

Pre-surgical evaluation for epilepsy surgery – European Standards

European Federation of Neurological Societies Task Force

A. Background

The European Federation of Neurological Societies (EFNS) Task Force on standards in pre-surgical evaluation was established in November 1997. It was the aim of the Task Force to produce a report on the state of pre-surgical evaluation for epilepsy surgery across Europe and to recommend standards. Task Force members were:

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B. Introduction

Worldwide surveys show that more patients with pharmaco-resistant epilepsies become amenable for epilepsy surgery using special diagnostic techniques or surgical procedures (Crandall, 1987; Lüders, 1992; Engel, 1993; Hauser and Anneger, 1993). Advances in the field of pre-surgical evaluation may permit investi-

gation and surgical treatment of a greater number of patients than in the past due to an improved accuracy of the location and/or a shorter time necessary for pre-surgical evaluation (Engel 1996). The average number of patients investigated and treated in an epilepsy surgery program increased from 15 operations per year (from 1979 to 1984) to 42 operations per year (from 1989 to 1994) (Polkey, 1996). The increasing numbers of epilepsy operations worldwide extended the knowledge about surgically amenable epileptic syndromes. Epilepsy surgery has been proved to be an established treatment in pharmaco-resistant focal epilepsies and is meanwhile established in so-called cryptogenic focal epilepsies (NIH Consensus Conference, 1990). The recent new wave in epilepsy surgery asks for quality control (Lüders, 1992; Engel, 1993; Shorvon *et al.*, 1996). Certain conditions must be fulfilled and certain ethical requirements should be observed before surgical treatment is considered or offered to patients.

Medical standards are generally acknowledged strategies in medical practice and may help to optimize treatment emphasizing individual care. However, they should only provide a guideline and should never be a set of compulsory and inflexible rules which could lead to undesirable legal consequences. With regard to various epilepsy syndromes such guidelines may help to identify those with good or poor prognosis. Discussing standards one has to consider how a common international consensus can be developed and how it is useful both in developing and in developed countries (Gumnit, 1992). Following these ideas minimal standards for the pre-surgical evaluation and surgical therapy of epilepsy have been formulated. International and regional standard concepts have been proposed in the past (Report of the Association of Epilepsy Centers, 1990; Stefan, 1992, 1995; Wieser and Siegel, 1992; Oliver and Russi, 1994; ILAE Commission Epilepsy Surgery, submitted to Epilepsia).

C. Definition

Epilepsy surgery is defined as any neurosurgical intervention whose primary objective is to relieve intractable epilepsy. The aim of epilepsy surgery is to maximize seizure relief, minimize side-effects and improve the quality of life.

In resective epilepsy surgery the aim is the elimination of the primary epileptogenic tissue (the seizure onset zone). In order to achieve this it is necessary to

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identify the epileptogenic tissue to be removed as precisely as possible. Only if this is not possible successful alternative surgical procedures may be used. Alternative surgical procedures comprise disconnective surgery, such as callosal section and multiple subpial transection (MST), and vagal nerve stimulation.

D. Conditions for pre-operative assessments

Proven drug intolerance or resistance: i.e. persistence of seizures despite adequate use of antiepileptic drugs (AEDs), with a minimum of two first-line drugs either as monotherapy and in combination as appropriate to the epileptic syndrome. All AEDs should be given to the limit of tolerance. Plasma AED levels must be monitored if compliance might be a problem.

Seizure illness duration: in adults this should not be less than two years, but in acute life-threatening conditions should be a duration sufficient to establish intractability. In children a period of less than two years may be appropriate. The long-term effects of chronic epileptic activity on the brain and especially their meaning for certain crucial ages in a child's development should be considered.

There are no strict age limits but when surgery is performed the patients normally are between ages 1 and 60 years. Patients outside this age group are the exception.

Selection of candidates for pre-operative assessment

Patients with poorly controlled epileptic seizures, in spite of optimal medical treatment, that interfere with the patient's daily activities, education, employment or social contacts are most in need of help. They therefore should be the first to be selected for further assessments. Classical pre-conditions as formulated by Walker (1974) (see Table 1) are still valid nowadays. In essence, however, they are criteria for resective surgery in adults. Modifications concern: (a) the demand for early surgery at least in certain epilepsy syndromes, such as the mesial

temporal lobe syndrome; (b) 'palliative' surgery; and (c) a more liberal indication in children, especially those with catastrophic epilepsies.

Whether and when surgical treatment is advisable in individual patients depends on the risks and benefits of the proposed surgical intervention. Surgically remediable syndromes, such as the syndrome of mesial temporal lobe epilepsy (MTLE: Wieser *et al.*, 1993; Engel, 1992) have been identified, i.e. it has been possible to define some specific syndromes, based on clinical features, seizure semiology and diagnostic test results that have a reasonable reliable surgical prognosis, and in some cases a consistent pathophysiological neurological substrate. Appropriate and timely referral of potential surgical candidates is a particularly important issue in those patients in whom 'curative' procedures can be envisaged, because relief of habitual seizures is insufficient to permit acceptable psychosocial rehabilitation in patients who have been disabled by their disorder for many years. The definition of medical intractability depends on the different epileptic syndromes and on the individual patient and is discussed by Bourgeois (1991), Camfield and Camfield, (1996), Engel *et al.* (1997) and Munari *et al.*, (1999).

Presurgical work-up

The pre-surgical assessment consists of the following.

