Endovascular Treatment of Simple ICA Bifurcation Aneurysms Is Feasible but May Not Endure

**Endovascular Therapy of Internal Carotid Artery Bifurcation Aneurysms.**

Oishi H, Yamamoto M, et al:

*J Neurointerv Surg* 2013; 5 (September): 400-404

The recurrence rate of simple internal carotid artery bifurcation aneurysms treated with endovascular therapy was 13.6%.

**Objective:** Internal carotid artery (ICA) bifurcation aneurysms are not common, and so, the endovascular series have been small. This study looked at the safety and efficacy of ICA bifurcation aneurysms treated by endovascular therapy.

**Methods:** A retrospective review of medical records from September 2003 to October 2011 found 25 patients (14 women and 11 men) with ICA bifurcation aneurysms. The mean age of these patients was 50 years. Of the 25 ICA bifurcation aneurysms in the 25 patients included in the study, 23 were unruptured and 2 were ruptured. All were treated with endovascular embolization. Magnetic resonance angiography was performed at 6 months and an angiogram at 1 and 2 years.

**Results:** Aneurysm size ranged from 2.5 mm to 10 mm, and the neck size ranged from 1.5 mm to 4 mm. The overall morbidity rate was 0% and the death rate was 4% for the endovascular procedures. Complete occlusion occurred immediately in 76%, residual neck in 16%, and residual aneurysm in 8%. The mean radiological outcome follow-up was 24.4 months. Anatomical outcomes in follow-up were unchanged in 63.7%, improved in 22.7%, and there was recurrence in 13.6%. There were no significant differences between the anatomical follow-ups of the bare platinum coils and the bioactive coils. Two thromboembolic events occurred after the use of bioactive coils. One death occurred from pneumonia.

**Conclusions:** It is safe and effective to treat ICA bifurcation aneurysms with endovascular therapy.

**Reviewer's Comments:** This series of aneurysms is small in overall number treated, the size of the aneurysms, and the neck-to-dome ratios, and mainly included incidentally found aneurysms. The recurrence rate was still 13.6% despite the less complex nature of this series. It may be feasible to coil ICA terminus aneurysms, but the treatment paradigm for aneurysms in my mind remains a balance between risk assessment and the likelihood of a good short- and long-term outcome. With more complex aneurysms, the risks and the recurrence rate would increase from what is seen in this study. Thus, open and endovascular techniques should be considered equally and decided based upon individual patients. (Reviewer-Sharon Webb, MD).

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Keywords: Subarachnoid Hemorrhage, Endovascular Coiling, ICA Bifurcation Aneurysms

Print Tag: Refer to original journal article
New Clinical Prediction Rule Highly Sensitive for Identifying SAH

Clinical Decision Rules to Rule Out Subarachnoid Hemorrhage for Acute Headache.
Perry JJ, Stiell IG, et al:

JAMA 2013; 310 (September 25): 1248-1255

The Ottawa subarachnoid hemorrhage (SAH) clinical prediction rule assures that the diagnosis of SAH is not missed in patients with acute nontraumatic headache and a normal neurologic examination.

Background: Headaches account for 2% of all emergency department (ED) visits, and clinical decision rules have been developed to identify which patients need a work-up for subarachnoid hemorrhage (SAH).

Objective: To assess the accuracy, reliability, and acceptability of the 3 existing clinical decision rules in a new cohort of patients with headache, and to modify the decision rules to improve their performance.

Design: Multicenter cohort study conducted in 10 university-affiliated EDs in Canada. Participants: A total of 2131 consecutive adult patients presented to the ED with the chief complaint of nontraumatic headache that reached maximal intensity within 1 hour. Exclusion criteria included any head trauma or fall within 7 days, pain lasting >14 days, established recurrent headache syndrome, history of SAH, papilledema, new focal neurologic deficits, and history of cerebral aneurysm, brain neoplasm, or hydrocephalus.

Methods: SAH was the primary outcome of the study. Attending physicians recorded clinical findings on data forms prior to ordering imaging and/or lumbar puncture on patients. Follow-up was by telephone at 1 and 6 months. Three proposed clinical decision rules were analyzed using the data collected.

Results/Conclusions: Of the 2131 patients, 132 had SAH. The Ottawa SAH Rule performed the best with 100% sensitivity for SAH (95% CI, 98.6% to 100.0%) and a specificity of 17.8% (95% CI, 16.6% to 19.1%).

Reviewer’s Comments: This study prospectively validates a new clinical decision support tool to help decide which patients with acute, nontraumatic headache need further work-up in the ED to rule out SAH. Although this tool was not estimated to decrease the rate of head CT scanning and lumbar punctures in Canada, it was estimated to decrease the number of SAHs missed when the tool is not used. It has been estimated that current practice misses up to 5% of SAHs in the ED. This rule is only for alert patients aged >15 years with new, severe, nontraumatic headache reaching maximum intensity within 1 hour. Exclusions include patients with new neurologic deficits, previous aneurysms, SAH, brain tumors, or a history of recurrent headaches. Patients should undergo additional investigations including CT and/or lumbar puncture if they have ≥1 of the following: age >40 years; neck pain or stiffness; witnessed loss of consciousness; onset during exertion; thunderclap headache (instantly peaking pain); or limited neck flexion on examination. Limitations of the study were that patients with a history of ≥3 similar headaches were excluded and lack of an established gold standard definition of SAH. This new clinical decision support rule is designed to prevent physicians from missing the diagnosis of SAH and is not meant to be used as an acute headache rule. Further implementation studies will be required prior to putting this rule into practice in our EDs. (Reviewer-Cynthia D. Smith, MD, FACP).

