

Association of type I and III collagen expression in children's inguinal hernia

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Abstract

Introduction: Inguinal hernia is a condition of protrusion or protrusion of visceral organs through a defect in the abdominal wall. Collagen plays a role in accelerating wound healing and scar formation during the connective tissue healing process.

Materials and Methods: This research is a descriptive observational study with a case series design. The study was conducted on all inguinal hernia patients at Haji Adam Malik General Hospital in Medan and USU's FK Anatomical Pathology Laboratory from January to June 2022. The data obtained was analyzed using a statistical program and distributed descriptively using a frequency distribution table.

Results: Of the 34 pediatric patients with inguinal hernias, most cases of inguinal hernias in children were found in children aged 1-4 years (35.3%) followed by 5-9 years (29.4%). Children who suffer from inguinal hernias are most found in boys, namely as many as 25 people (73.5%). Collagen appearance through histopathological examination was found in 33 patients (97.1%).

Conclusion: There is a description of collagen in inguinal hernias in children (97.1%), but this cannot prove that the absence of collagen causes inguinal hernias in children.

Keywords: Inguinal hernia, collagen, histopathology, children

1. Introduction

Inguinal hernia is a condition of protrusion or protrusion of a visceral organ through a defect in the abdominal wall. This defect or part of the wall that is thin and weak is in the inguinal canal. Hernias consist of rings, sacs and the contents of the hernia itself, namely the abdominal organs such as the small intestine, colon, fatty tissue to the omentum. (Norton et al., 2008) Inguinal hernias are estimated to occur in 5% of men and their incidence increases five to ten times in men compared to women. In 80,000 children in Taiwan with inguinal hernias, an increased incidence was found at the age of less than 1 year in boys and 4.7 years in girls. The results of a previous study of inguinal hernia patients in children at Adam Malik General Hospital in Medan stated that 58.3% of inguinal hernia patients in children were male, with the largest age group being 1-5 years. The most common hernia location is the right side (71.6%) (Sinalthan, 2016). Many conditions or risk factors are associated with the occurrence of hernias, including stunted fetal growth associated with the risk of preterm birth and low birth weight babies. This condition can cause neonatal problems, one of which is an inguinal hernia. The PPV allows for a connection between the peritoneum and the scrotum, which allows bowel or peritoneal fluid to descend into the scrotum. (June et al., 2015). This condition can cause neonatal

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Excessive mechanical stress or metabolic disturbances of the extracellular matrix components are believed to be factors for laxity of the anterior and posterior walls of the inguinal canal itself. More specifically, these components of the extracellular matrix provide strength and integrity to the aponeurosis and fascia in the walls of the inguinal canal (Meyer et al., 2007). The extracellular matrix has two main components, namely the interstitial component and the basement membrane. The interstitial component consists of proteins and proteoglycans which contain collagen, elastin, fibrillin, fibronectin and laminin. Of these protein components, collagen is the largest component in the extracellular matrix (Henriksen, 2016). Functionally and structurally, collagen is the most important protein of the extracellular matrix, because of its function in accelerating wound healing and its role in scar formation during the connective tissue healing process. Collagen has many types, there are about 21 components that have been identified genetically. Collagen I, II and III are the most abundant components of all existing types. This type of collagen plays an important role in increasing resistance and elasticity in tissues, especially in resisting intra-abdominal pressure that occurs in the walls of the inguinal canal and transversalis fascia. (Koruth & Narayanaswamy Chetty, 2017; Rangaraj et al., 2011) II and III are the most abundant components of all existing types. This type of collagen plays an important role in increasing resistance and elasticity in tissues, especially in resisting intra-abdominal pressure that occurs in the walls of the inguinal canal and transversalis fascia. (Koruth & Narayanaswamy Chetty, 2017; Rangaraj et al., 2011) II and III are the most abundant components of all existing types. This type of collagen plays an important role in increasing resistance and elasticity in tissues, especially in resisting intra-abdominal pressure that occurs in the walls of the inguinal canal and transversalis fascia. (Koruth & Narayanaswamy Chetty, 2017; Rangaraj et al., 2011)

Several studies have shown that there is an influence of collagen I, II and III on the occurrence of myoaponeurosis weakness in the anterior and posterior walls of the inguinal canal and transversalis fascia. A study conducted by Junge et al, (2004) showed that the average ratio of collagen-protein obtained in 78 patients who underwent prosthetic transplants after incisional and inguinal hernias was $45.3 \pm 8.5 \mu\text{g}/\text{mg}$, with significant differences between men ($43.8 \pm 9.1 \mu\text{g}/\text{mg}$) and female ($48.1 \pm 6.8 \mu\text{g}/\text{mg}$, $P=0.033$). The mean value of the type I/III ratio was found to be 2.1 ± 1.4 indicating that the composition of the scar tissue has a low collagen type I/III ratio. Therefore, decreased tensile strength is the most influential factor for hernia recurrence (June et al., 2015).

