HIGHLIGHTS FROM INTERNATIONAL NEUROSCIENCE MEETINGS

1st Annual Symposium of the Saudi Epilepsy Society Riyadh, KSA, January 11-13th 2011

Sonia Khan, *MD, FRCP.*
Department of Clinical Neurosciences, Riyadh Military Hospital, Riyadh, Saudi Arabia.

Under the Patronage of his Excellency Dr. Abdullah A. Al-Rabeah, Minister of Health, and with the Presence of Her Highness Princess Munira Bint Saud Al-Kabeer Al-Saud, SES Honorary President, the First Annual Saudi Epilepsy Society Symposium took place in the Riyadh Intercontinental Hotel from 11-13th January 2011. Over 600 participants from Saudi Arabia and the Gulf Region attended the symposium. Eight international epilepsy experts and many elite epileptologists from Saudi Arabia also participated in the symposium. The symposium was conducted under the Auspices of the Saudi Commission for Health Specialties, and in Collaboration with the Commission on East Mediterranean Affairs and the Saudi Chapter of Epilepsy, under the International League of Epilepsy and the Cleveland Clinic. The symposium was a great success, and the overall evaluation of the meeting was very good. The symposium included 2 full day courses, one on electroencephalography, and one on general epilepsy update, one half-day course on encephalography for nurses and technicians, 3 workshops including one on encephalography, one on epilepsy surgery, and one on seizure semiology in addition to several sessions on updated concepts and research in adult and pediatric epilepsy.

Abstracts

Neurophysiology of EEG

Shireen Qureshi, Saudi Aramco, Dhahran, Saudi Arabia

Cerebral sources of EEG potentials are 3-dimensional volumes of cortex producing 3-dimensional fields within the brain. From the surface of the scalp, 2-dimensional fields can be recorded of varying voltages in time. Localizing of cortical generators of the EEG, the physical and functional factors that determine the voltage fields that these sources produce. The cellular mechanisms underlying brain electrical activity are produced by generators of EEG measured on the surface of the brain as graded potentials of both excitatory post-synaptic potentials (EPSP) and inhibiting post-synaptic potentials (IPSP) of pyramidal neurosis. Different ion channels and neurotransmitters play a major role in various epileptiform discharges. These differ based on various seizure types and activation potentials. For instance, periodic depolarization shift is the EEG correlate for interictal discharges where activation of slow type of Ca++ channels play a role in thalamocortical circuits responsible for absences spike and slow wave discharges. Routine EEG measures cerebral electrical activity by means of sources of scalp electrode recorded brain electrical activity, neuronal processes that produce rhythmic oscillations characteristic of human EEG, and by defining fundamental ways in which disease affects the distribution and pattern of EEG. However, localization of discharges remains essential based on solid angle theorem and fundamental principles of volume conduction described by Gloor. In this review, the neurophysiological basis of the different types of epileptiform discharges is presented.

Fundamentals of EEG interpretation

Mohammad Kabiraj, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

Objectives: At the end of the session, the audience should understand the fundamental principles of EEG recording such as use of differential amplifiers, filters, EEG patterns, advantages of digital EEG, some recently developed mathematical algorithm for automated artifact correction, and principles involved in automated epileptiform

spikes hyper clustering and seizure detection. Thereby, a distinctive electroclinical diagnosis can be achieved. **Introduction:** EEG interpretation involves visual analysis of individual waveforms and patterns, making mental hypothesis on spatial/anatomical origins of the electrical sources and determining electro-clinical significance. EEG interpretation is similar to neurological examination; it cannot be learned from books. A working vocabulary such as channel, derivations, montages (Bipolar, Referential) should be used by the EEG viewers. An unknown EEG pattern is determined by the morphology (frequency, spike, sharp wave(s), complex, amplitude, polarity, phase(s), rhythmicity, and reactivity) and their spatial distribution on the scalp. The summated electrical current reaches the scalp electrodes through the volume conductor (body fluid). The large pyramidal cells of the cortex are best suited for generating scalp current. The vertically orientated pyramidal neurons form sheets for electrical dipoles. It is not known whether scalp electrical activity is due to EPSP or IPSP, although a microelectrode study showed spike in general by EPSPs (paroxysmal depolarizing shift) and slow component by IPSPs. The electrical current spreads out as it meets the different layers of electrical resistances (amplitudes and scalp current field distribution). Therefore, a prominent waveform detected by only one channel is an artifact until proven otherwise. Moreover, amplitudes also depend on the inter-electrode distance (in closer distances, they see the same activity, thus, cancelled by the differential amplifiers, causing lowering of the amplitude). The best way to improve the spatial resolution is to increase the number of the recording electrodes (like ADC). The spatial sampling involves the converter of the continuous voltage current contours into discrete points in space, with each point represented by a recording electrode. It is suggested that the expanded 10-20% system may yield inter-electrode distance close to 2.5cm with minimum sampling error and may be used for routine clinical practice, especially for the detection of an anterior temporal spike (Gibbs and Gibbs, 1952). The selection of electrodes for input 1 and 2 for any single amplifier channel is referred to as derivation. The combination of multiple derivations is known as montages, which function like spatial filtering (lens in a telescope). Bipolar montages consist of a series of overlapping bipolar derivation in straight line such as longitudinal (anterior-posterior), transversely left to right across the scalp. They act as filters that remove widespread potentials with similar amplitudes and phases (coherent waveform) from the record and thereby analyze low to medium amplitude waveforms that are highly localized by phase reversal. Common electrode reference montage consists of a series of derivations in which the same electrode is used in channel 2 of each amplifier. Input 2 is at a distance, preferably at quiet locations from the source. The location of the maximum potential on the head is determined by amplitude (with digital EEG, neck-chest electrodes should be used as non-cephalic reference). Average reference, all 19 electrodes are combined in input 2. Weighted average, similar to common average except that input one is not included in the reference. Laplacian montage (Hjorth, 1975, 1980), is like weighted-average montage, input one is referred to the nearest neighboring electrodes. Source localization: refers to the process of calculating the precise anatomical location of a current source within the brain using the distribution of potentials recorded from the scalp and other non-intracranial electrodes (solving the inverse problem). Montage display and design: American Clinical Neurophysiological Society: 3 basic montages: longitudinal bipolar, transverse, and reference. Retrospective analysis, retrospective manipulation of the signal display means that abnormalities that would go unnoticed in paper analog record can now be seen. Both high and low frequency artifacts obscure the EEG. Artifacts produced by biological and technical sources should be recognized, because they mimic epileptiform discharges. Removing artifacts from EEG, EEG contaminated with eye movements, blinks, muscle, heart, and line noises results in a serious problem for its interpretation. By application of software such as Independent Component Analysis (ICA) to multichannel EEG recordings, the above problem can be solved. Digital EEG becomes popular over analog EEG because it allows EEG record review with user-selected montage (montage reformatting), filters, vertical scaling (gain or sensitivity) and horizontal scaling (time resolution or compression). One should remember, however, that the digital EEG introduces subtle new problems like aliasing and dynamic range. **Clinical significance:** A wide variety of normal patterns can be seen in different persons of the same age. Source of benign patterns can occur infrequently. Therefore, normal EEG can be defined more effectively by the absence of abnormal component rather than by the presence or absence of normal patterns. The clinical significance of interictal epileptiform Spike (IED) is one of the most important and most misunderstood concepts of EEG interpretation. An analysis of the IED provides an important

