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ORIGINAL ARTICLE

Laparoscopic trans-abdominal pre-peritoneal (TAPP) surgery for incarcerated inguinal hernia repair

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Abstract

Purpose This series was aimed to analyze feasibility, safety and postoperative quality of life of trans-abdominal pre-peritoneal repair in incarcerated hernia; the rationale was a safe hernia reduction, more accurate abdomen exploration, diagnosis and treatment of contralateral unknown hernia.

Methods With a minimum follow-up of 30 months, 20 urgent incarcerated inguinal hernia patients were submitted to TAPP. Signs of strangulation, peritonitis and major comorbidity were exclusion criteria. Feasibility and safety were evaluated by ability to hernia reduction, conversion rate, operative time, perioperative mortality, morbidity, hospital stay, prosthesis infection and recurrence. Finally, quality of life was assessed by acute and chronic pain score, recovery of normal activities, return to work and patients' satisfaction survey.

Results Under vision sac reduction was always achieved, incision of internal ring during the reduction manoeuvre was necessary in 40% of pts, intraoperative complications, conversions or perioperative mortality were not observed. In one case (5%) partial omentectomy was necessary. Contralateral hernia was diagnosed and repaired in 20%. Median operative time was 81.3 min, postoperative minor complications were recorded in 5 patients (25%), median in hospital stay was 2 days. After a median follow-up of 39 months, 1 patient recurred (5%). Acute pain, was scored 3 as median value (range 1–5), only one patient scored 2 as chronic pain during follow-up.

Conclusions Laparoscopic approach for incarcerated inguinal hernia repair is not the standard treatment. In our experience, with the limit of a single-surgeon series, selected patients showed satisfactory results in terms of feasibility, safety, postoperative quality of life and patients' satisfaction were observed. Few series about this topic were published. More prospective trials are needed.

Keywords Inguinal · Hernia · Laparoscopic repair

Introduction

Laparoscopic hernia repair is an effective surgical technique performed in bilateral or recurrent inguinal hernia, offering a faster and less painful recovery than traditional approach and guaranteeing a similar recurrence rate [1–9].

The evolution of the laparoscopic devices increased diffusion of the endoscopic surgical technique for elective treatment of inguinal hernia in the last 20 years, but complicated inguinal hernia, especially in urgency, was considered traditionally a contraindication for the laparoscopic approach [10, 11].

The inguinal hernia is defined "incarcerated" when it is not clinically reducible in abdomen. The estimated incidence ranges from 0.29 to 2.9%, being the second most common cause of small bowel obstruction [12].

The present series was aimed to analyse the feasibility, safety and postoperative quality of life of trans-abdominal pre-peritoneal laparoscopic hernia repair (TAPP) in acute incarcerated inguinal hernia; the results were compared to the other series published about this topic.

Rationale of our experience was an easier and under vision safe hernia reduction with an accurate internal abdomen exploration, diagnosis and treatment of eventual unknown contralateral inguinal hernia in a setting of non-critical patients.

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Materials and methods

From September 2010 to April 2014, 20 consecutive patients, whit a minimum follow-up of 30 months, affected by incarcerated inguinal hernia were submitted to transperitoneal laparoscopic hernia repair in emergency surgery at the Department of Surgery, University of Rome "Sapienza", Polo Pontino, Terracina Hospital.

Inclusion criteria were age ≥ 18 years, performance status ranging between 0 and 2, American Association Anaesthesiologists (ASA) risk score ≤ 3, written informed consent.

All patients with "strangulated" hernia, leucocytosis ≥ 17,000/uL, Protein C Reactive levels ≥ 10 mg/dl, LDH ≥ 500 U/L, peritonitis signs, severe comorbidity and previous major abdominal surgery were excluded; the cases with bowel perforation and/or evidence of concomitant disease diagnosed intraoperatively were excluded, too.

With the aim to assess the feasibility of the TAPP in emergency we analysed the following criteria: ability to hernia reduction, conversion rate, median operative time, possibility to eventual organ resection and diagnosis of contralateral hernia, followed by surgical repair.

