

Clinical Application of Transumbilical Single-Site Mini-Laparoscopic Transabdominal Preperitoneal Hernia Repair (Postprint)

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Date: 2017-12-07T00:00:00+00:00

Abstract

Objective: To investigate the feasibility, safety, practicality, and simplicity of transumbilical single-site micro-laparoscopic transabdominal preperitoneal (TAPP) hernia repair in clinical application.

Methods: Since 2015, our hospital has performed a total of 71 cases of transumbilical single-site micro-laparoscopic TAPP. One hundred cases of conventional tension-free hernia repair were randomly selected for comparison of operative time, intraoperative blood loss, postoperative incision pain, incision cosmetic satisfaction, scrotal hematoma, incision infection rate, antibiotic usage rate, and postoperative hospital stay. Bard 3D Max mesh was utilized in all transumbilical single-site micro-laparoscopic TAPP procedures, whereas conventional tension-free hernia repairs employed meshes of varied specifications.

Results: All patients in both groups achieved successful outcomes. The transumbilical single-site micro-laparoscopic TAPP group demonstrated significant superiority over the conventional tension-free hernia repair group in operative time (unilateral 40 ± 5 min vs 50 ± 5 min, bilateral 60 ± 5 min vs 100 ± 5 min), intraoperative blood loss (unilateral 5 ± 2 mL vs 10 ± 2 mL, bilateral 8 ± 2 mL vs 20 ± 2 mL), postoperative incision pain, incision cosmetic satisfaction, antibiotic usage rate (unilateral 21.5% vs 0%, bilateral 100% vs 0%), and postoperative hospital stay (3 ± 1 d vs 8 ± 1 d) ($P<0.05$). Incision infection rates and scrotal hematoma were essentially equivalent between the two groups. During a follow-up period of 2 ± 0.5 years, no hernia recurrence or other complications occurred.

Conclusion: Transumbilical single-site micro-laparoscopic TAPP provides clear anatomical visualization and straightforward operation, offering advantages of clinical feasibility, safety, practicality, and simplicity, and is worthy of clinical promotion.

Full Text

Abstract

Objective: To investigate the feasibility, safety, practicality, and ease of operation of transumbilical single-site microlaparoscopic transabdominal preperitoneal (TAPP) hernia repair in clinical application.

Methods: Since 2015, our hospital has performed 71 cases of transumbilical single-site microlaparoscopic TAPP. We randomly selected 100 cases of traditional tension-free hernia repair for comparison. The two groups were compared in terms of operation time, intraoperative blood loss, postoperative incision pain, incision cosmetic satisfaction, scrotal hematoma, incision infection rate, antibiotic usage rate, and postoperative hospital stay. All transumbilical single-site microlaparoscopic TAPP procedures used Bard 3D Max mesh for repair, while the traditional tension-free hernia repair group used meshes of various specifications.

Results: All patients in both groups achieved successful surgery. The transumbilical single-site microlaparoscopic TAPP group demonstrated significant advantages over the traditional tension-free hernia repair group in operation time (unilateral: 40 ± 5 min vs 50 ± 5 min; bilateral: 60 ± 5 min vs 100 ± 5 min), intraoperative blood loss (unilateral: 5 ± 2 mL vs 10 ± 2 mL; bilateral: 8 ± 2 mL vs 20 ± 2 mL), postoperative incision pain, incision cosmetic satisfaction, antibiotic usage rate (unilateral: 21.5% vs 0%; bilateral: 100% vs 0%), and postoperative hospital stay (3 ± 1 d vs 8 ± 1 d) ($P<0.05$). The incision infection rate and scrotal hematoma incidence were essentially the same between groups. During a follow-up period of 2 ± 0.5 years, no hernia recurrence or other complications occurred.

Conclusion: Transumbilical single-site microlaparoscopic TAPP offers clear anatomy and simple operation, with advantages of clinical feasibility, safety, practicality, and simplicity. It is worthy of clinical promotion.

