Laparoscopic Extracorporeal Ligation of the Internal Inguinal Ring by a Spinal Needle: a Simple Method of Hernia Repair in Children

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Abstract Laparoscopic repair has emerged recently as an alternative technique for hernia repair in children. Various methods of repair have been described. Basic principle is to close the internal inguinal ring either by intracorporeal or by extracorporeal suturing. The objective of this study is to describe and evaluate the outcome of a simple technique of internal ring closure by a spinal needle. A total of 43 hernias in 41 patients were repaired. A prolene thread was passed percutaneously around the internal inguinal ring by threading it through a spinal needle under laparoscopic control. The suture is then tied extracorporeally in the subcutaneous plane. There were 15 female and 26 male patients in the age group of 1½ to 12 years. Right-sided hernia was present in 31 cases and left-sided hernia in eight cases, and two cases had bilateral hernia. All cases were repaired successfully. There was no intra-operative or postoperative complication. This new technique has all the advantages of laparoscopic hernia repair in children (minimally invasive, less pain, less complication, and cosmesis). In addition, the method is simple and it does not need any special equipment or advanced laparoscopic skill.

Keywords Laparoscopic hernia repair · Pediatric inguinal hernia · Internal inguinal ring

Introduction

Inguinal hernia is one of the most frequently performed operations in infant and children. Open herniotomy is the standard method of treatment based on which other modalities of repair are evaluated. However, in the recent years laparoscopic hernia repair is routinely performed in many centers and its efficacy and safety are well documented [1–4]. Most of these techniques begin with access through the umbilicus, and both internal rings are evaluated. Hernia repair begins with passage of a thread beneath the peritoneum around the internal inguinal ring (IIR), taking care to avoid the cord structures. The procedure is performed with a permanent suture to reduce recurrence rate. The suture is ligated either intracorporeally or extracorporeally to close the internal ring. Based on this principle, various techniques have been described by different authors [3–7]. We devised simple method of encircling the internal ring by using a conventional spinal needle. The aim of the study is to evaluate the feasibility, efficacy, and safety of the procedure in randomly selected cases.

Materials and Methods

From December 2011 to March 2013, 41 patients with inguinal hernia were treated by laparoscopic herniotomy by extracorporeal ligation of the internal inguinal ring (IIR). Age of the patients ranged from 1½ to 12 years. Age distribution is shown in Fig. 1.

All the procedures were done under general endotracheal anesthesia. Access was obtained through the umbilicus by inserting a 5-mm trocar by semi-open technique. One 3-mm Maryland forceps was inserted either through umbilicus or mid-line below umbilicus or lateral border of the rectus abdominis muscle below the umbilicus. Site of the internal ring closure

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Fig. 1 Bar diagram showing age distribution

was determined by finger pressure on the abdominal wall at the site of internal ring. Skin and subcutaneous tissue were incised at that point by a pointed knife. A 22-gauge spinal needle threaded with a 2-0/3-0 prolene in the form of a loop was inserted through the stab wound and pushed down along one side of the IIR just beneath the peritoneum. Maryland forceps was used to lift the peritoneum and make it taught for easy passage of the needle and also to protect the vas deferens and spermatic vessels or the round ligament (Fig. 2). Peritoneum was punctured by the needle at 6 o'clock position of the internal ring. Maryland forceps held the apex of the prolene loop and the spinal needle was withdrawn. Then the spinal needle was threaded just short of its tip with prolene. Needle was then reinserted through the same stab along other side of the ring in similar fashion and the peritoneum was punctured again at 6 o'clock position, and the prolene thread was pushed through the

needle for sufficient length. Thread was held by the Maryland forceps and the needle was withdrawn. Free end of the second thread was then passed through the prolene loop sufficiently. The prolene loop was then withdrawn from outside which kinked the second prolene thread and pulled it out. By this maneuver, the second prolene thread made a loop around the internal ring (Fig. 3). This loop was then tied subcutaneously to close the internal ring. Before closing the ring, any gas trapped inside the scrotum or labia was squeezed out and the pneumoperitoneum was deflated. Umbilical port was closed by absorbable suture. Stab wound and the 3-mm port site were not sutured. Steps of the procedure are schematically shown in Fig. 4.

