

Prediction of contralateral inguinal hernias in children: a prospective study of 357 unilateral inguinal hernias

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Abstract

Purpose Previously, we established a pre-operative risk scoring system to predict contralateral inguinal hernia in children with unilateral inguinal hernias. The current study aimed to verify the usefulness of our pre-operative scoring system.

Methods This was a prospective study of patients undergoing unilateral inguinal hernia repair from 2006 to 2009 at a single institution. Gender, age at initial operation, birth weight, initial operation side, and the pre-operative risk score were recorded. We analyzed the incidence of contralateral inguinal hernia, risk factors, and the usefulness of our pre-operative risk scoring system. The follow-up period was 36 months. We used forward multiple logistic regression analysis to predict contralateral hernia.

Results Of the 372 patients who underwent unilateral hernia repair, 357 (96.0 %) were completely followed-up for 36 months, and 23 patients (6.4 %) developed a contralateral hernia. Left-sided hernia (OR = 5.5, 95 %, CI = 1.3–24.3, $p = 0.023$) was associated with an increased risk of contralateral hernia. The following covariates were not associated with contralateral hernia development: gender ($p = 0.702$), age ($p = 0.215$), and birth weight ($p = 0.301$). The pre-operative risk score (cut-off point = 4.5) of the patients with a contralateral hernia was significantly higher, compared with the patients

without a contralateral hernia using the area under the receiver operating characteristic curve ($p = 0.024$).

Conclusions Using multivariate analysis, we confirmed usefulness of our pre-operative scoring system and initial side of the inguinal hernia, together, for the prediction of contralateral inguinal hernia in children.

Keywords Inguinal hernia · Contralateral occurrence · Risk factor · Children · Prospective study

Introduction

The incidence of contralateral inguinal hernias in children after unilateral hernia repair is 5.8–11.6 % [1, 2]. It is debatable whether contralateral exploration is necessary in children with unilateral inguinal hernia in conventional open herniorrhaphy. Although, inguinal hernia repair is among the most common procedures performed by pediatric surgeons, surgical management of the contralateral groin remains controversial. Exploration of the asymptomatic side is designed to detect a patent processus vaginalis or non-evident clinical hernia. The goals of identifying these two entities are to avoid a second anesthesia, minimize parental and patient inconvenience, avoid the chance of incarceration, and reduce costs [3]. Potential disadvantages to exploration of the asymptomatic side include injury to the contents of the spermatic cord, wound infection, increased pain, increased cost, and prolongation of the operation [3]. Studies of methods to predict contralateral inguinal hernia could be helpful to avoid negative contralateral exploration. For this reason, pre-operative evaluation of the contralateral inguinal hernia is important in patients with unilateral hernia.

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In our previous study [4], we retrospectively established a pre-operative risk scoring system for 662 patients with unilateral inguinal hernia to predict the incidence of contralateral hernia during 5 years (Fig. 1). The aim of the current study was to prospectively determine the incidence of contralateral inguinal hernia, risk factors, and the usefulness of our pre-operative risk scoring system.

Materials and methods

Population

Between April 2006 and March 2009, 357 patients ranging from 28 days to 13 years of age were enrolled in a prospective observational hernia study in the Department of Pediatric Surgery of Nihon University Hospital, Tokyo, Japan. The study was approved by the Nihon University Institutional Review Board with informed consent obtained in all cases. Of these, 213 boys and 144 girls had 192 right and 165 left unilateral inguinal hernias. The characteristics of the patients are shown in Table 1. We performed a herniotomy after 40 weeks of gestation (corrected for prematurity) for premature patients. In most of the cases, the initial diagnosis was established by a referring pediatrician and confirmed pre-operatively by a hospital-based

surgeon. When a patient with unilateral hernia was assessed, the parents were carefully questioned about a history of a bulge on the opposite, supposedly normal, side. This study included patients with a unilateral hernia only and no evidence of hernia on the contralateral side at physical examination.

All the patients underwent a standardized general anesthetic induction and maintenance. The open hernia repair was performed using a 1–3 cm inguinal skin incision, the inguinal canal was opened, and the hernia sac was isolated and transected. Conventional high ligation of the hernia sac was the choice of surgical procedure for all patients. The skin incisions were closed with continuous absorbable sutures and tape strips (Steri-Strips, 3 M). Patients were discharged the day after surgery and encouraged to resume unlimited activity as soon as possible. Post-operative analgesics were provided, when necessary.

Contralateral occurrences of inguinal hernia were confirmed by physical examination and ultrasonography. The patients were asked to return to the outpatient hospital 7 days, 1 month, 6 months, 1 year, and every 6 months after the operation for 3 years. When a hospital visit was not possible, we contacted the parents and/or patient by telephone, letter, or e-mail. If the results of telephone and e-mail were questionable or insufficient, we checked physical examination and ultrasonography.