Keywords

transumbilical single site; microlaparoscopy; TAPP

Introduction

Adult inguinal hernia is a common and frequently occurring disease in general surgery, including indirect and direct inguinal hernias. Its primary cause is weakness or defect of the abdominal wall, and any external abdominal hernia involves varying degrees of weakness or defect of the transversalis fascia [1]. The only treatment is surgical repair of the weakness or defect. Laparoscopic inguinal hernia repair began in 1990 [2]. With continuous evolution of synthetic mesh materials and rapid development of laparoscopic techniques, various laparoscopic hernia repair procedures have emerged. Currently, totally

extraperitoneal hernia repair and transabdominal preperitoneal (TAPP) repair are considered the two “gold standard” techniques for laparoscopic hernia repair [3]. Since 2015, our hospital has implemented transumbilical single-site microlaparoscopic TAPP for inguinal hernia in 71 patients, using 3D Max mesh. We now report our findings.

1. Materials and Methods

1.1 Clinical Data

A total of 71 patients underwent transumbilical single-site microlaparoscopic TAPP (laparoscopic group), including 62 cases of indirect inguinal hernia (70 sides) and 9 cases of direct inguinal hernia (14 sides). The group comprised 66 males and 5 females, with 6 cases of occult hernia discovered during surgery. Patient ages ranged from 25 to 67 years, with a mean age of 41 ± 3 years. In the traditional tension-free hernia repair group (traditional group), there were 81 cases of indirect inguinal hernia (85 sides) and 19 cases of direct inguinal hernia (22 sides), including 84 males and 16 females, with ages ranging from 31 to 74 years (mean 50 ± 5 years). No cases of incarcerated hernia were present in either group.

1.2 Surgical Methods

Transumbilical single-site microlaparoscopic TAPP group: All patients received general anesthesia with endotracheal intubation. The surgeon stood on the healthy side. A 5 mm incision was made at the upper edge of the umbilicus to establish pneumoperitoneum with pressure maintained at 12-14 mmHg. A 5 mm trocar was inserted, followed by two additional 5 mm incisions at the left and right edges of the umbilicus for trocar placement. To facilitate surgical manipulation, after successful puncture, the left and right umbilical edge trocars could be withdrawn extracorporeally to increase operating space and establish a triangular working relationship [4].

After entering the abdominal cavity, intra-abdominal organs were explored to determine the hernia type. The operating table was then adjusted to place the patient in a head-down, foot-up position tilted 30° toward the healthy side (or the contralateral side for bilateral cases) before beginning peritoneal flap dissection. Surgeons accustomed to single-handed bilateral operation could use a dissecting forceps in the left hand and an ultrasonic scalpel in the right hand to incise the peritoneum and preperitoneal fat 3 cm above the hernia ring. Dissection in the preperitoneal space extended medially to the pubic symphysis, laterally to the psoas muscle and anterior superior iliac spine, superiorly to the conjoint tendon and inferior epigastric artery, inferiorly to the pectineal ligament and iliopubic tract, and inferolaterally to achieve “parietalization” of the spermatic cord. The peritoneal flap was reflected downward from 2 cm above the internal ring, clearing preperitoneal connective tissue until the pectineal ligament, transversus abdominis tendon arch, and iliopubic tract were clearly

visualized [5], ensuring adequate circumferential dissection around the internal ring. Small hernia sacs could be completely dissected, while larger sacs were simply transected. An appropriately sized Bard 3D Max mesh was placed to cover the internal ring and inguinal hernia triangle. The assistant was instructed to compress the scrotum and inguinal canal to evacuate accumulated gas and fluid from the scrotum into the abdominal cavity. The peritoneum was then sutured closed, pneumoperitoneum released, and the umbilical incision sutured.

1.3 Postoperative Follow-up

Follow-up began after discharge and lasted for 2 ± 0.5 years. Methods included outpatient review and telephone follow-up, with primary content including incision condition, scrotal condition, hernia recurrence, and discomfort in the inguinal region.

