

## Critical Discussion and Commentary



E-quiz code: 31707N

### Issue Highlights

These articles have been selected by the Coordinating Editor as Key Reviews.

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## Open Microsurgery's Role in the Management of Giant Aneurysms

Experienced neurosurgeons can achieve excellent results with surgery as the first-line management approach and endovascular techniques as adjuncts

By Nicholas C. Bambakidis, MD

Based on: Sughrue ME, Saloner D, et al. Giant Intracranial Aneurysms: Evolution of Management in a Contemporary Surgical Series. *Neurosurgery* 2011; 69 (December): 1261–1270.

Giant intracranial aneurysms continue to pose significant challenges in management. Endovascular techniques continue to evolve, but open surgical treatment remains an important modality. The objective of a recent study is to provide information regarding outcomes following open surgical treatment in a single-center experience. In their methods, the authors reviewed their experience in the treatment of 140 patients with 141 giant aneurysms over a 13-year period. Of these cases, most aneurysms, 100 in fact, were located in the carotid circulation. The results reported a total occlusion rate of 77% with 23% of aneurysms left with some residual. Overall surgical mortality was 13%. Common complications included bypass occlusion, hemorrhage, thrombosis and stroke. Good outcomes were achieved in the majority of patients, 81%, and a permanent neurological morbidity rate of 9% was reported. The authors concluded that open surgical treatment of giant intracranial aneurysms remains an important tool with excellent results. There has been an evolution away from hypothermic circulatory arrest and toward a heavy reliance on bypass techniques and indirect aneurysm occlusion.

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reasonably good and certainly superior to endovascular outcome, in which the problem commonly becomes a chronic disease necessitating multiple retreatment and life-

long imaging follow-up. The evolution of surgical treatment away from hypothermic circulatory arrest and toward a pattern of bypass and flow diversion with trapping mirrors our own clinical practice in dealing with these lesions. Modern adjuncts of surgical treatment in-

cluding fluorescence videoangiography and real-time intraoperative flow measurements continue to increase the safety of complex bypass procedures. However, nothing replaces surgical experience, and these lesions should be treated in large tertiary care centers with open cerebrovascular surgical expertise. The authors note that flow diverters may provide a future endovascular means of treating these aneurysms. In fact, use of flow diverters in such situations has been associated with significant thromboembolic complications, primarily related to perforator thrombosis. For this reason, such diverters have only been approved for use in the United States in the carotid circulation. In fact, they may never be shown to have superior outcomes when compared to the techniques described in this article.

This paper is an important adjunct in the literature regarding the treatment of giant aneurysms. In experienced hands, the outcome of open surgical treatment is

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Chair, National Brain Aneurysm Center  
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## Go Slow & Gentle for Brain Mets

Whole-brain radiation therapy to 40 Gy in 20 fractions may be superior to treatment to 30 Gy in 10 fractions for brain metastases

By N. Scott Litofsky, MD, FACS

Based on: Rades D, Panzner A, et al. Dose-Escalation of Whole-Brain Radiotherapy for Brain Metastasis in Patients With a Favorable Survival Prognosis. *Cancer* 2011; December 13: epub ahead of print.

Whole-brain radiation therapy (WBRT) may be the only reasonable treatment option for some patients with brain metastases. Patients with favorable survival profile may live long enough to develop local (intracerebral) recurrence. Therefore, the authors of a recent study sought to compare local control and survival of brain metastases with WBRT 30 Gy in 10 fractions versus 40 Gy in 20 fractions. They designed a retrospective, single-institution case cohort to answer their questions.

Patients with favorable prognosis were defined using a prognostic scoring system based on age (< or ≥60 years), Karnofsky Performance Score (KPS) (>70, 70, or <70), extracranial metastases (absent or present), number of brain metastases (one, two to three, or ≥4), and interval from tumor diagnosis to WBRT (≤6 or >6 months). Patients were either treated with 30 Gy in 10 fractions or 40 Gy in 20 fractions at physician discretion. Local control (absence of progressive or recurrent brain metastases) determined by magnetic resonance imaging and overall survival rates were compared. Subgroup analysis was performed on patients with less radiosensitive tumors (renal cell carcinoma, colorectal cancer and malignant melanoma).

Of 184 patients, 109 patients received 30 Gy and 75 received 40 Gy. With median follow-up of 13 months, local recurrence occurred in 68% (at nine months median). Local control was associated with female gender and KPS >70. Cohort median survival was 15 months; no significant differences were observed for 30 Gy (13 months) and 40 Gy (17 months). Univariate analysis showed improved survival associated with 40 Gy, female gender, and interval from tumor diagnosis to WBRT >6 months. Rate of grade ≥2 acute toxicity was equivalent between treatment plans (17% for 30 Gy, 15% for 40 Gy), as was late toxicity (21% for 30 Gy, 19% for 40 Gy). For less radiosensitive tumors (27 patients), one-year local control rates (38% versus 7%) and survival rates (73% versus 40%) were significantly better for 40 Gy WBRT.

Based on these results, the authors conclude that WBRT of 40 Gy in 20 fractions may result in better intracerebral control and overall survival than 30 Gy in 10 fractions for patients with relatively good survival prognosis, particularly for less radiosensitive tumors.

This study suggests that WBRT to 40 Gy in 20 fractions may be associated with better survival in patients with a favorable prognosis from their cancer in comparison to treatment with 30 Gy. For patients with less "radiosensitive" tumors, both local control and survival may be better with smaller-fraction-to-higher-total-dose plan. Biases of patient selection are not

defined. Comparison of formally tested neurocognitive function was not done; improved results might be expected in the 40 Gy plan, as well. A randomized study is warranted to see if a slower and gentler treatment plan is better.

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## Radiosurgery Palliates Recurrent GBM

Single-fraction stereotactic radiosurgery can be used effectively for palliation of recurrent glioblastoma multiforme

By N. Scott Litofsky, MD, FACS

Based on: Sirin S, Oysul K, et al. Linear Accelerator-Based Stereotactic Radiosurgery in Recurrent Glioblastoma: A Single Center Experience. *Vojnosanit Pregl* 2011; 68 (November): 961–966.

Despite standard treatment for glioblastoma multiforme (GBM) of surgical resection, radiotherapy, and concurrent and adjuvant temozolomide after surgery, most patients' tumors recur. Stereotactic radiosurgery (SRS) can deliver tumoricidal doses precisely to tumor volume to reduce toxicity. Therefore, the authors of a recent study sought to report their experience of single-dose SRS to recurrent GBM patients. They reported their single-institution case series.

Between 1998 and 2010, patients with Karnofsky Performance Score (KPS) >70 and histologically confirmed GBM identified as recurrent by neuroimaging were candidates for SRS. All had previously received 54 to 62 Gy radiotherapy (median dose 60 Gy) in daily 2 Gy fractions. Temozolomide treatment prior to recurrence was available. SRS was delivered using a head frame for localization, and microscopic disease was covered with 3 mm expansion of target volume (GTV) in all directions. Dose constraints were 10 Gy for all critical structures. Radiation was delivered in single 360°, double 360°, or five 180° arcs to prescription tumor volume (PTV). Follow-up with MRI was initially at two months, then every three months thereafter. MR spectroscopy was used to assess radiation necrosis.

