Laparoscopic repair of inguinal hernia transabdominal preperitoneal (TAPP) versus total extraperitoneal (TEP) Techniques

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ABSTRACT
Background: The fundamental mechanism of abdominal wall hernia formation is the loss of structural integrity at the musculotendinous layer. The exact cause of inguinal hernia is still unknown but the factors contributing in its occurrence include; preformed congenital sac, chronic passive rise in the intra-abdominal pressure and weak abdominal wall. **Objective:** The aim of this study is to compare the results of laparoscopic hernioplasty with Transabdominal pre-peritoneal (TAPP) versus Totally Extraperitoneal (TEP) as techniques for repair of inguinal hernia. **Patients and Methods:** In our study, 30 patients were included divided on two groups, 15 for each. Group A; underwent laparoscopic Transabdominal pre-peritoneal (TAPP) repair with mesh, Group B; underwent laparoscopic Totally Extraperitoneal (TEP) repair with mesh. Follow up of patients was done in the out-patient clinic at ain shams hospitals, 7 days after discharge then at 3, and 6 months postoperatively at the period between March 2018 and August 2018. **Results:** Both groups were compared in terms of operative technique, operative time, intra & post operative complications, early post operative pain within one week, hospital stay, restriction of physical activity and incidence of recurrence and chronic pain. **Conclusion:** Interpretation of results revealed that the TEP repair appeared technically more difficult as evidenced by increased operative time and more post operative pain in first hours. It needs a long learning curve and a dedicated team for technique excellence. However, it is preferred because it is associated with less wound-related complications, shorter hospital stay and rapid return to normal activity.

Keywords: Transabdominal pre-peritoneal, totally extraperitoneal.

INTRODUCTION

Over 1 million abdominal wall hernia repairs are performed each year in the United States, with inguinal hernia repairs constituting nearly 770,000 of these cases; approximately 90% of all inguinal hernia repairs are performed on males [1].

Hernia repair went through several stages dating back to ancient Egypt through the conventional repair with tissue approximation that was associated with a recurrence rate of 60% till Francic C. Usher introduced a polypropylene based prosthesis to bridge the hernia defect and to reinforce the abdominal wall without tension. With the implantation of prosthesis the recurrence rate in hernia repair was downsized [1].

Repair of an inguinal hernia via surgery is the only treatment for inguinal hernias and can prevent incarceration and strangulation. Health care providers recommend surgery for most people with inguinal hernias and especially for people with hernias that cause symptoms. Research suggests that men with hernias that cause few or no symptoms may be able to safely delay surgery until their symptoms increase. Men who delay surgery should watch for symptoms and see a health care provider regularly. Health care providers usually recommend surgery for infants and children to prevent incarceration [2].

Conventional surgery was based on Bassini's operation; this consisted of apposition of the transversus abdominis

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and transversalis fascia and the lateral

However, the Lichtenstein technique is widely used, where a piece of open-weave polypropylene mesh is used to repair and reinforce the abdominal wall. This operation is easier to learn, gives earlier mobility and has a very low recurrence rate [3].

Since the early 1990s, laparoscopic techniques have entered the field of general surgery; the first cases of minimally invasive inguinal hernia repair were reported in 1992. Transabdominal preperitoneal (TAPP) inguinal hernia repair includes laparoscopic exploration of both inguinal areas and the whole peritoneal cavity, a further incision to the overlying peritoneal sheet in order to reduce the hernia sac and to place a prosthetic mesh against the inguinal wall at the level of properitoneal space. The technique of totally extraperitoneal repair (TEP) allows exploration of the myopectineal orifices, the dissection and reduction of the hernia sac and its content and placement of the mesh without entering the abdominal cavity [4].

The most common method in use is the use of nonabsorbable spiral tacks (e.g., ProtackR). The use of this technique in fixation is also demonstrated in laparoscopic inguinal hernia repair and for fixation of propylene mesh in rectopexy procedures for rectal prolapse. Other surgeons prefer to use the transabdominal suture with polypropylene that is knotted outside the abdomen and to which the surgeon has postoperative access [5].

The optimal method for fixation of the prosthetic mesh is controversial. Sutures pass through all layers of the fascia and muscle of the anterior abdominal wall, while tacks secure the mesh to only the innermost millimeters of the peritoneal cavity [6].

