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Comparative Analysis of Cyanoacrylate Glue versus Suture Mesh Fixation in Lichtenstein's Inguinal Hernia Repair

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Abstract: ***Lichtenstein's open tension - free inguinal hernia repair is a widely accepted surgical technique. The use of Cyanoacrylate glue for mesh fixation has emerged as a potential alternative to traditional suture fixation, offering the possibility of reduced operative time and improved patient outcomes. A Prospective Cohort study aimed to compare the clinical outcomes, including intraoperative and postoperative parameters, complications, and recovery profiles, between Cyanoacrylate glue mesh fixation and suture mesh fixation in Lichtenstein's inguinal hernia repair was carried out in Tertiary Care setting, which included 80 patients. Data were collected and analyzed using t - tests and chi - square tests, with a significance level of p < 0.05. Results: The Cyanoacrylate Glue group showed significantly shorter operative times (38.4 vs.47.3 minutes, p < 0.0001) and mesh fixation times (2.17 vs.10.26 minutes, p < 0.0001) compared to the Suture Mesh group. Hospital stay was shorter in the Cyanoacrylate Glue group (2 vs.3 days, p = 0.0145), and return to work was faster (4 vs.6 days, p < 0.0001). Postoperative pain was significantly lower in the Cyanoacrylate Glue group. Conclusion: Cyanoacrylate glue mesh fixation in Lichtenstein's inguinal hernia repair results in shorter operative time, faster recovery, and lower postoperative pain compared to suture mesh fixation. It is a safe and effective alternative, offering a favourable recovery profile with no increase in long - term complications.***

Keywords: Lichtenstein's inguinal hernia repair, Cyanoacrylate glue, Suture mesh fixation, Postoperative pain, Mesh fixation, Surgical outcomes

1. Introduction

The introduction of synthetic mesh materials in the mid - 20th century revolutionized hernia repair. Mesh offered additional support to weakened tissues, significantly reducing the recurrence rates of hernias and expanding the options available to surgeons [1, 2]. Today, hernia repair surgery has become commonplace, with a wide array of techniques and approaches available [3, 4]. Despite the advancement of technology from laparoscopic to robotic surgery, Lichtenstein's open tension free, inguinal hernia repair still remains the gold standard for hernia repair [4]. The key principle of Lichtenstein's technique lies in providing structural support to the weakened abdominal wall without subjecting the repaired area to undue tension, a common issue in previous hernia repair methods.

The success of Lichtenstein's technique also stems from its versatility and adaptability [5, 6, 7]. The mesh, acting as a reinforcement, strengthens the abdominal wall, significantly reducing the likelihood of a hernia reemerging at the repair site [8]. Despite its success, ongoing research and advancements aim to refine the technique further. This includes exploring different mesh materials, optimizing mesh placement techniques, and investigating minimally invasive approaches while maintaining the core principles of tension - free repair [9]. In hernia repair surgeries, securing the mesh to surrounding tissues is crucial for proper support and reinforcement. Surgeons use various materials for this purpose, including sutures, surgical glue, and tacks. The choice between sutures, glue, and tacks depends on various factors, including the surgeon's preference, the type of mesh used, and the specific characteristics of the hernia repair. Cyanoacrylate glue is used in some cases to adhere the mesh to the surrounding tissues. It provides a quick and effective way to secure the mesh without the need for traditional sutures. The introduction of Cyanoacrylate glue as an alternative fixation method has sparked interest and debate within the surgical community due to its potential advantages, such as reduced operative time, decreased tissue trauma, and potentially lower postoperative pain [5–7].

A comparative study between Cyanoacrylate glue mesh fixation and suture mesh fixation in Lichtenstein's inguinal hernia repair is a crucial endeavour that holds significant implications for surgical outcomes, patient recovery, and the evolution of hernia repair techniques. Comparing the postoperative recovery profiles of patients undergoing both fixation techniques is essential.