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Keywords: Subarachnoid Hemorrhage, Clinical Prediction Rule, Headache

Print Tag: Refer to original journal article
Diffusion-tensor trace imaging can detect smaller infarcts as compared to traditional diffusion-weighted imaging images.

**Objective:** To compare the sensitivity of diffusion-tensor trace imaging (DTI) versus conventional diffusion-weighted imaging (DWI) in the context of the detection of small cerebral infarcts.

**Design/Participants:** Retrospective review of 2537 studies in patients who underwent both a standard DWI series (3-orthogonal diffusion gradient) and a 15-direction DTI with parallel acquisition technique over a 1-year period.

**Methods:** All cases were initially reviewed by a single observer to identify those who were positive for cerebral infarction by standard DWI or 15-direction isotropic DWI. The total pool of infarction-positive imaging studies was reviewed by individual observers and divided into 2 groups: infarcts readily identified on both types of diffusion studies and those in which there appeared to be significant differences between the 2 studies, meriting a more detailed review. This latter group of studies (n=102) was reviewed on a PACS by 2 neuroradiologists to stratify cases into categories by consensus to reflect the impact on clinical management. Readers were asked to rate, in consensus, the image quality with a 5-point scale. Quantitative image analysis was then performed in 46 consecutive studies and 51 lesions. These were the first 46 consecutive patients of the study group. This evaluation included calculation of lesion contrast, calculation of percentage difference in lesion contrast with 15-direction isotropic DWI versus routine DWI, and estimation of lesion size.

**Results:** The presence of various artifacts contributed to lower image quality scores for standard DWI over 15-direction isotropic DWI. Because routine DWI is the clinical standard, these images were considered to be diagnostic in 18 of 20 patients, with most images falling into the satisfactory (7) and good (11) categories. In every case, isotropic DTI with parallel imaging was judged to produce higher image quality. Using single-factor analysis of variance, image quality scores were higher for 15-direction isotropic DWI. Average image quality scores for standard DWI were 3.45 and 4.68 for 15-direction isotropic DWI. Small infarcts were also better seen on DTI trace images, and in 12 cases, infarcts could only be seen on 15-direction isotropic DWI. The additional scanning time required for 15-direction isotropic DWI did not result in significantly increased motion-related reduction in image quality compared with standard DWI.

**Conclusions:** Diffusion-tensor trace imaging is more sensitive to detection of small cerebral infarcts and produces higher image quality than traditional DWI images.

**Reviewer's Comments:** I agree with the conclusions of this article in that diffusion-tensor trace imaging seems to detect smaller infarcts as compared to traditional DWI images. This may prove to have significant clinical implications, as there is growing evidence that these small lesions are often related to transient ischemic attack, which in turn is correlated to higher short-term risk of stroke (Reviewer-Sebastian Sadowski, MD).

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Keywords: Diffusion-Weighted Imaging, Diffusion-Tensor Trace Imaging, Small Cerebral Infarcts

Print Tag: Refer to original journal article
Evaluation of Isolated Pupil-Sparing Third, Fourth, and Sixth Cranial Nerve Palsy

Isolated Third, Fourth, and Sixth Cranial Nerve Palsies From Presumed Microvascular Versus Other Causes: A Prospective Study.
Tamhankar MA, Biousse V, et al:
Ophthalmology 2013; 120 (November): 2264-2269

Consider nonmicrovascular etiologies for vasculopathic patients presenting with isolated pupil-sparing third, fourth, and sixth cranial nerve palsy.

**Background:** Historical teaching on the management of neurologically isolated pupil-sparing third, fourth, and sixth cranial nerve (CN) palsy in adults is observation without neuroimaging unless spontaneous resolution has not occurred in 3 to 6 months. A microvascular etiology is thus presumed and only questioned when the patient does not recover function. Early diagnosis of other etiologies through the use of MRI, however, can result in timely intervention and may lead to cost-effective treatment.

**Objective:** To perform early MRI to determine the percentage of patients that have a diagnosis other than presumed microvascular etiology.

**Design:** Prospective, multicenter, observational case series.

**Participants:** 109 patients, aged ≥50 years with acute neurologically isolated ocular motor nerve palsy.

**Methods:** Patients presenting within 30 days of symptom onset were prospectively evaluated by neuro-ophthalmologists; appropriate diagnostic testing was obtained as indicated for potential infectious, inflammatory, or neoplastic causes. Exclusion criteria included history of strabismus, orbital disease, head trauma, neurosurgical intervention, or lumbar puncture. MRI with and without gadolinium was obtained for all patients. Patients were followed until resolution of diplopia (at which point a presumed diagnosis of microvascular etiology was established) or another diagnosis was made on the basis of ancillary testing.

**Results:** Mean age was 65 years; 22 patients had CN III palsy, 25 had CN IV palsy, and 62 had CN VI palsy. Eighteen patients (16.5%; 95% CI, 10.7 to 24.6) had etiologies other than microvascular etiology, including midbrain infarction, neoplasms, inflammation, pituitary apoplexy, and giant cell arteritis (GCA). Although the presence of vasculopathic risk factors was strongly associated with a presumed microvascular etiology (P = 0.003), vasculopathic risk factors were present in 61% of patients with other causes for CN palsy.

