV – PPV contains moving fluid without PPV widening; type V – PPV was widened with increases in abdominal pressure (the length is shorter than 20 mm); type VI – other findings. Types I, II, and III were regarded as positive potential candidates for inguinal hernia [13, 14].

Tanaka et al. assessed the size of the hernia orifice during laparoscopy and used the classification by the European Hernia Society (EHS) for adult patients [15] – the hernia orifice defect size of ≤ 1.5 cm was L1; hernia orifice defect size of > 1.5 cm (L2 or 3) [15]; hernia orifice over 3 cm considered as L3 [16].

In adult patients, computed tomography (CT) is used to classify inguinal hernia [16]. In children, however, it is reserved for complicated cases [17].

The heterogeneity of classifications used for adult patients with an inguinal hernia in the past, such as Aachen, Gilbert, Stoppa, Nyhus, Bendavid, Alexandre, Schumpelick, Corcione and Porrero, made comparison of the results of the treatment challenging [18]. To facilitate it, the European Hernia Society (EHS) proposed a classification based on the Aachen classification [16]. The Aachen classification distinguishing lateral, medial, and femoral hernia (anatomical localization), used 1.5 cm as a reference for the size of the hernia orifice (< 1.5 cm, 1.5 – 3 cm, > 3 cm) [16]. The choice of 1.5 cm as the reference value was practical. The usual size of the index finger was the reference in open surgery (mostly around 1.5 – 2 cm) [16].

Paediatric surgery faces the same problems with the classification of inguinal hernia. The implementation of the classification seems important because of the development of new surgical techniques. If a unified classification is used, comparison of the results of the treatment would be more accurate.

CONCLUSIONS

In the preoperative classification of inguinal hernia is important to choose an adequate method of treatment that can be made on the basis of clinical and radiological (such as ultrasound) examinations. It is possible to reveal the adequacy of radiological classifications during inguinal hernia surgical repair. Using the intraoperative classification of inguinal hernia would be of great value not only for this reason. Nowadays, in the era of fast development of minimal invasive surgical techniques, it is very important to be able to answer the question: ‘Which technique is best for my patient?’

Unified paediatric inguinal hernia classification would be useful not only for the pre- or intra-operative description of the anatomy and size of a hernia, a unification of the classification system of a paediatric inguinal hernia would also be helpful in the study design. Nowadays, when many new techniques of treatment are being developed, it is important to be able to compare the results. Studies comparing the results of different surgical techniques would be invaluable in personalized medicine.

A very promising classification is the original Nyhus classification for adults, modified for paediatric patients by Shehata et al., and the ultrasonographic classification proposed by Toki et al. The results of surgical treatment of patients with patent processus vaginalis and patients of irreducible inguinal hernias can differ. It must be underlined that comparing the results of treatment taking into consideration the anatomy of a particular case (classifying it radiologically and intra-operatively) would also have great value, because it would facilitate the choice of the technique that would be dedicated to the clinical situation of a particular patient.

Take-home message

The introduction of routine radiological and intra-operative classifications of paediatric inguinal hernias would increase the value of the studies aimed at comparing the results of the inguinal hernia treatment with different surgical techniques.

Table 1. Comparison of different classifications according to the different factors

Anatomy	Time	Clinical features
<ul style="list-style-type: none"> • location: inguinal lateral, inguinal medial, femoral... • course: direct (usually traverses only medial 1/3 of inguinal canal, external and parallel to vestige of processus vaginalis); indirect (traverses inguinal canal); • affected side right-sided, left-sided, bilateral • size - radiological classifications - intraoperative classifications 	<ul style="list-style-type: none"> • congenital; acquired - recurrent • in bilateral hernias: - metachronous (occurring at a different time); - synchronous (occurring at the same time); 	<ul style="list-style-type: none"> • reducible vs. non-reducible; • strangulated vs. non-strangulated • symptomatic vs. asymptomatic

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