

The Topical Effect of Coenzyme Q10 on Wound Healing in Mice

Ibtisam T. Al-Jureisy
BDS

Wael T. Al-Wattar
BDS, MSc (Asst. Prof.)

Ghada A. Taqa
BDS, MSc, PhD (Prof.)

Specialized Dental Centre-Right bank

Nineveh Health Directorate, Ministry Of Health. Iraq

Department of Oral and Maxillofacial Surgery
College of Dentistry, University of Mosul

Department of Dental Basic Science
College of Dentistry, University of Mosul

الخلاصة

الأهداف: يهدف البحث الى تقييم تأثير مرهم الكوانزيم كيوتين عشرة في شفاء الجروح على الفئران . **المواد وطرائق العمل:** تم اختيار خمسة عشر فأرة بيضاء ذات صحة جيدة وبنفس الأعمار وقسمت الى ثلاث مجاميع كل مجموعة مكونة من خمسة فئران ،المجموعة الأولى تم علاجها بوضع مرهم الفازلين لوحده على الجرح أما المجموعة الثانية والثالثة فتم علاجها بوضع مرهم الكوانزيم كيوتين عشرة بتركيز (4%، 8%) على منطقة الجرح على التوالي وكررت هذه المعالجة كل يوم لمدة سبعة أيام مع تدوين قياس حجم الجرح ونسبة تقلص الجرح في اليوم الاول والرابع والسابع. **النتائج:** لاحظنا أن هناك فرق معنوي بين المجاميع من حيث نسبة تقلص الجرح وحجمه ،فالمجموعات المعالجة باستخدام مرهم الكوانزيم كيوتين عشرة بأي تركيز تكون اسرع بامتثالها للشفاء. **الاستنتاجات:** مرهم الكوانزيم كيوتين عشرة يحفز ويسرع من شفاء جروح الجلد في الفئران المختبرية.

ABSTRACT

Aims: the current paper examines the topical effect of Coenzyme Q10 ointment in mice. **Materials and Methods:** Fifteen well male albino mice with equivalent age were designated for this research. The animals were divided into 3 clusters of five animals for each group. Group one worked as a control and was applied Vaseline ointment topically on skin wound. Groups; two and three were applied topically Coenzyme Q10 ointment 4%, 8% respectively on skin wound. These applications were repeated every day. The wound size and wound contraction ratios were measured in 1st, 4th, 7th days of the experimental procedure. **Result:** There were significant differences between groups in wound size and wound contraction ratios. The groups were treated with Coenzyme Q10 in different concentrations. They are better in rating the wound healing. **Conclusion:** The topical application of CoQ10 in different concentrations encourages the wound curing in the soft tissue of mice.

Key words: Coenzyme Q10; Wound healing; Wound contraction ratio.

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INTRODUCTION

Wound is described as a break in the continuity of tissues, resulting from trauma or pathological change that initiates a process of repair ^(1,2,3). Wounds can be

divided into two types; acute and chronic according to physiology of wound healing ⁽⁴⁾ Wound healing is a natural physiological reaction to tissue injury and a sequence of complex biological processes ⁽⁵⁾, furthermore, wound healing is a defensive

role of the body that efforts on rapid rescue⁽⁶⁾. The essential variance between wound healing and regeneration is that all matters are capable of renewal, but healed tissue does not continually own the identical functionality or morphology because the misplaced tissue⁽⁷⁾. According to time and methods of closure, there are three types of wound healing, wounds heal by primary, secondary and tertiary intention⁽⁸⁻⁹⁾.

Coenzyme Q10 is a fat-soluble antioxidant compound. It plays as a key element of the of the electron transport chain for cellular adenosine triphosphate (ATP) creation⁽¹⁰⁾. It has also an anti-inflammatory result⁽¹¹⁾. The biosynthesis of CoQ10 takes place in the mitochondria of the liver, heart, kidneys and muscles, where they require a greater quantity of energy for their multiple biological roles⁽¹²⁾. The chemical construction of CoQ10 is similar to vitamin K, while CoQ10 is not reflected in a vitamin, as it is the only lipid - soluble antioxidant that animal cells manufacture de novo in the body⁽¹³⁾. Coenzyme Q10 is known to be a redox-active lipophilic antioxidant, scavenging reactive oxygen species (ROS) and preventing lipid peroxidation in the body⁽¹⁴⁾.

The skill of it is a lot larger than vitamin E and it was also recognized to aid the absorption of lipid soluble antioxidant vitamins, such as vitamin A and E⁽¹⁵⁾.

