Cyanoacrylate glue mesh fixation versus suture mesh fixation in Lichtenstein inguinal hernia repair

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Background
Lichtenstein hernioplasty is becoming more popular in repairing inguinal hernia as it has a low recurrence rate, simplicity to learn, teach, and low costs to the hospital. Cyanoacrylate adhesives have developed over time, mainly through the lengthening of their chemical chains, making them more biocompatible, leading to minimize the toxicity and adverse effects in the host tissue, so it is an optimal choice for the atraumatic mesh fixation. The aim of our study is clarifying the efficacy of the cyanoacrylate glue versus nonabsorbable sutures for mesh fixation in Lichtenstein hernia repair methods with special regard to postoperative groin pain, operative duration, and any other postoperative complications during the follow-up.

Patients and methods
One hundred and sixty patients with primary inguinal hernia managed by the Lichtenstein hernioplasty were randomized into two groups to receive either glue (Histoacryl) or nonabsorbable polypropylene sutures for polypropylene mesh fixation. The chronic groin pain, recurrence, and other complications were analyzed postoperatively. The statistical analysis was carried out using the Statistical Package for the Social Science.

Results
We reached 160 patients to the present study. There was a significant difference regarding the groin pain during the first month postoperatively (acute postoperative pain) that is reduced in the glue fixation group (3.8 vs. 25%) ($P<0.001$). There was no significant differences in the chronic inguinal pain between the study groups that is reduced in the glue fixation group (7.5 vs. 15%) ($P=0.133$). The operative time was significantly longer in the suture than in the glue (median, 41 min; range, 33–44 min vs. median, 31 min; range, 30–38 min).

Conclusion
Compared with suture fixation of a mesh, the using of cyanoacrylate glue fixation is a safe and good alternative for Lichtenstein hernia repair with less postoperative pain, a shorter operating time, and a lower rate of recurrences.

Keywords:
hernia repair, Histoacryl, mesh fixation, sutures

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Introduction

Lichtenstein hernia repair is a common and widely used surgical procedure for treating inguinal hernia, first described in 1989 [1].

Lichtenstein hernia repair is easy to learn and is associated with low rate of recurrence and can be performed under local anesthesia. One of the most annoying complications posthernia repair is the chronic groin pain that may compromise a patient's quality of life [2].

Postoperative pain is defined by the international guidelines for the prevention and management of postoperative chronic pain following inguinal hernia surgery as a pain arising as a direct consequence of a nerve lesion or a disease affecting the somatosensory system in patients who were free of pain preoperatively [3].

Pain complex syndrome may be due to neuropathic or non-neuropathic cause. The neuropathic cause is the compression of one or more of three nerves by suture materials, staples or fibrosis. Another cause of neuropathic pain is the nerve injury either partial or complete during dissection. Non-neuropathic causes include periosteal reaction or mechanical pressure by a folded mesh [4].

Methods to avoid or decrease postoperative pain include the selection of patients, technique of repair, type of mesh, and method of fixation, avoiding hip pathology or back disease with unusual preoperative inguinal pain in an imperceptible hernia [5].

Regarding the technique of repair, preperitoneal mesh placement has low incidence of pain. Moreover identification of all three nerves, ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerve, helps to decrease nerve injury [6].

Lightweight mesh with wide pore and reduction in polypropylene volume is associated with less chronic pain and foreign body sensation [7].

The method of fixation of mesh has an important role in postoperative neuralgia as a multicenter RCT found that the fibrin sealant has a lower incidence of postoperative neuralgia than suture or staple fixation with no difference in the rate of recurrence [8].

Different forms of tissue adhesives are used, such as octyl cyanoacrylate (long chain) and n-butyl-2-cyanoacrylate (short chain) (i.e. Histoacryl, Indermil, Krazy glue) [9].

The glue has to meet the following criteria: biocompatibility, low cost, easy application, and average pack size to be adequate for fixation of one mesh. Fibrin glue and Histoacryl have these criteria but Histoacryl is less expensive [10].

In numerous controlled trials, compared with mesh fixation by sutures, the use of a tissue adhesive has been associated with less postoperative pain, a shorter operating time and a lower incidence of postoperative complications [11].

