ORIGINAL ARTICLE

A Prospective Randomized Study to Evaluate if Cyanoacrylate Glue is Superior over Traditional Suturing in Laparoscopic Port Site Skin Closure

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Abstract

Background: This study was undertaken to evaluate if the cyanoacrylate glue was superior to conventional suturing for skin closure of the laparoscopic port site.

Materials and methods: A prospective randomized trial was performed on patients scheduled for elective laparoscopic surgery at the department of general surgery at a tertiary care hospital. Patients were followed up to evaluate postoperative pain using the visual analog scale (VAS). The time required for closing the wound, postoperative pain at the wound site, rate of surgical site infection (SSI), and the period for which the patients stayed in the hospital were studied.

Results: A total of 70 patients were enrolled and divided into two groups. In group I (the study group) incisions were closed by applying *N*-Butyl-2-Cyanoacrylate glue and in group II (the control group) incisions were closed by conventional suturing method using Ethilon 2.0 RC. Statistically significant difference was found between the average time required for the closure of a single port site ($p < 0.0001$), surgical site infection ($p < 0.021$), and the average number of days the patient stayed in the hospital. It was less in the group I as compared with that of group II. There was no significant difference between the two groups for postoperative pain assessment.

Conclusion: The use of *N*-Butyl-2-Cyanoacrylate at laparoscopic port site skin closure was beneficial as it took comparatively less time for laparoscopic port skin closure and had less rate of surgical site infection at the wound site.

Keywords: Adhesive glues, Laparoscopic port site skin closure, Southampton scoring system, Surgical site infection, Visual analog scale.

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Introduction

Scar formation is an unavoidable result of wound healing after a traumatic or surgical intervention. The aesthetic look of a scar is the most crucial factor in evaluating the surgical outcome. The most common technique for wound closure continues to be sutures, which have been used for generations. Other new techniques such as the use of tapes, staples, and adhesive tapes have been developed over time.[1] To know which method will produce the best results, it is helpful to research and contrast new techniques, such as cyanoacrylate glue with conventional suture materials. The best technique for closing an incision must be simple, risk-free, fast, quick, inexpensive, painless, and bactericidal. It should also result in the best cosmetic appearance of the scar, less postoperative pain, less wound infection, and a shorter stay in the hospital.

Although cyanoacrylates, a liquid monomer that forms a strong bond between two wound edges when it comes into contact with it, were discovered in 1949, their practical use in the closure of surgical wounds was not documented until the next 10 years.

Cyanoacrylate glue can be used as tissue adhesive as they are easy to apply and takes less time to close, offering a hurdle to microorganisms at the healing location so it has less rate of wound infections, and the best cosmesis is achieved as compared to sutures.[2] As we can see in a conventional suturing technique, the source of infection is the puncture wounds created by the needle.[3] This is avoided in adhesive glue, decreasing the rate of surgical site infection using cyanoacrylate glue for skin closer, but in the use of cyanoacrylate glue, the dead space should be eliminated, and complete hemostasis is required to achieve a better result.

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One of the earliest instruments for assessing pain was the visual analog scale (VAS), which Hayes and Patterson used in 1921.[4] It is widely employed in clinical and epidemiologic studies to evaluate the frequency or severity of certain symptoms.

For instance, a patient may experience very little discomfort or very significant pain.

The most common way to show it is as a 100-mm horizontal line with a point in the middle that represents the patient's pain threshold between "no pain at all" and "worst pain imaginable."[5]

The VAS's validity, reliability, and simplicity make it the best instrument for describing the degree or intensity of pain.

One of the most often used wound rating systems is the Southampton wound grading system. It allows surgical wound healing to be assessed based on particular criteria and assigned

a numerical value, providing a more objective assessment of wounds.[6] minimally invasive surgeries have grown over the past decades this is due to less painful operations, quicker postoperative recovery, and fewer hospital stays. Traditionally laparoscopic port site skin was closed by Ethilon 2.0 RC.

This study's main goal was to assess the effectiveness of cyanoacrylate glue vs Ethilon 2.0 RC in terms of the average amount of time needed to close a wound, postoperative pain at the wound site, and surgical site infection.

Materials and Methods

A single-center prospective randomized trial was designed to compare the closure of laparoscopic port site incisions using cyanoacrylate glue vs Ethilon RC.

This study was approved by the institutional ethics committee. A signed informed permission form was required before the patients could be included in the trial. The study included all patients who underwent elective laparoscopic surgery in a tertiary care hospital's department of general surgery between November 2020 and November 2022.

Exclusion criteria included the patients who were immunocompromised, had collagen diseases and had a history of keloid formation and hypertrophic scars. The same group of surgeons with substantial laparoscopic experience performed all procedures. Consenting patients were randomized into two groups by chit-picking to eliminate the bias (Fig. 1A). All the surgical interventions were performed by the same set of surgeons. Demographic details, the average time required for closure of single port site incision, postoperative pain at the wound site using the VAS, and rate of surgical site infection according to the Southampton scoring system were analyzed.

