

## Original Research Article

# Impact of different meshes on patient reported outcomes and complications following TEP repair: a comparative approach

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## ABSTRACT

**Background:** Minimally invasive inguinal hernia surgery originated in the early 1990s and is gaining popularity in the field of general surgery. A mesh provides a tension-free repair with strengthening of the abdominal wall. This study was undertaken to compare traditional polypropylene and lightweight meshes in TEP inguinal hernioplasty in terms of post-operative patient reported outcomes.

**Methods:** A total of 65 patients were enrolled in the study. Patients were divided into 3 groups i.e. Polypropylene (21), TiMesh-16 (24) and Ultrapro (20) based on mesh used. Assessment of pain was done using visual analogue scale (VAS). Patient reported outcomes were observed on 1<sup>st</sup> post-operative day (POD), 7<sup>th</sup> day, 1 month, 6 months and 1 year. Data was analysed using SPSS software ver.22.

**Results:** A total of 94 hernias were operated in 65 patients. Mean operative time in both unilateral and bilateral cases was not significant and showed no correlation with type of mesh used. Mean VAS score of prolene group was significantly more than Ultrapro and TiMesh groups on POD1, POD7, 1 month and 6 months, showing  $p=0.027$  (POD1),  $p=0.002$  (POD7),  $p=0.017$  (1 month) and  $p=0.00$  (6 months) respectively. Patients in LWM groups showed earlier return to activities than Prolene group. No recurrence was observed in either group on 1 year follow-up. Among the study patients, complications of TEP observed were accidental rupture of peritoneum, scrotal swelling, seroma, sub-cutaneous emphysema and conversion to lichtenstein mesh hernioplasty.

**Conclusions:** As per the observations, Light weight mesh placement in TEP Hernioplasty results in better patient reported outcomes.

**Keywords:** Hernia, Heavy weight mesh, Light weight mesh, Total extraperitoneal repair

## INTRODUCTION

Hernia is an abnormal protrusion of a viscus or a part of viscus through the weak areas of the wall containing it.<sup>1</sup> Inguinal hernias are among the most common type of abdominal wall hernias.<sup>2</sup> Inguinal hernia repair is amongst the most commonly performed procedures in

general surgery.<sup>3</sup> A hernia can be repaired either by sutures or by placing a synthetic mesh over the hernial defect in one of the layers of the abdominal wall using either open technique or through minimal access (i.e. laparoscopic) technique. Hernia repairs were accomplished primarily using sutures, until 1958 when, Usher introduced the concept of using a polypropylene

mesh for hernia repair. Thirty years later, Lichtenstein performed first hernia repair using a mesh in 1980's.<sup>4</sup>

Laparoscopic techniques commonly employed for inguinal hernia repair are Transabdominal Preperitoneal (TAPP) repair and totally extraperitoneal (TEP) repair. Mesh is used in both the techniques. In TAPP, peritoneal cavity is accessed and mesh is placed over the hernial defects, whereas, in TEP, peritoneal cavity is not entered and mesh is used to seal the hernial defect from outside the peritoneum.<sup>5</sup>

Mesh repair is preferred in most countries and widely accepted as superior to primary suture repair. Currently, about one million meshes are used per year Worldwide. Mesh acts as a foreign material which results in inflammation and fibrotic scar formation, thereby strengthening the abdominal wall. However, this fibrotic reaction also leads to pain and restriction of movements. In an attempt to maintain sufficient tensile strength to prevent recurrence and at the same time reduce pain and stiffness, concept of lightweight mesh was introduced in 1998 with the development of a mesh composed of modified polypropylene with polyglactine.<sup>4</sup> The amount of material in mesh has been reduced to approximately 30% of common heavy weight meshes and pore size has increased by up to 500-600%. Titanium coated and polyglecaprone mesh represents new members in the light weight, large porous mesh family. Although hernia repairs are being carried out using existing meshes, but search for an ideal mesh continues.<sup>5</sup>

The paucity of information on the risks and benefits of using standard polypropylene and light weight meshes for repair of inguinal hernias has led us to conduct a study to compare post-operative patient related outcomes following placement of both types of meshes in TEP hernioplasty.

