The Fate of Free Grafts in the Common Bile Duct *

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THE SEARCH for a suitable tissue graft to restore continuity in a common bile duct injured by disease or trauma has attracted many investigators. A wide variety of free tissues has been utilized experimentally, but none can be relied upon to replace such defects and function satisfactorily. Murray and Jones [9] reported failures in bridging the common duct of dogs with fresh autografts of vein. Pearse *et al.*[10] reported unfavorable results utilizing free venous grafts in the reconstruction of the extrahepatic biliary system of the dog. Leary and his associates [6] used preserved bile duct homografts and concluded they were not suitable for bridging defects in the dog's common bile duct. Sedgewick [15] reported failures in dogs in attempting to repair common duct defects with free ureteral grafts. Ulin [17] and co-workers reported unsatisfactory results with the use of autogenous and homogenous fresh and preserved grafts of blood vessel, ureter, and common duct, in reconstructing the common bile duct of the dog. Hardin and Kittle [4] concluded that free arterial and split thickness skin grafts were not suitable for bridging defects in the common bile duct of the dog.

Success has been reported by some investigators using free grafts to reconstruct the common bile duct of the dog. Lord and Chenoweth [7] reported the use of fascia and vitallium tube in the common bile duct of nine dogs with two strictures, two strictures in six survivals of ten venous grafts, and one survival in five peritoneal grafts. Schatten and co-workers [14] employed free split thickness skin grafts to bridge defects of the common bile duct of 23 dogs and 31 per cent developed strictures. Shea and Hubay [16] reported success in 14 of 21 animals surviving 10 to 208 days utilizing free venous grafts over Blakemore-Lord tubes.

In the majority of instances, free tissues interposed in the common bile duct uniformly lose their identity by a process of destruction and replacement by scar tissue. The resultant circumferential and longitudinal contracture produces a stricture which has defeated attempts to repair the common bile duct in this manner.

Two series of experiments have been performed which seem pertinent to this problem. In the first, segments of autogenous bile duct, artery, and vein and segments of homogenous bile duct were grafted in the common bile duct of the dog. In the second series, autogenous grafts of common bile duct were interposed in the femoral artery of the dog to determine the survival of this tissue in an environment other than that of the common bile duct.

Experimental Procedure

In all experiments, adult mongrel dogs were utilized. Intravenous pentobarbital anesthesia and strict asepsis were employed. In the postoperative period intravenous fluid and antibiotics were used as indicated,

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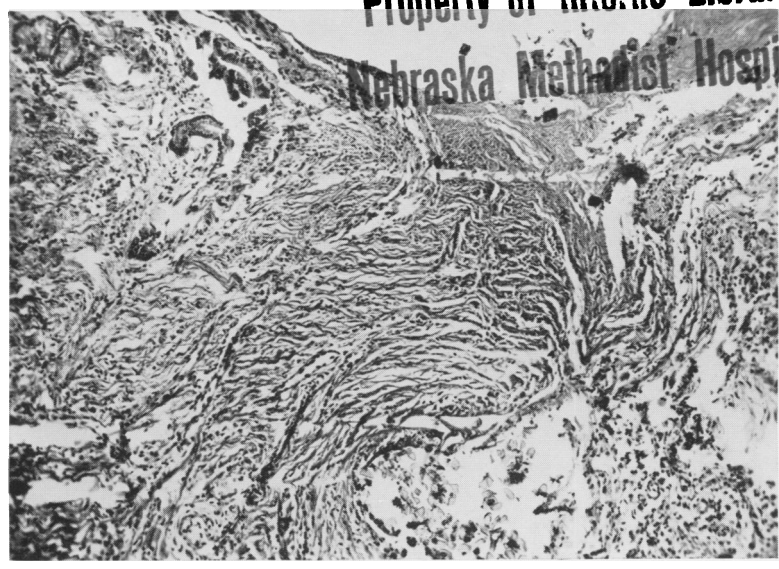

FIG. 1A. Homogenous bile duct graft at 377 days postoperatively.

and the animals were maintained on vitamin enriched high protein diets. In the first series, 28 dogs were utilized. The common duct was transected and resutured in five control dogs. Seventeen free segments of autogenous femoral artery, vein, and common duct, were removed and kept in physiological saline for the few minutes required for the preparation of the recipient site and each was then sutured in an end-to-end fashion in the common bile duct defect over a polyethylene tube. In six other dogs, free segments of homogenous bile duct were removed during simultaneous operation and grafted end-to-end with exchange of the grafts between the two animals.

