Sutureless inguinal hernia repair with creation of a peritoneal lesion in children: a novel laparoscopic technique with a low recurrence rate

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Received: 9 April 2017 / Accepted: 6 July 2017 © Springer Science+Business Media, LLC 2017

Abstract

Background Hernia repair represents about 25% of all pediatric surgeries. Repair can be done using an open or laparoscopic technique. The open approach has a reported recurrence rate of 1.2% but requires an additional incision to repair for a contralateral hernia. With the laparoscopic approach, no additional incision is needed but the recurrence rate has been reported to be as high as 4%. The objective of this study was to assess the safety and efficacy of a novel sutureless laparoscopic inguinal hernia repair that has the advantages of both approaches.

Methods Since April 2014 up to March 2017, 26 children (12 girls and 14 boys) aged 3 months to 13 years underwent sutureless laparoscopic inguinal hernia repair. The peritoneum around the internal inguinal ring was severed and folded into the inguinal canal. Regeneration of the peritoneum around the inguinal ring creates a scar that effectively closes the internal orifice.

Results No recurrences or complications were observed in any of the 26 cases after a follow-up of 1–35 months (median, 14 months).

Conclusions Sutureless laparoscopic inguinal hernia repair provides a new option for the management of patients with a pediatric inguinal hernia. The procedure does not require advanced laparoscopic skills, is easily reproducible, and is safe.

Therapeutic study Level of Evidence IV

Keywords Pediatric inguinal hernia · Recurrence rate · Laparoscopic hernia repair · Sutureless repair · Peritoneal lesion · New technique

Hernias are a common reason for pediatric surgical consultation and the most frequent indication for pediatric surgical intervention. Most pediatric inguinal hernias are of the indirect type and are the result of a failure of closure of the vaginal process [1].

Different management options exist and it has historically been accomplished through an open incision. However, in the last decade, there have been numerous reports of laparoscopic hernia repair [2]. The main advantage of the open approach is the lower rate of hernia recurrence. On the other hand, the main drawback is the need for an additional surgical incision to repair the contralateral side, because of the 5.8–15.8% incidence of a metachronous contralateral inguinal hernia following unilateral repair. With laparoscopy, no additional incisions are needed yet the recurrence rate is 3–4% [1, 3, 4]. Therefore, there is no optimal solution for the closure of the inguinal ring since open repair has less recurrence and laparoscopic repair has
the advantages of minimally invasive surgery. Trying to find a procedure with the benefits of laparoscopy and the low recurrence rate of open surgery has been addressed with no success.

Schier was the first to describe laparoscopic hernia repair in children [2, 3, 5]. Since then, a great number of laparoscopic techniques to obliterate the vaginal process have been described. One of the main advantages of laparoscopy is the ability to explore and treat the contralateral side without having to create a new incision. The laparoscopic approach provides better visualization of the anatomy and allows evaluation of the internal genitalia for other pathologies that might coexist. It also causes less trauma to cord structures if compared to the open approach and the esthetic results are excellent [4, 6]. In laparoscopic repair, the possible intraoperative complications could be damage to the vas deferens or a tear of the peritoneum during suture placement, while possible postoperative complications could be recurrence, hydrocele, testicular atrophy, and iatrogenic cryptorchidism [7].

As stated above, the recurrence rate is reportedly higher in laparoscopic repair compared to traditional open repair. This makes it difficult to recommend the laparoscopic approach over the open approach. The objective of the present work was to determine the safety and efficacy of a novel technique that allows to preserve the benefits of laparoscopy and the low recurrence rate of open surgery. This technique challenges the conventional technique of previously reported laparoscopic interventions for inguinal hernia repair: tying a knot. This study describes a sutureless inguinal hernia repair with the creation of a peritoneal lesion.

