ABSTRACT

Objective: comparison of different methods of mesh fixation in inguinal hernia repair.

Patients and methods: This study was conducted in the general surgery department at Alazhar university hospitals in the period from September 2016 to September 2017 (12 months). This prospective study included 100 patients undergoing inguinal hernia repair with different methods of mesh fixation. Results: Our study shows that mesh fixation with fibrin glue is suitable for use in open tension-free inguinal hernioplasty. There were no complications related to the technique. Conclusion: Mesh fixation with fibrin sealant in open hernia repair surgery is a simple, original and reproducible technique. It is accompanied by a reduction in chronic inguinal pain.

INTRODUCTION

Inguinal hernia repair is the most frequently performed operation in general surgery, there has been a great upsurge in interest in hernias over the last 15-20 years sparked by the introduction and widespread use of prosthetic mesh closely followed by the advent of laparoscopic surgery.

The tension free anterior repair of inguinal hernia using a mesh; initially described by Zagdoun in 1959 and perfectly clarified by Lichtenstein. {6}.

Over the last few years, the placement of a prosthetic mesh in front of the hernia orifice has become an increasingly popular strategy to prevent recurrence. Several techniques exist that require permanent fixation of the prosthesis to the abdominal wall. Prosthetic material used is secured by either using a conventional suture, or with staples. Despite the “tension-free “nature of these hernioplasties, suture may cause strangulation of muscle fibers, or even a lesion or compression of the regional nerves, leading to invalidating pain or dysesthesia. {1}.

In addition using tissue-penetrating devices like staples or sutures can cause post-operative bleeding as well as pain.

{2}.

In particular, most reports of chronic pain encountered after
tension-free groin hernia repair are related to the use of these tissue-penetrating devices. {8}.

The prevalence of post-operative pain syndromes after open and laparoscopic procedures has been reported to be as high as 30%. {10}.

Recent meta-analysis has calculated that 12% of patients feel themselves restricted in their daily activity because of pain. {9}.

For example, chronic groin pain is rated as the most important factor in patient dissatisfaction after inguinal hernia repair. {13}.

In assessment of outcomes for patients who report severe or very severe pain three months after groin hernia repair, Callesen et al described chronic groin pain as “the most serious problem that may affect the results of hernia surgery”.(14).

The recognized problem of complications associated with permanent mesh fixation methods in groin hernioplasty prompted the search for other fixation techniques. {12}.

Sutures and clips for mesh fixation are thought to be an important cause of the development of chronic inguinal pain syndrome. For this reason, there has been a search for possible improved approaches toward a traumatic mesh fixation in hernia surgery with the objective of reducing post-operative pain. It was found that “chronic post-hernioplasty pain” is significantly reduced after repair procedures when fibrin sealant is used, compared with traditional suture and staple fixation. In addition, use of fibrin sealant was not associated with any different risk of recurrence. {14}.

PATIENTS AND METHODS

Between January 2015 and September 2015 a total of One hundred patients with unilateral primary inguinal hernia were repaired by (LCHTENSTIEN) tension-free hemioplasty. For subsequent analysis, the study patients were divided into four groups, 1st group includes 21 patients who had undergone mesh fixation with fibrin sealant, 2nd group includes 37 patients who had undergone mesh fixation with sutures, 3rd group includes 18 patients who had undergone mesh fixation with staples, and 4th group includes 24 patients who had undergone mesh non-fixation. All patients were contacted to be interviewed and re-examined using a standardized questionnaire at 1 week, 30 days, 3 months, 6 months and 1 year after surgery.

General features of studied patients:
Age: the age range is 18-60 years.
Sex: only male patients were included.
Smoking: the total number of smokers in the study was sixty. Twenty of them were repaired with mesh fixation by stitches, thirteen of them were repaired with mesh fixation by staples, sixteen of them were repaired with mesh fixation by fibrin glue, and eleven of them were repaired with non-fixation of the mesh.
Medical history: 9 patients were diabetic. 2 of them were postponed for 1 week because of high RBS>450mg/dl. 5 of them were repaired with mesh fixation by sutures and 4 by mesh fixation by glue.