## METHODS

It is a prospective observational study carried out on 65 patients, who underwent TEP Mesh hernioplasty at Department of General Surgery at Max Super-specialty Hospital within the study duration of 2.5 years and satisfying following inclusion and exclusion criteria.

### Inclusion criteria

- All male patients above 18 years of age with inguinal hernia,
- Patients with either direct or indirect inguinal hernias and all the patients having unilateral or bilateral inguinal hernias.

### Exclusion criteria

- Patients with recurrent inguinal hernia,
- All the patients with complicated hernias and

- All patients with ascites due to any cause.

Patients were divided into 3 groups based on the Mesh used, such as Polypropylene (21), TiMesh 16 (24) and Ultrapro (20).

### Data collection

Patients undergoing surgery were explained regarding the study and a patient information sheet was provided. After obtaining informed consent, personal interviews were carried out and clinical information was recorded on a pre-designed Performa. The study complied with the ethical guidelines.

### Pre-operative work-up

Regular pre-operative investigations followed by Pre-Anesthetic Check-up for General Anesthesia (GA) was carried out. Single dose of Inj. Cefazolin 1gm was given intravenously 30 min. before making the incision.

### Operative procedure

Surgery was performed with standard under general anesthesia. An infra-umbilical incision was made. Rectus Sheath was opened and Hassan's trocar was introduced and anchored with sutures. A zero-degree telescope was used for creation of extra-peritoneal tunnel and capno-sufflation (10-12mmHg). First landmark identified was the symphysis pubis. Then telescope was changed and a standard length, 30-degree laparoscope was used. Two additional 5 mm ports were inserted, one above pubic symphysis, other through the center of umbilicus and pubic line (on the same median line with both trocars). The camera was held through the infraumbilical port and the operative instruments via the 5mm ports.

Dissection was carried out laterally starting from the midline. The inferior epigastric artery is identified as the 2<sup>nd</sup> landmark. Blunt dissection was carried out and iliac vessels were recognized. The spermatic cord was freed from the tissue behind with the help of a dissector. In case of an indirect hernia sac, it was located in the anteromedial aspect of the spermatic cord. Testicular vessels progress in the posterolateral aspect, vas deferens in the medial aspect of the hernia sac.

The hernia sac was captured with a grasper and pulled forward and inward perpendicular to the axis of the cord. The hernia sac was then identified and carefully reduced. If the hernia sac was small, it was left in the pre-peritoneal position or the distal part may be excised. In the case of large hernia sacs, the excess sac may be excised after being ligated. Myopectineal orifice of Fruchaud was exposed to examine all potential herniation sites (direct/indirect inguinal, femoral and obturator). A 15x12cm size mesh was positioned to cover the myopectineal orifice. Mesh was secured in place by

tackers and parieto-peritoneal apposition, as seen on desufflation. Procedure was completed with port closure.

**Post-operative follow-up**

On recovery from GA and after about 5-6 hours, patients were allowed orally. They were reviewed postoperatively on 1<sup>st</sup> day (D1). Pain assessment was done using visual analogue scale (VAS). Diclofenac (intravenous and oral) was used as routine analgesic. Patients were discharged on POD 1 or 2 depending on their comfort. They were advised to resume routine activities, morning/evening walk and climbing stairs as per their comfort on discharge. They were also told to avoid lifting heavy weight, vigorous exercise, persistent constipation and coughing. Demographic variables, clinical information, surgical parameters and patient-reported outcomes were assessed and recorded. Post-operative information was recorded by personal interview and physical examination on first post-operative day and during follow-up on 7<sup>th</sup> day following surgery, 1 month, 6 months and 1 year.

