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Risk factors for recurrence and contralateral inguinal hernia after laparoscopic percutaneous extraperitoneal closure for pediatric inguinal hernia

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ABSTRACT

Background: The use of laparoscopic percutaneous extraperitoneal closure (LPEC) for pediatric inguinal hernia has recently been increasing. Recurrence and contralateral metachronous inguinal hernia (CMIH) are important problems for LPEC. This study analyzed the risk factors for recurrence and CMIH.
Methods: This study included 1530 patients. The mean follow-up period was 48 months. Of 1530 patients, 847 were boys and 683 were girls. The mean age at operation was 3.9 years. The asymptomatic contralateral internal ring was routinely observed during the operation, and when a patent processus vaginalis (PPV) was confirmed, prophylactic surgery was performed.
Results: Recurrence was seen in 0.48% of patients (8/1653 sides), all of whom were male (P = 0.01: male versus female). On multivariate analysis, age less than 1 year was the only risk factor for recurrence in male patients (hazard ratio: 4.54, 95% CI: 1.07–19.25, P = 0.04). CMIH was seen in 0.22% of the patients (3/1382), again only in male patients (P = 0.12: male versus female). As a result of intraoperative observation, 44.6% of patients were confirmed to have an asymptomatic contralateral PPV and underwent prophylactic LPEC. Female, age 1 year or older, right side, and surgeon's experience were identified as factors associated with asymptomatic contralateral PPV.
Conclusions: To prevent recurrence, surgeons need to be careful when operating on young male patients. Whereas no specific factor could be identified as a risk factor for CMIH, some factors associated with asymptomatic PPV were identified. Further study and discussion will be needed to identify correlations between CMIH and these factors for PPV.
Level of evidence: Level III.

Indirect inguinal hernia is one of the most common diseases for pediatric surgeons. Recently, laparoscopic repair for pediatric inguinal hernia has become increasingly popular. The method of laparoscopic inguinal hernia repair can be divided into two groups: intraperitoneal internal ring closure [1,2] and extraperitoneal closure [3–5]. There is a trend for increased reports of laparoscopic percutaneous extraperitoneal closure (LPEC). We previously reported our results of a study comparing open repair and LPEC [6]. In that report, LPEC had a lower recurrence rate than open repair. In laparoscopic hernia repair, we can observe the asymptomatic contralateral inguinal ring, and when a patent processus vaginalis (PPV) is confirmed, prophylactic surgery can be performed. This contributes to a decrease in contralateral metachronous inguinal hernia (CMIH). Thus, the incidence of CMIH was significantly lower after LPEC than after open repair.

Although LPEC provides good results with respect to recurrence and CMIH, they remain important problems. The aim of this study was to identify risk factors for recurrence and CMIH in LPEC.

1. Methods

1.1. Patients

This study was approved by the Shizuoka Children's Hospital Ethics Board (201466) and complied with the Helsinki Declaration of 1975. Our institution started LPEC for essentially all patients with indirect inguinal hernia in July 2008. From July 2008 to December 2015, 1569 patients with indirect inguinal hernia underwent operation in our institution, and this study included the 1530 patients who underwent LPEC. During this period, 39 patients underwent conventional open repair for reasons such as a history of peritonitis and associated

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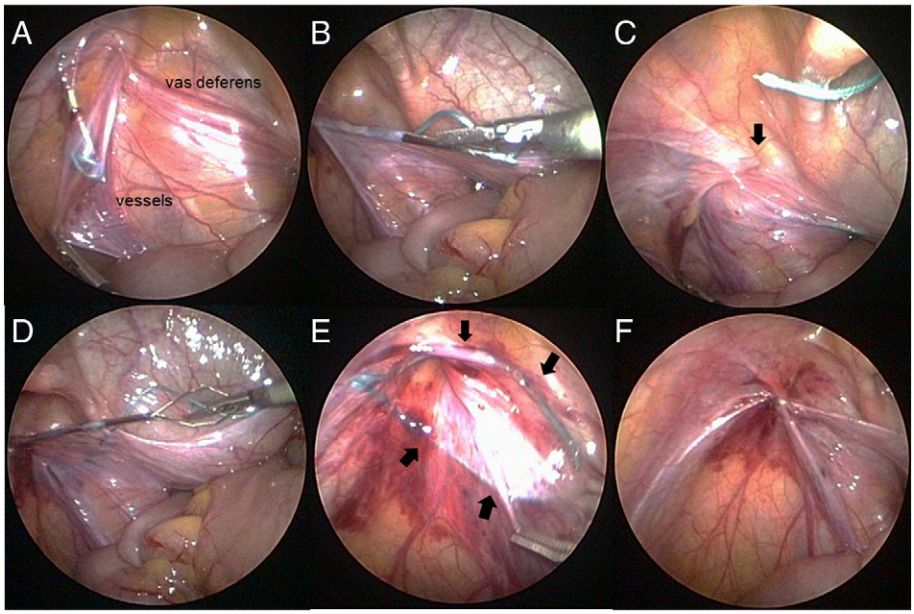