1.4 Statistical Analysis

Data are expressed as mean \pm standard deviation. Comparisons between groups were performed using t-tests, with $P < 0.05$ considered statistically significant.

2 Results

All surgical procedures in both groups were successful. The transumbilical single-site microlaparoscopic TAPP group showed significantly shorter operation times for both unilateral and bilateral repairs compared to the traditional tension-free hernia repair group (40 ± 5 min vs 50 ± 5 min; 60 ± 5 min vs 100 ± 5 min, $P < 0.05$). Intraoperative blood loss was also significantly lower in the laparoscopic group for both unilateral and bilateral cases (5 ± 2 mL vs 10 ± 2 mL; 8 ± 2 mL vs 20 ± 2 mL, $P < 0.05$). Postoperative pain was minimal in the laparoscopic group, with no analgesics required. Cosmetic satisfaction with the incision was 100%. Scrotal hematoma occurred in 3 cases, with swelling subsiding substantially within 20 ± 5 days. The incision infection rate was 0%, and no hernia recurrence was observed during follow-up.

In the traditional tension-free hernia repair group, postoperative pain was significant, requiring analgesics in 31 cases. Cosmetic satisfaction was moderate. Scrotal hematoma occurred in 2 cases, with swelling subsiding within 10 ± 5 days. The incision infection rate was 0%. Antibiotic usage rates were 21.5% for unilateral and 100% for bilateral repairs. Three cases of recurrence and two cases of contralateral hernia occurred during follow-up. Hospital stay was significantly shorter in the laparoscopic group compared to the traditional group (3 ± 1 d vs 8 ± 1 d, $P < 0.05$).

3 Discussion

The only effective treatment for adult indirect and direct inguinal hernias is surgical repair. The application of artificial materials has freed hernia surgery from

the shadow of high recurrence rates associated with traditional repairs, while significantly reducing postoperative complications such as infection, hematoma, and pain [6]. Laparoscopic hernia repair has been widely promoted clinically due to advantages including minimal trauma, rapid recovery, and reduced pain [7]. Transumbilical single-site microlaparoscopic TAPP can simultaneously repair the weak area of both indirect and direct inguinal hernias—the “myopectineal orifice” —conforming to the principles of inguinal hernia repair and theoretically preventing recurrence [8]. For bilateral hernias, repair can be completed without additional incisions, and the technique offers clear advantages for recurrent hernias, representing the preferred approach for such cases [9]. The use of Bard 3D Max mesh avoids complications such as bleeding and postoperative pain potentially caused by tack fixation, reduces economic burden for patients, and simplifies the surgical procedure.

Identification of key anatomical landmarks is crucial during surgery. Familiarity with and mastery of preperitoneal space anatomy under laparoscopic vision is key to successful laparoscopic inguinal hernia repair [10]. The anatomical structures in this region are complex. We believe the following points are particularly important: (1) The preperitoneal space is the interval between the superficial layer of transversalis fascia and the parietal peritoneum. Accurate dissection in this space generally results in minimal bleeding, clear visualization, and is where the mesh is placed. (2) The iliopubic tract lies deep to the inguinal ligament, and deep to the lateral aspect of the iliopubic tract are many branches of the lumbar plexus nerves, which must be avoided to prevent nerve injury. (3) The pectineal ligament is a fibrous structure covering the superior pubic ramus and serves as an inferior landmark for preperitoneal space dissection. (4) The corona mortis—an anastomotic branch between the inferior epigastric artery and obturator artery—is present in approximately 77% of patients and is sometimes substantial, forming an abnormal obturator artery branch. It passes medial to the femoral vein and posterior to the pectineal ligament in a circular fashion, being visible in about 14% of patients [11]. Injury to the corona mortis can be controlled with ultrasonic scalpel, but because it connects to an artery and may retract into the obturator canal after injury, it can be difficult to detect and may cause massive postoperative scrotal hematoma or even death. (5) The triangle of doom, proposed in 1991 [12], is the triangular space bounded by spermatic vessels and the vas deferens, containing the external iliac vessels. (6) The pain triangle is located lateral to the spermatic vessels and inferior to the iliopubic tract, through which the lateral femoral cutaneous nerve and genitofemoral nerve pass. Therefore, excessive dissection in the pain triangle should be avoided during preperitoneal space separation.

