

The Experience of Robot-assisted Laparoscopic Transabdominal Preperitoneal Inguinal Hernia Repair Following Robot-assisted Laparoscopic Radical Prostatectomy: A Cohort Study

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Abstract

Background

There are no reports of robot-assisted laparoscopic transabdominal preperitoneal inguinal hernia repair (R-TAPP) for the patients who underwent robot-assisted laparoscopic radical prostatectomy (RALP).

Aim

To evaluate the feasibility and safety of R-TAPP in patients who underwent RALP for postprostatectomy inguinal hernia (PIH).

Methods

This is a prospective, single-center retrospective cohort study. R-TAPP was conducted in 74 consecutive patients from September 2016 to March 2020. Except for women and patients who underwent previous abdominal surgery, 70 patients were classified into two groups based on the absence or presence of PIH (PIH group or non-PIH group). The data were retrospectively compared to those who had not undergone RALP.

Results

Seventy patients were reviewed. Among them, 22.9% had previously undergone RALP. We identified 22 lesions in 16 patients (unilateral in 10; bilateral in 6) in the PIH group, and 67 lesions in 54 patients (unilateral in 41; bilateral in 13) in the non-PIH group. The PIH group showed a longer median operation time compared to the non-PIH group. However, postoperative complications—including seroma formation, hematoma, and surgical site infections—were not significantly different between the groups. There were no recorded vascular, bladder, or spermatic cord injuries in either group. There was no conversion to laparoscopic or open surgery in either group. The estimated blood loss was small, and hospitalization duration was one day in all cases. Moreover, there were no hernia recurrences within the 90-day follow-up period in either group.

Conclusion

R-TAPP seem to be a feasible and safe approach for inguinal hernia repair, even in patients who underwent RALP for prostate cancer.

Introduction

Robot-assisted surgery using the da Vinci system is widely accepted in several organ diseases compared to laparoscopic surgery [1-3]. In particular, the robot system has been proactively introduced in urological diseases [4-6]. Robot-assisted laparoscopic radical prostatectomy (RALP) is a [prevailing surgical technology](#) for the treatment of prostate cancer. However, radical prostatectomy (RP) can result

in the development of postprostatectomy inguinal hernias (PIH), the estimated incidence rates of which were reported as 4.2%–15.9% following surgery [7,8]. A recent report showed that TAPP for PIH is potentially reliable without prolonging the duration of operation [9]. However, the appropriate approach and repair method of the surgical procedure for PIH remains controversial because of surgical difficulty arising from preperitoneal adhesion. The appropriate approach for PIH is still unknown. This study therefore evaluated the feasibility and safety of robot-assisted laparoscopic transabdominal preperitoneal inguinal hernia repair (R-TAPP) in patients who had PIH following RALP compared to those who did not undergo RALP.

Materials And Methods

Study design

The study protocol was reviewed and approved by the Ethics Committee of Ageo Central General Hospital (approval number: AMG935, 2021), and the study was conducted in accordance with the Helsinki Declaration as revised in 2013. The inclusion criteria for this study were R-TAPP cases for inguinal hernia in men without previous abdominal surgery excluding RALP and who had PIH following RALP. The exclusion criteria were as follows: (1) women, (2) patients who previously underwent abdominal surgery and (3) patients who had recurrent inguinal hernias (Fig 1). The primary endpoint of the present study was to evaluate the safety of R-TAPP for PIH after RALP compared to R-TAPP for inguinal hernia. Seventy-four patients (male: female = 71:3) who underwent R-TAPP were registered at Ageo Central General Hospital between September 2016 and October 2020. Of these, four patients were women and/or underwent previous abdominal surgery or had recurrent hernias and were excluded from this study. The patients were divided into two groups based on the presence of PIH following RALP. Thus, final analysis was performed on 16 with PIH (PIH group) and 54 without PIH patients (non-PIH group). The two groups were retrospectively reviewed and compared. The analyzed perioperative outcomes included operation time (min), estimated blood loss (mL), duration of postoperative hospital stay (day), conversion to open surgery, intra- or postoperative complications such as surgical site infections and intestinal injury—based on the Clavien–Dindo classification [10] (CD), and recurrence. TAPP or R-TAPP are the standard treatment for the inguinal hernia in our hospital. R-TAPP procedure was recommended for all patients with inguinal hernia at the first visit. However, R-TAPP was performed only for those who had accepted personal expense, because the Japanese universal health insurance system still has not approved robot-assisted surgery for inguinal hernia at present in Japan. We obtained written informed consent for medical treatment due to R-TAPP from all patients. But the patients provided no written informed consent for the use of their data in clinical research, because this study is retrospective study. Thus, the patient and their data were not anonymized before analysis. The follow-up period was a minimum of 10-postoperative months in both groups (Figure 1).

