Editorial

Whither lesional surgery for movement disorders

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Stereotactic surgery gained relevance in neurosurgery mainly as a surgical procedure to ameliorate symptoms of Parkinson's disease (PD) and other movement disorders. However stereotactic surgery for movement disorders has experienced fluctuating fortunes with a fall in the 1970s and resurgence in the 1990s. Lesional surgery for PD and other movement disorders gained momentum after the publication of the landmark article on pallidotomy by Laitinen *et al* in 1992.[1] This led to renewed interest in functional stereotactic surgery particularly pallidotomy in patients with PD. The interest in pallidotomy and thalamotomy, however, has died down in recent years due to emergence of deep brain stimulation (DBS). DBS is touted as being superior to lesional surgery such as thalamotomy and pallidotomy, as it does not destroy brain tissue and therefore, adverse effects, if any, of the stimulation are reversible unlike lesional surgery where the adverse effects of destruction of the target site are likely to be permanent. However, there have been very few articles discussing all the pros and cons of lesional surgery and DBS.

In recent years DBS has almost completely replaced thalamotomy and pallidotomy in most developed countries. The question being raised in this editorial is whether lesional surgery is still relevant and whether it should be promoted amongst neurologists, neurosurgeons and patients as a safe and effective surgery for selected patients with PD and other movement disorders. The author is not exploring the relative merits and drawbacks of the two procedures (lesional surgery and DBS) to arrive at a conclusion regarding the superiority of one of the procedures. The purpose of this editorial is only to evaluate the evidence on the safety, efficacy and durability of lesional surgery for movement disorders.

Thalamotomy

Thalamotomy is generally performed in patients with tremor-dominant PD especially if the symptoms are asymmetrical with one-sided limbs being more involved. Other appropriate indications include essential tremor (asymmetrical involvement is a better indication), tremor due to other pathologies (multiple sclerosis, post-traumatic, post-ischemic and post-infectious) and focal dystonias involving an upper limb or a lower limb.

The tremor is usually abolished immediately after thalamotomy.[2-5] If the tremor does not recur within 3 months to a year, it is unlikely to recur again and the effect can be termed permanent. There is a marked dimunition in tone in the targeted limbs. This is a concomitant effect and in our experience cannot be separated from the effect on tremor. There is no effect on bradykinesia. Jankovic *et al*[6] in a recent post CT series of 42 patients with PD undergoing thalamotomy, reported complete relief of tremor in 72% of patients with PD and significant improvement of tremor in another 14%. Fox *et al*[2] reported on 36 patients with PD who had undergone thalamotomy and 86% of patients had complete abolition and 5% had significant improvement of their tremor. Overall a recurrence of tremor occurs in 4-20% of patients.[3] A long-term follow up study with a mean follow up of 8.8 years has revealed that the beneficial effects of thalamotomy on tremor and rigidity in patients with PD are maintained for several years with no recurrence of symptoms on the operated side.[7]

Transient complications following thalamotomy occur in about 5 to 58% of patients.[2,3,6] However, most of these are minor and nondisabling and improve over varying periods of time. Persistent complications are seen in about 10-23% of patients.[2,3,6] Dysarthria, especially with left sided thalamotomy, hemiparesis of varying severity from mild weakness to hemiplegia and hemihypesthesia are the other common complications. Dysphasia can also occur in left sided thalamotomies.[3] Whether some of these should be termed complications or a concomitant effect of the surgery is a moot point as they occur in most patients undergoing the surgery.

Posteroventral Pallidotomy

The absolute indication for posteroventral pallidotomy (PVP) is the presence of disabling dopa-induced dyskinesias (DID). There is no consensus on the other indications for the procedure. Most surgeons would offer PVP only to patients who fulfill the following criteria:[8-11]

1. Definite diagnosis of PD responsive to l-dopa,
2. Peak dose dopa induced dyskinesias is a major symptom,
3. Had the disease for more than 5 years,

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4. Patients in Hoehn and Yahr grades worse than 3 in the "off" phase,
5. Patients can walk independently at some time during the day while on medications.

Exclusion criteria include:
1. PD plus syndromes,
2. Presence of dementia or severe depression, and
3. Severe uncontrolled systemic diseases such as hypertension, diabetes mellitus and cardiac disease which will increase the risk of surgical complications.

In a survey on PVP practice in North America,[12] dopa induced dyskinesias were uniformly cited by almost all centres, as the most important and ideal indication for the surgery. On-off fluctuations, dystonia, rigidity were felt to be fairly good indications but freezing, gait disturbances and tremor were stated to be poor indications.

Bilateral staged PVP can also be offered to patients with dystonia musculorum deformans especially those with the inherited variety.

