

Cyanoacrylate Glue Mesh Fixation versus Suture Mesh Fixation in Open Inguinal Hernia Repair

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ABSTRACT

Aim of the work: surgical sealants (adhesives) have been widely used in surgery to prevent air leaks (from holes in diseased soft tissues such as lung), liquid leaks (including hemostasis, as for oozing) and as adhesives (to bond two separate tissues, but very rarely). They have many advantages over traditional techniques (i.e., sutures and staples) such as reducing both operative time and physical load on patients. Sutures have been most extensively used for wound closure, though they have shortcomings such as the highly skilled procedures involved, the long time required for wound closure, and the postoperative removal of non-bioabsorbable Sutures.

Methods: forty male patients with primary unilateral groin hernia were randomized to undergo open hernia repair with suture fixation (**Group B**) or cyanoacrylate glue fixation of the mesh (**Group A**). Primary outcome was early and late postoperative pain. Secondary endpoints were use of painkillers after 24 hours, morbidity rate and recurrence rate.

Results: early postoperative pain and pain between 48 hours and 1 month after surgery were significantly lower in Group A. Only two patients had chronic pain and both were in Group B. Clinical recurrences were two, both in Group B.

Conclusion: cyanoacrylate seemed to be a simple, original, reasonable, feasible, reproducible technique and competitive alternative to the standard tissue-penetrating mesh fixation devices in open inguinal hernioplasty. It is accompanied by a reduction in chronic inguinal pain, with no increase in the early recurrence rate.

Keywords: inguinal hernia, hernia repair, cyanoacrylate glue, mesh fixation.

INTRODUCTION

Surgical sealants (adhesives) have been widely used in surgery to prevent air leaks (from holes in diseased soft tissues such as lung), liquid leaks (including hemostasis, as for oozing) and as adhesives (to bond two separate tissues, but very rarely). They have many advantages over traditional techniques (i.e., sutures and staples) such as reducing both operative time and physical load on patients. Sutures have been most extensively used for wound closure, though they have shortcomings such as the highly skilled procedures involved, the long time required for wound closure, and the postoperative removal of non-bioabsorbable sutures⁽¹⁾.

The surgical suture, both when realized with the traditional threads and with the most modern mechanical staplers, represents the "classic" method for wound repair. However, all surgeons sometimes have to deal with wounds hard to recover because, due to stretching and ischemic events of variable extent, complications such as hematomas, granulomata, dehiscences and fistulae may occur, impairing the tissue healing⁽²⁾. Cyanoacrylates are a class of synthetic glues that rapidly solidify on contact with weak bases, such as water and blood. Cyanoacrylate glue is a liquid

that may be mixed with lipiodol, oily contrast agent, before injection. Mixing cyanoacrylate glues with lipiodol slows the rate of solidification, it can be used in gastric varices, esophageal varices, nonvariceal hemostasis as treatment of bleeding peptic ulcers and fistulae⁽³⁾.

MATERIAL AND METHODS

This was a prospective study which was done in Department of Surgery, Sayed Galal Hospital, Al-Azhar University in the period from December 2016 to June 2017. It included 40 patients, 20 cases was used cyanoacrylate glue mesh fixation in open inguinal hernia repair and 20 cases was used suture mesh fixation in open inguinal hernia repair after approval by the medical director and the local ethical committee of the hospital.

Age : the age of patients ranged from 18 to 70 years.

Inclusion criteria

Adults with primary unilateral groin hernia suitable for elective open mesh repair were involved in this study and gave informed consent.

Exclusion criteria

Bilateral and/or recurrent hernia, femoral hernia, emergency presentation, chronic steroid

treatment, coagulation disorders, ongoing chemotherapy, connective tissue disorders and psychological or physical disorders that could affect the ability to feel and elaborate pain.

SURGICAL TECHNIQUE

Anaesthesia: operations were under spinal anaesthesia, except the patients who refused spinal anaesthesia; they were operated under general anaesthesia. Operation: all patients were operated with the same surgical technique (Ichtenstein) using a polypropylene mesh as prosthetic material. Identical surgical procedures were used for the two groups, apart from the method used to fix the mesh.

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 ilio-inguinal, ilio-hypogastric 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.

GROUP A.MESH FIXATION with CYANOACRYLATE GLUE:

Cyanoacrylate glue was applied by the use of specially syringe 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 was compressed against the inguinal floor for about 2 min.