example of how EEG interpretation is applied to the clinical practice. **Future developments in EEG interpretation:** Automated spike and SZ detection, SZ propagation, and SZ prediction are in the process of development. The current understanding of the anatomical and physiological basis of EEG is derived from a correlative study using: CT, MRI, angiography, pneumoencephalography, invasive (intracranial) recording, PET and ictal SPECT, fMRI of EEG events, complementary role of MEG and biopsy and autopsy results. Automated Spike and Seizure detection, a fast detection, visualization, and evaluation of epileptiform EEG activities can be performed using medical software called Brain Electrical Source Analysis (BESA) (recently approved by FDA). Source montages chosen from temporal, frontal, central, and parietal regions directly visualize the regional brain activity. The calculation is based on a linear inverse transformation of the EEG data derived from a multiple source model covering all brain regions. The sources can be displayed as hyper cluster forms and/or whole-head 3D maps. **Conclusion:** A detailed knowledge of the fundamental principles of EEG recording is essential for a systematic approach to identifying abnormal EEG patterns and the localization and lateralization of epileptic and nonepileptic abnormal events. Although EEG abnormalities are usually etiologically non-specific, a powerful clinical detail with competent and prudent EEG interpretation can provide information of differential diagnostic value. However, a wonderful day is knocking at the door when computer generated routine and long-term EEG interpretation will be feasible.

Neonatal EEG

Nabil Biary, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

The EEG in the neonate is unique. The EEG develops the same whether the infant remains within the uterus or has been born, therefore, the conceptional age (CA) is the most important variable in determining the EEG. The EEG abnormalities may appear in the form of patterns that are characteristics of a younger age of patient. Tracé discontinu pattern seen in premature less than 32 weeks CA and considered to be abnormal in full term babies. Active (rapid eye movement) sleep appears approximately at 32 weeks CA and low voltage irregular pattern (LVI) is seen with irregular respiration. Quiet (non-rapid eye movement) sleep is defined at 36 weeks. Respiration is regular and EEG will show tracé alternant pattern, or high voltage slow (HVS) pattern. At 37 weeks, the waking state will become organized with LVI pattern. The mixed (M) pattern can be seen during wake and sleep. Delta Brushes (DB) appear at 28 weeks and are gone at term. Frontal sharp transients appear at 26 weeks CA and disappear at one month past term. Sharp waves are usually considered abnormal if they repeatedly appear on a given focal region at least at 1-2 per minute and frequently in serial or runs. The positive central and temporal sharp waves are usually associated with periventricular leukomalacia and intraventricular hemorrhage and less often with seizures (29%). Electrical seizure activity is uncommon before the age of 34 weeks, however, ictal rhythms may occur without clinical evidence. Different seizures may be arising from different brain regions either sequentially or simultaneously, but asynchronously. The diagnosis of suppression burst is difficult to distinguish from trace discontinue in very preterm infants. At term, nearly 100% of the time synchronized rhythm will appear between both cerebral hemispheres.

EEG in the ICU

David B. MacDonald, Department of Neurosciences, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

The ICU EEG recordings assist the clinical diagnosis and management of stupor and coma. Most recordings simply confirm encephalopathy and exclude subclinical status epilepticus. Some patterns convey prognostic information that can help council families and support decisions to continue or discontinue heroic efforts. In particular, electrocerebral inactivity supports a properly made clinical diagnosis of brain death. Note that EEG cannot independently establish brain death. Occasionally, status patterns diagnose subclinical status indicating anticonvulsant therapy. However, status patterns must be differentiated from triphasic waves, periodic patterns,

and other findings that when mistaken for status may prompt inappropriate and potentially harmful deep anticonvulsant sedation. Continuous EEG monitoring helps manage clinical status epilepticus when properly used to titrate therapy to electrographic seizure resolution; burst-suppression is a commonly recommended end point for generalized convulsive status. It may also disclose clinically unsuspected intermittent seizures or cerebral deterioration that may prompt beneficial therapy. Useful EEG monitoring requires continuous bedside pattern recognition; interpretation after the fact has no therapeutic value. Thus, ICUs successfully implementing routine monitoring provide their staff with basic EEG training.

EEG in pediatric epilepsy

Ali El-Sayed, Department of Clinical Neurosciences, King Fahad Military Medical Complex, Dhahran, Saudi Arabia

The electroencephalogram has a pivotal role in the investigation and classification of childhood epilepsies. The EEG recording is different in children than adults because the brain, meninges, skull, scalp, head size as well as the child's behavior and ability to cooperate all change over time. Therefore, pediatric EEGs must be recorded and interpreted with special attention given to the child's age and developmental level. For a complete EEG, all states (awake, drowsy, and sleep) should be recorded. Lack of state change is abnormal in infants. The role of the EEG is to help the physician to establish an accurate diagnosis. However, with few exceptions, diagnosis does not depend primarily on EEG, as interictal EEG abnormalities are observed in 5-8% of healthy children. A normal interictal EEG does not exclude epilepsy when there is a convincing clinical history. Sleep EEG enhances the positivity rate of routine EEG from 60-90% (H. Gastaut and R. Broughton, Epileptic seizures, CC Thomas, Springfield, 1972). Intermittent photic stimulation and hyperventilation are essential in children. Video-EEG recordings, with simultaneous sampling of EEG, electromyogram, and electrocardiogram are invaluable for characterizing complex clinical manifestations. Long-term cable telemetry is essential to capture and quantify seizures. So a standard EEG is often a valuable tool in children with epileptic seizures. It contributes to identification of features of a focal or of generalized epilepsy. It also helps in syndromic diagnosis, choice of further investigation, the therapeutic management of epilepsy and its prognosis. Finally, it is curial that the EEG report that is sent to the referring physician, who requested the EEG, should be helpful and committed. It should not be an abbreviated factual report, and the conclusion should provide helpful electro-clinical information as much as possible, and to be supplemented by the pediatric neurologist opinion, which ultimately improves the EEG contribution.