History of previous surgery: 18 patients with the history of open appendectomy. Mesh was fixed by sutures in 8 patients, fixed by glue in 7 patients, and by staples in 3 patients.
Hernial repair of the other side: 5 patients with hemioplasty of the other side.3 of them were repaired with mesh fixation by glue, and 2 with non fixation of mesh.
SURGICAL TECHNIQUE:
ANESTHESIA: 89 Patients were operated under spinal anesthesia, 5 patients were sedated in addition to spinal anesthesia, and 6 patients refused spinal anesthesia and were operated under general anesthesia.
OPERATION: All patients were operated with the same surgical technique (LICHTENSTEIN) using a polypropylene mesh as prosthetic material. Identical surgical procedures were used for all groups, apart from the method used to secure the prosthesis.
TECHNIQUE:
An inguinal incision of 5–6 cm was made to expose the external oblique aponeurosis. The upper and lower leaves of the external oblique muscle were largely separated from the underlying tissues in order to establish a space to allow the subsequent placing of the mesh. In all groups particular attention was paid for identification and preservation of the (ilioinguinal, iliohypogastric and genital branch of genito-femoral nerve). The spermatic cord was then dissected and separated from the posterior wall. The cremasteric muscle was incised longitudinally. Two flaps were therefore isolated and resected. In the case of indirect oblique hernia, the sac was separated from the cord, resected and then closed with absorbable suture material. In the case of direct hernia, the sac was reduced with plication of the transversalis fascia. A 6×11 cm polypropylene mesh was placed to overlap the floor of inguinal canal extending from the pubic tubercle to behind the spermatic cord above the internal inguinal ring, and overlapping both conjoint tendon and shelving part of inguinal ligament or pubic tract.
MESH FIXATION: Then the mesh was fixed according to the group:
(GROUP A) MESH FIXATION WITH FIBRIN GLUE: fibrin glue was applied by the use of specially designed syringe with spraying canula to cover the whole surface of the mesh using minimal amount of the glue (0.5-2ml).( glue could be applied as drops at interrupted points over conjoint tendon, inguinal ligament, and pubic tubercle). Lateral to the spermatic cord, the upper part of the mesh was flipped over the lower one and they were joined with one polypropylene stitch. The mesh will be compressed against the inguinal floor for about 2 min.

(GROUP B) MESH FIXATION WITH SUTURES: Apex of the mesh was sutured to the pubic tubercle using a No. 3–0 Prolene suture. Continuous sutures were used to join the lower border of the mesh to the free edge of the inguinal ligament, after an opening was made into its lower edge to accommodate the spermatic cord. The continuous suture was extended up for a distance (1.5cm) behind the cord. Interrupted Prolene sutures were used to anchor the mesh to the conjointed tendon. Laterally to the spermatic cord, the upper flap of the mesh was sutured to the lower one with a single polypropylene stitch.

(GROUP C) MESH FIXATION WITH STAPPLER: Apex of the mesh was stapled to the pubic tubercle using skin titanium staples (that was available for us and was accepted in some
previous studies for mesh fixation). 3 or 4 staples were used to join the lower border of the mesh to the free edge of the inguinal ligament, after an opening was made into its lower edge to accommodate the spermatic cord. Another 3 or 4 staples were used to anchor the mesh to the conjoined tendon. Laterally to the spermatic cord, the upper flap of the mesh was stapled to the lower one creating a new ring.

MESH FIXATION BY STAPLER (figure 3)

(GROUP D) NON FIXATION OF THE MESH:
Mesh was adjusted to cover the floor of the inguinal canal and to encircle the cord with no stitches or staples were required to fix the mesh neither to the inguinal ligament nor to the conjoined tendon, but two stitches or staples were taken, one to fix the mesh to the pubic tubercle, and one to create a new ring around the cord.

CLOSURE: The aponeurosis was then closed anterior to the cord structures by an absorbable suture (vicryl 2/0). The operation was terminated by suture of the subcutaneous tissue by an absorbable suture (vicryl 2/0) and the skin by non-absorbable suture. No drainage system was used.

RECOVERY: Patients were monitored in a recovery room for a minimum of 2 hours. Systematic analgesia as nonsteroidal anti-inflammatory drugs was used.

DIET: Intake of liquid food was resumed in the evening after the operation and a normal diet as from the following day. Patient discharge to home was authorized from Day 1 after surgery.

FOLLOW UP: All patients were evaluated at 30 days, 3 months, 6 months and 1 year after surgery and had answered a previously established protocol. The objective of the follow up of this study was to compare between the different groups of mesh fixation regarding the (operative time, intra-operative complications, hospital stay, cost, post operative pain, and return to normal life style). For the postoperative pain sequelae, the pain was classified according to CUNNINGHAM’S criteria as follow:

- **Mild**: occasional pain or discomfort that did not limit activity, with a return to pre-hernia lifestyle.
- **Moderate**: pain preventing return to normal preoperative activities (inability to continue any sports or to lift objects without pain)
- **Severe**: pain constantly or intermittently present but so severe as to impair normal activities, such as walking.

