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**1 The effects of ACTH and the adrenocorticosteroids on seizure susceptibility in 15 day old male rats – W. McIntyre Burnham[a,b], Sutha Vimal[a,b], Heather E. Edwards[a,b] ([a]Bloorview Epilepsy Research Program, University of Toronto, School of Medicine, Toronto, Ontario, Canada; [b]Department of Pharmacology, University of Toronto, School of Medicine, Toronto, Ontario, Canada)**

Infantile spasms are generalized convulsive seizures which occur during the first year of life. They resist most of the conventional anticonvulsants, but are often responsive to adrenocorticotropic hormone (ACTH).

**Methods**: The present study tested the effects of ACTH and related adrenocorticosteroids in pre-pubertal 15 day old rats. Compounds were tested against minimal (MET) and maximal (MMT) pentylenetetrazol seizures, maximal electroconvulsive shock (MES) seizures, and hippocampal kindled seizures.

**Results**: ACTH was only mildly effective against MET and MMT forelimb clonus, and it was completely ineffective against MES seizures and hippocampal kindled motor seizures. Likewise, corticosterone, dexamethasone, and dihydroepiandrosterone had little anticonvulsant activity. Two of the metabolic precursors to corticosterone, however, had strong anticonvulsant effects. Deoxycorticosterone (DOC) and progesterone ($P_4$) suppressed MET, MMT, MES and kindled seizures within 15 min of injection (s.c.). Aldosterone was also effective against MET and MMT seizures.

**Conclusion**: These findings indicate that two of the adrenal steroid precursors, DOC and $P_4$, have broad-spectrum anticonvulsant activity in animal models. They may play a role in mediating the anticonvulsant effects of ACTH.

**2 The ketogenic diet. Does acetone stop seizures? – Sergei S. Likhodii[a], O. Carter Snead[b], W. McIntyre Burnham[a] ([a]Department of Pharmacology, University of Toronto, Toronto, Ontario, Canada; [b]Hospital for Sick Children, Toronto, Ontario, Canada)**

The ketogenic diet (KD), a therapy for epilepsy, was evolved in the 1920s, following early observations that fasting – which elevates ketones – ameliorates seizures. The KD is successful when anticonvulsants have failed, suggesting that it works by a unique mechanism. We hope to understand this mechanism, and to replicate it by pharmacological means. Acetone is one of the 3 ketones elevated by the KD. Accordingly, dose–response studies of the anticonvulsant effects of acetone were done in rats using 3 different seizure models: the maximal electroshock model, the maximal and the threshold pentylenetetrazol (scPTZ) models, and the amygdala kindling model. Acetone demonstrated significant anticonvulsant effects in all 3 models. Acetone also significantly delayed or prevented development of kindled seizures. The fact that acetone was equally effective in 3 standard seizure models suggests a broad spectrum of action, resembling that of the KD. Whether acetone is the sole mechanism of the KD, or a contributing factor, is not yet known.

**3 Post-traumatic changes in EEG and evoked potentials – Li Chen, Zeljka Jovicic, Paul Hwang (Bloorview Epilepsy Program, University of Toronto, Toronto, Ontario, Canada)**

The objective of this retrospective study of 17 consecutive patients with non-structural traumatic head and/or neck injuries was to determine the role of neurophysiological studies in patient management.

A consecutive series of 17 adults was obtained from a single neurophysiology laboratory. Digital electroencephalogram (EEG) was recorded with electrodes in the 10-20 positions, and evoked potential studies including brain-stem auditory evoked potentials, pattern reversal visual evoked potentials and median nerve somatosensory evoked potentials were performed. All studies were performed by one neurophysiologist (C.L.), analyzed by a blinded researcher (Z.J.) and reported by the same neurologist (P.H.).

Of the 17 subjects studied between 1 and 6 months post-trauma, 12/17 had abnormal EEGs (70%), 3/9 had abnormal VEPs (33%), but only 1/10 had abnormal BAEPs (10%), and 1/10 had abnormal median nerve SEP (10%).

This preliminary study suggests a role for neurophysiological investigations in non-structural traumatic head injuries in cases presenting with headaches, neck pain and/or paresthesiae. A larger prospective case-control study would be necessary to determine sensitivity and specificity of neurophysiological findings in traumatic head injuries.

