CONTENTS

List of tables

List of figures

Abbreviations

ACNS	American Clinical Neurophysiology Society
AD	Alzheimer's disease
ADC	Analog-to-digital converter
ADHD	Attention deficit/hyperactivity disorder
ADHDcom	ADHD combined type
ADHDin	ADHD inattentive type
ADL	Activity of daily living
ADR	Alpha power/delta power ratio
AED	Antiepileptic drugs
AP	Absolute power
ApoE	Apolipoprotein E
AUC	Area under the curve
BETS	Benign epileptiform transients of sleep
BREC	Benign rolandic epilepsy of childhood
BSI	Brain symmetry index
CBD	Corticobasal degeneration
cEEG	continuous electroencephalography
CH	Contralateral hemisphere
CNS	Central nervous system
CT	Computerized Tomography
Cz	Central midline
DAR	Delta/ alpha ratio
DC	Direct current
DCI	Delayed cerebral ischemia
DLB	Dementia with Lewybodies
DPBRF	Dominant posterior background rhythm frequency
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
DWI	Diffusion whited image
EEG	Electroencephalography

EPSP	Excitatory postsynaptic potential
ERP	Event Related Potentials
FAR	Frontal arousal rhythm
FFT	Fast Fourier transformation
fMRI	functional magnetic resonance imaging
Fp	Frontopolar
GABA	Gamma amino butyric acid
GAD	Generalized anxiety disorder
GDS	Global Deterioration Scale
GE	Generalized epilepsy
HD	Haemodialysis
HE	Hepatic encephalopathy
Hf	High frequency
HIE	Hypoxic ischemic encephalopathy
HV	Hyperventilation
Hz	Hertz
ICP	Intracranial pressure
ICU	Intensive care unite
IGE	Idiopathic generalized epilepsy
IH	Ipsilateral hemisphere
IMA	Ideomotor apraxia
IPSP	Inhibitory postsynaptic potential
JME	Juvenile myoclonic epilepsy
LDT	Laterodorsal tegmental
Lf	Low frequency
LMCA	Left Middle Cerebral Artery
MCA	Middle cerebral artery
MCI	Mild cognitive impairment
MDF	Mean dominant frequency
MEG	Magnetoencephalography
MF	Mean frequency
Mf	Median frequency
MID	Multi-infarct dementia

MMSE	Mini-Mental State Examination
MRI	Magnetic Resonance imaging
MRS	Magnetic resonance spectroscopy
MS	Multiple sclerosis
NIHSS	National Institutes of Health Stroke Scale
Nold	Normal elderly
OC	Obsessive–compulsive
OCD	Obsessive–compulsive disorder
PA	Panic attacks
PANSS	Positive and Negative Syndrome Scale
PD	Parkinson's disease
PD-D	Parkinson's disease -Dementia
PD-CogNL	Parkinson's disease -Cognitively Normal
PD-MCI	Parkinson's disease -Mild Cognitive impairment
PET	positron emission tomography
PMCI	Progressed mild cognitive impairment
PPT	pedunculopontine tegmental
PRI	Power ratio index
PSP	Progressive supranuclear palsy
PSWC	Polyspike-wave complexes
PWS	Port-wine stain
QEEG	Quantitative Electroencephalography
qEEG	Quantitative Electroencephalography
RBD	REM sleep behavior disorder
rCBF	regional cerebral blood flow
REM	Rapid eye movement
RLS–PLMS	Restless legs syndrome & periodic movements during sleep
RP	Relative power
rTMS	repetitive transcranial magnetic stimulation
SAH	Subarachnoid hemorrhage
SEF	Spectral edge frequency

SMCI	Stable mild cognitive impairment
SNRI	Serotonine-norepinephrine reuptake inhibitors
SPECT	Single photon emission computed tomography
SREDA	Subclinical rhythmic electrographic discharges in adults
SSRI	Selective serotonin reuptake inhibitors
SVD	Subcortical vascular dementia
SWC	Spike-wave complexes
SWS	Sturge-Weber syndrome
TCD	Transcranial Doppler ultrasound
TCS	Tonic-clonic seizures
TP	Total power
UPDRS	Unified Parkinson's Disease Rating Scale

Introduction

Clinical quantitative electroencephalography (qEEG) is a complex speciality that may include not only standard EEG but also digital EEG, topographic mapping, spectral analysis, spectral coherence, long latency and event related potentials (EP), significance probability mapping (SPM), dipole source localization methodology (DLM), and discriminant function analysis. There are three basic clinical uses: non-specific detection of organicity; as encephalopathy, specific categorization of disease or clinical condition, and epileptic source localization. **(Duffy, et al, 1994)**

Certain quantitative EEG techniques are considered established as an addition to digital EEG in: 1)Epilepsy: For screening for possible epileptic spikes or seizures in long-term EEG monitoring or ambulatory recording to facilitate subsequent expert visual EEG interpretation. 2)Intensive Care Unit and operating room monitoring: For continuous EEG monitoring by frequency trending to detect early acute intracranial complications in the ICU or operating room, and for screening for possible epileptic seizures in high-risk ICU patients. Certain quantitative EEG techniques are considered possibly useful practice options as an addition to digital EEG in: 1) Epilepsy: For topographic voltage and dipole analysis in presurgical evaluations. 2) Cerebrovascular Disease: QEEG in expert hands may possibly be useful in evaluating certain patients with symptoms of cerebrovascular disease whose neuroimaging and routine EEG studies are not conclusive. 3) Dementia: routine EEG has long been an established test used in evaluations of dementia and encephalopathy when the diagnosis remains unresolved after initial clinical evaluation. In occasional clinical evaluations, QEEG frequency analysis may be a useful adjunct to interpretation of the routine EEG when used in expert hands. On the basis of current clinical literature, opinions of most experts, and proposed rationales for their use, QEEG remains investigational for clinical use in postconcussion syndrome, mild or moderate

head injury, learning disability, attention disorders, schizophrenia, depression, alcoholism, and drug abuse. **(Nuwer, 1997)**