**Statistical analysis**

Data was recorded in Microsoft Excel. Continuous variables were presented as mean±S.D. and categorical variables were presented as absolute numbers and percentage. Normally distributed continuous variables were compared using the unpaired t-test. Categorical variables were analyzed using SPSS software and chi square test (p<0.05 indicates significant difference and p>0.05 indicates insignificant difference).

**RESULTS**

It is a prospective study conducted on 65 patients in the Department of General Surgery at Max Super specialty Hospital.

**Age distribution**

Patients enrolled in the study belong to the age group of 21-80years (youngest: 21 years, eldest: 78years). A majority of patients i.e. 19 (30%) were in 50 - 60 years of age group (Table 1). The mean age of presentation was 51 years.

**Table 1: Age Distribution of patients.**

Age group (years)	No. of patients	Percentage (%)
21-30	10	15
31-40	6	9
41-50	10	15
51-60	19	30
61-70	15	23
71-80	5	8
Total	65	100

**Co-morbid conditions**

Twenty-one (32%) out of these 65 patients, had an associated co-morbid condition. These included hypertension in 8 patients (12%), diabetes mellitus in 4 (6%), and benign prostatic hyperplasia in 3 (4.6%).

**Type of inguinal hernia**

Among 94 hernias reported, 51 (54%) hernias were of indirect type, out of which incomplete sac was present in 45 (48%) and complete in 6 (6.3%). Direct hernias were 44 (47%) in number and all were incomplete.

**Distribution of various meshes used for TEP hernioplasty**

In the present study three different meshes were used i.e. Prolene, TiMesh and Ultrapro for TEP Hernioplasty. Prolene mesh was used in repair of 30 hernias (21 patients), TiMesh in 33 hernias (24 patients) and Ultrapro in 31 hernias (20 patients).

**Duration of surgery**

During TEP hernioplasty, operative time was recorded from making skin incision to skin closure. Amongst unilateral cases, mean duration of surgery in each mesh group was 74.16 min (Prolene), 71.66 min (TiMesh), 74.44 min (Ultrapro). In bilateral cases, TEP on an average took 113.89 min (Prolene), 112.22 min (TiMesh), and 121.82 min (Ultrapro) (Table 2). It was statistically insignificant, which shows that duration of surgery is not dependent on the type of mesh used.

**Table 2: Mean duration of surgery (min.)**

Hernia	Meshes			P value
	Prolene	TiMesh	Ultrapro	
Unilateral	74.16	71.66	74.44	0.978
Bilateral	113.89	112.22	121.82	0.956

**Complications of TEP hernioplasty**

At the time of dissection, accidental rupture of peritoneum occurred in 3 patients. Due to which, pneumo-peritoneum developed and eventually space for dissection was compromised. So, Veress' needle was inserted through the Left Subcostal (Palmar's) point to decompress the peritoneum. Scrotal swelling developed in the immediate post-operative period in 4 patients. Though, it resolved spontaneously in 2-3 days.

In 1 patient, subcutaneous emphysema developed in the intra-operative period extending upto eyelids. It resolved in 2-3 days without any active intervention. Seroma formation was reported in 5 individuals on POD7. It subsequently resolved in about 10-14 days in all patients.

### Conversion from TEP to open lichtenstein mesh hernioplasty

In two patients, laparoscopic TEP hernia repair was converted to open lichtenstein mesh hernioplasty. In one case, a large aberrant tortuous vessel was identified while dissecting the retropubic space. In second case, large bowel was forming a mass and densely adhered to anterior abdominal wall at the hernial defect which led to conversion.

#### Post-operative pain

Post-operative inguinal pain was assessed using VAS. All patients reported mild to moderate pain and discomfort on POD1. Patients in Prolene group reported mild to moderate pain with mean Visual Analogue scores of 2.4. and mild pain in Ultrapro (1.7) and TiMesh (1.6) groups. On follow-up on POD7, patients reported mild pain in Prolene group (1.8) as compared to Ultrapro (1.0) and TiMesh (1.0) with just noticeable pain sensation. By the end of 6 months, inguinal pain was negligible in TiMesh (0.6; 0.0) and Ultrapro (0.8; 0.3) groups, in contrast to the patients in Prolene group (1.0; 0.7) with noticeable pain (Table 3).