To estimate the safety of the technique we evaluated the perioperative mortality, morbidity in terms of fever, surgical site infection or abdominal collections, median hospital stay, prosthesis rejection or infection, recurrence of hernia.

Finally, to estimate the quality of life we recorded acute (during admission) and chronic (during follow-up) pain by Visual Analogic Scale (VAS) score, moreover a suitable questionnaire, about return to normal activity, ability to work (sports included) and patients' compliance was administered. The grade of satisfaction, assessed by three possible answers ("satisfied", "partially satisfied", "unsatisfied"), was registered at 7, 30 days, 1 and 2 years after surgery.

Informed consent was obtained from all individual participants included in the study.

Surgical procedure

All the surgical procedures were performed by the same surgeon experienced by laparoscopic technique [13, 14].

Under general anaesthesia, after a single shot of cefazoline 2gr i.v., in Trendelenburg position a transumbilical 30° optical laparoscope was introduced through a 10 mm trocar, placed with open technique. After the exploration of the peritoneal cavity and the abdominal wall, other two 5 mm operative trocars were placed in the right and left side of the abdomen, at the transumbilical line level, depending on intraoperative findings.

A further accurate intraoperative abdominal exploration was performed, the reduction of the hernia was always possible favoured by general anaesthesia, when necessary the hernial ring was cut by a small incision to allow under vision visceral reduction without blind traction. This additional procedure was made in ventrolateral direction in indirect hernia, while mediolateral direction was preferred in direct hernia to avoid damage of spermatic cord, femoral or inguinal vessels.

A systematic research of a contralateral inguinal hernia, an accurate evaluation of the reduced organ vitality and its resection, if necessary, were carried out.

The following step was the hernia defect repair; the peritoneal incision was made 1 cm laterally and superiorly with respect to internal inguinal ring, directed to lateral bladder ligament. The pro-peritoneal space was prepared with complete reduction of hernia sac and with preparation and exposition of spermatic cord, vessels and Cooper's ligament. After the complete parietalization of the spermatic elements, an anatomicallyshaped 10 × 15 cm polypropylene mesh was placed into the preperitoneal space to cover hernia defect.

The mesh fixation was achieved by absorbable tacks on its upper edge and by fibrin glue on its lower edge, close to neurovascular structures. Finally, the peritoneum was closed by continuous self-locking suture.

The same procedure was performed in case of contralateral hernia repair.

Postoperative monitoring and follow-up

During the hospital stay, since the first day after surgery all the patients were evaluated for fever, acute pain by VAS score, need to analgesic and antibiotic drugs, time to canalization to gas and stools, ability for spontaneous urination, mobilization to bed.

The patients were evaluated 1 week later after surgery for fever, scar infections, chronic pain by VAS score, need to analgesic drugs, time to recovery from daily routinely functions and work activity.

The last clinical check was 30 days after surgery, when the grade of satisfaction was asked to patients by a finalized questionnaire; finally a follow-up was carried out 6 months, 1 and 2 years after surgery by telephone, for long-term results and eventual recurrence diagnosis.

"Collected series"

Moreover, a literature search by MEDLINE about laparoscopic treatment of incarcerated inguinal hernia was included to compare findings of present series with others in terms of median value of conversion rate, operative time, length of hospital stay, morbidity and intraoperative resection.

Table 1 Patients' Characteristics

Period	September 2010–April 2014
No	20
Male	All
Median age	50 years (35–77)
Median operative time	81.3 min (55–137)
Organ resection	1 (5%)
Morbidity	5 (25%)
Hospital stay	2 (1–6)
Recurrence	1 (5%)

Results

From September 2010 to April 2014, out of 1,132 patients undergone surgical inguinal hernia repair, 31 (2.7%) were submitted to emergency procedures, of whom 20 underwent to Trans Abdominal Pre-Peritoneal laparoscopic surgery for incarcerated hernia in our Surgical Division.

All of them were males; median age was 50 ranging from 35 to 77 years. Patients' characteristics are summarized in Table 1. In all the laparoscopic procedures we were able to reduce sac content under vision, incision of internal ring was necessary in 8 (40%) pts, no significant intraoperative complications were observed, while conversion to open surgery was not claimed.

