**Initial Experience with Laparoscopic Percutaneous Repair of Indirect Inguinal Hernia in Adolescents and Adults**

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**Abstract**

**Purpose:** High ligation of the patent processus vaginalis (PPV) as basis of the treatment of indirect inguinal hernia in pediatric patients is not applied to adults. Instead, the popular options are the laparoscopic transabdominal preperitoneal (TAPP) approach or totally extraperitoneal (TEP) approach. We developed a unique technique to achieve laparoscopic completely extra peritoneal closure (LPCEC) of the PPV and have applied it to adolescent and adult patients on their demand. The purpose of this paper is to introduce our initial experience with LPCEC in adolescents and adults and evaluate their outcomes.

**Material and methods:** This report includes 20 patients over 15 years of age with indirect inguinal hernia consecutively experienced since 2004. The medical records of these patients were analyzed in terms of intra operative findings of the internal inguinal ring (IIR), rates of contralateral patent processus vaginalis (cPPV), operation time, complications, postoperative recurrence rates, and rates of metachronous contralateral inguinal hernia (MCIH).

**Results:** There were 13 males and 7 females; 11 with right unilateral, seven with left unilateral and two with bilateral hernias. Ages ranged from 15 years to 67 years with an average of 23.4 years. Three males had an episode of open herniorrhaphy on the contralateral side during childhood. One male patient had a direct hernia on the contralateral groin. The two oldest patients were associated with omental incarceration. One male presented with bowel loop incarceration. The procedures were completed successfully without complications in all of the patients. The mean operation time was 45 minutes for unilateral and 53 minutes for bilateral hernia, respectively. No recurrence and MCIH has been noted. No patients reported postoperative chronic groin pain.

**Conclusions:** The advantages of our LPCEC include technical ease, short operation time, minimal invasion, preservation of reproductive systems, rapid return to daily activities and low recurrence rate. The LPCEC is a feasible alternative to the TAPP and TEP for the repair of inguinal hernia in adolescents and adults, when the diagnostic laparoscopy via umbilical port defines the inguinal hernia as indirect.

**ABBREVIATIONS**

PPV: Patent Processus Vaginalis; LPCEC: Laparoscopic Completely Extraperitoneal Closure; IIR: Internal Inguinal Ring; cPPV: contralateral PPV; MCIH: Metachronous Contralateral Inguinal Hernia

**INTRODUCTION**

The principle for the treatment of indirect inguinal hernia in pediatric populations is high ligation of the PPV. This procedure can be done using the laparoscopic approach [1]. We developed a unique technique to achieve completely extraperitoneal ligation of the PPV with percutaneously introduced suture, using specially devised needle kit (Endoneedle Kit) [2]. We have since experienced more than 2,000 cases. Successful outcome achieved through the procedure has encouraged us to apply it to adolescent and adult patients on patient's demand. The purpose of this paper is to introduce our initial experience with LPCEC of the PPV in adolescents and adults, and to evaluate their outcomes.

**MATERIAL AND METHODS**

There were 20 patients over 15 years of age with indirect inguinal hernia consecutively experienced since 2004 at the Saitama City Hospital. The medical records of those patients were analyzed in terms of intraoperative findings of the IIR, including, presence of cPPV, operation time, complications, and postoperative recurrence and MCIH rates. The patients were followed up regularly at our outpatient clinic for up to seven to 12 months, and at visit for any complaints or morbidities after that time. The follow-up period ranged from 1 year and 4 months to 11 years and 3 months with an average of 4 years and 9 months. Last information regarding long term postoperative complication, including testicular ascend, testicular atrophy and...
groin pain, was collected by telephone interview to the patients or their parents.

