VERTEBRAL ANGIOGRAPHY BY RETROGRADE INJECTION OF THE BRACHIAL ARTERY

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VERTEBRAL angiography has become of sufficient value in the diagnosis of lesions of the posterior fossa to warrant exploring new methods to accomplish the procedure. The technique of filling the vertebral system has been described by many authors (Moniz, Shimizu, Sjöqvist, Takahashi, Sugar et al., Lindgren, Radner, Sergent, and Hauge), and there are many excellent descriptions of the vascular anatomy and pathology available. At present there are three methods in general use: vertebral arterial catheterization (Radner); percutaneous puncture of the artery in the neck (Sugar); and percutaneous puncture of the artery at the base of the cranium (Sergent). These techniques are designed primarily for use in adults and are difficult to perform in children. The catheterization technique, while described by Radner in a child aged 2 years, requires considerable experience and equipment that ordinarily is not available in a radiological department. Hence there remains a need for a more adaptable method of obtaining filling of the vertebral-basilar system in infants and children.

The purpose of this report is to present our experience in a series of 16 cases in which an attempt was made to fill the intracranial vascular tree by retrograde brachial artery injection. Since 1952 this procedure has been carried out upon 9 adults and 7 children, ranging in age from 7 months to 65 years. Successful filling of the posterior fossa circulation was obtained in 5 of the 9 adults and in all of the children. In the 4 adult cases classified as unsuccessful there was some degree of contrast medium in the vessels but it was considered insufficient for diagnostic purposes.

TECHNIQUE AND ANATOMY

General anesthesia with intravenous pentothal-curare solution and endotracheal nitrous-oxide and oxygen was used on all of the children and 4 of the 9 adults. In the remaining 5 adults the anesthesia was limited to local infiltration with 1 per cent procaine.

An incision 3–4 cm. long was made over the bicipital groove at the junction of the middle and distal thirds of the arm. The segment of the brachial artery exposed at this level is distal to the origin of the profunda brachii and the superior ulnar collateral arteries. The brachial fascia was incised and the neurovascular bundle identified. The median and ulnar nerves were retracted to expose the deeper lying brachial artery. A 2–3 cm. segment of the artery was mobilized and isolated by
placing behind it a small rubber dam drain. A needle with stylet was selected according to the size of the artery. An 18-gauge spinal needle was used in the child 7 months old, while a 15-gauge needle was easily introduced in the older patients. The needle was inserted in a proximal direction for 1–2 cm. The stylet was left in place throughout the procedure except during the actual injection. A small bulldog clamp was placed on the artery distal to the entrance of the needle to prevent peripheral flow of the contrast medium. The clamp was removed between injections. The amount of the contrast medium (35 per cent Diodrast) used varied according to the size and age of the patient. A volume of 8 cc. was sufficient for adequate filling in the 7-month-old child, and 15 to 18 cc. was used in the older children. In the adults, as much as 30 cc. was injected but the average was approximately 20 cc. The dye was injected as rapidly as possible to produce a "bolus" of Diodrast travelling refluxly through the brachial into the subclavian artery. When it reached the origin of the vertebral artery the "bolus" was carried with the normal blood flow into the vertebral-basilar distribution.

Three radiographic exposures were made with each injection. The first exposure was made just as the injection was completed: the others, at 1-sec. intervals thereafter. The anteroposterior exposure was made with the x-ray tube inclined 35° above a horizontal plane through the skull.

The needle puncture defect in the artery in children was closed with a single arterial suture of 5–0 silk; in adults the arterial suture was not necessary because pressure for a few minutes with a sponge resulted in adequate closure of the needle hole. The incision was closed with interrupted silk sutures and the arm was wrapped with an elastic bandage to prevent later formation of a hematoma.

With this technique both the vertebral and carotid systems are usually filled.

CASE EXAMPLES

Case 1 (849387). D.H. was a 65-year-old male who had a sudden onset of a left hemiplegia 5 months before admission to hospital. Persistent vomiting began 1 month before admission. There was a spastic left hemiplegia and paresis of the right
VI nerve. Roentgenograms of the skull revealed a shift of the pineal calcifications 5 mm. to the left. Brachial reflux angiogram (Fig. 1) revealed a 2.5 cm. saccular lesion communicating with the basilar vein. This was interpreted as a venous angioma, inaccessible to surgical excision. The patient expired 2 years later of a subarachnoid hemorrhage.

