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COMMENTARY

Neurosurgical interventions for psychiatric illness – an underutilised option in treatment?†

Nigel I. Kennedy

Nigel I. Kennedy, MB BS, PhD, is Assistant Professor in Psychiatry at Icahn School of Medicine at Mount Sinai, New York, New York, USA. **Correspondence** Nigel I. Kennedy. Email: nigel.kennedy@mountsinai.org

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SUMMARY

Neurosurgery for mental disorder is performed in the UK for treatment-refractory obsessive–compulsive disorder and depression. In this commentary, the procedures used are considered alongside other surgical interventions for psychiatric conditions. Given the evidence for efficacy, this commentary agrees with Whitehead & Barrera's assessment that such procedures be considered more widely in treatment-refractory illness and concurs that the advent of minimally invasive radiosurgery is an exciting prospect for patients who have not responded to other treatments.

KEYWORDS

Neurosurgery; obsessive–compulsive disorder; deep brain stimulation; treatment-refractory illness; capsulotomy.

Referring patients for a neurosurgical procedure is not an idea that occurs readily to most psychiatrists in their everyday practice. The history of surgery in psychiatry ('psychosurgery') makes for sobering reading and its spectre still looms large, overshadowing a near century of advances in our understanding of the anatomical and functional pathways underpinning psychiatric symptoms.

The procedures commonly used today are supported by a strong evidence base for their efficacy and safety, in stark contrast to the cavalier approaches of the past. The term 'psychosurgery' has been discarded as a misnomer that implies the surgical target is the 'mind' or 'psyche' (Kopell 2003). The intended target is the neural substrate of the disorder, and the goal is the restoration of normal emotional, behavioural and cognitive function.

Whitehead & Barrera (2023, this issue) have written a narrowly focused review that achieves its educational objectives of reviewing the two most commonly used neurosurgical procedures for psychiatric illness in the UK. Neurosurgery for mental disorder (NMD) is currently performed for cases of severe depressive and obsessive–compulsive disorder (OCD) refractory to treatment, under stringent regulations as set out under the Mental Health Act 1983. The two procedures currently in use in the UK are anterior cingulotomy (ACING) and anterior capsulotomy (ACAPS).

By understanding the breadth of treatment options available, clinicians can engage in an informed discussion and ensure that patients maintain access to all options for treatment, ultimately leading to the best possible outcomes.

Historical perspective

Neurosurgical interventions for psychiatric illness are not novel and yet their use remains relatively rare. Such a discussion would be incomplete without acknowledgement of the lessons learned from the past. The frontal leucotomy was a technique developed by Egas Moniz (reviewed in Byard 2017) which involved severing the connections between the prefrontal cortex and the thalamus for the treatment of schizophrenia and depression. In 1949 Dr Moniz was awarded the Nobel Prize in Physiology or Medicine for his work. It is estimated that between 1939 and 1951, over 18 000 frontal leucotomies were performed in the USA alone. The procedure was associated with a high mortality rate (between 4 and 7%) (Byard 2017) and despite repeated calls for scientific evidence to justify these procedures, none was produced that would adequately meet modern acceptable standards. Consequently, the concept of 'psychosurgery' has become synonymous with this cavalier and poorly evidence-based practice. With the advent of chlorpromazine in 1953 came a safer, more effective method of managing psychosis. This, in addition to substantial public outcry, led to an abrupt end to the practice of frontal leucotomy (Braslow 1999). However, this abominable treatment understandably lives long in public memory and can be a source of trepidation when it comes to the discussion of surgical options for psychiatric illness with patients and their families.

ACING and ACAPS

Whitehead & Barrera highlight correctly that although sample sizes are small, there is convincing

evidence of efficacy for both NMD treatments described in their article. There is little head-to-head data in the literature but in a systematic review of observational studies, Brown et al (Brown 2016) report that the average full response rate to cingulotomy for refractory OCD at the last follow-up was 41% (range 38–47%, $n = 2$ studies, $n = 51$ participants) and to capsulotomy it was 54% (range 37–80%, $n = 5$ studies, $n = 50$ participants). Considering the severity of illness in these patients, who had not responded to a number of pharmacological agents at this point in treatment, this response rate is impressive.