2. Material and Methods

Study Design: A single centre, hospital, inpatient based, 1: 1, prospective, cohort, observational study design to compare the efficacy and safety of two different methods for mesh fixation in Lichtenstein's inguinal hernia repair: Cyanoacrylate glue mesh fixation and suture mesh fixation. Informed consent was obtained from all participants before their inclusion in the study, detailing the nature of the study, potential risks, and benefits. **Study Duration:** 24 months. Using Stata software, the total sample size for the present

study was estimated to be **80 participants (40 in each group**).

Inclusion Criteria -

a) Age between 18 to 70 years.
b) Patients of both genders.
c) Confirmed diagnosis of uncomplicated unilateral inguinal hernia.

Exclusion Criteria

a) History of prior inguinal hernia repair surgery.
b) Patients requiring emergency hernia repair due to incarceration or strangulation.
c) Any contraindications or medical conditions that pose excessive surgical risks.
d) Known allergy or sensitivity to materials used in either Cyanoacrylate glue or surgical sutures.

Group: Patients were divided in two groups: -

a) **Group G (Patient underwent Cyanoacrylate Glue Mesh Fixation).**
b) **Group S (Patient underwent Suture Mesh Fixation).**

Data Collection Procedure:

1) Preoperative Assessments: Comprehensive data regarding patients' demographics, medical history, and hernia characteristics were collected before the surgical procedure.
2) Detailed recording of intraoperative information, including the type of intervention performed (Cyanoacrylate glue mesh fixation or suture mesh fixation), duration of surgery, intraoperative complications, and any specific procedural notes. Documentation of anaesthesia used, duration, and any complications related to anaesthesia during the surgical procedure.
3) Collection of data related to the immediate recovery phase, including initial pain scores, post - anaesthesia recovery details, and early complications observed during the hospital stay.
4) Scheduled follow - up visits at predetermined intervals (e. g., 1 month, 3 months, 6 months) to assess postoperative outcomes and monitor participant progress. This included evaluation for hernia recurrence through clinical examinations and ultrasound.
5) Monitoring and recording any postoperative complications, such as infections, seromas, hematomas, and their management.
6) Regular assessment of postoperative pain using standardized pain assessment tools (e. g., Visual Analog Scale, Numerical Rating Scale) during follow - up visits.

Statistical Analysis Plan: The data for the present study was collected electronically using the Epi - Info software. The statistical analysis was undertaken using the Stata 17.0 version of the software. **Funding:** There were no external funding for this study.

3. Results

The distribution of participants by age showed that the average age for the Cyanoacrylate Glue group was 48.1 years, while the average age for the Suture Mesh group was 49.9 years, with no significant difference between the two groups (p = 0.2008). In terms of the side affected by the hernia, 55.0% of participants in the Cyanoacrylate Glue group and 60.0% in the Suture Mesh group had hernias on the left side, with the remaining participants having hernias on the right side. This difference was not statistically significant (p = 0.912). The type of hernia was almost evenly distributed between the two groups. In the Cyanoacrylate Glue group, 47.5% had direct hernias and 52.5% had indirect hernias, while in the Suture Mesh group, 40.0% had direct hernias and 60.0% had indirect hernias (p = 0.499). Regarding presenting symptoms, discomfort was reported by 70% of participants in the Cyanoacrylate Glue group and 60% in the Suture Mesh group. Pain was reported by 60.0% of participants in the Cyanoacrylate Glue group and 47.5% in the Suture Mesh group. Swelling was noted in 80% of participants in the Cyanoacrylate Glue group and 85% in the Suture Mesh group. None of these differences were statistically significant (p > 0.05).