**4 Synchronized hippocampal interneurons and in vitro seizures – Peter L. Carlen[a,b], Xiao-Lei Zhang[a,b], Liang Zhang[a,b], S.S. Jahromi[a,b], Jose Luis[a,b], Perez Velazquez[a,b] ([a]Toronto Western Research Institute, Toronto, Ontario, Canada; [b]Bloorview Epilepsy Research Program, University of Toronto, Toronto, Ontario, Canada)**

Pathological neuronal synchrony is a hallmark of seizures. Repetitive tetanization (80 Hz for 2 s) to the Schaffer collaterals in the hippocampal–parahippocampal horizontal brain slice produces seizure-like activity measured in the CA1 area. Whole cell recordings from stratum oriens–alveus interneurons show burst firing, which is synchronous with or slightly leads field events and pyramidal cell firing during ictal activity. Excitatory and inhibitory postsynaptic potentials are simultaneously received by pyramidal neurons during the ictal afterdischarge, and are synchronous with interneuronal bursting and field potential events. The gamma aminobutyric acid A (GABAA) receptor antagonist, bicuculline, greatly reduces the duration of the ictal activity in the CA1 layer, as do gap junctional blockers. Dual recordings of widely separated CA1 pyramidal neurons during ictal and interictal periods reveal synchronous IPSPs, indicative of widespread interneuronal firing synchrony. Dual recordings of stratum oriens interneurons in intact hippocampi show evidence of electrotonic coupling in ~20% of recordings. This coupling was weak and intermittent, possibly reflecting distal dendritic coupling and gap junctional gating characteristics. We conclude that interneuronal activity, synchronized by GABAergic and electrotonic mechanisms, significantly contributes to the genesis of seizure-like activity.

**5 Mutual information in the scalp EEG during the first sleep cycle – Robert B. Duckrow[a], Alfonso M. Albano[b] ([a]University of Connecticut Health Center, Farmington, CT, USA; [b]Bryn Mawr College, Bryn Mawr, PA, USA)**

Average mutual information (AMI) provides a nonlinear measure of the relationships among signals derived from complex systems. We used this measure to characterize interdependence in the multi-channel scalp electro-

encephalogram (EEG) of humans. Sleep records were obtained at home from 6 adult subjects referred for 24 h ambulatory EEG monitoring because of unexplained spells and selected because the recordings were normal. Signals from the traditional 19 scalp electrode locations of the 10-20 system were digitized at 200 Hz (Telefactor) and compared to a computed average reference. Bandpass was from 0.5 to 100 Hz. Data from the first sleep cycle (52–90 min) were visually edited for artifact, stages, an embedded ($m = 3$, $= 1$). AMI was calculated for 5 s epochs and averaged over all pairs of channels. Frequency-band power was calculated for the same epochs. We found that the EEG contains, on average, more mutual information during wakefulness, less during slow wave sleep, and an intermediate amount during rapid eye movement (REM) sleep. State-dependent values were similar across subjects (mean $\pm$ std bits: awake $1.85 \pm 0.15$, slow wave sleep (SWS) $1.15 \pm 0.06$, REM $1.60 \pm 0.18$). AMI varied inversely with delta-band power, suggesting that cortico-thalamic synchronization of delta-frequency activity during SWS occurs over a spatial scale that is smaller than that of our scalp electrodes.

**6 The effects of disordered sleep on epilepsy: 10 year experience with sleep disorders in epilepsy – Alcibiades J. Rodriguez, Rahul Gupta, Michele R. Sammaritano, Grant W. Su, Bruce L. Ehrenberg (Department of Neurology, New England Medical Center, Boston, MA, USA)**

In kindled epilepsy Shouse found altered sleep patterns, yet secondary seizure escalations are unproven. Epilepsy is clearly exacerbated by sleep apnea, but this effect has neither been correlated by severity nor by type of epilepsy. We studied seizure types/severity vs. two sleep disorders: obstructive sleep apnea (OSA) and periodic limb movements disorder of sleep (PLMS).

Polysomnogram (PSG) results on 233 epilepsy patients (1990–1999) defined 3 groups: OSA ($n = 19$, 15 males), PLMS ($n = 22$, 8 males) and combined sleep disorders (CSD; $n = 6$, 5 males) which were compared to age- and sex-matched controls by number of antiepileptic drugs, PSG findings and seizure type/rate during the preceding year.

