Cyanoacrylate occlusion of a spinal cord arteriovenous malformation

Case report

M. Theodore Margolis, M.D., Patrick C. Freeny, M.D., and Michael M. Kendrick, M.D.
The Mason Clinic, Seattle, and Madigan Army Hospital, Tacoma, Washington

An arteriovenous malformation of the spinal cord was successfully obliterated by a percutaneous transcatheter technique using isobutyl 2-cyanoacrylate.

KEY WORDS spinal cord arteriovenous malformation embolization cyanoacrylate bucrylate

It has been shown that nonsurgical transcatheter embolic occlusion is a satisfactory method of obliterating feeding arteries to arteriovenous malformations (AVM's) of the spinal cord. Although posterior extramedullary malformations may be excised surgically, the success of the procedure depends upon total ligation of all the feeding arteries. Identification and ligation of these arteries may be difficult, and extensive arachnoiditis due to previous bleeding episodes, laminectomies, or residual contrast medium may make total excision impossible. Percutaneous transcatheter occlusion may be effective and simple and, if the malformation is intramedullary or anterior in location, it may be the procedure of choice.

In this report we describe the successful obliteration of an anterior AVM of the spinal cord by embolization, using isobutyl 2-cyanoacrylate, a rapidly polymerizing tissue adhesive.

Case Report

This 35-year-old sailor entered Madigan Army Hospital with a 2-year history of progressive spastic paraparesis, beginning with numbness and weakness in the left leg. He also complained of urinary urgency for 1 year, and a more recent onset of urinary incontinence and constipation. His past and family history was noncontributory.

At the time of admission the patient was able to walk only short distances without resting, and was unable to run. Initial examination revealed marked spasticity in the lower extremities with hyperreflexia, ankle clonus, and extensor plantar responses. He had mild pyramidal weakness of the legs, greater on the left than the right, and a sensory level to pinprick at T-8 bilaterally.

Mylrography revealed what appeared to be tortuous vessels extending from the level of T-1 down to L-2. Cerebrospinal fluid protein was 126 mg%. Complete spinal cord angiography demonstrated an AVM lying anterior to the cord at the T-7 level fed from a single intercostal artery at the T8-9 level on the left. Venous drainage was seen extending superiorly as far as T-4 and inferiorly past the T-12 level (Fig. 1). A Kerber calibrated-leak balloon microcatheter* was maneuvered into the intercostal artery at T8-9 on the left, and 0.5 cc of isobutyl 2-cyanoacrylate (bucrylate) mixed with an equal amount of Pantopaque was injected under fluoroscopic control. Post-occlusion angiography revealed obliteration of the AVM and a bucrylate cast within the intercostal artery (Fig. 2).

Following this procedure the patient improved transiently, but 1 month later he was again symptomatic and examination revealed no change from the preembolization examination.

*Kerber calibrated-leak balloon microcatheter manufactured by Cook, Inc., Bloomington, Indiana.
Repeat angiography demonstrated a new feeder arising from the left T6-7 intercostal artery filling the AVM via the artery of Adamkiewicz (Fig. 3). A Kerber catheter was maneuvered into the intercostal artery at T6-7 on the left, and 0.5 cc of isobutyl 2-cyanoacrylate mixed with 0.5 cc of Pantopaque was injected, obliterating the intercostal artery and the artery of Adamkiewicz (Fig. 4). At this time the patient complained of left lateral intercostal pain which cleared in 3 days. Otherwise, there was no change in the neurological examination.

The patient noted a gradual and steady improvement following the second embolization procedure. By 6 weeks he was able to walk 10 blocks without resting, and had no urinary urgency or incontinence, although he continued to complain of constipation. His examination revealed normal strength in the lower extremities and absence of ankle clonus, although he continued to have some spasticity and mild sensory loss, greater on the right, below the mid-thoracic region. He returned to active duty in the Navy. At 6 months following the second embolization he has had no further improvement but no deterioration, and his neurological examination is unchanged from the examination at 6 weeks.

**Discussion**

Various substances have been used for vascular occlusion of spinal cord AVM's. These materials include muscle, metallic pellets, Gelfoam, Silastic spheres, and induction of occlusion by use of a Fogarty balloon catheter.\(^1,3,5,8,14,15\)

---

Fig. 1. Arteriovenous malformation (AVM) of the spinal cord demonstrated by selective injection into the T8–9 intercostal artery on the left. **Upper Left:** Anteroposterior view in the early arterial phase. **Right:** Venous drainage progressing superiorly to the level of T-4 and inferiorly to T-12. **Lower Left:** Lateral view demonstrating anterior position of the AVM.
It is difficult to predict the ultimate site of impaction of particulate emboli, and they frequently block proximal arteries rather than occlude the fistula itself. If the emboli are too small, they may pass through the shunt to the lungs. An inert plastic that could be injected as a liquid and polymerize rapidly in the blood stream would have many advantages over particulate material. Silicone fluids have been used experimentally for this purpose, but this material is viscous and precise polymerization at the desired site is difficult to control.

Isobutyl 2-cyanoacrylate (bucrylate) is a liquid bio-adhesive that polymerizes immediately on contact with blood. Its unique advantages include the following: 1) low viscosity, and therefore capability of delivery via small catheters; 2) tenacious intravascular positional stability, and therefore lack of undesirable peripheral embolization; 3) high-flow (AVM) occlusive capability; and 4) lack of significant contiguous tissue or systemic toxicity in humans. Its disadvantage is that it is still an experimental drug, obtainable only with permission of the Food and Drug Administration.
Occlusion of the arterial feeder within the spinal canal theoretically would exclude potential collateralization from adjacent intercostal or lumbar vessels. Impregnated with tantalum for visibility, bucrylate has been used to occlude a renal arteriovenous fistula and a spinal cord AVM. A relative disadvantage of bucrylate is its almost instantaneous polymerization. This usually means only the proximal portion of the feeding vessel can be occluded and there is danger of gluing the catheter in place. Pantopaque used in place of tantalum in a 50:50 mixture with bucrylate slows the polymerization process, allowing the polymer to travel into the more distal branches of the feeding arteries and lessening the risk of being unable to withdraw the catheter. This technique worked satisfactorily in our patient.

References

2. Cromwell L, Freeny PC: Personal communication, 1978

Address reprint requests to: M. Theodore Margolis, M.D., The Mason Clinic, 1100 Ninth Avenue, Seattle, Washington 98101.