**Operative procedures**

A 2-0 suture held on the tip of a puncture needle was introduced percutaneously and advanced along the lower and upper hemicircumference of the IIR extraperitoneally, in sequence, to place a suture around the IIR circumferentially, and finally taken out at the puncture site where the suture was initially introduced. Both ends of the suture were tied extracorporeally and the knot was buried beneath the puncture site. At the medial aspect of the IIR, the suture was advanced through a plane between the peritoneum and the vas and vessel structures to achieve completely extraperitoneal ligation of the IIR saving these structures (Figure 1). In female patients, the suture was advanced behind the round ligament (Figure 2). Technical details are described in the previous report [2].

**RESULTS**

Demographic data and surgical findings of adolescent and adult patients are summarized in Table (1). There were 13 males and seven females. Among them, 11 patients exhibited right unilateral hernia, seven patients with left unilateral and two with bilateral hernias. The ages ranged from 15 years to 67 years with an average of 23.4 +/- 14.1 years. The age range in male patients was 15 - 67 years (average, 24.2 +/- 17.1) and in female patients it was 16 - 31 years (21.7 +/- 6.5). In patients with unilateral hernia excluding those who had previously undergone repair for contralateral hernia, four out of nine males (44%) and four out of six females (67%) had a cPPV. Six of the 10 patients with right side unilateral hernia (60%) and two of the five patients with left side hernia (40%) had a cPPV. There were female and right side preponderance in rates of cPPV. The contralateral IIRs of three males who had undergone open herniorrhaphy in their childhood were found to be completely obliterated.

A 67-year-old male patient with bilateral hernia had a right indirect hernia and a left direct hernia. The two oldest patients were associated with omental incarceration, in which the tip of the omentum was found to be adhered to the margin of the IIR and the bottom of the hernial sac. In these patients, the IIRs were closed after detaching the incarcerated omentum with an electric scalpel from the margin of the IIR and the bottom of the sac (Figure 3). One male presented with associated bowel loop incarceration into right PPV, who’s IIR was closed after reduction of the intestinal loop under laparoscopic observation. Associated direct hernia in one patient was repaired using open pubic tract repair under laparoscopic inspection. The IIRs of two males, who had a long episode of hernia since childhood, were closed with double ligation (Figure 3) because of the wide opening (30 mm in diameter) of the PPV orifice and large hernial sac, respectively. Contralateral PPVs detected during laparoscopic inspection were repaired using a LPCEC in the same session. The procedures were completed successfully without complication in all of these patients. Patients were discharged on the day after the surgery and returned to their daily lives including school or business activities after 7 days. No recurrence or MCIH have occurred during the follow-up period. No testicular ascend or atrophy was seen in the male patients. No patients in both groups have complained about postoperative chronic groin pain.

**DISCUSSION**

During the early stage of hernia treatment, several techniques...
Table 1: Patient characteristics and operative finding.

<table>
<thead>
<tr>
<th>number</th>
<th>gender</th>
<th>averaged age (years) mean +/- SD</th>
<th>affected side</th>
<th>operative procedures</th>
<th>operative time (minutes) mean +/- SD</th>
<th>cPPV ratio (%)</th>
<th>past history of cPPV</th>
<th>comorbidity</th>
</tr>
</thead>
</table>

Note: (1) one of two is bilateral indirect hernia, and the other is indirect and direct hernia (2). Operation done for direct hernia (3). cPPVs that underwent open herniorraphy in childhood (4). Turner’s syndrome (5). esophageal varices associated with liver cirrhosis.

Abbreviations: IH: Indirect Hernia; DH: Direct Hernia; uni: Unilateral Repair; bilat: bilateral repair

Table 2: Comparison between group A (adolescents and adult) and group P (infants and children).