Pediatric electroencephalography: Parents' knowledge and experience

Marwa Al-Baharna, Z. M. Shivji, M. M. Al-Baharna, G. A. Kadi, A. M. Al-Osaimi, B. M. Bin Sadiq, M. M. Jan, Department of Neurosciences, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia

Background: Parent's understanding, support, and cooperation are essential for a successful pediatric EEG. We aim to study parent's perceptions and knowledge of the EEG procedure before the study and examine their impressions afterward. **Methods:** Consecutive parents of children coming for outpatient EEG were included prospectively. A 21-item questionnaire was designed to examine their demographics, knowledge, cooperation, and experience during the EEG procedure. **Results:** One hundred questionnaires were completed during the study period. Only 24% of the families reported receiving prior information about the EEG procedure, and only 16% felt very well informed. Up to 11% of the parents had misconceptions about the EEG procedure including that it involves needles, electrical shocks, pain, or intravenous medications. After the EEG procedure, 71% of parents found their experience better or much better than they expected. Those who were informed were more likely to have an as expected experience (34% versus 9%, p=0.004). The level of EEG information did not correlate with the parent's or child's behavior during the procedure. **Conclusions:** Most parents are poorly informed about the EEG procedure, which affects their expectation, and EEG experience. Few parents have significant apprehensions, and misconceptions, however, most found the overall EEG experience better that they expected.

HIGHLIGHTS FROM INTERNATIONAL NEUROSCIENCE MEETINGS

EEG features of temporal lobe epilepsy

Mohammed Jan, Department of Pediatrics, King Abdulaziz University, Jeddah, Saudi Arabia

Electroencephalography (EEG) is an important tool for diagnosing, lateralizing, and localizing temporal lobe seizures. In this paper, we review the EEG characteristics of temporal lobe epilepsy (TLE). Several "nonstandard" electrodes may be needed to further evaluate the EEG localization. Ictal EEG recording is a major component of preoperative protocols for surgical consideration. Various ictal rhythms have been described including background attenuation, start-stop-start phenomenon, irregular 2-5 Hz lateralized activity, and 5-10 Hz sinusoidal waves or repetitive epileptiform discharges. The postictal EEG can also provide valuable lateralizing information. Postictal delta can be lateralized in 60% of patients with TLE and is concordant with the side of seizure onset in most patients. When patients are being considered for resective surgery, invasive EEG recordings may be needed. Accurate localization of the seizure onset in these patients is required for successful surgical management.

Stereo-Electroencephalography (SEEG)

Philippe Kahane, Neurology Department and INSERM U836-IJF-CEA, Grenoble University Hospital, and the Epilepsy Institute for Children and Adolescents (IDEE), Lyon, France

The term stereoelectroencephalography (SEEG) was coined by Bancaud and collaborators in 1962 to account for a new method aiming at recording partial epileptic seizures by means of intracerebral electrodes implanted in stereotactic conditions. This method directly derived from a new conceptual approach for studying partial epileptic seizures, which was based on the assumption that the chronological occurrence of ictal clinical signs reflects the spatio-temporal organization of the epileptic discharge within the brain. Therefore, the strategy for selection of target locations of depth electrodes was based on hypotheses derived from non-invasive study, and aimed at simultaneous 3-dimensional display of all cortical areas potentially involved in the onset, propagation, and clinical manifestations of the seizures. This approach, named 'anatomo-electro-clinical correlations,' has remained the principal guide of the whole presurgical process that Talairach and Bancaud will use all along their career, and that they will transmit to their pupils. Nowadays, a number of epilepsy-surgery centers have developed a SEEG program, not only in France and Italy but also in other European countries as well as in the US. Indeed, one of the advantages of using intracerebral electrodes is that they penetrate the brain tissue directly. They are therefore, best suited to record from deep, buried structures such as amygdala, hippocampus, planum temporalis, or insula, as well as to record from the sulcal cortex. They are also essential to target lesions in deep cerebral locations such as one or several heterotopic gray matter abnormality(ies) or, when necessary, hypothalamic hamartomas. The quality of spatial sampling of intracerebral electrodes, when compared with subdural grids or strips, can appear inferior since recordings are taken from a series of paired leads that only explore a very restricted part of the cortex. Such multilead electrodes, however, provide an accurate coverage of all the structures that each electrode crosses along its trajectory, from its site of penetration to its final impact point, thus providing a true 3-D assessment of the epileptogenic network. Obviously, the position and number of intracerebral electrodes results from the harmony between the need to map most cortical regions where ictal discharges are supposed to originate from, and to rapidly propagate, anatomical constraints, and the will to limit the risk of parenchymatous damage. The technique, indeed, carries some risks that have been evaluated around 1.8% for infection, and 0.8% of intracranial hematoma.

Classification of seizures and epilepsies

Khalid Al-Quliti, Neuroscience Center, King Fahad Specialist Hospital, Dammam, Saudi Arabia

The development of an international classification for epilepsies and epileptic syndromes has led to substantial progress in the understanding and treatment of patients with epilepsy. Epilepsy is a heterogeneous group of disorders that encompass various epilepsy syndromes ranging from benign to progressive and catastrophic. The

past 2 decades have seen major advancements in the appreciation of epilepsy syndromes and their underlying mechanisms. Modern neuroimaging methods have helped to identify structural pathologies, and genetic discoveries led to identifying new syndromes and characterization of old syndromes. Epilepsy syndromes are categorized on the basis of a number of features including seizure types, age of onset, clinical features, electroencephalographic expression, and response to treatment. Multiple seizure types, evolution from one type to and another and age dependent expression are some of the unique features of epilepsy syndromes. The International League Against Epilepsy uses the age-related expression of these syndromes and classifies them by different age groups, allowing easy identification. Early recognition and identification of epilepsy syndromes is essential to provide valuable information on management and prognosis.

Diagnosis of epilepsy

Taher Obeid, Neurology Section, King Abdulaziz Medical City, KKNGH, Jeddah, Saudi Arabia

The correct diagnosis of epilepsy should aim at specific seizure type, the cause, and type of epileptic syndrome. History remains the main corner stone in diagnosis of epilepsy. Every effort should be made to take a detailed history given by the patient and a reliable eye witness. Physical examination may give a clue about the underlying etiology. Laboratory and diagnostic procedures are supplementary evidence to the suspected diagnosis and should be individualized. The EEG remains the most important diagnostic test in the diagnosis of epilepsy. It is important to remember the pit falls of EEG, as a normal EEG does not mean the patient has no epilepsy. It can be complemented by telemetric and video-EEG monitoring. Neuroradiologic investigations such CT-scan, MRI, PETS, and SPECTS may be carried out when the need arises. Genetic testing has a role in a growing number of telemetry disorders with epileptic seizures. It is always important to remember that other paroxysmal events may be difficult to differentiate from epilepsy.

