COMPARSION OF "2-OCTYL-CYANOACRYLATE" AND SUTURE IN THE CLOSURE OF SKIN GRAFT

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T. Şapçı, M.D.** / A. Karavuş, M.D.* / G. Yıldırım, M.D.*******
H. Onmuş, M.D. / M. Gürdal, M.D.*** / İ. Kurtuluş, M.D.********

* *Specialist, Department of Otorhinolaryngology Head and Neck Surgery, PTT Training Hospital, Istanbul, Turkey.*
** *Specialist, Department of Pathology, SSK Göztepe Training Hospital, Istanbul, Turkey.*
*** *Specialist, Department of Urology, Haydarpaşa Numune Training Hospital, Istanbul, Turkey.*
**** *Instructor, Department of Otorhinolaryngology Head and Neck Surgery, PTT Training Hospital, Istanbul, Turkey.*
***** *Instructor, Department of Otorhinolaryngology Head and Neck Surgery, SSK Okmeydanı Training Hospital, Istanbul, Turkey.*
****** *Resident, Department of Urology, Haydarpaşa Numune Training Hospital, Istanbul, Turkey.*

ABSTRACT

Objective: Every year emergency clinics are accepting many patients having traumatic injuries. Suturing the lacerated injury using local anesthetics and injection materials creates stress and fear in patients; besides suturing is a time taking procedure. The cyanoacyrylate derivatives that have been first used as tissue glues in 1950 have improved quite a lot up to date. At present they are being used in various areas of otolaryngology-head and neck surgery.

Methods: In this study a total of 8 adult Wistar albino rats have been used; 6 of them being the study group and 2 of them being the control group. On the back of 2 rats pediculated and rectangle shaped (2x4 cm in size) skin flaps; on the back of another 2 rats triangle shaped skin flaps and finally on the remaining 2 rats rectangle shaped skin flaps with irregular edges (traumatic) were elevated. Then Coaptex® (2-octyl-cyanoacrylate) tissue glue has been applied underneath the flaps and flaps were glued back to their original places. In the control group (2 rats) pediculated rectangle shaped (2x4 cm) skin flaps were elevated and have been stitched back to their places using 4/0 silk thread.

Results: In the study group very good clinical and cosmetic healing was observed, in the control group mild edema was detected first, then at later stages this edema slowly disappeared. No other problem worth mentioning was detected. In the histopathological evaluation subcutaneous moderate foreign body reaction was detected in the study group (Coaptex group), however epidermis had healed completely. In the control group, however, severe acute inflammation was detected in all layers of incision, epidermis had disappeared with superficial ulceration taking its place and no regeneration being present underneath.

Conclusion: We believe tissue glues can be used with confidence in the treatment of lacerations because they give cosmetically and histopathologically very good results. They can be applied easily and quickly, they give no pain to the patient and they do not require local anesthesia.

Key Words: Tissue glue, 2-Octyl-cyanoacrylate, skin flaps

INTRODUCTION

Sticking lacerated tissues of traumatic and surgical injuries using cyanoacrylate has mounted interest in the recent years (1). Cyanoacrylate derivatives are being used for several purposes in otolaryngology and head and neck surgery. Ossicular chain reconstruction (2,3), repair of the larynx (4), facial plastic intervention (5), rhinoplasties carried out using cartilage and bone grafts (6) and bleferoplasty (5) are among several areas where cyanoacrylate derivatives are used.

Cyanoacrylate was first developed in the year 1949; however its usage in the clinic extended up to the end of year 1949 (7). The first derivatives of

cyanoacrylate namely methyl-2 and ethyl-cyanoacrylate were used in injury repair (8). These two derivatives had short alkyl chains, were easy to apply and could be rapidly polymerized.

However, histopathological studies proved these derivatives to accumulate in tissues causing acute and chronic inflammation, thus ending up with severe histotoxicity. For this reason using these derivatives was forbidden at those years until the production of a new cyanoacrylate namely N-butyl-2- cyanoacrylate (1,9). To date this product has been the cyanoacrylate on which the greatest number of studies have been carried out and which is being used most frequently (10). This product causes no problem in the avascular tissues like bone and cartilage and causes only moderate acute or chronic inflammation in relatively well vascularized tissues.