One of the most dramatic effects of PVP is an almost immediate feeling of well being in the patient soon after the surgery; in some cases this effect is even seen on the operating table.[10] As reported by several workers,[8-17] contralateral dopa induced dyskinesias are almost completely abolished after the surgery. Ipsilateral and axial dyskinesias are also markedly diminished but not to the same extent as the contralateral dyskinesias. The choreoathetotic dyskinetic movements are relieved to a greater extent than the dystonic movements.[16] Rigidity is diminished in the contralateral limbs. Rest tremor in the contralateral limbs is usually reduced or abolished. Bradykinesia is ameliorated in the contralateral limbs. All workers have recorded an improvement in the "off" period UPDRS scores by 25-57% following PVP.[8,10,15-17] Except for the series reported by Iacono *et al*,[10] all others have reported that the "on" period UPDRS scores are not significantly improved by PVP. Although the relief of most of the symptoms of PD is sustained even at 1 year after PVP, the improvement does tend to wane slightly with time.[8,11,12,16] However, even at 3 months and 1 year after the surgery the patient is functionally better than preoperatively.[8,10,11,16] Improvement in symptoms in the ipsilateral limbs and axial musculature generally wanes with time so that by 1 year the patient returns to preoperative function in the ipsilateral limbs.

Quadrantanopias or hemianopias can occur due to damage to the optic tract.[1,8-12,15] Hemiparesis and dysarthria are the other common complications of PVP.[1,8-12,15] In a large series of 796 patients undergoing PVP (1156 PVP procedures overall), the complication rate, including temporary problems, was 15.3%. Permanent complications occurred in 3.6% of total operations.[18] Other common but transient complication following either procedure is disorientation or confusion lasting a few days.

Simultaneous bilateral thalamotomy is generally not advocated because of the high incidence of speech abnormalities (hypophonia). However, bilateral PVP at the same sitting is being practised in some centers.[10,12] We prefer to stage bilateral surgeries, separating them by at least 6 months. This we believe is safer and gives the patient and the surgeon the opportunity to assess the outcome after the unilateral procedure and decide whether to proceed with the other sided surgery.

Relative Features of Deep Brain Stimulation and Lesional Surgery

The author does not intend to compare the relative merits and demerits of lesional surgery and DBS but would like to highlight certain features of DBS and lesional surgery. The main advantages of DBS are:
1. the adverse effects of stimulation are reversible with the cessation of stimulation,
2. bilateral surgery is safer and causes less adverse effects except in the thalamus where both DBS and lesional surgery can result in unacceptable side effects,
3. bilateral subthalamic nucleus stimulation offers relief of axial symptoms such as gait freezing for which lesional surgery is not beneficial,
4. functional regions of the brain will be available for repair or replacement (neural transplant) should such therapies become available in the future.

In a randomized study, Schuurman *et al*[19] compared thalamic stimulation and thalamotomy in 68 patients with drug resistant severe tremor. They found that both procedures were equally effective in suppressing the tremor but thalamic stimulation was associated with fewer adverse effects and resulted in a greater improvement in function. In another comparative age and sex matched study, Pahwa *et al*,[20] came to a similar conclusion. But they noted that a larger proportion of patients undergoing DBS required repeat surgeries due to mechanical failure of the device. It must be recognized that not all adverse events associated with DBS are reversible. Adverse events which are procedure related as opposed to stimulation related can be of a permanent nature. The commonly reported complications with DBS and their rates (in parentheses) are bleeding (1-4%), infection (5-12%) and mechanical failure (6-25%).[21-23]

The main difference between the complications of the two procedures is that all the adverse events in patients undergoing lesional surgery are manifest soon after the surgery and patients are unlikely to develop further deterioration in function except due to the progression of the disease. On the other hand, patients who have had DBS can have complications occurring several months or years following the procedure. Hardware related complications and infection of the implanted hardware are not time-bound and could occur several years after the initial procedure. Additionally, the implanted battery has an average life of around 4 years and will need replacement. There have been reports of tolerance developing requiring increasing stimulation currents to maintain the relief of symptoms. All the above features of DBS mandate periodic and probably life-long monitoring of the patient.

Several authors have reported that DBS has a lower complication rate compared to lesional surgery but there is no

difference in efficacy for symptoms that respond to both procedures. However, in a recent article, Blomstedt and Hariz[24] compared the complication rates in 256 procedures in patients undergoing DBS (129 procedures) and lesional surgery (127 lesions) for movement disorders wherein they concluded that unilateral lesional surgery "may not harbor more postoperative complications or side effects than DBS". Most of the adverse effects of lesional surgery are transient while not all side effects of DBS are reversible. Interestingly, lesional surgery might on occasion succeed in patients in whom DBS has failed to provide relief.[25]

Cost Effectiveness of Lesional Surgery

Besides its safety and efficacy that have stood the test of time, the main attraction of lesional surgery lies in its low cost to the patient when compared to that of deep brain stimulation (DBS). All the costs of lesional surgery are borne upfront at the time of the surgery. Besides the large difference in the initial costs of the two procedures with lesional surgery costing approximately less than 10% of DBS, patients undergoing lesional surgery are spared the incremental costs of repeated follow up monitoring to fine tune the stimulation parameters and the cost of replacement of batteries or hardware related revisional procedures which are required in patients undergoing DBS. Herein lies the crux of the issue that is being addressed through this editorial. The author believes that given the socio-economic environment in which we work, wherein the vast majority of our patients with PD and other movement disorders cannot afford DBS, lesional surgery is a safe and effective alternative. Therefore, I urge neurologists and neurosurgeons to offer lesional surgery to patients who can benefit from it and promote it as an important therapeutic intervention in helping selected patients with PD and other movement disorders. While interested parties are avidly promoting DBS, lesional surgery is an orphan that is awaiting adoption and deserves better recognition and promotion amongst doctors and the lay public.

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