GROUP B. MESH FIXATION with SUTURES:

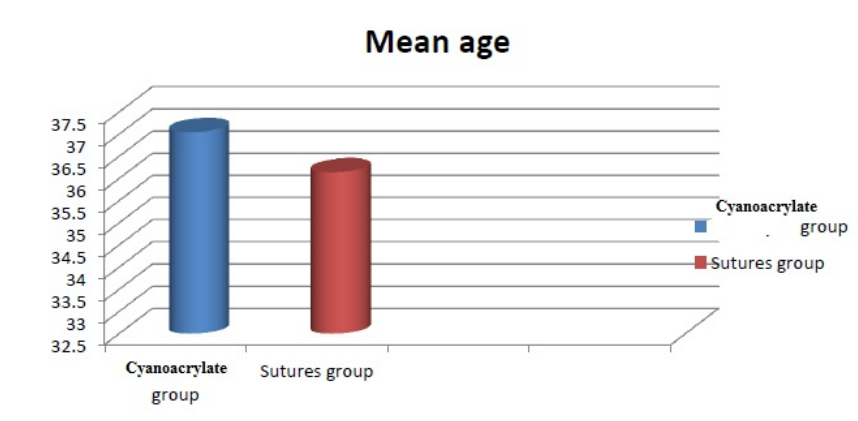
Apex of the mesh was sutured to the pubic tubercle using a No. 3–0 prolene suture. Continuous sutures were used to join the lower border of the mesh to the free edge of the inguinal ligament, after an opening was made into its lower edge to accommodate the spermatic cord. The continuous suture was extended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

RESULTS

This study was a prospective, randomized, comparative study. It was held in Department of Surgery, Sayed Galal Hospital, Al Azhar University on 40 adult males who were attendant to outpatient surgery clinic with inguinal hernia diagnosed clinically. Only males were included in this study which was carried out between December 2016 to June 2017. The 40 patients were categorized into two groups according to the to the method of mesh fixation; **group A** cyanoacrylate glue group and **group B** suture group. The results were statistically analyzed. The program used was SPSS version 20. Quantitative data were analyzed using mean and standard deviation, while qualitative data were analyzed using frequency and percentage. Chi square test (X²) and T test were used when appropriate to compare frequencies.

Table1: showing distribution of cases according to the age

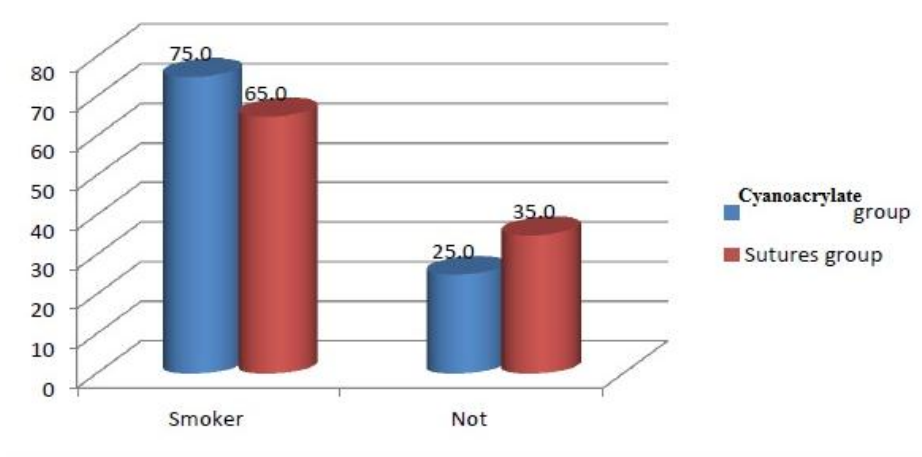
Variable	Groups	Range	Mean± SD	T test	P value
Age	Cyanoacrylate group	28-55 yrs	37.05±7.76	0.32	0.74 NS
	Sutures group	25-60 yrs	36.14±10.0		



The mean age in **group A** was 37.05 ± 7.76 (28-55) years, it was 36.14 ± 10.0 (25-60) years in **group B**. Mean age in cyanoacrylate group was higher than the other group (37.05 ± 7.76) which was statistically not significant ($p > 0.05$).