This study aimed at examining the histopathological influences of a new generation cyanoacrylate 2-octyl-cyanoacrylate having a long chain on some tissues and how effective it is in injury healing.

MATERIAL AND METHODS

This study that was approved by the ethical committee was carried out on 8 adult Wistar albino rats (each one weighing 250±20 grams) at the animal Laboratory of Haydarpaşa Numune Hospital. Six of the rats were the study group, the remaining two were the control group. All the surgical procedures were carried out under intramuscularly applied ketamine hidrochloride (30 mg/kg) anesthesia.

The dorsal skins of the animals were shaved first, then cleaned with betadine®. Skin flaps together with some subdermal tissue (2x4 cm) and having a pedicule were elevated on the back of two rats; triangle shaped skin flaps on the back of other two rats and on the back of the remaining two rats rectangle shaped and traumatic (having relatively irregular edges) skin flaps were elevated. Then Coaptex® (2-octyl-cyanoacrylate) tissue adhesive was applied under these flaps and flaps were pasted back to their places (Fig.1). The tips of the flaps and the healthy tissue were pasted to one another while applying little pressure on them for 30 seconds (Fig.2). Pediculated and rectangle shaped skin flaps (2x4 cm) were elevated on the control rats also; but these flaps were stitched back to their places using 4/0 silk thread. On the seventh postoperative day the sutures were removed under ketamine anesthesia.

The animals were kept alive for 10 days. Every day injury healing was followed up and photographed. At the end of 10 days rats were sacrificed using ether anesthesia. Skin flaps with the underlying healthy tissue were extracted up to the muscular tissue and fixated in 10 % formaldehyde. Later on, the specimens were processed with paraffin, painted with hematoxylene-eosin (HE) and examined under microscope.

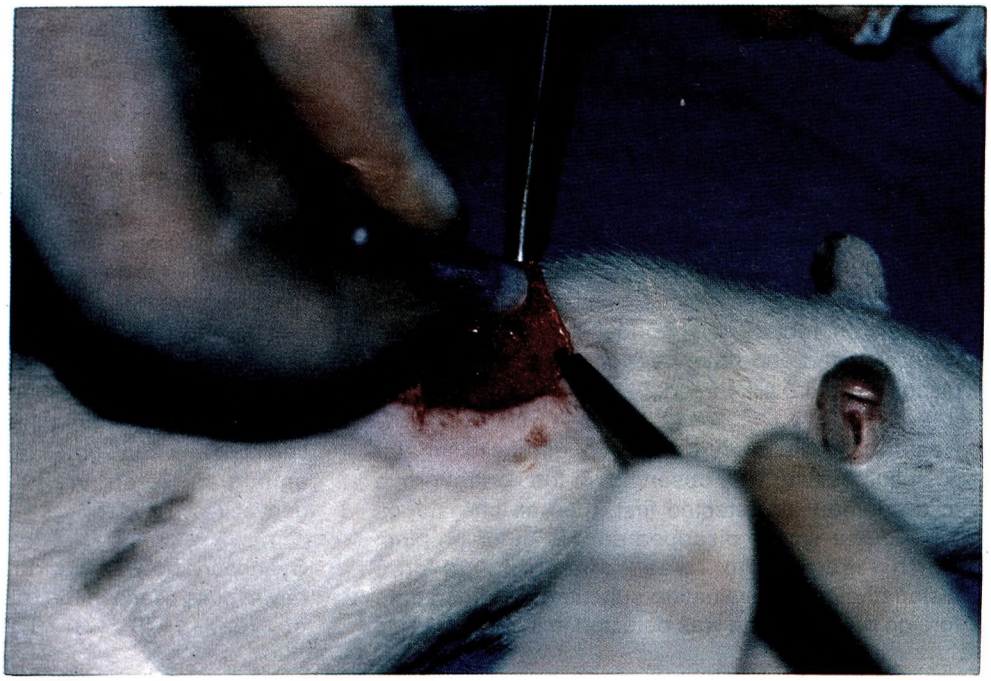

Fig. 1: Applying Coaptex® to the skin flap

Fig. 2:
Stabilization of the flap after applying Coaptex®

RESULTS

Injury healing was evaluated using 5 clinical characteristics stated below (Table I).