Consequently, the aim of the present study is to make a different concentration of Coenzyme Q10 as ointment to study the topical effect of it on wound healing in mice.

MATERIALS AND METHODS

Animals

In the present study, we selected fifteen healthy male albino mice with equal age, about 20-30 gm weighted. Mice were gotten from animal maintenance housed in Collage of Dentistry / Mosul University (Iraq). The animals were kept in plastic cages under 12hs. light\12h dark cycle at 22±2°C and access to fed with normal diet and tap water.

Preparation of Coenzyme Q10 ointment

Two different concentrations of Coenzyme Q10 ointment were prepared⁽¹⁶⁾ by mixing (4, 8 g) from Coenzyme Q10 powder (Windmill, USA) in 100 gm Vaseline (India) to provide final dose (4%, 8%) W\W with constant mixing utilizing a glass rode until identical ointment were made. The ointment was saved in plastic bowls and kept in refrigerator at 4C° till used.

Testing on animals:

Each mouse was given 50 mg/kg ketamine hydrochloride (anesthetic) mixed with xylazine 10mg/kg (sedative analgesic and muscle relaxant), after 5-10 minutes the mouse reflexes were checked to ensure

that anesthesia was taken. Each animal was anesthetized, laid down in ventral side on the surgical board, covered with sterile towel exposing dorsal side only. The hair on surgical area was shaved, washed with a tap water and antiseptic was performed, 10 mm longitudinal full thickness line incision was done. The wound (area of incision) in control group was covered with Vaseline only, while, the wounds in the second study group was covered with Coenzyme Q10 ointment. The wounds in the third study group was covered with Coenzyme Q10 ointment. These application were repeated every day, and the wound size measured in 1st, 4th, 7th days of the experimental procedure by multiplied length with width of wound⁽¹⁷⁾. The wound contraction ratio (WCR) was calculated by using this equation:

$$WCR = (A_0 - A_1) / A_0 * 100$$

Where A_0 and A_1 are respectively the initial area and the wound area after the application of the treatment⁽¹⁸⁾.

Statistical Analysis

The records were stated as mean \pm SD, variance between three experimental sets were statistically analyzed by one way analysis of variance (ANOVA) followed by Duncan test. The close of significance was at $p < 0.05$.

RESULTS

In our study, it is found that after 24 hs. of induced the wound. The mean value of wound size was 2.25 mm² and wound contraction ratio was 77.5% in control group which was the lowest value, while the mean value of wound size was 1.33 mm² and wound contraction ratio was 86.7% in group treated topically with 8% of Coenzyme Q10 which was the highest one when comparing it with control group and group treated topically with 4% of Coenzyme Q10, but has no significant difference in wound size between three groups at p -value was > 0.05 (Table 1,2) (Figure 1,4).

Table (1): Wound Size Finding of Skin Comparing Between Control ,Q10 4% and Q10 8% Groups Treated Topically.

Duration	Group	Mean \pm Stander Deviation	P-value
1 st day	Control	2.25 \pm 0.45	0.1
	CoenzymeQ10 ointment(4%)	1.78 \pm 0.53	
	CoenzymeQ10 ointment(8%)	1.33 \pm 0.23	
4 th day	Control	1.88 \pm 0.33	0.002*
	CoenzymeQ10	1.20 \pm 0.00	

7 th day	ointment(4%) CoenzymeQ10	0.76 ± 0.15	0.012*
	ointment(8%) Control	1.23 ± 0.25	
	CoenzymeQ10	0.81 ± 0.31	
	ointment(4%) CoenzymeQ10	0.30 ± 0.17	
	ointment(8%)		

Table (2) : Effect of Coenzyme Q10 (4%, Topically) and Coenzyme Q10 (8%, Topically) on Wound contraction ratio (mm²).