Organ resection was carried out only in one case (5%) when a partial omentectomy for necrosis was necessary and the specimen was taken out by endobag through umbilical site. In the case of reduction of a bowel loop as sac content, a very careful observation of its vitality, for at least 30 min, during hernia repair and before trocars drawing was mandatory.

Contralateral hernia was diagnosed intraoperatively and then repaired by TAPP during the same procedure in 4 pts (20%).

Median operative time was 81.3 min, being 55 as minimum and 137 as the longest one of the entire series, stratifying between monolateral and bilateral median operative time was 49 and 88 min, respectively.

Perioperative mortality, calculated within 60 days after surgery, was not observed; postoperative minor complications were recorded in 5 patients (25%): two of them had fever after 48 h from surgery, cleared up by antibiotic therapy, one patients had wound infection of umbilical port that was drained 7 days after surgery during follow-up, in another one un infection of urinary tract was diagnosed by bacteriological profile of urine (Escherichia coli) during follow-up. Finally, in a last patient with scrotal hernia, a serohaematoma of inguinal and suprapubic site was observed and drained after 7 days of surgery.

The median hospital stay was 2 days, ranging between 1 and 6 days. This value was satisfactory considering the urgency setting of patients.

After a median follow-up of 39 months and 30 months as minimum, 1 patient recurred (5%), in particular, it was the patient affected by postoperative serohaematoma. The hernia recurrence was diagnosed 12 months after surgery. The patient was reoperated by open access: a defect of transversalis fascia due to mesh displacement was found.

In terms of quality of life, the evaluation of acute pain at 48 h after surgery by VAS score showed good results: the median value was 3, ranging from 1 to 5. The most common postoperative symptom observed was shoulder pain but analgesic drugs administration was really sparing with a 1 vial of ketorolac 30 mg/ml for patient as median.

Chronic pain after 7 days from surgery recorded during follow-up was 0 in terms of median value; only the two patients drained for infection of umbilical access and serohaematoma reported 2 as value in the compilation of VAS score; none of the cases included in the present series complained pain after 30 days of surgery.

Finally, the results of a questionnaire about the grade of patients' satisfaction, administered 7, 30 days and one year after surgery are detailed in Table 2 with just one patient unsatisfied (different possible answers were: "satisfied", "partially satisfied", "unsatisfied").

Results of our collected series, as reported in Table 3 [10, 11, 15–24], about Laparoscopic treatment of complicated inguinal hernia confirmed how this approach is still unusual. The series published were few and a lack of prospective randomized trials was observed, too.

The Median sample size of the collected series was 20 pts. (range: 4–194). Most of the authors reported a conversion rate of 0, just four paper declared a conversion rate different from zero increasing up to 27,2% as maximum. The median Operative Time was 72 min, with a very large range (33–143) related to the heterogeneity of intraoperative findings in the enrolled patients or to technical difficulties. Hospital Stay was 3.0 days as median, ranging from 1.03 to 5.4 days in the collected series; median morbidity was satisfactory, too: 15.5% (range: 0–67), whereas the need of resection was 3.1% as median value (range 0–32.1).

Table 2 Postoperative patients' satisfaction

	Follow-up (%)		
	7 days	30 days	1 year
Satisfied	16 (80)	17 (85)	18 (90)
Partially	3 (15)	3 (15)	1 (5)
Unsatisfied	1 (5)	–	1 (5)