In line with this study, a study conducted by Klosterhalfen, (2013) on 623 patients showed that there was a ratio of collagen type I/III in 285 patients (46%) which was otherwise normal, while the ratio of collagen type I/ III in 338 (54%) patients has decreased. However, several studies conducted in literature studies show that problems in collagen metabolism which result in a decrease in the quantity of this type of collagen have no statistical relationship to the occurrence of hernias (Koruth & Narayanaswamy Chetty, 2017), (June et al. , 2015). The purpose of this study was to determine the appearance of collagen in inguinal hernia tissue in children stained with hematoxylin & eosin.

2. Methods

This research is a descriptive observational study with a case series design, where the case is inguinal hernia patients in children. The study was conducted at the Haji Adam Malik General Hospital in Medan and

the USU Medical Faculty Anatomical Pathology Laboratory on all inguinal hernia patients who met the inclusion and exclusion criteria from January to June 2022. The research inclusion criteria were children aged 0-18 years. Exclusion criteria were hernias other than inguinal hernias and patients diagnosed with inguinal hernias but had other congenital abnormalities. This research was carried out by taking samples by herniotomy and histopathological examination was carried out, namely examining the appearance of collagen with hematoxylin & eosin staining in the anatomical pathology laboratory.

3. Results

This research is a descriptive observational study to analyze the appearance of collagen seen through histopathological examination of hernia tissue. During the study period, data were obtained from January to June 2022 as many as 34 pediatric patients with inguinal hernias. The sample met the inclusion and exclusion criteria and had histopathological examination done with hematoxylin & eosin staining.

Based on table 1, the most numerous research samples were samples aged 1-4 years (35.3%) followed by samples aged 5-9 years (29.4%). The fewest samples were found in patients aged <4 weeks, namely 1 person (2.9%).

Table 1. Frequency Distribution of Research Subjects by Age

Age	Amount	%
<4 weeks	1	2,9
1-12 months	5	14,7
1-4 years	12	35,3
5-9 years	10	29,4
10-14 years	4	11,8
15-18 years	2	5,9
Total	34	100

From the results it was found that the distribution of the frequency of children suffering from inguinal hernias was mostly found in boys, namely 25 people (73.5%). In contrast, there were fewer female patients with inguinal hernias, namely 9 children (26.5%).

Table 2. Frequency Distribution of Research Subjects by Gender

Gender	Amount	%
Man	25	73.5
Woman	9	26.5
Total	34	100

Based on the sample data that was taken, namely 34 pediatric patients with inguinal hernias, collagen was obtained through histopathological examination in 33 patients (97.1%). No collagen was found in 1 other pediatric patient. These results can be seen in table 3 below.

Table 3. Distribution of Collagen Samples in Pediatric Inguinal Hernia Patients

Collagen	Amount	%
Exist	33	97.1
There isn't any	1	2,9
Total	34	100

Based on table 4, only 3 of 4 children found collagen in the age group of 10-14 years through histopathological examination. On the other hand, the results showed the appearance of collagen through histopathological examination in other pediatric age groups.

Table 4. Distribution of Collagen Samples in Pediatric Inguinal Hernia Patients by Age

Age	Collagen			
	Exist	%	There isn't any	%
<4 weeks	1	100	0	0
1-12 months	5	100	0	0
1-4 years	12	100	0	0
5-9 years	10	100	0	0
10-14 years	3	75	1	25
15-18 years	2	100	0	0
Total	33	97.1	1	2,9

In this study it was found that Collagen picture through histopathological examination found in all sample of male patients. On the other hand, only 8 out of 9 samples of female patients were found Collagen picture by histopathological examination.

Table 5. Distribution of Collagen Samples in Pediatric Inguinal Hernia Patients by Gender

Gender	Collagen			
	Exist	%	There isn't any	%
Man	25	100	0	0
Woman	8	88.9	1	11,1

Total	33	97.1	1	2,9
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After histopathological examination was carried out on the study sample, collagen was obtained as shown in Figure 1. Inguinal hernia tissue in children with hematoxylin & eosin staining where no collagen is found can be seen in Figure 2.

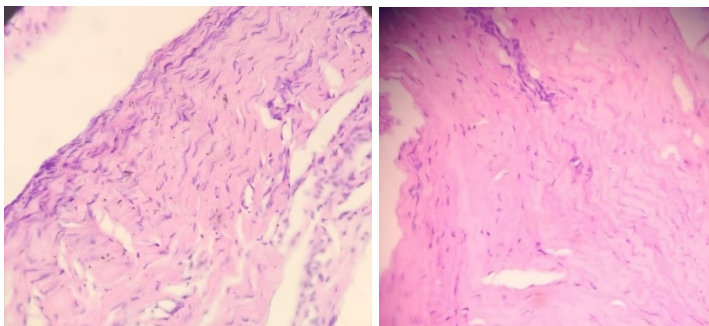


Figure 1. Description of collagen in inguinal hernia tissue in children with hematoxylin & eosin staining

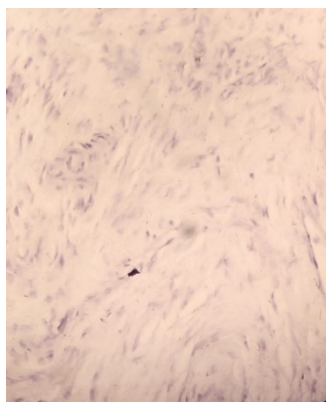


Figure 2. Inguinal hernia tissue in children with hematoxylin & eosin staining with no collagen appearance

