PATCHING OF INTRACRANIAL INTERNAL CAROTID ARTERY
IN MAN USING A PLASTIC ADHESIVE (EAST-MAN 910 ADHESIVE)*

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Intracranial arterial hemostasis has undergone considerable evolution from
the first muscle stamp to the present silver clip and cautery. These latter methods,
however, do not permit reconstructive vascular surgery, such as closing of an accidental
or elective arteriotomy (or venotomy), end-to-end orlar
sylvania.

society, the
Burklund
the
tially,
discussed
difficulties
of intracranial suturing have been
discussed in a previous publication;6 essentially, they are inaccessibility of the vessel,
inability to rotate the vessel because of minute perforators, thinness of the wall
of the vessel because of difference in structure from that of peripheral vessels,2,17 and limitation
of the time of occlusion. Certain of these factors may be modified by the use of mannitol
or of urea for greater exposure, and of hypothermia to allow for a longer time of occlusion
(distal perfusion still requires closure of an arteriotomy after removal of the perfusing
tube).

Suturing of intracranial arteries has been tried
in the past with limited success.13 Campbell and
Burklund6 have sutured the neck of two aneurysms of the middle cerebral artery, after excision
of most of the sac, using running 5-0 arterial silk,
with postoperative patency of the parent vessel.
Welch23 reported the case of a 47-year-old male in whom a thrombus was removed from the mid-
ddle cerebral artery by means of an arteriotomy;
the latter was closed with a single figure-of-8 silk
suture. Postoperative angiography revealed pa-
tency of the middle cerebral artery and its ascending branches. A second case showed postoperative
angiographic occlusion. We have closed a hole in a normal anterior cerebral artery, caused by
inadvertent avulsion of a small branch during retraction, using 6-0 double-armied arterial silk.
Scheibert22,29 has attempted endarterectomy and suturing of the middle cerebral artery in 5 cases,
with success in 1 case; there was return of blood
flow in both the middle and anterior cerebral
arteries. Sweet29 and Pool21 have failed to maintain
patency of the vessel after suture or by-passing
attempts.

Jacobson et al.9,14 also have performed endar-
terectomy and suturing of middle cerebral ves-
sels, using the dissecting microscope and ex-
tremely fine instruments and suture material;
patency was not achieved in their 2 cases. Their
results in peripheral arteries of the dog, with ves-
sels 1.5 to 4 mm. in diameter, have been impres-
sive; end-to-end anastomosis, and grafts, both autografts and homografts, of arteries and veins,
have remained patent. Seidenberg et al.28 have
had equally encouraging results in end-to-end
small peripheral anastomosis in both dog and
man using a meticulous technique with 6-0 ar-
terial silk without the microscope. Transfer of
these animal data to human cerebral vessels,
however, leaves much to be desired, as has been
shown above.

In earlier reports4,6,15 we have traced our interest in a nonsuture method of small-ves-
sel surgery using a plastic adhesive (Eastman
910 Adhesive). As of this writing, approximately
390 arteriotomies have been repaired in the carotid, femoral and mesenteric ar-
teries of the dog, using this method. These
vessels have varied from 1.5 to 4 mm. in exter-
ternal diameter, the majority being 3–4 mm.
Both linear incisions and holes in the vessels
(roof-patch) have been patched. Patency has
been achieved in 100 per cent of these

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patches, with verification by periodic angiography; some of the dogs have been followed for 2 years. A more detailed summary of patching, ring-anastomosis, stent anastomosis, and grafting, comprising 537 experiments in 164 dogs, is in preparation.

This experimental work has been supported and amplified by other investigators.18,24 Nathan et al.20 reported the use of a similar adhesive (Borden’s Ad/Here) in sealing arteriotomies in the dog’s aorta. Their histological studies were well done and agree with our own experience (to be reported). Healey et al.10,11 have worked out a slightly different method of sealing arteries and veins; they also have performed end-to-end anastomosis using split-rings (modified Fryfogle technique) and Eastman 910 Adhesive. Garrett and Law9 have used Borden’s Ad/Here in heparinized dogs to reinforce the suture lines between aorta and Teflon graft, with considerable reduction of postanastomotic loss of blood through the holes of the sutures.

We have hesitated to use this material electively intracranially in man (here, specifically in repair of blood vessels) prior to obtaining further experimental data, as follows: (1) duplication of the work on peripheral vessels in intracranial vessels of primates (now in progress); (2) demonstration of lack of toxicity of the material to the cerebral cortex, particularly concerning production of seizures; (3) further studies on sterility, with better packaging (sterile, 1-dose unit), a logical corollary. Certain other studies have been instituted by the drug company (Ethicon, Inc.) to insure the safety of the material (2-year study of implants, radioactive tagged studies for metabolic fate of the plastic, acute studies on toxicity, incorporation of a coloring substance for ease of application, etc.).

Both Smith29 and ourselves have implanted both the monomer and Eastman 910 Adhesive on the cortical surface of the dog hemisphere, without clinically observable toxic effects over a 6-month follow-up period; histological studies are not yet available. The adhesive has been used intracranially in man by Smith29 in watertight closure of dural flaps in cases of glioblastoma; by Tindall31 in sealing a cerebrospinal-fluid fistula; and by Araki et al.1 to coat and reinforce intracranial aneurysms in 2 cases after “inadequate resection or clipping of aneurysmal sacs” (the Eastman 910 Adhesive was combined with Hycar No. 1041 and Desmodur T). Clark et al.7 have used the adhesive to seal off the ends of a cut jugular vein in the neck, after radical dissection of the neck for carcinoma; and we have used the material for arterial patching after right brachial angiography in a 38-year-old female.

The present case report discusses the use of Eastman 910 Adhesive (monomer) in repairing a hole at the site of an aneurysm in the internal carotid artery intracranially, in which the material was used as an alternative to sacrificing the vessel.

CASE REPORT

R.L., a 61-year-old white male, on Oct. 12, 1961 complained of sudden onset of severe bifrontal and suboccipital headache associated with nausea, vomiting, and lethargy. Past history was noncontributory, except for mild hypertension of some duration. He was admitted to the Mount Sinai Hospital the same day (by M.D.H.).

Examination. The patient was a right-handed, somewhat lethargic and obtunded white male, with nuchal rigidity and positive Kernig and Brudzinski signs. The fundi were normal. There was no intracranial bruit.

The following laboratory studies were within normal limits: hemoglobin, hematocrit, counts of red and white blood cells, urine, blood urea nitrogen, platelets, bleeding and clotting time, prothrombin time, serology and roentgenograms of skull and chest. The electrocardiogram showed nonspecific changes.

Course. The patient was felt to have a subarachnoid hemorrhage, which was confirmed on lumbar puncture; the initial pressure was 340 mm. of cerebrospinal fluid and the fluid was grossly bloody. Bilateral carotid angiography was performed on Oct. 17, 1961. These studies revealed a bilobed aneurysm arising from the intracranial portion of the right internal carotid artery, pointing inferiorly and laterally; there was definite constriction of the internal carotid artery just prior to the origin of the aneurysm (Fig. 1).

Operation. On Oct. 23, 1961, while under hypothermia (30°C), a right frontal craniotomy was performed. The internal carotid artery on the right was identified and followed to its bifurcation into middle and anterior cerebral arteries (Fig. 2A). The internal carotid artery was yellow