Table 3 Collected Series

Country	Author	Year	Surgery	No. Pts.	Conversion(%)	Operative time (min)	Length of stay (days)	Morbidity no. (%)	Resection no. (%)
Japan	Ishihara [10]	1996	TAPP	6	0	88	NA	1 (16)	NA
Germany	Leibl [11]	2001	TAPP	194	0	55	NA	7 (3.6)	6 (3.1)
USA	Ferzli [15]	2004	TEP	11	27.2	50	5.4	2 (7.4)	1 (9.1)
India	Saggar [16]	2005	TEP	34	0	84.4	30	23 (67)	NA
Germany	Mainik [17]	2005	TEP	46	NA	NA	4.7	NA	NA
Italy	Rebuffat [18]	2006	TAPP	28	10.7	72	3.9	1 (3.5)	9 (32.1)
Italy	Legnani [19]	2007	TAPP	9	0	72	2.7	0 (0)	1 (11.1)
India	Jagad [20]	2009	TAPP	4	NA	114	2.75	1 (25)	0 (0)
Israel	Hoffman [21]	2010	TEP	12	8.3	51	3	0 (0)	0 (0)
Korea	Choi [22]	2011	TEP	66	NA	33	1.03	16 (24)	NA
Malaysia	Siow [23]	2013	TAPP	20	0	143	1.9	3 (15)	0 (0)
China	Sho [24]	2016	TAPP	73	2.7	54	3.9	32 (43.8)	2 (2.7)
Present Series		2016	TAPP	20	0	81.3	2.0	5 (25)	1 (5)

Discussion

Laparoscopic repair in the surgical treatment of inguinal hernia was well established for bilateral or recurrent disease, recently it was proposed as first approach even for monolateral, but it is still debated in case of complicated disease especially in the urgency setting [25].

Watson et al. described for the first time laparoscopic repair and intestinal resection for incarcerated hernia in1993 [26]. Some authors successively proposed laparoscopic/open combined approach to better evaluate abdominal cavity and bowel viability in case of irreducible inguinal mass [27, 28].

Afterwards, as observed in Table 3, other authors also proposed laparoscopic TAPP and TEP surgery in the treatment of complicated urgent inguinal hernia.

Laparoscopic hernia repair showed in elective surgery very satisfactory results in terms of morbidity related to procedure: the most common injuries were bladder damages, ranged between 0 and 2%, intestinal injury observed in 0–3% of cases or the damage of great vessels reported in 0–0.11% of patients [9, 29, 30].

More recently, similar satisfactory results, in terms of clinical outcomes, were reported in the American College of Surgeon National Surgical Quality Improvement Program (ACS-NSQIP) database, concluding that laparoscopic hernia repair was associated with lower 30-day morbidity, particularly when hernias are complicated [31].

The rationale of the laparoscopic approach in the treatment of complicated inguinal hernia is the ability to perform the hernia reduction procedures under vision, allowing more accuracy and safety in this manoeuvres. Moreover, the abdominal laparoscopic approach permits a more accurate internal abdomen exploration than inguinal access and it is also able to evaluate organs' vitality, during all hernia repair procedure. In fact, colour change, peristaltic movement and viability of the bowel, in case of doubtful, of the tract involved in the incarceration for long time is an indubitable advantage respect to open procedure where surgeon has less time to take a decision about bowel resection.

Last but not least, the added value of the laparoscopic intraperitoneal approach to herniorrhaphy is its performance in the diagnosis and treatment of unrecognized contralateral inguinal hernia.

On these basis, our study was thought to perform laparoscopic TAPP in the treatment of complicated (incarcerated) inguinal hernia in the urgent setting with the aims to confirm its feasibility, safety and security with possible advantages in terms of postoperative quality of life.

However, the role of TAPP in the treatment of incarcerated hernias remains still controversial and largely debated. The main topic of discussion reported by some authors is the technical difficulty of laparoscopic hernia repair; this is a procedure requiring surgical expertise and often irrespective of classical surgical planes [23].

It is so hard to define and estimate technical difficulties related to this approach, because there is not yet an objective, validated scoring system to classify them; usually, the parameters taken into consideration to evaluate technical difficulties are conversion rate, operative time and others not specific.

In our experience, there were no conversion to open surgery, therefore, hernias were reduced and repaired laparoscopically in all patients included in the study, as well as in the other series but three published (Table 3). Therefore, if we consider conversion rate as a parameter of evaluation of the feasibility of laparoscopic hernia repair, we can postulate that this approach is achievable even in the urgency setting.

Analysing more in detail data about the 3 series reporting a rate of conversion different from zero, it arises that in two of them the laparoscopic approach was, despite everything, maintained: the TEP technique was converted into TAPP [15, 21]; whereas in the third paper, the authors did not exclude the patients with strangulated hernias, in fact, conversion rate was higher in this subgroup, suggesting that bowel distension was the most important cause of laparoscopic failure [18].

