EDITORIAL

Neurosurgery for mental disorder

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Origins of neurosurgery for mental disorder

At the historic second Neurological Congress held at University College, London (July 29 - Aug 5, 1935), where Pavlov, aged 86, gave a valedictory review of his life's work, a symposium on the Frontal Lobes took place. Fulton from Yale presented frontal lobectomy studies on two chimpanzees, Becky and Lucy carried out in collaboration with his colleague Jacobson. The major finding was that the manifestations of 'frustration' induced by delayed response tasks of increasing difficulty were abolished by bilateral frontal ablation with resulting calmness and passivity. Egas Moniz, the 59 year old professor of neurology in Lisbon, was the first discussant of Fulton's paper, pointing out its potential application to psychiatry. Born Antonio Caetano in northern Portugal, he adopted the pen name Egas Moniz, a Portuguese military hero of the 12th century who led his countrymen to end the Muslim invasion of Portugal. He was an active liberal and republican during the reactionary monarchy of the time. The monarchy was overthrown and a republic proclaimed in 1911, the year Moniz was appointed to the Lisbon Chair of Neurology. Between 1914 and 1918 he served the new government as Ambassador to Spain and later as Foreign Minister, taking time from his diplomatic duties to write a textbook on the neurology of brain injury. He returned to neurology at the end of the first World War, when the liberal government was replaced by a conservative one. Between 1927 and 1935, he developed cerebral angiography.

After the second neurological congress, he returned to Portugal determined to apply Fulton and Jacobson's techniques to intractably disturbed psychiatric patients. With the collaboration of a young neurosurgeon Lima, the first psychosurgery operations were performed on November 12, 1935, in Lisbon. Four patients, two with chronic depression and two with paranoid schizophrenia, were operated on. Within the next year, they had completed 20 operations, initially using alcohol injections into the depths of each frontal lobe and later a special instrument called a leucotome manufactured in Paris. They reported the clinical outcome as recovery in seven, improvement in seven and no change in six patients.[1] Subsequently Moniz had difficulty in recruiting cases because of the hostility of the local psychiatric establishment. An excellent review of the early days of psychosurgery is given by Shutts.[2]

The lobotomy era

Meanwhile, Walter Freeman, a neuropathologist and neurologist at George Washington University, USA, collaborated with James Warts, a neurosurgeon who had previously done experimental neurophysiology with Fulton. They developed the prefrontal leucotomy. In this operation a burr hole was made in each temporal region though which a leucotomy knife was swept up and down in an arc, severing the frontal cortical-subcortical connecting white matter and making large lesions of variable size.[3] The blind 'freehand' operation and its many modifications were used over the next 20 years. The transorbital leucotomy technique developed by Freeman was widely used and particularly controversial. This psychosurgery variant did not require neurosurgical skill and involved penetrating the roof of each orbit with a sharp instrument like an ice pick, angled upwards and backwards and rotated laterally on each side to make the cut. Freeman used to anaesthetise the patients with ECT prior to carrying out the operation in a range of non-surgical settings! Prefrontal leucotomy and related psychosurgical procedures were carried out widely in the western world.[4] Even in the early days their use was a source of controversy since mind altering surgery was regarded as unethical by many psychiatrists, especially those with a psychoanalytic background.

The mortality was surprisingly low (0.3%) considering the blind nature of the surgery. The incidence of post operative epilepsy was 1.3%. More serious was the 3% prevalence of severe frontal lobe syndrome and less extreme but still serious personality defects in perhaps as many as one third of patients. These adverse complications greatly added to the controversy about the ethics of such surgery. The cavalier attitudes of many of its early practitioners towards selection and assessment of patients and uncritical claims about efficacy also added fuel to the storm of criticism

What has tended to be overshadowed by the ethical debate concerning the early operations is their relative clinical efficacy in the era before effective psychotropic medication. In a review of 9,284 patients operated on in England and Wales between 1942 and 1954, 41% were recovered or greatly improved, 28% minimally improved, 25% unchanged, 2% worse and 4% died. [5] Two-thirds of those operated on had a diagnosis of schizophrenia and one third affective disorder. Of the latter 63% were recovered or greatly improved, compared to 30% of the former.