Nineteen patients were treated with SRS for GBM recurrence five to 49 months (median nine) after initial radiotherapy. KPS was 90–100 in nine, 80 in eight, and 70 in two; 57.9% had received temozolomide prior to recurrence. Median PTV was 13 cc (range 7–19), and median margin dose was 16 Gy (10–19) to the 80–95% isodose line. Median overall survival from diagnosis of initial GBM was 21 months (6.1–58.8 months). After SRS, median progression-free survival was 5.7 months and overall survival was 9.3 months. No acute toxicity greater than grade 2 were observed; 15.8% had headache, nausea and vomiting, which resolved after steroid treatment. Seventy-nine percent had local tumor control with median duration seven months. All patients died of tumor progression.

Based on these results, the authors conclude that single-fraction SRS can be a safe and well-tolerated palliative treatment for recurrent GBM.

In my opinion, this study illustrates the potential palliation that can be achieved in patients with recurrent GBM utilizing

SRS. The authors did not indicate the total number of GBM patients under their care, but over the 12 years of the study, only 19 patients were treated with SRS. By definition, all had good KPS. The authors did not define other treatment modalities used at recurrence, such as chemotherapy in addition to or different from temozolomide. They also did not discuss incidence of delayed radiation necrosis or neurological outcome.

The data presented suggest that relatively few patients are candidates for SRS, but with appropriate selection criteria, those treated can have reasonable responses. In our center, we use SRS sparingly for recurrent GBM and other recurrent high-grade gliomas. Some results have been quite gratifying, others less so.

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## Should NICUs Be Staffed With Trained Neurointensivists, Nurses?

Current thinking is neurocritical care would be enhanced in neurointensive care units staffed by specialty-trained neurointensivists

By N. Scott Litofsky, MD, FACS

Based on: Markandaya M, Thomas KP, et al. The Role of Neurocritical Care: A Brief Report on the Survey Results of Neurosciences and Critical Care Specialists. *Neurocrit Care* 2011; September 16: epub ahead of print.

Neurointensive care units (NICU) are relatively uncommon worldwide, despite increasing recognition of their potential benefits by multiple groups, including the Leapfrog Group in 2008. Therefore, the authors of a recent study sought to assess the perceived need for and roles of neurocritical care intensivists and neurointensive care units among physicians involved with intensive care and neurosciences. They designed a physician survey to answer their questions.

A 44-question survey with brief introductory letter was sent by email on two occasions one week apart to physicians practicing or involved with critical care or neurosciences, members of the Neurocritical Care Society, Society of Critical Care Medicine, and the American Academy of Neurology. Participation was voluntary, with survey responses possible from July 2008 to July 2009. Via descriptive statistics, data were analyzed by neurointensivists (mostly neurologists and internists), non-neurointensivists (mostly internists and anesthesiologists) and non-intensivists (mostly neurologists).

Nine hundred eighty responses were received from 7,524 potentials (13%); 620 (364 neuro, 257 non-neuro) were intensivists, 240 were not, and 120 did not identify specialty; 17 (1.9%) were neurosurgeons. Of respondents, 79.9% practiced in North American, 68.8% practiced in university or teaching hospitals, 55.5% worked in facilities with NICU or with neurointensivists, and 29.3% had a primary speciality of neurocritical care. More than half, 56.7%, agreed with four

and 35% agreed with three goals of neurocritical care, including pre- and post-op neurosurgical patients, patients with neurological disease warranting critical care, patients requiring critical care with concomitant neurological disease, and acute stroke/post thrombotic or endovascular therapy; 76.2% felt neuro-ICU would improve care, and 74.2% thought neurointensivists would improve care. These opinions were enhanced by experience in neuroscience or with a NICU. Of respondents, 53.3% responded that neurointensivist background should be neurology. ICU care by neurologist with neurointensivist fellowship training (78.5%) or a neurosurgeon with fellowship training (50.5%) would be appropriate. Fifty-seven percent thought neurology residency programs should have a neurocritical care training track.

Based on these results, the authors conclude that establishment of NICUs staffed with trained neurointensivists is strongly favored by respondents. This study confirms the growing sentiment among neurosurgeons, neurologists and others that NICUs staffed with fellowship-trained neurointensivists is the way that critical care should be provided for patients with neurological disorders. Potential benefits may include lower mortality and morbidity, shorter length of stay and lower costs, realized by the ability of these specialists to focus on state-of-the-art critical care interventions and nursing care skilled in neurological assessment.

The study suffers from methodological problems inherent in survey data, particularly with regard to a paltry 13% response rate from a biased source of potential respondents. Even so, I agree with the opinion of the majority of respondents. Neurosurgeons should try to influence their respective institutions to channel resources toward building and staffing NICUs with fellowship-trained neurointensivists and neurologically knowledgeable nursing staffs.

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## Is Craniectomy for Trauma Cost Effective?

In patients with severe brain injury, calculated costs increase exponentially once there is a 70% chance of a poor outcome

By Paul L. Penar, MD

Based on: Ho KM, Honeybul S, et al. Cost-Effectiveness of Decompressive Craniectomy as a Lifesaving Rescue Procedure for Patients With Severe Traumatic Brain Injury. *J Trauma* 2011; 71 (December): 1637–1644.

There is no doubt that decompressive craniectomy is a useful lifesaving procedure for patients with severe head injury. The authors of a recent study wish to answer the question as to whether craniectomy is cost effective. They analyzed a group of 168 patients treated between 2004 and 2010 in Western Australia at two trauma centers. Studies showing lifesaving effectiveness have pointed to a shift from death to severe disability in the outcome groups. Small studies show many survivors satisfied with the outcome as an alternative to death. The authors had done previous studies

showing a better-than-expected neurologic outcome when their predictive model for risk adjustment showed an unfavorable outcome chance of less than 80%. Does cost per life-year gained and quality-adjusted life-year gained depend on the severity of the injury prior to treatment with surgery?

In this study, both unilateral, 49%, and bilateral, 51%, decompressive craniectomies were considered. The indications for these procedures were well-described. The unilaterals were done for mass lesions where the bone was left off because of ICPs over 20 mmHg. The bilateral procedure was done for elevated ICP not responding to treatment. Hospital stays averaged 52 days with 45 rehab days, 42% had a good or Glasgow Outcome Score of 5 outcome, 16% were moderately disabled, 20% were severely disabled, 3% were vegetative, and 19% had died. Forty-five patients had a predicted risk of unfavorable outcome over 80% as determined by their CRSH Risk Model. Of these, three, or 7% were moderately disabled, 49% were severely disabled or vegetative, and 44% had died by 18-month follow-up.

A financial cost analysis requires several detailed assumptions, and I suggest the reader review these. Quality Adjusted Life-Year (QALY) was calculated from life-year gained and the clinical status of the patients at 18-month follow-up. They also assumed that patients did not improve after 18 months, and costs related to long-term care after rehab discharge were not considered. For a sensitivity analysis, it was assumed that moderately disabled patients recovered to near normal and survivors with disability at 18 months had a perception of utility similar to those with normal function. That is, they adjusted their expectations to a normal quality of life. There are many other details to consider in these assumptions.