The points of fixation are mostly the same for both techniques, mostly the tails of the mesh are fixed to Cooper's ligament with two tacks or sutures, One

rectus sheath to the inguinal ligament. additional point is lateral above the iliopubic tract fixing while feeling the tip of the device on the outside of the abdomen with the opposite hand to ensure that fixation occurs above the iliopubic tract; to avoid injury to the lateral femoral cutaneous nerve. It is also important to completely dissect the preperitoneal space so that the edge of the mesh does not fold. The mesh should be placed with a slight overlap of the midline to ensure adequate coverage of the myopectineal orifice [7].

It has been estimated that complications like ischaemic orchitis and testicular atrophy occur in approximately 2% to 3% of all hernia repairs, Recurrence occur in 1.0% (most happening within five years of operation), other complications that may happen include wound infection, bladder injury, intestinal injury, a hydrocele from fluid accumulation in the distal sac usually resolves spontaneously but sometimes requires aspiration. The overall prognosis is good depending on comorbidity [8].

AIM OF THE WORK

The aim of this work is to compare the outcome of laparoscopic Transabdominal preperitoneal technique (TAPP) versus laparoscopic totally extra peritoneal technique (TEP) in hernioplasty as regard their efficacy, postoperative complications and recurrence.

Patients and Methods
Patients Selection:

This is a prospective randomized comparative study between laparoscopic transabdominal preperitoneal mesh versus laparoscopic totally extraperitoneal mesh repair of inguinal hernia. The study include 30 patients that were presented in the outpatient clinic at Ain- Shams University Hospitals at the period between march 2018 and April 2018 and followed up till August 2018. **The study was approved by the Ethics Board of Ain Shams University and an informed**

written consent was taken from each participant in the study.

Inclusion criteria: All patients are males at or above the age of 14 years old. All patients have unilateral indirect inguinal hernia either primary or recurrent.

Exclusion criteria: It is vital that we properly evaluate patient's co-morbidities before operation procedure. Thus the risk/benefit ratio is considered when assessing patients for laparoscopic surgeries. Accordingly, patients whose co-morbid conditions outweigh the risk of surgery; who have important organ failure like heart failure, respiratory failure and pulmonary hypertension was excluded from our study. Also, psychological unstable patients and those who won't follow up in outpatient clinic will be excluded. Patients who have underwent previous abdominal surgeries as Pfannenstiel, lower midline and other abdominal incisions below the umbilicus on the same side of the hernia and also those with previous lower abdominal irradiation were excluded from this study. Patient with complicated inguinal hernia (infected, obstructed, strangulated, etc.,) Patients with direct hernia (Nyhus classification type IIIA). Femoral Hernia (Nyhus Type IIIC). Obesity (BMI≥30). Contraindications for laparoscopy. Patient refusal.

All the patients in this study were under the care of one surgical team under supervision of consultant surgeon and were randomly divided into two groups taking care that both groups were age matched. A unique computer generated randomization schedule. This consisted of alternating blocks, and was faithfully reproduced into sealed, ordered envelopes and kept in the operating theatre.

Preoperative assessment:
History:

Clinical history taking included; personal history including age, occupation, and special habits of medical importance particularly smoking; complaint and its duration; history of present illness including analysis of the complaint, and a review of other body systems specially chest complaints, bowel problems like constipation and urinary problems specially prostatism; past history of medical diseases, drug allergy, previous blood transfusion, and previous operations specially previous hernia repair and family history of the presence of inguinal hernia and other diseases in the family.

Examination:

Clinical examination included general examination including vital data; chest examination for signs of chronic obstructive lung disease; abdominal examination for abdominal masses, and P/R examination for prostatic enlargement; and local examination of the inguinal region and scrotum to confirm the diagnosis of inguinal hernia and its type, and for the presence of complications.

1) Investigation:

Investigations were requested for whenever required for patients including complete blood picture, coagulation profile, liver function tests, kidney function tests, fasting blood sugar, ECG for those patients over 40s or with positive cardiac history, and chest x- ray.

