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ORIGINAL ARTICLE

Independent risk factors for contralateral patent processus vaginalis undetected by pre-operative ultrasonography in boys with unilateral inguinal hernia

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Abstract

Purpose Many trials have been done to make sure probability of metachronous contralateral side hernia (MCH) and contralateral patent processus vaginalis (CPPV). But the necessity of contralateral side exploration is still on debate. The aim is to investigate the risk factors for the consideration of contralateral examination on operation.

Materials and methods The study was designed as retrospectively. Patients with unilateral inguinal hernia from January 2010 to May 2015 were enrolled. Pre-operative ultrasonography was done in all patients. Patients with obvious contralateral side hernia on pre-operative US were excluded. The presence of CPPV was evaluated by transinguinal laparoscopy during the operation.

Results In univariate analysis, hernial sac size only shows difference (*P* value: 0.001). The others, location of the hernia, age at surgery, gestational age (preterm), low birth weight and parent's age, did not show statistically significant differences. Multivariate analysis also demonstrates CPPV is more common in patients with large hernial sac (Odds ratio: 2.727, 95% confidence interval 1.495–4.974, *P* value: 0.001).

Conclusion We propose that surgeons should consider contralateral evaluation during operation in case with large ipsilateral hernial sac, although CPPV was not detected by pre-operative US.

Keywords Inguinal hernia · Metachronous hernia · Contralateral patent processus vaginalis · Risk factors

Introduction

Inguinal hernia is one of the most common reasons for operation in childhood. The prevalence of inguinal hernia in child is 1–4% [1]. Metachronous contralateral side hernia (MCH) is one of the most uncomfortable situations that can occur post-operatively. In meta-analysis study, the average incidence of a child who presents with a unilateral hernia developing a contralateral hernia was 7% (of the 15,310 patients who underwent unilateral inguinal hernia repair, 197 had a contralateral hernia repair and 865 developed a subsequent metachronous hernia) [2]. Re-operation due to MCH can be frustrating for both surgeons and patient's family. So the way to detect possibility of contralateral herniation has been studied. Pre-operative ultrasonography and pneumoperitoneum, and some physical findings (such as "silk sign") are the result of those trials. Since the laparoscopy had introduced as a new diagnostic test in 1992, it was used as an accurate and convenient tool to detect contralateral true hernia or patent processus vaginalis (CPPV) [3]. Nevertheless, clinicians always feel uneasy at the moment of decision of contralateral exploration. Therefore, more preoperative information is necessary to make precise decision for exploration. The aim of this study is to find out risk factors for CPPV in boys with unilateral inguinal hernia without obvious contralateral hernia or hydrocele by pre-operative US.

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Materials and methods

Study design

A retrospective chart review was performed at an 859-bed university-affiliated secondary care hospital in South Korea, from January 2010 to May 2015. Boys with unilateral inguinal hernia or hydrocele were recruited. Patients with contralateral hernia sac detected at pre-operative ultrasonography (US) were excluded. The following data were recorded: gestational age, birth weight, age at operation, hernia laterality, hernial sac size, and parents' age at the time of patient's birth.

Surgical procedure

All enrolled patients underwent transinguinal laparoscopy during the ipsilateral herniorrhaphy. During the operation, hernial sac was dissected and opened at the middle of the inguinal canal. 5-mm trocar was inserted through the internal inguinal ring. After CO_2 gas insufflation, 70°-angled endoscope was used for inspecting contralateral internal inguinal ring.

To ensure the existence of CPPV, we classified internal ring by shape. (Fig. 1) Boys who have flat and blocked internal ring opening were classified as group 1. Their spermatic cord and vas was totally covered by peritoneum. Group 2 was grouped into two groups, group 2a and 2b. Group 2a defined as closed end, which has been covered with peritoneal veil. If remaining processus vaginalis was found to be opened, they were classified as group 2b. Completely open hole, where spermatic cord and vas deferens exit, was grouped as group 3. We defined group 2b and group 3 as CPPV.

If CPPV is invisible to the laparoscope, we used other methods to find out patency of processus vaginalis. Traction of ipsilateral testis or vas makes widening of the opening, and it can be seen as the presence of air bubble. Proceeding guidewire through the opening can be a modality to figure out patency of processus vaginalis. At that time, we precede contralateral side herniorrhaphy with high ligation of the sac.