The authors calculated that the average cost per life-year gained was \$671,000 U.S. and QALY at \$682,000 when the risk of an unfavorable outcome was greater than 80%; when less than 80%, it was \$100,000 per QALY, considered an “acceptable” amount relative to other medical costs. The cost per QALY increased exponentially over 80% unfavorable outcome. This exponential rise is shown well in graphic form, and subjectively seems to begin at about 70% risk of unfavorable outcome. As with any good financial analysis, the results were not sensitive to several factors such as the cost of surgery or whether a unilateral or bilateral procedure was involved.

The authors concluded that severity of injury had a significant relationship to total hospital costs and cost effectiveness of decompressive craniectomy, and the cost per life-year and QALY gained were remarkably high for patients with more severe brain injury, especially when the predicted risk of unfavorable outcome approached 70%.

As with many studies of cost effectiveness that require generalized assumptions and use mean cost rather than individual patient data, several points of criticism can be brought to bear. They did not use individual costs but average costs, and this calculation renders it less sound. Further limiting the study is the assumption that if a decompressive craniectomy was not performed death would be the outcome, which makes the procedure appear more likely to be cost effective. However, balancing that in the discussion, they point out that the true cost of these procedures may be higher than it would seem based on the simple charges for the procedure, and they did not consider the ongoing costs of medical care or nursing home care in those with severe disability or requiring

delayed procedures such as shunting. We note that, even though there was no effect of the bilateral versus unilateral variable, the unilateral was not done as an independent procedure to relieve ICP and the analysis would have been stronger if only bifrontal craniectomy was considered here.

The point of the study is to demonstrate an interaction between cost effectiveness and severity of illness. This is crucial because the decision to do a craniectomy may be based on a prediction of outcome and not on a priori knowledge of clinical condition 18 months hence. They agree that this procedure may not be cost effective from a societal perspective for patients with extreme brain injury but that a predictive model of outcome should not replace clinical judgment and cost effectiveness as the only consideration in making these decisions. In this current day, we are balancing the cost issues of severe illness with resources used in treatment. One can easily predict that we will see more of this type of analysis, and it behooves us to understand these analysis techniques.

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## Children With CP Spasticity – Does Intrathecal Baclofen Infusion Improve Outcome?

The use of an intrathecal baclofen pump in the treatment of severe cerebral palsy-related spasticity in children improves comfort and care but not function or social interaction

By Amir Kershenovich, MD

Based on: Morton RE, Gray N, Vloeberghs M. Controlled Study of the Effects of Continuous Intrathecal Baclofen Infusion in Non-Ambulant Children With Cerebral Palsy. *Dev Med Child Neurol* 2011; 53 (August): 736–741.

A recent article is the largest prospective series published to date on the treatment of children with spasticity due to cerebral palsy with intrathecal baclofen. The take home message is that intrathecal baclofen for the very disabled cerebral palsy, nonambulatory, spastic children improves comfort and care but not the function's course nor social interaction. Intrathecal baclofen (ITB) is used to treat spasticity in a variety of conditions including cerebral palsy, spinal cord injury, multiple sclerosis and traumatic brain injury. The authors studied in a prospective way, 38 children, five to 16 years old, with severe spastic cerebral palsy (CP), at least grade 3 on the Modified Ashworth Scale, who were

evaluated prior to and up to 18 months after surgical implanting an ITB pump. They compared the nine-month outcomes of the first 20 patients with that of 18 patients waiting for surgery for nine months. The main outcome measure was the Pediatric Evaluation of Disability Inventory (PEDI), which measures function in terms of self care, social skills and mobility, both for the child alone and the amount of caregiver assistance required. Other assessments were function, ease of care, quality of life and cost of new equipment. In the results, no significant change was found in the PEDI score between groups or in the lifestyle assessment questionnaire or the cost of new equipment. Significant changes were found between the groups as follows — children after surgery improved their Ashworth Score, Spasm Score, joint range of movement, and Caregiver Questionnaire compared to the ones who did not have an operation.

In their discussion, the authors commented that the PEDI score is not an ideal evaluation for these very disabled and dependent children, as the scale measures self-care functions, which these kids do not have. The authors conclude that, "ITB in children with severe spastic CP over the first 18 months improves their quality of life in terms of comfort and ease of care. It has less effect on function, participation in society or the overall cost of new equipment."

As the authors comment, their series is the largest prospective one in children and includes a relative control group. Despite the strong literature evidence, the concept of surgical treatment of spasticity is not completely or obviously adopted everywhere, and the withdrawal and overdose complications is a kick back for many referring providers.

The following are some of the most relevant publication conclusions in the past 15 years, which clearly support the surgical treatment of children with spasticity. "ITB Decreases Spasticity and Improves Gait in Children with Cerebral Palsy"; *Pediatric Neurology*, 2009. "Improves Ambulation in Children with Lower Extremity Spasticity and Is Not Contraindicated in Those Who Rely Upon Their Spasticity for Support During Ambulation"; *Pediatric Neurosurgery*, 1997. "Improves the Mean GMFM Score, Even More So For Children Younger Than 8 Years Old"; *Pediatric Rehabilitation*, 2005. "Subjects and Caregivers Report of Improvements in Positioning, Transfers, Dressing, Toileting, Hygiene, and Comfort"; *Pediatric Rehabilitation*, 2006. "ITB Offers Improved Sleep Time, Sleep Efficiency, and Reduction in Periodic Leg Movements"; *Neurology*, 2006. "Improves and Stabilizes Hip Dislocation"; *Pediatric Neurology*, 2004. "No Difference Was Seen in the Progression of Scoliosis in Cerebral Palsy between Surgical and Nonsurgical Groups"; *Journal of Pediatric Orthopedics*, 2008 and *Spine* 2007. And finally, "The Cost-Effectiveness Ratio Was Shown to be Within the Range of Offering Good Value for the Money"; *Journal of Child Neurology*, 2007.

### Outcome Prediction for WFNS Grade V SAH Better at 48 Hours



Aneurysm/  
Subarachnoid Hemorrhage

**Take Home Pearl:**

Assessment at 48 hours in patients with World Federation of Neurologic Surgeons grade V subarachnoid hemorrhage has prognostic value in determining the potential for a favorable outcome, and it assists decision making for aggressive surgical intervention.

**Background:** World Federation of Neurologic Surgeons (WFNS) grade V patients account for 20% of subarachnoid hemorrhage (SAH) cases and rarely have favorable outcomes.

**Objective:** To assess impact of early rebleeding, response to external ventricular drainage (EVD), age, and motor score of the Glasgow Coma Scale (GCSm) or extended Glasgow Outcome Scale (GOS) score.

**Design:** Retrospective study.

**Participants:** 126 consecutive patients with grade V SAH.

**Methods:** GCSm was recorded daily and dichotomized as  $\leq 3$  or  $\geq 4$ . At 6 months, patients were classified as having a favorable (good recovery or

moderate disability) or unfavorable (severely disabled or persistent vegetative state) outcome.

