ETHYLENE OXIDE STERILIZED, FREEZE-DRIED DURA MATER FOR THE REPAIR OF PACHYMENINGEAL DEFECTS*

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During the past several decades, many substances have been evaluated in the search for an ideal material with which to repair defects of the dura mater. These have included metal foils (gold, silver, nickel, aluminum, platinum, stainless steel, tantalum), biological tissues (fascia lata, periostium, peritoneum, fat), nonviable membranes (amnion, allantoic membrane, amnioplastin, Cargile membrane), and miscellaneous substances (celluloid, cellophane, rubber, olive oil, parchment, Gelfoam, fibrin film, Vinyon N, Orlon). The aim of these attempts has been to find a substitute that would simulate the properties of autogenous dura mater, but no one of these materials has fulfilled all the requisite criteria.

The present study was directed toward finding a natural rather than artificial tissue substitute that would be biologically acceptable and that could be sterilized and preserved without losing functional integrity. The tissue chosen was dura mater from homologous and heterologous species. It was sterilized chemically by immersion in ethylene oxide and preserved by freeze-drying. This biological, but nonviable tissue has physical properties approximating those of autogenous dura mater. It was implanted into surgically created dural defects for evaluation as a substance of replacement.

METHODS

A craniotomy was performed and bilateral, large dural defects were created in 12 male mongrel dogs. The defects were repaired with a total of 24 dural grafts, representing 3 experimental groups of animals. In the first group of 4 dogs, fresh autogenous grafts were placed on one side to be compared with ethylene oxide sterilized, freeze-dried homologous canine dura mater on the other side; in the second group of 4 dogs, fresh autogenous grafts were placed on one side to be compared with treated heterologous human grafts on the other side; and in the third group of 4 dogs, treated homologous canine grafts were placed on one side to be compared with treated heterologous human grafts on the other side. The grafts were inserted...
with their margins tucked under the edge of the host dura mater in such a manner as to insure an overlapping of the host dura mater above the graft on all sides (Fig. 1). The graft lay freely in situ without fixation by sutures. Sutures were not used so as to avoid the introduction of any foreign body into the area tested other than the material to be evaluated. In alternate animals, a 1.0 × 1.0 × 0.5 cm. injury was made in the leptomeninges and cerebral cortex subjacent to the center of the dural defect prior to grafting. The injury was created by multiple needle punctures and electrocauterization. Upon completion of the dural repair, the bone flap was replaced and the incision was closed in layers. All animals received 600,000 units of long-acting Benzathine Penicillin G, intramuscularly, on the day of operation. No anticonvulsant medication was given. The dogs were observed and sacrificed at intervals of 6, 12, 18 and 24 weeks. Sacrifice was achieved by intracardiac formalin perfusion, following which the brain and meninges were removed en bloc. The anterior one-half of each graft was reflected for gross examination; the posterior one-half was maintained in contiguity with the brain for histologic preparation and study.

**PREPARATION OF THE ETHYLENE OXIDE STERILIZED, FREEZE-DRIED DURA MATER**

Homologous and heterologous dura mater were obtained from the dog and man, respectively, within 12 hours of death. No sterile precautions were taken at the time...