<table>
<thead>
<tr>
<th>Number</th>
<th>averaged age (years) mean +/- SD</th>
<th>Gender</th>
<th>affected side</th>
<th>cPPV ratio (%)</th>
<th>operation time (minutes) mean +/- SD</th>
<th>recurrence (%)</th>
<th>MCH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>20</td>
<td>23.4 +/- 14.1</td>
<td>male: 13 female: 7</td>
<td>right: 12 left: 7 bilat: 1</td>
<td>right: 60 left: 40</td>
<td>uni: 46 +/- 18 bilat: 51 +/- 22</td>
<td>0</td>
</tr>
<tr>
<td>Group P</td>
<td>1,800</td>
<td>3.6 +/- 2.95</td>
<td>male: 920 female: 880</td>
<td>right: 1,006 left: 720 bilat: 74</td>
<td>right: 43 left: 56</td>
<td>uni: 30 +/- 11 bilat: 38 +/- 14</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note: (1). includes 1 patient with contralateral direct hernia and 1 with contralateral repaired hernia (2). Includes 2 patients with contralateral repaired hernia (3). includes only patients with primary unilateral hernia.

Abbreviations: uni: unilateral repair; bilat: bilateral repair.

including high ligation of the hernia sac and narrowing of the IIR had resulted in hernia recurrence in all patients. The Bassini technique achieved a breakthrough to overcome this problem and has since become a mainstream treatment [3], while the previous techniques were ostracized for the treatment of adult populations. Upon the introduction of artificial materials that could be used to reinforce the posterior wall of the inguinal tract, the tension-free era commenced, and the Lichtenstein repair has remained popular until today [4].

With the advent of the laparoscopic era, the trend moved toward the application of laparoscopic techniques for herniorrhaphy. After several techniques such as plug and patch repair, intraperitoneal onlay mesh repair was developed in the 1990s. Nowadays, most laparoscopic inguinal hernia repairs are performed with the placement of a synthetic mesh into the peritoneal space, which can be accomplished in one of two ways: the transabdominalpreperitoneal (TAPP) approach or the totally extraperitoneal (TEP) approach [5]. The EHS guidelines recommended using mesh for men over 30 years, with the Lichtenstein method and endoscopic techniques being the most preferred, irrespective of the type of inguinal hernia. A mesh is also recommended for inguinal hernia in younger men (aged 18–30 years) [6].

On the other hand, the use of a mesh has inherent risks, such as pain, infection, shrinkage, erosion and dislocation. Chronic postoperative pain is a major drawback of inguinal hernia repair. Using a mesh induces the risk of persisting pain and foreign body sensation induced by a strong reaction to it [7]. Postoperative chronic pain developed in 22.9% of young adults with indirect inguinal hernia who underwent Lichtenstein mesh repair, Shouldice or Marcy repair [8]. A randomized multicenter study with five years’ follow-up, revealed 9.4% incidence of moderate or severe chronic pain in the TEP group [9]. A MRC trial revealed persistent groin pain one year after the operation in 28.7% of the patient who received TAPP or TEP [10].
Major complications such as bladder injury, common iliac artery injury, injury to the lateral femoral cutaneous nerve, and other less serious complications involving trocar site hemorrhage, trocar site herniation, and injury to the epiapastic or gonadal vessels, during TAPP have been reported [5]. The VA Cooperative Study [11] concluded that the rate of complication was 39%, the SCUR Hernia Repair Group accounted for 31% [12] and the MRC trial [10,13] found a 29.9% rate of complications regardless of TAPP or TEP.

Infertility after endoscopic TEP has been reported. Since the mesh in endoscopic inguinal hernia repair is placed in close contact to the vas deferens and spermatic vessels, mesh-induced inflammatory reaction could lead to a dysfunction of these structures [15]. Insertion of the preperitoneal prosthesis has been considered potentially harmful for young men in view of their reproductive age [16].

Despite the rigorous studies devoted to laparoscopic inguinal hernia repair, the TAPP or TEP procedure is usually reserved for specific indications and performed by surgeons specializing in these techniques. One of the reasons is the mastery with longer learning curve [5]. In TEP technique, the learning curve is longer and varies between 50 and 100 operations, having in mind that the first 30 surgeries are critical [EHS guideline]. In the case of indirect hernia, the TAPP and TEP procedures need special technique to reduce the hernial sac. The hernial sac should be dissected off from the cord structures and divided beyond the internal ring after reducing of the contents into the peritoneal cavity, and the subsequent peritoneal defect closed with an endoloop suture [14].