2) Optimization of general condition:

Co-morbidities like COPD, cardiac diseases, chest diseases, hepatic diseases and DM were controlled and optimized preoperatively.

II) Patients randomization:

The selected patients were randomized into 2 groups by the closed envelop method.

Group A: 30 patients underwent laparoscopic transabdominal preperitoneal (TAPP) hernioplasty.

Group B: 30 patients underwent laparoscopic total extraperitoneal (TEP) hernioplasty.

Patients permission and education (informed consent):

All patients had given permission to take part in the study. Patients were educated about the procedure to be performed, the possible complications and their management and schedule of follow up. In addition, patients were specially educated about how to describe their pain level at rest in the first post operative day. Pain is expressed as: no pain, mild pain, discomforting pain (analgesia is preferred), distressing pain (analgesia is a must) and horrible pain not responding to usual analgesics.

Data recorded:

Descriptive data about patients characteristics including age, sex, occupation, physical activity, smoking, relevant medications, body mass index, ASA score, and type of hernia according to *Nyhus* classification.

RESULTS

Table 1: Intraoperative complications in Group A and B.

Intra operative. Complications	Group A	Group B	Test value*	P value	Sig.
	No. = 15	No. = 15			
Peritoneal teas	1 (6.7%)	2 (13.3%)	0.370	0.543	NS
Vascular injuries	1 (6.7%)	2 (13.3%)	0.370	0.543	NS
Bowel injuries	0 (0.0%)	0 (0.0%)	0.000	1.000	NS
Conversion	0 (0.0%)	0 (0.0%)	0.000	1.000	NS
Bladder injury	0 (0.0%)	0 (0.0%)	0.000	1.000	NS
Total	2 (13.3%)	4 (26.7%)	0.833	0.361	NS

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

*:Chi-square test

Table 2: Early postoperative complications in GroupA and GroupB: **Fisher exact test

Postoperative complications	Group A	Group b	Test value	P-value	Sig.
	No. = 15	No. = 15			
Wound serama	1 (6.7%)	1 (6.7%)	0.000	1.000	NS
Wound infection	0 (0.0%)	0 (0.0%)	0.000	1.000	NS
Ing-scrotal edema	1 (6.7%)	1 (6.7%)	0.000	1.000	NS
Delayed bowel movements	2 (13.3%)	0 (0.0%)	2.143	0.143	NS
Nausea and vomiting	0(0.0%)	0 (0.0%)	0.000	1.000	NS
Urine retention	0 (0.0%)	0 (0.0%)	0.000	1.000	NS
Subcut. Emphysema	0 (0.0%)	2 (13.3%)	2.143	0.143	NS
Inject able analgesic16 hrs	2 (13.3%)	0 (0.0%)	2.143	0.143	NS
16-24	3 (20.0%)	9 (60.0%)	5.000	0.025	S
24 – 32	9 (60.0%)	6 (40.0%)	1.200	0.273	NS
> 32	1 (6.7%)	0 (0.0%)	1.034	0.309	NS

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

DISCUSSION

Hernioplasty is still the most commonly performed surgical procedure in the Western world. Approximately 800000 repairs are performed yearly in the USA [9].

The best technique for hernioplasty is still controversial. Although, open tension free mesh repair is still widely used, the laparoscopic technique has many advantages including better cosmetic appearance given the ability to make the repair sing only 3 port sites (10,10 and 5 mm) [10].

The lack of standardized techniques for minimally invasive inguinal hernia repair is a pragmatic issue and is reflected by the wide variety of technical details presented in the contemporary

literature.   Modification   and   standardization of the operative steps, such

as the method of entrance into the preperitoneal space and the creation of the operative space, the extent of dissection, the size and type of mesh, and the fixation of the mesh, may result in a reduction of operative times in TEP repair. Similarly, the location of the peritoneal incision, the extent of preperitoneal dissection, the management of the hernia sac, the fixation of the mesh, and the type of peritoneal closure are subjects for further evaluation with regard to their clinical effect on patient-oriented outcomes and the length of surgery in the context of laparoscopic hernia repair [11].