**Conclusions:** Initial brain MRI along with laboratory work-up for neurologically isolated third, fourth, and sixth CN palsy in adults ≥50 years of age is supported by the findings, regardless of whether vasculopathic risk factors are present and is recommended by the authors. Other causes, including neoplasm, GCA, and brain stem infarction, were seen in 16.5% of patients.

**Reviewer's Comments:** This well-designed study supports routinely ordering MRIs on adult patients presenting with isolated pupil-sparing-third, fourth, and sixth CN palsy, regardless of whether they are vasculopathic. One potential bias is that patients in the study had been referred to neuro-ophthalmology clinics, and as such, may have had subtle findings suggestive of nonmicrovascular etiology, thereby increasing the proportion of patients with serious underlying pathologies. On the other hand, referring physicians may have imaged a subset of patients with more obvious signs of nonmicrovascular etiology and directly referred these patients to other specialists, such as neurosurgeons, thus underestimating the true incidence of nonmicrovascular etiology. (Reviewer-Jason Goldsmith, MD, MS).

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Keywords: Cranial Nerve Palsy, MRI

Print Tag: Refer to original journal article
Coagulopathy, particularly low platelet count, is a predictor of intracranial hemorrhage progression, need for neurosurgical intervention, and mortality for patients with a traumatic brain injury.

**Background:** Coagulopathy is an important factor causing progression of intracranial hemorrhage (ICH) after traumatic brain injury (TBI) and subsequently determining disability and mortality. Laboratory tests, including international normalized ratio (INR), partial thromboplastin time (PTT), and platelet count (PC) can be used to assess coagulopathy.

**Objective:** To determine the predictive value of coagulopathy on ICH, need for neurosurgical intervention, and mortality.

**Design:** Single institution retrospective cohort study.

**Methods:** Patients with isolated blunt TBI progression of ICH evaluated with INR, PTT, and PC were analyzed, excluding those treated pre-morbidly with anticoagulation and antiplatelet agents. Isolated TBI was defined as a head Abbreviated Injury Scale (AIS) score ≥3 and other body region AIS score <3. Initial and follow-up (8 hours later) head CT scans were reviewed for skull fracture and ICH – epidural hemorrhage (EDH), subdural hemorrhage (SDH), subarachnoid hemorrhage (SAH), intraparenchymal hemorrhage (IPH), and intraventricular hemorrhage (IVH). Coagulopathy was defined as INR ≥1.5, PTT ≥35 seconds, or PC ≤100,000. Coagulopathic patients were compared to those without coagulopathy for outcome measure of ICH progression and mortality. ICH size was determined by measuring the largest diameter in the axial plane, and progression was defined as increase in size of ICH or new ICH on follow-up head CT. Neurosurgical intervention was defined as craniotomy or craniectomy.

**Results:** A total of 3608 patients had TBI, 1398 had ICH on initial head CT. Of the patients with ICH, 804 had isolated TBI, and of those, 591 (mean age, 46.8 years, 67% male) met inclusion criteria. A fall was the most common mechanism of injury (40%); 13.4% were coagulopathic, 3.6% had low PC, 6.6% had elevated INR, and 8.0% had elevated PTT. Coagulopathic patients had lower Glasgow Coma Scale score (12 vs 15), but AIS was similar. SAH (54%) and SDH (49.4%) were most common. Twenty-two percent had ICH progression; coagulopathic was more common with progression (39.3% vs 19.2%). Progression of ICH was associated with low PC and elevated INR but not with elevated PTT. Overall, 4.4% required neurosurgical intervention, and low PC was a positive predictor. The mortality rate was 13.2%, and low PC was a positive predictor for death.

**Conclusions:** Coagulopathy, particularly low PC, is a predictor of ICH progression, need for neurosurgical intervention, and mortality for patients with TBI.

**Reviewer's Comments:** This study emphasizes an important observation of which most neurosurgeons are aware, which is that coagulopathy is an important determinant of increased need for neurosurgical intervention and poor outcome. This study does not evaluate the additional impact of anticoagulant and antiplatelet agents, which also are associated with ICH progression and poorer outcome. The authors acknowledge that they did not include thromboelastography (TEG) in determining coagulopathy. This test, which is becoming more widely available, can assess overall coagulation status, including platelet dysfunction. I suspect TEG will supplant these other tests in the future. (Reviewer-N. Scott Litofsky, MD, FACS).

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Keywords: TBI, Coagulopathy, Platelet Count, ICH, Neurosurgical Intervention, Mortality

Print Tag: Refer to original journal article
No sure way yet to reverse direct-acting anticoagulants.

**Background:** While vitamin K and coagulation factor replacement (fresh frozen plasma [FFP] or prothrombin complex concentrates [PCCs], or VIIa) is the standard to reverse warfarin, there is no therapy agreed upon to reverse the direct acting anticoagulants. Furthermore, most hospitals lack tests to determine the degree of anticoagulation in patients taking these drugs. The international normalized ratio (INR) and the prothromboplastin time (PTT) can be normal despite an adequate anticoagulation.