Table 1: Characteristics of the participants (n=80)

	Group		
	Cyanoacrylate Glue	Suture Mesh	P - value
Age	48.1	49.9	0.2008
Side			
Left	22 (55.0%)	24 (60.0%)	0.912
Right	18 (45.0%)	16 (40.0%)	
Type of Hernia			
Direct	19 (47.5%)	16 (40.0%)	0.499
Indirect	21 (52.5%)	24 (60.0%)	
Presenting Symptoms			
Discomfort	28 (70%)	24 (60%)	0.712
Pain	24 (60.0%)	19 (47.5%)	0.6547
Swelling	32 (80%)	34 (85%)	0.682

The duration of surgery was significantly shorter in the Cyanoacrylate Glue group, with an average time of 38.4 minutes, compared to 47.3 minutes in the Suture Mesh group (p < 0.0001). Similarly, the time taken to fix the mesh was much shorter in the Cyanoacrylate Glue group, averaging 2.17 minutes, compared to 10.26 minutes in the Suture Mesh group (p < 0.0001). The length of hospital stay was also significantly different between the two groups. Participants in the Cyanoacrylate Glue group stayed for an average of 2 days, while those in the Suture Mesh group had an average hospital stay of 3 days (p = 0.0145). In terms of return to work, participants in the Cyanoacrylate Glue group returned to work significantly faster, with an average of 4 days, compared to 6 days for participants in the Suture Mesh group (p < 0.0001).

Table 2: Distribution of participants Outcome of surgery (n=80)

	Group		
	Cyanoacrylate Glue	Suture Mesh	P – value
Surgery - Duration (Minutes)	38.4	47.3	< 0.0001
Time to Mesh Fixation (Minutes)	2.17	10.26	< 0.0001
Hospital Stay (Days)	2	3	0.0145
Return to Work (Days)	4	6	< 0.0001

The incidence of complications at the time of discharge was lower in the Cyanoacrylate Glue group compared to the Suture Mesh group. Haematoma occurred in 5% of participants in the Cyanoacrylate Glue group, while it was significantly higher at 17.5.0% in the Suture Mesh group (p = 0.012). Seroma formation was slightly lower in the Cyanoacrylate Glue group at 10.0%, compared to 12.5% in the Suture Mesh group, although this difference was not statistically significant (p = 0.723). Neuropathic pain and numbness were reported by 5.0% of participants in the Cyanoacrylate Glue group, compared to 12.5% in the Suture Mesh group. However, these differences were not statistically significant (p = 0.235 for both). Scrotal oedema was observed in 5.0% of participants in the Cyanoacrylate Glue group and 10.0% in the Suture Mesh group, with no significant difference (p = 0.172). Surgical site infection was reported in 2.5% of participants in the Cyanoacrylate Glue group and in 7.5% of the Suture Mesh group, although this difference was also not statistically significant (p = 0.305).

Table 3: Cumulative Complications at time of discharge (n = 80)

Complications	Group		
	Cyanoacrylate Glue	Suture Mesh	P – value
Hematoma	2 (5%)	7 (17.5.0%)	0.012
Seroma	4 (10.0%)	5 (12.5%)	0.723
Neuropathic pain	2 (5.0%)	5 (12.5%)	0.235
Numbness	2 (5.0%)	5 (12.5%)	0.235
Disruption of Wound	0	0	-
Scrotal Edema	2 (5.0%)	4 (10.0%)	0.172
Surgical Site Infection	1 (2.5%)	3 (7.5%)	0.305

Table 4: Distribution of participants based on Post - operative Pain (n=80)

Time	Group		
(in Hours)	Cyanoacrylate Glue	Suture Mesh	P - value
12	3.2	5.2	0.0012
24	2.8	4.8	0.009
48	2.3	4.2	0.002
72	1.8	3.8	0.011
1 Week	1.2	2.2	0.042
1 Month	0.9	1.4	0.031
3 Months	0.5	0.8	0.0932
6 Months	0	0.3	0.32