**Table 3: Post-operative pain score.**

Mesh	Post-operative pain (Mean Visual Analogue Scale Scores)			
	POD 1	POD 7	At 1 month	At 6 months
Prolene	2.4 (1-5)	1.8 (0-3)	1.0 (0-2)	0.7 (0-1)
Ultrapro	1.7 (1-4)	1.0 (0-2)	0.8 (0-1)	0.3 (0-1)
TiMesh	1.6 (1-3)	1.0 (0-2)	0.6 (0-1)	0.0
p-value	0.027	0.002	0.017	0.0001

#### Other post-operative findings

##### Foreign body sensation

In Prolene group, 15 patients (71%) reported mild to moderate foreign body sensation on POD1. In all patients, it gradually resolved by POD7. In Ultrapro group, 7 patients (35%) felt mild foreign body sensation on POD1, by POD5 no patients reported significant foreign body sensation. In TiMesh group, 9 patients (37.5%) reported mild foreign body sensation on POD1, which resolved by POD3.

##### Heaviness

In the prolene group, 12 patients (57%) patients reported mild to moderate heaviness in the inguinal region on POD1. It gradually resolved in all patients by 1 week. In Ultrapro 6 patients (30%) complained of mild heaviness on POD1, which settled in about 5 days following surgery. In TiMesh group, 7 patients (29%) patients reported noticeable heaviness, with subsequent resolution by 5-7 days.

#### Stiffness

Stiffness in the inguinal region following surgery was not a common feature in any of the groups. Though, 3 patients (14%) in prolene complained of stiffness by POD7. None of the patients in TiMesh and Ultrapro groups had feeling of stiffness by POD7.

#### Difficulty in getting up from bed

All patients on POD1 had mild difficulty in getting up from bed. By POD7, 4 (19%) patients in prolene group and none in other two groups had any difficulty.

#### Post-operative return to daily routine activities

All patients were ambulatory and could go to washroom on the day of surgery itself. Patients in Prolene group, on an average took 3.5(±1.5) days to resume their morning/evening walk or minor outdoor activities, whereas, time taken by TiMesh and Ultrapro group patients was significantly less i.e. 2.0 (±1.0) and 2.5 (±0.5) days respectively (Table 4).

**Table 4: Time to resume daily routine activities with respect to mesh used.**

Mesh	Time to resume regular day to day activities	Climbing Stairs	No. of days absent from work
Prolene	3.5±1.5	3.5±1.0	7.0±1.0
TiMesh	2.0±1.0	2.5±0.5	6.0±2.0
Ultrapro	2.5±0.5	3.0±1.0	6.0±1.0
p-value	0.0001	0.001	0.091

A majority of patients on an average took about 3.5 days in Prolene, 2.5 days in TiMesh, and 3.0 days in Ultrapro groups to climb stairs comfortably. Irrespective of mesh used most of patients resumed going to office by 6-7 days after surgery.

#### Recurrence

During the follow-up period, none of the patients in any of the mesh groups had recurrence of hernia till 1 year follow-up.

### DISCUSSION

It is a prospective observational study that intends to find out whether implanting a lightweight mesh provides a better subjective improvement in pain and quality of life as compared to a conventional heavy weight mesh during inguinal hernia repair. Postoperative pain has adverse implications on morbidity, healthcare costs, and quality of life.<sup>6</sup> Groin pain reduction is considered as an important goal for improving outcome in TEP hernia repair<sup>7</sup>. There is evidence that lightweight mesh is

associated with lesser rate of chronic pain as compared with heavyweight mesh.<sup>7</sup>