**Objective:** To review treatment options for bleedings associated with the direct acting anticoagulants.

**Design:** Retrospective.

**Methods:** Literature review.

**Results:** Currently, the best test for evaluating the degree of anticoagulation with dabigatran is the hemoclot assay, which measures thrombin inhibition. Xa activity, in turn, is the best way to evaluate patients taking rivaroxaban and apixaban. When assessing these patients, one has to remember that these new anticoagulants take about 12 hours to clear unless renal function is altered, especially with dabigatran, which is essentially cleared by the kidney. You also need to know that the plasma levels of direct-acting anticoagulants are increased by P-glycoprotein such as amiodarone, verapamil, quinine, and clarithromycin. Plasma levels are also increased by grapefruit juice, antymycotics, and HIV protease inhibitors. A proposed algorithm to treat patients with life-threatening bleeding is as follows: patients taking dabigatran are currently best treated with prothrombin complex concentrates (PCCs), while those taking rivaroxaban and apixaban are best treated with 4-factor activated PCCs. Hemodialysis is also prescribed for dabigatran removal. Finally, charcoal hemoperfusion, desmopressin, and antifibrinolytic can be ordered. There is no evidence that FFP or VIIa are of any use.

**Conclusions:** There are no accepted guidelines on how to treat acute intracranial bleeding in patients taking direct-acting anticoagulants.

**Reviewer's Comments:** Antidotes are urgently needed if we are to treat these patients appropriately. And that is about to happen. A humanized monoclonal antibody fragment against dabigatran is now being tested clinically and a decoy inactive Xa will be used to reverse the effect of rivaroxaban and apixaban. (Reviewer-Luc Jasmin, MD, PhD, FRCS (C), FACS, FAANS).

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Keywords: Oral Anticoagulants, Dabigatran, Rivaroxaban and Apixaban, Atrial Fibrillation, Stroke, ICH

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Vasopressor therapy for acute spinal cord injury has complications associated with it and we need further clarification on what mean arterial pressure goal to obtain as well as what drugs to use and for how long.

**Objective:** To study the effectiveness of vasopressor use and their complications among spinal cord injury (SCI) patients.

**Methods:** This observational retrospective cohort study included 131 adult patients with acute SCI and neurological deficit who received vasopressor therapy for a minimum of 24 hours.

**Results:** Overall, 95.4% of patients received a single vasopressor. Dopamine was the first choice in 60.3% and phenylephrine was the second in 33.6%. The overall complication rate was 74.0%. The complication rate was higher with dopamine (69.2%) than with phenylephrine (46.5%) (\(P = 0.0012\)). The most common type of complication was tachycardia (41.2%). The more serious complications of ventricular tachycardia, ST-segment elevation, and elevated troponins were caused by dopamine (10.3%) more often than by phenylephrine (3%) (\(P = 0.036\)). Bradycardia was significantly higher with phenylephrine in the cervical SCI at or above C4 (33.3% vs 15.5%; \(P = 0.001\)). In the multivariate analysis, both dopamine and phenylephrine were associated with an increase in complications and neither improved outcome significantly when compared with acute surgery (<24 hours after SCI).

**Conclusions:** This study has shown a concerning complication rate with vasopressor therapy. Further studies evaluating vasopressors and looking at different mean arterial pressure (MAP) goals, complication rates, and neurological improvements are needed.

**Reviewer's Comments:** Although this article is a retrospective analysis, good points concerning the medical treatment of acute SCI are made. Our guidelines recommend maintaining MAP goals, but also state that the most appropriate threshold levels and length of therapy need definition. The high complication rate associated with these drugs gives one pause when considering whether to use them or not. SCI patients at this institute received vasopressors in contradiction to the guidelines accentuating that the guidelines are not always followed due to the lack of evidence behind them. Maintaining a good blood pressure in SCI is important, but good data on what goal to obtain, what drugs to use, and for how long is not yet established. (Reviewer-Sharon Webb, MD).

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Keywords: Traumatic Spinal Cord Injury, Guidelines, Vasopressors

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Variations occur in the use of a trauma center, and therefore neurosurgical care, for patients with severe traumatic brain injury.

**Background:** Care at trauma centers (TCs) is thought to improve outcome of patients with traumatic brain injury (TBI), in part related to implementation of Brain Trauma Foundation guidelines. Access to these trauma centers occurs via direct admission from the scene or transfer from a nontrauma center (NTC).

**Objective:** To evaluate access of severe TBI patients to a TC within the first 24 hours of injury.

**Design:** Population-based, retrospective cohort study.

**Methods:** The National Ambulatory Care Reporting System and the Discharge Abstract Database were reviewed for patients ≥18 years old with isolated severe TBI (Injury Severity Score >15, head Abbreviated Injury Score ≥3, and all other body regions Abbreviated Injury Score ≤2). Outcomes measured were TC access, either by direct admission from scene or transfer from an NTC within 24 hours. Characteristics of TC and NTC patients were compared, as were transferred TC and NTC patients. In addition to demographics, mechanism of injury, and comorbidities, CT imaging findings of epidural hematoma (EDH), subdural hematoma (SDH), and subarachnoid hemorrhage (SAH) were assessed. Neurosurgical care was concentrated in TC.

**Results:** Of 9448 patients with isolated TBI (30-day mortality, 19%), 5701 were initially admitted to an NTC. A total of 1737 were transferred to a TC within 24 hours, for total TC access of 5466 (57.8% of total) and 30-day mortality of 19%. NTC care was provided for 3982 patients (18% mortality). Characteristics of TC-access patients included younger age, more likely male, fewer comorbidities, more severely injured, more likely injured in motor vehicle accidents or by penetrating injuries, and more likely with EDH, SDH, and SAH. Those transferred to a TC shared similar characteristics, except SDH was not more likely in those transferred; 53% of EDH, 50% of SAH, and 30% of SDH patients were transferred to a TC within 24 hours of an NTC admission. As age increased, the likelihood of transfer diminished. EDH and SAH increased the likelihood of transfer, but SDH did not.