On the other hand laparoscopic techniques have other disadvantages including: bowel perforation, major vascular injury, possible adhesions at sites where the peritoneum has been breached exposing prosthetic material, the need for a general anaesthetic, and increased cost because of the expensive equipment. On the other hand, the open tension free technique can be done with local anaesthesia on outpatient basis, with minimal risk of intra-abdominal injury, and the cost is less. In addition, it is the best option in cases of strangulation in which sutures is the best repair via open technique and mesh is contraindicated. The majority of randomized trials coming from centers specialized in laparoscopic herniorrhaphy, demonstrates a recurrence rate similar to the conventional tension free operation [10].

Two laparoscopic techniques have become the most commonly used: the transabdominal preperitoneal repair (TAPP) and the totally extraperitoneal (TEP) endoscopic repair.

TAPP inguinal hernia repair involves laparoscopic exploration of both inguinal areas and a further incision to the overlying peritoneum in order to explore the myopectineal orifices, then reduction of hernia contents, before placement of a mesh against the inguinal wall. The technique of TEP allows exploration of the myopectineal orifices and placement of the

mesh without entering the abdominal cavity [12].

Core to the success of laparoscopic inguinal hernia surgery is adequate space creation. As the fundamental difference between TAPP and TEP is the approach to preperitoneal space creation, it emerges as an important differentiating parameter in comparative assessment of these two procedures. We did not use special balloon dissectors for space creation in TEP thereby incurring no additional cost due to need for specialized instruments for the process. Assessing the difficulty of space creation in laparoscopic hernia is by and large a subjective criterion with no well-defined scoring systems available, therefore we used an indigenously designed scoring system for evaluation of space creation assessments. Proper space creation is directly related to identification of structures during surgery [13].

In our study, space creation was described as easy in all TAPP cases, whereas in only 13.33% TEP cases were they categorized as easy.

TEP is superior to TAPP in being performed from outside the peritoneal cavity, so leading to less intra-abdominal complications. The theoretical advantages include less peritoneal access-related injuries including port-site hernias, fewer incidences of pneumoperitoneum-related complications, less Mesh-related bowel adhesions, less need for mesh fixation (intact peritoneum), possible spinal anaesthesia and feasibility in cases of intra-abdominal adhesions. TAPP may be superior to TEP in cases of multiple intrabdominal procedures and if diagnosis is uncertain. It also allows easier identification of contralateral hernia and is considered a much easier procedure with steeper learning curve [14].

The objective of this study is to compare two of the best and most frequently performed less invasive laparoscopic techniques TAPP and TEP.

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The study was performed at Ain Shams university hospitals, and included 30 patients all of them were males reflecting the great sex predominance of this disease. The age of the study group ranged between 20 and 65 years with a mean of 42.5± 12.3 years. The study group's BMI ranged between 18 and 40 with a mean of24.9± 2.45 Kg/m^2.

The patients are randomized into two groups by the sealed envelope technique which adequately resulted in roughly similar groups as regards patients characteristics

In **TAPP group**, the bleeding was minor and did not adversely affect the haemodynamics of those patients. It happened during creation of the preperitoneal space and the source -in one case- was one of the branches of the inferior epigastric vessels. The bleeding vessel was rapidly identified and diathermied. Also in **TEP group** bleeding was not significant and was controlled successfully using diathermy.

Bleeding from inferior epigastric vessels is one of the most common sources encountered. It is critical to identify the inferiorepigastric vessels behind the rectus muscles and these vessels are best left adhered to them during dissection of the preperitoneal space. It is a key landmark of the groin, as it separates the direct and indirect inguinal hernia defects. Dissecting the inferior epigastric vessels off the rectus muscles will cause more bleeding during the procedure and makes placement of the mesh difficult [15].

In the third case, the source is believed to be abnormal obturator vessels crossing the pubis that formed wide ecchymotic bleeding area over the pubis covered by thin layer of transversalisfascia. The bleeder was not obvious and was thought to be a vein that was partially compressed by the pressure of insufflation gas. The insufflation pressure was reduced to identify the bleeding vessel.

However, bleeding spontaneously stopped and the operation was resumed after gas pressure adjustment.

In about 25% of the cases, aberrant obturator vessels are present and could lead to unexpected bleeding if not properly recognized [16].

Those vessels are branches from inferior epigastric vessels and pass over the superior pubic ramus to reach the obturator foramen, so good understanding of the anatomy protects against injury of this dangerous vessels [13].