Pharmacologic management of epilepsy

Abdullah Al-Humaidan, National Drug and Poison Center, Saudi Food and Drug Authority, Riyadh, Saudi Arabia

Despite the new advancements in antiepileptic drug (AED) development, thousands of people with epilepsy remain intractable to medication. Choosing the most appropriate treatment for a patient with epilepsy depends on complicated and critical decisions. The AEDs also differ in their safety, tolerability, and potential for pharmacologic interactions. The aim of antiepileptic treatment is to control the seizures as quickly as possible with no or minimal side effects and with no negative impact on the quality of life. There are numerous guidelines that have been produced for choosing the AEDs by several societies and organizations with different kinds of recommendations based on peer-reviewed scientific literature. 20-30% of patients were drug-resistant to all the available medications. In general, there are many hypotheses to explain the pharmaco resistance of AEDs, and based on these theories, there were many pharmacological strategies that can be utilized to treat these groups of patients. The purpose of this lecture is to address the main options and the limitations of treating patients with epilepsy in addition to the third generation of AEDs that provide potential new treatment options for patients failing treatment with previous AEDs.

Intractable neonatal seizures

Ali El-Sayed, Ali Mohamed, Children's Hospital, Taif, Saudi Arabia

Seizures are the most clinical neurological manifestation in neonates. Seizures have potential harmful and devastating effects, especially if intractable. Detection of neonatal seizures and the underlying causes and the differentiation of epileptic neonatal encephalopathic syndrome are critical and an emergency. The CNS infections, stroke, metabolic, inborn errors of metabolism (IEOM) and CNS malformations with neuronal migrational defects are all known

causes. The IEOM represent 1-3% of neonatal seizures and 30% of intractable neonatal seizures. Some of these are treatable, such as pyridoxine dependent seizures, folinic acid responsive, creatinine deficiency, and serine deficiency syndromes. Others are non-treatable such as NCL, mitochondrial, and paroxysmal disorders, with particular malignant forms such as neonatal myoclonic seizure associated with non-ketotic hyperglycinemia, usually with high plasma and CSF glycine levels, but if the level of glycine becomes low, what is the diagnosis? Three specific malignant epileptic encephalopathic neonatal syndromes are known, which are age-related, intractable, and multiple seizure types. These are EME, Ohtahara Syndrome, and Migratory Partial Seizures of Infancy. Differentiation of these syndromes has prognostic and treatment importance.

Basic terminology in EEG

Daher Al-Shammari, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

The EEG technologists, neurophysiologists, epileptologists, and neurologists are working in the EEG labs as a team where they communicate with each other using common EEG vocabularies. The objective of this topic is to clarify those terms used in the EEG lab. Let us start with the term EEG: refers to the recording of the brain electrical activity by placing of scalp electrodes. Electrodes: a solid electric conductor through which an electric current enters or leaves an electrolytic cell or other medium (silver chloride cup electrodes, sphenoidal electrodes, subdural and depth electrode). Impedance: electrical impedance, or simply impedance, describes a measure of opposition to alternating current (AC). Electrical impedance extends the concept of resistance to AC circuits. For EEG recording the impedance should be less than 5 Kohms. Amplifier: an electronic amplifier is a device for increasing the power of a signal. It does this by taking energy from a power supply, and controlling the output to match the input signal shape but with larger amplitude. In this sense, an amplifier may be considered as modulating the output of the power supply. Filters: after EEG signals are subtracted and amplified, the output is filtered to remove specified frequency components. Typical settings for the high-pass filter, and a low-pass filter are 0.5-1 Hz and 35-70 Hz respectively. The digital EEG signal is stored electronically and can be filtered for display. Montages: localization of normal or abnormal brain waves in bipolar montages is usually accomplished by identifying 'phase reversal,' a deflection of the 2 channels within a chain pointing to opposite directions. In a referential montage, all channels may show deflections in the same direction. EEG recording: scalp electrodes are placed using the international 10-20% system of Gesper. Background activity is the dominant frequency of the EEG record such as alpha frequency in patients at rest with eyes closed. Artifacts: the noncerebral potentials of physiologic and instrumental sources intermixed with EEG potentials that may mimic epileptic discharges. Focal slowing is nonspecific asymmetric delta-theta activity usually associated with an under-laying structural lesion. Spikes: this is a sharp potential with a duration of 20-70 Usec, and a sharp wave has a duration of 70-200 Usec, however, both of them are epileptogenic. Phase reversal: in bipolar montage, phase reversal of spike/sharp waves at 180 degree to one recording electrode determines the localization of an epileptic focus. EMU: the epilepsy monitoring unit is a hospital-based unit where patients are admitted to record long term EEG for epilepsy classification and for pre-surgical evaluation for epilepsy surgery. Seizure classification: generalized - it may idiopathic (genetic), childhood absence epilepsy, juvenile absence epilepsy, juvenile myoclonic epilepsy. Epilepsy with grand mal seizures on awakening and other idiopathic generalized epilepsies, and/or symptomatic or cryptogenic (West syndrome, Lennox-Gastaut syndrome, and other symptomatic generalized epilepsies). Localization-related: benign focal epilepsy of childhood (2 types), autosomal dominant nocturnal frontal lobe epilepsy, primary reading epilepsy mesiotemporal lobe epilepsy, and neocortical focal epilepsy.

Electroencephalogram instrumentation: Understand and effective usage

Zaitoon Shivji, Department of Neurosciences, King Faisal Specialist Hospital and Research Center, Saudi Arabia

Introduction: The instrumentation used in the EEG and other electro-diagnostic fields represents both a critical recording pathway as well as a potentially challenging field of study. Every professional in the field should strive

to improve knowledge of electrical components used in the EEG equipment and the instrumentation. As a result, talking about the EEG instrumentation is a significant opportunity for improving our clinical techniques and outcomes; simply by developing a greater understanding and mastery of key instrumentation concepts. **Goals:** Clearly, EEG instrumentation is a vast topic that can be explored at great depth, far beyond the scope of such a discussion as this. To limit the discussion for the time allotted, the goal here is to focus on 4 key components of instrumentation to gain a clear and memorable learning moment: the basic components of EEG equipment, how differential amplifiers work, a brief look at polarity of the signals, filters, and the effective use of a look at the calibration check list. These topics are addressed because each one can greatly impact success in accuracy of EEG recordings, if not used appropriately can easily lead to misdiagnosis. Further, these topics are frequently the focus of questions asked to the author by technologists and clinicians.