Table 2: showing distribution of cases according to smoking

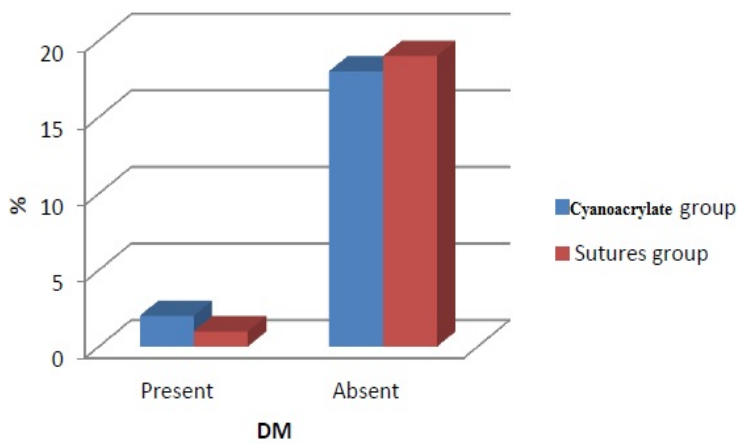
Group \ Smoking status	Cyanoacrylate group		Sutures group		Total		X2 test	P value
	No	%	No	%	No	%		
Smoker	15	75.0	13	65.0	28	70.0	0.48	0.49 NS
Not	5	25.0	7	35.0	12	30.0		
Total	20	100.0	20	100.0	40	100.0		



Smoking: 75.0% of **group A** patients and 65.0% of **group B** patients were smokers with p value > 0.05 which was statistically not significant.

Table 3: showing distribution of cases according to medical history (DM)

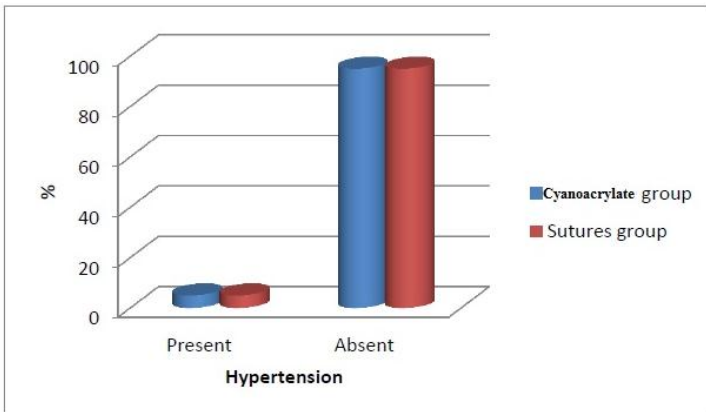
Group \ DM	Cyanoacrylate group		Sutures group		Total		X2 test	P value
	No	%	No	%	No	%		
Present	2	10.0	1	5.0	3	7.5	0.36	0.54 NS
Absent	18	90.0	19	95.0	37	92.5		
Total	20	100.0	20	100.0	40	100.0		



DM: 2 patients of **group A** (10%) were diabetic and 1 patient of **group B** (5%) were diabetic with p value > 0.05 which was statistically not significant.

Table 4: showing distribution of cases according to medical history (HTN)

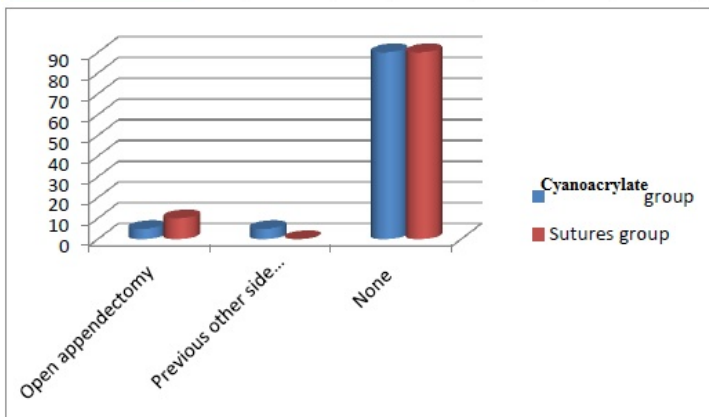
Group \ HTN	Cyanoacrylate group		Sutures group		Total		X2 test	P value
	No	%	No	%	No	%		
Present	1	5.0	1	5.0	2	5.0	0.0	1.0 NS
Absent	19	95.0	19	95.0	38	95.0		
Total	20	100.0	20	100.0	100	100.0		



HTN: 1 patients of **group A** (5.0%) were HTN and 1 patient of **group B** (5.0%) was HTN with p value > 0.05 which was statistically not significant.

