Use of an anteromedial subdural strip electrode in the evaluation of medial temporal lobe epilepsy

Technical note

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Intracranial monitoring electrodes have facilitated seizure focus localization as part of a workup for some patients who are candidates for resection to treat epilepsy. In patients without concordant noninvasive localization of the ictal onset but with clinical evidence of medial TLE, intracranial electrodes can provide important information regarding the site of seizure onset. Various devices, including depth (intraparenchymal), foramen ovale, and subdural strip electrodes have been used during invasive medial TLE evaluation. The standard scheme for subdural strip implantation involves placement of two electrode strips perpendicular to the long axis of the temporal lobe. These two (anterior and posterior) temporobasal strips allow reasonable coverage of the basal medial temporal lobe cortex. The authors describe the use of an anteromedial strip as an alternative to provide more extensive and consistent coverage of the entorhinal cortex and parahippocampal gyrus.

Surgical Indications and Technique

The anteromedial strip may be used to evaluate the involvement of medial temporal lobe structures in epileptogenesis among patients who are suspected of having temporal or extratemporal neocortical epilepsy in which the anterior sylvian fissure and superior lateral temporal lobe are exposed. The authors have used such strips for patients in whom no medial temporal lesion is evident on preoperative imaging. A subdural strip containing one row of 10 contacts (each 10 mm in diameter and 10 mm apart from their centers; Ad Tec Medical, Racine, WI) is typically used. After exposure of the temporal neocortex and placement of other depth or grid electrodes, this strip is held along the direction of the long axis of the temporal lobe and is advanced around the temporal pole underneath the lesser wing of the sphenoid bone. The strip will follow the curvature of the lesser wing. Ample irrigation with saline underneath the strip will allow a smooth and atraumatic passage. The strip is placed in its final position with the proximal last three to four contacts embracing the temporal pole surface (Fig. 1). The authors have not implanted an anteromedial strip through a burr hole; however, such placement may be considered if aided by stereotactic guidance and if the pterion is identified to assure proper placement of the strip around the temporal pole.

Discussion

Noninvasive evaluation in up to 30% of the patients referred for consideration of epilepsy surgery fails to provide adequate seizure focus localization. In these patients, electrophysiological examination of the cerebral cortex by using intracranial electrodes may allow precise definition of the epileptogenic zone. The number and type of electrodes necessary are tailored based on the individual patient. In TLE, evaluation of the medial cortex has been typically conducted using two temporobasal subdural strips (one row of four contacts). These strips are passed in a lateral-to-me-
dial direction until resistance is noted when the strips are in contact with the basal cistern contents. With this method the strips will be introduced in variable final positions.

The alternative placement of a single anteromedial strip may offer certain advantages. This procedure allows a more extensive coverage of the entorhinal cortex and parahippocampal gyrus along their long axis extending posterior to the level of the collicular plate (Fig. 1). The use of added medial subdural contacts may increase seizure detection sensitivity. Unlike the laterally placed subtemporal strips, the anteromedial strip follows a consistent path and final position as confirmed by postoperative MR images in every case in this series (Fig. 2). The strip is in position when the last proximal contacts provide coverage for the temporal pole. This is in contrast to the lateral temporobasal method of strip insertion, in which the strips are advanced and typically stopped by striking the delicate structures residing in the basal cisterns. Therefore, the use of the anteromedial strip may be considered safer and more reliable. No patient in our series had adverse effects related to this method of strip placement.

The efficacy of subdural electrodes alone in the diagnosis of the seizure focus in TLE has been documented in several studies, whereas in others their potential as a substitute for a depth electrode has been questioned. Eisenschenk, et al., reported localization of the TLE foci in 32 patients who were studied using bilateral hippocampal depth and subtemporal strip electrodes. In three patients, false localization based on the information provided by subdural electrodes alone occurred when compared with readings provided by the depth electrode. In all three cases, suboptimal subdural electrode placement lateral to the collateral sulcus (due to anatomical constraints) was achieved and noted on the postoperative MR images. The anteromedial subdural electrode strip provides multiple recording contacts medial to the collateral sulcus, facilitating epileptogenic zone lateralization.

The standard posterior temporobasal (subtemporal) strip may encounter and injure the bridging veins in the more posterior basal temporal lobe region, limiting lateral strip placement.
Anteromedial subdural strip electrodes

insertion. These bridging veins are not likely to be encountered during anteromedial strip placement. In addition, insertion of the anteromedial strip does not always require a standard frontotemporal craniotomy and extensive exposure of the lateral temporal cortex. This strip can be used during craniotomies for other approaches as long as the sylvian fissure is visualized to allow introduction of the strip along the correct path. If the strip is introduced superior to the sylvian fissure, it most likely will be placed underneath the frontal lobe.

The anteromedial strip may facilitate study of the hippocampal networks as they interact with entorhinal/postrhinal/perirhinal cortices, although it may not provide direct electrophysiological information about the hippocampus. Entorhinal cortex and hippocampus contain mutual facilitatory neural connections to create epileptiform discharges. Seizure onset has been detected by electrodes sampling hippocampus or entorhinal cortex independently. Nonetheless, epileptic discharges propagate from the hippocampus first to the ipsilateral entorhinal cortex and parahippocampal gyrus before further generalization. Further studies are needed to compare the data obtained from the bilaterally placed anteromedial strip and hippocampal depth electrodes. This information would allow an assessment of the efficacy of the anteromedial strip alone in seizure focus sampling and as a substitute for the hippocampal depth electrode.

Acknowledgment

We are indebted to Mr. David Factor for his expert preparation of Fig. 1.

References


Manuscript received April 11, 2003.
Accepted in final form June 30, 2003.
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