EEG reports

Miguela Santos, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

Objectives: At the end of the workshop, the audience should be able to understand and learn how to read the EEG, its utility and clinical importance, especially its role in diagnosis of epilepsy. The EEG reports start with the preparation of the patient, which includes the pertinent information about the patient (such as name, age, gender, hospital identification number, including EEG identification number). The patient is fully informed about the harmless, non-invasive technique of brain waves. Electrodes are placed using international 10/20 system for routine EEG, and 10/10 system or 10/20 extended programs covering the mesial temporal and orbito-frontal cortex (using the guidelines of the American Electroencephalographic Society). During recording, the technologist should remain alert with a vigilant eye on the record and the patient, to document annotations of any physiological changes. At the end of the record, he or she should go through the EEG record and write a factual report stating the background activity its frequency, persistent/intermittent, location, amplitude symmetry, asymmetry, and rhythmic or irregular. One should mark the effects of reactivity (such as eye opening and eye closure). The description of background activity should be followed by the abnormal activity if applicable. The paroxysmal activity should be fully described (spikes, slow waves and sharp waves, diffuse or focal, symmetry and synchrony). The description of the activation procedures such as hyperventilation (poor, fair or good cooperation) and intermittent photic stimulation should be stated. Sleep deprivation should also be mentioned in terms of stages of sleep. Artifacts should be recognized and if possible should be eliminated. Impression should be given as normal or abnormal. Clinical correlation should also be attempted to explain how the findings fit or do not fit with the clinical picture, these findings should be consulted with the Electroencephalographer/Neurophysiologist/Epileptologist, however, all the above subject with regards to EEG interpretations will be illustrated during discussion.

Gyratory seizures (GSs) video EEG recording

Ayman E. H. Hassan, Neurology Department, Saudi German Hospital, Jeddah, Saudi Arabia

Gyratory seizures (GSs) have been described rarely in generalized as well as in focal epilepsies. The GSs are defined as a rotation around the body axis during a seizure for at least 180 degrees. The mechanisms of generation of GSs are still unknown and have been discussed controversially. The GSs occur more frequently in frontal lobe epilepsy than temporal lobe epilepsy. The direction of rotation lateralizes seizure onset zone in focal epilepsy depending on the seizure evolution. We will discuss a patient with gyratory seizure recorded by video EEG monitory, who became seizure free after surgery.

HIGHLIGHTS FROM INTERNATIONAL NEUROSCIENCE MEETINGS

EEG case presentation

Mohammad Kabiraj, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

A 26-year-old right handed lady, a product of NSVD. She has seizures starting at the age of 7 years. The first seizure is GTCS. The seizures are nocturnal and diurnal and preceded by rising epigastric aura and feeling of suffocation with palpitation, sometimes with loss of consciousness and headache. No perinatal complication with normal development, no history of head injury, and no family history of epilepsy. Video EEG study showed 8 stereotyped electroclinical seizures, starting with a loud cry and brief asymmetric tonic posturing of the upper limbs, predominantly the right upper limb. The interictal and ictal VEEG will be discussed for proper lateralization and localization of the epileptogenic zone(s) and its co-existence with the MRI lesion and functional neuroimaging findings.

Effects of seizures on developing brain

Solomon Moshé, Saul R. Korey, Dominick P. Purpura, Albert Einstein College of Medicine and Montefiore Medical Center, New York, USA

Epidemiological studies suggest that early in life, the brain is unusually susceptible to seizures and especially status epilepticus (SE). Epidemiologic and outcome-related clinical studies are important to generate hypotheses that can be tested in model systems and then brought back to practice. However, 2-way translational studies from the bedside to the animal model are crucial. Experimental studies suggest that the increased propensity of the developing brain to experience SE may be related to immaturity of the networks (such as the substantia nigra based network) that can suppress recurrent seizures in adults. There is an ongoing debate on the effects of SE on the brain as a function of age. Most of the studies focus on effects on hippocampal function, based on the notion that SE early in life may lead to the development of temporal lobe epilepsy (TLE). However, there are many factors that contribute to the development of TLE following SE including the age the SE occurred. Indeed, during early infancy, SE may not predispose to TLE. On the other hand, it may have more widespread effects that are specific for discrete developmental windows, brain sites, and often sex-related. Some of these changes may be important for the propensity of subsequent seizures to also be prolonged as the systems involved in seizure control may be substantially altered. Other changes may contribute to cognitive deficits that may occasionally occur. Understanding the spectrum and progressive nature of SE-induced changes in brain function may have important implications in the design of treatments aimed at disease modification. These treatments can potentially be used over relative short periods, thus avoiding the potentially detrimental effects of long-term drug administration.

Interictal discharges and cognitive dysfunction

Raidah Al-Baradie, King Fahad Specialist Hospital, Dammam University, Saudi Arabia

Several relationships have been obtained between cognitive impairment and epilepsy-related or treatment-related factors. One of these factors is treatment-related: the central cognitive side effects of the antiepileptic drugs (AEDs). The second and third factors are disease-related factors, namely, the effect of the seizures and underlying epileptiform discharges in the brain, and the localization of the epileptogenic focus in specific areas of the brain. Although most cognitive problems have a multifactorial origin and often several factors combined are responsible for the "make-up" of a cognitive problem, we have attempted to isolate one factor: the effect of seizures and epileptiform EEG discharges on cognitive function. Several studies show the impact of ictal activity, but special attention is required for the postictal and interictal effects of epilepsy on cognitive functions. This may explain substantial cognitive impairments in children with subclinical epileptiform discharges or with infrequent subtle seizures.

HIGHLIGHTS FROM INTERNATIONAL NEUROSCIENCE MEETINGS

Recent concepts regarding the neurophysiological basis of experiential phenomena in temporal lobe epilepsy

Taha S. Ahmed, Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia

Experiential phenomena during temporal lobe seizures are perceptual (visual, auditory, olfactory gustatory, or somatic) hallucinations, memory flashbacks, illusions of familiarity, forced thinking, or emotions. They were first described by Hughlins Jackson who called them "dreamy states." Beside occurring during epileptic seizures, they can be produced by electrical stimulation of temporal lobe structures. For a long time they were thought to be negative phenomena resulting from ictal paralysis, until recently proved to be the contrary. Current thinking considers them as positive expressions of cortical function, which largely relate to the patient's individual experiences. These hallucinatory experiences, whether spontaneously occurring during epileptic seizure or induced by electrical stimulation, are comparable to similar experiences in primary psychosis, and semiological analysis showed a clinical continuity between déjà vu and visual hallucinations. Their anatomical substrates reside within the hippocampus, amygdala, and parahippocampal gyrus. Both epileptic patients and epileptic experimental animals display preferential loss of inhibitory GABAergic neurons in layer III of the entorhinal cortex. This leads to hyperexcitability of layer II stellate cells and seizure initiation. From there excitation spreads through the perforant path to the hippocampus and amygdala, which lead to memory recall and emotionally tinted experiential phenomena. As a result, the patient 'relives' disorganized fragments of personal memories. This explanation is in conformity with the known physiological role of the hippocampus and amygdala in autobiographic memory.