Table 5: showing distribution of cases according to the history of previous surgery

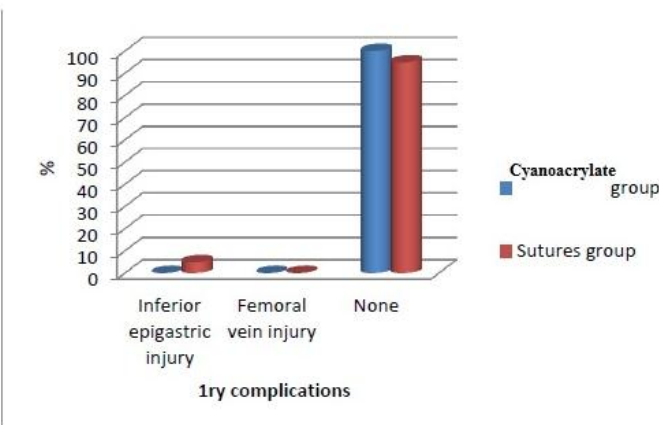
Previous surgery	Cyanoacrylate group		Sutures group		Total		X2 test	P value
	No	%	No	%	No	%		
Open appendectomy	1	5.0	2	10.0	3	7.5	1.33	0.51 NS
Previous other side surgery	1	5.0	0	0.0	1	2.5		
None	18	90.0	18	90.0	36	90.0		
Total	20	100.0	20	100.0	100	100.0		



History of previous surgery: 3 patients with history of open appendectomy and 1 in **group A**(5.0%),2 in **group B**(10.0%) and 1 patient with history of hernioplasty of the other side in **group A**(5.0%), with p value > 0.05 which was statistically not significant.

Table 6: showing distribution of cases according to primary complications

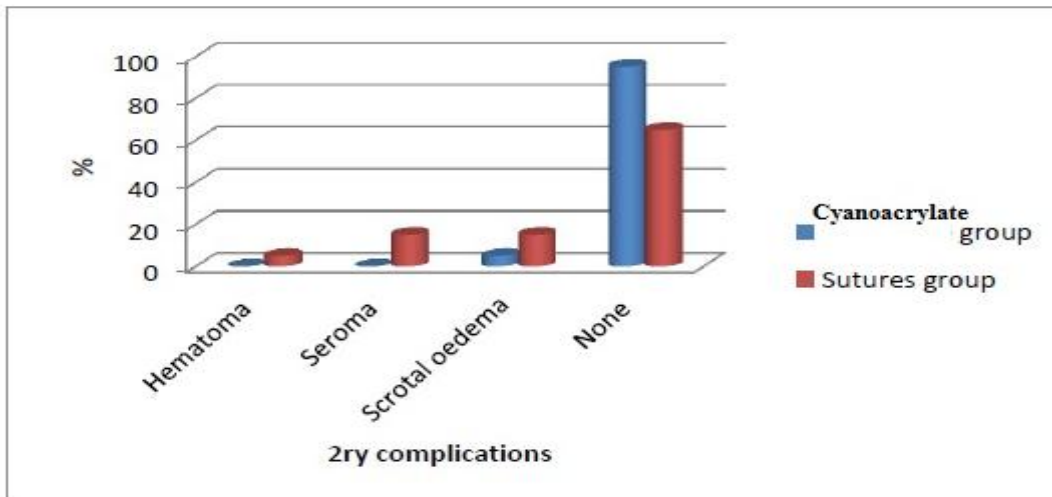
1ry complication	Group Cyanoacrylate		Sutures		Total		X2 test	P value
	group		group					
	No	%	No	%	No	%		
Inferior epigastric injury	0	0.0	1	5.0	1	2.5	0.0	1.0 NS
Femoral vein injury	0	0.0	0	0	0	0		
None	20	100.0	19	95.0	91	97.5		
Total	20	100.0	20	100.0	100	100.0		



Intra-operative (primary) complication during mesh fixation occurred in the form of: inferior epigastric injury occurred in 1 patient (in suture group). Femoral vein injury did not occur in any patients with p value >0.05 which was not statistically significant.