Modified operations

The next step in the evolution of psychosurgery was made possible by Fulton.[6] He carefully analysed the extent and site of the lesions at post-mortem examination. By relating the latter findings to clinical outcome, he was able to demonstrate that lesions confined to ventromedial quadrants of the frontal lobes gave the best clinical results with the lowest risk of serious personality change. This led to open brain surgery with the lesions restricted to the ventromedial quadrants of the frontal lobe or related areas. The most popular operation of this period was the bimedial leucotomy. By the mid 1950s the introduction of

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antipsychotic drugs provided an effective medical treatment for the positive symptoms of schizophrenia and psychosurgery was no longer an indication in this condition. In addition, follow-up of both the standard and restricted lesions operations has shown that patients with intractable depressive, anxiety or obsessive-compulsive disorders had a consistently better outcome than schizophrenic patients.

Stereotactic neurosurgery

The advent of stereotactic neurosurgery provided neurosurgeons with the capacity to make precisely localised lesions. There is no consensus on the optimum target site for the operation but the aim in most procedures is to interrupt the limbic system circuits at a convenient site usually in the orbitomedial frontal cortex, anterior limbs of the internal capsule or cingulate areas.

Sites of stereotactic lesions

Geoffrey Knight pioneered the stereotactic subcaudate tractomy (SST) operation to simulate the open freehand orbital undercut procedure which had to be abandoned because of a high prevalence of epilepsy. In the initial SST operation, lesions were made deep in the frontal lobes in the subcaudate areas using radioactivity from arrays of implanted ceramic rods containing radio-yttrium (^{90}y) which has a half life of about 68 hours. This proved a safe technique and well over 1,000 operations have been performed in London by Knight and his successors.[7] Since radio-yttrium is no longer readily available, similar lesions in the same sites are now made by electro coagulation.

In Sweden, the anterior limbs of each internal capsule have been targeted, an operation known as a bilateral anterior capsulotomy.[8] The lesions are usually thermal, though a gamma knife technique is now being pioneered in Sweden and USA. In contrast, the anterior cingulotomy operation targets the cingulate tracts on each side.[9] Finally, the limbic leucotomy procedure involves lesions in both the orbitomedial quadrants of each frontal lobe and the cingulate areas on each side.[10] It has been suggested that depression is best treated by lesions in the basomedial frontal region (ie. SST or cingulotomy), while OCD responds best to capsulotomy operations. More rigorous evidence is required to substantiate this claim. Studies directly comparing the effect of the different target sites on clinical outcome have yet to be carried out.

Acute complications of stereotactic surgery

All these operations have in common an operative mortality of less than 0.1% and a low prevalence of immediate and long-term adverse effects. Like all operations on the brain, haemorrhage and/or infection are acute risks with hemiplegia in less than 0.3%. More benign post-operative complications are transient confusion, lethargy and incontinence of urine which may persist for a few days or weeks post-operatively. Reduced tolerance to maintenance psychotropic medication carried on unchanged over the post-operative period seems a significant factor in the development of confusion. Transient post-operative oedema is another factor.

Longer term complications

In the longer term, epilepsy is a significant complication; between 1% and 2% for the SST and the capsulotomy operations and a higher prevalence of 9% for the cingulotomy procedure. The seizures are usually few in number, infrequent in recurrence and responsive to anti-epileptic medication. The frontal lobe syndrome is a very rare but not unknown complication of the stereotactic operations.[11,12] Personality trait changes such as 'outspokenness', disinhibition, irritability, lack of consideration and lack of initiative, have been described after surgery. None have been regarded as socially incapacitating and some indicate changes in psychosocial adjustment rather than organic deficits. Some reflect mental state improvements following surgery, eg. improved mood leading to more assertiveness and less dependence. Others mark a return to premorbid functioning styles. Indeed, the only two long-term systematic studies of personality change after surgery report that in the majority of patients there was no significant negative impact on personality. In fact, there were improvements in mood, depth of feeling, anxiety proneness, obsessionality, sociability and level of dependency.[13,14]