RESULTS

The 100 patients were divided into four groups. The age in the fibrin sealant group ranged from 28-55 years (mean: 37.05±7.76). The age ranged from 25-60 years (mean: 36.14±10.0) in the suture group. The age in the staples group ranged from 23-53 years (mean: 36.14±10.0) the age in the mesh non-fixation group ranged from 18-50 years (mean: 25.33±8.53)

Objective data found in the assessment was as follows:

It was planned to operate all patient under spinal anesthesia but 5/100 patients were sedated in addition to spinal anesthesia, and 6/100 patients refused spinal anesthesia and were operated under general anesthesia, and the rest of 89/100 Patients were operated under spinal anesthesia. Spinal anesthesia did not cause any complication immediately post-operatively, but late following surgery some patients (9/100= 9%) experienced headache which was resolved by nonsteroidal anti-inflammatory drugs, small doses of caffeine, Intra-operative (primary) complication during mesh fixation occurred in the form of:

- **Bleeding** due to vascular injury of inferior epigastric vessels and femoral vein. In Group
II (6/37 patients) 2 of them due injury of the femoral and 4 due to injury of inferior epigastric vessels caused by deep sutures and all were managed by stitch removal and compression for awhile (10mins). Bleeding occurred (3/18 patients) of Group III due to vascular injury of inferior epigastric vessels by staples- which were managed by exploration of the floor and ligation of the bleeder. No vascular injury occurred in both Group I and IV. (Secondary) complications to surgery which appeared in the first month of the follow up period:

- **Hematoma and seroma:** No hematoma or seroma of the surgical wound of the inguinal region was noticed in any patients of Group I. Only Scrotal edema in (1/21=4.76%) patients which remitted in a short time. In Group II hematoma of the surgical wound of the inguinal region was found in (2/37=5.4%) patients, which was necessary to drain. Seroma in the surgical wound in (3/37=8.1%) patients which was aspirated for a single time. Scrotal edema in (6/37=15.38%) patients which remitted in 7 days. In Group III hematoma occurred in (2/18=11.11%) patients with the patients re-admitted for evacuation and drainage. No seroma but scrotal edema in (4/18=22.22%) patients which was subsided 1 week after surgery. For patients of Group IV hematoma was found in (1/24=4.16%) patient, seroma in (5/24=20.83%) patients, and scrotal edema in (2/24=8.33%) patients. For seroma and scrotal edema they had been disappeared after 1 week while it was necessary to evacuate and drain hematoma by re-operation

<table>
<thead>
<tr>
<th>Complication</th>
<th>Fibrin glue group</th>
<th>Sutures group</th>
<th>Stales group</th>
<th>Non fixation group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematoma</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>11.1</td>
<td>5.0</td>
</tr>
<tr>
<td>Seroma</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Scrotal edema</td>
<td>1</td>
<td>4.8</td>
<td>6</td>
<td>16.2</td>
<td>13.0</td>
</tr>
<tr>
<td>None</td>
<td>20</td>
<td>95.2</td>
<td>26</td>
<td>70.3</td>
<td>74.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
<td><strong>100.0</strong></td>
<td><strong>37</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
</tr>
<tr>
<td>X2 test</td>
<td>12.699</td>
<td></td>
<td></td>
<td></td>
<td>0.102 NS</td>
</tr>
</tbody>
</table>

- **Pain:** As regards pain assessment according to CUNNINGHAM'S criteria, it was found that; In Group I: One case was lost during the follow up program, 11/21 patients presented with no pain whatsoever (52.3%), 6/21 patients (28.5%) presented with mild pain, 3/21 patients (14.28%) had moderate pain. Pain remitted rapidly in all cases with analgesics (nonsteroidal anti-inflammatory drugs). One patient complained of chronic pain of moderate intensity one month after surgery and remained constant, although this was tolerable at 6 months after surgery.

In Group III: 1 case was lost during the follow up program, 8/18 patients presented with no pain whatsoever (44.4%), 6/18 patients (33.3%) presented with mild pain, 3/18 patients (16.66%) had moderate pain.

In Group IV: 2 cases were lost during the follow up program, 11/24 patients presented with no pain whatsoever (45.8%), 7/24 patients (29.1%) presented mild pain, 4/24 patients (16.66%) had moderate pain.

