
COMPARATIVE CLINICAL ASSESSMENT OF COTTON HAIR THREAD AND SILK SUTURE ON SURGICALLY INDUCED SKIN WOUNDS ON NEW ZEALAND RABBITS (*Oryctolagus cunicullus*)

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ABSTRACT

The gross tissue reactivity, bacterial load counts and clinical parameters were investigated following the use of cotton hair thread (CHT) and silk suture on surgically induced wounds on rabbits. Twelve clinically healthy male rabbits of New Zealand breed were used. They were acclimatized for two weeks and randomly assigned into three groups A, B and C of four (4) rabbits each. A 6 cm long paralumber skin incision was aseptically performed in both groups of animals using xylazine and ketamine. The incised skin wounds in groups A and B rabbits were apposed with conventional silk and cotton hair thread (CHT) sutures respectively while no surgery was performed in the group C rabbits. The sutured sites in the groups (A and B) were evaluated for both bacterial load counts and gross features: swelling, erythema and percentage suture breakage and scored at post-surgical days (psd) 1, 7, 10, 14 and 21. Clinical vital signs: heart and respiratory rates and temperature were evaluated in the three groups before (day 0) and during the above psd. The means of the bacterial load counts, clinical vital parameters demonstrated no statistical significance ($p > 0.05$) in the study. There was no significant difference ($p > 0.05$) in the gross tissue reactivity in the two groups throughout the period. It was concluded that CHT showed promise for possible use as skin suture in rabbits.

Keywords: Silk, Cotton hair thread, Rabbits, Incision, Bacterial load, Surgically induced skin wounds

INTRODUCTION

Wound closure is an important critical stage in surgical management (Knecht *et al.*, 1987). The types of surgical suture material used play an important role in surgical management. The search for more appropriate suture material has resulted in availability of variety of both natural and synthetic suture materials commercially. Suture materials influence a biological reaction to the suture permitting a great diversity of clinical application (Bennett, 1988; Tan *et al.*,

2003). Silk is usually used to close skin wounds because of its excellent knot security and tensile strength *in-vivo*, but bacterial wicking is its major disadvantage (Li *et al.*, 2007).

The principal role of suture is to approximate wound edges so as to enhance wound healing. Wound healing is an intricate process in which the skin (or another organ-tissue) repairs itself after injury (Nguyen *et al.*, 2009).

Healing of wound starts from the moment of injury and can continue for varying

periods of time depending on the extent of wounding (Sumitra *et al.*, 2005; Ayyanar and Ignacimuthu, 2009).

Research has shown that sutures have effect on the degree of inflammation, edema and are characterized by numerous amoebocytes infiltrating the tissue and large dense granulomas that dramatically disrupt normal tissue architecture (Laura *et al.*, 2010). In available literature plastic surgery, most of wound complications were related to patient characteristics (age and sex) and wound properties (location and length) rather than to suture materials or surgical technique (Laura *et al.*, 2010). However, it has been observed that some veterinarians use cotton hair thread (CHT) in the field probably because of its low cost and availability in approximating skin wound edges without evaluating the level of tissue reactivity; erythema, swelling and percentage suture breakage.

Surgical infection can be encountered as a primary surgical disease or be as a result of surgical intervention. Infection that develops after surgical procedure may be a complication of the surgical procedure or may result from invasive, diagnostic or supportive procedures such as intravenous (i/v) therapy or urinary catheter placement. Other ideal characteristics of surgical implants including sutures are their ability to not potentiate bacteria contamination (Slatter, 2002).

The main objective of the study was to assess the post-surgical tissue reactivity such as erythema, swelling, percentage suture breakages, the bacterial loads of the suture sites and the associated vital parameter changes in the surgically induced wounds of rabbits approximated with silk and CHT.

MATERIALS AND METHODS

Twelve (12) clinically male healthy rabbits of New Zealand breed; aged 6 – 8 months, weighing between 1.5 – 1.8kg were used for the study. They were housed and acclimatized in the experimental animal house of the Department of Veterinary Surgery for two weeks and were randomly assigned into three groups A, B and C of four (4) rabbits each.