Analytical Statistics

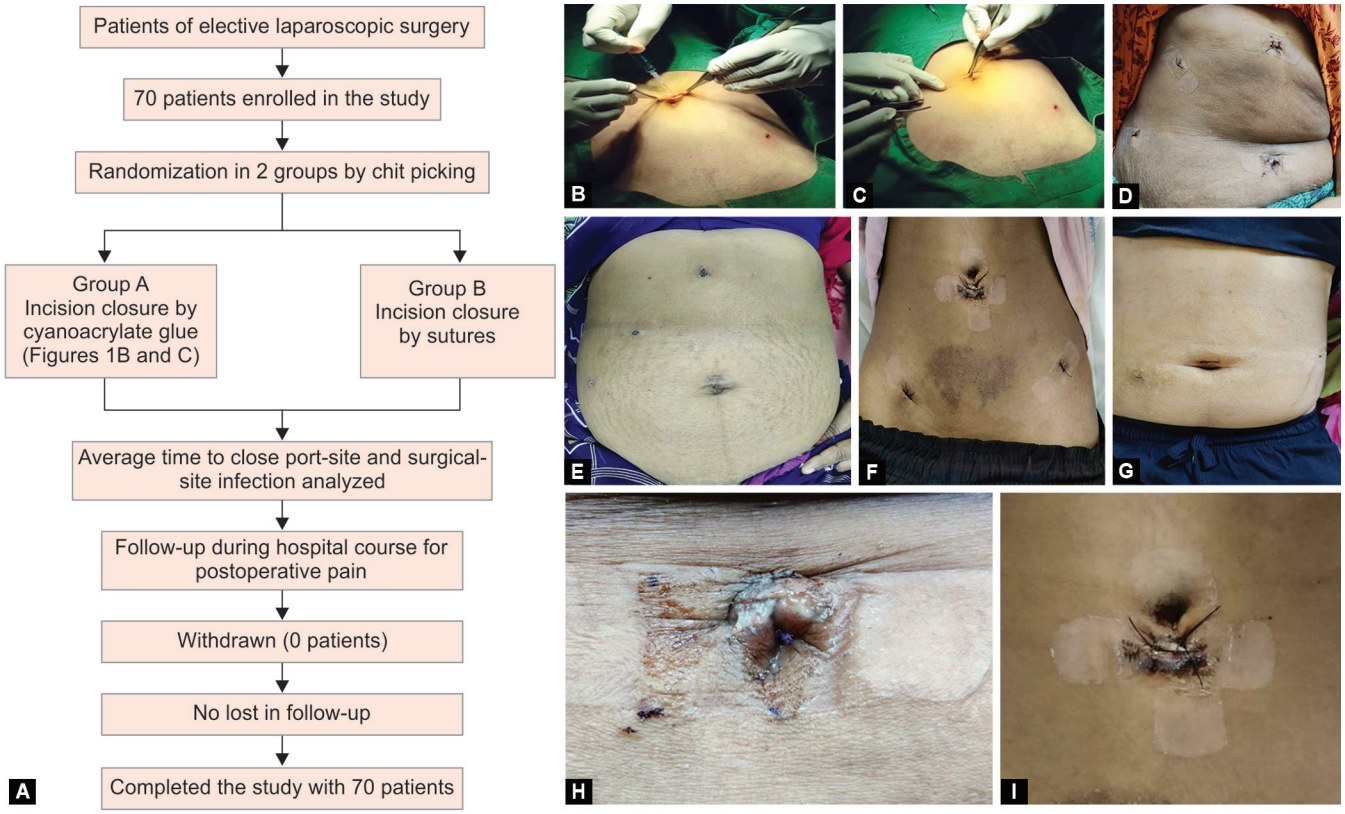
A statistical tool for the social sciences (version 20.0) was used to undertake statistical analysis after the collected data was entered into a Microsoft Excel sheet.

The Independent *t*-test was used to compare continuously distributed data with a normal distribution between the two groups. The Mann–Whitney *U* test was employed for variables that were not regularly distributed. To compare categorical variables between the two groups, the Mann–Whitney test was employed. Statistics were deemed significant when $p < 0.05$. Every statistical test that was run was two-tailed.

Results

The study involved the enrolment of 70 patients, of whom 35 were randomly assigned to group I (closure by cyanoacrylate glue) and 35 to group II (closure by sutures).