Temporal lobe epilepsy surgery in lesional epilepsies

Saleh S. Baeesa, King Abdulaziz University and King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia

Successful outcome of temporal lobe epilepsy surgery is directly related to the ability to localize and resect the epileptogenic cortex. Precise localization requires good quality MRI to identify lesions such as hippocampal sclerosis (HS), cortical developmental and vascular malformations, tumors, traumatic, or congenital lesions. Despite advances in MRI qualities to identify subtle lesions, no clear lesions can be reported in 20-30% of patients with temporal lobe epilepsy. Several reported studies in the literature have predicted better surgical outcome in patients who had MRI, or pathological, abnormalities ranging from 60-80% compared with 36-50% of those who did not. In our retrospective analysis of 80 patients who underwent temporal lobe resection for intractable epilepsy between 2003-2009 at KFSHRC-Jeddah, we evaluated the frequency of different types of lesions and surgical outcomes in relation to pathological findings. The age ranges from 6 to 55 years, 49 were females, and with at least one year of follow-up. We found tumors in 14 patients, arteriovenous malformation (AVM) in 5 patients, 2 with no pathology, and 59 with HS. On the other hand, HS was present in association with one tumor, 4 cortical dysplasia, and 8 neocortical gliosis. Overall, Class 1 outcome was identified in 55/80 (69%) and 15/80 (19%) had rare seizures or had significant improvement in seizure frequency (Classes 2 or 3). A Class I outcome was identified in 93% of cases with tumors, 80% in cases with AVMs, and 64% with HS. Neocortical abnormalities are significantly associated with HS, and support the concept that an optimal outcome is obtained when mesial and neocortical structures are removed. The literature, and our results, supports the importance of obtaining high quality, expertly interpreted MRI in evaluating patients for surgery. These results play an important role in counseling patients and in predicting the surgical outcomes.

Insular epilepsy

Philippe Kahane, Neurology Department and INSERM U836-IJF-CEA, Grenoble University Hospital, and the Epilepsy Institute for Children and Adolescents (IDEE), Lyon, France

These last 20 years, lesional studies, and intracranial recordings have pointed to the insular cortex as a potential ictal generator of some forms of focal seizures, as well as its role in the propagation of epileptic discharges arising

from the temporal lobe. Yet, insular surgery can be performed safely with very satisfactory results, even when MRI does not show any epileptogenic lesion. Ictal semiology of insular lobe seizures, however, is far to be homogeneous and a number of clinical signs have been reported. These include abdominal, gustatory, and somatosensory auras, autonomic symptoms such as piloerection and bradycardia, automotor and hypermotor behaviors, tonic and/or clonic motor manifestations, and postictal motor deficit. In line with the variety of ictal manifestations attributed to the insular cortex, insular cortical electrical stimulations may also elicit a variety of symptoms, including somatosensory, painful, viscerosensitive, gustatory, auditory, and vestibular sensations, as well as language disturbances, and motor manifestations. It therefore appears that substantial data are lacking on the clinical pattern of insular lobe seizures. Indeed, although a well-defined "perisylvian' clinical pattern has been recently individualized, insular seizures may also manifest with temporal-like or frontal-like symptoms, therefore supporting the idea that insular epilepsy is a great mimicker and might play a role in some epilepsy surgery failures. This emphasizes the need to better delineate the spectrum of insular epilepsy.

Intractable epilepsy in paralimbic WHO grade II glioma: Should the hippocampus be resected when not invaded by the tumor?

Fadi Ghareeb, Hugues Duffau, Department of Neurosurgery, Hopital Gui de Chuliac, CHU de Montpelleir, France

The fact of low-grade glioma primary association with seizure presentation is well known, and it was proven that the less residual after tumor excision leads to better clinical seizure control post operatively. In our study, the surgical results of 15 cases of insular/paralimbic (type 5A Yasargil) low-grade gliomas with intractable seizures were studied retrospectively. Even without complete excision, 8 cases had 80.6% improvement in seizure control after excision of tumor alone, and the 100% seizure free state was achieved after excision of the hippocampus with the tumor in the other 7 cases. The recruitment of non infiltrated (non pathological) hippocampus by the tumor is true. This lead us to our new approach that epilepsy surgery should not be restricted to the classical excision of sclerotic mesial temporal structures, or tumors involving temporal pole and its mesial structures, and oncology neurosurgery should not concentrate on tumor excision alone. These 2 separate surgical techniques should be modified and combined to involve the excision of the non-infiltrated hippocampus along with the tumor as both work as strong epileptogenic focus to obtain the maximum outcome in seizure control post operatively.

Surgery of focal cortical dysplasia

Philippe Kahane, Neurology Department and INSERM U836-IJF-CEA, Grenoble University Hospital, and the Epilepsy Institute for Children and Adolescents (IDEE), Lyon, France

Malformations of cortical development, of which most are diagnosed as focal cortical dysplasias (FCDs), represent the third most frequent entity found on surgical specimens, after hippocampal sclerosis and longterm epilepsy-associated tumors (Blumcke et al, 2009). Intrinsic epileptogenicity of dysplastic tissue has been demonstrated by means first of electrocorticography and then with intracerebral recordings, particularly in FCD Palmini Type II, so that it is usually thought that FCDs directly cause the epileptic condition. Therefore, as a rule, complete resection of MRI and EEG focus appears as a major factor for post-operative outcome (Lerner et al, 2009). However, surgical resection achieves seizure control to a variable degree, with a broad range of Engel I seizure control in 21-67% of operated patients (Blumcke et al, 2009). A number of factors may explain such a variability, including age at seizure onset and at surgery, presurgical investigation workshop, type of epilepsy, functional anatomical constraints, and visibility of the lesion on MRI. Last but not least, the histological type of FCD also plays a major role for seizure control after surgery and in the only study which addressed seizure control after surgical resection in isolated FCD, favorable Engel I and II outcomes were obtained in 42% of patients with isolated FCD Palmini classification Type I, compared with 94% of patients with FCD Palmini classification Type II (Krsek et al, 2009). Improvement of surgical outcome in FCD type I patients represent a major challenge, but the lack of distinguishing isolated

versus HS-associated FCD variants in most studies probably explain the inconsistencies in the surgical outcome. Particularly, different clinico-pathological entities are probably encountered within the Palmini classification of FCD Type I, and an International League against Epilepsy (ILAE) task force has recently re-evaluated available data and proposed a new neuropathologic classification system of FCDs. The major change since the prior classification presents the introduction of FCD Type III, which occurs in combination with different kinds of lesions such as hippocampal sclerosis (IIIa), tumors (IIIb), vascular malformations (IIIc), or lesions acquired in early life (IIId) (Blumcke et al, 2010). This new classification system should help to better characterize specific clinico-pathological entities among epileptic patients with FCDs, and is an important basis to further understand postsurgical seizure control.

Outcome after temporal lobectomy: Our local experience in KFMC

Majed Al-Hameed, Neuroscience Center, King Fahad Medical City, Riyadh

Background: the surgical treatment for epileptic patients is well known as management for intractable epilepsy. We are gathering the data from our local hospital, as we are a new epilepsy center in Riyadh. **Methods:** Analysis of all patients who underwent surgical treatment for epilepsy in our epilepsy medical unit between 2007-2010.