A 6 cm long paralumber skin incision was aseptically performed in both groups of animals using xylazine (0.5mg/kg) and ketamine (22mg/kg) as pre-medication and anesthetic respectively.

The incised skins in groups A and B rabbits were apposed with conventional silk and CHT sutures respectively while no surgery was performed in the group C rabbits (control).

Surgical sites in both groups were evaluated and the gross features: swelling, erythema and wound dehiscence (percentage suture breakage) were semi quantitatively assessed and scored at post-operative days (PDS) 1, 7, 10, 14 and 21 as described by Qiu *et al.* (2007). Clinical vital signs were taken and the bacterial load assessment was determined on the similar post-operative days (Cappuccino and Sherman, 2004).

Statistical analysis: Semiquantitative gross score values as well as the bacterial load counts in groups A and B were subjected to t – test. Clinical vital signs values in the three groups (A, B and C) were subjected to one-way analysis of variance (ANOVA). Significance was accepted at 5% probability level.

RESULTS

The results showed that the group sutured with CHT demonstrated a slightly higher rate of tissue reactivity (swelling) within the first 24 hours post-surgery compared to the group sutured with silk (Figure 1). However, the differences in the swelling in the two groups showed no statistical significance ($p > 0.05$) difference throughout the post-operative periods of the experiment. Tissue reactivity (erythema, and percentage suture breakage) in the two groups were also not statistically significant ($p > 0.05$) throughout the post-operative period of the study (Figures 2 and 3). Again the mean bacterial load counts (Figure 4) and clinical vital parameters such as heart rate, respiratory rate and temperature (Figures 5, 6 and 7) demonstrated no statistical significance ($p > 0.05$) in the study.

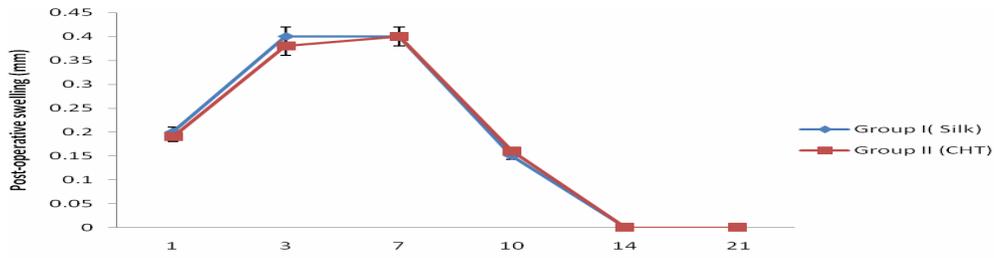


Figure 1 : Suture line swelling on the post-operative days

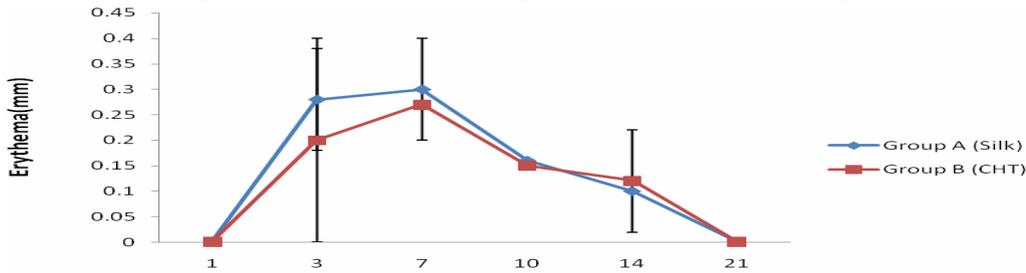


Figure 2: Post-operative erythema (mm)