Analysis was performed on all the enrolled subjects and there were no dropouts. None of the patients enrolled in the study had



Figs 1A to I: (A) Study outlines and milestones; (B) Application of *N*-Butyl-2-Cyanoacrylate Glue; (C) Skin holding with forceps after application of *N*-Butyl-2-Cyanoacrylate glue; (D) Postoperative day 3 laparoscopic cholecystectomy port site skin closure by suture; (E) Postoperative day 3 laparoscopic cholecystectomy port site skin closure by *N*-Butyl-2-Cyanoacrylate glue; (F) Postoperative day 3 laparoscopic appendicectomy port site skin closure by suture; (G) Postoperative day 3 of laparoscopic mesh hernioplasty (TAPP) port site skin closure by *N*-Butyl-2-Cyanoacrylate glue; (H) Grade-IV surgical site infection on POD 3 in laparoscopic cholecystectomy port site skin closure by suture; (I) Grade-II surgical site infection on POD 3 in laparoscopic appendicectomy port site skin closure by suture

any comorbid condition. The demographic details are as given in Table 1.

In both groups of the current investigation, there were male and female patients. Both the study group and the control group included the same number of men and women. Ages ranged from 10 to over 60 in both groups. The patients from the 30- to 39-year-old age group were found to be the majority in both groups. The demographic information of the patients enrolled in the two groups did not significantly differ from one another.

The diagnosis of the patients was based on blood investigations, ultrasonography, and endoscopic findings. The maximum number of patients were diagnosed with cholelithiasis (39) followed by acute appendicitis (18), recurrent appendicitis (7), left indirect inguinal hernia (2), hiatus hernia (2) and achalasia cardia type 3 (2). The maximum number of patients underwent laparoscopic cholecystectomy (39) (Figs 1D and E), followed by laparoscopic appendicectomy (25) (Fig. 1F), laparoscopic modified hellers cardiomyotomy (1), laparoscopic Toupet fundoplication anterior cardiomyotomy (1), laparoscopic Toupet fundoplication posterior cardiomyotomy (1), laparoscopic Nissen fundoplication (1), and laparoscopic mesh hernioplasty [transabdominal preperitoneal (TAPP)] (2) (Fig. 1G).

It was noted how long it typically took to close a single port location. It was discovered that the control group needed 17.80 seconds on average to close a single port site, while the study group needed 7.94 seconds on average. After running the Mann–Whitney *U* test, a *p*-value of 0.0001 was found. A statistically significant variation was seen in the mean duration needed for the shutdown of a single port location. Visual analog scale was used to measure postoperative pain after six hours as well as on days 1, 2, and 3 of the procedure in both the study group and the control group. The results were not statistically significant.

An analysis was conducted on the mean duration of hospitalization for the patient. It was discovered that the research group's average patient stay was 4.89 days, whereas the control group's average stay was 5.46 days. The average number of days spent in the hospital did not differ significantly between the two groups. The Southampton scoring system was also used to evaluate surgical site infections (SSIs). A study was conducted to determine the rate of surgical site infection using the Southampton scoring system. The study group did not have any instances, while the control group had five cases (Figs 1H and I) which is significant ($p = 0.021$). Among the five cases found, three were of acute appendicitis and two were cholelithiasis which was significant; it is shown in Table 2.

Table 1: Demographic details of the patients enrolled in the study

	Study group	*Control group*	*Mann–Whitney U test*	*p-value**
Mean age	32.34	37.57	513.000	0.242
Gender				
Male	13	13	–	–
Female	22	22		

*Significant when $p < 0.05$

Discussion

Techniques for suturing can be meticulous and time consuming. Early removal of sutures can cause dehiscence, which can lead to an increase in the need for a dressing to cover the wound and a suture. Tissue glue was created as a result of these disadvantages. Methyl-2-cyanoacrylate and ethyl-2-cyanoacrylate, are two hazardous forms of cyanoacrylate that are employed for adhesion in nonmedical applications. Currently, the optimal nontoxic.

Version for medical application is the longer chain *N*-Butyl-2 Cyanoacrylate and 2-octyl-cyanoacrylate.[7] Applications of cyanoacrylate in various surgical situations and the enclosure of laparoscopic port site closure operations have grown in popularity in recent years.[8] Compared to traditional sutures, cyanoacrylates have a number of useful advantages. The main advantage is how simple and convenient their application is, which leads to quicker wound healing.

Sterility is preserved because cyanoacrylates provide an antibacterial barrier around the incision, negating the need for topical antibiotics.[9] In addition, they make a waterproof bandage that allows the patient to take a shower sooner following surgery. The ease of not needing postoperative suture removal is another benefit for the patients.

