Modification of the Richmond subarachnoid screw for monitoring intracranial pressure

Technical note

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The authors describe a modification of a subarachnoid screw for monitoring intracranial pressure by hydrostatic coupling of the subarachnoid space to an external transducer. The device can be used in both children and adults, and features more assured placement of the distal tip, increased stability, and enhanced safety on insertion.

KEY WORDS: intracranial pressure, monitoring system, head injury, Richmond screw, instrumentation

Simplicity, accuracy, and safety are important requirements for any device utilized for monitoring intracranial pressure (ICP). Despite controversy over the accuracy of convexity ICP measurement, we have found that the Richmond screw device, which employs hydrostatic coupling of the subarachnoid space to an external transducer, largely fulfills these requisites. However, there is usually some uncertainty regarding the precise depth of insertion, and frequently there is loosening and displacement of the device, especially in children. We have sought to modify the Richmond screw design to provide increased stability with respect to the calvaria, to safeguard against accidental plunging on insertion, and to adjust to varying skull thicknesses.

Description of the Device

The device currently used on the Neurosurgical Service at the Massachusetts General Hospital is shown in Fig. 1 left.* The screw threads extend to the tip of the shaft to provide grip in thin bone. An adjustable lockable collar designed to rest on the outer table of the skull can be moved along the shaft to match the measured skull thickness (see below). The collar is locked in place with an Allen wrench (Fig. 1 right). The collar insures accurate placement of the screw tip, prevents accidental plunging on insertion, and provides increased stability within the skull.

* Intracranial pressure monitoring device manufactured by Radionics, Inc., 76 Cambridge Street, Burlington, Massachusetts.
Modification of Richmond screw

We believe that precise placement of the screw tip is important. Insertion too deep can place the open end in brain substance and lead to blockage and loss of pressure tracing. Insertion too shallow may also lead to a poor tracing due to blockage by blood coagulum and debris within the skull hole. We therefore use a depth-measuring tool (Fig. 1 right) that has a flat end plate and millimeter markings to measure the depth from the outer table to the subarachnoid space.

Clinical Experience with the Device

This device has been used for continuous monitoring of ICP in 12 patients since February, 1983. There have been no complications associated with its use. It has been utilized in patients with subdural, epidural, and intracerebral hemorrhages as well as in patients with massive cerebral swelling after stroke and a patient with herpes simplex encephalitis. Duration of use averaged 5 days. In all patients, a pulsatile waveform was obtained throughout the monitoring period.

Two patients were evaluated while both the subarachnoid screw and an ipsilateral ventricular catheter were in place. One patient had undergone evacuation of a posterior fossa epidural hemorrhage and the other had had an intracerebral hemorrhage. In both patients, pressure measurements obtained over several days were virtually the same in recordings from both devices. Compliance testing via the ventricular catheter led to concomitant changes in the pressures measured by both the catheter and the screw. A graph detailing the result of compliance testing in the patient who underwent evacuation of a posterior fossa epidural hematoma is shown in Fig. 2. These data were obtained by sampling, independently, at 5-second intervals strip chart recordings of mean ICP measured by the ventricular catheter and the subarachnoid screw.

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References


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