Epilepsy surgery case presentation

Tarek Jallul, Neurosciences Centre, King Fahad Specialist Hospital, Dammam, Saudi Arabia

Epilepsy associated with low-grade glioma is a well-known entity in epilepsy surgery. In these cases there are a few debatable issues regarding their pre-surgical work-up, operative details, and their post-operative management. In this case discussion, we present a patient who suffered from seizure disorder due to low-grade astrocytoma in the left temporal lobe. He underwent resection while awake with electrocorticography utilized to treat his seizure problem. This example will hopefully set the stage for a fruitful discussion of different controversies inherently attached to these cases.

Definition of intractable epilepsy

Emilio Perucca, National Institute of Neurology IRCCS C Mondino, and the Clinical Pharmacology Unit, University of Pavia, Pavia, Italy

There has been considerable confusion in the epilepsy literature about the use of terms such as "intractable," "drug resistant," "drug refractory," and "difficult to treat." At a time at which over 20 antiepileptic drugs (AEDs) and non-pharmacological treatments are available, the term "intractability" should probably be best avoided, because it is always possible that a person who failed to respond to many treatments will eventually respond to a newly tried one. The same criticism can be applied to the term "drug resistance", although in the latter case, qualified definitions can be made based on the number of AEDs to which a person has been unsuccessfully exposed. Indeed, the realization that patients who failed at least 2 AEDs have a low probability of achieving seizure control on subsequent drugs has led an Ad Hoc Task Force of the International League against Epilepsy (ILAE) to define drug resistance as failure to achieve sustained seizure freedom after adequate trials of at least 2 appropriately used AEDs, either alone or in combination. In this definition, sustained seizure freedom is defined as at least one year without seizures, or 3 times the longest pre-intervention interval between seizures, whichever is longer. The purpose of this definition is to alert clinicians that failure to respond to 2 AEDs is a signal of difficult to control epilepsy, and should prompt referral to a specialist and, when appropriate, consideration of the feasibility of epilepsy surgery. It should be stressed that drug resistance is not synonymous with intractability - indeed, some patients meeting the ILAE criteria for drug resistance do achieve seizure freedom with an alternative AED. Drug resistance is also a dynamic condition, because changes in seizure susceptibility over time may result in drug resistant patients eventually responding to a previously

ineffective AED (or, vice versa, previously drug responsive patients losing seizure control on an unaltered drug regimen). Drug resistance should be differentiated from pseudo-resistance, a condition in which inadequate seizure control is the consequence of poor compliance, choice of an inappropriate AED, or use of inadequate dosing regimen. The modern management of difficult to control epilepsy benefits from a systematic approach, which must include: (i) an assessment of patient's compliance; (ii) re-assessment of the diagnosis, to exclude a nonepileptic nature of the seizures and, if epilepsy is confirmed, to verify the correct syndromic diagnosis; (iii) verification that the AEDs used are correct for the patient's seizure types and have been administered at appropriate dosages; (iv) consideration of what additional AEDs or specific AED combinations should be tried; (v) early evaluation for potential for epilepsy surgery, and consideration of other non-pharmacological therapies. Although some patients benefit from specific AED combinations, many do best on just one AED, and over treatment should be carefully avoided. Co-morbidities, particularly depression, also need to be addressed to ensure the best possible quality of life. In the future, breakthroughs could come from genomically driven individualization of treatment, and from development of newer and more efficacious drugs.

Psychiatric and neurobehavioral disorders of epilepsy

El Sheikh R. Ibrahim, Department of Clinical Neurosciences, King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia

The association between psychiatric and neurobehavioral disorders and epilepsy can be dated through the ages, mainly due to the phenomenology of epilepsy. Initially, epilepsy was considered a psychological disorder with a functional cause. However, it was not until the late 19th century when Hughlings, Jackson, and Gowers proposed a physiological etiology for epilepsy, which led the clinicians, in part, to focus their approach in epilepsy treatment on "…stopping the seizures…." Due to the work of Sackelleres and Berent, as well as a biological revolution in psychiatry, research in the realm of treatment of epilepsy was directed to the neurological underpinnings of the psychological, psychiatric, and emotional charges in epilepsy "… the comprehensive care of the epilepsy patient requires attention to the psychological and social consequences of epilepsy as well as to the control of the seizures…." This presentation will discuss the following: the risk factors for the development of psychiatric and neurobehavioral disorders of epilepsy, psychopathology of epilepsy, the ILAE's 2007 proposed neuropsychiatric disorder in epilepsy classifications, interictal psychiatric, and neurobehavioral disorders in epilepsy and their treatment in children and adults. The psychogenic non-epileptic seizures (PNES) neurobehavioral outcome of epilepsysurgery will be discussed as well.

Status epilepticus

Shobhit Sinha, Neuroscience Center, King Fahad Medical City, Riyadh, Saudi Arabia

Status epilepticus (SE) occurs in 15% of the patients with epilepsy and carries a mortality of around 20%. The risk factors for the mortality are older age, longer duration, and etiology of SE. Although SE is traditionally defined as continuous seizures or intermittent seizures without recovery of conscious lasting at least 30 minutes, the operational definition proposes a time limit of 5 minutes. Early recognition, especially of non-convulsive status, and initiation of appropriate treatment are the key to successful management of SE with the goal being complete cessation of clinical and electrographic seizures while maintaining vital functions. The seizures are initially treated as per standard protocols with benzodiazepines followed by phenytoin and/or phenobarbiturates. Other intravenous (IV) AEDs such as valproate and levetiracetam have been used in select cases prior to barbiturates. Refractory SE (failure to respond to 2 or more AEDs) are treated with continuous IV infusions of anesthetic agents such as midazolam, propofol, or a barbiturate, either alone, or in combination to suppress the seizure activity and achieve burst/complete suppression on EEG for a few hours while closely monitoring the vital functions. Further research in rapid prehospital management and neuroprotection may help in reducing morbidity and mortality related to SE.

HIGHLIGHTS FROM INTERNATIONAL NEUROSCIENCE MEETINGS

Epileptic encephalopathies in infancy

Solomon Moshé, Saul R. Korey, Dominick P. Purpura, Albert Einstein College of Medicine and Montefiore Medical Center, New York, USA

Epileptic encephalopathies in infancy include syndromes with onset in the neonatal period and during the first year of age. The most common is infantile spasms. Infantile spasms are an age-specific seizure disorder with the presence of intractable seizures, a characteristic EEG pattern, and often progressive mental deterioration. To date, there are several clinical controversies that need to be addressed before effective treatments are designed. These include whether infantile spasms and hypsarrhythmia are a form of status epilepticus; what is the common substrate that may underlie the emergence of infantile spasms; what are the factors that influence the transition to other epileptic syndromes; finally, what factors determine the outcome. Current treatments include the use of hormonal based regimens, common antiepileptic drugs, administration of vitamins, immunotherapy, the ketogenic diet, and surgery. The recent description of several new models of infantile spasms is a positive step towards the development of novel treatments that can stop the progression of spasms and prevent mental retardation.