**Conclusions:** Variability in access to TC care exists for patients with severe isolated TBI.

**Reviewer’s Comments:** This study of an Ontario, Canada, population shows that >40% of patients with isolated severe TBI defined by head Abbreviated Injury Score are not provided access to TC care. Interesting, mortality was not different between TC and NTC patients, despite the NTC patients being older. The study does not capture treatment differences between TC and NTC, nor does it examine reasons for transfer or deferring transfer. The author’s description of regionalized neurosurgical care in Ontario suggests that NTC patients likely did not have the opportunity for neurosurgical procedures or guidance. Other studies that have investigated transfer of patients have also revealed an age bias, with older patients being less likely to be transferred; further evaluation of age-related health resource utilization is warranted. (Reviewer-N. Scott Litofsky, MD, FACS).
Absence of brainstem reflexes or motor response in a normothermic, drug-free comatose patient with no metabolic disorder.

The assessment of brain death is an evaluation of brainstem function. One must rule out survivable conditions, including locked-in syndrome, hypothermia, and drug intoxication. Locked-in syndrome is classical, incomplete, or total. The diagnosis can be missed if eye movements are not assessed or in a patient with the total variant. You should also know that rapidly progressing Guillain-Barré syndrome can present itself as a "locked-in" syndrome. Hypothermia, which is defined as body temperature <35°C, is associated with a loss of key reflexes as the temperature drops. Below 32°C, the pupillary light reflex is lost, and at <28°C, all brainstem reflexes are absent. Hypothermic patients have a decreased metabolism, which means that in them, the half-life of most drugs is increased. Restoring the core temperature to normal becomes essential. If a drug screen is positive, the neurological evaluation should be delayed for a duration equal to 5 times a drug's half-life or until plasma levels are below therapeutic levels. **Step 1:** Achieve normothermia, euvoolemia, normal blood gases, and systolic blood pressure ≥100 mm Hg. **Step 2:** The neurologic exam should show absence of pupillary reflex, ocular movement, corneal reflex, movement on stimulation, or tracheal reflex. Spinal reflexes, however, can be present. **Step 3:** Apnea test. Pre-administer 100% O₂ for 10 minutes. Disconnect the ventilator and administer 6 L/min of 100% O₂ through a tube that goes down to the carina. Monitor for any respiratory attempt for 8 to 10 minutes. Abort if the systolic blood pressure is <90 mm Hg or the pulse oximetry is <85% for >30 seconds. If you had to abort, retry with positive airway pressure at 10 cm H₂O or with a T-piece and 100% O₂ at 12 L/minute. If no respiratory movement is seen, repeat the arterial blood gas after 10 minutes. If the PCO₂ has increased to ≥ 60 mm Hg the apnea test is positive. In a patient with known respiratory disease, such as COPD, the apnea test is positive if the PCO₂ increases by more than 20 mm Hg above their baseline. If the evaluation is questionable, it can be repeated for 10 to 15 minutes as long as the patient is hemodynamically stable. **Step 4:** Ancillary tests including electroencephalography, cerebral scintigraphy, cerebral angiogram, CT-angiogram or transcranial Doppler.

**Conclusions:** More stringent criteria are used in children, and the diagnosis of brain death cannot be made in infants <37 weeks of gestational age. **Reviewer’s Comments:** Some people were diagnosed as brain dead, and they ended up going home and living a normal life. This includes a donor in which the surgeons started to harvest the organs. I am guessing that in all these cases, the physicians did not follow protocol. (Reviewer-Luc Jasmin, MD, PhD, FRCS (C), FACS, FAANS).

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Keywords: Brain Death Determination, Protocol, Neurological Exam, Medicolegal

Print Tag: Refer to original journal article
Neurocognitive Testing Is Required for Postconcussion Evaluation

Neurocognitive Test Performance and Symptom Reporting in Cheerleaders With Concussions.

Lovell MR, Solomon GS:

J Pediatr 2013; 163 (October): 1192.e1-1195.e1

Neurocognitive tests detect postconcussion problems.

**Background:** Studies show that cheerleading is responsible for 66% of all catastrophic injuries in girls. The number of emergency department visits for cheerleaders is increasing each year. Shields and Smith reported in 2006 to 2007 that concussions accounted for 6% of total cheerleading-related injuries, with stunt-related activities being the main activity leading to concussions. In another study, self reporting of symptoms determined the fitness of the athletes to return to action. The results of that study showed that only 62% of the previously reported sample of athletes with concussion had a significant increase on the symptom scale within 7 days of the injury. Of the group, 36% did not report an increase of symptoms, but they had at least 1 abnormal indicator in the neurocognitive component.

**Objective:** To compare the agreement of neurocognitive test results and symptom reporting after a sports-related concussion in cheerleaders.

**Methods:** A total of 138 cheerleaders underwent baseline testing and were later tested with Immediate Postconcussion Assessment and Cognitive Testing (ImPACT) within 7 days of a concussion. The ImPACT tool includes a neurocognitive test, a demographic questionnaire, a symptom inventory, an injury evaluation form, and a 25-minute neurocognitive assessment battery. The neurocognitive component addresses cognitive functioning, attention, visual scanning, information processing, and verbal recognition memory. Postinjury test scores and symptom scores were then compared to preinjury baseline results. Test results were compared with the self reports by the cheerleaders.