Hernial sac size was measured by ruler just before we put laparoscopy in peritoneum through internal inguinal ring. Dissected hernial sac was straightened 10–15 mm distal from internal inguinal ring, the very point where we operate high ligation.

All pre-operative US and the transinguinal laparoscopy and operation were performed by one surgeon (Dr. Woo).

Statistical analysis

All statistical analyses were performed using R-statistical program version 3.5.1. Categorical variables were analyzed by the chi-square test or Fisher's exact test. Continuous variables were analyzed using the Mann–Whitney *U* test or the independent *t* test. A multivariable logistic regression analysis was performed to evaluate the effect of independent

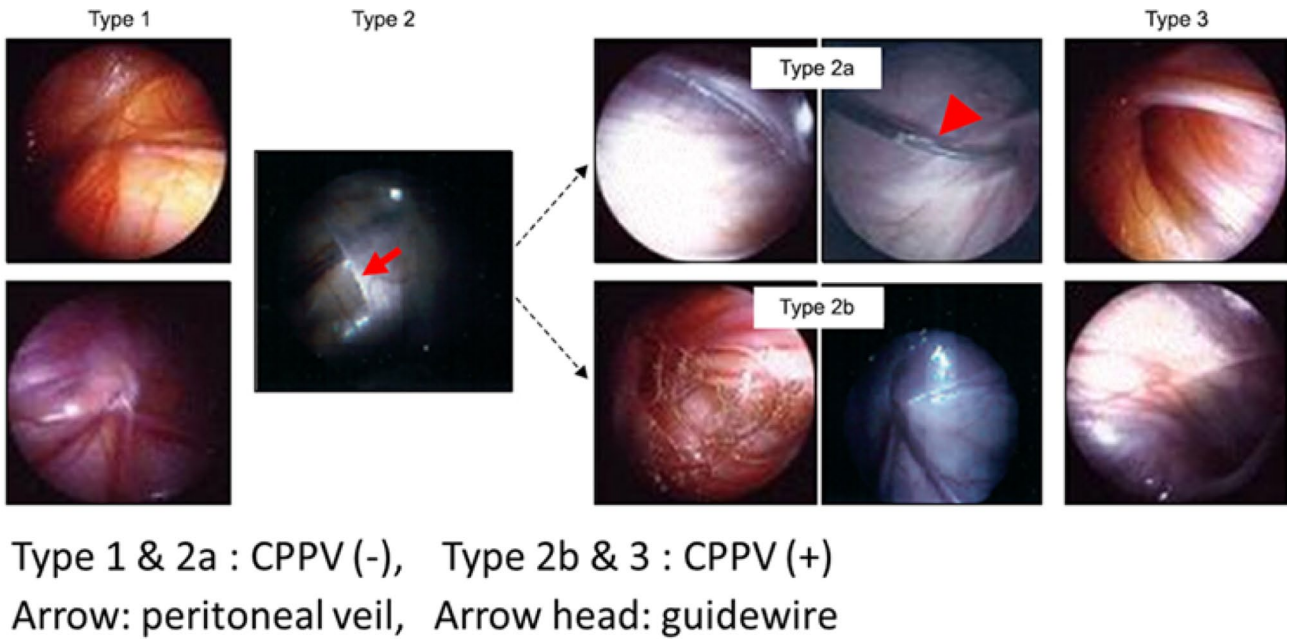

Fig. 1 Morphological classification of internal ring

Table 1 Patients' characteristics

	Mean (±SD), *n* (%)
Age (age at operation)	49.4 (±32.7) (months)
Gestational age	39.2 (±1.8) (weeks)
Preterm	20 (7.6%)
Low birth weight	12 (4.6%)
Twin	4 (1.5%)
Mother's age	31.8 (±3.8) (years)
Father's age	34.3 (±4.0) (years)

SD Standard deviation

Table 2 Post-operative data

	n (%) (total 262 patients)
Hernial sac size (average 0.97 cm, median 1 cm)	
≥1 cm	132 (50.4%)
Hernia side	
Right	156 (59.5%)
Left	106 (40.5%)
CPPV	68 (26%)

variables on risk. Using a two-tailed test, a *P* value of <0.05 was considered to be statistically significant.