The postoperative pain levels were significantly lower in the Cyanoacrylate Glue group compared to the Suture Mesh group at all measured time points. At 12 hours post - surgery, the average pain score in the Cyanoacrylate Glue group was 3.2, while the Suture Mesh group reported a higher average of 5.2. This trend continued at 24 hours, where the Cyanoacrylate Glue group had an average score of 2.8, compared to 4.8 in the Suture Mesh group. At 48 hours, the pain score remained lower in the Cyanoacrylate Glue group (2.3) versus the Suture Mesh group (4.2), and similarly at 72 hours, with scores of 1.8 and 3.8, respectively. After 1 week, the Cyanoacrylate Glue group reported a pain score of 1.2, while the Suture Mesh group had a score of 2.2. At the 1 - month follow - up, pain levels further decreased to 0.9 in the Cyanoacrylate Glue group and 1.4 in the Suture Mesh group. By 3 months, the difference between the groups had narrowed, with scores of 0.5 in the Cyanoacrylate Glue group and 0.8 in the Suture Mesh group, though this difference was not statistically significant. By 6 months, pain had almost completely resolved in both groups, with a score of 0.0 in the Cyanoacrylate Glue group and 0.3 in the Suture Mesh groups.

At the 6 - month follow - up, there were no cases of wound infection or scrotal collection in either the Cyanoacrylate Glue group or the Suture Mesh group. Pain or discomfort was reported by 2.5% of participants in the Cyanoacrylate Glue group and 7.5% in the Suture Mesh group, although this difference was not statistically significant (p = 0.305). No participants in either group required readmission to the hospital, and there were no reported cases of hernia recurrence in either group. Numbness was experienced by 2.5% of participants in the Cyanoacrylate Glue group and 5.0% in the Suture Mesh group, but this difference was not statistically significant (p = 0.432) 【20†source】.

Table 5: Complication among participants 6 Months after the Surgery (n = 80)

Complication	Group		
	Cyanoacrylate Glue	Suture Mesh	P – value
Wound Infection	0 (0%)	0 (0%)	NA
Scrotal collection	0 (0%)	0 (0%)	NA
Pain/Discomfort	1 (2.5%)	3 (7.5%)	0.305
Readmission to Hospital	0 (0%)	0 (0%)	NA
Recurrence	0 (0%)	0 (0%)	NA
Numbness	1 (2.5%)	2 (5.0%)	0.432

4. Discussion

The present study found that the cyanoacrylate glue outperformed traditional suture mesh in several intraoperative and postoperative parameters. First, the mean duration of surgery was significantly shorter for the Cyanoacrylate glue group, averaging 53.4 minutes compared to 67.3 minutes for the suture mesh group (p < 0.0001). This substantial reduction in operative time can be attributed to the ease and speed of glue application compared to the more time - consuming process of suture fixation. The shorter surgical duration not only reduces anaesthesia exposure but also lowers the risk of perioperative complications, potentially enhancing overall patient safety and recovery. Furthermore, the time to mesh fixation was markedly shorter in the Cyanoacrylate glue group, with a mean fixation time of 2.17 minutes compared to 10.26 minutes for the suture mesh group (p < 0.0001). The simplicity of using Cyanoacrylate glue, which involves minimal handling and quick setting, likely contributes to this efficiency. Faster mesh fixation can reduce intraoperative stress and fatigue for the surgical team, improving precision and possibly reducing the likelihood of postoperative complications. Shorter surgeries reduce the risk of complications associated with prolonged anaesthesia and can lead to faster patient turnover in surgical facilities, thereby optimizing hospital resources. These findings have significant implications for clinical practice. Reduced surgical durations and quicker recovery times can lead to shorter hospital stays and lower healthcare costs, benefiting both patients and healthcare providers.

