Neurosurgical techniques in the management of chronic pain

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Abstract

Neurosurgical treatments for pain can be classified into three categories: treatment of the cause, neuromodulation and neuroablative techniques in order of preference of application. In general, it is important to be able offer all treatments in a pluripotential context. All of these treatments are now delivered in a multidisciplinary context, with other adjunctive treatments including pain medicine, cognitive techniques and pain management programmes. There is increasing emphasis on outcome measurement in all categories, using both condition-specific and generic assessment tools such as the EuroQuol-5D. In this context, it is longer term outcomes that are important – meaning several years.

Keywords Neuromodulation; neurosurgery for chronic pain; stimulation; trigeminal neuralgia

Royal College of Anaesthetists CPD Matrix: 2E00

Learning objectives

After reading this article, you should be able to:

- classify neurosurgical techniques for pain management
- compare lesioning techniques used to treat trigeminal neuralgia
- list neuromodulation options and describe their limitations
- give an overview of the management of trigeminal neuralgia

General principles

The place for a surgical treatment is for focal problems and can be highly efficacious – indeed it has the highest efficacy of any the treatments discussed here, and then without side effects. A usual standard for medical or neuromodulation treatments is a reduction in visual analogue scale (VAS) of 50%, but surgical treatments often achieve a reduction of the VAS score to zero. By contrast, medical management is necessarily systemic, so even if a drug agent is efficacious side effects will exist and can be problematic. The exception to this is targeted drug delivery systems such as intrathecal drug delivery, and perhaps in the future infusion into solid organs, for example by convection systems. Often invasive surgical interventions are only considered after the failure of conventional medical management. This approach is enshrined in conventional medical training and expressed in the WHO pain ladder. However, it can be argued that this approach inhibits the uptake of effective surgical options and can be positively harmful. It arises when practitioners are unable to provide a complete portfolio of options – neurosurgical treatments, such as deep brain stimulation being highly specialized, are available in only a few centres and it is inevitable that patient access to these therapeutic options are limited. Logically it may be better to consider surgical techniques earlier, especially where a focal problem can be identified. Patients have a right to be provided with balanced information and to be told of the existence of surgical options at an early stage so that they can make informed treatment choices. There is a case therefore for revising the philosophy of the WHO ladder (Box 1).

Treatment for the cause – these are examples and not intended to be a comprehensive list. It is important never to forget the cause of the symptoms in management, particularly noting that chronic pain is a symptom and not a diagnosis.

Lumbar microdiscectomy

In this example, pain radiating down the patient's leg associated with a surgically significant lumbar disc prolapse and without neurological deficit is considered. A surgical patient group and a conservatively managed group have similar outcomes when assessed at 5 years.[1] Surgery, however, offers a reduction in pain immediately at the expense of surgical morbidity and a small

Classification of neurosurgical techniques

Treatment of the cause

- Once the cause is removed, then pain should and usually does immediately resolve: example is microvascular decompression for trigeminal neuralgia and lumbar microdiscectomy for sciatica

Lesioning of pain pathways

- Lesioning for pain control is still performed for trigeminal neuralgia, for focal pain of malignant origin (cordotomy) and brachial plexus avulsion

Neuromodulation

- Neuromodulation includes two groups of therapies: electrical modulation, by stimulation of the central or peripheral nervous system, and drug delivery systems

Techniques alleviating the cause are preferred over those treating symptoms. Non-lesional techniques (e.g. spinal cord stimulation or drug delivery systems) are preferred over lesional techniques, yet each has its place

Box 1

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procedural risk. The morbidity of simple microdiscectomy is low; it can be performed as a day case, and rarely involves hospital stay of more than 24 hours postoperatively. These factors must be compared with the conservative option, which involves loss of function due to pain, side effects from analgesic use and time – in years – for pain to settle.

Spinal fusion with or without instrumentation

There is little controversy over the need for spinal fixation in cases of deformity, for example scoliosis, spondylolisthesis or trauma as a means of alleviating pain. The situation has until recently been much less clear regarding metastatic tumour, or degenerative low-back pain.

Spinal metastatic tumour

Recent evidence from a prospective randomized controlled trial shows that improvements in mobility, survival and pain control can be achieved by decompression and stabilization.