The absence of conversion to open surgery in our series was favourite by the strict selection of patients enrolled: we excluded all patients with signs of strangulation or peritoneal irritation. Furthermore, other authors underlined that in these procedures, the accurate choice of surgical devices is mandatory: the use of non-traumatic forceps could allow a reduction of risk of bleeding and/or damage of bowel; moreover the opening of hernia sac in case of severe incarceration of its content should be strongly suggested [18, 19, 23].

This accuracy in the selection of patients, probably, allowed also a satisfactory operative time in our series. In the other published papers, the reduction of the operative time in the laparoscopic approach seemed to be due to the easier identification of the correct surgical plane and, consequently, a faster hernia defect repair. This is not always feasible in the open access cause of the difficulties related to the derangement of surgical planes in complicated long-term hernias [18, 19, 23].

However, there is no doubt that laparoscopic hernia repair requires a thorough training before being performed safely and quickly above all in complicated urgent hernias; previous series reported, indeed, a learning curve relatively long [18, 24].

Other relevant advantages observed in patients submitted to laparoscopic repair of incarcerated inguinal hernias were related to the faster postoperative recovery and the improvement of quality of life. Particularly, the control of the postoperative acute pain showed encouraging results; whereas the chronic pain was even almost absent in our experience. In fact, just one patient, affected by postoperative serohematoma, reported a VAS score value different from zero during follow-up, resolved within 30 days. In the literature, similar results concerning postoperative pain were observed above all in the series in which mesh fixing was carried out by glue or in which self-gripping mesh were utilized [24].

In terms of patients' satisfaction we had the most positive advantage related to the laparoscopic approach, due, mostly, to the prompt reprise of the daily activities and a swift return to work. This was indirectly related to the postoperative pain control.

The laparoscopic approach was, therefore, well accepted, even in the urgency setting, as confirmed by the interviews and the questionnaires administered during the follow-up. The main favorable factors which surprised the patients were the rapid resolution of the pain and the contemporaneous treatment of the contralateral hernia without any additional invasive procedure emerged.

Despite these favorable elements, historically, the main limitations to the widespread laparoscopic approach in the incarcerated hernia are represented by the fear of postoperative complications but, analyzing the literature about this topic, it emerged that, actually, in the laparoscopic approach in this setting of patients the results in terms of morbidity are nevertheless satisfactory.

In the past, in fact, the authors discouraged the use of prosthesis in case of loop bowel involvement, especially when incarcerated, because they were considered the cause of severe infections. Instead, recently, some trials demonstrated that the infection of mesh and seroma was definitely controlled when the reduction manoeuvres were carried out under a careful vision of the structures involved and through a non-traumatic traction of the bowel wall, when a true tension-free technique was achieved and when a complete closing of the peritoneum was performed, as shown in the collected series.

Moreover, in the literature, postoperative haematoma and seroma were the events most observed in terms of morbidity; they were diagnosed more frequently in patients with a long-term inguinoscrotal hernia, requiring distal sac resection during surgery. Indeed, it could promote the formation of small cavity at the site of postoperative collection. That is why in case of inguinoscrotal hernias or sac resection a drain placement could be advocated.

In conclusion, the laparoscopic approach in the treatment of incarcerated inguinal hernia repair is not still the standard of care. Our series, limited by a single-surgeon experience, with strictly selected patients showed satisfactory results in terms of feasibility evaluated by the ability to hernia reduction, low conversion rate, contained median operative time and the ability of organ resection.

Even results about safety were considered favourable, in consideration of the absence of mortality, the low morbidity rate, the short in-hospital stay and the controlled recurrence rate. This mini-invasive approach showed, furthermore, excellent outcomes in terms of postoperative quality of life, measured by postoperative pain control, rapid recovery of daily activities and return to work; the grade of patients' satisfaction encourages to extend the laparoscopic technique to incarcerated inguinal hernia in urgency. Few series about this topic were published with a low number of patients included; therefore, more prospective randomized trials are mandatory.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval Approval from the institution review board was not required for this study.

Human and animal rights This article does not contain any studies with animal performed by any of the authors.

Informed consent All human patients gave us a written informed consent.

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