Table 7: showing distribution of cases according to 2ry complications

2ry complication	Group Cyanoacrylate		Sutures		Total		X2 test	P value
	group		group					
	No	%	No	%	No	%		
Hematoma	0	0.0	1	5.0	1	2.5	7.38	0.05 S
Seroma	0	0.0	3	15	3	7.5		
Scrotal edema	1	5.0	4	20	5	12.5		
None	19	95.0	12	60	31	77.5		
Total	20	100.0	20	100.0	100	100.0		

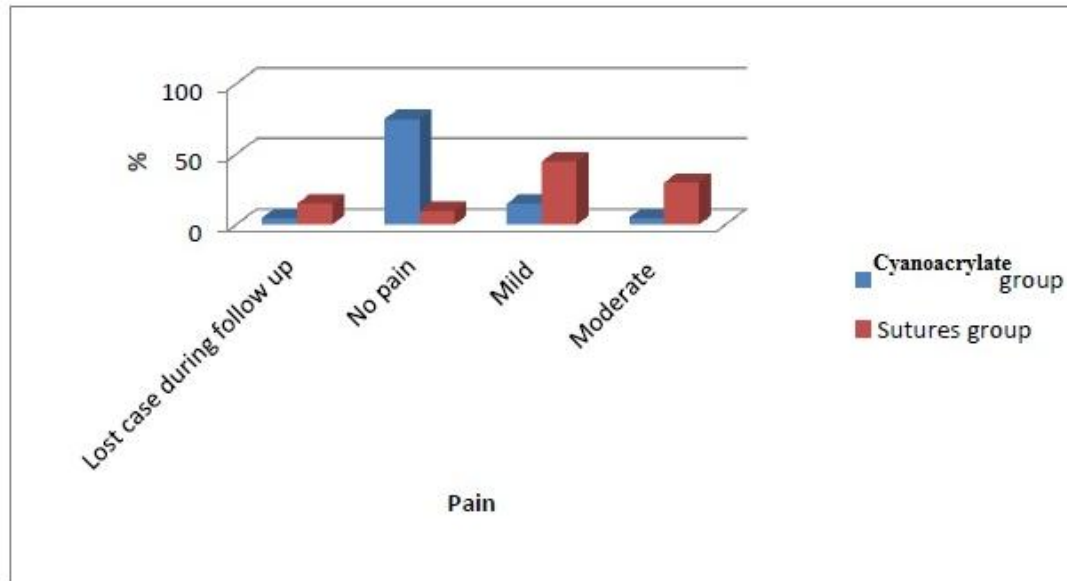


Secondary complications to surgery appeared in the first month of the follow up period: no hematoma or seroma of the surgical wound of the inguinal region was noticed in any patients of **group A**.

Only scrotal edema was detected in 1/20(5.0%) patients which remitted in a short time. In **group B** hematoma of the surgical wound occurred in 1/20(5%) patient, seroma of the surgical wound occurred in 3/20(15%) patients and scrotal edema occurred in 4/15(20.0%) patients which remitted in a short time. P value was = 0.05; it was statistically significant.

Table 8: showing distribution of cases according to degree of pain

Group \ pain	Cyanoacrylate group		Sutures group		Total		X2 test	P value
	No	%	No	%	No	%		
Lost case during follow up	1	5.0	2	10.0	3	7.5	12.19	0.002 HS
No pain	15	78.9	4	22.2	19	51.4		
Mild	3	15.8	8	44.4	11	29.7		
Moderate	1	5.3	6	33.4	7	18.9		
Total	20	100.0	20	100.0	37	100.0		



As regards pain assessment according to Cunningham's criteria, it was found that in **group A** 15/20 (75.0%) patients presented with no pain, 3/20(15.0%) patients presented with mild pain and (1/20 (5.0%) patients had a moderate pain. In **group B:** (2/20=10%) patients presented with no pain, 9/20 (45.0%) patients presented with mild pain and 6/20 (30.0%) patients had a moderate pain with p value < 0.05 which was statistically highly significant.

DISCUSSION

Nearly 800 000 patients undergo surgery for inguinal hernia repair in the United States each year, making this disease a major public health issue. Before the revolution of inguinal hernia repair by tension-free techniques about 20 years ago, traditional groin hernioplasty techniques (i.e., Bassini, McVay and Shouldice) were associated with a high rate of recurrence and a high rate of postoperative chronic pain because of the tension of the tissue. The main end-point for the evaluation of the treatment of inguinal hernia was the recurrence rate. In this respect, wall reinforcement with prosthetic mesh was clearly superior to simple herniorrhaphy. An improvement in postoperative comfort and a lower incidence of recurrence have been reported among patients repaired with tension-free techniques compared to non-mesh techniques. Chronic pain was the most important complication associated with hernia-mesh repair. In fact, post hernioplasty pain can significantly influence the patient's quality of life⁽⁴⁾. Although tension-free hernia repair is reputed for its simplicity, it may lead to neurological complications, such as neuralgia, dysesthesia or

