



E-ISSN: 2616-3470
P-ISSN: 2616-3462
© Surgery Science
www.surgeryscience.com
2019; 3(1): 217-217
Received: 19-11-2018
Accepted: 23-12-2018

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Wound infection rate between isoamyl-2-cyanoacrylate and subcuticular polyamide suture for skin closure in elective surgical procedures

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DOI: <https://doi.org/10.33545/surgery.2019.v3.i1d.38>

Abstract

Traditionally, needle skin suturing with suture material is used because of its cost effectiveness. In traditional skin closure with suture material, patients experience more pain during post operative period, patients cannot have a shower and patients have to come for suture removal. Even after healing, there will be track marks of suture. Chances of wound infection are higher with needle skin suturing than with closure using adhesive glue. This was a comparative study in which patients were studied in two groups. One group comprised of incision closure with subcuticular 3-0 polyamide suture material and the other group comprised of closure with 2 - octylcyanoacrylate adhesive glue. For all patients, subcutaneous sutures were applied to relieve tension, close dead space and appose wound edges, and then the wound was closed by subcuticular stitches using polyamide 3-0 or using Isoamyl-2-cyanoacrylate. Complications noted on 3rd day for the adhesive glue group are 2 seromas, 1 erythema amounting to 12% of the group. At the same time complications noted for subcuticular skin suturing group are 3 seromas, 2 erythemas amounting to 20% of the group. This indicates that incidence of complications on 3rd day was 8% more in subcuticular skin suturing group than in adhesive glue group.

Keywords: Wound infection rate, Isoamyl-2-cyanoacrylate, Subcuticular polyamide suture

Introduction

A new technology that is available for wound closure is surgical adhesives. Cyanoacrylate provides patients the option of suture less skin closure and its use is fast catching up. Presently 2 octylcyanoacrylate, a longer chain polymer which gives a stronger bond is in use. Several other compounds from the same family of cyanocrylates have been developed, such as methylcyanoacrylate, ethylcyanoacrylate, isobutyl cyanoacrylate, and butyl cyanoacrylate. Histotoxicity responsible for the degree of inflammatory response, is related to the chain length of these compounds [1].

The last generation of these adhesives is octyl cyanoacrylates, which results in less heat when applied, lower inflammatory reaction, and relatively higher tensile strength than the previous compounds. The polymer 2 octyl cyanoacrylate was formulated to correct some of the deficiencies of the shorter chain cyanoacrylate derivatives. As an 8 carbon alkyl derivative, this polymer should be less reactive than the shorter chain derivatives. The slower degradation of the octyl derivatives may result in lower concentration of the cyanoacrylate polymer by-products in surrounding tissues resulting in less inflammation. The Cyanoacrylates are safe for clinical use with no reports of adverse effects or carcinogenicity [2].

The Cyanoacrylates were first synthesized in 1949 by Airdis and since then they have been applied for medical use Coove *et al.* described their adhesive properties and suggested their possible use for surgical adhesives. In the early 1960s, various surgical applications were investigated for these adhesives. Cyanoacrylates can be synthesized by reacting formaldehyde with alkyl Cyanoacetate to obtain a prepolymer which by heating, is depolymerized into a liquid monomer. This monomer can then be modified by altering the alkoxy carbonyl (-CooR) group of the molecule to obtain compounds of different chain lengths. Upon application to living tissues (water or base), the monomer undergoes an exothermic hydroxylation reaction that results in polymerization of the adhesive. The shorter chain derivatives tend to have higher degree of tissue toxicity than the longer chain derivatives.

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Cyanoacrylates may be very simplistically defined as solvent free, synthetic adhesives. They are reactive monomer liquids that polymerize into a film when initiated by moisture or certain chemicals. A key property of cyanoacrylates is that the monomer liquid actually polymerizes directly on the surface where it is applied, creating a high quality and very tenacious polymer film. Cyanoacrylates typically fix within a minute and achieve full bond strength in 24 hours [3, 4].

The first Cyanoacrylate glues comprised short chain molecules with low breaking strength and a brittle consistency which left them prone to fracturing. Their use was restricted to low tension wounds where little tensile strength was required in the closure material and *in vitro* studies demonstrated a low tensile wound strength compared to monofilament sutures. Recently longer chain Cyanoacrylates have been introduced with improved tensile strength and more powerful adhesion of wound edges. Additionally plasticizers are added to these longer chain cyanoacrylates to produce more pliable and tissue compatible product that flexes with the skin and remains inherent for longer periods of time. The 3 dimensional wound breaking strength of 2 octyl Cyanoacrylates is 4 times that of n-2 butylcyanoacrylate. This stronger flexible bond may allow its use on longer incisions. Animal studies suggest its tensile strength to be superior to adhesive tape strips, equivalent to subcuticular suturing but inferior to skin staples and its use in higher tension wounds is not recommended. This was reinforced clinically by Bernard *et al.*, who demonstrated an improved cosmetic outcome where suturing was used to close wounds involving tissue excision resulting in higher wound tension [5, 6].