**Results:** All patients were treated aggressively, except for 28 (22%) presenting with absent brainstem reflexes that did not improve with EVD (all died). Failure of neurologic improvement in GCSm by day 2, age  $>65$  years, high Fisher grade, and rebleeding were all associated with unfavorable outcome or death. Overall, favorable outcome occurred in 24 of 126 patients (19%). Of 98 patients with intention to treat maximally, 24% had a favorable outcome. Of 28 patients aged  $>65$  years, 26 died and only 1 showed a favorable outcome. Of 71 patients with hydrocephalus, 28 had a positive response to EVD (29% favorable outcome, which was not significantly different from 28% without positive EVD response and favorable outcome). Of 33 patients with GCSm  $\leq 3$  on day 1 after admission, 10 improved clinically to GCSm  $\geq 4$  on day 2. Six-month outcome for patients with GCSm  $\geq 4$  at day 2 was favorable in 24 of 61 patients (39%) and significantly better than patients with GCSm  $\leq 3$  on day 2.

**Conclusions:** In grade V SAH patients with neurologic improvement to GCSm  $\geq 4$  at day 2, favorable outcomes occurred in 39% of cases versus 19% for the total group. No patients without improvement to GCSm  $\geq 4$  showed favorable outcomes.

**Reviewer's Comments:** This study suggests that 24-hour assessment is too early for prognosis in severe SAH. In the absence of clinical improvement by day 2, or in elderly patients, meaningful recovery is very unlikely. This study confirms the importance of early rebleeding in grade V patients as a marker of poor prognosis. The importance of EVD in grade V patients appears to be limited, likely reflecting the severe injury of the initial hemorrhage and subsequent intractable intracranial hypertension or cerebral ischemia. One potential limitation of this study is the inclusion of patients in whom treatment was withdrawn due to the assumption of a poor prognosis.

**Reviewer:** Wendy C. Ziai, MD

**Article Reviewed:** van den Berg R, Foumani M, et al. Predictors of Outcome in World Federation of Neurologic Surgeons Grade V Aneurysmal Subarachnoid Hemorrhage Patients. *Crit Care Med* 2011; 39 (December): 2722–2727.

### Severe Bacterial Meningitis Has High Mortality Rates Even With Appropriate Antibiotics



Cranial Infection

**Take Home Pearl:**

Intracranial pressure monitoring in patients with severe meningitis may reduce mortality and morbidity.

**Background:** High intracranial pressure (ICP) is the most frequent cause of death in patients with community-acquired meningitis. ICP can be secondary to increased cerebral blood volume due to vasodilatation, vasogenic edema, cytotoxic edema, or interstitial brain edema and communicating hydrocephalus. Treatment of ICP in severe cases of meningitis could reduce mortality in patients with severe community-acquired meningitis.

**Objective:** To review the hospital course, management, and outcomes of patients with bacterial meningitis receiving neurointensive care.

**Methods:** Between 2000 and 2007, consecutive patients with community-acquired meningitis at University Hospital, Uppsala, Sweden, were studied. Neurointensive care was considered in patients with Reaction Level Scale grade  $\geq 3B$ , in alert patients with sudden deterioration, and in patients with recurrent seizures, severe agitation, cranial nerve palsy, hypertonia, bradycardia, papilledema, or CT findings of ICP. Patients received cefotaxime plus ampicillin or meropenem initially. Betamethasone was given before the first

dose of antibiotic and continued for 4 days. A ventricular catheter drainage system or intracerebral pressure transducers were used. Patients were intubated and an escalated ICP-cerebral perfusion pressure-directed protocol was used. Telephone interviews were conducted  $>6$  months after neurointensive care.

**Results:** 36 patients were included in this study. Twenty-two patients had  $\geq 1$  concurrent diseases. In total,  $>90\%$  had impaired consciousness on presentation and 10 had seizures. *Streptococcus pneumoniae* was identified in approximately 50% of patients. Cerebrospinal fluid was drained in 15 of 26 patients with ventriculostomy. Six of 36

patients died during neurointensive care; 7 of 36 died after discharge. Fourteen of 36 patients had good recovery; 6 had moderate disability, and 2 patients had severe disability.

**Conclusions:** Approximately 40% of patients with severe community-acquired meningitis had good recovery following neurointensive care and ICP monitoring.

**Reviewer's Comments:** The authors suggest that intensive ICP monitoring in these patients improved recovery. The recovery may take months to evaluate long-term prognosis. Although this is a small sample size and not controlled, this study suggests that more aggressive treatment should be considered, and a multi-center trial to extend these observations is warranted.

**Reviewer:** Stephen B. Greenberg, MD  
**Article Reviewed:** Edberg M, Furebring M, et al. Neurointensive Care of Patients With Severe Community-Acquired Meningitis. *Acta Anaesthesiol Scand* 2011; 55 (July): 732–739.

## Is ICU Necessary After Elective Craniotomy?



### Take Home Pearl:

Most elective craniotomy patients do not need ICU care.

**Background:** By tradition, craniotomy patients spend the night in the ICU to monitor for possible complications. In many centers, however, patients are directly transferred from the recovery area to the floor.

**Objective:** To report the results of 394 patients who underwent craniotomy from January 2006 to June 2010.

**Design:** Retrospective study.

**Methods:** This study included individuals aged  $\geq 16$  years who underwent an elective craniotomy or endoscopic surgery for a sellar lesion or a ventriculostomy. Those who had emergency craniotomies and burr holes for subdural collections or for needle biopsies were excluded. The criteria for planned ICU admissions were prolonged surgery, high anesthesia risk, arteriovenous malformations needing postoperative management of blood pressure, and sleep apnea requiring CPAP. The criteria for unplanned ICU admissions were reduced postoperative Glasgow Coma Scale score, unexpected blood loss or prolonged

surgery, high blood pressure, and refractory seizures.

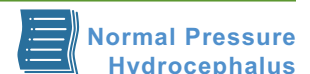
**Results:** Most craniotomies were for tumors (220 supratentorial, 37 infratentorial); the remaining surgeries were for vascular procedures (31), ventriculostomy (22), skull base surgeries (including those of the inner/middle ear [8]), and Chiari I decompression (13). Sixty-three transsphenoidal procedures are also included. Of the 394 patients, 343 were directly admitted to the floor. There were 51 admissions to the ICU; 43 were planned, and 8 were unplanned. The MET (a hospital-based call team that responds to a call by a staff member when a patient's vital signs have fallen outside set criteria) had to be called for 10 of the direct floor admissions (only 3 of these occurred during the first 48 hours postoperatively). Patients for whom the MET was called and patients who had an unplanned ICU admission were older by 5 to 10 years. Their mean length of stay was longer by 5 and 3 days, respectively. None of the patients admitted to the floor had to be transferred to the ICU. Of the 4 deaths, 1 occurred in a patient who had an unplanned admission from the operating room (OR) to the ICU, 3 were in patients who had a planned ICU admission.

**Conclusions:** Patients aged  $>60$  years or those with extended surgery time, excessive blood loss, and high anesthetic risks should be considered for ICU admission.