Hernia recurrence after laparoscopic repair is necessarily related to the diameter of the hernia ring. Rather than simply using larger mesh to complete the repair, the internal ring can be sutured to reduce the hernia ring diameter, which simultaneously increases support for the mesh and reduces recurrence rates. Practice has shown that when the internal ring diameter exceeds 4 cm, suturing the ring [13] before mesh placement can reduce recurrence. Management of

the hernia sac is particularly important in TAPP. Two options exist: complete dissection or transection. Improper selection increases intraoperative blood loss, operation time, and postoperative hematoma formation. The most common complication of laparoscopic hernia repair is surgical site hematoma, with an incidence of 0.5%-12.2% [14]. Hematoma primarily results from intraoperative oozing of fluid and blood, and dissecting the hernia sac inevitably increases surgical trauma and bleeding. Thus, hematoma formation is directly related to hernia sac dissection. Studies have reported [15] that type III inguinal hernias (according to the 2004 classification by the Hernia and Abdominal Wall Surgery Group of the Chinese Society of Surgery) have large sacs that adhere densely to surrounding tissues due to long duration, resulting in more oozing during dissection and higher postoperative hematoma rates. Therefore, transecting the hernia sac in type III inguinal hernias not only reduces surgical difficulty and shortens operation time but also significantly decreases postoperative hematoma formation.

Occult hernias are frequently discovered during pediatric inguinal hernia surgery, with detection rates as high as 70.5% [16]. In our series of 71 adult inguinal hernia cases, 6 occult hernias were discovered (8.5%), with internal ring diameters of approximately 1 cm. Whether such lesions require surgical repair or simply high ligation of the hernia sac remains controversial, as they may never become symptomatic. We believe that repairing discovered occult hernias is necessary when it can be done without additional incisional trauma, and all 5 occult hernias discovered in our series were repaired.

Indirect inguinal hernias account for 75%-90% of external abdominal hernias and 85%-95% of inguinal hernias. In males, the spermatic cord passes through the inguinal canal and must be preserved during surgery. In females, the round ligament of the uterus passes through the inguinal canal and plays an important role in maintaining uterine anteversion [17], making it unsuitable for transection. The round ligament has no clear plane of separation from the peritoneum, making dissection difficult. We therefore adopted longitudinal peritoneal incision along the round ligament to avoid it, then separated the plane to achieve parietalization. Studies have shown that longitudinal splitting of the peritoneum along the round ligament to completely separate it from the peritoneum and achieve parietalization offers significant advantages [18].

The incarceration rate for adult inguinal and femoral hernias is 0.29%-2.9% [19], requiring emergency surgery. None of our 71 patients experienced incarceration. During laparoscopic surgery for incarcerated hernia, assessment of viability of the incarcerated contents is more accurate, and TAPP for incarcerated hernia has been reported. For viable contents, reduction followed by TAPP is performed. For nonviable contents, a small groin incision is used for open resection of necrotic bowel and anastomosis, with routine drainage and simultaneous intra-abdominal TAPP [20].

In summary, transumbilical single-site microlaparoscopic TAPP meets the requirements of modern hernia surgery [21]. The transumbilical single-site ap-

proach provides more concealed and cosmetic incisions with less trauma, requires no special laparoscopic instruments, and is easy to implement in primary hospitals. The technique offers advantages of clinical feasibility, safety, practicality, and simplicity, making it worthy of clinical promotion.

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