



Experience with peritoneal thermal injury during subcutaneous endoscopically assisted ligation for pediatric inguinal hernia[☆]

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ABSTRACT

Background: Subcutaneous endoscopically-assisted ligation (SEAL) for pediatric inguinal hernia repair has gained in popularity although variations in techniques exist. Peritoneal scarring by thermal injury has been described as an adjunct. We explored the hypothesized inverse-correlation between peritoneal scarring and recurrence after SEAL. **Methods:** We conducted a single-center retrospective review of all patients <18 years old undergoing SEAL between 2010 and 2016 (REB-20172727). Demographics and outcomes were investigated. Univariate and multivariable logistic regressions were performed to evaluate the association between peritoneal scarring and recurrence.

Results: We identified 272 patients. Median age was 3 years, 35% were female, and 19% were born premature. Median follow-up was 30 months, ≥ 1 visit/patient. Bilaterality was noted in 35%. There were no reported cases of metachronous hernia, vas injury, testicular atrophy or chronic pain, and recurrence rate was 4.6%. Prematurity, unilateral repair, incarceration, and suture-type (Ti-Cron® vs. Ethibond®) had significant correlation with recurrence on univariate analysis ($p < 0.25$). Surgeon experience did not. Peritoneal scarring, performed in 195 cases (72%), was not predictive of recurrence (adjusted OR = 0.87, $p = 0.830$) on multivariable analysis.

Conclusion: The rate of complications with SEAL compares favorably to published data. Thermal injury was not associated with improved recurrence rates. The benefits of peritoneal scarring may not outweigh the risks.

Level of Evidence: III – Retrospective Case–Control Study.

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Inguinal hernia repair (IHR) is one of the most commonly performed procedures in children in North America [1]. Laparoscopic approaches to IHR in children have gained in popularity [2]. Many variations in the technique exist, often motivated by a concern over a nonnegligible recurrence rate in laparoscopic IHR, reported to be 3–4% in the literature [3–5]. One such variation, first described in 2007 by Ozgediz, et al., is the subcutaneous endoscopically assisted ligation (SEAL) for the repair of pediatric inguinal hernias [6]. Peritoneal scarring by deliberate thermal injury has been described as an adjunct with the potential to decrease the rate of recurrence after SEAL [7]. This study aims to explore the hypothesized inverse-correlation between peritoneal scarring and inguinal hernia recurrence after SEAL.

1. Methods

1.1. Study setting

We conducted a single-center retrospective chart review at the Montreal Children's Hospital, a quaternary Canadian institution. The institutional Ethics Review Board approved the project, in adherence to the Tri-Council Policy statement (REB-20172727). We included all patients below age 18 who underwent SEAL for pediatric IHR between January 1, 2010 and December 31, 2016. All patients and caregivers were explained and offered both the open or laparoscopic approach, with no absolute contraindications to either technique. The senior author (RB) performed the majority of cases representing this dataset, with colleagues gradually adopting the technique in select cases.

1.2. Technique

During the study period, the senior author (RB) modified operative techniques in 2012 from that described by Ozgediz et al. to include intentional thermal injury of the anterolateral surface of peritoneum within the patent processus vaginalis (PPV) [6]. This transition occurred

Abbreviations: SEAL, subcutaneous endoscopically assisted ligation; aOR, adjusted odds ratio; cOR, crude odds ratio; OR, odds ratio; CI, confidence interval; PPV, patent processus vaginalis.

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as a natural adoption of technical modifications as they were published and demonstrated safety and efficacy — details of this technique were clarified by RB and the senior author of the technical report (TP) [7]. The technique consists of the introduction of a 30-degree laparoscope through an umbilical port allowing visualization of both internal rings. A stab incision is made in the left mid-abdomen and a three-millimeter laparoscopic grasper is introduced. Peritoneal scarring is performed by inducing thermal injury of the peritoneum using a monopolar electro-surgical device (“cautery”) at the anterolateral aspect of the internal inguinal ring, taking care to avoid the vas and named vessels. This differs slightly from the sharp peritoneal injury described by Blatnik, et al. [7]. The ideal site of internal inguinal ring circumnavigation is identified under direct vision with a finder needle. A stab incision is then made, allowing the operator to encircle the underlying internal inguinal ring by passing a nonabsorbable suture on a large needle from one side, excluding the vas and vessels, and bringing only the tip out through the skin on the other side. The needle is then reversed through the subcutaneous tissue, heel first, and back out of the original stab incision. The needle is then cut and the suture secured and buried, thus ligating the internal ring [6].

1.3. Data collection

Data pertaining to patient demographics, operator characteristics, operative procedure, postoperative complications, and follow-up outcomes were collected using a preestablished data extraction template. For each operation, surgeon experience was defined as the number of cases performed by the same surgeon to date, while institution experience was defined as the number of cases performed in the institution to date. In all cases, presence or absence of deliberate peritoneal injury during SEAL procedure for IHR was noted. The primary outcome was inguinal hernia recurrence. Secondary outcomes included postoperative complications, hydrocele formation, metachronous hernia, vas injury, testicular atrophy, and chronic pain.