Materials and methods

From April 2014 to March 2017, 26 children underwent sutureless inguinal hernia repair with the creation of a peritoneal lesion at a public general hospital in Mexico City. Prior to surgery, informed consent was obtained from the patients’ caretakers. Data for this retrospective and descriptive study were collected after approval from the hospital’s ethics and investigation committees. All children <16 years old, diagnosed clinically by one of the authors (AM), were included in the study and underwent sutureless inguinal hernia repair with the creation of a peritoneal lesion. The Pediatric Surgery department includes three pediatric surgeons. The other two pediatric surgeons employ an open approach for inguinal hernia repair.

One surgeon (AM) operated on all patients. The surgery was performed under general anesthesia with endotracheal intubation. With the patient in the supine position, an approximately 1 cm transverse incision was made above the umbilicus. A pneumoperitoneum of 8–12 mmHg was created using a Hasson approach with a carbon dioxide flow of 5 L/min. Under direct vision, with a 5 mm 0° laparoscope, two 3 mm trocars were inserted at the intersection of the horizontal umbilical line and the vertical anterior axillary line. A diagnostic laparoscopy was done. With laparoscopic scissors or cautery, the peritoneum around the internal inguinal ring was cut circumferentially and peeled away from the abdominal wall, taking care not to damage the spermatic vessels or the vas deferens. Once the peritoneum was freed up around the internal inguinal ring and part of the inguinal canal, it was folded into the inguinal canal. Regeneration of the peritoneum around the denuded internal inguinal ring creates a scar that closes the hernia (Figs. 1 and 2).

After the procedure, the patients were followed up by the author at 1, 2 weeks, 1, 3, 6 months, and then annually until they reached the age of 16. No patients were lost to follow-up. The primary endpoint was the recurrence rate after the surgical repair. It was evaluated during each of these visits with a thorough physical exam.

Results

A total of 26 children underwent the procedure, including 12 girls and 14 boys, with ages ranging from 3 months to 13 years old (mean age, 5 years 10 months). Twelve right inguinal hernias, 11 left inguinal hernias, and 3 bilateral hernias were diagnosed preoperatively. During laparoscopy two patients with a unilateral inguinal hernia were found to have a previously undetected contralateral inguinal hernia. Surgical times ranged from 15 to 50 min, with a mean time of 20 min. All patients were discharged after a hospital stay of 2 to 4 h. Postoperative follow-up ranged from 1 to 35 months, with a median follow-up of 14 months. No recurrences were observed during the follow-up period. There were no intraoperative or postoperative complications.

Discussion

With this technique, we keep the low recurrence rate of open surgery since recurrences happen during the first year after the repair and we have not seen a single one during the follow-up. In addition, we were able to keep the advantages of minimally invasive surgery.

The reported higher recurrence rate with laparoscopic hernia repair has driven the search for an improved surgical technique with a lower recurrence rate. These different techniques can be divided into two groups, the...
intracorporeal and the percutaneous approach [2]. The success of both of these approaches is based on closing the hernia by tying a knot.

The intracorporeal techniques employ a fully laparoscopic repair to accomplish closure of the vaginal process. They require the placement of at least two laparoscopic instruments and the laparoscope [2]. They all require the placement of intracorporeal knots (Z type, W type, N type, purse string type) using absorbable or non-absorbable suture, and may involve the creation of a peritoneal lesion (ligation of the sac, excision of the sac, or creation of a peritoneal flap) [4, 8, 9]. Becmeur et al. described the excision of the peritoneal sac before closure of the hernia with an intracorporeal knot [10]. Esposito et al. applied this modification on the surgical technique and reported a significant reduction in the recurrence rate, from 3.4 to 0.6%, with a follow-up of 2 years [11]. Other investigators that created a peritoneal lesion have reported similar reductions in the recurrence rate after inguinal hernia repair [7, 10, 12].