Fusion for low-back pain associated with degenerative lumbar spine disease: when surgical fusion is compared to an intensive functional restoration program, both groups performed better than the reported natural history.[2]

However, there was significant morbidity associated with surgery. A recent National Institute for Health and Care Excellence guidance stated that there was a limited role for surgery. 'failed back surgery syndrome' (FBSS) is a reasonably frequent condition following this type of surgery, and is one of the commonest indications for spinal cord stimulation.

Microvascular decompression for trigeminal neuralgia (TGN)

In a large proportion of cases, trigeminal neuralgia is associated with an artery or vein in contact with the trigeminal nerve at its root entry zone, so that it is now accepted that this is one of the causative influences in the aetiology of TGN. Classically, the compressing vessel is the superior cerebellar artery. The operation involves moving this vessel away via a small craniectomy in the posterior fossa. The vessel is mobilized from the trigeminal nerve and held away with pieces of Teflon.

Outcome evidence comprises observation data from large numbers of patients, in some cases for over 20 years – the importance of considering long- term outcomes has been noted above. These series show that long-term complete pain relief and coming off medication is achieved in about 75% of cases and that this pain relief is permanent.[3] Risks are low, but they can be serious. A mortality and serious morbidity (e.g. stroke) rate exists (0.1%), and there is a risk of ipsilateral hearing impairment (2%). This surgery is safe even in elderly patients, provided they are selected for fitness for anaesthesia. This rate of efficacy is unsurpassed in any other area of pain medicine. It should be noted and recognized that the most difficult part of the whole procedure is making a clear diagnosis, and this can often be difficult; particularly the distinction from trigeminal autonomic cephalgias. Interestingly, MVD has been used with success in some of these syndromes – usually the shorter time course examples such as SUNCT (Short-lasting Unilateral Neuralgiform headache attacks with Conjunctival injection and Tearing).

Lesioning for pain control

Trigeminal neuralgia

The trigeminal nerve can be lesioned open or percutaneously. The percutaneous approach is to the foramen ovale. The procedure involves a needle introduced from a point 2.5 cm lateral to the angle of the mouth, lined up in the plane of the mid-pupillary point and the root of the zygoma, so as to pass in the direction of the foramen, with the position confirmed using fluoroscopy, ideally now in a biplanar high resolution X-ray suite. Anaesthesia dolorosa is a rare but serious side-effect. Paraesthesia is common and in up to 8% this may be unpleasant. Statistical analysis has found no difference in efficacy amongst these techniques:

Radiofrequency lesioning: positioning of the needle is usually performed under general anaesthesia. The patient is then woken, and the electrode is stimulated until paraesthesia is obtained in the division of the nerve corresponding to the location of the pain. The patient is then re-anaesthetized and a thermal lesion made by heating the tip of the electrode with a radiofrequency lesion generator. The patient is then woken again and tested for analgesia. If this is inadequate then the whole process is repeated. The wake–sleep process may be difficult to tolerate especially in elderly patients. The technique is more difficult to use for the first division and carries a risk of corneal anaesthesia, leading to ulceration. Some practitioners now perform the whole procedure under GA.

Glycerol injection: once the needle is in position the patient sits up and a mixture of glycerol in contrast is injected until Meckel's cave is filled. It is awkward to sit the patient up with the needle in situ, and cranial nerve palsies can occur if material leaks from the intended position. It has been performed without this manoeuvre.

Balloon micro compression is carried out under general anaesthetic with a larger-gauge needle and is the preferred technique of the author. When the needle is in position a catheter with a balloon at the tip is introduced and inflated, compressing the nerve against the wall of the foramen ovale. The larger-gauge needle does increase the risk of damage to nearby vessels (internal carotid, jugular vein and complex).

Radiosurgery: a dose of radiation is delivered to the root entry zone or the Gasserian ganglion. The effect is usually not immediate. The efficacy is dose-related, as is the side effect of dysaesthesia. In some analyses, the pain relief is not as good as the other lesioning techniques.

Partial sensory rhizotomy is performed by the same approach as for microvascular decompression, as is a newly promoted procedure known as *intraneurolysis*. Both procedures cause numbness, the former definitively and permanently so, whilst the latter is more temporary.

Most difficulties arise when the TGN is mistaken for trigeminal neuropathy or atypical facial pain, and especially when lesioning techniques are employed.

To date neuromodulation techniques have not been used successfully for TGN.