Aim of this study

The aim of our investigation is to clarify the efficacy of the cyanoacrylate glue versus nonabsorbable sutures for mesh fixation in Lichtenstein hernia repair methods with special regard to postoperative groin pain as a primary endpoint, operative duration, and any other postoperative complications during the follow-up, such as wound infection or seroma, mesh rejection, recurrence, scrotal edema, and hematoma as secondary endpoints.

Patients and methods

This prospective, observational study was carried out between December 2015 and December 2018 in the General Surgery Department at Zagazig University Hospitals. The present study includes 100 patients of primary inguinal hernia. The patients were divided randomly into two equal groups. Group A includes 50 patients treated by ordinary Lichtenstein repair with fixation of mesh by 2/0 polypropylene sutures, while group B includes 50 patients treated by sutureless repair with fixation of mesh by Histoacryl.

Inclusions criteria

(1) Male patients.
(2) Age between 20 and 60 years.
(3) Unilateral primary inguinal hernia.

Exclusions criteria

(1) Female patients.
(2) Recurrent hernia.
(3) Bilateral hernia.
(4) Complicated hernia.
(5) Patients on oral anticoagulants.
(6) Patients on long-term analgesia or steroid treatment.
(7) BMI of more than 35.
(8) Liver cirrhosis.

Technique

Operations were done under spinal or general anesthesia. Incision was made half an inch above and parallel to the medial two-thirds of the inguinal ligament. After opening external oblique aponeurosis up to the external ring, identification and preservation of ilioinguinal and iliohypogastric nerves were done. In case of indirect hernia, the sac was dissected till the internal ring and transfixed then excised. In case of direct hernia, the inversion of the sac was done and closure of the defect by 2/0 polypropylene before the application of mesh. The mesh was polypropylene 6×11 cm tailored for every patient to cover 2 cm medial to the pubic tubercle.

In group A, the mesh was fixed by 2/0 polypropylene (Prolene) in continuous sutures to the inguinal ligament and interrupted sutures to the internal oblique muscle. Lateral to the internal ring, the mesh was incised and the cranial part fixed to the lower one to the inguinal ligament by a suture. In group B, all sutures were replaced by dots of Histoacryl. External oblique aponeurosis was closed by a 2/0 vicryl suture and the skin with a 3/0 prolene subcuticular suture. Senior surgeons operated or supervised all operations performed by the resident

surgeons. All operations were done on a morning operating list.

Postoperative follow-up

The patients were discharged at the same day or next postoperative day. They were advised to move freely but with restrict lifting heavy objects for 2 weeks. Postoperative pain during the first month was recorded. Evaluation of the postoperative complications was done for all patients by clinical examination in outpatients at 1 week, 1 month, and then at a 6-month interval. These parameters are defined in Table 1.

Sample size calculation

Power analysis was performed using independent samples Student's *t*-test, because visual analog scale of pain was the main outcome variable in the present study. According to the Hoyuela *et al.* [12] study, the mean±SD of the visual analog scale at 24 h was 3.4±2.2 and 4.4±2.3 in the glue group and the suture group, respectively. At a power of 0.8 and alpha error of 0.05, a minimum sample size of 80 patients was required in each group. A total of 160 patients were included in this study that randomly allocated between the study arms using physical randomization with balance. MedCalc 13 for Windows, MedCalc Software bvba (Ostend, Belgium).

Table 1 Definitions of outcome measures collected from the randomized, controlled studies

Terms	Definition
Preoperative groin pain	VAS almost immediately prior to the index operation
Duration of operation	Time from skin incision to skin closure
Acute postoperative pain	VAS most immediately after and during 1 week of the operation
Chronic groin pain	Groin pain persisting at least 3 months after the index operation. VAS C 40 mm if scoring system was utilized
Recurrence	Clinical or radiological recurrence of inguinal hernia
Complications requiring further surgery	Any complications requiring further procedures in the theater during the same surgical admission
Hematoma	Includes scrotal or wound hematoma or ecchymosis but not bruising
Wound infection	Any superficial or deep infection
Seroma	Includes hydrocele
Persisting groin numbness	Includes groin paresthesia and dysesthesia at least 3 months after the index operation
Hospital stay	Time from the index operation to discharge
Time taken to return to normal activity	Time from the index operation to the resumption of normal daily activities, or employment where the former was unavailable

VAS, visual analog scale.