**Results:** There were no significant differences for the position of fliers, tumblers, or spotters. There was a significant decline in ImPACT neurocognitive and symptom scores compared to baseline results. Visual memory, visual motor (processing) speed, reaction time, and total symptom scores were significantly different from the baseline score. Of 60 cheerleaders who denied any increase in symptoms from baseline, 20 (33%) had at least 1 ImPACT composite score different from the baseline score. The most common problems were headache and concentration problems.

**Conclusions:** Self-reporting of symptoms should not be the only factor in deciding to return to the activity after a concussion. Neurocognitive testing is an important component of the evaluation of the injury. Relying on an athlete's report of symptoms will not detect deficiencies documented by neurocognitive tests.

**Reviewer's Comments:** It may be surprising to learn that in sports, soccer and basketball are responsible for most concussions (11% and 9%, respectively). Recent attention to concussions in football players is a welcome effort to prevent future brain damage. This study involving cheerleaders expands the groups that sustain concussions. These teens need to be evaluated with more than a reassurance from the subject stating that she/he is ready to return to action as shown by the sensitivity of neurocognitive testing. (Reviewer-Charles I. Schwartz, MD).

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Keywords: Concussion, Neurocognitive Testing, Cheerleader Injuries, Impact Test

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FDOPA-PET Differentiates Radiation Injury From Recurrent Brain Tumor

18F-FDOPA PET for Differentiating Recurrent or Progressive Brain Metastatic Tumors From Late or Delayed Radiation Injury After Radiation Treatment.


FDOPA-PET is 81% sensitive and 84% specific for distinguishing recurrent brain tumor from late or delayed radiation injury in patients who have previously undergone radiation therapy for brain metastases.

Background: Treatment of brain metastases with radiotherapy can result in late or delayed radiation injury (LDRI), occurring months to years after radiotherapy, which can be difficult to distinguish from recurrent or progressive brain metastasis (RPBM). Both types of lesions can result in neurologic symptoms and have similar appearances on MRI. F-18 FDG-PET and TI-201 scintigraphy have been used to differentiate LDRI from RPBM. Amino acid analog PET tracers, such as C-11 methionine, also show some promise.

Objective: To determine the diagnostic accuracy of 6-18F-FDOPA PET for distinguishing LDRI from RPBM and to evaluate the prognostic ability of FDOPA-PET in patients who have been treated with radiotherapy for brain metastases.

Design: Retrospective study.

Participants: Thirty-two patients with 83 previously irradiated brain metastases.

Methods: The median time from completion of radiotherapy to FDOPA-PET imaging was 13.7 months. PET findings were validated with surgical pathology specimens (9 lesions) or radiologic course (74 lesions) within 6 months of PET imaging. PET lesions were evaluated semiquantitatively using SUV and ratios of lesion intensity to normal brain in the contralateral hemisphere or to normal striatum.

Results: All semiquantitative indices were significantly higher for RPBM than for LDRI. Areas under the receiver operator characteristic curves ranged from 0.822 for SUV (mean or maximum) to 0.892 for visual comparison with normal striatum. Lesions showing FDOPA uptake equal to or higher than normal striatum were classified as positive for RPBM: the sensitivity and specificity for distinguishing RPBM from LDRI were 81.3% and 84.3%, respectively. Mean time to progression was 16.7 months for PET-positive lesions and 76.5 months for PET-negative lesions \( (P<0.001) \). There was a trend toward better survival for patients with PET-negative lesions \( (P=0.06) \).

Conclusions: FDOPA-PET provides high diagnostic accuracy for distinguishing RPBM from LDRI and is predictive of freedom from progression.

Reviewer's Comments: Normal uptake of FDG by the brain is often blamed for reduced diagnostic accuracy of FDG-PET for distinguishing brain tumor from radiation injury. Normal brain also takes up FDOPA, so there is background radiotracer activity, but the signal-to-noise difference is improved in comparison with FDG. (See image[s] for this review at practicalreviews.com.) (Reviewer-Shayne Squires, MD).

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Keywords: Brain Metastases, Delayed Radiation Injury, Recurrent Metastases

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The median survival after salvage stereotactic radiosurgery is 11.7 months, and local control of the treated metastases is 60.1% at 1 year and 46.8% at 3 years.
Blood Transfusion Volume Linked to Risk of Surgical Site Infection

The Association Between Perioperative Allogeneic Transfusion Volume and Postoperative Infection in Patients Following Lumbar Spine Surgery.

Woods BI, Rosario BL, et al:

The volume of blood transfused during lumbar spine surgery is associated with an increased risk of surgical site infection in adult lumbar spine surgery.

Background: Surgical site infection, as any surgeon now knows, is a hot topic. It has been shown that spine surgery with implants is one of surgical categories with an increased risk of surgical site infections. Several articles have examined the relationship between blood loss and infection. Effect: To examine whether the volume of blood transfused during lumbar spine surgery increases the risk of surgical site infection.

