Mineralization of Short Term Pericardial Cardiac Patch Grafts

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Mineralization of Short Term Pericardial Cardiac Patch Grafts

Abstract
Glutaraldehyde fixed patch grafts of bovine pericardium were implanted in myocardial windows in young (3-4 months old) sheep. The samples were retrieved after one to three weeks for study with scanning electron microscopy (SEM) and energy dispersive x-ray microanalysis (EDX).

A layer of porous material (pseudoneointima, PNI), consisting mostly of a dense mesh of fibers interspersed with blood cells, was noted to form on the blood contacting surface of the graft. Four distinct sets of mineralization were noted in the retrieved grafts: (1) at the blood contacting surface of the PNI; (2) within the PNI at the junction between layers of PNI with differing densities; (3) near the junction of PNI and pericardium (but in the PNI); and (4) within the pericardium.

In both the PNI and pericardium the mineral was shown by EDX analysis to contain both calcium and phosphorous indicating the mineral to be a calcium phosphate. Mineralization in the PNI differed from that in the pericardium; in the PNI it was deposited in discrete regions and apparently in association with thrombi while in the pericardium it was distributed diffusely within the collagen matrix, which may influence its formation.

Disciplines
Hematology | Medical Cell Biology | Medicine and Health Sciences | Veterinary Medicine | Veterinary Microbiology and Immunobiology

Author(s)

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What relation did that great wave to the silicea stones? The answer in this question may give a clue as to where the stone came from.

Authors: The crystalline was crystallized and closely applied to the stone.

Secondary: The crystalline was crystallized and closely applied to the stone. In the absence of a clear understanding of the properties of entities containing silicea which were removed by surgery, or the parts which also have other common urinary tract components, can be admitted in the paper.

Authors: We refer to the possibility of similitudes of stones in patients. We, however, believe that for the single case clined, the stone was being managed by the person who handled the Similis symptomatically composed of silicon dioxide. We were able to identify the extent of the purpose of the paper. It is stating our belief that silicon dioxide stones do exist in the absence of suppression trichloroacetic injection. We feel that the exclusion of the cases discussed in the paper is valid.

K.K. Sia: Have there been studies on the kinetics of silicon dioxide crystal nucleation and growth in amorphous solution?

Authors: Studies of the Amorphous by M. J. Bhella, John Wiley and Sons, New York 1982. It is to show any known correlation between silicea calculus and nephrolithiasis.

Abstract

Gastrographin fixed patch grafts of bovine pericardium were implanted in subcutaneous windows in young (4-5 months old) sheep. The samples were retrieved after one to three weeks for study with scanning electron microscopy (SEM) and energy dispersive x-ray microanalysis (EDX).

A layer of porous material (pseudomesenchyme, PM), consisting mainly of a dense mesh of fibers interlaced with blood cells, was seen to form on the blood contacting surface of the graft. The four distinct sets of microstructures were seen in four distinct stages of differentiation in the contact surface of the PM: (1) within the PM at the interface between layers of PM with differing densities; (2) near the junction of PM and periosteum (3) near the junction of PM and periosteum (4) within the peritoneum.

In both the PM and peritoneum the mineral was shown by SEM analysis to contain both calcium and phosphorus. Mineralization in the PM differed from that in the peritoneum. In the PM it was deposited in discrete regions and apparently in association with the collagen matrix. A schematic representation of the mineral deposit is described.

Keywords: Pericardium, scanning electron microscopy, x-ray microanalysis, mineralization, pseudomesenchyme

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Introduction

Bioprosthetic valves and vascular conduits are used extensively to correct both congenital and acquired circulatory defects. Gastrographin fixed pericardial valves and grafts constructed of bovine pericardium are commonly utilized; these yield good long term results in animals. In clinical application of these grafts it has been reported that the bioprosthetic valves and conduits have been reported to be primarily due to calcification of the prosthetic.