Operative technique for R-TAPP

The patient was placed in the Trendelenburg position under general anesthesia. The da Vinci® X or Xi surgical system (Intuitive Surgical Inc.) was used and docked with the patient from the left side. Three robotic arms were used including one for the camera and two for robotic instruments. The camera trocar was placed at the umbilical area with a 30-degree camera. Two other robotic trocars were localized 9 cm apart from the umbilicus (each site) at the level of the umbilicus (Figure 2). Surgical devices included Cadiere forceps in the left hand and Maryland bipolar forceps in the right hand. Initially, a 15 cm transverse peritoneal incision was made 4–5 cm above the internal inguinal ring (Figure 3A). The hernia sac was completely dissected from the spermatic cord and reversed into the abdominal cavity. Cooper's ligament was dissected and identified carefully after reaching the psoas muscle and pubic symphysis (Figure 3B). The spermatic cord and vas deferens were carefully confirmed and preserved. A lateral dissection of the preperitoneal space was then required to insert a mesh. In all cases, a self-fixating mesh (Parietex ProGrip®, Medtronic) was used. This mesh comprises of anatomical monofilament polyester (Figure 3C). The fixation of the mesh was shortened to avoid postoperative neural pain. In case of bilateral inguinal hernia repair, the peritoneal incision was extended on the opposite side. Finally, the peritoneum was closed with continuous sutures using monofilament thread (3–0 Prolene®, Ethicon) (Figure 3D).

Statistical analysis

All statistical analyses were performed using GraphPad Prism v5.0 (GraphPad Software Inc., La Jolla, CA, USA) and SPSS version 24 (SPSS Inc., Chicago, IL, USA). Continuous data were expressed as median range. Categorical data were expressed as number and percentages. The statistical analyses were determined using Student's t-test, χ^2 test, or Fisher's exact probability test, as appropriate. P-value of <0.05 was considered to indicate a statistically significant difference. A multivariate analysis, based on the logistic regression model, was used to identify whether PIH was a risk factor for postoperative complications following R-TAPP. P-value of <0.05 was considered statistically significant.

Results

Seventy registered patients were reviewed. According to the Japan Hernia Society Classification [11], our cohort included type I hernias in 69 patients, type II in 13 patients, and type IV in 7 patients. Also, there were 51 patients with unilateral hernias and 19 patients with bilateral hernias. There were 16 patients with PIH (PIH group) and 54 patients without PIH (non-PIH group). There were no differences in variables such as age, American Society of Anesthesiologists (ASA) classification, and body mass index (BMI) (Table 1). Twenty-nine patients underwent R-TAPP on the right, 22 on the left, and 19 bilaterally (Fig 4). Table 2 shows perioperative outcomes following R-TAPP. The median operation time was 180.4 and 123.4 min in the PIH and non-PIH group, respectively (P = 0.001). Additionally, for the unilateral inguinal hernias, the median operation time was 167.2 min (range: 123–247 min) in the PIH group and 114.9 min (range: 51–204 min) in the non-PIH group (P = 0.001). For the bilateral inguinal hernias, the median operation time was 202.5 min (range: 152–306 min) and 149.2 min (range: 103–251 min) in the PIH and non-PIH groups, respectively (P = 0.018) (Fig 5). All R-TAPP procedures were completed without

conversion to open or laparoscopic approach in both groups. Additionally, all patients had tackless mesh fixation to avoid the risk of postoperative pain. Peritoneal closure was accomplished with 4-0 Polydioxanone (PDS) monofilament suture (Ethicon Inc.) with sequential running sutures using one or two threads. With the exception of one patient with a hematoma (CD classification-I) in the non-PIH group, no patient experienced postoperative complications or chronic pain according to the CD classification. Moreover, no recurrence was seen in either group within at least three months.

