

Lining of Autogenous Vein Patch Grafts of Small Canine Arteries.* (29498)

JAMES A. HARPER,[†] MICHAEL M. STUMP,[‡] WALTER S. HENLY,
MICHAEL E. DE BAKEY, AND BÉLA HALPERT

*Cora and Webb Mading Department of Surgery and Department of Pathology, Baylor University
College of Medicine and Veterans Administration Hospital, Houston, Texas*

Patch grafting of small arteries is a relatively recent procedure(1-5) that is increasing in significance as the technique is improved and the application widens. Small canine arteries were patch grafted with autogenous veins of whole thickness to permit study of the intimal surface.

Materials and methods. Autogenous vein patch grafts were placed in 22 femoral arteries of 13 dogs. Microsurgical technique was used. The grafts were sutured with 7-0 black silk. Patches were placed in the mid-portions of the superficial femoral arteries where the external diameter was 0.2 to 0.4 cm. Patches used were 0.9 to 3 cm long and 0.3 to 0.4 cm wide, and were taken from adjacent femoral or saphenous veins. The patch was sutured into a longitudinal slit made in the recipient artery. The animals were observed for periods from 2 to 531 days. Peripheral pulses were recorded at weekly intervals. Prior to termination of the experiment, patency was demonstrated by aortography. The removed specimen was placed in physiologic saline. Silver nitrate solution, 0.4%, was then applied to the

intimal surface. After rinsing and immersion in 10% formalin, the intimal surface was exposed to a sunlamp until it darkened. The specimens were then studied *en face*. Subsequently, pellicle preparations were stained with hematoxylin and eosin(6). Conventional microscopic preparations were also made from cross sections of the arteries with the patch, and were stained with hematoxylin and eosin, Weigert's elastic tissue stain, or Masson's trichrome stain.

Observations. Healing was studied on 11 arteries with patches in place for 2, 2, 4, 14, 22, 30, 35, 45, 55, 60, and 66 days respectively; and on 11 arteries with patches in place for 18, 25, 32, 39, 45, 49, 57, 70, 72, 74, and 76 weeks respectively. In every grafted artery, arteriography disclosed complete patency with no or slight dilatation at the site of operation. This is well illustrated in an arteriogram (Fig. 1) of dog MM 50 with patches in place for 4 days (left) and 66 days (right) respectively. The patency of the arteries with patches in place for 45 and 70 weeks, respectively, is illustrated in Fig. 2 (FF 72).

FIG. 1. Arteriogram of femoral arteries with venous patches in place for 4 days (left) and 66 days (right), respectively. Sites of the patches are hardly discernible.

FIG. 2. Arteriogram of femoral arteries with venous patches in place for 45 weeks (right) and 70 weeks (left), respectively. Only slight irregularity of contour is discernible.

FIG. 3. Gross appearance of inner surface of artery with patch in place for 35 days. Silk sutures are covered by a smooth membrane. Patch is slightly elevated above the surface. $\times 2$.

FIG. 4. Appearance of inner surface of the artery with patch in place for 66 days is similar to that in Fig. 3. $\times 2$.

FIG. 5. *En face* silver preparation of patch in place for 30 days. The mosaic pattern of silver stained cell borders is clearly outlined. $\times 100$.