Statistical analysis

Continuous variables were expressed as the mean ±SD and median (range) and the categorical variables were expressed as a number (percentage). Continuous variables were checked for normality by using the Shapiro–Wilk test and Mann–Whitney *U* test was used to compare between two groups of non-normally distributed data. Percent of categorical variables were compared using the χ^2 test or Fisher's exact test when appropriate. All tests were two sided. A *P* value of less than 0.05 was considered statistically significant. All data were analyzed using the Statistical Package for Social Science for Windows, version 20.0 (SPSS Inc., Chicago, Illinois, USA).

Results

In the present study, 160 patients were included in this randomized, prospective, observational trial. In each study groups (glue vs. sutures), there were 80 patients. The baseline patient characteristics between the compared groups in this study are presented in Tables 2 and 3. Positioning the mesh was undertaken without difficulty in the case of both groups; fixation with suture or Histoacryl.

The operative time was significantly longer in the suture than in the glue (median, 41 min; range, 33–44 min vs. median, 31 min; range, 30–38 min). This study shows that there was a significant difference regarding the groin pain during first-month postoperatively (acute postoperative pain) that is reduced in the glue fixation group (3.8 vs. 25%) (P <0.001). There was no significant differences in the chronic inguinal pain between the study groups that is reduced in the glue fixation group (7.5 vs. 15%) (P=0.133).

We have also demonstrated that scrotal edema and seroma were reduced when glue fixation of mesh is used; 1.2 versus 3.8%, respectively. Recurrence was recorded during that short-term follow-up and was reduced in the glue fixation group; 3.8 versus 6.2% (P=0.719). We have also demonstrated that hematoma of the surgical wound, surgical-site infection, and reoperations for hemorrhage are reduced in the mesh fixation group; 3.8 versus 5%, 1.2 versus 2.5%, and 0 versus 1.2%, respectively. Reoperation for mesh removal was not detected in either group. Return to normal work was on average after 16 days. In the glue fixation group, no manifestations of irritation were recorded during the follow-up period (Figs 1 and 2).

Table 2 Demographic data of patients undergoing hernia repair

Demographic data	Glue fixation group (*N*=80) [*n* (%)]	Suture fixation group (*N*=80) [*n* (%)]	*P* value
Age (years)			
Mean±SD	31.47±7.40	32.31±7.46	0.214[a]
Median (range)	32 (20–60)	34 (20–55)	
BMI			
Average	31 (38.8)	41 (51.2)	0.151[b]
Overweight	49 (61.3)	38 (47.5)	
Obese	0 (0)	1 (1.2)	
Smoking			
Nonsmoker	46 (57.5)	52 (65)	0.330[b]
Smoker	34 (42.5)	28 (35)	
COPD			
Absent	55 (68.8)	55 (68.8)	1.000[b]
Present	25 (31.2)	25 (31.2)	
Side of hernia			
Left	63 (78.8)	52 (65)	0.053[b]
Right	17 (21.2)	28 (35)	
Duration of symptoms (months)			
Mean±SD	29.91±2.78	29.98±2.58	0.893[a]
Median (range)	30 (24–35)	30 (24–35)	

Quantitative data were expressed as mean±SD and median (range); qualitative data were expressed as *n* (%). [a]Mann–Whitney *U* test. [b]χ^2 test. A *P* value less than 0.05 is significant.

Discussion

Given that the open mesh repair of inguinal hernias is associated with a low risk of recurrence and other life-threatening complications [13], chronic groin pain has become the most serious long-term complication [14].

The chronic pain may occur if nerves are injured or trapped when a mesh is fixed using sutures [15], which along with postoperative fibrosis, may be even disabling for the patient [16].

Some studies have shown that chronic pain was influenced by the type of the mesh implanted and its fixation [17].

A number of different studies which have appeared recently tackle the problem of sutures, or the possibility of fixation with mesh and no stitches [18].

Generally, sutures are generally used to secure the prosthetic mesh; however, that may lead to chronic pain and other problems such as numbness or groin discomfort, presumably through tension or nerve compression [18].

In the hernia surgery, the first publications related to using a synthetic tissue adhesive were written by Farouk *et al*. [19], with an anterior approach, and by Jourdan in 1998, using laparoscopy.