**Reviewer's Comments:** Given that supratentorial tumor removal, transsphenoidal surgery, ventriculostomy, and Chiari I decompression represent 81% of the patients in this series, the conclusions best apply to these surgeries, not to infratentorial or vascular surgeries. In fact, after a supratentorial craniotomy for a tumor, some patients are discharged home the same day at the University of Toronto (*Neurosurg* 69: 119–127, 2011). The first step to sending a patient directly to the floor is to extubate in the OR, and this is not always an easy decision, especially after an infratentorial craniotomy (*J Neurosurg Anesthesiol* 23: 25–29, 2011). While a number of studies state that direct floor admission is safe for most craniotomy patients, this is not yet a risk-free decision.

**Reviewer:** Luc Jasmin, MD  
**Article Reviewed:** Bui JQH, Mendis RL, et al. Is Postoperative Intensive Care Unit Admission a Prerequisite for Elective Craniotomy? *J Neurosurg* 2011; 115 (December): 1236–1241.

## Independent Living May Be Possible After CSF Diversion in NPH



### Take Home Pearl:

Ventriculoperitoneal shunt or endoscopic third ventriculostomy will improve quality of life in patients with normal pressure hydrocephalus.

**Background:** Normal pressure hydrocephalus (NPH) occurs with an

incidence of 0.18 to 2.2 cases per 1,000,000. NPH affects the quality of life (QoL) of patients and their caregivers. Symptoms of NPH can mimic Alzheimer or Parkinson disease, which can compromise treatment. Untreated NPH negatively affects QoL.

**Objective:** To analyze the outcome of NPH treatment.

**Design:** Retrospective study.

**Participants/Methods:** NPH patients completed a self-reported survey between February 2003 and June 2006. All patients were aged  $>46$  years. Their social and functional outcome data (including their living arrangements and dependence, driving ability, employment status, and volunteer record) were analyzed. Patients were

separated into surgical and nonsurgical treatment groups. Surgical treatments of ventriculoperitoneal shunt (VPS) and endoscopic third ventriculostomy (ETV) were compared.

**Results:** 252 patients (130 men and 122 women) aged 46 to 64 years were diagnosed with NPH. The duration of follow-up was 0 to 30 years (median, 5 to 10 years), with surveys completed by patients aged 46 to 90 years; 66.7% of patients completed surveys themselves. One-hundred eighty-five patients (73.7%) had surgical treatment, and 66 patients (26.3%) did not; 176 patients (95.1%) had VPS, 4 (2.2%) had ETV, and 5 (2.7%) had both VPS and ETV. Twenty-two of 176 (12.4%) VPS patients developed shunt infection, 72 (40%) required shunt revision, and 116 (64%) had additional shunt-related complications. Fifty-five patients required 1 to 3 shunt revisions. Living independently without daily assistance (92.4% vs 90.8%) and

driving ability (68.1% vs 60%) were similar in surgical versus nonsurgical patients. Employment status after treatment was also similar, with 42 patients (22.8%) working after surgery compared to 13 patients (20%) without surgery. Few patients worked >41 hours per week in either group. Patients working <40 hours per week were similar (61.9% surgery vs 53.8% nonsurgery). Participation in volunteer work was higher at 32.4% in the surgery group compared to 10.9% in the nonsurgical group. Functions improved after surgery, including gait (81.1%), urinary incontinence (55.9%), and cognition (64.4%). Worsening symptoms were observed in 6.6%, 6.6%, and 6.7%, respectively, and symptoms were unchanged in 8.3%, 16.7%, and 12.8%. Most surgical patients never required assistance in-house (54.4% VPS and 88.9% ETV). Decreased necessity for home assistance for those requiring assistance before surgery

was 21.7% after VPS and 11.1% after ETV. Overall improvement of QoL was 72.2% after VPS and 55.6% after ETV.

**Conclusions:** VPS or ETV for NPH treatment demonstrated improved NPH symptoms and function and decreased necessity of assistance.

**Reviewer's Comments:** VPS and ETV have been established as treatments for NPH. This study detailed outcomes, including function and QoL after surgical treatment for NPH. Encouraging results were seen in a decreased need for home assistance. Patients who lived dependently could potentially become independent. Hesitant elderly, dependent patients with NPH should reconsider surgical indication.

**Reviewer:** Tomoko Tanaka, MD  
**Article Reviewed:** Cage TA, Auguste KI, et al. Self-Reported Functional Outcome After Surgical Intervention in Patients With Idiopathic Normal Pressure Hydrocephalus. *J Clin Neurosci* 2011; 18 (May): 649–654.

## Do Not Ignore Single-Suture Craniosynostosis



### Take Home Pearl:

Minimal cranial deformity may cause intracranial hypertension.

**Background:** Chronic elevation of intracranial pressure (ICP) in young children may lead to neurological deficits and/or developmental delay. The relationship between craniosynostosis and elevated intracranial pressure has never been fully understood.

**Objective:** To review the relationship between ICP and craniofacial deformity.

**Design:** Single-institution retrospective review.

**Participants/Methods:** 222 patients underwent craniofacial reconstruction (98 endoscopic surgery and 124 cranial vault reconstruction) between August 2000 and June 2007 at Rady Children's Hospital in San Diego. Of these 222 patients, 17 demonstrated continuing increased ICP. Medical record and clinical data on these 17 patients were analyzed. Seven patients had invasive ICP monitor placement for 24 to 48 hours. ICP criteria were as follows: normal, <10 mm Hg; borderline, 10 to 15 mm Hg; and high, >15 mm Hg. Pathologic ICP was defined as ICP >15 mm Hg continuously for >1 minute during non-REM sleep. Multi-disciplinary services were used

for all patients, which included the evaluations by a pediatric neurosurgeon, craniofacial/plastic surgeon, pediatric neuro-ophthalmologist, and pediatric neuroradiologist.

**Results:** 17 patients (11 males and 6 females) had a total of 21 cranial vault reconstructions after diagnoses of increased ICP. Thirteen patients had 1 operation, and 4 patients had additional operations to adequately reduce ICP. All 4 patients improved after second operations. Six of 222 patients (2.7%) had a history of previous craniofacial surgery; of these procedures, 5 were reconstructions and 1 was endoscopic strip craniectomy. The diagnoses included metopic (7), multiple suture synostosis (4), slit-ventricle syndrome (3), Crouzon syndrome (2), shunt-induced craniosynostosis (2), Saethre-Chotzen (1), achondroplasia (1), and unicoronal (1). The symptoms of increased ICP were papilledema in 10 patients (58.8%), headache in 8 (47.1%), optic atrophy in 1 (5.8%), unexplained irritability in 1 (5.8%), and seizure in 1 (5.8%). Seven patients had invasive ICP monitoring, with 4 having pathological intracranial hypertension. Three of 7 patients were determined to have normal ICP and were observed. Patient age at surgery ranged from 3 months to 13.5 years (mean, 5 years). Operative data showed a mean operative duration of

2 hours 20 minutes, an estimated mean blood loss of 178.5 mL, and an average hospitalization of 4.25 days. The only complication was 1 patient with CSF rhinorrhea, treated successfully by lumbar drainage.

**Conclusions:** The management of craniofacial abnormalities requires a multidisciplinary experienced team. The development of intracranial hypertension should be considered a surgical indication.