Score table for the evaluation of the risk factors for contralateral hernia

(A) Age at Initial Operation

	Score
< 6 months	5
< 12 months	4
< 4 years	3
< 7 years	2
< 13 years	1
> 13 years	0

A

(B) Gender and Initial Operation Side

Female with left-side	3
Male with left-side	2
Female with right-side	1
Male with right-side	0

B

(C) Birth Weight

< 1,000g	4
< 1,500g	3
< 2,500g	2
< 4,000g	1
> 4,000g	0

C

A + **B** + **C** = Total Point of Risk Scores

Evaluation

According to our previous study [4], the incidence of contralateral inguinal hernias were related to gender, age at initial operation, birth weight, and initial operation side, and we established a pre-operative risk scoring system for unilateral inguinal hernia patients to predict the incidence of contralateral hernia (Fig. 1). The following data were prospectively recorded for every patient: gender, age at initial operation, birth weight, initial operation side, pre-operative risk score, and incidence of contralateral hernia.

Statistics

All statistical calculations were performed using SPSS software (Statistical Package for Social Science, Munich, Germany). Interest reliability analysis was performed to determine the consistency between the tests. The Student's *t* test and Chi square test were used to detect the significance ($p < 0.05$ was considered significant). Multivariate analysis was completed using forward stepwise logistic regression. The dependent variable was the development of a contralateral hernia ($p < 0.05$ was considered significant). The pre-operative risk score was predictive in 357 patients, and these patients were separated into high- or

Fig. 1 Pre-operative risk scoring system for the prediction of contralateral inguinal hernia in children

Table 1 Clinical characteristics of the patients with inguinal hernia ($n = 357$)

	Contralateral inguinal hernia ($n = 23$)	No contralateral inguinal hernia ($n = 334$)	<i>p</i> value
Gender			0.450
Male (%)/ female (%)	12 (52.2)/11 (47.8)	201 (60.2)/133 (39.8)	
Age at initial operation			0.840
<6 months (%)	6 (26.1)	50 (15.0)	
<12 months (%)	3 (13.0)	17 (5.1)	
<4 years (%)	7 (30.5)	121 (36.2)	
<7 years (%)	4 (17.4)	92 (27.5)	
<13 years (%)	3 (13.0)	53 (15.9)	
>13 years (%)	0 (0.0)	1 (0.3)	
Birth weight			0.864
<1,000 g (%)	1 (4.3)	9 (2.7)	
<1,500 g (%)	1 (4.3)	9 (2.7)	
<2,500 g (%)	5 (21.8)	47 (14.1)	
<4,000 g (%)	16 (69.6)	268 (80.2)	
>4,000 g (%)	0 (0.0)	0 (0.0)	
Unknown (%)	0 (0.0)	1 (0.3)	
Initial operation side			0.035
Right (%)/ left (%)	7 (30.4)/16 (69.6)	185 (55.4)/149 (44.6)	

low-score groups using the area under the receiver operating characteristic (ROC) curve. We then evaluated the predictive value of our pre-operative risk scoring system for contralateral hernia between high- and low-score groups.

Results

A total of 372 consecutive patients were eligible for participation in the trial, of which 357 (96.0 %) patients were enrolled. Fifteen excluded patients were lost to follow-up. Surgery was performed in all cases at the Pediatric Surgery Department, Nihon University Hospital. No patients from the study had complications during surgery or follow-up or recurrence of the inguinal hernia. There was no history of trauma or urinary tract infection, and none of the patients had systemic disorders or chronic disease.

We performed 357 unilateral inguinal hernias and all were repairs of indirect hernias. The distribution per group is shown in Table 1. The gender distribution was 213 (59.7 %) males and 144 (40.3 %) females. The median age at the time of the initial operation was 41 months (range 28 days–13 years). Seventy-two (20.2 %) were low birth weight infants; 192 (53.8 %) had a hernia on the right side and 165 (46.2 %) on the left; and 23 (6.4 %) developed a

Table 2 Incidence of contralateral inguinal hernia in males and females with initial right or left-sided inguinal hernia (number of patients with contralateral hernia/number of patients with inguinal hernia, $n = 357$)

	Initial right-sided	Initial left-sided	Total
Males (%)	4/128 (3.1)	8/85 (9.4)	12/213 (5.6)
Females (%)	3/64 (4.7)	8/80 (10.0)	11/144 (7.6)
Total (%)	7/192 (3.6)	16/165 (9.7)	23/357 (6.4)

contralateral inguinal hernia. Although the contralateral hernia developed significantly and more frequently in patients with left-sided hernia ($p = 0.035$), there was no significant difference between the groups regarding other factors such as gender, age, and birth weight using univariate analysis (Table 1).

The incidence of contralateral hernia by gender and initial operation side is shown in Table 2. The most frequent rate of occurrence of the contralateral hernia was 10.0 % in the girls whose initial operation side was the left. These results approximated our previous retrospective study (data not shown).