In female patients, the procedure was quite easy. Here, we have described our standard technique, but the 3-mm Maryland forceps was not routinely needed in female patients, second thread could be negotiated into the prolene loop by manipulating the spinal needle. In the male patients, the main limiting factor was avoiding the vas and vessels. There was inadvertent intermediate puncture of the peritoneum in three cases but that was covered by partially withdrawing the needle and passing it again after lifting the peritoneum. In one male patient, the omentum was adherent to the sac (irreducible hernia). It was separated from the sac by diathermy without any additional port. All the patients were discharged on the next day and called for follow-up visits at 2 weeks, 1 month, 6 months, and 1 year. During follow-up, outcome measurements—scrotal edema, postoperative hydrocele formation, iatrogenic testicular ascent, testicular atrophy, recurrence rate, and cosmetic results were evaluated.

Fig. 2 Steps to lift the peritoneum to preserve the vas

Results

There were 43 hernias in 41 patients. There were 26 male and 15 female patients. In male patients, 20 hernias

Fig. 3 **a** Preoperative picture. **b** Second thread passed through the loop. **c** Prolene threads are interlocked. **d** Prolene thread pulled out around the IIR extraperitoneally. **e** Prolene thread ready for tying. **f** Procedure completed. Arrow: **a** 5-mm telescope, **b** 3-mm Maryland, **c** needle entry site

were on the right side and six on the left side. In the females, 11 hernias were on right side and two on the left side. Two girls had clinical hernia on right side but bilateral hernias were detected by laparoscopy and repaired at the same time. Operating time varied from 25 min to 10 min (mean 12.5 min). There was no major complication during surgery except excessive bleeding (external) from the stab wound site in one case but stopped spontaneously by pressure. Vas and vessels were spared in all cases. There was no case of conversion due to technical difficulty.

All the patients tolerated feed after 6 h. Pain could be managed by oral analgesic (acetaminophen or ibuprofen) and no case needed injectable analgesic for postoperative pain. Postoperative scrotal edema was minimal even in cases with large hernias. In female, postoperative sign in labia was unobvious. During follow-up visits, there was no case of testicular atrophy, testicular ascent, or hydrocele. One right inguinal hernia in an 8-year-old girl recurred on 1 month follow-up visit and that was repaired by open herniotomy. Stab wound site was inconspicuous, 3-mm port sites healed with no or minimal scar, and the umbilical incision was unobvious.

Fig. 4 Schematic diagrams showing how prolene threads 1 and 2 are passed around the IIR and the thread-2 is brought out to encircle the internal ring

Discussion

In children, the standard surgical treatment of inguinal hernia is limited to ligation of the hernia sac at the IIR [5]. Internal ring is normally reached by dissecting the hernia sac from the cord structures, which bears potential risk of injuring the spermatic vessels and the vas deferens, hematoma formation, wound infection, iatrogenic testicular ascent, testicular atrophy, and recurrence of the hernia. It also carries potential risk of damaging the tubes and ovaries which may lead to infertility [1, 4, 8].

Laparoscopic repair of hernia in children has emerged recently as an alternative method of treatment and is rapidly gaining popularity with more and more authors endorsing its feasibility, efficacy, and safety [1–5, 9].

Advantages of laparoscopic repair include excellent visual exposure, ready evaluation of the contralateral side, minimum dissection and avoidance of injury to vas and vessels and iatrogenic ascent of the testis, and decreased operating time especially in obese child and in recurrent cases [5, 10].

In the open hernia repair, initial time is spent in gaining access to the internal ring by localizing and dissecting the sac from the cord structures. Whereas, in laparoscopy internal ring is visualized directly from within the abdomen which

makes the area of dissection bloodless, and magnification renders anatomy very clear, making surgery precise [1, 9, 11]. In addition, the incidence of testicular atrophy is rare in laparoscopic hernia repair because of the multiple collaterals of the testis which are not disturbed [12, 13].