Total sleep time, sleep efficiency, rapid eye movement sleep and stages 3/4 were significantly decreased in patients with OSA and PLMS compared to epilepsy controls. Stage 1 and total arousals per hour were significantly increased in both disorders.

The percentage of patients with focal seizures was significantly higher in OSA (89%), PLMS (73%) and CSD (100%) compared to controls (68, 50 and 33%, respectively). Patients with exclusively nocturnal seizures were over-represented in OSA but not PLMS.

Seizure rates and number of drugs in use were significantly higher in OSA (21.6, 2.4) than controls (5.5, 1.3). In addition the PLMS patients showed a trend ($P = 0.10$) toward a higher seizure rate than controls (7.0 vs. 2.6).

**7 A physical model of the EEG – Robert Cohn[a], Stephen Ousley[b], Russell L. Myers[c] ([a]Howard University College of Medicine, Washington, DC, USA; [b]Smithsonian Institute, Washington, DC, USA; [c]Long Island University, Southampton Campus, Long Island, NY, USA)**

In serial and 'chaos' scatter plot recordings of the EEG it became clear that the EEG was basically a homeostatic process operating around a mean value. The primary driving parameter appeared to be a local energy source sufficient to induce turbulence of the medium. Boiling water met the sufficiency condition of the physical system. On this basis a beaker was loaded with water and heated to turbulence. The water movement was measured by a fixed incandescent lamp whose beam shined through the flask onto a photosensitive surface. The resultant voltage variations were amplified and recorded with a Grass EEG Model 8-10E electroencephalograph in parallel with a dedicated digital computer capable of organizing the statistical character of the produced 'waves'. With this system the recorded 'waves' had the character of the usual EEG, as well as frequency distributions, scatter pots and other standard statistics. This model has the fundamental character of a metabolic process, and furthermore eliminates 'spontaneity'.

**8 Ultrafast EEG frequencies in PTZ-induced paroxysmal bursts in rats – David L. Sherman[a], Ning Zhang[a], Marek Mirski[b], Ernst Niedemeyer[b] ([a]Department of Biomedical Engineering, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA; [b]Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA)**

This study is based upon the observation of ultrafast electroencephalographic (EEG) frequencies in 10 Sprague–Dawley rats following the administration of pentylenetetrazol (PTZ) under halothane anesthesia (0.5%). The EEG data were obtained with the use of cortical screw electrodes and deep twisted pair bipolar electrodes in anterior thalamus, posterior thalamus, and hippocampus (CA 1) that were histologically verified. Emphasis was placed on the relationship between ensuing spikes or sharp waves and ripples of ultrafast (200–300/s). A sampling of 1000 Hz was chosen along with low pass filters with half-power bandwidth of 300 Hz.

The PTZ effect manifested itself in massive change of background activity complemented by spikes and sharp waves that were most impressive in neocortical levels. By contrast, the subcortical leads showed repetitive ripples of spiky activity in the 200–300 Hz range, most prominent in the hippocampal region and slightly less eminent in the thalamic region. These ultrafast bursts would assume quasi-rhythmical character at about 6–7 Hz. Interestingly, this rhythm was not congruent with neocortical activity.

In view of this discrepancy one wonders if the neocortex with its classical spikes and sharp waves possesses the property of suppressing the ultrafast rhythms.

**9 Ultrafast frequencies and their role in epileptology – Ernst Niedermeyer, David Sherman (Departments of Biomedical Engineering and Neurology, Johns Hopkins University Medical Institutions, Baltimore, MD, USA)**

The recent upsurge of interest in ultrafast electroencephalographic (EEG) frequencies – frequencies above 100 Hz – is likely to provide deeper insights into basic epileptic mechanisms. Ripples in the 120–300 Hz/s range are noted in Metrazol-induced convulsions, associated with spike bursts that, however, can also be ripple-free. The significance of presence or absence of ultrafast activity in spike bursts could be meaningful and requires further work. This is also true for their location.

In human epileptology, ultrafast activity (escaping conventional EEG recording) might play a role in electro-decremental seizures during the initial (apparently flat) fast phase. Massive afferent influx of very high frequency may lead to a negative deflection of the tracing, its 'flat' plateau also indicating very rapid firing. Before, however, such a full frequency extension can be introduced, the vast domain of ultrafast activities requires bountiful investigation.