This study is a comparative study that assessed if cyanoacrylate glue application is superior over conventional suturing for the incision closure of the laparoscopic port site. Endobags were used in Laparoscopic cholecystectomy and laparoscopic appendicectomy surgery to reduce the specimen contact with port site skin. While performing the procedures, the appendix specimen was removed from the telescopic 10 mm port, and GB was removed from the epigastric 10-mm port. In our study, the maximum number of patients underwent Laparoscopic cholecystectomy followed by laparoscopic appendicectomy, laparoscopic modified heller's cardiomyotomy, laparoscopic Toupet fundoplication anterior cardiomyotomy, laparoscopic Toupet fundoplication posterior cardiomyotomy, laparoscopic mesh hernioplasty, and laparoscopic Nissen fundoplication. In a study conducted by Tapsi Sharma et al.[10] All patients enrolled were for elective laparoscopic cholecystectomy. In a similar study by Maniar N et al.[11] most

Table 2: Average time to close the port site, postoperative pain, SSI score, and hospital stay

	Mean value						
Groups	*Average time to close port site in seconds*	*PO pain 6 hours*	*POD 1*	*POD 2*	*POD 3*	*Hospital stay (Number of days)*	*SSI score*
Study group	7.94	9.00	6.37	3.03	0.57	4.89	0.00
Control group	17.80	9.17	6.40	3.49	0.91	5.46	0.40
Mann–Whitney *U* test value	0	562.500	595.000	517.500	524.500	475.000	525.000
p-value	0.0001*	0.527	0.832	0.247	0.200	0.098	0.021*

*Statistically significant. PO pain, Postoperative pain; POD, Postoperative day

commonly performed surgery was laparoscopic cholecystectomy. It was discovered that the control group needed 17.80 seconds on average to close a single port site, while the study group needed 7.94 seconds on average. A statistically significant variation was seen in the mean duration needed to close a single port site. When comparing the study group that employed cyanoacrylate glue to the control group that used the traditional suturing approach, there was a decrease. Studies by Michael J Sebesta and Jay T Bishoff[12] and Tapsi Sharma et al.[10] also produced findings that were comparable.

One of the earliest studies which was conducted by Quinn J et al.[13] in 1997 also reported similar results. In a Cochrane review done by Dumville JC et al.[14] it was found that sutures were significantly faster to use when compared to glue. Additionally, working in the surgical sector with fewer tools, sutures, and needles is undoubtedly simpler, safer, and more practical. Also, the possibility of a needle stick injury need not be a concern. The average score of 9 was obtained in the study group and 9.17 in the control group after a 6-hour postoperative pain assessment done using VAS.

There was no discernible statistically significant variation in the postoperative pain assessment conducted 6 hours after the surgical operations. Our findings concurred with those of a related study by Dowson et al.[15]

In the study group, the mean postoperative pain value obtained postoperative day (POD) 1 (6.37), POD 2 (3.03) and POD 3 (.57) was compared with the mean postoperative pain value in the control group, that is POD 1 (6.40), POD 2 (3.49), and POD 3 (0.91).

The postoperative pain assessment showed no statistically significant difference; this is because postoperative pain varies depending on the type of surgery, intraoperative tissue handling, and complications. Similar outcomes were observed in research by Ben Safta et al.[16]

It was investigated how often surgical site infections occurred using the Southampton scoring system. It is noteworthy that there were five cases reported in the control group and none in the study group. This might be a result of the polymerized adhesive's barrier qualities, which stop microorganisms from infecting the wound site. Similar findings were found in studies conducted by Michael J Sebesta and Jay T Bishoff[12] and Aitchison LP et al.[17] Early time points in a related trial by Dumville JC et al.[14] revealed that both techniques periodically had mild wound problems, with the adhesive group suffering little superficial dehiscence and the sutured group experiencing erythema and edema. The average number of days the patient stayed in the hospital was studied. It was found that the patients in the study group stayed an average of 4.89 days as compared with that in the control group which was 5.46 days. It was found that the average number of days of hospital stay was not significant.

Conclusion

Our research showed that *N*-Butyl-2-Cyanoacrylate closure of the skin at the laparoscopic port site was quicker than with conventional suturing. It also resulted in a lesser rate of surgical site infection due to the bacteriostatic properties of *N*-Butyl-2-Cyanoacrylate, which helps in better wound healing without any complications and cosmetically better scarring as compared to conventional suturing. Although the price of glue is costlier than that of the suture, it results in reduced overall cost. The reason is that it does not require frequent follow-up visits for suture removal which makes it more convenient for patients and early return to work. This method of closing the incision site is simple to learn and requires little technical expertise, which reduces the length of the entire procedure and brings minimally invasive surgery one step closer. It is however important to apply it correctly and choose the wounds carefully. The difference in postoperative pain and hospital stay was not significant between conventional suturing and *N*-Butyl-2-Cyanoacrylate glue as it depends upon the type of surgery, intraoperative tissue handling, and other complications. By undertaking this study, we can conclude that *N*-Butyl-2-Cyanoacrylate is better than conventional suturing in laparoscopic port site skin closure. More studies should be conducted to compare the effectiveness of *N*-Butyl-2-Cyanoacrylate as compared to conventional suturing in other types of surgeries as well.

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