I- Hematoma or edema under the flap
II- Separation of 1 mm or more around the edges of the flaps
III- Retraction around the edges or irregular border formation
IV- Necrosis of the flap
V- Cosmetic (good-looking) appearance

Postoperative problems like infection, flap necrosis and severe separation of the flap were not observed in our study. The triangle flaps were the group showing the best healing (Fig.3a, 3b). On the first postoperative day 1 mm separation around the incision areas were observed in the rectangle and traumatic rectangle flaps. However later on, these flaps showed crust formation and on the postoperative 10th day epithelization was observed beneath these crusts. Finaly the incision borders disappeared. Generally groups showed excellent healing on the overall outer appearance on the 10th day. Mild edema was observed under the stitched flaps of the control rats on the first postoperative days. This edema disappeared gradually. On the seventh postoperative day when the sutures were removed retraction around the incision were observed (Fig.4a, 4b).

The histopathological evaluation of the study group revealed subcutaneous foreign body reaction of moderate intensity. Furthermore giant cells which have phagocyted the foreign body and inflammation cells like lymphocytes and plasmocytes were observed. Complete healing of the epidermis and healing with smooth fibrosis of the dermis were also detected (Fig.5). In the control group acute inflammation cells with neutrophils dominating appeared in all layers of the incision. Also in the control group epidermis had disappeared; superficial ulceration had appeared in its place with no regeneration underneath (Fig.6).

Table I. Clinical evaluation of the injury healing*

SCORE	TRIANGLE FLAP	RECTANGLE FLAP	TRAUMATIC RECTANGLE FLAP	CONTROL
I	0	0	0	1
II	0	1	1	0
III	0	0	1	1
IV	0	0	0	0
V	0	0	1	1

* (0: Good, 1: Moderate, 2: Bad)

Fig. 3a: Triangle shaped skin flap (peroperative appearance)

Fig. 3b: Triangle shaped skin flap (postoperative 7th day)

Fig. 4a:

Rectangle shaped skin flap (peroperative appearance "control group")

Fig. 4b:

Rectangle shaped skin flap (postoperative 7th day "control group")

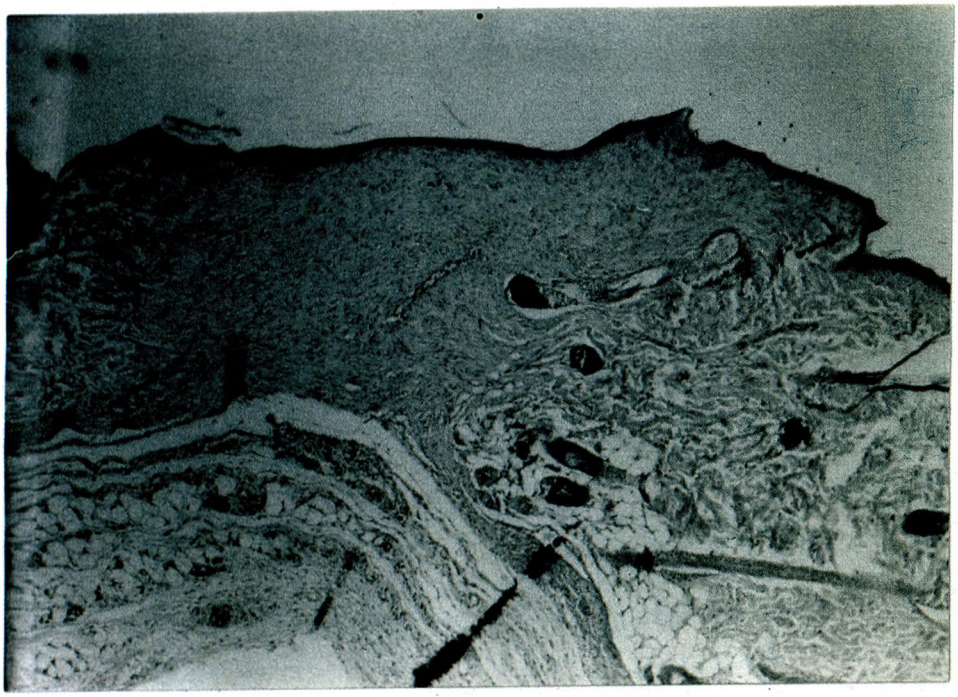

Fig. 5:

Healing with minimal fibrosis along the incision; foreign body reaction at the subcutaneous fatty tissue (study group, HEx100)

Fig. 6:

Ulceration at the epidermis; acute inflammation at all layers (control group, HEx200)

DISCUSSION

Every day many patients apply to the emergency clinics for treatment of traumatic injuries. Using local anesthesia and injection before and during treatment in suturing creates stress and fear in several patients (11); furthermore this procedure takes quite a long time. Especially the pediatric group is affected a lot during this procedure. The cyanoacrylate glues first developed in 1949 were not used seriously as topical skin adhesives until its first scientific use in Canada in 1980's (12). The first derivatives of cynaoacrylate in 1950's caused severe inflammations. For this reason many new generation adhesives started to be studied on for years. At present the generations that are being used cause almost no tissue reactions.

To produce a perfect result with tissue adhesive one needs to identify a correct indication and to know how to use it properly. One needs to take care not to use the tissue adhesives on regions already having some missing tissues or regions that are under tension. If the incision is deeper than 5 mm subcutenous vicryl sutures should be applied definitely. After applying the tissue adhesives under the flap, the edges of the incision and healthy tisue should be brought together and should be pressed lightly together for 30-60 seconds (12-14). Literature search shows usage of tissue adhesive not only in skin injury healing, but also in the subcutaneous pasting of the ossicular and cartilage flap. Toriumi et al (15) have pasted subcutaneous nonvascularized bone and cartilage grafts using histoacryl (butyl-2-cyanoacrylate) in rabbits in 1991. They had very good results and they reported histologicaly minimal inflammation. When histoacryl was directly applied subcutaneously over relatively well vascularized regions; tissues showed to stick well together but acute inflammation and foreign body reactions were produced.

Brown et al (16) pasted the ear cartilage of the rabbit to the cranium using N-octyl-cyanoacrylate and sutured the same areas in the control group. No histopathological changes were observed in neither of the groups. Sachs (6) reported excellent results after pasting cartilage grafts with histoacryl during nasal augmentation surgery.

The 2-octyl-cyanoacrylate (Coaptex®) that we have used in our study is the most recently developed cyanoacrylate derivative. Its most important characteristic is that it freezes very fast; faster than all other cyanoacrylate derivatives and it does not create any inflammation (17). We used 2-octyl-cyanoacrylate (Coaptex®) on wide skin lacerations as on alternative to suturing, and aimed at comparing the clinical and histopathological influences. Our clinical and cosmetic healing was very good; besides the control (suturing) group also showed no severe complications, merely mild edema on the first postoperative days, that disappeared spontaneously later.

Our histopathological examinations revealed subcutaneous foreign body reactions of moderate intensity in the Coaptex® group; besides epidermis had healed completely and dermis had healed with forming smooth fibrosis; whereas in the control group acute inflammation reaction with severe intensity showed up in all layers of the incision and also ulceration appeared in the place of the epidermis with no regeneration along the suture line.

Good cosmetic and histologic results we have obtained with 2-octyl-cyanoacrylate are in accordance with the literature. Particularly its causing very little foreign body reaction and the absence of acute inflammation as compared to the control group are among the findings that ressemble the findings of Brown (16) who used the new generation cyanoacrylate, namely N-octyl-cyanoacrylate. Furthermore the fact that it freezes in as quickly as 15-20 seconds is one of its important advantages as compared to the other cyanoacrylate derivatives stated in literature.

Quinn et al (12) used octyl-cyanoacrylate alternative to suturing in 136 lacerations of patients in 1997. He observed no cosmetic differences in injury healing between the intervention and the control groups; however he reported octyl-cyanoacrylate as a quick and painless procedure. Bruns et al (13) used HAB (N-Butyl-2-cyanoacrylate) in half of laceration of 61 pediatric patients and used suturing in the remaining half. They obtained better cosmetic results with the HAB group as compared to the suturing group. He also praised HAB because it was a painless procedure and it could be applied very quickly.

As a result we believe the new generation tissue adhesives can be used with confidence even in pediatric patients because it has very good cosmetic and histological results; besides its application is easy, quick and painless requiring no local anesthesia around the laceration.

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