Group	Wound contraction ratio (WCR)%		
	1 st day	4 th days	7 th days
Control	77.5%	81.2%	87.7%
Coenzyme Q10 ointment(4%)	82.2%	88%	91.84%
Coenzyme Q10 ointment(8%)	86.7%	92.34%	97%

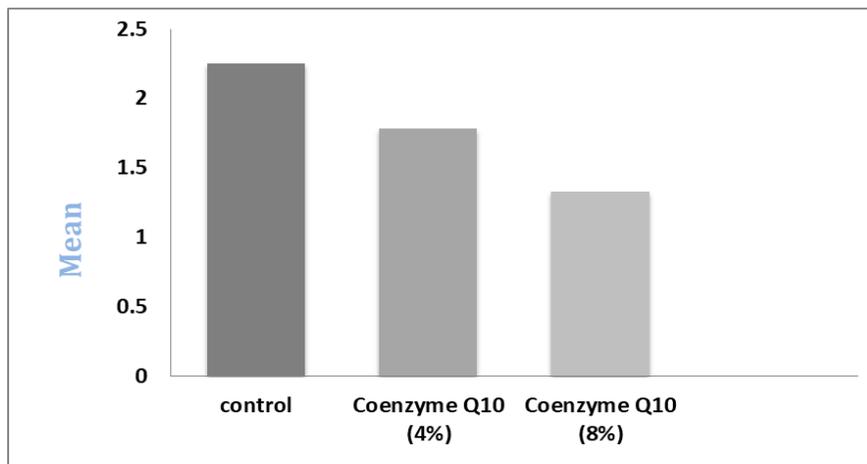


Figure (1): Mean Rank Differences of skin wound size between variables treated topically at 1st day .

Outcomes of Coenzyme Q10 Ointment on Wound Healing

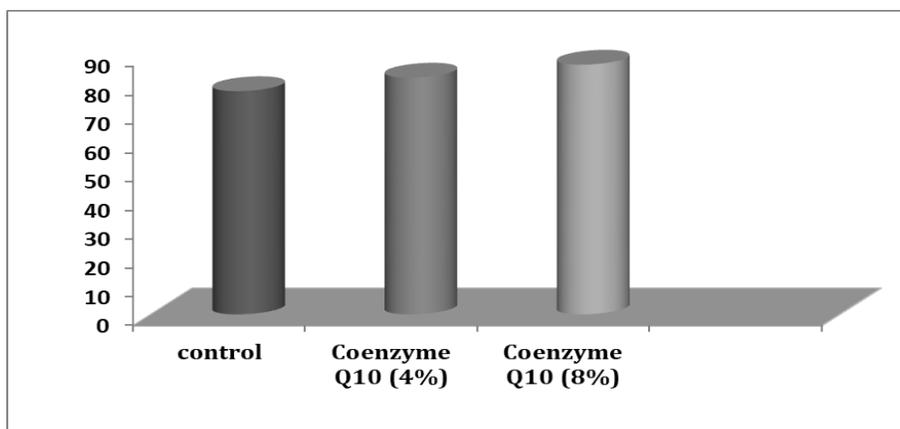


Figure (4): Effect of Coenzyme Q10 (4% topically) and Coenzyme Q10 (8% topically) on wound contraction ratio in mice after one day.

After four days the group treated topically with 8% of Coenzyme Q10 remained the highest one in wound healing score. The mean value of wound size was 0.76 mm² and wound contraction ratio was 92.34% , while the mean value of wound size was 1.2 mm² and wound contraction ratio was 88% in group. This group was

treated topically with 4% of Coenzyme Q10. However, the mean value of wound size 1.88 mm² and wound contraction ratio was 81.2% in control group, *p*-value of wound size was found to be ≤ 0.05 which indicating significant difference between three groups (Table 1, 2) (Figure 2, 5).