Long-term EEG monitoring increases the scope of EEG techniques and improves the diagnostic value of standard EEG recordings providing up to 90% positive diagnostic information. Allowing quantification of epileptic activity recorded in real-life situation, useful information not available by means of standard EEG recordings can be obtained. **(Logar, et al, 1994)**

Our results raised the possibility that some quantitative EEG changes indicating EEG normalization might be markers of seizure control as predicted for the antiepileptic drugs .Parallelism between neuronal synchronization, presence of generalized spike-wave paroxysms, and cortical excitability is the theoretical basis for this possibility .The relationship between them was supported by human studies. **(Clemens, et al, 2007)**

Our data indicate that conventional EEG revealed abnormalities in patients affected by acute ischemic stroke, whereas EEG mapping had slightly higher sensitivity in showing these abnormalities. Therefore, it seems that the longer time involved and the higher cost of EEG mapping may allow with several improvements in diagnostic definition. **(Murri, et al, 1998)**

Quantitative EEG measures such as Sub-acute delta: alpha power ratio (DAR) demonstrates potential to augment bedside assessment of cerebral pathophysiology and prognostication of stroke evolution. QEEG measures from a standard number of electrodes, if available rapidly and robust to potential artifacts, may inform future management of stroke patients. **(Simon, et al, 2007)**

Degenerative diseases have two outstanding characteristics: (1) They tend to affect specific parts or functional systems of the nervous system. (2) They begin insidiously, after a long period of normal nervous system function, and pursue a gradually progressive course that continues for many years, often a decade or longer. In respect to their temporal evolution, these

diseases differ from most of the metabolic and slow viral disorders. **(Allan, et al, 2005)**

It was thought that quantitative EEG had the possibility as a diagnostic tool of degenerative dementias. **(Kai, 2007)**

In subcortical vascular dementia, like in Alzheimer's disease disturbances were found in cholinergic transmission. The cholinergic deficit as manifested in changes of synaptic potentials is reflected in EEG signals. **(Gawel, et al, 2007**)

The data suggest that neurophysiological endophenotype of non-demented individuals at genetic risk for AD, characterized by increased excitability and dysfunction of deep brain and alpha rhythm-generating structures may be revealed decades before the first clinical symptoms of presumable dementia. **(Ponomareva, et al, 2006)**

Cognitive decline which is a common feature of Parkinson disease is not usually the severe type of dementia seen in Alzheimer disease. Memory impairment is not a feature of PD; rather; the patient is just slow in responding to questions, so- called *bradyphrenia*. Fifteen percent to 20% of patients with PD have a more profound dementia, similar to that in Alzheimer disease. **(Fahn, et al, 2005)**

The electroencephalogram (EEG) contains abnormally lower frequencies in some patients with Parkinson’s disease (PD). Quantitative EEG could show significant differences between clinical cognitive states in PD, particularly between cognitively normal PD patients and those with mild cognitive impairment. And also QEEG can assess whether focal measures or a global EEG measure correlated better with cognitive status and/or neuropsychological test results. An objective physiological measurement for early cognitive changes in PD would provide a useful biomarker for studying cognitive decline in PD. **(Cavinessa, et al, 2007)**

AIM OF THE WORK :

1- To review the advanced quantitative EEG diagnostic techniques.

2- To review the value of quantitative EEG in certain neuropsychaitric disorders.

References

Allan H. Ropper, Robert H. Brown, 2005: Degenerative diseases of the nervous system in *Adams and Victor principles of neurology*, 8th edition, by McGraw-Hill Companies, Inc: 895.

Caviness J.N., Hentzb J.G., Evidentea V.G., et al, 2007: Both early &late cognitive dysfunction affects the electroencephalogram in Parkinson's disease, *Parkinsonism &Related disorders 13*: 348-354.

Clemens B., Piros P., Bessenyei M., et al, 2007: Lamotrigine decreases EEG synchronization in a use-dependent manner in patients with idiopathic generalized epilepsy, *Clinical Neurophysiology 118*: 910-917.

Duffy F.H., Hughes J.R., Miranda F., et al, 1994: Status of quantitative EEG in clinical practice, *Clinical Electroencephalogram, 4*: VI - XXII.

Engel J., Gretchen L. Birbeck, Gallo A., et al, 2005: Epilepsy: Global Issues for the Practicing Neurologist, what is epilepsy? Demos Medical Publishing, LLC by World Federation of Neurology: 1.

Fahn S., Przedborski S., 2005: Parkinsonism, in *Merritt's neurology*, by Lippincott Williams & Wilkins, USA, 11th edition, vol.3, 831.

Gawel M., Zalewska E., Szmidt-Sałkowska E., et al, 2007: Does EEG (visual and quantitative) reflect mental impairment in subcortical vascular dementia? *Journal of the Neurological Sciences 257*: 11–16.

Kai T. 2007: Quantitative EEG in dementia with Lewy bodies and Alzheimer's disease, *clinical neurophysiology 118*, e208.