**Reviewer's Comments:** The results of this study crossed over several dimensions, which included symptoms of intracranial hypertension, patient age, and diagnosis. Craniofacial surgery for developing intracranial hypertension requires complex decision making, but clearly this is an issue that should be considered. Interestingly, this study demonstrated that single-suture synostosis also causes elevated ICP. The technique of ICP monitoring, while invasive, may confirm the diagnosis of elevated ICP in the more difficult situation of milder deformity. The clinical data from multidisciplinary services will help in the determination of surgical indication.

**Reviewer:** Tomoko Tanaka, MD  
**Article Reviewed:** Baird LC, Gonda D, et al. Craniofacial Reconstruction as a Treatment for Elevated Intracranial Pressure. *Childs Nerv Syst* 2011; November 9: epub ahead of print.

## Nucleus Accumbens — Critical Brain Region in Pathophysiology, Treatment of OCD



### Take Home Pearl:

Patients with obsessive-compulsive disorder (OCD) exhibit reduced activity in the nucleus accumbens when anticipating reward compared to control subjects, an effect that is more exaggerated in contamination/cleaning type OCD.

**Background:** Obsessive-compulsive disorder (OCD) has been associated with aberrant activity in the nucleus accumbens, which is part of the ventral striatum involved in reward circuitry. Patients with OCD often exhibit deficits in reward behavior, perhaps in part because compulsions can temporarily be rewarding in a repetitive, self-defeating manner.

**Objective:** To use functional magnetic resonance imaging (fMRI) during a monetary-delayed incentive task in patients with and without OCD to correlate changes in brain activity with reward responsiveness in both groups. The authors hypothesized that patients with OCD would exhibit decreased activity in the nucleus accumbens associated with reward anticipation as well as decreased orbitofrontal cortex activation related to receipt of the reward. They specifically recruited OCD patients (n=18, mean

Yale-Brown Obsessive-Compulsive scale [Y-BOCS]=29) with either contamination/cleaning symptoms (n=7) or doubt/checking symptoms (n=11) based on data that patients with the former were more likely to exhibit altered brain imaging under emotional conditions.

**Participants/Methods:** Only half of these patients were taking psychotropic medication. Reward testing was completed in the fMRI scanner using a computer screen to cue the patient when they were eligible for monetary reward if they responded in a timely manner to a command. Feedback was given regarding performance to this command (reward vs no reward), and all patients ended the trial with the same monetary compensation. The fMRI scanner monitored blood oxygenation levels in response to anticipation of reward and following receipt of the reward.

**Results:** Reaction times were generally slower in OCD patients than controls (n=19), but both groups exhibited quicker reaction times when expecting a reward than when not expecting a reward. Receipt of a reward was associated with increased brain activation in the ventral striatum, putamen, thalamus, insula, and frontal regions in both groups. Patients with OCD showed lower activity in the nucleus

accumbens and left insula when anticipating a reward than did control subjects; this reduction was more pronounced in patients with cleaning behaviors rather than checking behaviors. Ventro-striatal activation upon receipt of reward was similar in patient and control subjects. fMRI activity in the striatal regions was not correlated with scores on the Y-BOCS, Hamilton Anxiety Rating Scale, or the Hamilton Depression Rating Scale.

**Conclusions:** These data support the hypothesis of reduced nucleus accumbens activity in anticipation of reward in patients with OCD, particularly in those with contamination and cleaning symptoms.

**Reviewer's Comments:** Interestingly, half of the patients with OCD in this sample went on to receive deep brain stimulation of the nucleus accumbens in a separate study that I reviewed last year. That treatment was remarkably effective for both mood and obsessions but less so for compulsions. Collectively, these data suggest that the nucleus accumbens is a critical brain region in the pathophysiology and treatment of OCD.

**Reviewer:** Charlotte O. Ladd, MD, PhD  
**Article Reviewed:** Figeo M, Vink M, et al. Dysfunctional Reward Circuitry in Obsessive-Compulsive Disorder. *Biol Psychiatry* 2011; 69 (May 1): 867–874.

## L-Dopa Response, Age, Attention Predict Outcome After STN DBS for PD



### Take Home Pearl:

Increased apathy, resulting from decreased dopaminergic treatment, after subthalamic nucleus deep brain stimulation for Parkinson disease might result in an appearance of cognitive decline that is not really there.

**Background:** Selection of Parkinson disease (PD) candidates for deep brain stimulation (DBS) is critical to obtaining a good outcome. Many physicians lack proper knowledge of inclusion and exclusion criteria for DBS for PD.

**Objective:** To investigate predictors of a positive response to subthalamic nucleus (STN) DBS for PD.

**Design:** Comparative controlled study.

**Participants:** 105 consecutive PD patients who underwent STN DBS for PD, with reduction in OFF symptoms (Sxs), severe treatment (Tx) fluctuations, and dyskinesia were included. They were compared to 40 control PD subjects who did not want surgery or for whom the treating neurologist did not believe DBS was indicated (no significant baseline difference from the operative group). Patients with severe brain atrophy on neuroimaging, Hoehn & Yahr Stage 4 to 5, dementia, psychosis, depression, surgical contraindications, or predominantly unilateral Sxs without severe Tx fluctuations were excluded.

**Methods:** Of 105 PD subjects, microelectrode recording was done in 43,

followed by optimal programming. If possible, medication was reduced, especially dopamine agonists; the 40 control PD subjects continued medical treatment. All subjects were tested at baseline and at 12 months with instruments including the Unified Parkinson's Disease Rating Scale (UPDRS-3), Mattis Dementia Rating Scale, categorical fluency, Trail Making Test parts A and B, Boston Naming test, the Dysexecutive Syndrome Questionnaire (DEX), and the CES-Depression and the Parkinson's Disease quality-of-life (QOL) scales. Analysis was done in 111 STN DBS patients and 40 controls.

**Results:** The STN DBS group was significantly younger than the control group, had fewer years of education, had longer disease duration, and used

more dopaminergic medication. DBS had a positive effect on PD motor function, with 34% improvement on the UPDRS-3 at 6 months and 41% improvement after 1 year. About 80% of STN DBS subjects reported subjective improvement, with QOL improvement in one-third. Compared to the control group, the DBS group had a significant decline in cognitive function after 12 months. Decline in verbal fluency was common. Subjective cognitive decline was reported by 36% of DBS subjects, although 9% reported improved QOL despite cognitive decline. Overall, the

STN group showed a more negative affect and a lower QOL than the control group at baseline. Worsening of mood and improvement of mood were both seen in 15% of operated subjects.

**Conclusions:** Cognitive decline is fairly common after STN DBS for PD, despite improvement in QOL. About 15% have improved mood and about 15% have worsening of mood. The best candidates for STN DBS for PD are relatively young patients without impaired attention and with a high L-dopa response.

**Reviewer's Comments:** Cognitive decline can be expected after STN DBS for PD, and mood can worsen in about 15% of patients, despite increased QOL. Younger patients without impaired attention and with a large response to L-dopa are the best candidates.