Predictors for contralateral inguinal hernia

The most likely predictor of developing a contralateral inguinal hernia using multivariable analysis was an initial left-sided hernia (OR = 5.5, 95 % CI = 1.3–24.3, $p = 0.023$). Other covariates [gender ($p = 0.702$), age at initial operation ($p = 0.215$) and birth weight ($p = 0.301$)] were not associated with an increased risk of contralateral hernia development.

The patients were assessed for the risk of a contralateral hernia using our pre-operative risk scoring system. We analyzed the incidence of contralateral hernia at every point count for the 357 patients. The 15 of 23 patients (65 %) with a contralateral hernia had noticeably high scores, and the optimal cut-off point on the ROC curve was 4.5. The high pre-operative score group had a significantly higher incidence of contralateral hernia, compared with the low-score group ($p = 0.024$).

Discussion

We verified the accuracy of our pre-operative risk score and initial operation side for the prediction of contralateral inguinal hernia in children.

Inguinal hernia repair is the most common operation in pediatric surgical practice with most pediatric surgeons performing hundreds of hernia repairs each year. The incidence of contralateral occurrence of pediatric inguinal hernia after repair of unilateral inguinal hernia is

5.8–11.6 % [1, 2]. Although the risk of pediatric general anesthesia and the complication rate of inguinal hernia repairs are low, second operations should be avoided by identifying the patients who are at high risk for contralateral hernia before the initial surgery.

There is some controversy about the management of the contralateral groin in patients with unilateral hernia. Physical examination findings (such as “silk sign”), herniography [5], the Goldstein test using pneumoperitoneum [6, 7], contralateral exploration [8, 9], laparoscopy [10–13], and ultrasonography [14] are reported methods for predicting contralateral occurrence. Physical examination signs such as the “silk sign” do not reliably identify a contralateral hernia because detection varies according to the subjective palpation of the surgeons. Herniography was designed to detect the presence of a contralateral patent processus vaginalis (CPPV), and although this technique is accurate, the main disadvantages are pain, gonadal irradiation, and complications from the injection. The Goldstein test is a method to insufflate air into the contralateral groin using a catheter placed in the hernia sac. This technique is difficult in preterm infants and newborns because of a friable hernia sac. Contralateral exploration is a method to diagnose the presence of a CPPV in patients who undergo repair of unilateral inguinal hernia. This technique may lead to spermatic cord injury, testicular atrophy, and wound infection. Even if contralateral inguinal exploration was technically easy and safe, hernia repair on the other side in all patients with unilateral hernia who have positive findings on exploration is an overtreatment. Contralateral laparoscopy can accurately diagnose the presence of a CPPV, but the relationship between the presence of a CPPV and the subsequent development of a contralateral inguinal hernia remains unknown. This is why routine contralateral inguinal exploration using laparoscopy has not been widely accepted [15, 16]. Ultrasonography is a safe and non-invasive method to detect the presence of CPPV. The main advantage of this technique is that it can diagnose the hernia before the initial operation. Hata [14] reported that CPPV was detected correctly using ultrasound in 74 of 348 (21.3 %) patients. However, the incidence of contralateral occurrence of pediatric inguinal hernia after hernia repair [1, 2] is lower than the incidence of CPPV confirmed by ultrasonography [14] and laparoscopy [8–13]. This finding indicates that patency of the processus vaginalis alone cannot be considered a sufficient condition for inguinal hernia development.

Based on our previous study [4], we retrospectively established a pre-operative risk scoring system to predict the incidence of contralateral hernia in 662 patients with unilateral hernia. In the current study, we prospectively analyzed 357 patients with unilateral hernia for the risk of developing a contralateral hernia using multivariate

analysis and the pre-operative risk score. We found that an initial presentation with a left-sided hernia was associated with a 5.5-fold increased risk for developing a contralateral hernia. The odds ratio for left-sided hernia was high and similar to our previous report using multivariate methods [17]. We also confirmed the utility of our pre-operative risk scoring system for the prediction of the development of a contralateral hernia, especially over 4.5 points patients.

In conclusion, in this prospective study using multivariate analysis, we demonstrated the utility of our pre-operative risk score and initial operation side for the prediction of the development of a contralateral inguinal hernia in children. We believe that contralateral exploration based on our pre-operative risk scoring system was reliable in minimizing unnecessary surgical exploration. A wait-and-see policy is recommended in patients at low risk for contralateral hernia development, while those at high risk for contralateral hernia would benefit from laparoscopic exploration of the contralateral side. However, our pre-operative risk score alone is insufficient to predict the development of a contralateral hernia, and other methods with higher sensitivity and specificity are still needed.

Conflict of interest The authors (M. H., K. S., H. K., S. G., H. K., T. F., T. H., T. M., K. O., M. I., T. I., R. T., T. K.) each declare we have no disclosures to make.

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