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Evaluation of maxillary sinus membrane repair using two different sutureless techniques

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Abstract

Aim: The aim of this experimental study was to evaluate the repair of maxillary sinus membrane clinically and histologically using two different sutureless techniques.
Materials and methods: This study was conducted on eighteen adult male New Zealand White rabbits selected in healthy condition, with an average weight between of 2–3 kgs. The rabbits were divided randomly into two equal group:Study group (chitosan group):- Eighteen rabbits in which right sinus membrane windows were repaired by chitosan membranes fixed with fibrin glue and the created bony defects were grafted with natural hydroxyapatite Control group (collagen group): The same rabbits in which left sinus membrane windows were repaired by resorbable collagen membranes fixed with fibrin glue and the created bony defects were grafted with natural hydroxyapatite.
Result: None of the eighteen rabbits exhibited any sign of infection during all postoperative periods, and repairing and maturation of sinus membrane perforation were seen more rapid in chitosan membrane group than collagen membrane group.
Conclusion: This study demonstrated that the use of chitosan membrane to close large sinus membrane perforations during sinus lift might offer a reliable technique. There was no failure in eighteen consecutive experimental situations. The clinical use of chitosan membrane for sinus membrane perforation repair might be recommended.

Keywords: Maxillary sinus membrane repair; Sutureless technique; Chitosan membrane; Collagen membrane; Fibrin glue; Natural hydroxyapatite

1. Introduction

Perforation of the Schneiderian membrane is the most prevalent intra-operative complication associated with the sinus elevation procedure. Small sinus membrane perforations may be adequately reconstructed and covered, and therefore are not an absolute contraindication to the continuation of surgery, provided that they do not allow the passage of graft material inside the maxillary sinus, the survival rates of these implants correlate inversely with the size of the perforations [1].

Chanavaz suggested that if a small perforation of less than (2 or 3 mm) occurs, surgery may be continued by releasing all the attachments of the membrane to the

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bone [2]. However, for a larger perforation, surgery must be interrupted, and the site must be hermetically closed. As has been extensively reported in the literature large perforations represent an absolute contraindication to continuation of surgery, especially if the graft material is granular or in chip form may cause loss of the graft into the sinus, lead to graft infection and early failure of implant procedure [3,4].

Sinus membrane repair can be problematic and unpredictable for both large perforations and membranes with complete tears, so suturing is not possible because the membrane edges cannot be approximated. In addition, these membranes are thin and will tear upon suturing [5].

The sinus membrane perforation repaired by various sutureless techniques including; collagen membranes, fibrin sealants, cyanoacrylate adhesives, and autologous fibrin glue have been proposed for managing these perforations [6−11]. At present, two methods are commonly used for such perforations; one involves a resorbable membrane and the other involves fibrin glue [4].

Fibrin glue is an adhesive, which was developed knowing that during the healing process in the living body, fibrinogen solidifies to form fibrin nets, which have an adhesive action. Several reports are available on closing the antral perforations with fibrin glue. There are cases in which closure of small perforations was obtained successfully without loss of graft material [8,12].

Chitosan, a deacetylated derivative of chitin (the chitin was isolated from shrimp shells). Chitosan is a natural biopolymer with a potential application in the tissue engineering and drug delivery fields, composed by (1-4)-linked D-glucosamine and N-acetyl-D-glucosamine. This biopolymer is obtained through the deacetylation of chitin, one of the most abundant naturally occurring polysaccharides and a waste material of the seafood industry [13].

Chitosan is biocompatible, biodegradable, and antimicrobial material. It acts as hydrating agent and possesses tissue healing and osteoinducing effect. Chitosan can be easily processed into membranes, gels, nanofibers, beads, nanoparticles, scaffolds, and sponges' forms and can be used in drug delivery systems [14,15].

The amino group in Chitosan has a pKa value of ~6.5, which leads to a protonation in acidic to neutral solution with a charge density dependent on pH and the %DA-value. This makes Chitosan water soluble and a bioadhesive which readily binds to negatively charged surfaces such as mucosal membranes. Chitosan enhances the transport of polar drugs across epithelial surfaces, and is biocompatible and biodegradable. Purified quantities of Chitosans are available for biomedical applications [4].

It is clear that the results of closure of large antral membrane perforation during sinus lifting were controversial and unsatisfactory. While the chitosan is a biocompatible, biodegradable, and antimicrobial material. It acts as hydrating agent and possesses tissue healing and osteoinducing effect. Chitosan can be easily processed into membranes. It was selected as a recent and novel material for closure of large sinus membrane perforations and was adopted to be applied on an animal model (rabbits) to avoid accentuation of the antral membrane perforation that was noticed with suturing techniques.

2. Materials and Methods

2.1. Animals

This study was conducted on eighteen adult white healthy male New Zealand rabbits, with an average weight of (2−3 kgs). The rabbits were obtained from local supplier, and were housed in the Faculty of Pharmacy, Pharmacology Department, Tanta University.

All rabbits were caged in specially designed cages with hygiene control in manufacturing and material handling. The rabbits were caged individually and supplied diet and water for two to three days for accommodation prior to the surgery and throughout the follow up periods. Temperature, humidity, ventilation, lighting, noise, chemical and microbiological control were considered.

The rabbits were divided randomly into two equal groups:

Study group (chitosan group):- Eighteen rabbits in which right sinus membrane windows were repaired by chitosan membrane[1] fixed with fibrin glue® and the created bony defects were grafted with natural hydroxyapatite.[2]

Control group (collagen group):- The same rabbits in which left sinus membrane windows were repaired by resorbable collagen membrane[3] fixed with fibrin

[1] Cognes, Chitopharm Postboks 193, 5501 Haugesund,Norway. ® Fibrin glue: Blood Bank product, Al-Shabrawshi Hospital, Doki Cairo Egypt.

[2] Eurr-oss hydroxyapatite 600-250 grand size, made at Pharco Company Cairo Egypt.

[3] Collagen membrane BioMend manufactured for Zimmer dental integra life Scienes corporation 311 Enterprise drive.,Plaibnsboro,NJ 08536 USA.