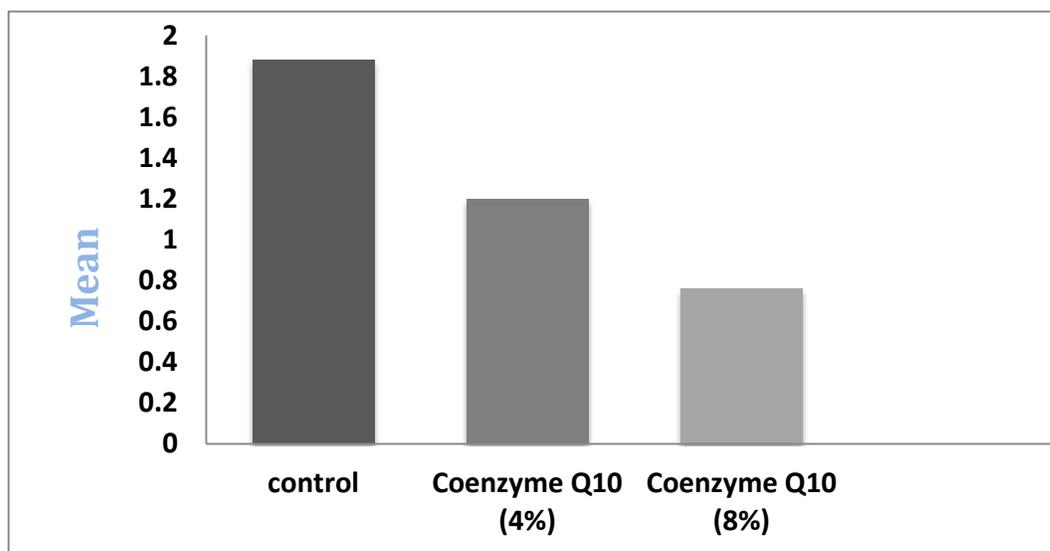


Figure (2): Mean Rank Differences of skin wound size between variables treated topically at 4th day.

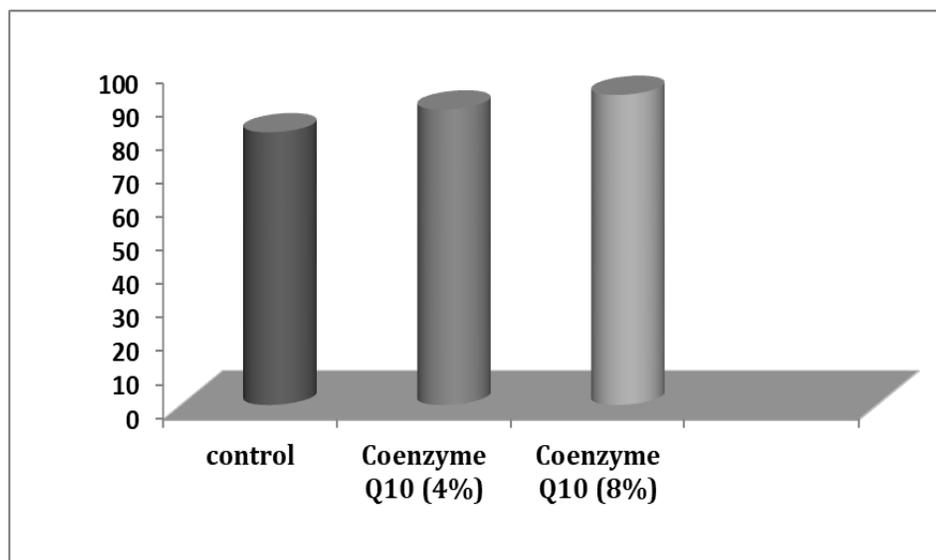


Figure (5): Effect of Coenzyme Q10 (4% topically) and Coenzyme Q10 (8% topically) on wound contraction ratio in mice after four days.

Observation of the wound healing found that the mean value of wound size in group treated topically with Coenzyme Q10 4%, 8% after seven days 0.81mm² and 0.30 mm² respectively after induced the wound in comparison with control group 1.23 mm². The wound contraction ratio in group was

treated topically with Coenzyme Q10 4%, 8% after seven days 91.87% and 97% respectively after induced the wound in comparison with control group 87.7%, *p*-value of wound size was found to be ≤ 0.05 which indicating significant difference between three groups (Table 1,2)(Figure 3, 6).