**Reviewer:** W. Steven Metzger, MD  
**Article Reviewed:** Smeding HMM, Speelman JD, et al. Predictors of Cognitive and Psychosocial Outcome After STN DBS in Parkinson's Disease. *J Neurol Neurosurg Psychiatry* 2011; 82 (July): 754–760.

## How About Getting Your Neck Stretched & Twisted?



### Take Home Pearl:

New neck pain accompanied by vague complaints or frank neurological deficits could be due to a carotid or vertebral artery dissection.

**Background:** Arterial dissections are known to occur after chiropractic manipulations of the neck.

**Objective:** To describe the authors' personal experience in 13 patients seen over 3 years.

**Design:** Retrospective study.

**Participants/Methods:** 8 women and 5 men presented with neurological symptoms and/or signs from a dissection of the carotid and/or vertebral arteries after chiropractic manipulations of the neck. Follow-up ranged from 4 to 34 months.

**Results:** Patients presented within an interval of hours to 2 weeks after chiropractic cervical manipulations because of suboccipital neck pain and neurologic symptoms or signs, including nausea, vomiting, vertigo, Horner syndrome, paralysis, and sensory loss. Vertebral artery dissection was

present in 12 patients, involving the V2 and V3 segments in 9 patients. In 3 patients, the dissection had progressed rostrally to the basilar trunk. One patient also had a bilateral dissection of the internal carotid arteries, (ICA) and 1 patient had a dissection of the petrocavernous portion of the ICA. All were anticoagulated and treated with antiplatelets. Endovascular stenting was done in 5 patients (for a total of 14 stents). All stents were patent at long-term follow-up. Short term, one of the stents occluded and the patient had to undergo thrombectomy. Thrombolysis of the basilar artery was done in 1 patient. Suboccipital craniotomy and cerebellar lobectomy had to be done in 3 patients. Complications included 1 patient who deteriorated 24 hours after stent placement and had to undergo an emergency angioplasty and thrombolysis. Two patients underwent decompressive craniotomy following stenting. Another patient required 2 craniotomies because of spontaneous cerebellar swelling and postoperative hematoma. These 3 patients were permanently incapacitated. Another patient died before surgery because of a cerebrovascular accident in the territory of the posterior inferior cerebellar artery.

**Conclusions:** Severe complication from cervical artery dissection can be as high as 31% despite aggressive treatment.

**Reviewer's Comments:** The mechanism of cervical artery dissection often involves torsion and stretching, causing a tear of the arterial wall and the formation of an intramural hematoma. The V3 segment of the vertebral artery (between C1 and C2) is particularly vulnerable, as is the internal carotid distally to the carotid bulb. Chiropractors are adamant that they do not put patients at risk of arterial dissection (Choi et al, *J Manip Physiol Therap* 2011; 34:15–22); MDs are of another opinion (Ernst E, *Int J Clin Pract*, July 2010, 64,1162–1165). I believe that the public should be informed of this association given its consequences. Also, emergency physicians should be vigilant because patients initially can present with only vague complaints and suboccipital or neck pain and be sent home only to come back much worse.

**Reviewer:** Luc Jasmin, MD  
**Article Reviewed:** Albuquerque FC, Hu YC, et al. Craniocervical Arterial Dissections as Sequelae of Chiropractic Manipulation: Patterns of Injury and Management. *J Neurosurg* 2011; 115 (December): 1197–1205.

## Cranioplasty Timing Matters



### Take Home Pearl:

The timing of cranioplasty may affect the risk of complications.

**Background:** Decompressive craniectomy (DC) is a common procedure used to treat cerebral edema, and, in

most cases, a cranioplasty (CP) follows. Some studies suggest that early cranioplasty within 2 months is associated with fewer complications than when the procedure is performed with a traditional delay of 3 to 6 months.

**Objective:** The authors analyzed their "prospectively conducted database of

consecutive patients undergoing DC and subsequent CP with special attention on timing of CP and associated postoperative complications."

**Design/Methods:** The records of 280 cranioplasties were reviewed. Timing of cranioplasty varied by surgeon, with some preferring  $\leq 2$  months and others

preferring >2 months. A ventriculostomy was performed if the flap was difficult to place because of brain bulging. Other techniques were standard. Thirty-five percent of procedures were performed for traumatic brain injury, 29% for stroke, 26% for subarachnoid hemorrhage, 7% for intracranial hemorrhage (ICH), and 3% for other diagnoses; 87% of procedures were unilateral, and 13% were bifrontal.

**Results:** Cranioplasty was performed early in 19.3% and late in 80.7%. Forty-six patients (16.4%) had complications, including hematoma in 6%, wound problems in 5.7%, abscess in 1.4%, and hygroma in 1.1%. There was no effect of unilateral or bilateral craniectomy on the complication rate. Ventriculoperitoneal shunting was

associated with a higher rate of complications (28% vs 13%) and accounted for all postoperative hygromas. Early CP after DC was also associated with a higher rate of complications (25.9% vs 14.2%). In 3 early patients, the procedure was aborted due to brain swelling; this occurred in only 1 of the 226 late cranioplasty patients. A multivariate regression model showed higher complication rates with early CP, the presence of a VP shunt, and ICH as pathology.

**Conclusions:** Complication rates are higher in cranioplasties performed <2 months after craniectomy. The authors propose that the optimal time for cranioplasty may be 2 to 6 months.

**Reviewer's Comments:** Others have shown reduced complication rates for

early cranioplasty or no association with timing. This current study, interestingly, contradicts other trials. The relationship to VP shunting is also in contrast to other results in the literature. The authors point out that the heterogeneous pathologies and the retrospective nature may have affected the results. I chose this study because I find it to show an interesting difference in practice in the neurosurgical community, which may depend more on training and tradition than actual data. However, as we can see, the issue is not yet settled.

**Reviewer:** Paul L. Penar, MD

**Article Reviewed:** Schuss P, Vatter H, et al. Cranioplasty After Decompressive Craniectomy: The Effect of Timing on Postoperative Complications. *J Neurotrauma* 2011; December 27: epub ahead of print.

## Transsphenoidal Surgery Is Effective Treatment for Cushing Disease



### Take Home Pearl:

A positive inferior petrosal sinus sampling despite a negative MRI is an indication for transsphenoidal pituitary surgery.

**Background:** Hypercortisolism is associated with significant morbidity and mortality. When associated with adrenocorticotropic (ACTH)-producing pituitary adenomas, medical and radiation treatments are limited. Surgery remains the first and best treatment option.

**Objective:** To identify factors that influence the short-term and long-term results for patients with Cushing disease undergoing transsphenoidal surgery.

**Design/Participants:** This is a retrospective review of patients with Cushing disease receiving transsphenoidal surgery at Evanston Hospital in Evanston, Illinois, between March 1970 and April 2010.

