



Cerebral Vasospasm After Temporal Lobe Epilepsy Surgery: Clinically Important?

Cerebral Vasospasm Following Temporal Lobe Epilepsy Surgery.

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OBJECTIVE: Selective amygdalohippocampectomy (AHE) has been associated with postoperative cerebral vasospasm (CVS) in patients with medically intractable temporal lobe epilepsy. The incidence in temporal lobe resection (TLR) is unknown. This retrospective cohort study evaluates the incidence of and risk factors for the development of CVS in patients with TLR and AHE. **METHODS:** A total of 119 patients were included between 1998 and 2009. All patients were evaluated by standardized preoperative and postoperative transcranial Doppler sonography (TCD) evaluations and neurologic examinations. Postoperative CT scans were evaluated by an independent radiologist and the volume of bleeding within the resection cavity was quantified. **RESULTS:** Of 107 patients with longitudinal TCD data, 35 (32.7%) developed postoperative CVS. The incidence of CVS did not differ between patients with TLR and AHE. CVS was associated with female gender and a higher bleeding volume in the postoperative CT scan ($p = 0.035$ and 0.046). Patients with CVS showed a significantly higher incidence of postoperative neurologic signs and symptoms (48.6%) compared to patients without CVS (25%, $p = 0.015$). The mean length of stay was significantly prolonged in patients with diffuse CVS compared to patients with localized CVS or no CVS (28.8 \pm 10.9, 24.2 \pm 6.6, and 18.2 \pm 6.1 days, $p = 0.001$). **CONCLUSION:** CVS is a frequent complication of surgery for temporal lobe epilepsy irrespective of the resection method. Important risk factors for the development of postoperative CVS are female gender and a higher amount of bleeding in the postoperative CT. Patients with CVS more frequently have neurologic signs and symptoms resulting in prolonged hospital stay.

Commentary

Cerebral vasospasm (CVS) is well known to be clinically significant after subarachnoid hemorrhage and has been thoroughly studied in that setting. There has been limited study of CVS following cranial surgeries for tumors, vascular lesions and epilepsy. The incidence of transcranial Doppler sonography (TCD)-defined CVS after certain cranial surgeries has been documented in several studies, but its clinical significance has not been well characterized. There is reason to suspect that the incidence of CVS may vary among surgeries for various pathologies and among various surgical approaches and techniques for similar pathologies. It is important to gain a better understanding of the causes of postoperative CVS and understand its clinical significance.

The current study provides a large experience at a single center, documenting the occurrence of TCD-defined CVS following two different methods of temporal lobe resection for medically intractable temporal lobe epilepsy and the correlation of this CVS with neurologic morbidity. The two different methods of temporal lobe resection were selective amygdalohip-

pocampectomy (AHE) using the transylvian fissure technique developed by Yasargil (1) and the anterior temporal lobe (TLR) resection technique used by Falconer (2). This well-conducted study succeeds in demonstrating that TCD-defined CVS has a relatively high incidence following temporal lobe surgery, revealing some of the factors that may be causative. The study does not address the clinical significance of this TCD-defined CVS, but does demonstrate that it is associated with a higher incidence of postoperative neurologic signs and symptoms. This association certainly suggests that factors causing some of the postoperative neurologic morbidity may also cause the occurrence of TCD-defined CVS. However, it is important to note that postoperative neurologic morbidity typically is apparent immediately after surgery and that TCD-defined CVS is delayed in its onset. This study does not provide evidence of neurologic morbidity being associated with the time course of the TCD-defined CVS. Future studies will be needed to reveal the clinical significance of this TCD-defined CVS.