Results

A total of 302 boys, who presented with unilateral inguinal hernia or hydrocele, were enrolled. Contralateral hernial sac was detected from 40 boys in pre-operative US and they were excluded. Table 1 shows patients' characteristics. Average age of patients is 49.4 months (2–168 months). Twenty (7.6%, 20/262) patients were preterm (gestational age < 37 weeks). Low birth weight was seen in 12 of 262 patients (4.6%). Average age of patient's mother at the birth of patent was 31.8 years and that of patient's father was 34.7 years. Table 2 shows patients' data during operation. 156 (59.5%) of unilateral hernia patients had it on their right side and 106 (40.5%) were on the left. Average sac size of hernia was 0.97 cm (median 1.00 cm) and it varies 0.20–3.00 cm. 68 patients found to have CPPV during operation and bilateral herniorrhaphy was done.

In univariate analysis, width of hernia only shows difference, when divided by median (1.00 cm) of the data (*P* value: 0.001). The others, laterality of the hernia, age at surgery, gestational age (preterm), low birth weight and parent's age, did not have statistically significant differences. The result of multivariate analysis adjusting all the above variables is shown in Table 3. Multivariate analysis also demonstrates CPPV is more common in patients with large hernial sac (Odds ratio: 2.727, 95% confidence interval 1.495–4.974, *P* value: 0.001).

Discussion

Since the proposal of bilateral exploration for unilateral inguinal hernia patient by Rothenburg and Barnett [4], treatment of contralateral inguinal lesion in pediatric patients with a unilateral inguinal hernia has remained controversial. Clinicians must consider both invasiveness and benefit of the contralateral side exploration.

Many studies show the risk of MCH is closely related to the existence of CPPV [5, 6]. Pre-operative ultrasonography can identify contralateral side inguinal hernia, but not the all CPPV. Laparoscopy is an effective and reliable method for finding CPPV [1, 7–9]. Additional time necessary for laparoscopy was just 5 min and 45 s in one meta-analysis [3].

Despite the advantages of the laparoscopy, there is a possibility to miss some cases of CPPV [10]. Sometimes, a vague finding on the operation field makes it difficult to identify patent processus vaginalis [3]. Peritoneal veil makes patent processus vaginalis indistinguishable. Small-sized sac discourages trocar introduction through the sac.

Age is an important risk factor for the presence of CPPV. Hall et al. [11] suggested that CPPV decreased with age. Rowe et al. [12] reported the incidence of CPPV is highest at first 2 months, decreases until 2 years, and steady after then.

Table 3 Univariate analysis and multiple logistic regression analysis for risk factors for contralateral patent processus vaginalis

Risk factors	Univariate analysis			Multivariate analysis		
	n (%)	CPPV (%)	*P* value	Odds ratio	95% CI	*P* value
Age(≥24 months)	198 (75.6%)	49 (72.0%)	0.435	0.654	0.337–1.266	0.207
Hernial sac size (≥1 cm)	132 (50.4%)	46 (67.6%)	0.001	2.727	1.495–4.974	0.001
Low birth weight (<2.5 kg)	12 (4.6%)	5 (7.4%)	0.205	1.938	0.417–9.001	0.399
Preterm (<37 weeks)	20 (7.6%)	6 (8.8%)	0.669	0.669	0.179–2.505	0.551
Right laterality	156 (59.5%)	39 (57.4%)	0.671	0.832	0.464–1.492	0.536
Mother's age (≥34 years)	56 (21.4%)	19 (27.9%)	0.126	1.404	0.660–2.988	0.379
Father's age (≥34 years)	132 (50.4%)	40 (58.8%)	0.106	1.395	0.723–2.688	0.321

On the other hand, there are some research results that the age and CPPV prevalence are not related each other [2, 13]. Age was not associated with the presence of CPPV, neither in univariate analysis nor multivariate analysis in our study.

The laterality of original hernia has been suggested an another risk factor for the presence of CPPV [2]. In a meta-analysis, left-sided hernia had greater chance of MCH. However, it also is still controversial. Other studies represent that the hernia side was not a risk factor for the presence of CPPV [14, 15]. In the present study, we cannot find any difference between left sided and right sided hernia.

In our study, size of the hernial sac was the only significant risk factor for prediction of the presence of CPPV. Vogels et al. [14] reported the size of clinical hernial sac appeared to be predictive of the size of a patent processus vaginalis/hernial sac on the contralateral side. There was a positive correlation between hernial sac size and CPPV size. And they assumed that the larger CPPV size means more probability of clinical hernia. The result of our research allows us to be more confident of that.