hypoesthesia. This may be caused by nerve entrapment or direct injury (neuropathic pain) and by inflammation of the periost of the pubic bone or ischemic muscles (nociceptive pain). 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 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 for securing the prosthesis in order to reduce them⁽⁵⁾. Ghazy⁽⁶⁾ was the first to demonstrate the feasibility of a technique of hernia repair using fibrin sealant in animals with promising results.

Tissue adhesives have been proposed as an alternative to permanent fixation devices in hernia repair with the aim of reducing the post operative chronic pain. The adhesives can be divided into three main categories: biologic products (e.g., fibrin), synthetic glues (e.g., cyanoacrylate based) and genetically engineered polymer protein glues. Fibrin sealant is a two-component topical hemostat, sealant and tissue adhesive consisting of fibrinogen and thrombin that has been used in the United States as a blood bank- or laboratory-derived product since the 1980s and has been commercially available since 1998. Fibrin glue has been used extensively in all surgical disciplines as tissue adhesive material, tissue sealant, hemostatic agent, drug delivery, and in tissue engineering⁽⁷⁾.

The successful use of cyanoacrylate in the different surgical disciplines was the motive to perform such a prospective, randomized controlled study to compare the efficacy of mesh fixation by cyanoacrylate and suture during 1-day surgery of open inguinal hernia repair and all patients was re-examined using a standardized questionnaire at 1 week, 30 days, 3 months and 6 months after surgery.

In this study we found no significant difference regarding age smoking, medical history of chronic illness (DM and HTN) and history of previous surgery. When we discuss the result of primary complications or recurrence, there was no significant difference in them in our study. There was an inferior epigastric injury in one patient in the suture group with no primary complications in cyanoacrylate group, and this was compatible with results of **Amer *et al.***⁽⁸⁾ that confirms our result in both groups. In our study we found that operative time was shorter in fibrin glue group. It took about 37-43 min in cyanoacrylate group and in range of 45-50 min in the suture group, with p value=0.001 which was statistically highly significant. And this was cyanoacrylate group in comparison with 61.2 min in the suture compatible with results of **Negro *et al.***⁽⁹⁾ study.

Also we found that there was significant difference in comparison between both groups as regarding to secondary complications especially in scrotal edema which was less in cyanoacrylate group, as it happened in one patient only in cyanoacrylate group and in 4 patients in the suture group. Also hematoma and seroma occurred only in the suture group (3 patients seroma and 1 patient hematoma). With total secondary complications P value was = 0.05 which was statistically significant. This is not compatible with results of **Ladwa *et al.***⁽¹⁰⁾ study. They found that the risk of developing post-operative complications was statistically similar following cyanoacrylate fixation group compared to the suture group fixation.

According to the degree of pain we found that in the cyanoacrylate group the overall pain was less in comparison with the other group. There was no pain in 15 patients in the CAG in comparison with only 4 patients in the SG, mild pain was detected in 3 patients in CAG compared to 8 in the SG, also moderate pain occurred in 1 patient in the CAG and occurred in 6 patients in the SG with P value < 0.05 which was statistically highly significant.

The same result was realized results of **Liu *et al.***⁽¹¹⁾. In their meta-analysis they examined the use of cyanoacrylate mesh fixation versus suture mesh fixation in open inguinal hernia repair. Their study had been based on nine articles which were identified for inclusion and all the trials were considered to be of fair quality. Their results showed that there was a lower incidence of chronic pain in cyanoacrylate mesh fixation group. In results of this study it was 69 per 1000 patient in the suture group compared to 25 per 1000 patient in the cyanoacrylate group. The follow up in this study was for 12 month. This study showed that mesh fixation with cyanoacrylate was suitable for securing prosthesis in open tension-free inguinal hernioplasty.

In this study there were no complications related to such technique. In particular, no hematomas, seromas or neuralgias were observed over 6 months of follow-up interval. Moreover, the mean operating time was shorter when compared to the mean operating time of the classic Lichtenstein technique. Although the sample size was small, the results in terms of immediate and late post-operative pain were encouraging, with a reduction in both incidence and severity of the pain. In addition; surgeons reported a low level of perceived difficulty and a high level of satisfaction. The present results confirmed the efficacy of mesh fixation with cyanoacrylate and supported the viability of a sutureless Lichtenstein procedure.