The current study identified several statistically significant findings. Female gender was associated with a significantly increased incidence of TCD-defined CVS. A higher volume of blood measured in the surgical resection bed on the CT scan done on postoperative day one was also associated with an increased incidence of TCD-defined CVS. The presence of



TCD-defined CVS was associated with a significantly higher incidence of postoperative neurologic signs and symptoms and a higher mean length of hospital stay (LOS). In addition, diffuse TCD-defined CVS was associated with a statistically significant greater LOS than was localized TCD-defined CVS, and patients with localized TCD-defined CVS had a greater LOS than did patients without TCD-defined CVS. Another important observation is that there was no statistically significant difference for the incidence of TCD-defined CVS between the two different surgical approaches (AHE and TLR). While these statistically significant findings are important observations, they may not have straightforward explanations. Although not directly reported, the results suggest that female patients undergoing surgery for TLE may be at greater risk for postoperative neurologic morbidity than are males. Fortunately, the incidence of neurologic morbidity after temporal lobe epilepsy surgery has been low, and gender has not been clearly identified as a risk factor (3, 4).

As noted by the authors, the current study, in large part, is an extension of the previous studies reported from the Bonn Epilepsy Group (5, 6, 7). These studies examined temporal lobe resection patients in the postoperative period to determine the incidence and degree of increased blood flow velocity or cerebral vasospasm. These studies were largely prompted by the previous observations of clinical CVS in patients after certain skull base tumor surgeries (8). As noted in the Discussion section of the current study, the Schaller study (5) showed greater blood flow velocity increases in the transylvian (TS) versus the transcortical (TC) approach for AHE. Also, this study found a different time course for the two approaches, with the velocity increase peaking at 7 days for the TS approach but at only 3 days for the TC approach. The authors postulated that this might be due to different underlying mechanisms, with delayed blood product degradation as the cause in the TS approach and mechanical disturbance postulated as the mechanism in the TC approach. Importantly, these studies focused on pooled blood flow velocity data and did not focus on the incidence of significant increases occurring after these surgeries. Furthermore, these studies reported no incidence of delayed neurologic morbidity, as might be expected if the delayed CVS was clinically significant. The current study did not identify a different time course for CVS occurrence between the two different surgical approaches, although it does not appear that the time course was systematically assessed, since the timing of the postoperative TCD's was not held uniform for the series. Although in distinction to the TS versus TC approach study, the two groups in the current study had similar incidences of CVS and similar degrees of blood flow velocity increase. This, along with the findings that increased blood volumes on the early postoperative CT scan correlated with an increased incidence of CVS in both surgical approaches, reinforces the authors' hypothesis that the CVS is likely due to blood product degradation in both groups.

Although the authors note in the Discussion section that a "high" amount of bleeding in the resection cavity was correlated with a higher incidence of CVS, the actual volumes of blood measured were modest in all groups. A more appropriate phrasing might have been that a higher blood volume correlated with a higher incidence of CVS. An interesting observation in this study was that the volume of blood measured on the

postoperative CT scans in the two surgical groups was very different, with the volume much greater in the TLR group than the AHE group, even in the TLR patients without CVS. One explanation for this is that the location of the postoperative blood may be more relevant than the absolute volume for the production of CVS. Another interesting observation of this study relates to the finding of "diffuse" or bilateral CVS in many postoperative patients. This also adds weight to the hypothesis that blood product degradation in the CSF is the likely mediator of delayed CVS. However, some other factor or factors may be involved in CVS production, and this may be determined in future studies.

It is important to note that this study was possible only because of the relatively long postoperative hospital stays of these patients. The typical postoperative stay for these patients in the United States would be 3 to 5 days, which would preclude the observation of CVS occurring more than 7 days after surgery. It is not clear why the patients in this study had a mean LOS of 21 days. Furthermore, as acknowledged by the authors, the longer length of stay for the patients with CVS may be due only to the identification and treatment of the CVS and not related to any other factor. Further, since there was not delayed onset neurologic deficit that suggested that the CVS was symptomatic, there is no evidence that the treatment instituted for the TCD-defined CVS was beneficial.

The phenomenon of delayed CVS after cranial surgery remains minimally documented and poorly understood. The current study represents a significant contribution to our knowledge in this area and should prompt further studies. It will be particularly important to expand our understanding to other pathologies undergoing cranial surgery and identify situations in which TCD-defined CVS is associated with clinical consequences. Once identified, it is these situations in which it will be important to identify the role for therapeutic interventions.

by Robert R. Goodman, MD, PhD

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