Our LPCEC was derived from a unique concept to overcome the need for intracorporeal manipulations. The concept basically consists of extraperitoneal encircling of the IIR with a suture introduced percutaneously and extracorporeal tying, resulting in the completion of the repair without mesh. The averaged operation time for TAPP among nine investigators ranged from 45 minutes to 109 minutes, and for TEP, between 32 and 81 minutes. Two multicenter, prospective randomized trials showed 58 and 65 minutes, respectively [5]. In our LPCEC series, the mean operation time was shorter than or equal to those of TAPP and TEP.

In our series, no intraoperative complications occurred. No postoperative chronic pain has been reported. Testicular ascend and atrophy have never been observed, because, theoretically, the multiple collateral circulations of the testis, which makes dissection at the IIR level extremely safe [17].

The advantage of our technique includes ease of application for unaccustomed surgeons. In our hospital, after having experienced 15 surgeries for female and 30 surgeries for male patients as an assistant, dependence is permitted the trainee as a practiced hand.

TAPP or TEP is recommended for patients who are eager to return to normal life rapidly, because it usually takes about two to three weeks for patients to do so after the operation [5]. Regarding the motivation to opt for LPCEC for male patients, the primary motivation was to return to school or business life or resume sports activities as soon as possible. In LPCEC, patients can return to daily activity more rapidly between seven and 10 days. While adult female patients showed desired for mostly cosmetic reasons, in particular for those who were about to get married.

Recurrence rate after TAPP and TEP procedure has been reported as 1.9% in the MRC trial [10] and 10.1% in the VA cooperative study [11]. The mechanisms of recurrence were mostly related to technique. The recurrence rates were higher for surgeons in the early period after completion of their personal learning curves less than 50 operations [18]. The recurrence rates after LPCEC were 0% by now.

Matsufuji et al. [19], investigated the spectrum of inguinal hernias among 1,492 patients experienced over 23 years. The incidence of indirect hernia that mostly involves infants and children sharply decreased toward adolescent, and then slowly increased again with age forming a plateau at 50 to 80 years of age with a peak around the 60s. Women had a low second peak around the 30s and the occurrence after was scare. Direct hernia in men increased after 50 years of age and formed a plateau around the 60s. Between 50 and 80 years old, the ratio of indirect and direct hernia was 1:1. This means there is a high occupation rate of indirect inguinal hernia even in adults, especially before the 50s.

According to the observation of cPPV, a PPV may not necessarily develop into clinical hernia promptly because of the laminar structure of muscles and fasciae at the inguinal region, which works as a shutter and sphincter mechanism [13]. A direct hernia that develops in the 50 to 80 years age group or obese men is considered to be the result of breakdown of these sphincter actions [20]. On the other hand, MCH develops even in younger age group from a tiny orifice of PPV, in which the shutter mechanism must be preserved. Simple high ligation of the PPV is the treatment of choice with good outcome reported. The long-term effects of pediatric inguinal hernia over an average of 49-year follow-up demonstrated an 8.4% recurrence at an average of 38.4 years postoperatively, in which the majority were new direct hernias rather than recurrence of an indirect hernia [21]. This suggests that indirect inguinal hernia in adult is not the consequence of a destruction of the inguinal floor but a bougienage effect of intraperitoneal viscera that go in and out of the PPV. This consideration may justify simple high ligation techniques to revive after long hiding to treat indirect hernia in adults.

In conclusion, the advantages of our LPCEC over TAPP and TEP include technical simplicity, short operation time, minimal invasion, preservation of reproductive system, rapid return to daily activities and low recurrence rate. These advantages render the LPCEC as an interesting alternative to the TAPP and TEP for the repair of inguinal hernia in adolescents and adults, when the diagnostic laparoscopy via umbilical port defines the inguinal hernia as indirect.

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REFERENCES


