Sonographic Imaging of Foramen Ovale Electrodes

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Objective. In patients with medically intractable partial epilepsy of mesiotemporal origin, video electroencephalographic monitoring with foramen ovale electrodes is necessary to plan neurosurgical interventions. Imaging of these electrodes after implantation hitherto required conventional radiography, magnetic resonance imaging, or computed tomography of the skull. These methods are expensive. Therefore, the aim of our work was to show the capability of more cost-effective transcranial B-mode sonography for visualization of the electrodes. Methods. In this pilot study, a 42-year-old female patient with implanted foramen ovale electrodes was examined transtemporally with a 2-MHz sector transducer to visualize the intracranially implanted electroencephalographic recording device. Results. Foramen ovale electrodes could be detected easily in the patient, and bedside monitoring of explantation was possible. Conclusions. We were able to show the applicability of transcranial B-mode sonography for visualization of foramen ovale electrodes in preoperative electroencephalographic monitoring of patients with epilepsy. Further evaluation of this method in additional patients will follow. Key words: foramen ovale electrodes; sonography; imaging; electroencephalography; epilepsy surgery.

Foramen ovale (FO) electrodes are important devices for the presurgical video electroencephalographic monitoring of drug-resistant epilepsy.\(^1\) Complications are rare but may be serious events such as subarachnoidal hemorrhage,\(^1,2\) brain stem lesions,\(^3\) and transient palsy of the fourth cranial nerve.\(^4\)

For implantation, the FO is punctured percutaneously, and a multicontact electrode is inserted under radiographic control. Usually a lateral radiograph of the skull confirms the correct location of the FO electrode (Fig. 1). Computed tomography or magnetic resonance tomography can be used for imaging the electrodes in the vicinity of brain stem structures (Figs. 2 and 3). All these techniques, however, have considerable drawbacks. Conventional radiography can only be used for visualization of the recording devices in relation to skull structures. Results of computed tomography or magnetic resonance tomography are often insufficient because of artifacts of the metal contacts of the electrodes and the

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Figure 1. Lateral radiograph of the skull with implanted FO electrodes.

Figure 2. Computed tomogram of the skull showing typical artifacts of FO electrodes in the vicinity of the brain stem.

base of the skull. Both methods are expensive and not easy to perform at bedside to exclude complications such as bleeding. Consequently, we decided to show the capability of more cost-effective transcranial B-mode sonography for visualization of the electrodes.

Materials and Methods

In this pilot study, a 42-year-old female patient was examined transtemporally with a 2-MHz sector transducer (S222 with a LOGIQ 500 sonographic system; GE Medical Systems, Milwaukee, WI) after implantation of the FO electrodes. B-mode scanning in the mesencephalic plane was performed. The FO electrodes were identified by imaging of their 6 recording sites. After long-term electroencephalography was finished, explantation of the electrodes was monitored by sonographic examination.

Results

The left FO electrode could be visualized easily close to the brain stem (Fig. 4). Imaging of the right electrode was possible but difficult because of echo interference with the base of the skull and the tentorium. Removal could be monitored with excellent quality.

Discussion

Because of technical problems, especially poor transtemporal penetration of ultrasound, the use of sonographic techniques in visualization of intracranial structures is limited in adults. To our knowledge, only a few attempts have been made to monitor intracranial insertion of biopsy needles or catheters sonographically. In one study, sonography was used to guide periventricular stereotaxis and could aid the biopsy of deep intracranial lesions.5 Cedzich et al6 applied a sonographically guided technique to the puncture of a Dandy-Walker cyst in a neonate.

Our approach of sonographic imaging of FO electrodes seems to be well suited for localization of the recording devices after implantation, because standard examination procedures can be used. Subarachnoidal hemorrhage is a rare but severe complication during explantation of electrodes.1,2 It has been shown that intracranial hemorrhage can be accurately diagnosed on the
basis of sonography in neonates, infants, and adults. Therefore, transcranial sonographic imaging is an ideal approach for the diagnosis of bleeding complications, especially during explantation of electrodes. Validation of our approach will be necessary in additional patients.

References