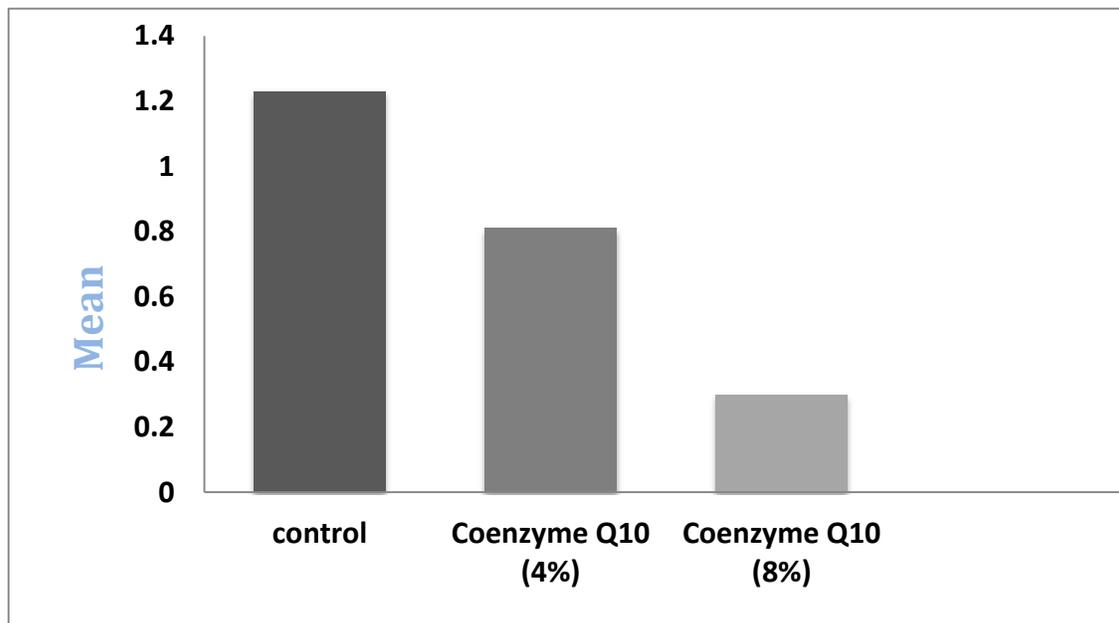


Figure (3): Mean Rank Differences of skin wound size between variables treated topically at 7th day.

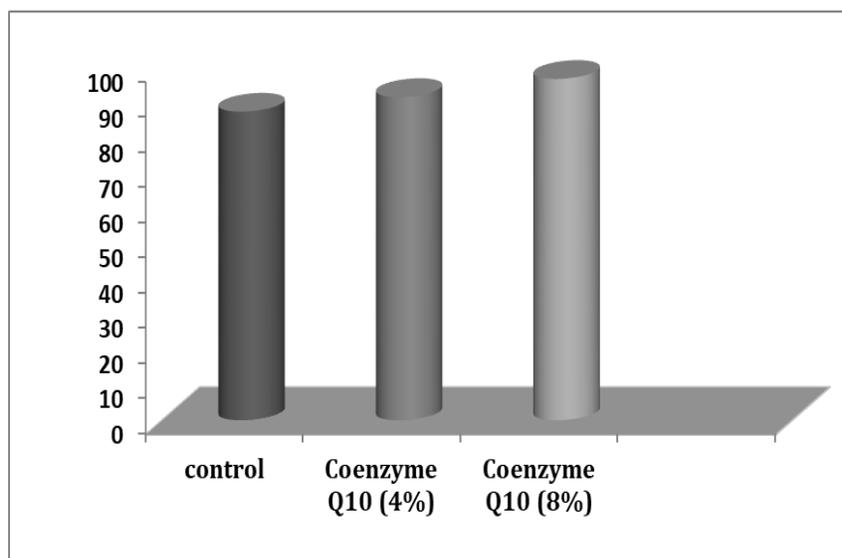


Figure (6): Effect of Coenzyme Q10 (4% topically) and Coenzyme Q10 (8% topically) on wound contraction ratio in mice after seven days.

DISCUSSION

Wound healing is a complex process consisting of many steps starting by inflammation, granulation tissue formation, angiogenesis, re-epithelization and wound contraction⁽¹⁹⁾. In present study, the wound contraction ratio (WCR) in treated animals with Coenzyme Q10 was faster than control group. In the first part of wound healing is characterized by the progress of the inflammatory response and removal of debris, and the early proliferation step, with the advance of the granulation tissue⁽²⁰⁾. Neutrophils produce a collection of proteolytic enzymes which digest hurt tissue elements and reactive oxygen species (ROS) and several other inflammatory mediators. The phagocytic action of inflammatory cells eliminates necrotic cell fragments and coagulum⁽²⁰⁾. Drop in inflammation and rise in collagen installation three days next surgical procedure were obtained in animals. Free CoQ10 was used in a form of ointment⁽²¹⁾. Also, the appearance of IL-1 β , TNF- α , NF- κ B and HO-1, cytokines utilized in inflammation and oxidative tissue damage were considerably inhibited by CoQ10 application for three days next surgical procedure⁽²¹⁾. The drop in inflammatory response, helps damage tissue readily go in the later stages of healing which included cell proliferation and tissue remodeling⁽²²⁾ and contributing to the theory where the

decrease in inflammation rise healing processes⁽²³⁾.

Topical application of CoQ10 inhibited oxidative stress and its associated inflammatory reactions, and this may quicken wound healing, this is steady with other study, which established that anti-oxidative properties of CoQ10 made cutaneous wound healing in mice⁽²⁴⁾.

CONCLUSION

The data of this study revealed that topical application of Coenzyme Q10 accelerate the wound healing of skin .

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