Discussion

RALP has become a commonplace surgical approach for local prostate cancer over the last decade [12]. Recent evidence demonstrated that RALP was associated with better intraoperative outcomes compared to laparoscopic radical prostatectomy (LRP) [13], although high volume center became a requirement for better outcomes [14]. However, RP including RALP sometimes leads to PIH, which is painful and affects the patient's quality of life. The reported incidence rate of PIH was 3.4%–7.3% after RALP and 8.4% after open RP [15,16]. PIH occurs within the first three years after RP [17]. A large nationwide population-based study also demonstrated that no significant difference was found regarding the risk of PIH between RP and RALP in 11,212 patients [18]. Generally, patients who previously underwent robot-assisted surgery tend to desire robot-assisted surgery for another surgery. The present study therefore aimed to evaluate whether R-TAPP was available for PIH.

Well-known risk factors for developing PIH include older age, previous inguinal hernia repair, and low BMI [19,20]. Moreover, Otaki et al. showed that psoas muscle volume (PMV) $< 350 \text{ cm}^3$ was an independent risk factor for PIH [21]. Additionally, Iwamoto et al. showed that dilatation of the internal inguinal ring represents an important risk factor for PIH [22]. The precise mechanism of developing PIH is still unknown, but it is definitive that a surgical procedure is a crucial factor in the development of PIH. A presently accepted theory is that a potentially existing [vaginal process](#) of the [peritoneum](#) becomes clinically evident because of peritoneal dissection around the internal inguinal ring [23]. Therefore, indirect inguinal hernia is the most frequent hernia type of PIH [24,25]. There is present data to support the relevance of this hypothesis.

Regarding prophylactic methods, Kadono et al. reported that dissection of the peritoneum from the internal inguinal ring, and separating the spermatic cord and vessels from the peritoneum, could reduce the incidence of PIH following RALP; however, they did not acquire statistical significance [26]. In contrast, Iwamoto et al. described creating an incisional line of peritoneum as an important prophylactic method. They proposed that incising the peritoneum sufficiently close to the internal inguinal ring could prevent PIH [22].

Regarding treatment in patients with histories of pelvic or abdominal surgeries including RP inguinal hernia repair, such as transabdominal preperitoneal (TAPP) and totally extra peritoneal (TEP) repair, may be difficult because of the need to dissect peritoneal adhesions, unlike in patients without surgical histories. Izadipani et al. showed that L-TAPP for PIH has good results and is effective [27]. In addition,

Dulucq et al. reported that L-TEPP for PIH can be performed efficiently and safely in patients after RP by skilled and experienced laparoscopic surgeons [28]. Moreover, Sakon et al. showed that L-TAPP inguinal hernia repair after RALP was comparably safer and more effective than open surgery. They concluded that L-TAPP repair may be a valuable alternative to open hernioplasty [29]. In contrast, Angus et al. showed that R-TAPP might be an alternative to open repair in patients with a history of prior urologic pelvic operation [30]. Additionally, Bitnner and Leblanc et al. reported that operation times were longer for robotic hernia repair patients than laparoscopic patients, but there was no difference in the safety [31,32]. Under such conditions, the safety of R-TAPP for PIH has not been established. To our knowledge, there is no evidence that R-TAPP is a useful and safe procedure for PIH. Thus, in this study, we reviewed 16 cases of R-TAPP for PIH and evaluated their surgical outcomes in comparison with 54 cases of R-TAPP for non-PIH. R-TAPP was first introduced in our department in September 2016 under the mentorship of professor Kudsi [33]. Thus, we perform R-TAPP according to his instructions. The point to ponder is that R-TAPP is still not covered by Japanese health insurance. Therefore, surgical cost will become an obstacle to patients with inguinal hernias and thereby make patient recruitment for R-TAPP difficult in Japan. However, several institutions have gradually shown evidence of spread of R-TAPP in Japan [34].

The fact that R-TAPP is a more suitable surgical technique for PIH may lead to its increased demand and popularity. On the other hand, Prabhu et al. exhibited no clinical benefit to the robotic approach for straightforward inguinal hernia repair compared with the laparoscopic approach. They concluded that the robotic approach incurred higher costs and longer operation time compared with the laparoscopic approach [35]. Additionally, Kohraki et al. revealed that the outcomes of L-TAPP were significantly superior to the R-TAPP and at lower hospital costs [36]. In contrast, Forrester et al. reported that short-term quality of life after R-TEPP was improved compared to open and laparoscopic repairs. Thus, although the relative merit by approach for inguinal hernia repair is still controversial, we believe that the clinical benefit of robotic surgery is the multiarticular function of ease of performing peritoneal suturing compared to L-TAPP. However, our study has several noteworthy limitations. First, the relatively small number of PIH cases may cause a lack of statistical power. Next, our data were from a retrospective cohort study and collected at a single hospital. Thereafter, a more comprehensive prospective study should be conducted to confirm our findings in the near future.