Patients/Methods: The authors examined 1799 adult lumbar spine surgical procedures from the practice of 1 surgeon at the University of Pittsburgh. Procedures included lumbar laminectomy, instrumented and noninstrumented fusion, and anterior and posterior interbody fusion. The mean patient age was 60 years. The infection rate for this population was 3.1% (n=56). The patients with infection were matched with controls for comorbidities, age, smoking status, diabetes, the Charlson Comorbidities index, body mass index, and other factors. Blood replacement was defined as that given intraoperatively as well as in the first 24 hours after surgery. The match varied between 1:1 and 3:1 controls per infected case. All infections were treated with surgical irrigation and debridement, therefore appearing to represent deep wound infections. Spinal as well as iliac crest site infections were included.

Results: The estimated blood loss for these patients averaged 1300 to 1500 mL. The volume of transfusion increased the risk of surgical site infection (OR, 4.00). This was true even after adjusting for preoperative hemoglobin and the intraoperative blood loss.

Conclusions: Both the need for transfusion and the volume of transfused blood are risk factors for surgical site infection after lumbar spine fusion. The authors discuss the available literature on the subject. Potential causes for this effect have been purported to be lowering of the host immune system by the allogenic transfusion as well as introduction of infectious agents.

Reviewer's Comments: This is an important article adding to the discussion about perioperative transfusion. My first question is whether there is, perhaps, an effect of inadequate matching for all possible risk factors associated with increased blood loss. Nonetheless, it appears that the best strategy is to decrease overall blood loss by a number of actions, including antifibrinolytics as well as surgical actions. (Reviewer-Paul D. Sponseller, MS, MD, MBA).

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Keywords: Surgical Site Infection Risk vs Transfusions, Lumbar Spine Surgery

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Familiarity With Imaging Features of Coccidioidomycosis of the CNS Is Important

Imaging Spectrum of CNS Coccidioidomycosis: Prevalence and Significance of Concurrent Brain and Spinal Disease.

Lammering JC, Iv M, et al:

AJR Am J Roentgenol 2013; 200 (June): 1334-1346

Patients with coccidioidal meningitis have a high prevalence of simultaneous involvement of the spine.

**Objective:** To evaluate the prevalence and significant imaging features of concomitant brain and spinal coccidioidomycosis.

**Design/Participants:** Retrospective study of 23 patients with proven coccidioidal meningitis who underwent central nervous system (CNS) imaging between January 1998 and August 2011.

**Methods:** All patients underwent MRI imaging of the brain. Additional studies were also obtained and included MR angiography of the circle of Willis (n=10), MRI of the cervical spine (n=19), MRI of the thoracic spine (n=15), MRI of the lumbar spine (n=17), and CT and fluoroscopic myelogram (n=15).

**Results:** All 23 patients had intracranial MRI abnormalities. Leptomeningeal enhancement occurred in 21 patients (91%), predominantly localized to the basilar cisterns. In addition, 19 of these 21 patients (90%) had enhancement in the middle cerebral artery cisterns, in whom 18 had bilateral and 1 had unilateral right-sided enhancement. Hydrocephalus occurred in 18 of 23 patients (78%) and was graded as moderate to severe in 13 of these 18 patients (72%). Of these 18 patients, 11 (61%) had transependymal flow of cerebrospinal fluid (CSF), and 12 (67%) had CSF shunting. Infarcts were seen in 8 of 23 patients (35%). Focal parenchymal lesions were identified in 3 of 23 patients (13%). Nine of 23 patients (39%) had scattered periventricular white matter T2-hyperintense signal abnormalities. Of the 23 patients with abnormal brain MRI findings, 22 underwent spinal imaging in the form of MRI or post-myelography CT (or both); of these, 19 (86%) had concomitant spinal abnormalities. On initial spinal MRI, 14 of 19 patients (74%) had spinal leptomeningeal enhancement, 7 of 19 patients (37%) had nerve root clumping and thickening, 3 of 19 patients (16%) had intramedullary spinal cord T2-hyperintense signal abnormality, and 3 of 19 patients (16%) had focal extramedullary intradural lesions. Fluoroscopic and CT myelograms were performed in 15 patients, of whom 10 (67%) had focal extramedullary intradural lesions and nerve clumping. Of these 10 patients, 3 (30%) had nonobstructive filling defects and 7 (70%) had complete subarachnoid CSF blocks.

**Conclusions:** Knowledge of imaging features of spinal coccidioidomycosis is important due to the high prevalence of concurrent spinal disease in patients with coccidioidal meningitis.

**Reviewer's Comments:** I agree with the authors in that familiarity with imaging features of coccidioidomycosis of the CNS is important, as delay in diagnosis can have devastating consequences for the patient. After reading this article, radiologists should remember to maintain a low threshold for imaging of the spine in patients diagnosed with coccidioidal meningitis. (Reviewer-Sebastian Sadowski, MD).

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Keywords: Central Nervous System Coccidioidomycosis, Spine

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Cranio-vault reconstruction can improve neurodevelopmental milestones.

Background: The incidence of premature suture closer has increased over the last few decades. Trigonocephaly is the second most frequent type. In addition to the esthetic deformity, 50% of patients have increased intracranial pressure. Despite this finding, intellectual performance has been reported to be relatively preserved.

Objective: To review neurocognitive, motor, and speech development in patients with metopic craniosynostosis.

Design: Single institution retrospective study.