There was a certain doubt about the glue and its efficacy to provide sufficient attachment of the mesh and prevention of hernia recurrence in the long term. Although follow-up was short, no recurrence has been observed in cyanoacrylate group. Some studies provided similar results⁽¹²⁻¹⁴⁾, although the follow-up period was even longer in the 1st study.

Nevertheless, pure logic makes it impossible that detachment of the glue could occur after 6 months. In addition, cyanoacrylate, which was recognized for its hemostatic and healing properties, was also found to be useful for reduction of certain local complications, such as hematomas, seromas or wound sepsis. In this study, hematomas and seromas were not common in cyanoacrylate group, but this result was not significant. Total morbidity was less common in cyanoacrylate group but it was not significant.

For this approach, to become widespread it will need further evaluation in multicenter with controlled trials for longer time.

CONCLUSION

In summary, cyanoacrylate seemed to be a simple, original, reasonable, feasible, reproducible technique and competitive alternative to the standard tissue-penetrating mesh fixation devices in open inguinal hernioplasty. It is accompanied by a reduction in chronic inguinal pain, with no increase in the early recurrence rate. We welcome larger, preferably randomized and controlled trials to confirm the results of this study in the future.

REFERENCES

- 1- **Rees C, Kenneth F and Binmoeller (2013):** Cyanoacrylate applications in the GI tract. American Society for Gastrointestinal Endoscopy , 77: 846-857.
- 2- **Canonica S (2003):** The use of human fibrin glue in the surgical operations. Acta Bio. Medica, 74(2): 21-25.
- 3- **Seewald S, Sriram PVJ, Nagra M et al.(2002):** The expert approach: cyanoacrylate glue in gastric variceal bleeding. Endoscopy,34:926-932.
- 4- **Erhan Y, Erhan E and Aydede H (2008):** Chronic pain after Lichtenstein and preperitoneal (posterior) hernia repair. Can. J. Surg., 51:383–387.
- 5- **René H Fortelny , Alexander H, Petter-Puchner H, Christopher M, Wolfgang P and Karl G (2014):** Assessment of pain and quality of life in Lichtenstein hernia repair using a new monofilament PTFE mesh: comparison of suture vs. fibrin-sealant mesh fixation. Front. Surg., 2014: 1: 45.
- 6- **Ghazy H (2010):** Open inguinal hernioplasty by Lichtenstein technique for mesh fixation with fibrin glue, Egyptian Journal of Surgery, 29:23-28.
- 7- **Paola L, Silvia B, and Dario S (2010):** Cyanoacrylate surgical glue as an alternative to suture threads for mesh fixation in hernia repair. Journal of Surgical Research, 163(2): 5-8.
- 8- **Amer O, Goran K, Mirsad H, Sefik H and Aida S (2014):** The role of fibrin glue polypropylene mesh fixation in open inguinal hernia Repair Medarh., 68.90-93.
- 9- **Negro P, Basile F, Brescia A and Buonanno GM(2011):** Open tension-free Lichtenstein repair of inguinal hernia: use of fibrin glue versus sutures for mesh fixation. Hernia, 15:7–14.
- 10- **Ladwa N, Kalra L, McFall M, Baig MK and Sains P (2013):** A meta-analysis examining the use of tacker mesh fixation versus glue mesh fixation in laparoscopic inguinal hernia repair. Am. J. of Surg., 206: 103-111.
- 11- **Liu H, Zheng X, Gu Y and Guo S(2015):** A meta-analysis examining the use of fibrin glue mesh fixation versus suture mesh fixation in open inguinal hernia repair. Dig. Surg., 31(6):444-451.
- 12- **Morales-Conde S and Barranco A (2011):** Systematic review of the use of fibrin sealant in abdominal-wall repair surgery. Hernia, 15:361–369.
- 13- **Negro P, Basile F, Brescia A, and Buonanno GM (2011):** Open tension-free Lichtenstein repair of inguinal hernia: use of fibrin glue versus sutures for mesh fixation. Hernia, 15:7–14.
- 14- **Helbling C and Schlumpf R (2003):** Sutureless Lichtenstein: first results of a prospective randomized clinical trial. Hernia, 7:80–84.