Clinical Neurophysiology

Guidelines:

These Guidelines have been drawn up along the lines of those of the Department of Clinical Radiology to help referring clinicians make the best use of Clinical Neurophysiology. The role of the Clinical Neurophysiologist in justifying the examination remains paramount and is dependent on each clinical case (discussion is therefore very much encouraged with the Clinical Neurophysiologists – see contact details below).

Use of recommendations of this kind can lead to a reduction in the number of referrals for investigation (and hence waiting times) and also to prevent patient exposure to a potentially unnecessary and at times uncomfortable examination. Whilst there are few side effects to neurophysiological examinations, but by their very nature (involving electrical stimulation of peripheral nerves and needle examination of muscles) they can be unpleasant, and in a few instances carry a small risk of adverse events (particularly in those patients with implanted electrical devices, such as cardiac pacemakers or defibrillators, and bleeding disorders or on anticoagulants). However, the primary objective of this guidance is to improve clinical practice. Such Guidelines work best if they are used as part of clinico-neurophysiological dialogue and the audit process. They are intended for use by all referring practitioners, in particular extended scope practitioners and recently qualified doctors.

Why are guidelines needed?

A useful investigation is one in which the result - positive or negative - will alter clinical management and/or add confidence to the clinician's diagnosis and localization. As with radiology the chief causes of wasteful use of neurophysiology are:

1. *Repeating investigations which have already been done:* e.g. at another hospital with the sole purpose of obtaining *local baseline data* (please note that we also have a Dept. at UHB), or to ‘monitor’ progress of chronic axonal polyneuropathy (when there are robust clinical methods of assessment, such as Neuropathy Impairment Score or Modified Rankin Scale).
2. *Investigation when results are unlikely to affect patient management:* because the anticipated 'positive' finding is usually irrelevant, e.g. radicular pain syndrome without neurological deficit due to degenerative spine disease.
3. *Failing to provide appropriate clinical information and specific questions that the investigation should answer.* Deficiencies here may lead to the wrong technique being used, e.g. sending a diabetic patient to our Extended Scope Practitioner carpal tunnel clinic when they may have a generalized peripheral neuropathy.
4. *Over-investigating.* Some clinicians tend to rely on investigations more than others. Some patients take comfort in being investigated For example, ordering Single Fibre EMG studies in a patient with a clinical diagnosis of myasthenia gravis and positive acetyl choline receptor antibodies.

In the Overview of Clinical Neurophysiology the techniques are briefly described. In the Clinical Indications specific conditions, appropriate neurophysiological investigations and their relative worth are listed, based on current best practice, what evidence-base there is and the opinion of the local Consultants.

1. *Indicated*. This shows an investigation most likely to contribute to clinical diagnosis and management.
2. *Not indicated initially*. This includes situations where experience shows that the clinical problem usually resolves with time or that early investigation may produce 'reassuringly' false negative results. We therefore suggest deferring the study and only performing it then if symptoms persist. (Neurapraxia after nerve compression such as "Saturday night palsy "or carpal tunnel syndrome during pregnancy are typical examples).
3. *Not indicated.* Examinations in this group are those where the supposed rationale for the investigation is untenable as the investigation is often normal or none specific, and therefore neither rules in nor rules out the disorder. Experience shows that these conditions often have no demonstrable neurophysiological abnormality. (Chronic fatigue syndrome or polymalgia rheumatica for example).
4. *Specialised investigation.* These are frequently complex, time-consuming or resource-intensive investigations which will often only be performed after discussion with a Consultant Clinical Neurophysiologist (e.g. SFEMG or PSG).

Overview of Clinical Neurophysiology

Clinical neurophysiologists undertake a variety of recordings and measurements of the electrical activity of the central and peripheral nervous systems. This information can be used to aid the diagnosis and management of a wide range of neurological conditions in all age groups.

Nerve conduction studies (NCS) and electromyography (EMG)

NCS recordings are made after electrical stimulation of the peripheral nerves. EMG activity measures the spontaneous and voluntary electrical activity produced in skeletal muscle. Many general medical disorders, as well as neurological disorders and trauma, can cause damage to the peripheral nervous system. EMG and NCS identify and characterise the site and nature of the pathological processes affecting the peripheral nervous system.

1. Clinical Indications For Nerve Conduction Studies (NCS)

A. Polyneuropathy of unknown cause - allowing classification into axonal or demyelinating types.
B. Mononeuropathy that cannot be localized clinically or requiring localization pre-operatively, particularly when there is co-existing pathology (e.g. CTS and cervical spondylosis +/- radiculopathy).
C. Mononeuritis multiplex.
D. Disorders of neuromuscular junction i.e. myasthenia gravis, LEMS.
E. Disorders of anterior horn cells i.e. motor neuron disease.