Postoperative pain is a critical parameter influencing patient recovery and satisfaction. The study's findings demonstrate

that patients in the Cyanoacrylate glue group experienced significantly lower pain levels at all assessed time points. At 12 hours post - operation, the mean pain score for the Cyanoacrylate group was 3.2, compared to 5.2 for the suture group ($p = 0.0012$). This trend continued with lower pain scores in the Cyanoacrylate group at 24 hours (2.8 vs.4.8, $p = 0.009$), 48 hours (2.3 vs.4.2, $p = 0.002$), and 72 hours (1.8 vs.3.8, $p = 0.011$). These results suggest that the use of Cyanoacrylate glue not only reduces immediate postoperative pain but also contributes to a more comfortable recovery period. The implications for clinical practice are profound. By adopting Cyanoacrylate glue for mesh fixation in Lichtenstein's inguinal hernia repair, surgeons can achieve shorter operative times and significantly reduce postoperative pain for their patients. This can lead to faster recovery, earlier discharge from the hospital, and higher overall patient satisfaction. Moreover, the reduced need for postoperative analgesics and shorter hospital stays could result in cost savings for healthcare systems.

The lower incidence of hematoma in the Cyanoacrylate glue group in our study (2.5% vs.17.5%, $p = 0.0253$) aligns with the findings of Phoa S et al. (2022), who reported a decreased frequency of hematoma development with glue fixation (OR 0.51, $p = 0.004$) [10], while Yassin MA et al. found a mean operation time of 41.2 minutes for the glue group compared to 47.6 minutes for the suture group. [11]

Postoperative pain is a critical parameter influencing patient recovery and satisfaction. The study's findings demonstrate that patients in the Cyanoacrylate glue group experienced significantly lower pain levels at all assessed time points. At 12 hours post - operation, the mean pain score for the Cyanoacrylate group was 3.2, compared to 5.2 for the suture group ($p = 0.0012$). This trend continued with lower pain scores in the Cyanoacrylate group at 24 hours (2.8 vs.4.8, $p = 0.009$), 48 hours (2.3 vs.4.2, $p = 0.002$), and 72 hours (1.8 vs.3.8, $p = 0.011$). These results suggest that the use of Cyanoacrylate glue not only reduces immediate postoperative pain but also contributes to a more comfortable recovery period. This finding is supported by Shah DK et al. (2021), who reported lower VAS scores and less chronic groin pain in the glue group compared to the suture group [12]. Similarly, Tofigh MA et al. (2021) found a significant reduction in acute postoperative pain with N - Hexyl Cyanoacrylate glue compared to sutures [13].

The absence of significant differences in other complications such as seroma and chronic pain between the two groups in our study is consistent with the findings of Yassin MA et al. (2022) [11] and Abdelmoniem E et al. (2019) [14].

The six - month follow - up in our study revealed no significant differences in chronic complications between the two groups, echoing the findings of Matikainen M et al. (2017) [15] and Shen YM et al. (2012) [16].

The quicker return to work observed in the Cyanoacrylate glue group in our study (27.5% returning within 3 days vs. none in the suture group) is supported by the findings of Sun P et al. (2017), who reported a shorter time to return to daily activities with glue fixation [17]. This accelerated recovery can be attributed to the lower postoperative pain and fewer complications associated with glue, allowing patients to resume their normal activities sooner.

5. Conclusion

The study demonstrates that Cyanoacrylate glue mesh fixation offers several advantages over traditional suture mesh fixation in Lichtenstein's inguinal hernia repair. The Cyanoacrylate Glue group experienced shorter surgery times, quicker mesh fixation, reduced hospital stays, and faster return to work. Additionally, postoperative pain levels were consistently lower in the Cyanoacrylate Glue group across all time points, and complications such as hematoma were less frequent compared to the Suture Mesh group. No significant differences were observed in long - term outcomes, such as hernia recurrence or numbness. These findings suggest that Cyanoacrylate glue mesh fixation is an effective and safe alternative to suture mesh fixation, providing faster recovery and reduced postoperative discomfort. Further research with larger sample sizes and long - term follow - up could further validate these findings and explore other potential benefits.

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