Case 2 (#858366). M.H., a 56-year-old housewife, had a spontaneous subarachnoid hemorrhage 24 hours before admission. Examination revealed nuchal rigidity
and blood in the lumbar cerebrospinal fluid. Bilateral carotid angiograms revealed no abnormality. Brachial reflux angiogram (Fig. 2) visualized the vertebral system without demonstrating a lesion. She was discharged from the hospital with a diagnosis of spontaneous subarachnoid hemorrhage, etiology undetermined.

**Case 3** (#874566). Y.S., a 12-year-old girl, had a spastic left hemiparesis that developed 2 years prior to admission. Severe headaches and occasional vomiting began 3 months before admission. Examination revealed a left hemiparesis, hemiathetosis and bilateral papilledema. Brachial reflux angiogram (Fig. 3) showed a shift of the anterior cerebral artery to the left. On the lateral projection displacement of the same vessel indicated hydrocephalus. No definite vascular pattern of a tumor could be seen. A ventriculogram revealed evidence of a tumor of the right thalamus. At operation, a cystic astrocytoma was found.

**Fig. 4.** Right retrograde brachial angiograms. Left common carotid artery compressed in the neck.
Note filling of both internal carotid systems and the vertebral circulation.

**Case 4** (#877346). M.B., an 11-year-old girl, had three episodes of focal seizures beginning in the left foot and leg. Neurological examination revealed no abnormality. Brachial reflux angiogram (Fig. 4) visualized the vertebral and carotid system on the right. On the second injection for anteroposterior views, with compression of the left carotid in the neck, bilateral filling of the carotid systems occurred in addition to the vertebral-basilar circulation. No abnormality was noted. She was discharged to return later for a pneumoencephalogram.

**COMPLICATIONS**

The only complication observed in this small series of 16 patients was tingling in the fingers in one patient. It was felt that this was caused by the use of more than the usual traction of the nerves to expose the artery. The
tingling ceased upon relaxing the traction. No neurological deficit could be found after the procedure was completed. No attempts have been made to inject the brachial artery percutaneously because it was felt that the danger of trauma to the median and ulnar nerves exceeded the disadvantages of a minor incision.

The possibility of spasm occurring in the brachial artery has been considered but was not seen in any of these cases. Radner and Hauge reported that this complication usually occurs when the catheter reaches the subclavian artery. Radner advised that a 2.5 per cent solution of papaverine hydrochloride be administered 1 hour before injection to prevent spasm from occurring. In none of our cases was medication employed to prevent spasm since the needle was introduced only 1–2 cm. into the brachial artery.

The site of the exposure was selected with the possibility that thrombosis might occur. Since the exposure is distal to the major collateral arteries the circulation should be entirely adequate if thrombosis occurs. In all of our cases radial arterial pulsations were easily palpated following removal of the needle.

The use of a stylet obviates the need for continuous saline in the interval between injections. The volume of saline needed to maintain patency of the lumen of the needle might overload an infant’s circulation.

No patient exhibited any reaction from the injection of Diodrast other than the usual flushing sensation similar to that seen during carotid angiography. One adult received a total of 175 cc. of 35 per cent Diodrast in five injections in an attempt to obtain adequate filling.

DISCUSSION

This procedure has proven quite successful in children. In addition to the vertebral filling there has been excellent visualization of the ipsilateral internal carotid circulation in all the children except one. On the anteroposterior projection, contralateral compression of the carotid artery in the neck improves the ipsilateral filling of the carotid system and may lead to adequate visualization of the distribution of both internal carotid arteries (Fig. 4). The filling of the right internal carotid circulation has been sufficient with this technique to justify its use for investigating lesions in younger children in whom percutaneous puncture might be difficult. However, carotid arterial filling cannot be expected when the left brachial artery is injected because the contrast medium would need to travel through the left subclavian artery and then in a retrograde direction in the aorta to reach the origin of the common carotid artery.

The results with this technique in adults have not been encouraging. The adult arteries are proportionately larger and consequently the greater quantity of blood dilutes the “bolus” of contrast medium. In order to overcome this dilution factor it was necessary to inject excessively large amounts of dye. The possible risk with the use of such large dosages makes this technique in adults less feasible than percutaneous vertebral artery puncture.
CONCLUSION

A technique for performing vertebral angiography has been described. It is recommended for use in children in whom it is desired to investigate the vertebral or right internal carotid circulation. It is not recommended for use in adults except when other attempts at vertebral angiography by the usual methods have failed.

REFERENCES