Conclusion

In conclusion, RALP for prostate cancer is gradually becoming a prevalent procedure. When PIH occurs after RALP, patients are more likely to hope for a similar procedure using a robotic system. We believe that R-TAPP might be a feasible and safe approach, even in cases of PIH.

Declarations

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Author contributions

Naotake Funamizu designed this study. Sho Mineta, Takahiro Ozaki, Kohei Mishima, and Kazuharu Igarashi collected data. Kenji Omura and Yasutsugu Takada contributed to analyze the data. Go Wakabayashi contributed to its critical revision. All the authors read and approved the final manuscript.

Availability of data and materials

The data is available by contacting the authors.

Ethics approval and consent to participate

Institutional review board statement: This study was reviewed and approved by the Ethics Committee of Ageo Central General Hospital (approval number: AMG935, 2021).

Consent for publication

Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent. For full disclosure, the details of the study are published on the home page of Ageo Central General Hospital.

Competing interests

We have no competing interests to disclose.

Data sharing statement: No additional data are available.

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Tables

Due to technical limitations, table 1 and 2 is only available as a download in the Supplemental Files section.

Figures

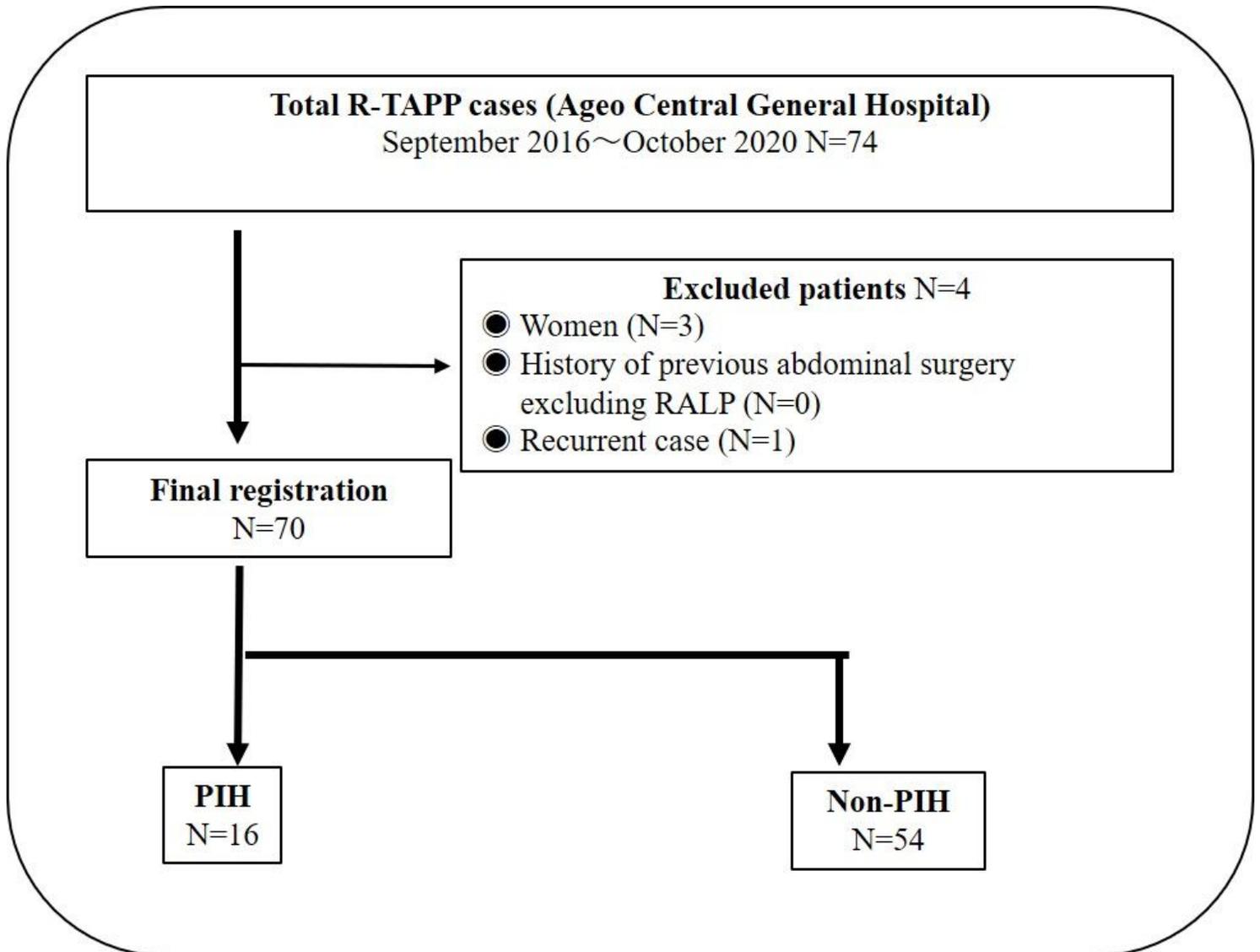


Figure 1

Flowchart of study population

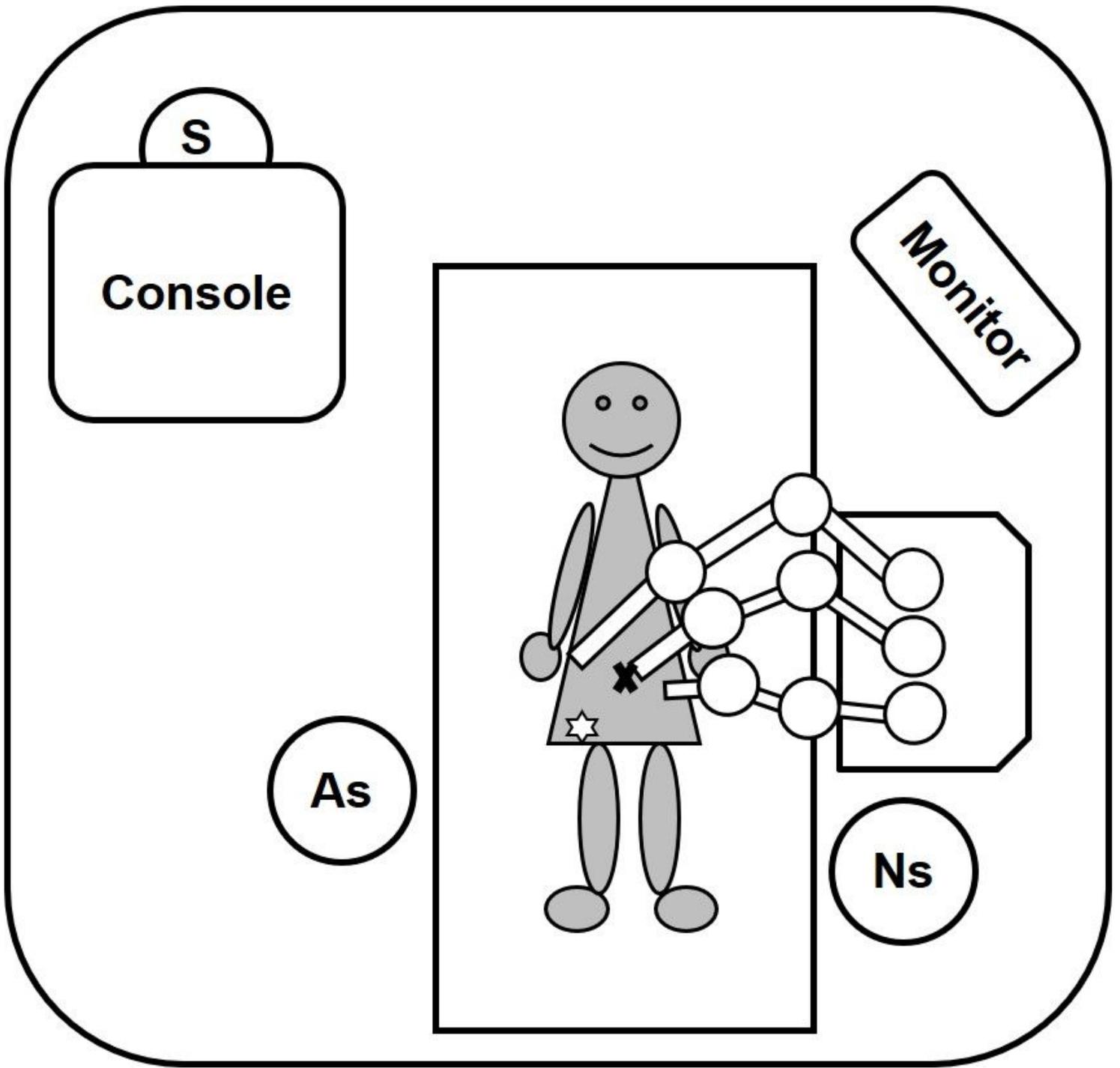


Figure 2

Layout diagram

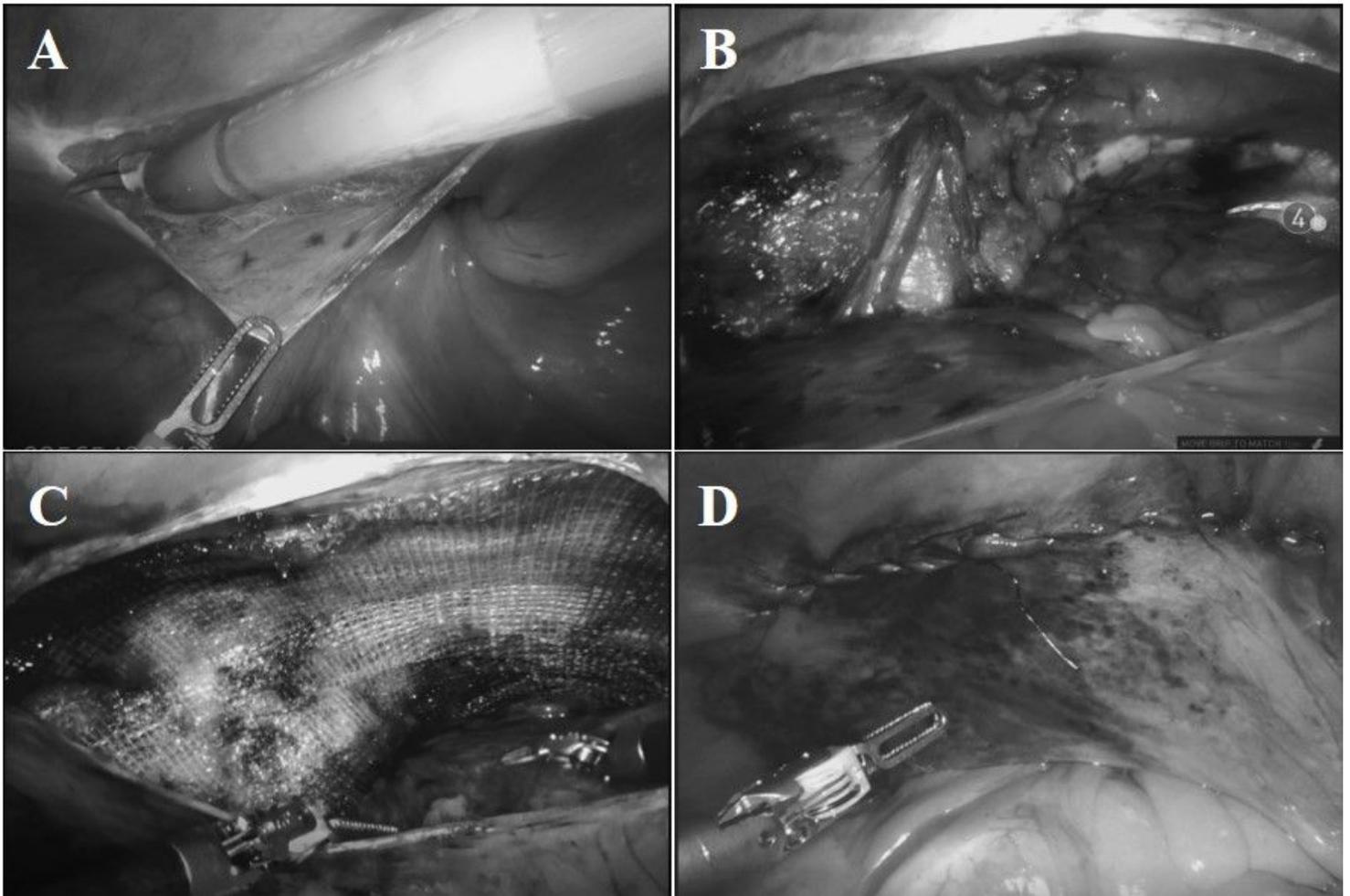


Figure 3

Surgical procedure

(A) The peritoneum is laid open 4–5 cm above the internal inguinal ring. (B) The hernia sac is dissected without injury of the spermatic cord and testicular vessels. (C) After securing the peritoneal flap, the Parietex ProGrip™ is placed. (D) Open peritoneum is closed by suturing using monofilament thread.