Calcification results in altered mechanical properties and functional impairment which often requires replacement of the device. We report herein, preliminary results of a study designed to investigate mechanisms underlying mineralization of bioprosthetic materials. Specifically, we examine the formation of mineral in bovine pericardial grafts implanted in the young sheep.

Materials and Methods

Gastrographin fixed patch grafts of bovine pericardium were implanted in subcutaneous windows in young (4-5 months old) sheep (Fig. 1). Clinical quality processed pericardium was supplied by Shirley Laboratories of Fresno, Califonia. The grafts consisted of pericardium approximately 0.5 mm in thickness. The grafts were surgically implanted in both subcutaneous and intravenous walls using subcutaneous sutures. Post implantation graft retrieval period ranged between seven days to 21 days.

Patch grafts were removed from the sheep after induction of anesthesia and anticoagulation with heparin. The graft was surgically exposed, the sheep were exsanguinated and the graft with surrounding pericardial fat and muscle were rinsed in isotonic physiological solution and then freeze-dried. Specimens were then mounted on 100-mesh grids with silver paint and coated with thin layer of gold. A JOEL 3C 3500 and a Jeol 7000 energy dispersive x-ray
The ultrastructure of native periodontium was well documented. It consists of three layers: acellular, fibrous and epithelial. The thickness of these layers, the fibres, is composed of collagen, non-collagenous proteins, and some glycosaminoglycans. The basal lamina is well developed in the periodontium, separating the periodontium from the overlying bone.

Histological examination of the periodontium showed that the periodontium consists of two main components: the collagen fibres and the non-collagenous proteins. The collagen fibres are arranged in a regular pattern, forming the collagen fibres network. The non-collagenous proteins are mainly glycosaminoglycans, which are present in the extracellular matrix.

The ultrastructure of the periodontium was studied using electron microscopy. The periodontium was found to consist of a complex network of collagen fibres, non-collagenous proteins, and glycosaminoglycans. The collagen fibres are arranged in a regular pattern, forming the collagen fibres network. The non-collagenous proteins are mainly glycosaminoglycans, which are present in the extracellular matrix.

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Figure 8. SEM of mineral particles.

Figure 9. Calcium map of mineral seen in Figure 8.

Figure 10. Micrograph of bone contact surface of the PM (magnified 15,000x). Clumps of mineral can be seen occupying reticulated spaces.

Discussion and Conclusions

This study clearly shows that soon after implantation of periodontal patch grafts a PM forms on the bone contacting surface. The PM is composed of a dense mesh of fibers interposed with bone cells. At this stage of PM development, no ingrowth of cells from the surrounding tissue was noted. In some specimens, the PM was seen to consist of layers of differing density. The most dense zone was adjacent to the periodontal membrane in close contact with the bone contacting surface of the PM; remnants of thrombi could be observed throughout the layers.

A major finding of this study was that mineralization occurred within three weeks of implantation. Mineralization was seen at five distinct sites: (1) at the bone contactting surface of the PM; (2) at the junction of PM layers of differing density; (3) near the interface of the periodontium with the PM; (4) within the periodontal defect; and (5) within the periodontal defect. It is likely that the mineralized zones show characteristics similar to those of the PM seen in human bone. This finding is consistent with the idea that thrombi can become mineralized, with mineralization of the PM, additional mineral is incorporated and sequenced within the bone-like material. The presence of mineral deposits may be the crystallization of calcium phosphate in the PM. Thus, the presence of mineral may indicate that specific bone-related factors may be preferentially taken up at sites of mineralization. Together, thrombus formation, bone and mineralization processes may control mineralization in discrete sites in the PM.

Acknowledgments

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References


Figure 11. Distribution of mineral in the PM (stained using silver impregnation technique). The PM is stained black. The PM is not mineralized. The PM is not mineralized.

Mineralization of Grafts: A CD34 positive cells are seen occupying reticulated spaces.

Authors: We have no competions for this post.

Figure 12. Location of mineralization in the PM (stained using silver impregnation technique). The PM is stained black. The PM is not mineralized.

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