**Post-operative pain**

In the present study, all patients reported mild to moderate pain and discomfort on POD1. Patients in Prolene group reported mild to moderate pain with mean Visual Analogue scores of 2.4 and mild pain in Ultrapro (1.7) and TiMesh (1.6) groups. On POD7, patients reported mild pain in Prolene group (1.8) as compared to just noticeable pain sensation in Ultrapro (1.0) and TiMesh (1.0). By the end of 6 months, inguinal pain was negligible in TiMesh (0.6; 0.0) and Ultrapro (0.8; 0.3) groups, in contrast to the patients in Prolene group (1.0; 0.7) with noticeable pain. Patients with prolene mesh placement had significantly higher pain score (visual analogue scale) than in whom light weight meshes were used. Though, no significant difference in pain scores in Ultrapro and TiMesh groups was noticed. No patient had moderate or severe groin pain at follow-up on POD7 or on further follow-up with any of the meshes. There are a few studies that compare chronic groin pain in TEP

inguinal hernia repair between lightweight and heavyweight meshes. Our findings are in accordance with the study conducted by Chowbey et al, in which, mean VAS score for pain on POD1 was 2.48 in Prolene group and 2.39 in Ultrapro group, which was not statistically significant (p=0.289).<sup>8</sup> On POD7 it was 1.07 in Ultrapro group vs. 1.31 in Prolene group, this observation was statistically significant (p=0.00). Similarly, in a study carried out by Agarwal et al, showed that out of 114 TEP hernia repairs performed using standard polypropylene mesh in 84 patients and light weight mesh in 30 patients, group with light weight mesh reported mean VAS scores for pain. On POD3, VAS scores were 5.4 in HWM group and 3.2 in LWM group, which was statistically significant (p=0.00).<sup>9</sup> Similarly, pain scores were significantly less on POD7, 3<sup>rd</sup> week and 3<sup>rd</sup> month. In another double blinded randomized control trial conducted by Agarwal et al, on 50 patients, who underwent TEP, similar findings were reported.<sup>9</sup> In a latest study conducted by Prakash et al, in 2016, the mean VAS score for pain was reported to be similar and was statistically not significant as shown in Table 5.<sup>10</sup>

**Table 5: Comparison of VAS pain scores in various studies.**

Studies	Mesh	POD1	POD3	POD7	W3	Chronic inguinal pain
Chowbey et al <sup>8</sup>	LWM	2.39	-	1.07	-	3.7% pts
	HWM	2.48	-	1.31	-	7.1% pts
	P value	0.29	-	0.00	-	0.164
Agarwal et al <sup>6</sup>	LWM	-	3.2	2	1	0
	HWM	-	5.4	5.4	3.2	1.9
	P value	-	0.00	0.00	0.00	0.00
Agarwal et al <sup>9</sup>	LWM	-	3.88	3.24	2.04	0.52
	HWM	-	5.28	5.28	3.48	1.44
	P value	-	0.032	0.00	0.00	0.00
Shah et al <sup>11</sup>	LWM	-	-	-	-	5.7% pts
	HWM	-	-	-	-	18.7% pts
	P value	-	-	-	-	0.05
Prakash et al <sup>10</sup>	LWM	2.2	-	1.4	-	1.11
	HWM	2.1	-	1.5	-	1.12
	P value	0.60	-	0.11	-	0.80
Present study	LWM (Ultrapro)	1.7	-	1.0	-	0.3
	LWM (TiMesh)	1.6	-	1.0	-	0.0
	HWM (Prolene)	2.4 (1-5)	-	1.8 (0-3)	-	0.7 (0-1)
	P value	0.027	-	0.002	-	0.00