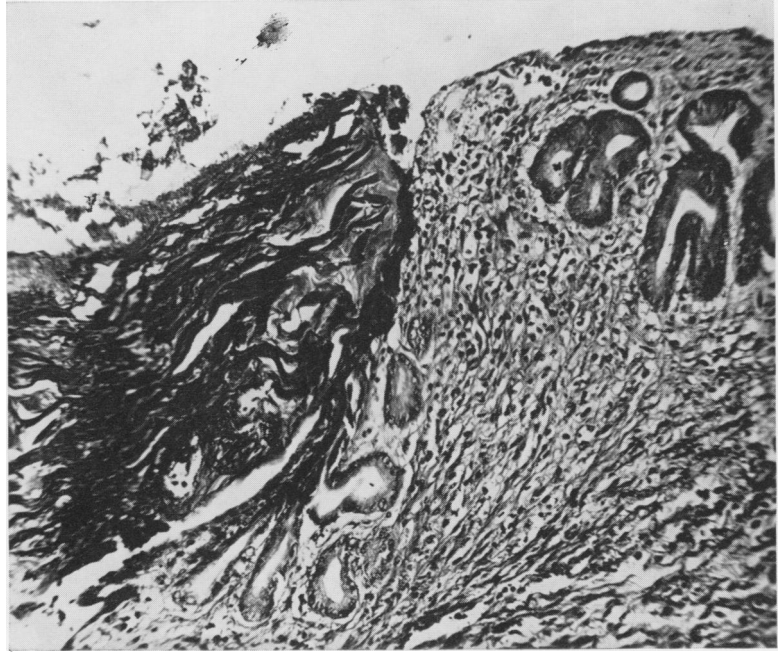

FIG. 1B. Autogenous artery graft at 64 days postoperatively.

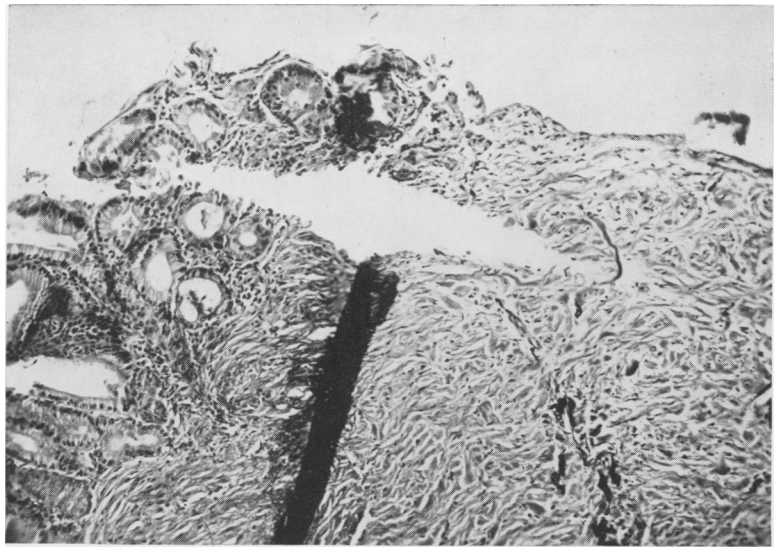

FIG. 1C. Autogenous bile duct graft at 313 days postoperatively.

These dogs were autopsied at death or when sacrificed from three days to 449 days postoperatively. Eight dogs survived less than 13 days. The average survival of the remaining dogs living beyond 51 days was 187 days. Examination of the transected common bile ducts used as controls up to 449 days postoperatively showed no evidence of stricture. In the group grafted, there was uniform failure in restoration of

