دراسة تجريبية عن التفاعلات النسيجية للاستم العظمي

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Tissue Reaction to Bone Cement: An Experimental Study

(With 3 Figures)

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Summary

An experimental work was performed in dogs to study the reaction of bone to implanted acrylic cement in the holes bored in the lateral surface of the mandible. Response of bone tissue adjacent to the acrylic cement was good and repair occurred with no evidence of bone necrosis. A thin layer of fibrous connective tissue was present between the acrylic material and the adjacent bone.

Introduction

The use of self-setting acrylic cement in bone surgery is relatively limited. It can be used as a tooth implant (Hodosh et al., 1964) and in fixation of mandibular fractures (Kangur et al., 1976). There have been very little histopathological studies in human beings. Animal studies are conflicting. In the early published work little or no fibrous tissue was found between the cement surface and bone or soft tissues (Waerhaug and Zander, 1956), while recently, the intervention of layers of thick fibrous tissue has been reported (Shklar et al., 1966 and Harmel, 1970). Other workers pointed out to the occurrence of malignant transformation resulting from tissue contact with polymethyl methacrylate (Oppenheim et al., 1958 and Stinson, 1966).

The present study was carried out to investigate tissue bone reaction against an acrylic cement in dogs.

Material and Methods

The study was conducted on 9 apparently health mongrel dogs aging 1-4 years and of 8-19 Kg body weight.

The animals were anaesthetized with i.v. thiopental sodium, ten minutes after i.m. tranquilization with Cohnilen (Bayer) in a dose of 0.05 ml/kg body weight. The extroral approach was used during the surgical intervention. Periosteum was then reflected from the site of the last molar to a point just posterior to the canine tooth. Three holes were drilled into the lateral surface of the body of the mandible. These retentive holes were approximately 0.5 cm in diameter. The depth extended just into the cancellous bone. Saline irrigation was used during the operation.

In a sterile container 10 cm of orthopaedic bone cement polymer (polymethyl methacrylate) were mixed with 5 ml of the corresponding liquid monomer (methyl methacrylate). The retentive area was maintained in a dry condition. The bone cement was inserted into two holes as a doughy state and compressed, while the third one remained as a control. The excess of the soft bone cement had been trimmed. The surgical area was flushed with saline and the periosteum was closed with 3/0 chronic sutures. The skin was then sutured as usual.

Three dogs were killed at 2, 4, and 6 weeks after operation. The bone segments were carefully removed and fixed in 10% neutral buffered formalin. The specimen were decalcified and stained with haematoxylin and eosin.

Results

All dogs did not show any change in appetite and maintained their post-operative weights.

Microscopical examination of the bone specimen revealed no haemorrhage, blood vessels were intact, no evidence of acute inflammatory reactions and the borders of bone holes which adhered to bone cement appeared more or less regular. The later was mainly due to formation of a narrow band of highly vascular connective tissue.

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between bone surface and the implanted cement (Fig. 1). Small bone fragments and speueules occuring in the area undergo resorption (Fig. 2). Active osteoclasts were observed both around these bone remnants and adjoining the serrated edges of the bony holes. At many sites, the surface of the later was covered by a single layer of osteoblasts probably originating from the blood vessels. Narrow rim of newly deposited bone matrix was occasionally observed (Fig. 3).

In one sample, the neighbouring cancellous bone revealed areas consisted of connective tissue associated with some giant cells and early fibrillar bone formation. Periosteocytic osteolysis was observed in the lacunae of adjacent bone.

**DISCUSSION**

In the present study, microscopical examination revealed that the implanted bone cement could remain in the healthy bone tissue without any signs of rejection. Clinically, no inflammatory signs were observed around the implanted cement. Histologically, the reaction induced by it was mild and that bone healing of injured area of bone proceeded to an advanced stage at the end of experimental duration.

These results are in agreement with many investigators who found that the inclusion of acrylic cement in tissues was associated with the formation of thin fibrous connective tissue band filling all the defect produced by the surgical bur (CASTELLI et al., 1971 and YAMAN et al., 1973) and with no features of bone or formation of fibrocartilage (SHKLAR et al., 1966 and KANGUR et al., 1976). However, YAMAN et al. (1973) observed an irregular layer of a necrosed bone adjacent to the acrylic material.

In the present experiment, fibrillar bone formation and periosteocytic osteolysis were found in the adjacent bone area of one case. These changes may occur probably under thermal effect produced during polymerization of the cement at the moment of injection.

OPPENHEIMER et al. (1958), HUEPER (1959) and STINSON (1966) have warned of carcinogenic potential of acrylic resin since they were able to induce the formation of fibrosarcomas after a relatively short period of time when the resin was implanted subcutaneously in small laboratory animals.

No evidence whatever of dysplastic epithelium was observed in our experiment. This is in agreement with SHKLAR et al. (1966) who stated that there has not been the slightest histologic indication of premalignant lesions, and certainly there has been no occurrence of malignant transformation resulting from tissue contact with the polymethyl methacrylate.

**REFERENCES**


Tissue Reaction


Fig. (1): Regular surface of implanted hole with a narrow band of vascular connective tissue (10 X 10).

Fig. (2): Bone resorption at the surface of operated hole. An osteoclast lying against bone surface (10 X 10).
Fig. (3): Affected area in the neighbourhood of operated hole showing depolymerization of bone matrix and fibrillar bone formation. (10 X 10).