Glycerol Preserved Bovine Pericardium for Abdominal Wall Reconstruction: Experimental Study in Rat Model


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Summary

The aim of this study was to evaluate bovine pericardium surgical patch in rat model. Bovine pericardial sacs collected from local abattoir were cleaned, disinfected and cut into pieces of 3x2.5cm and preserved in 99.5% glycerol. Full thickness abdominal wall defects of 3x2.5 cm were created in 30 adult male Sprague Dawley rats and repaired with glycerol preserved pieces. The rats were serially sacrificed in a group of six rats at 1, 3, 6, 9 and 18 weeks post-surgical intervals for morphological and tensometric study. Macroscopically, no mortality or postoperative surgical complications was encountered except slight adhesions between implanted grafts and some visceral organs in 10% of the rats. Microscopically no calcification or foreign body giant cell formation was found in the explanted grafts. The implanted grafts were replaced gradually with recipient tissue, which made mainly of dense collagenous bundles. The healing strength between the implanted grafts and the recipient abdominal wall was gradually increased with time. The results of this study showed that glycerol preserved bovine pericardium act as scaffold for transformation into living tissue without clinical complications such as that associated with prostheses.

Introduction

Prosthetic materials are commonly used for replacement of lost abdominal wall muscle and fascia or for reinforcement of a repair accomplished by primary approximation of native tissue1. Post-surgical clinical complications associated with prosthetic materials2, initiate searching for biodegradable material that can be replaced by the recipient's tissue. Fast resorption and calcification are behind the failure of lyophilized and glutaraldehyde preserved bovine pericardium used for replacement of abdominal wall and cardiac valve respectively3,4. Therefore, the aim of this study was to evaluate the use of bovine pericardium preserved in 99.5% glycerol for repair of full thickness abdominal wall defect in rat model.

Materials and Methods

Fresh bovine pericardial sacs collected from local abattoir, were cleaned and cut into pieces of 3 x 2.5cm, disinfected in 0.05% sodium hypochlorite, shaken in serial changes of sterile normal saline for 60 minutes and then preserved in 99.5% glycerol at 4°C. The pericardial pieces were used to repair the same size of full thickness mid ventral abdominal wall defect created in a group of 30 male Sprague Dawley rats (350-400 g) aseptically and under general anesthesia. The rats were sacrificed at 1,3,6,9, and 18 weeks post implantation for macroscopic evaluation and specimens collection for H&E, Van Kossa, Man's Trichome staining and for SEM. Strips of 4 x 1cm were cut from explanted grafts for measurement of healing tensile strength between the implanted graft and recipient abdominal wall. The biomechanical properties of glycerol preserved bovine pericardium were measured by instron machine using 4 x 1cm strips. The bacterial load of the preserved grafts was also measured using Bioburden test.

Results

Bovine pericardium is fibro-collagenous in nature with few cellular elements. Glycerol preserved bovine
pericardium tensile strength and elongation rate were 9.804 ± 0.421 MPa and 43.16% respectively. Bioburden test was negative for bacterial growth. No mortality or postoperative surgical complications such as infection, hernia, and fistula were observed except slight adhesions between implanted graft and recipient liver and intestines. Microscopical findings showed that at one-week post implantation the graft was remained intact and infiltrated with inflammatory cells, adjacent to implanted graft there was newly developed connective tissue made of young collagenous fibers, fibroblast and newly developed blood vessels. The intensity of the inflammatory cells decreased with time intervals. The implanted graft was gradually replaced with dense collagenous fibers, and fibroblasts that changed into fibrocytes by the end of last post surgical intervals. No signs of calcification or foreign body giant cell were detected in this study. The healing tensile strength between the implanted graft and host abdominal wall increased with time intervals (Figure 1).

**Discussion**

The tensile strength of the glycerol preserved pericardium measured in this study is far beyond the 16N/cm (0.16 MPa) reported by U Klinge1 for physiologic strength of human abdominal wall. The result of Bioburden test obtained in present study agrees with BJ Van1 who reported about glycerol antibacterial properties. Macroscopic observations and the histological findings in this study confirmed the histocompatibility of the glycerol preserved bovine pericardium with recipient animal tissue. Absence of calcification in present study showed the safety of glycerol preservation compared to glutaraldehyde preservation, which associated with calcification1. Gradual replacement of the implanted graft with recipient tissue in this study is in accord with JA Werkmeister2 who reported about the merits of biodegradable biomaterials over the synthetic one. The results of this study revealed that glycerol preserved bovine pericardium act as scaffold for transformation into living tissue without post-implantation surgical complication. However, further investigations are required about the ability of glycerol preservation to inactivate and eliminate BSE Prion and other transmissible disease agent before it is recommendation for clinical application.

**Fig. 1:** Healing tensile strength between implanted grafts and the recipient abdominal wall

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**References**