Necessity of kidney ultrasound in topiramate users

Tamer M. G. Rizk, Neuroscience Center, King Fahad Medical City, Riyadh, Saudi Arabia

Among its various pharmacological actions, topiramate (TPM) has been shown to inhibit the activity of specific carbonic anhydrase enzymes in the kidney. This action is associated with the development of metabolic acidosis, hypocitraturia, hypercalciuria, and elevated urine pH, leading to an increased risk of kidney stone disease (Welch et al., 2006). The incidence of renal stone disease in patients receiving topiramate is 2-4 times that expected in the background population (Lamb et al., 2004), an incidence about 10 times higher than in a similar untreated population with no clear evidence regarding the duration of treatment or the dosage (G. Pawliuk et al., 2003). Few prescribing physicians are aware of these complications, underscoring the need for improved surveillance. The study aimed to: 1. Investigate the prevalence of renal nephrolithiasis in a group of patients on topiramate therapy for at least 6 months. 2. Come to a conclusion regarding worth of performing routine ultrasound during use of TPM. Evaluate the role of routine follow up US for patients on TPM. 3. Compare those with nephrolithiasis thought to be secondary to drug use in controls of the same family members.

Selection of appropriate antiepileptic drugs

Emilio Perucca, National Institute of Neurology IRCCS C Mondino, and the Clinical Pharmacology Unit, University of Pavia, Pavia, Italy

With the introduction of over a dozen second-generation antiepileptic drugs (AEDs), the number of medications available to treat epilepsy has virtually trebled since the early nineties. Although this provides the treating neurologist with welcome new options, choosing the optimal agent has also become increasingly more complicated. Ideally, rational therapy would require identification of the pathophysiological basis of the disorder, and selection of a drug whose mechanism of action counteracts the specific abnormality leading to the manifestation of the disease in the individual patient. At the current state of knowledge, however, this approach is not yet feasible in epilepsy, and drug choice has to be made empirically by considering the clinical properties of each specific AED, assessing their influence on the probability of maximizing seizure control and minimizing side effects, and selecting the drug whose properties provide the best match for the characteristics of the individual patient. Specific questions to be addressed in choosing an AED include: (i) Does the efficacy spectrum of the drug protect against the seizure types experienced by my patient? (ii) Is the probability of achieving complete seizure freedom any greater with any specific agent? (iii) Is the side effect profile likely to interfere with the patient's quality of life? (iv) Is the drug likely to exhibit interactions with other AEDs, and are these interactions adverse or beneficial? (v) Is there a risk of interactions with medications used for unrelated conditions, such as the contraceptive pill? (vi) Are there any co-morbidities for which a specific AED would be beneficial, or would be contraindicated? (vii) Is the dose titration process simple,

and can the drug be given in a convenient formulation and with a convenient frequency of administration? (viii) Will special laboratory monitoring, or any special monitoring procedure be required? (ix) Are there reimbursability or cost issues to be considered? Each AED differs from the others with respect to the above considerations, and careful evaluation of these issues is essential for the optimal selection of an AED in the individual patient.

Optimal medical treatment of epilepsy

Emilio Perucca, National Institute of Neurology IRCCS C Mondino, and the Clinical Pharmacology Unit, University of Pavia, Pavia, Italy

Before pharmacological treatment is initiated, a firm diagnosis of epilepsy must be established. Not all epilepsies require drug treatment, and an individual assessment of the risks/benefit ratio of prescribing antiepileptic drugs (AEDs) should always be made. As a rule, treatment should be started with a single drug. Although available AEDs allow achievement of complete seizure control in up to two-thirds of treated patients, these drugs differ in efficacy spectrum and are characterized by a narrow therapeutic index, requiring careful tailoring of therapy to meet individual needs. Important predictors of therapeutic response, which influence to an important extent drug selection, are seizure type and epilepsy syndrome. Because AEDs differ in their side effect profiles, tolerability considerations are also major factors in drug selection. The AEDs exhibit a large pharmacokinetic variability, and individualizing dosage is as essential as choosing the correct drug. Sources of kinetic variability include changes in rate of drug metabolism due to genetic and developmental factors, drug interactions, and associated disease. Measurement of serum drug levels can be of value in individualizing AED dosage. If the patient does not respond to the initially prescribed AED at the maximally tolerated dosage, an alternative monotherapy may be tried, though patients with severe epilepsies may benefit from earlier use of combination therapy. Though some patients refractory to monotherapy may respond to drug combinations, multiple drug therapy also carries greater risks in terms of side effects. Duration of treatment is largely determined by the patient's response and by the epilepsy syndrome. In self-remitting syndromes, such as childhood absence epilepsy and rolandic epilepsy, treatment may be usually safely discontinued after at least 2 years of seizure freedom, with minimal risk of seizure recurrence. Juvenile myoclonic epilepsy, on the other hand, carries a high risk of relapse and treatment may need to be continued for life in these patients. In other syndromic forms, the risks, and benefits of withdrawing drug treatment must be considered on an individual basis.

Starting and stopping of AEDs in the management of epilepsy

Sonia Khan, Department of Clinical Neurosciences, Riyadh Military Hospital, Saudi Arabia

Starting an antiepileptic drug (AED) after a seizure often implies continuous daily medication for many years, which are sometimes life long. Therefore, this should be strictly initiated in those with unacceptably high rates of seizure recurrence or high risk of seizure injury. Some patients do not need prophylactic AED treatment as in febrile convulsions. In other patients, the avoidance of precipitating factors may be sufficiently prophylactic, as in reflex seizures or in individuals with a low threshold to seizures. For those patients with first unprovoked seizure, AED prophylaxis is not usually started if the patient has normal neurological examination, normal electroencephalography, and normal brain MRI until the patient develops a second seizure. For those in need of prophylactic treatment, the first choice AED should primarily be in accordance with seizure type. Before starting prophylactic AEDs in a patient with newly diagnosed seizures, the physician should be confident that the patient unequivocally has epileptic seizures and the most appropriate AED is selected for the particular patient with the particular type of seizures. Consideration of total withdrawal of AEDs is needed in patients who do not suffer from epileptic seizures, patients suffering from age related and age limited epileptic syndromes who have reached an appropriate age of remission, such as benign epilepsy with centrotemporal spikes and most cases of childhood absence epilepsy, and in patients who are seizure free for more than 3-5 years provided that they do not suffer from epileptic syndromes requiring long term treatment such as juvenile myoclonic epilepsy. Discontinuation of AEDs should be extremely slow in small doses and in long steps of weeks or months.