**Mean operative time**

In the present study, the mean operative time for unilateral cases in Prolene, TiMesh and Ultrapro groups were 74.16 min, 71.66min and 74.44min respectively, which is not statistically significant (p=0.978). Similarly, in bilateral TEP cases, the mean operative time for Prolene, TiMesh and Ultrapro groups were 113.89min, 112.22min and 121.82min respectively, this observation

was also not statistically significant (p=0.956). In a study conducted by Chowbey et al, mean duration of surgery in Ultrapro group was 58.74min and Prolene group was 58.00min.<sup>8</sup> It was marginally higher in the Ultrapro group, but it was not statistically significant (p=0.725). In a study conducted by Shah et al, mean surgical time in TEP cases for unilateral cases was 59.3min and in bilateral cases 86.6 min.<sup>11</sup> In a study conducted by Agarwal et al, mean operative time recorded was 80min

in Lightweight mesh group and 55min in Polypropylene group.<sup>9</sup> Duration of surgery is variable depending upon the surgeon's expertise and facilities at the institution. In a study carried out by Prakash et al, no significant association was found between mean operative time

between LWM group and HWM group ( $p=0.22$ ).<sup>10</sup> In most of the studies, duration of surgery was not statistically significant with respect to the type of mesh used (Table 6).

**Table 6: Comparison of mean operative time among various studies.**

Studies	Heavyweight mesh (HWM)		Light weight mesh (LWM)	
	Unilateral	Bilateral	Unilateral	Bilateral
Chowbey et al. <sup>6</sup>	58 min		58.74min	
Agarwal et al. <sup>9</sup>	55 min		80min	
Shah et al. <sup>11</sup>	59.3 min		86.6min	
Prakash et al. <sup>10</sup>	53.9 min	63.7 min	57min	66.9min
Present study	74.16 min	113.89 min	TiMesh	
			71.66 min	112.22min
			Ultrapro	
		74.44min	121.82min	

#### Other patient related primary outcomes

These include foreign body sensation, heaviness, stiffness and difficulty in moving hip joint. Foreign body reaction was reported to occur in up to 71% (15 out of 21) patients in prolene, 35% (7 out of 20) patients in Ultrapro and 37.5%, (9 out of 24) patients in TiMesh groups on POD1 in our study. It was found to be less with lightweight meshes (TiMesh and Ultrapro) compared with heavyweight polypropylene mesh. Though, in all the patients it got resolved within a weeks' time. In a study conducted by Shah et al, 18.7% patients in Polypropylene and 5.7% patients in Lightweight mesh groups reported feeling mesh (foreign body reaction) in long term outcomes.<sup>11</sup> In another study by Prakash et al, foreign body sensation was reported by 24 (18.3%) patients at 3 months follow-up.<sup>10</sup> The incidence was less in patients in LW mesh group (15.4%) as compared to HW mesh group (21.2%). However, the difference was not significant ( $p=0.38$ ). It is believed to be caused by the intense local fibrous reaction that occurs with polypropylene. The fibroblast in growth and chronic inflammatory reaction that alloplastic mesh induces result in the formation of a scar plate. It is expected that a greater amount of material in a heavyweight mesh results in a greater degree of foreign body reaction and scar formation.<sup>12</sup>

In present study, besides foreign body reaction, heaviness, stiffness and difficulty in getting up from bed was found to be less when comparing light weight mesh with heavy weight mesh for laparoscopic inguinal hernia repair (TEP). Heaviness in groin, on POD1, was reported in 57% (12 patients), 30% (6 patients) and 29% (7 patients) in Prolene, Ultrapro and TiMesh groups respectively. It completely subsided in about 5-7 days in all patients. Feeling of stiffness was present in all

patients, but by POD7, 14% (3 patients) in prolene group felt stiffness in contrast to 5% (1 patient) in Ultrapro group and none in TiMesh group. All the patients on POD1 had difficulty in getting up from bed. In 4 out of 65 patients (19%), only in prolene group it persisted upto POD7. Plausible explanation is that, heavyweight mesh tends to shrink more than lightweight mesh and hence is stiffer, and can therefore make normal abdominal movements difficult and uncomfortable<sup>12</sup>.