The cyanoacrylate glue was first used by Helbling and Schlumpf [18] in the Lichtenstein mesh repair in 1993. Cyanoacrylate adhesives have developed over time, mainly through the lengthening of their chemical chains, making them more biocompatible and thus minimizing the toxicity and adverse effects in the host tissue [20].

A preliminary study on the use of n-butyl-2-cyanoacrylate as an alternative adhesive for tension-free inguinal hernia repair has shown that this sealant can clog mesh pores, promoting septic complications [19]. More recently, a clinical trial examining the use of n-butyl-2-cyanoacrylate for fixing the mesh prosthesis in inguinal hernia repair has shown promising early results [18]. However, cyanoacrylates are chemical sealants and dry too quickly (within 5–7 s), forming a rigid binding. This means that the mesh can be fixed only at a few points at the edges, so hematomas or seromas can occur under the prosthesis. Helbling and Schlumpf [18] noticed a 13.5% incidence of early hematomas.

Testini *et al*. [10] have published lower postoperative pain rates with tissue adhesives. The present investigation confirms this clinical finding.

Kim-Fuchs *et al*. [11] published a 5-year follow-up comparing sutures versus cyanoacrylate glue fixation for Lichtenstein hernia repair, clarifying that the recurrence rate and chronic pain were similar between the two groups.

Short-term results of two, large randomized trials show that either the glue fixation or self-fixing mesh was

Table 3 Intraoperative data and postoperative complications

Intraoperative data and postoperative complications	Glue fixation group (*N*=80) [*n* (%)]	Suture fixation group (*N*=80) [*n* (%)]	*P* value
Type of anesthesia			
Spinal	64 (80)	71 (88.8)	0.127[b]
General	16 (20)	9 (11.2)	
Operative time (min)			
Mean±SD	32.43±1.96	40.53±1.89	<0.001[a]
Median (range)	31 (30–38)	41 (33–44)	
Hernia size			
<1.5 cm (type 1)	43 (53.8)	42 (52.5)	0.987[b]
1.5–3 cm (type 2)	36 (45)	37 (46.2)	
>3 cn (type 3)	1 (1.2)	1 (1.2)	
Pain during the first month postoperatively			
Absent	77 (96.2)	60 (75)	<0.001[b]
Present	3 (3.8)	20 (25)	
Chronic pain			
Absent	74 (92.5)	68 (85)	0.133[b]
Present	6 (7.5)	12 (15)	
Recurrence			
Absent	77 (96.2)	75 (93.8)	0.719[b]
Present	3 (3.8)	5 (6.2)	
Reoperations (hemorrhage)			
Absent	79 (98.8)	80 (100)	1.000[b]
Present	1 (1.2)	0 (0)	
Reoperation for mesh removal			
Absent	80 (100)	80 (100)	–
Present	0 (0)	0 (0)	
Hematoma of the surgical wound			
Absent	76 (95)	77 (96.2)	1.000[b]
Present	4 (5)	3 (3.8)	
Scrotal edema and seroma			
Absent	79 (98.8)	77 (96.2)	0.620[b]
Present	1 (1.2)	3 (3.8)	
Surgical-site infection			
Absent	78 (97.5)	79 (98.8)	1.000[b]
Present	2 (2.5)	1 (1.2)	

Quantitative data were expressed as mean±SD and median (range); qualitative data were expressed as *n* (%). [a]Mann–Whitney *U* test. [b]χ^2 test. A *P* value less than 0.05 is significant.

better than the suture fixation in Lichtenstein hernioplasty [21].

Accordingly, the synthetic adhesives are a good option for mesh fixation as they minimize postoperative pain and avoid the residual pain that follows some hernioplasties [22].