Different laparoscopic techniques of inguinal hernia repair in children have been described. Schier (1998) used 2-mm instruments without a trocar for intraabdominal suturing of the IIR in 25 girls by the placement of two Z-sutures with good result [6]. Lee and Liang performed microlaparoscopic high ligation of IIR in 450 patients with good results and low recurrence rate (0.88 %) [5].

But intracorporeal suturing needs a considerable laparoscopic skill, and it is well documented in the literature as limiting factor [5, 14].

Shalaby et al. used Reverdin needle (Martin Medizin Technik, Tuttlingen, Germany) for extracorporeal ligation of the IIR in 187 groin hernias in 150 patients with superior results over intracorporeal techniques [4]. Endo and Ukiyama introduced the Endoneedle that is designed especially for extracorporeal closure of the patent processus vaginalis [7]. Tam et al. had reported laparoscopic extracorporeal hernia repair by hook method in 433 cases with low recurrence rate (0.35 %) [3].

Shalaby et al. had further compared the intracorporeal purse string suture with extracorporeal closure using Reverdin needle (RN). Laparoscopic hernia repair by RN resulted in a marked reduction of operative time and excellent cosmetic results with low recurrence rate [4].

Common features of all the laparoscopic repairs are ligation the internal ring by an encircling suture. On these footings, we devised an innovative the technique of encircling the internal ring by a spinal needle which is readily available. This method does not need any special needle or hook and can be performed by a surgeon with basic laparoscopic skill without knowledge of intracorporeal knotting techniques. Lifting the peritoneum with the help of 3-mm Maryland forceps ensures a complete encirclement of the internal ring without skip area. Literature search revealed that a similar method was described by Tatekawa [15] in 2012 by the use of an epidural needle and preperitoneal hydrodissection to separate the vas and vessels. But we believe that vas and vessels can be well preserved by lifting the peritoneum by the 3-mm Maryland forceps.

Open herniotomy in children has been reported to have recurrence rates of 0.8–3.8 %. While in laparoscopic hernia repair, it ranged from 0.7 to 4.5 % [16]. On the contrary, Shalaby et al. had reported a lower recurrence rate (0.8 %) after laparoscopic repair by RN and 2.4 % recurrence after open herniotomy [15]. Avoiding the gonadal vessels and vas deferens during subcutaneous endoscopic ligation may leave a small gap in the IIR [9, 17, 18]. And an important step of transecting the sac in open herniotomy is not achieved in many laparoscopic techniques. The skip areas in the IIR and

leaving the sac in continuity without disconnection may be the cause of subsequent recurrence of hernia and hydrocele formation in the postoperative period [9, 16, 17].

We believe that complete encirclement of the ring, emptying the sac, and reducing the abdominal pressure before tying may help in reducing hydrocele formation and recurrence of hernia. We have not encountered any hydrocele during the 1 year follow-up. Only one case recurred.

Due to learning period, we took longer time at the beginning but it is significantly reduced at present (from 25 to 10 min).

Though we have selected the cases randomly, there was preferential bias of selecting older cases in our series. But looking at the ease and efficacy of the procedure, it can be applied to smaller children also.

Contralateral exploration for patent processus vaginalis (PPV) remained a controversial topic. But during laparoscopy, it becomes obvious automatically. Some authors suggest that PPVs less than 2 mm may be left alone [6], but other had routinely ligated it to avoid development of metachronous hernia [15]. In our series, contralateral hernias were detected in two cases by laparoscopy and were repaired at the same time.

We conclude that our technique is simple, safe, and efficacious for pediatric inguinal hernia repair. It does not need any special equipment and the procedure can be performed by surgeons with basic laparoscopic skill. Large number of cases and long-term follow-up is needed to establish recurrence rate.

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