Our study didn't encounter any major vessels injuries including external iliac and deep circumflex iliac vessels, due to proper identification of the triangle of doom and better skills of working surgeons at our hospitals.

Peritoneal tear occurred in 3/30 patients (10%) and it was more common in TEP group.

The resulting pneumoperitoneum in (TEP) caused loss of the operative space. The situation was managed by inserting a *Veress* needle to decompress the peritoneal cavity together with increasing the insufflation pressure to 15 mmHg thereby maintaining the preperitoneal space. This event significantly increased the operative time.

Some surgeons prefer suturing peritoneal tears but this was not done in our study.

The conversion rate is reported to be around 0.5% to 5% and usually due to large tears, poor control of bleeding or visceral injury [17].

Fortunately, our study didn't encounter any case of conversion.

Visceral injury didn't occur in our study due to better learning curve and skills.

This trivial visceral injury and absence of urinary bladder injuries in accordance with most studies that considers laparoscopic approach safe and

feasible [18] and against the earlier disappointing results that is believed to be related to the early phase of learning curve.

In our study, postoperative complications was encountered in 8/30 (26%) of patients. All of our encountered postoperative complications were well controlled and tolerated by our patients. There was no need for a second operative intervention as most complications were managed conservatively reflecting the general safety of the procedures.

Postoperative complications were approximately 26% of cases equally in both groups with no significant difference between our study groups.

The most common postoperative complication was inguinoscrotal swelling due to seroma formation which affected 2/30 (3.3%) of our patients distributed between both of the study groups equally 1 (3.3%) in TAPP and 1 (3.3%)in TEP). This happened mainly in patients suffering from large hernial sacs including congenital type of inguinal hernia. It was also evident in cases with chronic liver disease.

In those patients our technique aims at limiting the dissection of hernia from the cord by ligating and transecting the hernia and reducing the proximal part while leaving the distal part open. The distal end accumulated operative blood and discharge. Those patients were managed conservatively without the need for operative drainage and haematoma gradually diminished in size till resolution within one month. In addition, our technique adheres to Stoppa principle of avoiding suture repair of the groin muscles. However, the cost of leaving weak abdominal wall bulging seems to be accumulating postoperative fluids.

Another factor may be that creation of a relatively large operative space involves cutting of more lymphatics and small venules thus impairs drainage of body fluids. To reduce dead space in large

sacs, the redundant fascia transversalis can be grasped at its bulging apex, invaginated, then its apex taken to the anterior abdominal wall or to Cooper's ligament. Plication of the redundant fascia transversalis can also be tried with placement of end loop of PDS at its base. On the contrary, other surgeons thought that this is not necessary and the dead space will collapse spontaneously after absorption of fluids [19].

The *inguinoscrotal seroma* resembled recurrent hernia and necessitated ultrasonography in two patients to rule out recurrence. Postoperative pressure dressing and scrotal support was applied together with "α-chemotrypsin" injection for three days followed by "Alphentern" for one week. Reassurance and watchful waiting was the basis of treatment. However, in the late cases of our study we started to put a drain in those risky patients with satisfactory results.

Superficial wound infection/discharge occurred in 2/30 cases one in each group in our study due to proper wound care and minimally invasive techniques as well the short hospital stay and routine use of preoperative prophylactic antibiotics decreases incidence of the wound infections.

None of our patients suffered from deep infections related to the mesh. The deep infection rate is generally rare in the groin and is found to be in the range of 0.3% -0.6% [20]. This may be further helped by the deeper location of the mesh in the preperitoneal approach.

Urine retention didn't occur in our study which is contrary to most studies (4-8%) [21]. In these patients, this can be attributed to old age (> 55 years) with history of prostatism due to senile prostatic enlargement. All were managed conservatively without catheterization.

In our study we did not routinely insert urinary catheter and asked our patients to urinate before surgery.

However, the anaesthetist sometimes asked for on table catheterization if the operative duration is long and patient received large amount of intravenous fluid. Nelaton catheter is used and removed before patient's recovery.

postoperative ileus occurred in 2/30 patients (13,3%) and was exclusively inTAPP group (6.6%).The case presented as postoperative ilius for 2 days improved on conservative treatment and didn't need active intervention.