In the present study, patients with light weight mesh returned to their daily routine activities earlier as compared to patients with Prolene mesh. Patients in prolene group took on an average 3.5 days to resume their daily routines, in contrast to TiMesh and Ultrapro group patients in which, it was 2.0 and 2.5 days respectively, which was statistically significant ( $p=0.00$ ). Similar findings were revealed in a study conducted by Chowbey and co-workers<sup>6</sup>. The mean time taken by the patients in prolene group to resume their daily activities was 2.09 days and in LWM (Ultrapro) group 1.82 days ( $p=0.00$ ) in their series. In a study by Prakash et al.<sup>10</sup>, Patients in HW mesh group took significantly longer time to return to walking freely ( $2.1\pm 0.6$  vs.  $1.7\pm 0.7$ ,  $p$  value= $0.002$ ) and return to driving vehicles ( $20.8\pm 5.2$  vs.  $19\pm 6.7$ ,  $p$  value= $0.05$ ). Although the time to return to work was also longer in HW mesh group, but it was not statistically significant.

In the present study, a majority of patients on an average took about 7 days in Prolene, 6 days in TiMesh, and 6 days in Ultrapro groups to resume their work/office, which was not statistically significant ( $p=0.091$ ). In accordance with other reference studies, patients took on an average leave of 7 days from work irrespective of mesh used.

## **Complications of TEP**

Laparoscopic inguinal hernia repairs are looked upon as technically demanding procedures having a stiff 'learning curve'. The complication rate for laparoscopic repair of inguinal hernia ranges from less than 3% to as high as 20%. Complications of a totally extraperitoneal (TEP) repair include peritoneal injury, visceral injury, vascular injury, nerve injury and injury to the cord structures. Intraoperative complications can occur at every step of the operation, even though some of them are only occasionally reported.<sup>13</sup>

### **Accidental injury to peritoneum**

In the present study, accidental injury to peritoneum occurred during dissection of the hernial sac in 3 patients (4.6%). Following peritoneal tear, insufflated gas escaped into the intraperitoneal cavity. This led to loss of working domain, making further dissection difficult and possibly dangerous.

In all three cases, the pneumo-peritoneum occurred and required placement of a Veress needle in the left subcostal position (Palmer's point) to desufflate peritoneum and restore the extra-peritoneal domain. Though, in present study none of these patients required conversion to open surgery. In a study conducted by Hasbahceci et al, peritoneal injury occurred in 21.4% of the cases and was regarded as the reason for conversion in two out of seven conversions.<sup>14</sup> Peritoneal injury has been regarded as the most important operative complication to cause the loss of exposure in a limited preperitoneal area. It has been reported that the occurrence of this complication can be seen in almost half of the cases. In the study conducted by Prakash et al, two patients in HW mesh group had accidental pneumo-peritoneum due to major peritoneal tear.<sup>10</sup> It lead to conversion to TAPP in both these cases.

### **Post-operative seroma formation and scrotal swelling**

Postoperative swellings, e.g. Scrotal swelling and Seroma formation are amongst the common complications after laparoscopic TEP repair of inguinal hernias.<sup>15</sup> In the present study, scrotal swelling was noticed in 4 patients in immediate post-operative period. It resolved spontaneously by third post-op day without any intervention. Seroma formation was reported in 5 patients on follow-up after a week and all got absorbed spontaneously by 2 weeks. Out of these 5 patients, 2 belonged to Prolene group, 2 to TiMesh and 1 to Ultrapro group. No significant association with age, type of hernia or mesh used was found. Though, most swellings are minor complications, but they are perceived as recurrence by patients. However, these not associated with hernia recurrence. These generally subside spontaneously, but they do lead to patient dissatisfaction and distress. In a study carried out by Agarwal et al, seroma formation was observed in 12 patients in HWM group and 2 patients in

LWM group on follow-up during third week, which was not statistically significant ( $p>0.26$ ).<sup>9</sup> In the same study, 3 patients in HWM group developed seroma on follow-up in third month, in contrast to none of the patients in LWM group, though it also was not found to be statistically significant ( $p<0.085$ ). In a study by Chowbey et al, seroma formation was found to be more in prolene group (39), than in the Ultrapro group (32).<sup>6</sup> Though it was not statistically significant ( $p=0.666$ ). Seroma formation is specially seen after large indirect hernia repair. Most resolve spontaneously over 4-6 weeks. In a study by Prakash et al, the incidence of seroma formation was more in HW mesh group as compared to LW mesh group but it was statistically not significant ( $p=0.6$ ).<sup>10</sup> A total of 16 (12.2%) patients had seroma at the first follow-up at 1-week, 9 (13.5%) patients in HW group and 7 (10.8%) in LW group.