There are many trials to define the risk factors of MCH and CPPV. But the risk factors are not defined clearly yet. So there is no definite standard for the contralateral exploration. Recently, Lee et al. [15] insisted that the suspicious ultrasound findings and a history of contralateral disease are the risk factors. It is different from our research result because we regarded pre-operative US result as definite evidence of MCH and excluded those patients who had suspicious US finding.

Recently, laparoscopic herniorrhaphy has emerged as a new treatment option. And it can put all doubts to rest for MCH, because of the convenience for detecting CPPV. Nevertheless, laparoscopic herniorrhaphy may have a potential risk associated with injury during the procedure of ligating the internal ring by suture material. Vasal obstruction and varicocele caused by the injury of vas deference and internal spermatic vessels may occur. Unfortunately, these complications can be confirmed after the patients become an adult, but not yet. Long-term observational study for safety of laparoscopic herniorrhaphy will be needed for this issue.

This concern of complications may interfere with the placement of laparoscopic herniorrhaphy as a universal technique. But the classical open inguinal herniorrhaphy has limitation of detecting CPPV and MCH. So, it is necessary to study the risk factors of CPPV to perform the contralateral surgery or transinguinal laparoscopic examination before or during surgery. Prospective data collection will be more informative.

As our research result suggests, if the hernial sac is large enough, then operator should consider the CPPV and MCH. At least laparoscopic examination should be done in large hernia sac patient. We decided to use 1 cm as reference point for large hernia sac. It because '1 cm' was median of our data. And we thought 1 cm is very intuitive. However, it seems that this research alone is not enough to make what is 'large enough'. Further research will be needed to make it.

Conclusion

Size of the hernia sac might predict the presence of CPPV. When surgeons encounter large hernial sac, they should consider the possibility of the presence of CPPV and MCH.

Compliance with ethical standards

Conflict of interest None declared.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was not obtained because this study was done retrospectively.

References

1. Mollen KP, Kane TD (2007) Inguinal hernia: what we have learned from laparoscopic evaluation of the contralateral side. Curr Opin Pediatr 19(3):344–348
2. Miltenburg DM et al (1997) Meta-analysis of the risk of metachronous hernia in infants and children. Am J Surg 174(6):741–744
3. Miltenburg DM et al (1998) Laparoscopic evaluation of the pediatric inguinal hernia–a meta-analysis. J Pediatr Surg 33(6):874–879
4. Rothenberg RE, Barnett T (1955) Bilateral herniotomy in infants and children. Surgery 37(6):947–950
5. Kokorowski PJ et al (2014) Evaluation of the contralateral inguinal ring in clinically unilateral inguinal hernia: a systematic review and meta-analysis. Hernia 18(3):311–324
6. Maddox MM, Smith DP (2008) A long-term prospective analysis of pediatric unilateral inguinal hernias: should laparoscopy or anything else influence the management of the contralateral side? J Pediatr Urol 4(2):141–145
7. Lotan G et al (2004) Transinguinal laparoscopic examination: an end to the controversy on repair of inguinal hernia in children. Isr Med Assoc J 6(6):339–341
8. Lazar DA et al (2011) Transinguinal laparoscopic exploration for identification of contralateral inguinal hernias in pediatric patients. J Pediatr Surg 46(12):2349–2352
9. Valusek PA et al (2006) Laparoscopic evaluation for contralateral patent processus vaginalis in children with unilateral inguinal hernia. J Laparoendosc Adv Surg Tech A 16(6):650–653
10. Zhong H, Wang F (2014) Contralateral metachronous hernia following negative laparoscopic evaluation for contralateral patent processus vaginalis: a meta-analysis. J Laparoendosc Adv Surg Tech A 24(2):111–116
11. Hall NJ et al (2012) Age-related probability of contralateral processus vaginalis patency in children with unilateral inguinal hernia. Pediatr Surg Int 28(11):1085–1088
12. Rowe M, Copelson L, Clatworthy HW (1969) The patent processus vaginalis and the inguinal hernia. J Pediatr Surg 4:102–107

13. Sumida W et al (2016) Incidence of contralateral patent processus vaginalis in relation to age at laparoscopic percutaneous extraperitoneal closure for pediatric inguinal hernia. Surg Today 46(4):466–470
14. Vogels HD et al (2009) The degree to which the size and side of an inguinal hernia is predictive of a hernia on the other side. Pediatr Surg Int 25(3):229–233
15. Lee DG et al (2015) Risk factors for contralateral patent processus vaginalis determined by transinguinal laparoscopic examination. Exp Ther Med 9(2):421–424