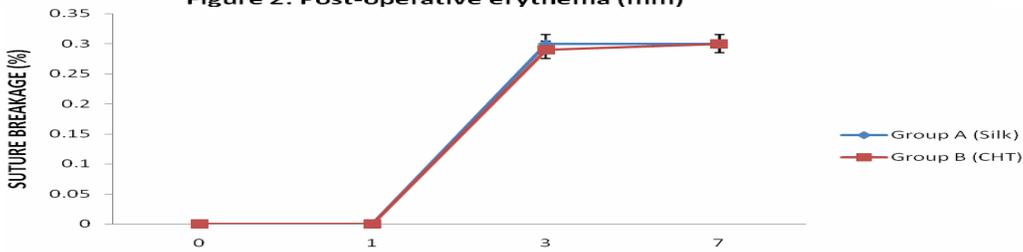


Figure 3: post-operative Mean Suture Line Breakage (%)

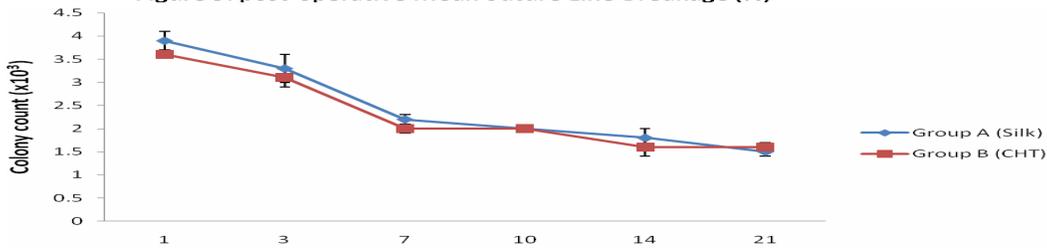


Figure 4: Colony counts (bacterial load) in the experimental groups (x10³)

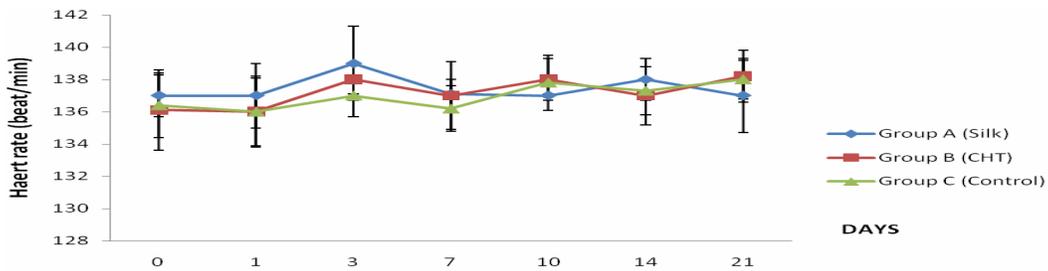


Figure 5: Pre and post-operative heart rates in the three groups

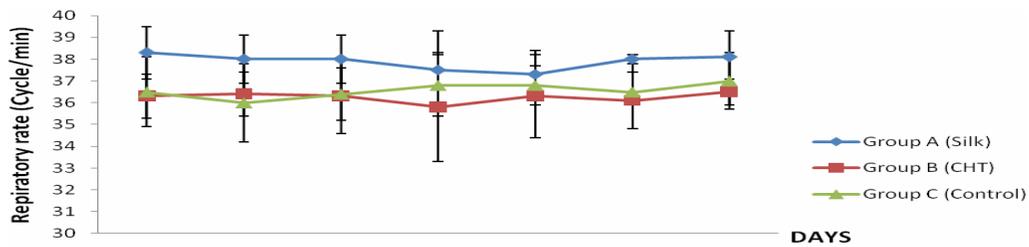


Figure 6: Pre and post-operative respiratory rates (Cycle/min) of the three groups.