**Methods:** The relevant demographic, endocrine, imaging, and outcome data were loaded into a database. All patients presented with characteristic cushingoid signs and symptoms. Standard endocrine evaluation included 24-hour urinary-free cortisol and

plasma cortisol levels, as well as the low-dose dexamethasone suppression test. When a pituitary adenoma was suspected, detailed imaging with CT prior to 1986 and then MRI after 1986 was obtained. If MRI evaluation was negative for adenoma, inferior petrosal sinus sampling (IPSS) was performed. When a microadenoma was identified at surgery, the adenoma and surrounding pseudocapsule were removed. Frozen section analysis of tissue from the tumor bed confirmed complete resection. If no microadenoma was identified, a partial or complete hypophysectomy was performed. Tumor was not followed into the cavernous sinus. Postoperatively, patients were monitored clinically for signs of cortisol insufficiency. Signs of cortisol insufficiency and the need for cortisol replacement were taken as evidence of immediate postoperative biochemical remission (IPBR). Plasma cortisol levels were checked every 6 hours until cortisol replacement was started.

**Results:** Of 136 patients, 13 harbored macroadenomas and 123 had microadenomas. There were 109 female and 27 male patients. Surgical complications included diabetes insipidus in 12.5% of patients, SIADH in 1.4%, and cerebrospinal fluid rhinorrhea in 4.4%.

For the entire series, IPBR was achieved in 83.4% of patients and in 89.8% of patients with microadenoma, with 90.0% of these patients having long-term remission. In 13 patients with macroadenoma, IPBR occurred in 4 patients (30%). Nineteen of 23 patients with negative MRI underwent IPSS. Sixteen of these patients had a significant central to peripheral ACTH gradient. In 15 of these patients, IPBR was achieved. Of the 4 macroadenoma patients with IPBR, 1 was lost to follow-up and the remaining 3 experienced long-term remission.

**Conclusions:** Transsphenoidal surgery is a safe and effective treatment for Cushing disease. Patients with a negative MRI and a positive IPSS should be offered surgery.

**Reviewer's Comments:** I highly recommend reading the article for the passages containing operative nuances. I plan to incorporate the authors' preoperative work-up and postoperative management algorithm into my practice.

**Reviewer:** Richard Rovin, MD

**Article Reviewed:** Ciric I, Zhao J-C, et al. Transsphenoidal Surgery for Cushing Disease: Experience With 136 Patients. *Neurosurgery* 2012; 70 (January): 70–81.

To receive credit for this activity, answer the practice quiz questions below, read the content, and complete the online post activity quiz at [www.practicalreviews.com](http://www.practicalreviews.com). Log in using your email address and password, click on take a quiz and enter the e-quiz code located below.

**E-quiz code: 31707N**

1. Open surgical treatment of giant intracranial aneurysms provides poor results.  
  
Practice: T F      **Answer Submitted: T F**
2. Craniotomy is sometimes indicated for arterial dissection of the vertebral arteries.  
  
Practice: T F      **Answer Submitted: T F**
3. Patients with brain metastases have better survival if treated with fewer but larger fractions.  
  
Practice: T F      **Answer Submitted: T F**
4. Single-fraction stereotactic radiosurgery can be a safe and well-tolerated palliative treatment for recurrent glioblastoma multiforme.  
  
Practice: T F      **Answer Submitted: T F**
5. In a recent study, 90% of patients undergoing transsphenoidal surgery for Cushing disease due to microadenoma had long-term biochemical remission.  
  
Practice: T F      **Answer Submitted: T F**
6. Most physicians who responded to a recent survey felt that neurointensive care units and neurointensivists could improve care for patients with neurological disease who required critical care.  
  
Practice: T F      **Answer Submitted: T F**
7. Patient age is not a predictor of complications if they are admitted directly to the neurosurgical floor after undergoing elective craniotomy.  
  
Practice: T F      **Answer Submitted: T F**
8. The costs of managing severe head injury seem to have no relationship to severity of injury for those with poor outcomes.  
  
Practice: T F      **Answer Submitted: T F**
9. Cranioplasty performed 1 month after craniectomy seems to be associated with an increased rate of complications.  
  
Practice: T F      **Answer Submitted: T F**
10. Intrathecal baclofen pump therapy for severe cerebral palsy-associated spasticity in children improves function after 18 months of follow-up.  
  
Practice: T F      **Answer Submitted: T F**
11. In a recent study, ventriculoperitoneal shunt or endoscopic third ventriculostomy for normal pressure hydrocephalus (NPH) treatment demonstrated improved NPH symptoms and function and decreased necessity of assistance.  
  
Practice: T F      **Answer Submitted: T F**
12. The development of intracranial hypertension should be considered a surgical indication.  
  
Practice: T F      **Answer Submitted: T F**
13. Patients with obsessive-compulsive disorder exhibit reduced activity in the nucleus accumbens when anticipating receipt of reward compared to control subjects.  
  
Practice: T F      **Answer Submitted: T F**
14. Intracranial pressure monitoring in severe meningitis cases may lower mortality rate.  
  
Practice: T F      **Answer Submitted: T F**
15. Patients with World Federation of Neurologic Surgeons grade V subarachnoid hemorrhage who achieve a Glasgow Coma Scale motor score  $\geq 4$  on day 2 have a reasonable chance of a favorable outcome and should be treated aggressively.  
  
Practice: T F      **Answer Submitted: T F**
16. A common observation in mental status testing after subthalamic nucleus deep brain stimulation for Parkinson disease is a decline in verbal fluency.  
  
Practice: T F      **Answer Submitted: T F**

1. **T** The diagnostic yield of repeat cerebral angiography at 7 days in the setting of an initially negative cerebral angiogram is in the range of 5% to 7%.
2. **F** According to the literature, the incidence of complications from deep brain stimulation electrode implant is <1%.
3. **F** The antidepressive effect of anterior cingulate cortex stimulation improves over time.
4. **F** The prognosis for patients with glioblastoma multiforme (GBM) metastatic to the liver is worse than that for patients with GBM metastatic to the lung.
5. **F** The graded prognostic assessment score accurately predicts 30-day and 3-month mortality in patients with brain metastases treated surgically.
6. **T** First-degree relatives of patients with meningiomas are at higher risk of harboring meningiomas.
7. **T** Patients with head trauma who do not clinically deteriorate do not have lesions on head CT requiring intervention.
8. **F** Size of intracranial hemorrhage is an important part of a clinical decision rule for determining if a patient does not require intensive care unit admission.
9. **F** The transsphenoidal approach should be elected for all children with a craniopharyngioma.
10. **T** The majority of residents in a recent study believe that the new Accreditation Council for Graduate Medical Education proposed standards will have a negative effect on their residency training.
11. **F** Endoscopic third ventriculostomy success score only predicts short-term outcome of endoscopic third ventriculostomy.
12. **F** There is no chance for cure after failed first invasive epilepsy monitoring.
13. **F** In patients with asymptomatic intracranial aneurysms, taking aspirin daily significantly increases the risk of aneurysm rupture compared to not taking aspirin.
14. **T** In a recent follow-up study, the majority of patients with treatment-resistant depression who were treated for 3 to 6 years with deep brain stimulation of the subcallosal cingulate gyrus had a clinical response.
15. **T** Despite technical success, an extracranial-intracranial bypass procedure did not provide any benefit in a selected group of patients known to be at high risk for stroke.
16. **T** Factors associated with late neurologic recovery in patients with traumatic brain injury undergoing decompressive craniectomy are absence of a non-evacuated intracerebral hematoma (>1 cm in diameter) and high admission Glasgow Coma Scale score.

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