In particular there were no significant changes in measures of impulsivity or hostility. A 1988 review of 834 stereotactic operations reported marked personality change in 0.4% and mild personality change in 3%.[15] General intelligence, cognitive processing speed, attention and memory show no long-term deficits, though in one of the long-term studies OCD patients operated on had a significantly poorer performance on the Wisconsin Card Sorting Test, a test of frontal lobe functioning.[12] In contrast 23 depressed patients who underwent SST showed no deficits in frontal lobe functioning.[16]

Contemporary indications

The main contemporary indications for stereotactic neurosurgery are chronic treatment refractory major depressive disorder and obsessive-compulsive disorder. Despite the advances in the medical and psychological therapies for these conditions, there seems to be a residual number of treatment resistant patients for whom NMD is an appropriate treatment option when other potentially effective therapeutic strategies have failed. A 1994 survey of Scottish psychiatrists covering a population of five million estimated 195 such patients seen over the previous five years, at least 10 times greater than the number actually assessed. In the UK as a whole, the number of operations has averaged 23 a year in the 1990 to 1994 period, over 70% having been SST procedures performed at the Geoffrey Knight unit in London, now relocated from the Brook to Kings College Hospital. Other UK centres are Cardiff, Leeds, the Atkinson's Morley Hospital London, and Dundee, which is the national Scottish centre.

Efficacy of stereotactic neurosurgery

The clinical efficacy of NMD is difficult to evaluate. Ethical issues make randomised controlled trials difficult, if not impossible, to organise. The various centres use different stereotactic targeted lesions and there are no comparative studies examining the relative efficacies of the various techniques. The distribution of the clinical diagnoses of the patients operated upon varies between centres as well as the nature and scientific rigour of assessment instruments, making comparison difficult. Long-term outcome studies (with post operative follow-up periods of 10 years or more) contain small sample sizes. Clinical

outcome is rarely assessed by raters independent of the NMD team

Nevertheless, there are now a number of well documented published studies from centres in Sweden, UK, USA and Australia using reliable and valid measures of mental state and behaviour. In several, comparison with small samples of age and gender matched patients suffering from the same disorder but not operated upon have been possible. A literature review on clinical effectiveness is published in the Scottish Office report (1996).[17] For both major depressive and obsessive-compulsive disorder, between one third and two thirds of patients are in the Pippard rating scale A and B categories (recovered; much improved or showing considerable symptom alleviation). The median percentage of patients showing significant improvement is around 50%. An exception is the Bristol study of 142 OCD patients followed-up for 15-20 years.[18] Of these 68% showed complete recovery or marked improvement. Gold electrodes were implanted in the orbital and paracingulate areas of the frontal lobe and left in place for up to 10 months in 72 subjects. Electrical stimulation and subsequently electrocoagulation was progressively carried out until the optimum response was reached. These procedures were performed during a prolonged inpatient stay with intense psychological support and behavioural therapy, which may have contributed to the impressive outcome. This operation is no longer carried out. It was the brain child of Harry Crow, neuropsychiatrist at the Burden Neurological Hospital, and did not outlast his retirement.[19] In any event, inpatient stays of up to 10 months at a time do not fit in with the aegis of the new NHS!

Another observation that supports the relatively favourable follow-up study data is comparisons with the suicide rates following neurosurgery. Compared to the 15% suicide rate for non-surgically treated patients with chronic major depressive disorders, the suicide rates in the years following neurosurgery are much lower; 1% for SST, 5% for limbic leucotomy, 9% for cingulotomy. The total lack of suicides following capsulotomy may relate to the fact that capsulotomy has been used more often for OCD patients than for depressed patients. Nevertheless, for the above mentioned reasons, the follow-up outcome data remains unsatisfactory, and open to challenge from sceptics. A recent editorial[20] calling for better evaluation of NMD has suggested five requirements for such an assessment. These are as follows:

1. Independent assessment by mental health workers who had no role in the decision making and who have different professional backgrounds; through audio taping or video taping of interviews before surgery and at follow up for further independent evaluation.
2. Clear pre-operative and post-operative information and psychometric tests assessing aspects of both symptom severity and cognitive function.
3. An adequate period following the intervention of at least a year before follow-up.
4. Information from brain imaging before and after surgery in order to establish the location and extent of the stereotactic lesions. The fact that different centres use different stereotactic techniques adds to the confusion. However, if the various centres can be persuaded to use a common pre- and post-operative assessment protocol, then it should be possible to do comparative studies examining the efficacy of different techniques.
5. A complete sample of patients, not just those who are willing and able to travel to take part in a clinic-based follow-up. This requires home based evaluation.