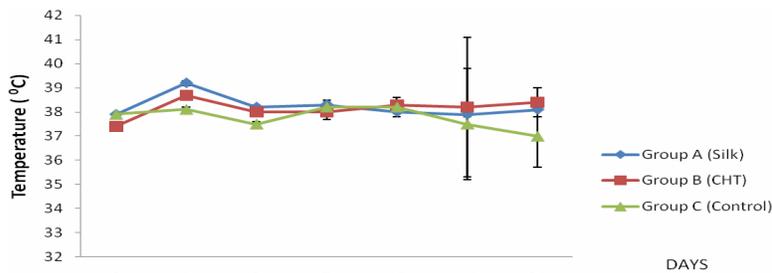


Figure 7: Pre and post operation body temperatures in the three groups

DISCUSSION

Black braided silk is an organic, multifilament, non absorbable suture material that is produced by silkworms (*Bombyx mori*) (Hurty *et al.*, 2002).

Conventional surgical cotton suture is a multifilament suture that is well tolerated by the tissues; it knots well and can easily be sterilized. The non conventional suture material (CHT) is made from long cotton fibers that are twisted into a strand (Knecht *et al.*, 1987). Cotton hair thread share gross physical attributes with silk as both are multifilament materials. However, while CHT is used for hair plaiting, silk is one of the standard skin suture used for both human animal surgical stitching. The tissue reactivity has been attributed both to the material itself (chemical composition) and to its physical multifilament properties (Li *et al.*, 2007). The multifilament structure of a suture increases the surface area for bacteria to be wicked into the suture tracts. Due to this natural wicking of the multifilament sutures, poor performance in animal would be expected because of possible surgical sites infection. Hurty *et al.* (2002) have documented that silk is moderately reactive in Koi carp (*Cyprinus carpio*) while Wagner *et al.* (2000) showed that silk incites marked tissue reaction in rainbow trout (*Oncorhynchus mykiss*). Similar reactivity in African clawed frogs (*Xenopus leavis*) has also been demonstrated (Li *et al.*, 2007). We anticipated similar results in rabbits. However, in the current study, silk and CHT (multifilaments) did not elicit marked tissue reaction throughout the study.

In the study, swelling and erythema noted in groups A and B 24 hours post-surgery may have been due to surgical tissue handling as well as presence of implanted suture in the tissue. Implanted sutures stimulate the immune system to react to the foreign material, thus eliciting an inflammatory response which is characterized by swelling, reddening and hotness which are characteristics of foreign body reaction (Boothe, 1993). The response is crucial for normal wound healing to occur. Swelling and erythema did not appear to be associated with any one type of suture, meaning that both possess similar quality. However mild swelling and erythema were observed in both groups (A and B) post-operatively after placement. This is in contrast with the marked tissue reactions (swelling) observed by (Wagner *et al.*, 2000) following the use of silk as external suture in Rainbow trout. But our observations agree with the work of (Hurty *et al.*, 2002) in Koi carp in which silk demonstrated mild tissue reaction.

The clinical vital parameters in the groups (A, B and C) demonstrated no statistical significance difference ($p > 0.05$) throughout the study. This is similar to what was observed by Mohammed *et al.* (2008) following approximation of laparotomy incision with silk suture in goats. The increased temperatures noted on post-surgical days 1 and 3 in groups A and B might be attributed to post-operative inflammatory complications following surgical trauma. This is related to the observations made by Mohammed *et al.* (2008) following elective castration in sheep. However, this observable increased temperature in groups A and B was statistically not significant ($p > 0.05$) when compared to the non-surgical group (Group C). No significant difference was noted in the bacterial load counts in the two groups. However, a stepwise decrease in the bacterial load counts (post-operatively) in groups A and B might be due to the effective role of the inflammatory cells.

Neutrophils and monocytes (macrophages) migrate into the wound site post-operatively for phagocytosis of the pathogens (Li *et al.*, 2007). Perhaps innate antimicrobial peptides produced by all mammals helped to prevent some contaminants from being wicked into the suture tracts (Eric *et al.*, 2010).

In conclusion, post-operative clinical and bacterial load counts features observed in the group sutured with CHT were statistically indistinguishable to the group sutured with conventional silk suture. These suggest that CHT could safely be used to close skin wounds in rabbits.

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