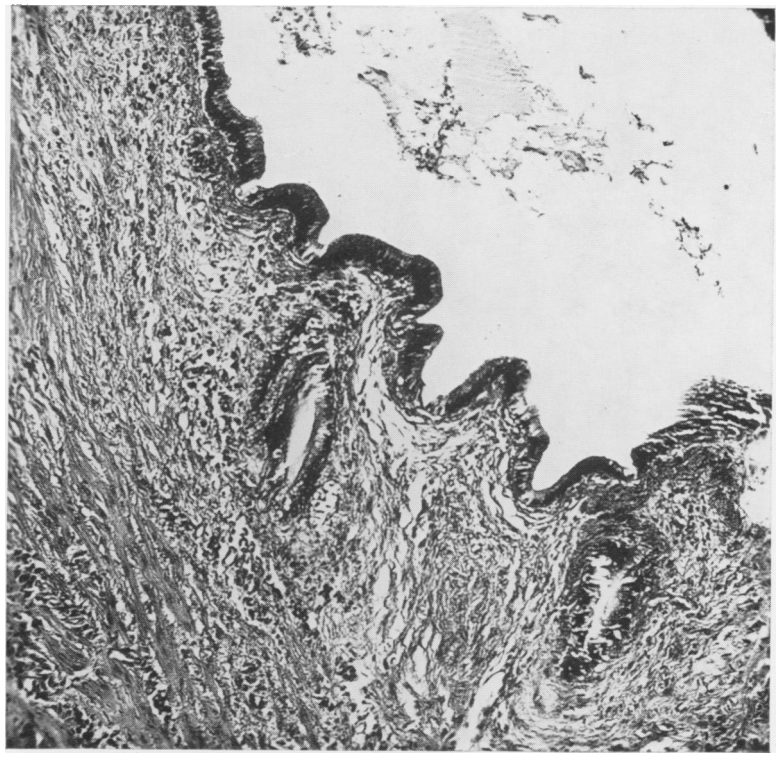

FIG. 2. Photomicrograph at 120 days of autogenous common duct grafted into the femoral artery of the dog. Note the preservation of the architecture of this grafted segment.

continuity of the common bile duct. The mucosa, or lining endothelium, and the wall of the graft were destroyed in all cases and replaced by scar tissue. In none was there evidence of epithelialization with bile duct epithelium. The resultant circumferential and longitudinal stricture produced marked to complete obstruction of the common bile duct.

In the second series, seven autogenous grafts of common bile duct were removed under aseptic conditions and used to replace segments of femoral arteries of similar length. Biliary continuity was maintained by end-to-end anastomosis or cholecystoenterostomy.

In this series all animals survived. They were sacrificed between the 90th and 120th postoperative day and the grafted common duct was examined grossly and microscopically. The results were uniform. The integrity of the mucosa and the wall of the grafted duct was maintained in each instance. There was no fibrous tissue replacement. In all respects the grafted tissues resembled the normal biliary tract epithelium, submucosa, and retaining wall.

Discussion

Homografted tissues are rejected by the recipient as a result of an actively acquired immunity.[8] The fact that these tissues are rejected does not defeat in all instances the purpose for which the tissue was grafted. The very satisfactory experience with aortic homografts is a notable example of this fortunate circumstance. The rapidity of destruction, as well as the degree of associated fibrosis, varies with the intensity of inflammatory reaction set up by the graft as well as the environment into which the tissue is transplanted.[3]

Autografts are not rejected immunologically and in general are received well when transplanted as complete cell entities in favorable transplantation sites. If the cells of the autografts survive the initial transfer and are not subjected to unfavorable influences at the recipient site, they tend to flourish and function in their usual fashion and follow their normal physiological cycle of cell senescence, death, and new cell replacement.[11] The survival of autogenous bile duct as a complete cell entity when transplanted into the femoral artery of the dog reported here, is further proof of this fact.

In either type of graft, the environment into which the tissue is transplanted is important. The irritating characteristics of bile are known and its adverse effect upon the regeneration of biliary mucosa has been demonstrated.[2] In the first series of experiments reported here, both homografts and autografts transplanted into the environment, either failed to survive initially, or if they survived, underwent a process of dissolution in which all cellular elements were destroyed and the entire graft was replaced by fibrous tissue. In all animals surviving 51 days and beyond, marked stricture formation occurred. In no graft did the epithelial or endothelial lining survive, nor was there any regeneration of recipient biliary epithelium to cover the grafted segment. Autografted bile duct did survive as a complete cell entity when transplanted into a more favorable environment.

This experience and that of others would indicate that it is unlikely that free tissue grafts will ever function satisfactorily to bridge defects in the common bile duct. The work of Anderson and Hoer,[1] Ulin, *et al.*,[18] and that of Remine and Grindlay,[12] suggests an advantage in using vascularized autografts to repair defects in the common duct. The use of jejunal pedicle grafts as reported by Kirby and Fitts[5] has further appeal in that these grafts contain a mucosa which resists the inflammatory effect of bile. Experiments are in progress at present utilizing vascularized autografts of bile duct to determine the effectiveness of such grafts in the reconstruction of common bile ducts.

Summary

The failure of free homogenous grafts of common bile duct and free autogenous grafts of vein, artery, and common bile duct, to repair satisfactorily defects in the common bile duct of the dog is described. The survival of autogenous bile duct as a complete cell entity when transplanted into the femoral artery of the dog is reported.

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Discussion

Dr. Frank Glenn: I think that the reported experience of Dr. Jones is a very excellent one. I think that the mortality rate is most unusual. I should like to show you a slide of an experience—

(Slide) This is a composite of our results at the New York Hospital dating back to 1932. I should like to point out three things.

In the first place the type of operation is most important in the treatment of acute cholecystitis. Cholecystostomy as has been emphasized by Dr. Jones should be employed whenever there is a contraindication to risking injury by doing a cholecystectomy.

Now as far as the mortality rate is concerned I would point out to you that the mortality rate with cholecystostomy is quite high in those over