Fig. 1. LPEC procedure for a left inguinal hernia in male patient. A) Half of the circuit suturing was done extraperitoneally, using LPEC needle with nonabsorbable suture. B) After LPEC needle run on the vessels and vas deferens, peritoneum was punctured at the medial edge of the internal ring. The suture was released into the abdominal cavity. C) Circuit suture of the medial side of the internal ring was done extraperitoneally. Arrow indicates the tip of the LPEC needle. D) The LPEC needle got into the abdominal cavity through the same puncture hole as lateral circuit. Then suture was held in the wire loop inside the LPEC needle. E) The LPEC needle was removed from the abdomen with suture. Arrow indicates suture. F) The circuit suturing was tied extraperitoneally. The internal ring was completely closed.

cryptorchidism. These 39 patients were excluded from the study. A diagnosis of inguinal hernia was made when herniation was confirmed by examination by a surgeon or ultrasound. Diagnoses of recurrence and CMIH were made in a similar way. All operations were performed by pediatric surgical fellows. Most patients were discharged on the same day of operation. Then patients came to our clinic one week after operation. In the postoperative clinic, we explained possible complications, such as recurrence, CMIH, surgical site infection and testicular complication. We directed patients and parents to come our clinic when these postoperative problems happened.

1.2. Operative procedure

The LPEC procedure was based on that described by Takehara et al. A 3-mm cannula for the laparoscope was placed at the umbilicus, and a 2-mm cannula for the grasping forceps was placed on the right side of the umbilicus. First, bilateral internal inguinal rings were checked carefully using forceps, and when a PPV was confirmed on the asymptomatic side, prophylactic surgery was performed. The orifice of the hernia sac was closed extraperitoneally with complete circuit suturing around the internal inguinal ring using an LPEC needle (Lapaherclosure; Hakko Medical Co., Nagano, Japan), which has a wire loop to hold the material at the tip with nonabsorbable suture. The details of the technique have been described previously [3,6]. (See Fig. 1.)

1.3. Analysis

For the multivariate analysis, EZR (Saitama Medical Center, Jichi Medical University), which is a graphical user interface for R (The R Foundation for Statistical Computing, version 2.13.0), was used [7]. GraphPad Prism 6 (GraphPad Software Inc., San Diego, CA) was used for the other statistical analyses. For univariate analyses, continuous data were analyzed using the Mann–Whitney test. Categorical data were mainly analyzed using the Chi-squared test and Fisher's exact test. Only long-term results (incidence of recurrence and CMIH) were analyzed using the log-rank test, and *P* values <0.05 were considered significant. Data are quoted as mean (range) unless indicated otherwise.

2. Results

Patient characteristics are shown in Table 1. Mean age and mean body weight at operation were 3.88 years and 15.1 kg, respectively. The mean follow-up period was 48 (4–93) months. The male/female ratio was 847/683. Mean age and weight at operation were significantly lower in female patients than in male patients (age: $P < 0.01$, body weight: $P < 0.01$). Of all 1530 patients, 1407 patients (780 male and 627 female) were preoperatively diagnosed with unilateral inguinal hernia. The other 123 patients (67 male and 56 female) were diagnosed with bilateral inguinal hernias. The total number of treated inguinal hernias was thus 1653, and these 1653 hernias were analyzed for recurrence. Of the 1407 patients who had clinically unilateral inguinal hernia, 25 patients had a history of a contralateral inguinal hernia. Thus, the remaining 1382 patients were analyzed for CMIH. In the operation, the asymptomatic contralateral internal ring was routinely observed, and when a PPV was confirmed, prophylactic surgery was performed regardless of the size of the patency. Patency of the asymptomatic contralateral PPV was also analyzed.

Table 1
Patients characteristics.

	All patients	Male	Female	P[a]
Cases	1530	847	683	
Age (years) (mean)	3.88	3.25	4.67	<0.01
Body weight (kg) (mean)	15.1	14	16.5	<0.01
Age less than 1 year	17.7% (271/1530)	23.5% (199/847)	10.5% (72/683)	<0.01
Side (right/left/bilateral)	786/621/123	473/307/67	313/314/56	<0.01
Mean follow-up period (months)	48	47.8	48.3	0.67

[a] Male versus female.