Since its first use in 1996, the topical tissue adhesive 2 octyl cyanoacrylate has become a popular method for closing skin lesions, such as laparoscopic incisions and trauma induced lacerations, in areas of low tension. Although cyanoacrylates are licensed for external use but many studies report their use in various internal situations such as the repair of bronchopleural fistulae myocardial tears, mesh fixation for inguinal hernia and adhesion of bone or cartilage. 2 Octyl Cyanoacrylate adhesive polymerizes through an exothermic reaction in which a small amount of heat is released. With the proper technique of applying adhesive in multiple thin layers (atleast three) onto a dry wound and allowing time for polymerization between applications, heat is released slowly and the sensation of heat or pain experienced by the patient is minimized. If adhesive is applied so that large droplets of liquid are allowed to remain unspread, the patient may experience a sensation of heat or discomfort. Extra caution should be taken to avoid depositing any adhesive in the wound; the adhesive will not seep into the wound since it starts to polymerize instantaneously. A common mistake is to inadvertently deposit the adhesive in the wound by pushing the tip of the vial into the wound and separating the wound edges [7, 8].

Traditionally, needle skin suturing with suture material is used because of its cost effectiveness. In traditional skin closure with suture material, patients experience more pain during post operative period, patients cannot have a shower and patients have to come for suture removal. Even after healing, there will be track marks of suture. Chances of wound infection are higher with needle skin suturing than with closure using adhesive glue. The risk of getting blood borne viral infections like HIV, HBV etc., however small it is, always exists with needle skin closure. On the other hand 2 octylcyanoacrylate is easier to use and provides a flexible, water resistant, sealed skin closure. 2 Octylcyanoacrylate gives a cosmetically better outcome than with needle skin suturing. 2 octylcyanoacrylate provides a

needle free method of wound closure, an important consideration because of blood borne viruses (eg. HIV). It requires no bandaging due to its antimicrobial properties. Advantages with the use of glue are: gives less pain during the post operative period, patients can have a shower, needs no suture or staple removal, disappears naturally as incision heals without leaving a mark [9, 10].

The engineering of sutures in synthetic material along with standardization of traditional materials (eg, catgut, silk) has made for superior aesthetic results. Similarly the creation of natural glues, surgical staples and tapes to substitute for sutures has supplemented the armamentarium of wound closure techniques. Aesthetic closure is based on knowledge of healing mechanisms. Choosing the proper material and wound closure technique ensures optimal healing. 2 octyl cyanoacrylate is the latest skin adhesive glue, used for faster skin closure. So it is essential to do a comparative study of the two techniques of skin closure.

Methodology

Study Design: This was a comparative study conducted on 50 patients in two groups.

Settings: Department of General Surgery

Source of Data: 50 patients (25 in each group) undergoing clean elective surgery with no focus of infection on the body admitted in the department of general surgery.

Method of Collection of data: This was a comparative study in which patients were studied in two groups. One group comprised of incision closure with subcuticular 3-0 polyamide suture material and the other group comprised of closure with 2 - octylcyanoacrylate adhesive glue. For all patients, subcutaneous sutures were applied to relieve tension, close dead space and appose wound edges, then the wound was closed by subcuticular stitches using polyamide 3-0 or using Isoamyl-2-cyanoacrylate. The adhesive was applied in a single layer while keeping the two ends of the incised wound stretched using forceps. This will approximate the two edges of the incised wound. In each patient of both the groups, detailed history was taken and routine investigations like hemoglobin, total count, differential count, ESR, Blood sugar, bleeding time and clotting time were done. In appropriate cases care was taken to rule out any acute or chronic infection or malignancy through relevant investigations. Preoperative preparation of the patient was done on the previous evening of surgery. Same antibiotic protocol was followed in every case. In all the recruited patients Inj Ceftriaxone 2gm IV was started one hour before surgery and repeated with 1gm IV at 8 hrs and 24 hrs post operatively.