4. Discussion

In this study, it was found that the age group with inguinal hernias in children was the most in the 1-4 year age group, namely 12 of 34 children (35.3%) followed by a sample of the 5-9 year age group, namely 10 of 34 children (29,4%). In addition, the age group of children with inguinal hernias was the least in the age group <4 weeks, namely 1 person. This is in line with previous research by Chen et al. who reported the largest group of children with inguinal hernia repair during the period 2007 to 2011 in the National Health Insurance (NHI) database were those aged 1 to 4 years, which accounted for 46.9% of the total number of

children aged 0 to 18 years. with inguinal hernia repair.(Chen et al., 2018). In addition, in a pediatric survey and according to Nataraja and Mahomed and Ron et al., the incidence of hernia in children is closely related to age and the risk is especially increased in children under 2 years of age.(Ksia et al., 2017).

In this study, the distribution of the frequency of children with inguinal hernias based on gender was more common in boys. The results showed that of the 34 samples, pediatric patients with inguinal hernias were 25 boys and 9 girls with a ratio of 2.7:1. Based on the research by Wang et al., it was concluded that the ratio of inguinal hernias in males and females was 4.8:1, higher than that reported by Alshammari et al. i.e. 2.5:1. Alshammari et al. say that their study results may be a better representation of true morbidity(Alshammari et al., 2020; Wang et al., 2021).

Ksia et al. performed an analytical retrospective study of the medical charts of children with inguinal hernias managed at the Department of Pediatric Surgery from 2010 to 2013. The mean age in the study group was 2 years (range 10 days to 12 years). Males were mostly affected (84%, n = 779)(Ksia et al., 2017). This is also supported by a study by Chang et al. (2016) who used a national database to evaluate the incidence of inguinal hernias and risk factors associated with incarcerated hernias in children from birth to 15 years of age. Through this national and longitudinal study, the cumulative incidence of inguinal hernias from birth to 15 years of age is greater in males, namely 6.62%, while in females, it is 0.74%.(SJ Chang et al., 2016).

In this study, histopathological examination to see the appearance of collagen in hernia tissue was carried out in 34 samples of pediatric patients with inguinal hernias. The results showed that there was a picture of collagen in 33 of the 34 samples of these children. The etiology of hernias is multifactorial, the components of the extracellular matrix, and the importance of collagen causing the loss of resistance and elasticity of the transversalis fascia in determining the occurrence and recurrence of hernias must be taken into account in the decision-making process for surgical repair of inguinal hernias. It has been proven that the presence of adequate amounts of collagen and its properties are essential for the fascia transversalis to function and provide adequate strength. Collagen types I and III are associated with the occurrence of inguinal hernias. Type I collagen is characteristic for mature scar or fascial tissue whereas type III collagen represents the less mechanically stable crosslinked collagen synthesized during the early days of wound healing. In the study by Antonio Britto Casanova et al., results showed 17.3% less total collagen in patients with hernias compared to the control group ($P < 0.01$). Type I collagen in patients with indirect inguinal hernia was 23.7% less than the control group ($P < 0.01$), type III collagen was 6.4% less in the control group ($P < 0.01$). Wagh et al. showed that reduced collagen in the patient's rectus abdominis sheath causes indirect or direct inguinal hernias (Koruth & Narayanaswamy Chetty, 2017).

Familial history of inguinal hernia is a risk factor for inguinal hernia. This increased risk may be related to changes in connective tissue metabolism, which appear to contribute to inguinal hernia formation. Thinner collagen fibrils, an imbalance of type I collagen in relation to type III collagen, and increased collagen levels decrease MMPs have been reported in patients with inguinal hernias. The most pronounced changes have been reported in patients with direct inguinal hernias and recurrences of inguinal and incisional hernias. Several changes in the extracellular matrix have been found in the fascia as well as in the skin of hernia patients indicating a systemic etiology (Henriksen, 2016).

Recently, research has focused on biological and genetic factors for hernia development, including extracellular matrix components, amounts and ratios of different types of collagen, and genetic variants of associated genes. A decrease in the ratio of type I to type III collagen has been shown to decrease the strength and elasticity of the tendons and fascia, thereby increasing the likelihood of inguinal hernia formation.(HH Chang et al., 2022). In this study there are several limitations, such as this research is an observational descriptive research so it is impossible to show a causal relationship between the variables studied. In addition, this study could only show an overview of collagen in inguinal hernias in children based on the results of anatomic pathology with hematoxylin & eosin staining, but could not determine the type of collagen

in the tissue studied. This study shows that there is a description of collagen in inguinal hernias in children, but this cannot prove that the absence of collagen causes inguinal hernias in children. Therefore, further research is needed to analyze the relationship between collagen and inguinal hernias in children.

5. Conclusion

There is a picture of collagen in inguinal hernias in children(97.1%), but this cannot prove that the absence of collagen causes inguinal hernias in children

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