2. Clinical Conditions where NCS/EMG are Not Indicated Initially

A. Polyneuropathy of a known cause such as complicating metabolic/systemic conditions (e.g. diabetes mellitus/impaired GTT, alcohol abuse, uraemia, vitamin deficiency and neurotoxic drugs).
B. Suspected large fibre polyneuropathy but no clinical signs in particular those with brisk reflexes).
C. Clinically isolated small fibre neuropathy (as NCS are usually normal).
D. Children with *pes cavus*, normal neurology and no family history of hereditary neuropathy.
E. Radiculopathy when the diagnosis is secure based on clinical and imaging findings –clinical and imaging concordance (e.g. foot drop due to L4/5 radiculopathy).
F. Clinical and family history suggestive of genetic or metabolic myopathy – Muscle MRI/ biopsy and/or genetic tests provide more definite diagnosis.
G. Post-polio syndrome.
H. Chronic fatigue syndrome.
I. Isolated fasciculations and dementia without lower motor neuron signs.

3. Clinical Conditions where NCS are Not Indicated

A. Pain syndrome without 'neurology' (no signs of large fibre dysfunction) and negative imaging.
B. Certain "controversial" entrapment mononeuropathies including *meralgia paraesthetica*, radial tunnel syndrome, tarsal tunnel syndrome, because the yield is so low. Furthermore, the sensory nerve action potentials (i.e. lateral femoral cutaneous and medial plantar) are commonly unobtainable in asymptomatic individuals.
C. Myalgia – no weakness or objective signs and only mildly elevated CPK (<2 times upper limit of normal).
D. Endocrine, metabolic and steroid myopathy.
E. Fibromyalgia and *Polymyalgia rheumatica*.
F. Vascular thoracic outlet syndrome

4.Specialised Investigations

Single fibre EMG in myaesthenia gravis and botulism when AChR and MuSK antibodies are negative.

5. Contraindications

There are no absolute contraindications to NCS/EMG.

Relative contraindications: Pace makers and implanted cardiac defibrillators

Anticoagulation (needle EMG)

Electroencephalopathy (EEG)

The electrical activity of the brain (the EEG) can be recorded using either scalp (surface) or, in special circumstances, intracranial electrodes. The majority of studies are undertaken on an outpatient basis using scalp electrodes. Recordings may last from a half to several hours, particularly if a period of sleep is included. The principal indication for EEG is in the investigation of epilepsy and disorders of consciousness. Since it is rare for brief recordings to capture a clinical attack, these EEGs are usually referred to as interictal recordings, when a *liability* to seizures may be demonstrated. Interictal EEG is used to support a clinical diagnosis of epilepsy and to help classify the seizure type and/or epilepsy syndrome, and now usually include video recording, as well as activation by photic stimulation and hyperventilation, with the patient's informed consent (Note there is a small risk of inducing seizures in patients with epilepsy).

EEG activity includes more specialist studies such as ambulatory EEG and video telemetry monitoring (the latter only available on the Epilepsy Surgery Program). These studies monitor EEG for several days or weeks in an attempt to capture a clinical attack and characterise the associated EEG changes or not (i.e. ictal recording). For ambulatory EEG to be cost effective a recording of 48 hours is sufficient to record interictal activity, if routine awake and sleep EEGs are normal, and if clinical attacks occur at least 3/per week. Some patients, particularly those being considered for surgical treatment of intractable epilepsy, may require intracranial electrodes (depth or sub-dural electrodes) as part of video telemetry EEG studies.

EEG is also used in the diagnosis and management of other conditions such as viral or autoimmune encephalitis, Creutzfelt Jacob disease (CJD), coma, developmental and neurodegenerative disorders, including dementia. EEG, EP and EMG studies may be undertaken during neurosurgical procedures to monitor cerebral activity, identify particular neural or cortical structures (mapping), and to assist in the placement of deep-brain stimulators with intractable movement disorders.

1. Clinical Indications For Electroencephalography (EEG)

A. *Seizures: to support the diagnosis of epilepsy, determine seizure type and/or epilepsy syndrome.*
B. *To assess the risk of seizure recurrence after a first unprovoked seizure, for driving regulation for example.*
C. *Any undiagnosed coma, stupor or unconsciousness and acute confusional state (because of the possibility of Non-Convulsive Status Epilepticus and encephalitis).*

2. Clinical Conditions where EEGs are Not Indicated Initially (watchful waiting)

A. *General screening of Psychiatric patients.*
B. *Intellectual impairment or early in the course of dementia >60 years of age.*
C. *Probable syncope (risk of false positive result – see NICE CG 137)*

3. Clinical Conditions where EEGs are Not Indicated

A. *To "exclude" a diagnosis of epilepsy or brain tumour.*
B. *Headaches or migraine.*
C. *Dizziness and fatigue.*
D. *Attention deficit disorder.*
E. *Aggression or disinhibition.*

4. Specialised Investigations

A. *Multiple Sleep Latency Test (MSLT) to support the diagnosis of Narcolepsy, and Polysomnography (PSG) for Sleep disorders come under the auspices of the sleep clinic at the Rosa Burden Unit.*
B. *Ambulatory monitoring (AEEG) – when the diagnosis of epilepsy is in doubt after 'normal' routine awake and sleep deprived EEG, or there is a possibility of non epileptic attack disorder (pseudoseizures, when attack occurrence is >3/week).*

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