Who should carry out neurosurgery for mental disorder?

It is best carried out in specialist centres where a multidisciplinary team of psychiatrists, a neurosurgeon and a clinical psychologist with a special interest in these disorders, who can work together to carry out the assessment of suitability for this type of surgery, the pre-operative assessments, the surgery itself and subsequent follow-up.

The selection for surgery requires confirmation of the diagnosis, the establishment of chronicity (five years or more continuous illness) and the treatment refractory nature of the disorder according to a standard protocol of available treatments, both physical and psychological. The patient, their next-of-kin and carers need to be fully informed about the advantages and disadvantages of surgery by one or more members of the multidisciplinary team and be given the opportunity to discuss these issues not only with members of the multidisciplinary team but with their friends and usual carers.

Communication can be facilitated with the use of an information sheet written in simple language describing the nature of the operation, the reasons for using it, possible complications and predicted outcome. Preparing information in this way facilitates the development of informed consent. One such initial consent is obtained, it is necessary to involve the statutory bodies that deal with the protection of patients' interests; Mental Health Act Commission in England and the Mental Welfare Commission Commission in Scotland. Their consent is mandatory in England. In Scotland the Mental Welfare Commission is required by law to give consent in a case of detained patients only, but an informal arrangement exists for them to assess other patients and give their opinion about suitability for surgery.

A number of baseline assessments of mental statement, social adjustment, personality, quality of life and cognitive function are required before the operation, with standard videotape recording of mental state. MRI scanning is also necessary prior to surgery.

Post-operative management

Physical recovery from surgery is rapid (within a few days). The standardised assessments of mental state can be repeated at this stage and the rehabilitation programme initiated. Patients are actively encouraged to a follow a graded programme of occupational and social activities. An important aspect is that there is often a slow response to the operation. Although some patients manifest a dramatic improvement shortly after the operation, the majority pursue a gradual and varying rate of recovery over a period of up to six to12 months after surgery. It is essential therefore to organise a continuing active rehabilitation programme for all patients, which should continue after return to their base hospitals 10 days to two weeks after surgery.

Paradoxically, the significant improvements in mood and mental state following lead to increased independence and assertiveness and place strains on the family relationships, especially when family members have been used to having a chronically depressed and therefore submissive quiet and dependent person to care for. Such changes can be challenging for family and friends to adjust to. Equally,

the patient may have difficulties in adjusting to independent living after having been used to years of dependence upon other people. Such issues need to be identified by the mental health team responsible for the patient's long-term aftercare, and dealt with.

Another factor to take account of is that relapses in mental state occur months and/or years following surgery, even in a patient who has a relatively successful outcome. These need to be treated effectively by conventional methods. The patient needs to be reassured that such lapses do not necessarily mean a return to the chronicity of the preoperative condition. Indeed, it is worthy of comment that patients after surgery often respond better to physical treatments such as ECT and antidepressant drugs, as well as psychological treatments such as cognitive therapy.

Conclusion

Just over 60 years after its introduction, psychosurgery in modern dress known as Neurosurgery for Mental Disorder (NMD) continues to have a role in the management of chronic, treatment refractory, major depressive and obsessive-compulsive disorders.[21] Its practice needs to be restricted to a few specialist centres with rigorous preoperative assessment and outcome follow-up, and multicentre collaboration to facilitate comparative outcome studies of the effects of the different stereotactic lesions. Its application is likely to become even more restricted as advances in other psychiatric treatments progress. It is equally likely that in time a better understanding of the neurobiology of major depressive and obsessive-compulsive disorders and the accumulation of 'harder' outcome data will give NMD a stronger theoretical and empirical base. Finally, NMD in the future may not be restricted to making lesions in brain tissue. Transplantation into the human brain may eventually evolve into a viable form of treatment.

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