Table 1
Baseline demographic and operative characteristics of study population.

Variable	N (%)	Median (Range)
<i>Demographics</i>		
Age (years)	–	3 (0–18)
Female gender	94 (35%)	–
Male gender	178 (65%)	–
History of prematurity (<37 weeks)	52 (19%)	–
Presence of comorbidities	73 (27%)	–
Number of comorbidities	–	0 (0–7)
<i>Operative Factors</i>		
Previous surgery	32 (12%)	–
Primary operator was fellow	200 (74%)	–
Resident / medical student present	147 (54%)	–
Unilateral left	66 (24%)	–
Unilateral right	110 (40%)	–
Bilateral (identified preoperatively)	23 (8%)	–
Bilateral (diagnosed intraoperatively)	73 (27%)	–
Incarcerated	24 (9%)	–
Strangulated	0 (0%)	–
Insufflation pressure	–	12 (8–15)
Peritoneal scarring	195 (72%)	–
<i>Suture Type</i>		
2-0 Ethibond®	270 (99%)	–
2-0 Ti-Cron®	2 (1%)	–
<i>Needle Type</i>		
CT-1	119 (44%)	–
SH	78 (28%)	–
Not specified	75 (28%)	–
Concurrent procedure	63 (23%)	–
Duration of surgery (min)	–	30 (10–255)
Blood loss (mL)	–	0 (0–50)

1.4. Analysis

Results were reported on a patient-level basis rather than per-hernia basis, given the clinical and patient-centered significance of recurrence for individual patients, and accounting the association of other patient-level factors with hernia recurrence. Based on the animal model's eight-fold reduction in hernia recurrence [7], and published baseline pediatric inguinal hernia recurrence rates of 3%–5% [8–10], we estimated a sample size of 221 patients in each group would be required to achieve significance with a power of 0.80 in a one-sided test. Univariate logistic regression was performed to identify potential predictors of hernia recurrence. Stepwise multivariable logistic regression analysis was performed to investigate the independent predictive significance of intentional peritoneal scarring and other variables having achieved a p-value <0.25 on univariate analysis. The multivariable logistic regression model also included variables having previously been reported to correlate positively with recurrence, such as prematurity, presence of comorbidity, and emergency repair [11,12]. Time to recurrence was measured in months and Kaplan–Meier survival analysis was performed to compare recurrence-free survival of repaired hernias in patients who underwent peritoneal injury and those who did not. The Wilcoxon Rank Sum Test was used to compare median time to recurrence in both groups. A p-value <0.05 was considered statistically significant. Data analysis was performed using R version 3.2.3 (Auckland, New Zealand) [13].

2. Results

We identified 380 cases performed in 272 patients by 6 surgeons during the study period. Median age was 3 years old. Thirty-five percent of patients were female and 19% had a history of prematurity. Peritoneal scarring was performed in 195 patients (72%). Median follow-up was 30 months with all patients receiving at least one follow-up visit. Follow-up was achieved through routine postoperative visit (94%), or through phone follow-up (6%). Eight percent of patients had a preoperative diagnosis of bilateral inguinal hernias. A contralateral PPV was noted intraoperatively in an additional 27% of patients. There were no reported cases of metachronous hernia, vas injury, or chronic pain. There were no cases with associated testicular atrophy, as reported by surgeon's physical exam. Recurrence occurred in 3% of repairs, impacting 4.7% of patients. Among the 13 patients with recurrence, 8 had ipsilateral recurrence after unilateral repair, 1 had recurrence on the right side after planned bilateral repair, 3 had recurrence on the side that was clinically evident prior to operation after unplanned bilateral repair, and 1 had recurrence on the side that was not clinically evident prior to operation after unplanned bilateral repair. Complete baseline characteristics are shown in Table 1. Overall complications,

Table 2
Complications, follow-up and outcomes after subcutaneous endoscopically-assisted ligation (SEAL) technique for inguinal hernia repair.

Variable	N (%)	Median (Range)
Time to first follow-up (days)	–	19 (2–414)
Duration of follow-up (months)	–	30 (4–73)
<i>Follow-up location</i>		
Clinic	247 (94%)	–
Phone	15 (6%)	–
Recurrence	13 (4%)	–
Postoperative complications	21 (8%)	–
Clavien–Dindo >2	5 (2%)	–
Hydrocele	5 (2%)	–
High-riding testicle	2 (1%)	–
Surgical site infection	5 (2%)	–
Chronic postoperative pain	0 (0%)	–
Readmission	1 (0%)	–
Metachronous hernia	0 (0%)	–
Vas injury	0 (0%)	–

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