The percutaneous techniques are based on the placement of a circumferential suture around the internal inguinal ring. This suture is tied percutaneously and only requires the placement of the laparoscope. Different techniques have been reported on how to place the suture [2, 13–16]. Ostlie and Ponsky, added a step to create a more lasting repair by cauterizing the internal inguinal ring, sparing the peritoneum overlying the cord structures [2].

The observation that adding a peritoneal lesion reduces the recurrence rate in both intracorporeal and percutaneous techniques may be due to the peritoneum healing properties. Peritoneum not only regenerates itself from within and not from the edges, as with skin, but also heals with fewer adhesions if left open instead of being closed with silk or

Fig. 1 The internal inguinal ring was incised and its peritoneum dissected (schematic view of the right groin on the left and an intraoperative image of the right groin on the right)

Fig. 2 The peritoneum around the internal inguinal ring was peeled and then folded into the inguinal canal (schematic view of the right groin on the left and an intraoperative image of the left groin on the right)
This was illustrated in a study with 28 male rabbits that had an open vaginal process whose objective was to assess the laparoscopic repair using two different techniques. In the first group, a laparoscopic percutaneous inguinal hernia repair was used, and after removal of the suture, the majority of repairs failed when the abdomen was insufflated to 35 mmHg, whereas in the second group, the same technique was used but a peritoneal lesion was created and the majority of repairs persisted after removal of the suture. The investigators concluded that the creation of a peritoneal lesion could induce a healing process that leads to a more lasting repair versus a repair accomplished with only a suture [21].

Smedberg et al. and Shulman et al. performed open inguinal hernia repairs in adults without ligating the sac. They did not find any difference in the recurrence rate compared with those in whom the sac was ligated [24, 25]. In a randomized study of 50 boys between the ages of 5 months and 12 years, the sac was ligated before division in the open hernia repair control group, whereas in the intervention open hernia repair group the sac was left open after division. The patients were followed up at 1, 2, 6, 12 weeks, 6 months, and 1 year after the surgery; no difference in recurrence rate was found between the two groups. They concluded that the hernia sac could be left open in children [26].

Schier first suggested in 2006, and again in 2007, that it might be possible to omit the suture [22, 23]. However, it was never done. So instead of tying a knot, we decided to make the creation of a peritoneal lesion, the fundamental aspect of our repair. It is the scar induced by the peritoneal lesion that closes the hernia and not the tying of a knot.

We created the peritoneal lesion by cutting and peeling off all of the peritoneum that covered the internal inguinal ring, being careful not to damage the cord structures. As soon as the peritoneum was removed from the internal inguinal ring, the defect collapsed itself and no immediate reappearance of the defect was seen even when the children cried on waking up. We believe this is due because once the peritoneum is removed from the abdominal wall the persistence of the vaginal process is interrupted and the defect spontaneously closes. Afterward, the scar from the peritoneal lesion effectively closes the hernia. Suture material was not used for closure, demonstrating that suture placement is not needed. Since removing the flap of peritoneum through the 3 mm trocar is cumbersome, it was used to plug the hernia putting it instead in the inguinal canal.

By eliminating the need for suture placement and knot tying, the procedure becomes easier, less laparoscopic skills are required, and some complications may be avoided. Yet, by creating a peritoneal lesion, a better closure of the hernia with a lower recurrence risk is assured.

Favorable results were obtained in this study using the novel technique described. Sutureless laparoscopic repair with creation of a peritoneal lesion is a good option for the management of pediatric patients with an inguinal hernia. The small sample size and the fact that a single surgeon at a single institution performed all surgeries are limitations of this study. Nonetheless, our study establishes a basis for additional research using this novel technique. This technique may change our perception regarding laparoscopic inguinal hernia repair in children and on our daily surgical practice.

**Funding** This study was not funded by any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Compliance with ethical standards**

**Disclosure** Drs. Alfonso Galván Montaño, Paul Manuel Ali Ouddane Robles and Silvia García Moreno have no conflicts of interest or financial ties to disclose.

**References**