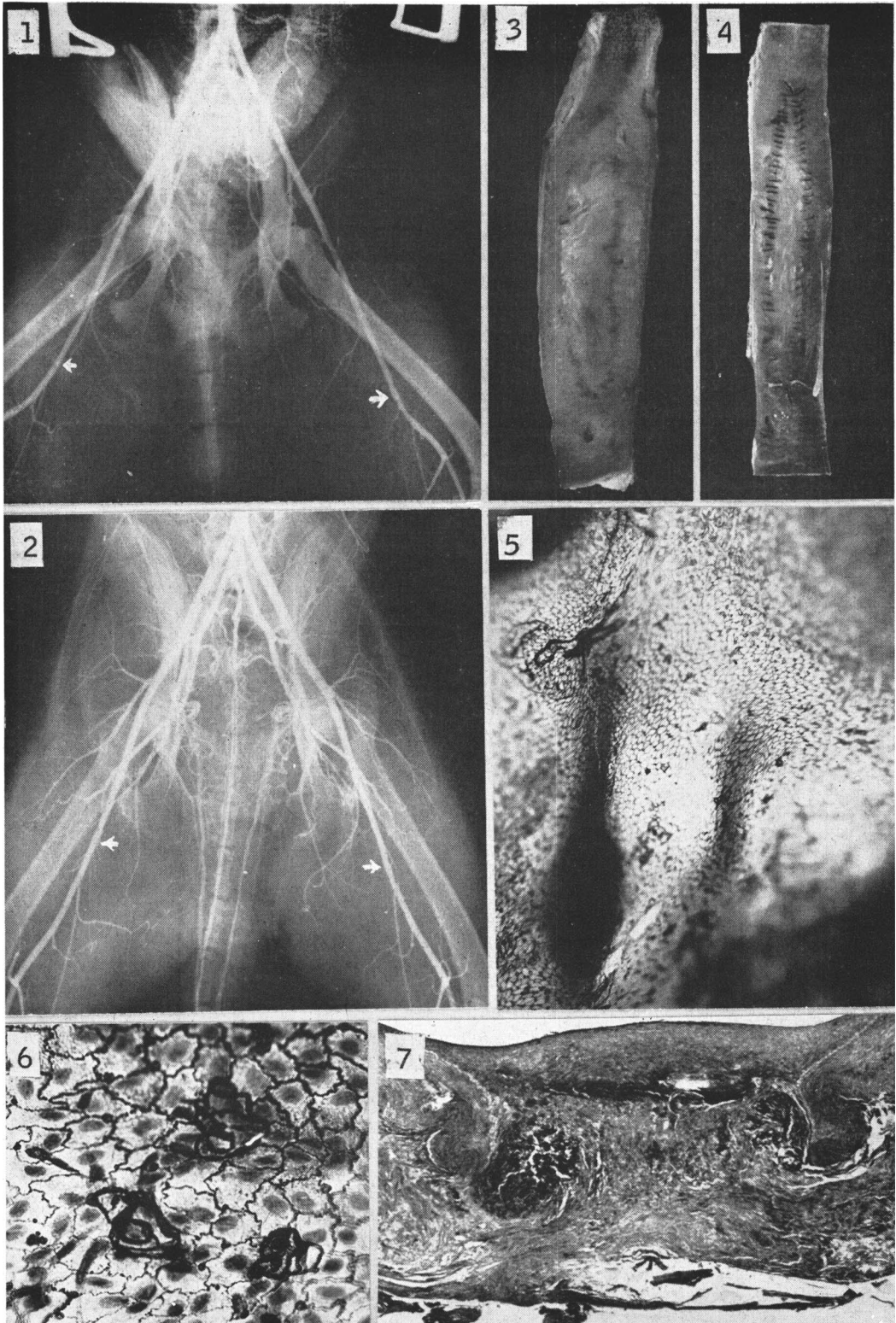
FIG. 6. Pellicle preparation stained also with hematoxylin and eosin reveals the cell nuclei within the endothelial cells. $\times 400$.

FIG. 7. Microscopic preparation of patch in place for 45 days. There is marked thickening of the subendothelial tissue of the graft, thinning gradually over the inner elastic lamina of the artery. The borders of the patch are clearly delineated. Masson's trichrome $\times 20$.

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[†] Present address: School of Med., Univ. of California, Los Angeles.

[‡] Baroness Erlanger Hospital, Chattanooga, Tenn.



Examination of the arteries disclosed a smooth intimal surface with the sutures clearly discernible. In Fig. 3 the patch was in place for 35 days (MM 45). In Fig. 4 the patch was in place for 66 days (MM 50).

En face silver preparations disclosed that the intimal surfaces of the grafts were covered with endothelium by the 4th day. Black silver stained outlines of cell borders in a mosaic pattern were seen as in Fig. 5 of the patch in place for 30 days (MM 37). The endothelial cells were demonstrated in pellicle preparations stained with hematoxylin and eosin. The endothelium that covered the intimal surfaces of the arteries and of the patches was alike and contiguous. In Fig. 6 is shown the pellicle preparation from the patch in Fig. 5, in place for 30 days.

On microscopic preparations of a patch in place for 45 days, the suture lines were discernible. There was marked thickening of the subendothelial tissue over the patch, thinning gradually over the inner elastic lamina of the artery. In the thick portion of the patch, shreds of elastic fibers, apparently remains of the vein wall, were discernible. The elastic lamina of the artery did not continue over the patch past the suture lines (Fig. 7).

Comment. Our experiments further demonstrate the feasibility of patch grafting of small arteries by microsurgical technique. This may be a further possible step in the repair of smaller arteries that are not amenable to replacement by vascular prostheses (7,8). The autogenous vein contributes its own substance, particularly the elastic fibers, to the repair of the arterial wall. Its surface towards the blood stream becomes covered with endothelium. The exact source of the endothelium has not been determined. However, it may be derived from the original

covering of the patch itself, from the adjacent arterial intimal lining, or from cells in the blood stream(9). In any event, the prompt lining of the patch with endothelial cells reduces the hazard of thrombosis at the site of the patch.

Summary. The inner lining of autogenous vein patch grafts placed into small canine arteries by microsurgical techniques was studied. The grafts placed in 22 femoral arteries of 13 dogs were kept in place from 2 days to 76 weeks. Aortography disclosed patency of all the arteries grafted with no or slight dilatation at the site of operation.

En face silver preparations disclosed that the intimal surfaces of the grafts were covered with endothelium after the 4th day. Endothelial cells were demonstrated in pellicle preparations. The patch contributed its own substance, particularly elastic fibers, to the repair of the arterial wall.

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