In a study conducted by Choi et al, in 1,065 laparoscopic TEP inguinal hernia repairs performed on 944 patients between December 2000 and December 2008, overall incidence of swelling formation was reported to be 6.5% (70 of 1,065 cases).<sup>15</sup> Fifty-eight (83%) of 70 patients who had swelling did not need any intervention and the swelling resolved spontaneously.

### **Subcutaneous emphysema**

In the present study, one patient was reported to have subcutaneous emphysema in intra-operative period. The incidence of subcutaneous emphysema in laparoscopic extraperitoneal hernia repairs is under-reported. Once it is noted, the progression of the surgical emphysema during this type of surgery can have serious implications (e.g., cardiovascular and hemodynamic disturbances) unless timely, appropriate measures are taken.

Aetiology of subcutaneous emphysema is multifactorial, with no single factor having a prominent association. There is a paucity of published data on the incidence of subcutaneous emphysema and the causative factors responsible for its occurrence during laparoscopic procedures. In a study conducted by Saggari and co-workers, a BMI  $<25$ , longer operating time (especially  $>1$  hour), and higher end-tidal carbon-dioxide tension (start, peak, and difference) were found to be significantly associated with the development of subcutaneous emphysema.<sup>16</sup> Age and type of hernia - unilateral versus bilateral, direct versus indirect - were not found to be statistically significant factors.

### **Conversion to open/TAPP surgery**

Conversion to open surgery is an important problem, especially during the learning curve of laparoscopic total extraperitoneal (TEP) inguinal hernia repair. In the present study, 2 patients had to be converted from TEP to open surgery. In one case, aberrant vascular anatomy and in second case, a large irreducible sac densely adhered to anterior abdominal wall at the hernia defect were

responsible for conversion to open surgery. In a study by Prakash et al, three cases were converted from TEP to TAPP; two in HW mesh group and one in LW mesh group.<sup>10</sup> The reason for conversion was loss of space due to major peritoneal tear in two patients and difficulty in creation of space due to dense adhesions in one patient. There was no conversion to open repair. No conversion to open surgery was reported by Agarwal et al, and Chowbey et al, in their respective studies.<sup>6,9</sup>

Most of the data published on laparoscopy in hernia surgery have focused on patient outcomes and surgical technique. Although these endpoints are important, most of those studies, it seems, have ignored conversion as an intraoperative complication, which may occur in up to 10.6% of cases.

In a study conducted by Ates et al, on 259 patients with 281 inguinal hernias, who underwent laparoscopic TEP inguinal hernia repair, thirty-one hernia repairs (11%) were converted to open conventional surgical procedures.<sup>17</sup> Twenty-eight of 31, were converted to modified Stoppa procedures, because of technical difficulties. Three of these patients underwent Lichtenstein hernia repairs, because they had undergone previous surgeries. In a study carried out by Hasbahceci et al, 7 cases out of 42 (16.7%), underwent conversion to open surgery.<sup>14</sup> Various causes of conversion are as follows (Table 7).

**Table 7: Causes for conversion.**

Reason	Percentage (%)
Peritoneal injury causing loss of exposure	5
Difficulty to determine the anatomy	5
Adhesions caused by previous hernia repair	5
Sliding hernia	2.4

**CONCLUSION**

Light weight mesh placement in laparoscopic TEP hernioplasty results in better patient related outcomes. Post-operative pain was less, patient reported outcomes were better and early resumption of routine activities (p=0.000) and climbing stairs (p=0.001) observed in Ultrapro and TiMesh groups than in Prolene group.

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