Comparison of ACING and ACAPS is further complicated by the fact that the locus of disease is anatomically variable between patients. Central nervous system functions are known to involve a number of functionally redundant neuronal networks, leading to a complex, orchestrated pattern of neuronal stimulation and inhibition with control executed at a cellular and molecular level. The anterior cingulate gyrus itself is complex and is functionally important in cognition, emotion and the perception of pain. These functions are generally localised within the organ but a significant amount of variability exists. The goal of surgery is to isolate the aberrant pathways underpinning disease, leaving functional tissue intact. To this end, careful preoperative planning is essential to identify the optimal lesion site and to account for anatomical and functional variation between individuals. Whitehead & Barrera suggest that more careful neuropsychological analysis of surgical candidates pre- and post-procedure may lead to optimisation of the procedure. This, combined with advanced neuroimaging, may eventually allow surgeons to tailor treatments to individual patients by more accurately identifying the aberrant pathways preoperatively. The authors correctly highlight that such an approach when combined with a minimally invasive technique such as Gamma Knife® stereotactic radiosurgery has the potential to enhance the accuracy of the procedure while reducing the risk of adverse effects.

Deep brain stimulation

The irreversible nature of the cingulotomy and capsulotomy procedures used today can often give referring clinicians pause, particularly when considered alongside 'reversible' procedures such as deep brain stimulation (DBS), the implantation of an electrode within the deep brain to selectively modulate potentially aberrant pathways underpinning psychiatric symptoms. The electrode can be removed and stimulation parameters can be adjusted in clinic, thus preventing the need for surgical revision.

In over two decades of research, as is the case for ACING and ACAPS procedures, clinical outcomes in DBS have also been variable. Whitehead & Barrera correctly note that there have been no head-to-head trials comparing DBS and NMD. In a comparative meta-analysis, Kumar et al (Kumar 2019) report that the two techniques offer similar outcomes. Reporting across 56 studies, totalling 681 cases (367 surgical ablation; 314 DBS), surgical ablation exhibited greater overall utility than DBS. Pooled ability to reduce Yale–Brown Obsessive Compulsive Scale (Y-BOCS) scores was 50.4% (s.d. = 22.7%) for ablation and 40.9% (s.d. = 13.7%) for DBS. Meta-regression revealed no significant change in percentage improvement in Y-BOCS scores over the length of follow-up for either ablation or DBS. Adverse events occurred in 43.6% (s.d. = 4.2%) of ablation cases and 64.6% (s.d. = 4.1%) of DBS cases ($P < 0.001$). Complications reduced utility of ablation by 72.6% (s.d. = 4.0%) and utility of DBS by 71.7% (s.d. = 4.3%). Ablation utility (0.189, s.d. = 0.03) was superior to DBS utility (0.167, s.d. = 0.04) ($P < 0.001$).

For all the successes of DBS, it remains a costly procedure that requires extensive long-term follow-up. Nevertheless, there is evidence that, when effective, the cost of treatment is comparable to 'treatment as usual' (Ooms 2017). Another consideration is that DBS implantation precludes any future treatment with electroconvulsive therapy (ECT), should the treatment be unsuccessful. Whitehead & Barrera correctly highlight that the risk of surgical complications with DBS is greater than for ablative surgical procedures. There is no question that the development of DBS and advances in neuroimaging have led to a better understanding of the neural pathways involved in OCD and depression. Advances continue to be made to further improve the procedure and its efficacy.

Conclusions

McGilloway (McGilloway 2021) wrote an excellent commentary in this journal on the importance of ECT, asking whether we are withholding effective treatment from our patients owing to a lack of understanding. I would suggest that the same argument could be made as regards NMD and also neuromodulation-based treatments such as repetitive transcranial magnetic stimulation (rTMS), the discussion of which is unfortunately beyond the scope of this commentary. Given the dearth of novel pharmacological targets in treating refractory mental illness, it is increasingly important for clinicians to fully understand the options that exist beyond pharmacology and psychotherapy.

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Declaration of interest

None.

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