Table 1: ASEPSIS wound score

| Wound characteristic | Proportion of wound affected | | | | | |
|----------------------------|------------------------------|------|-------|-------|-------|------|
| | 0 | < 20 | 20-39 | 40-59 | 60-79 | > 80 |
| Serous exudate | 0 | 1 | 2 | 3 | 4 | 5 |
| Erythema | 0 | 1 | 2 | 3 | 4 | 5 |
| Purulent exudate | 0 | 2 | 4 | 6 | 8 | 10 |
| Separation of Deep tissues | 0 | 2 | 4 | 6 | 8 | 10 |

The wound is assessed for cosmesis on 7th Post-operative day and at the end of 1st and 3rd month using Modified Hollander cosmesis scale which has six clinical variables as step off borders, edge inversion, contour irregularities, excess inflammation, wound margin separation and good overall appearance. Wound will be assigned 0 or 1 point each for the

presence or absence of the following,

- Step off the borders, (0 for yes, 1 for no)
- Contour irregularities – puckering, (0 for yes, 1 for no)
- 3 Wound margin separation, (0 for yes, 1 for no)
- 4 Wound edge inversion, (0 for yes, 1 for no)
- 5 Excessive wound distortion, (0 for yes, 1 for no)

- 6 Good overall appearance (0 for poor, 1 for acceptable)

Wounds with a score of 6 are considered to have an optimal cosmetic appearance and others suboptimal appearance.

Results

Table 2: Gender distribution among the two study groups

| Type of material used | Sex | | Total |
|----------------------------|----------|----------|-------|
| | Male | Female | |
| Adhesive Glue | 15 (60%) | 10 (40%) | 25 |
| Subcuticular Skin Suturing | 16 (64%) | 09 (36%) | 25 |
| Total | 31 | 19 | 50 |

Table -2 shows sex distribution in each group. Out of the 25 patients in the adhesive glue group, there were 15 males constituting 60% of the group and 10 females constituting 40%

of the group. There were 16 males comprising 64% and 09 females comprising 36% in the subcuticular suture group.

Table 3: Total complications observed in each group.

| Complications | 3 rd Day | | 7 th Day | |
|------------------|-----------------------|-----------------------------------|-----------------------|-----------------------------------|
| | Type of material used | | Type of material used | |
| | Adhesive glue (N=25) | Subcuticular Skin Suturing (N=25) | Adhesive glue (N=25) | Subcuticular Skin Suturing (N=25) |
| Seroma | 2 | 3 | 0 | 0 |
| Erythema | 1 | 2 | 0 | 0 |
| Purulent | 0 | 0 | 1* | 1* |
| Wound separation | 0 | 0 | 1* | 1* |
| Total | 3 (12%) | 5 (20%) | 1 (4%) | 1 (4%) |

* Same patient in glue group and subcuticular suture group had purulent discharge and wound separation.

Complications noted on 3rd day for the adhesive glue group are 2 seromas, 1 erythema amounting to 12% of the group. At the same time complications noted for subcuticular skin suturing group are 3 seromas, 2 erythemas amounting to 20% of the group. This indicates that incidence of complications on 3rd day was 8% more in subcuticular skin suturing group than in adhesive glue group. However as the post-operative period progressed to 7th day all the seromas and erythemas resolved leaving behind 1 purulent wound in each group amounting to 4% in each group indicating similar outcome in both the groups.

Discussion

Patients after having screened for inclusion and exclusion criterion were randomly divided into two groups of twenty five patients each irrespective of their age and sex. A detailed history was taken and relevant investigations were done to rule out any focus of infection or malignancy. Patients with comorbid medical conditions, patients undergoing contaminated or emergency surgeries were excluded from the study. The nature of operation and site of incision were variable. In Adhesive Glue group skin closure was done with 2 – octylcyanoacrylate. In Skin suturing group subcuticular skin closure using 3.0 polyamide sutures was done.

At the end of 7 days both adhesive glue group and skin suturing group ended up with one wound separation each. On day 3 there were 2 seromas and 1 erythema in adhesive glue group and there were 3 seromas and 2 erythemas in subcuticular skin suturing group. Day 5 in the post operative period, there were 1 seroma and 1 purulent exudates with wound separation in adhesive glue group and there were 2 seromas and 1 purulent exudates with wound separation in subcuticular skin suturing group.

At the end of the discussion it seems that Adhesive glue group had fewer complications, a smooth sailing towards a good

cosmetic outcome. These findings when summed up with other advantages of adhesive glues like

- they form a water resistant barrier allowing the patients to have shower
- No need to apply bandage
- NO need for suture removal and
- Shorter hospital stay, make the adhesive glues a good alternative to skin suturing skin closure.

Conclusion

The incidence of infection and wound complications are comparable in both the groups. In addition octylcyanoacrylate provides certain practical advantages to the patients. The advice as to which method is used for closure of wound may come down to economics and operator preference.

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