- The medical history, including interictal and ictal symptoms and signs with the aim of establishing the diagnosis of epilepsy and classify it. The type of epilepsy may influence subsequent investigations and may be clarified by them.
- The search for the type, anatomical location and extent of a morphological structural lesion. High-quality neuroimaging is indispensable, magnetic resonance imaging being the preferred modality.
- The documentation of a functional deficit, and of possible deficits resulting from proposed procedures, utilizing one or more of the following techniques: specialized neuropsychological testing, single positron emission computed tomography (SPECT) and positron emission tomography (PET). Transient inactivation of restricted brain regions by pharmacological means are useful in certain patients (e.g. intracarotid and selective amygdala tests).
- The electrophysiological localization of the 'epileptogenic zone', including seizure monitoring and, where necessary, the use of intracranial recording techniques.

In most cases localization of the seizure origin will necessitate video-EEG with scalp electrodes to record a sufficient number of seizures consistent with the patient's habitual seizure pattern. It is advisable to

Table 1 'Classical' selection criteria for resective epilepsy surgery

1	Focal seizure onset
2	Pharmacoresistance
3	Seizures represent a severe handicap
4	Seizures exist for sufficient time, in general about at least two years, to assess drug resistance
5	Sufficient general and mental health state of the patient who is sufficiently motivated and compliant in order to collaborate pre-, intra- (if necessary) and post-operatively

use scalp video-EEG to establish the epileptic nature of the attacks. Thereafter, further seizure monitoring, with the use of minor and/or major invasive recording techniques, may be necessary. Intracranial recordings have to be considered in the case of discordant non-invasive data and/or if a degree of precision is required for an intended selective and/or tailored resective surgical approach, which cannot be obtained by non-invasive means. The use of invasive techniques implies a careful risk/benefit calculation which, of course, is based on special expertise. In some cases ictal recording may not be necessary if there is a concordance between interictal scalp EEG findings and clinical, brain imaging and neuropsychological data, and if the epileptic nature and semiology of the patient's attacks is not in doubt.

Ancillary neurophysiological techniques used before or during operation include: evoked potential studies, cerebral functional mapping, magnetoencephalography (MEG) and electrocorticography (ECoG), magnetic stimulation.

- Careful assessment of the patient's psychiatric state, using recognized psychiatric rating scales where appropriate.

E. Requirements for pre-surgical assessment

These are listed in Table 2.

- The availability of a core team of specialists, consisting of a specialized neurophysiologist, a neurologist and an especially experienced neurosurgeon. Twenty five epilepsy operations in a centre per year are considered sufficient to gain and maintain the necessary expertise.
- Regular interdisciplinary teamwork of the members of the core team with neuropaediatricians, neuroanaesthetists, neuropsychiatrists, neuroradiologists, neuropathologists and neuropsychologists with special experience in epileptology as well as the cooperation with specially trained medical, (e.g. nuclear medicine) and technical personnel is necessary; there is a possibility of Wada testing.
- In the case of invasive assessment there is the possibility of immediate interdisciplinary cooperation,

including the availability of an intensive monitoring unit, combined with a neurosurgical department.

- Regular follow-up investigations of patients for a minimum of five years have to be guaranteed as far as quality control is concerned. Documentation of data must be such that they permit international multicentre follow-up studies, e.g. seizure outcome and quality of life outcome should be measured according to the recommendation of the respective ILAE commissions.
- Facilities for long-term video-EEG recording must be such that a sufficient number of seizures and a sufficient interictal EEG period can be recorded and analysed. Experience shows that this requires specific arrangements.
- The team responsible for pre-operative assessment must be able to recognize when invasive recordings are indicated. For invasive seizure monitoring a continuous 24-h surveillance is strongly recommended.

F. Special considerations

The ILAE Commission on Neurosurgery of Epilepsy described the resources required in two possible scenarios distinguishing 'basic centres' and 'reference centres'. The members of the commission stressed that this, however, does not imply that a two tier system is recommended. Where resources are limited only basic centres may be possible. Otherwise the service should be based on reference centres and the basic centre is envisaged only as a transitional phase in the establishment of a new reference centre. A basic centre provides service to a limited range of patients from the local population; it might also be a new establishment that is expected to develop into a reference centre in the future. A basic centre limits its activities to those patients whose pre-operative and operative needs can be met by the resources available. It is essential that the medical staff has a wide range of experience and is able to distinguish patients who can be treated with limited resources from those who require more complex facilities. So called 'palliative surgical therapies' and 'experimental procedures' should only be performed in reference centres.

A reference centre provides a comprehensive program for epilepsy surgery and is situated within a comprehensive neuroscience centre. It is able to provide the full range of established pre-surgical assessment and surgical treatment. It is affiliated to a university with academic staff as well as research and clinical experts in epileptology. A reference centre also offers programs for education and research (Wieser, 1998).

Table 2 Requirements for pre-surgical assessment

1	Availability of an interdisciplinary core team with special expertise
2	Twenty five epilepsy operations in a centre per year
3	Intensive monitoring unit combined with a neurosurgical department
4	Regular follow-up investigation over long time periods
5	Expertise to recognize when invasive recordings are indicated

As pre-operative assessment and epilepsy surgery in many countries still are in an initial stage, a definition of minimum standards will allow new groups the possibility to work in this field. These minimal standards can only be accomplished after a transitional phase. In the meantime initial help could be provided by the establishment of a European workgroup which could also assist in the final definition of standards for centres and give detailed guidelines for the training of medical personnel. Reference centres should collaborate with new groups, whose staff are assisted and supervised until sufficient expertise has been gathered. An interactive cooperation between centres with different diagnostic foci is useful. A certificate for epileptology and in particular pre-surgical evaluation for epilepsy surgery is presently under consideration in German-speaking countries and Italy. This could be modified for use elsewhere in Europe. A European workgroup could eventually publish a list of European epilepsy centres indicating in detail what kind of surgical procedures (e.g. standard/tailored/selective resections, multiple subpial transections, vagus nerve stimulation and focal stereotactic radiotherapy) are carried out in individual centres.

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