Pre-operative evaluation and outcome of surgical treatment of epilepsy

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It has been estimated that there are approximately 750–1500 new cases per annum in the UK who could benefit from epilepsy surgery, and who thus require presurgical assessment. Others may require surgery regardless of seizure control for removal of a progressive lesion (e.g. tumour) or a lesion that has other inherent risks such as danger of haemorrhage (e.g. arteriovenous malformation).

The purpose of pre-operative evaluation is three-fold:
1) to assess the potential for operative success
2) to identify the most suitable type of operation
3) to assess the risk-benefits of such an operation.

Patient selection

The principles for patient selection are:

Drug resistant seizures. Before someone can be considered drug resistant, there has to be an adequate trial of therapy; there is, however, some debate as to what constitutes an adequate trial of therapy. Most centres would consider treatment with at least two first-line antiepileptic drugs (AEDs) appropriate to the type of epilepsy over a period of two years. This is because the chance of a patient becoming seizure free diminishes if control is not achieved with initial therapies, and evaluation for surgery should not be delayed while every possible combination of medication is tried.

Seizure frequency and severity such as to cause significant social and medical disability. It is again difficult to be proscriptive here, and each case needs to be discussed on an individual basis. It is important to remember that there is not only an associated morbidity attached to seizures, but also an associated mortality (including sudden unexpected death, or SUDEP) that may be higher than 1% per annum for the type of patients undergoing pre-surgical assessment.

Reducing or stopping the seizures would result in a significant improvement in quality of life. Severe learning difficulties and psychiatric disease are relative contraindications, as seizures may constitute a minor part of the person's disability. Furthermore there has to be a realistic view of the possible benefits by both patient and carers. Careful counselling to assess and to inform patient expectations is necessary before surgery.

Convergent data from different investigative modalities localise the epileptogenic zone. This important for curative epilepsy surgery (see below), but is of lesser importance for palliative surgery such as corpus callosotomy and vagal nerve stimulation.

Acceptable risk-benefit ratio benefit for surgery. Even though there may be a high chance of seizure freedom, the risks of operation may be unacceptable (e.g. removal of dominant temporal lobe may result in unacceptable memory deficits even if seizures are halted). The longer-term consequences of seizures (especially in children and adolescents) have to be weighed against the immediate risks of operation. When such an assessment has been made, it is important that the patient is fully informed and is clear about the possible risks and benefits (this requires careful pre-operative counselling).

Presurgical evaluation

Assessment for surgery involves a multidisciplinary approach including: neurologist, neurosurgeon, psychologist, psychiatrist, neurophysiologist and radiologist. There are two main strategies for the surgical treatment of seizures. The first involves resective surgery, in which the aim of the surgery is the removal of the epileptic focus itself. Examples of this type of surgery are anterior temporal lobectomy, selective amygdalohippocampectomy (in which only the mesial temporal structures are removed), or resection of a specific lesion. At the other extreme of resective surgery is hemispherectomy, suitable for patients in whom most or all of one hemisphere is abnormal. The other strategy for surgical treatment is palliative, either to interrupt the pathways of seizure spread (e.g. corpus callosotomy and multiple subpial transection) or to reduce brain excitability (e.g. vagal nerve stimulation).

For curative resective surgery, it is imperative to identify the epileptogenic zone. Congruence is thus sought between the results of the following investigations:

- Clinical history and seizure pattern (seizure semiology)
- Neuropsychometry
- Neuroimaging (high resolution MRI with thin T1-weighted sections, T2-weighted sequences, proton density sequences, and FLAIR sequences)
- Scalp EEG (ictal onset, inter-ictal abnormalities).

The precise roles of other investigative techniques (e.g. magnetoencephalopgraphy, ictal SPECT, PET) still have to be defined, but are useful in selected cases.

These results are interdependent, and thus, for example, the numbers of seizures that need to be recorded on video-EEG telemetry will vary according to the results of the neuroimaging and type of epilepsy. Indeed, in some patients, in whom there is strong concordance of inter-ictal abnormalities with other investigative modalities, video-EEG telemetry may be unnecessary.

Discordance amongst these investigations reduces the chance of a good outcome. The relative weighting for each of these investigations has yet to be established, but it is clear that neuroimaging revealing the underlying pathology is of high significance. Intracranial EEG monitoring with subdural electrodes and/or depth electrodes may be required in cases of discordance or to localise accurately the epileptogenic zone. In addition, intracranial stimulation either during awake craniotomy or extra-operatively with chronic intracranial electrodes may be necessary to define the safe margins of resection.

Patient history can also give information that may inform the odds of success, including patient age, age of epilepsy onset, epilepsy duration, the occurrence of secondary generalised seizures and status epilepticus and antecedent history, including the presence of head injuries, meningitis or febrile seizures.

Pre-operative assessment is also used to determine the possible risks of operation. These will depend upon the site of operation, the pathology and the type of operation. Psychiatric assessment prior to surgery is mandatory in order to document evidence of psychiatric

morbidity prior to surgery, determine adequacy of consent, identify treatable psychiatric conditions that may require separate interventions and to flag up patients who may need additional psychiatric support peri- and post-operatively.

Neuropsychological assessment is also used to estimate the psychological sequelae of epilepsy surgery. This is frequently used to estimate the possible deterioration in memory that will occur with temporal lobe resection. The use of the intracarotid sodium amytal test in patients undergoing temporal lobe resection is diminishing, because of concerns about its accuracy and usefulness in predicting memory decline following surgery. At the National Hospital, we have largely abandoned this test. It is still used in some centres, however, to test patients in whom there is discordance between neuropsychometric testing and neuroimaging and in whom an operation is thought to have a reasonable chance of success. fMRI is increasingly being used to lateralise language function, and may in the future also be used to help with memory lateralisation.

Details of risk-benefit discussions with the patient and family need to be recorded in the patient notes and given to the patient in writing. This information should include an estimate of the chances of operative success, along with the risks of complications from the operation (including the risks of permanent neurological sequelae) and the impact that these will have on the patient's lifestyle. Information on the potential psychiatric and psychological sequelae also needs to be given. Pre- and peri-operative counselling is crucial for all patients undergoing epilepsy neurosurgery.

Further reading

SHORVON S, PERUCCA E, ENGEL J et al (2009) *Treatment of Epilepsy* (3rd Edition). Wiley-Blackwell, Oxford.