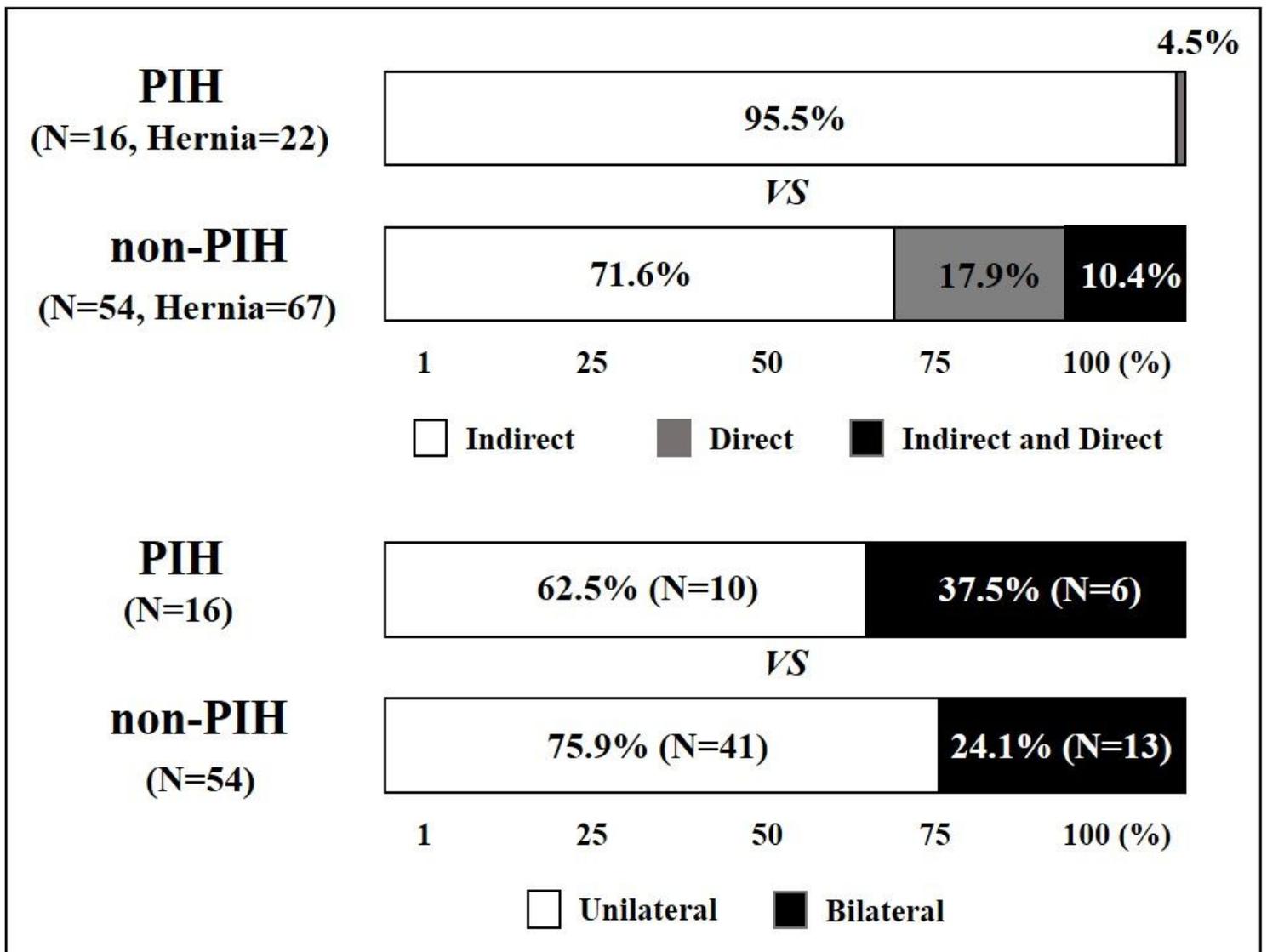


Figure 4

Rate of hernia type and side

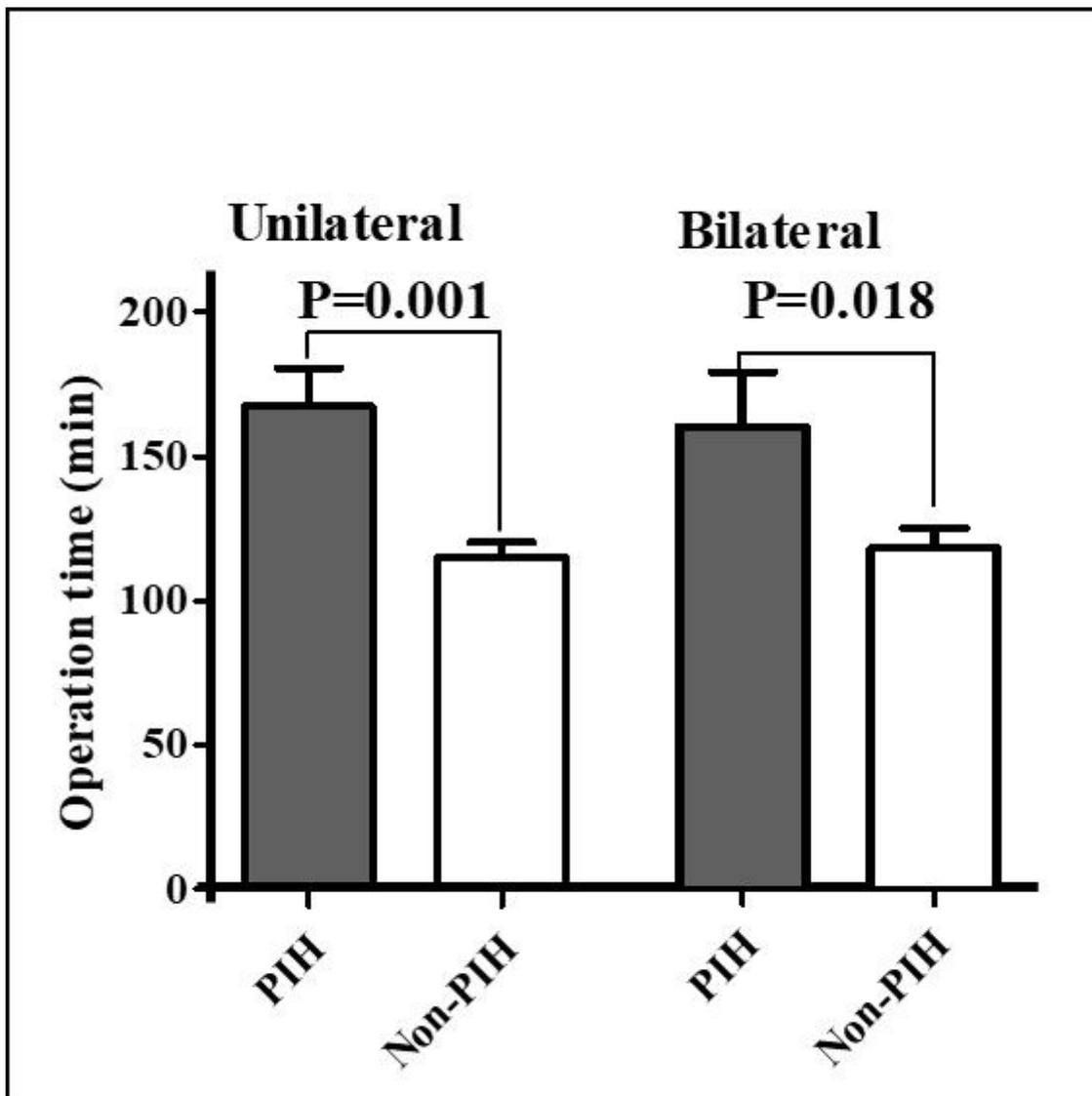


Figure 5

Comparison of operation type according to hernia number

Supplementary Files

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- [FinalFileTable1.xlsx](#)
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