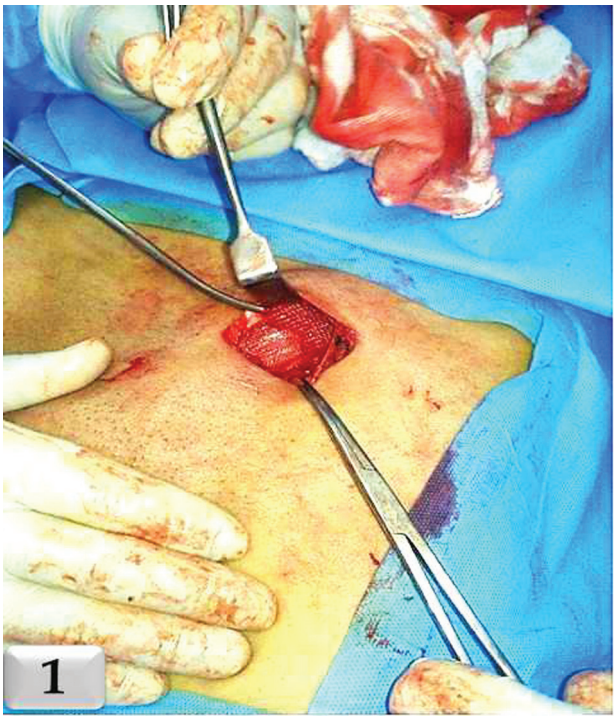
The literature [11] claims that follow-up has to be long enough (5 years) to accurately identify recurrences.

Limitations of this study include the relatively short follow-up and potentially insufficient number of patients to show a difference between the two fixation methods for endpoints that occur infrequently, such as recurrence and wound infection.

Other important considerations, such as cost-effectiveness and quality of life, are not included in this report because of the lack of sufficient number of studies to perform a meaningful meta-analysis. Campanelli *et al.* conducted the only study to assess quality of life, and they did not demonstrate a difference between the two fixation methods.The best postsurgical tolerance, less pain, and discomfort in the region where Histoacryl has been used is in keeping with the absence of sutures, and therefore with a less inflammatory component and less possibility of the iliopubic nerve branches compression. Also, the absence of neuralgia at the pubic tubercle level underlines the importance of sutures in the appearance of this complication [23].

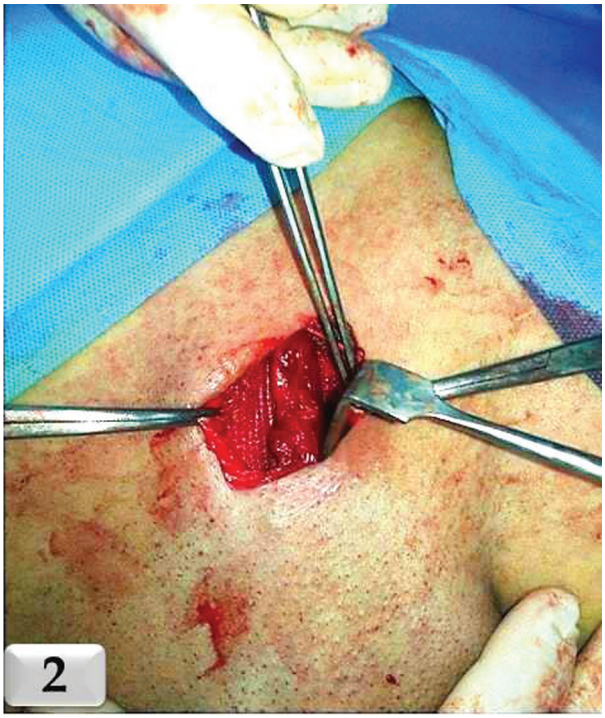
The traditional methods of mesh fixation by sutures are still being done but we could recommend the previous technique for its benefits mentioned before [9].

Figure 1



The polypropylene mesh 6×11 cm tailored for every patient to cover 2 cm medial to the pubic tubercle.

Figure 2



The spermatic cord overlying the mesh after fixation by Histoacryl.

The use of tissue adhesives as an alternative method to sutures in the closure of wound has long been an area of interest [24].

Conclusion

According to the results obtained in our study, it seems that the Histoacryl glue can be a good alternative for the fixation of mesh in Lichtenstein inguinal hernia repair, mimicking the tissue incorporation and mechanical behavior of sutures with less postoperative pain and a shorter operating time.

In our study, we were concerned with the postoperative pain, since it was the main patient complaint for 2 years postoperatively which, at times, was chronic and permanent and leads to poor quality of life. Also that pain could be assessed well during that short period of follow-up.

To evaluate the reliable number of recurrences after inguinal hernioplasty, at least 5- to 10-year follow-up is mandatory; thus further studies with a longer duration of follow-up are needed for clarifying the efficacy of Histoacryl on recurrence rate.

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Conflicts of interest

There are no conflicts of interest.

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