

2011;38:909-917). (Respond: Dr HB Sarnat, Alberta Children's Hospital, 2888 Shaganappi Trail NW, Calgary, Alberta T3B 6A8, Canada).

COMMENT. Metabolic tissue markers of epileptic foci help define a total excision of brain tissue in the surgical management of refractory epilepsies. Increased mitochondrial respiratory chain enzymes and/or intense  $\alpha$ -B-crystallin reactivity at the periphery of resected brain tissue may indicate incomplete removal of a focus and an increased risk of seizure recurrence. (Sarnat HB, Flores-Sarnat L. *Can J Neurol Sci* 2009;36:566-574). These novel tissue markers add immunohistochemistry to EEG telemetry, ECoG, and MRI as tools to determine the extent of resection of epileptic foci of brain tissue.

**Epileptic networks in focal cortical dysplasia revealed by EEG and fMRI.** Of 23 patients with focal cortical dysplasia and epilepsy undergoing presurgical evaluation with intracranial EEG (icEEG) and simultaneous EEG-fMRI, 12 had interictal discharges (IED) during recording, and 11 of 12 had IED-related hemodynamic changes. The fMRI results were concordant with the seizure onset zone (SOZ) on icEEG in 5 of 11 patients. Four of 5 had >50% reduction in seizure frequency following resective surgery. The remaining 6 had discordant IED-related fMRI signal change. Five of 6 had a poor surgical outcome. Discordant regions of IED-related hemodynamic change are associated with a widespread seizure onset zone and poor surgical outcome. (Thornton R et al. *Ann Neurol* Nov 2011;70(5):822-837). (Response: Louis Lemieux PhD, Institute of Neurology, London, UK. E-mail: [Louis.lemieux@ucl.ac.uk](mailto:Louis.lemieux@ucl.ac.uk)).

## **HEADACHE DISORDERS**

### **HEADACHE POST-TRAUMATIC BRAIN INJURY**

Researchers at University of Washington, Seattle, and Children's Hospital of Philadelphia, PA conducted a prospective cohort study of the prevalence of headache 3 and 12 months after traumatic brain injury (TBI) in children ages 5 to 17 years. Follow-up interviews with parents or adolescents found the prevalence of headache 3 months after injury was significantly higher after mild TBI than in controls after arm injury overall (43% vs 26%), in adolescents, and in girls. It was also higher after moderate/severe TBI in younger children. At 12 months after injury, TBI was not associated with a significantly increased frequency of headaches, but girls with mild TBI reported serious headache more often than controls. (Blume HK, Vavilala MS, Jaffe KM, et al. Headache after pediatric traumatic brain injury: A cohort study. *Pediatrics* 2012;129:1-9). (Respond: Heidi K Blume MD, MPH, Division of Pediatric Neurology, University of Washington, Seattle Children's Hospital and Research Institute, Seattle, WA 98105. E-mail: [Heidi.blume@seattlechildrens.org](mailto:Heidi.blume@seattlechildrens.org)).

COMMENT. Girls and adolescents are at highest risk of headache in the months after mild TBI. Younger children also suffer long-term headache after moderate/severe TBI. Posttraumatic headache after mild TBI shares similarities with migraine and tension-type headache. Migraine headache in children may be precipitated by head

trauma (Stang PE et al. **Neurology** 1992;42:1657-1662). Headache after hospitalization for closed head injury in children followed for 6 years did not appear to be accident related. (Lanser JBK et al. **Headache** 1988;28:176-179). Several investigators allude to the onset of migraine following mild TBI.

## **METABOLIC DISORDERS**

### **CARBONIC ANHYDRASE TYPE II DEFICIENCY SYNDROME**

Researchers at King Saud University, Saudi Arabia and other centers describe the neurological, neuro-ophthalmological and neuroradiological features of 23 patients (10 male, 13 female; age at final exam 2-29 years) from 10 unrelated consanguineous families with carbonic anhydrase type II deficiency syndrome due to homozygous mutation (the 'Arabic mutation'). All patients had osteopetrosis, renal tubular acidosis, developmental delay, short stature, and craniofacial disproportion with large cranial vault and broad forehead. Two-thirds had mental retardation, mild to severe, associated with spastic quadriparesis in 2. Optic atrophy was bilateral in 10 patients and unilateral in 3, associated with pendular nystagmus in 6. Neuroimaging studies in 18 patients showed thickened skulls, small paranasal sinuses, small optic canals, and intracranial calcifications involving the basal ganglia and thalami bilaterally, usually progressive, but less severe in patients with more severe mental retardation. Early treatment of systemic acidosis with bicarbonate slowed the progressive course of the disease. (Bosley TM, Salih MA, Alorainy IA, et al. The neurology of carbonic anhydrase type II deficiency syndrome. **Brain** Dec 2011;134:3499-3512). (Respond: Dr Khaled K Abu-Amero, Department of Ophthalmology, College of Medicine, King Saud University, PO Box 245, Riyadh 11411, Saudi Arabia. E-mail: [abuamero@gmail.com](mailto:abuamero@gmail.com)).

COMMENT. This autosomal recessive disorder may be diagnosed prenatally by direct CA2 gene sequencing, testing for the causative Arabic mutation identified in 70% of patients of Arabic descent. Early treatment with bicarbonate in the present cohort could explain the reduced phenotypic severity compared to most reports. Carbonic anhydrase type II is a cytoplasmic enzyme, 1 of 14 known isoenzymes, with the highest catalytic activity. The physiological functions of CAII include electrolyte and water balance, pH homeostasis, CO<sub>2</sub> and HCO<sub>3</sub> transport, and production of cerebrospinal fluid, aqueous humor, gastric acidity and pancreatic secretions.

Levels of carbonic anhydrase in the rat brain are low at birth. The rapid development of the enzyme is associated with a maturation of experimental seizure patterns from subtle, swimming movements to clonic, and generalized tonic-clonic patterns by 1 month of age. (Millichap JG. Seizure patterns in young animals. Significance of brain carbonic anhydrase. II. **Proc Soc Exp Biol and Med.** 1958;97:606-611). The anticonvulsant activity of the carbonic anhydrase inhibitor, acetazolamide, is directly related to the inhibition of brain carbonic anhydrase (**J Pharmacol & Exper Therap** 1955;115(3):251-258; **Neurology** 1956;6(8):552-559). It is noteworthy that seizures are not included in the phenotype of patients with CA deficiency syndrome.