2 cases of subcutaneous emphysema reaching the penis was found in TEP group which resolved spontaneously after 4 days of conservative treatment on outpatient basis.

Secondary bleeding didn't occur in our study

Early postoperative pain analgesic requirements were higher in initial hours postoperatively in TEP group with clinically significant value at p 0.02, however, the scores settled to equal levels after 32 hours of surgery , but group A cases showed lower mean VAS compared to group B cases (5.8vs 6.13)but those results were proven to be statistically insignificant.

None of our patients suffered from unbearable acute postoperative abdominal pain (score of 10).

The TEP group patients generally appeared to experience more *acute postoperative pain* levels when compared to the TAPP group in first 16 to 24 hours. This was clearly evident in their pain scores in the first postoperative hours (6.13vs.5.8) and confirmed by the total oral analgesic requirements consumed by our patients in the first postoperative week while maintaining normal physical activity and on-demand consumption of pain killers (523.0 vs. 425.00mg/week) Our results agree with the findings of study by *Lepere et al.* [22] comparing TAPP vs. TEP groups

No significant difference was found between Group A and B cases regarding VAS at 7th postoperative day visit in the outpatient clinic this difference although small but is still clearly in favour of the TAPP group.

Similarly, *postoperative hospital stay* was longer in TAPP group compared with the TEP group with a mean of 1.2 vs. 1 days mainly related to postoperative complications and this agree with study by *Baca et al.* [23].

There is a surprisingly large number of studies with very wide range of differences describing the length of hospital stay in the literature. The duration of hospital stay, although a good indication of early postoperative outcome and cost, is much more affected by the hospital policy than by the technique. There were greater differences in the mean length of stay between different hospitals than between different operative techniques [24].

The results were unsurprisingly in favour of the TEP group compared to group A (4.74 vs3.94) and this agree with result of *Lepere et al.* [22]*and Baca et al.*[23].

The definition of *chronic pain* is any type of pain or discomfort which lasts for more than three months postoperatively [25].

According to this definition, none of our patients suffer from chronic pain. However, we had one patient of group A suffering from nonspecific *groin pain* and discomfort with occasional parathesia around the incision line and foreign body sensation in the groin. These pains lasted for 8 and 10 weeks post operatively. Fortunately, it did not adversely affect the quality of life of these patients and reassurance was enough. No cases of such groin pains were recorded in the TEP group. At the three months postoperative visit, all patients of both groups returned to their usual ordinary activity.

At the three months clinic visit all patients from both groups were pain and recurrence free. Follow up continued at six and 12 months postoperatively without new events. **_Recurrence_** was not detected in any of the patients in the current study. This may be due to the use of big mesh, short term follow up or small number of cases.

Finally, even if not included in the present study, **_Cost_** must be considered when evaluating hernia repair. The TEP group is generally expected to be more expensive than open repair. However, the cost of mesh anchoring devices and balloon dissectors can be omitted - as in our modified technique- that the operative cost will become closer to that of TAPP group. This could be further augmented by the use of reusable instruments, the shorter hospital stay, the less required analgesia, and earlier return to normal activity including work.

CONCLUSION

Both TAPP and TEP techniques are considered safe as all perioperative complications are well tolerated by patients and there was no need for a second operative intervention. Both techniques showed similar results as regards intraoperative complications with TAPP group more vascular and visceral injuries while TEP group more peritoneal tears and conversion. In our study, TAPP repair is a much easier procedure with steeper learning curve in contrast to the TEP repair which appeared technically more difficult as evidenced by increased operative time, conversion and secondary bleeding. Patients treated by TEP repair suffered more acute postoperative pain compared with the TAPP repairs as expressed by lower pain scores and analgesic consumption. TEP repair is associated with shorter hospital stay and rapid return to normal activity. Our data suggested TEP being extra peritoneal repair is comparatively safe whereas TAPP on the other hand offers good visualization of and easy learning curve.

However, further more targeted wider scale studies are recommended. Both techniques are effective in the management of inguinal hernia and were associated with 0% recurrence. However, due to small sample size and short follow up duration, longer-term studies are also recommended.

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