- **Recurrence:** At 3 months follow-up, there was one case of recurrence in Group IV 1/24 patient (4.16%), with no cases of recurrence was recorded during the follow up.
All patients were questioned specifically on pain and postoperative comfort at 24 h and 7 days after surgery, with clear distinction between the four groups. From these results it was found that comfort was greater in Group I followed by Group IV. And there was less local inflammatory reaction in this area (clinical data verified through physical examination). Pain was more often present and more frequent in both of suture and staples group. Although tolerable in all cases, few cases required higher doses of analgesia.

- **Mean hospital stay:** Mean hospital stay was 1 day ± 12 hrs in all groups. (5/100 = 5%) patients were re-admitted for evacuation and drainage of hematoma and stayed in the hospital for 4 ± 1 days more.

**Table 6 mean time to return to work**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>Mean± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to normal work</td>
<td>Fibrin glue group</td>
<td>14.0±0.0</td>
<td>14-14</td>
</tr>
<tr>
<td></td>
<td>Sutures group</td>
<td>21.0±0.0</td>
<td>21-21</td>
</tr>
<tr>
<td></td>
<td>Stales group</td>
<td>21.0±0.0</td>
<td>21-21</td>
</tr>
<tr>
<td></td>
<td>Non fixation group</td>
<td>21.0±0.0</td>
<td>21-21</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The main end-point for the evaluation of the treatment of inguinal hernia is the recurrence rate. In this respect, wall reinforcement with prosthetic meshes is clearly superior to simple herniorrhaphy. An improvement in postoperative comfort and a lower incidence of recurrence have been reported among patients who undergo tension-free techniques compared with non-mesh techniques. Chronic pain is now the most important complication associated with hernia- mesh repair. In fact, post hernioplasty pain can significantly influence the patients’ quality of life. (16). Although “tension-free” hernia repair is reputed for its simplicity, it may lead to neurological complications, such as neuralgia, dysesthesia or hypoesthesia. Lesions mainly involve the ilio-hypogastric, ilio-inguinal or genito-femoral nerves and may be due to severing of the nerve, trapping in a suture, stretching or even electro coagulation, which usually occurs during the dissection of the hernia or securing of the mesh. These lesions are all

### Table 4 recurrence of hernia after different methods of mesh fixation

<table>
<thead>
<tr>
<th>Group</th>
<th>Fibrin glue group</th>
<th>Sutures group</th>
<th>Stales group</th>
<th>Non fixation group</th>
<th>Total</th>
<th>X2 test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>1 4.2</td>
<td>1 1.0</td>
<td>3.068</td>
<td>0.63 NS</td>
</tr>
<tr>
<td>Absent</td>
<td>21 100.0</td>
<td>37 100.0</td>
<td>18 100.0</td>
<td>24 100.0</td>
<td>99 99.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5 mean hospital stay after operation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>Mean± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital stay</td>
<td>Fibrin glue group</td>
<td>16.05±5.56</td>
<td>12-30</td>
</tr>
<tr>
<td></td>
<td>Sutures group</td>
<td>19.84±8.45</td>
<td>4-36</td>
</tr>
<tr>
<td></td>
<td>Stales group</td>
<td>18.5±7.13</td>
<td>4-30</td>
</tr>
<tr>
<td></td>
<td>Non fixation group</td>
<td>20.75±8.25</td>
<td>2-36</td>
</tr>
</tbody>
</table>
the more frequent as there are numerous anatomical variations in the neurological parts of the region. These painful sequelae are so frequent that we sought an alternative means of securing the prosthese in order to reduce them. Katkhouda et al. was the first to demonstrate the feasibility of a technique of laparoscopic repair using fibrin sealant in animals with promising results. (16)

Our study shows that mesh fixation with fibrin glue is suitable for use in open tension-free inguinal hernioplasty. There were no complications related to the technique. In particular, no hematomas, seromas or neuralgias were observed over 12 months of follow-up. Moreover, the mean operating time was shorter when compared with the mean operating time of the classic Lichtenstein technique. In addition, surgeons reported a low level of perceived difficulty and a high level of satisfaction. Our results confirm the efficacy of mesh fixation with fibrin glue and support the viability of a sutureless Lichtenstein procedure. Whether this approach becomes widespread will depend on further evaluation in multicentre controlled trials. Lastly, the excess costs due to spraying the fibrin sealant (2 ml are sufficient for a hernia repair) should be compared with the cost of sutures or staples required for conventional fixation, the reduced operative time, hospital stay and the cost of the chronic pain.

CONCLUSION
Mesh fixation with fibrin sealant in open hernia repair surgery is a simple, original and reproducible technique. It is accompanied by a reduction in chronic inguinal pain, with no increase in the early recurrence rate.

REFERENCES