Methods: Metopic craniosynostosis patients’ medical records and radiological findings were reviewed. The typical clinical appearance of a narrow forehead with metopic ridge, hypotelorism, fleeing eyebrow region, and shallow temples were confirmed by low-dose spiral CT with 3-D reconstruction or MRI. Fundoscopy was obtained. Pediatricians or pediatric neurologists evaluated neurodevelopment. Suspected syndromic cases were evaluated by genetic work-up. Surgical reconstructions were done by a team of 3 neurosurgeons, 2 pediatric surgeons, and a cranio-maxillofacial surgeon. Postoperative evaluations were done at 3, 6, and 12 months and annually thereafter. Measurement of skull circumference, satisfactory correction of forehead cosmesis, gross motor function, speech, and cognitive function were evaluated. Pre- and postoperative developmental deficits were graded as mild, moderate, or severe and compared.

Results: Twenty-five cases of trigonocephaly (21 boys, 4 girls) were treated (median age at surgery, 9.2 months); mean follow-up was 33 months. Two children were diagnosed as syndromic postoperatively. Preoperatively, all patients’ fundoscopy examinations were normal. CT and MRI showed premature fusion in metopic suture. Mean blood loss was 291 mL (21% to 49% of body circulating blood volume) and transfusion was necessary in 23 cases; 2 patients not requiring transfusion were >1 year. Neurodevelopment results were normal in 12 (48%) and mild deficit in 6, moderate in 4, and severe in 3. Normal developed children continued showing normal development after surgery. Four of the 6 mild motor deficit patients improved with intensive physical therapy after surgery by 6 months. Two of the 6 mild motor deficit patients improved at 12-month follow-up; 1 of the 2 moderate motor deficit patients progressed to mild at 6 months, and 1 improved to mild deficit at 12 months with physical therapy. Two of the 3 severe motor deficit patients improved to moderate deficit at 6 months, and 1 patient improved to moderate deficit at 12 months. Speech and cognitive deficits had similar results. No patient deteriorated following surgery.

Conclusions: Approximately 52% of trigonocephaly children who underwent cranial vault reconstruction had neurodevelopmental delay. Deficits showed some improvement after surgical intervention, including severe deficit.

Reviewer’s Comments: Single-suture craniosynostosis is associated with neurodevelopmental delay. This study analyzed deficits in 3 separate areas (motor, speech, and cognition) and demonstrated improvements by 12 months postoperatively. Awareness of potential neurodevelopmental delay and postoperative supportive physical, speech, and cognitive therapies can improve quality of metopic craniosynostosis patients’ function. (Reviewer-Tomoko Tanaka, MD).

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Keywords: Metopic Craniosynostosis, Metopic Suture, Synostosis, Trigonocephaly, Esthetics, Orbital Advancement

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Evaluation of CSF Shunts -- A Comprehensive Review

Imaging Evaluation of CSF Shunts.
Wallace AN, McConathy J, et al:

AJR Am J Roentgenol 2014; 202 (January): 38-53

Cerebrospinal fluid shunt malfunction is common.

Objective: To evaluate imaging findings seen in a variety of cerebrospinal fluid (CSF) shunts and their malfunction.

Design: Retrospective literature review.

Results: Ventricular enlargement may be subtle, and comparison with prior examinations is mandatory; however, the shunt may fail without definite ventriculomegaly. Secondary signs of acute shunt failure that may be helpful in equivocal cases include transependymal flow of CSF, edema adjacent to the catheter, and subgaleal fluid collections. MRI shows similar findings and is being increasingly used to minimize radiation exposure. Conventional radiography is primarily performed to evaluate for breaks, disconnections, or distal catheter migration. Intraperitoneal catheters can also be evaluated with ultrasound or CT, the former being preferred in children because of the absence of radiation. Radionuclide CSF shunt studies can evaluate shunt patency, differentiate proximal versus distal limb obstruction, and in some cases, show the site of obstruction where activity fails to progress through the system. Within the first 2 years after shunt placement, obstruction of the proximal catheter accounts for 50% of all failures, and distal blockages account for 14%. The most common cause of proximal obstruction is occlusion of the ventricular catheter tip by ingrowth of choroid plexus and particulate debris or blood products in the shunt valve. The proximal catheter can also migrate within the ventricle into a position where CSF does not drain properly. Pseudocyst formation is a common cause of distal catheter obstruction. Diagnosis can be made by CT or ultrasound showing a loculated fluid collection surrounding the catheter tip. Infected pseudocysts require shunt removal, external ventricular drain placement, and antibiotics. Other causes of distal obstruction include catheter migration or erosion into soft tissues. Disconnection most commonly occurs shortly after shunt placement. Material defects or surgical error are generally responsible. Breaks most commonly occur in the neck region where the catheter is most mobile. Shunt infection most commonly occurs within 6 months of placement due to intraoperative contamination with skin flora. Ventricular loculations create noncommunicating pockets of CSF. Over time, loculations that do not communicate with the shunted ventricular segment enlarge and produce symptoms of hydrocephalus. If the lateral ventricles collapse too rapidly, the brain may not be elastic enough to fill the space. The resulting disparity between the sizes of the brain and calvarium leads to formation of a subdural hygroma or hematoma. Chronic overdrainage is common, with small slit-like ventricles seen in up to 50% of children with shunts.

Conclusions: Radiologist should be familiar with imaging features and common complications of CSF shunts.

Reviewer’s Comments: I agree that radiologists should be familiar with imaging appearance of shunt-related complications. (Reviewer-Sebastian Sadowski, MD).

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Keywords: Cerebrospinal Fluid Shunts, Imaging Evaluation

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