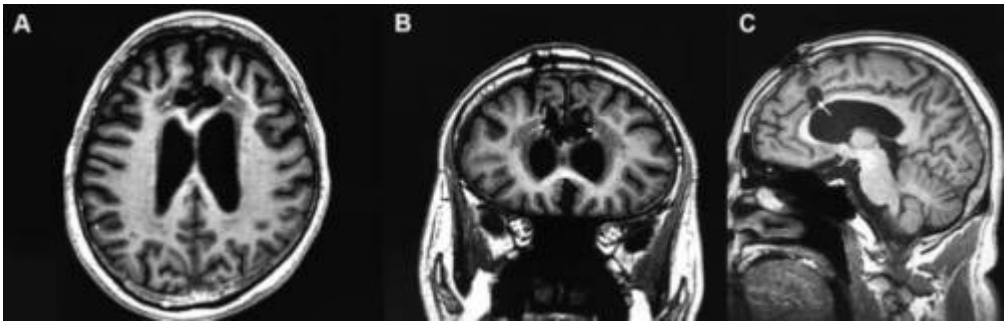
Bilateral anterior cingulotomy



Bilateral anterior cingulotomy is a form of psychosurgery, introduced in 1948 as an alternative to lobotomy.

Lesioning of the target area is typically performed using bilateral stereotactic electrode placement and target ablation, which involves transparenchymal access through both hemispheres.

Lauri Laitinen was a pioneer of stereotactic psychosurgery in the 1950s to 1970s, especially by introducing the subgenual cingulotomy.

Indications

Bilateral anterior cingulotomy has been used to treat chronic pain, obsessive-compulsive disorder.

In the early years of the twenty-first century, it was used in Russia to treat addiction.

The objective of this surgical procedure is the severing of the supracallosal fibers of the cingulum bundle, which pass through the anterior cingulate gyrus.

Early localizationists linked anterior cingulate cortex (ACC: Brodmann's area 24 and adjacent regions) with emotional behavior, paving the way for bilateral cingulotomy psychosurgery in severe, treatment resistant, cases of obsessive-compulsive disorder, chronic pain, depression, and substance abuse.

Limbic system surgery based on initial cingulotomy offers a durable and effective treatment option for appropriately selected patients with severe obsessive compulsive disorder who have not responded to conventional pharmacotherapy or psychotherapy [1].

There are features of anterior cingulate cortex structure and connectivity that predict clinical response to dorsal anterior cingulotomy for refractory obsessive compulsive disorder. These results suggest that the variability seen in individual responses to a highly consistent, stereotyped procedure may be due to neuroanatomical variation in the patients. Furthermore, these variations may allow us to predict which patients are most likely to respond to cingulotomy, thereby refining our ability to individualize this treatment for refractory psychiatric disorders [2]

The presence of neuropathic pain can severely impinge on emotional regulation and activities of daily living including social activities, resulting in diminished life satisfaction. Unfortunately, the majority of patients with neuropathic pain do not experience an amelioration of symptoms from conventional therapies, even when multimodal therapies are used. Chronic refractory neuropathic pain is usually accompanied by severe depression that is prone to incur suicidal events; thus clinical management of chronic neuropathic pain and depression presents a serious challenge for clinicians and patients

Two patients presented with neuropathic pain and severe depression. The patients had different pain symptoms emerging a few months after central or peripheral nervous system impairment. These symptoms were associated with the development of severe depression, social isolation, and a gradual inability to perform daily activities. Both patients were referred for bilateral anterior cingulotomy. After surgery, both patients showed significant progressive improvements in perceived pain, mental health status, and daily functioning.

Bilateral anterior cingulotomy may serve as an alternative treatment for medically refractory neuropathic pain, especially for patients who also experience depression [3].

Stereotactic anterior cingulotomy has been used in the treatment of patients suffering from refractory oncological pain due to its effects on pain perception. However, the optimal targets as well as suitable candidates and outcome measures have not been well defined. We report our initial experience in the ablation of 2 cingulotomy targets on each side and the use of the Brief Pain Inventory (BPI) as a perioperative assessment tool.

A retrospective review of all patients who underwent stereotactic anterior cingulotomy in our Department between November 2015 and February 2017 was performed. All patients had advanced metastatic cancer with a limited prognosis and suffered from intractable oncological pain.

Thirteen patients (10 women and 3 men) underwent 14 cingulotomy procedures. Their mean age was 54 ± 14 years. All patients reported substantial pain relief immediately after the operation. Out of the 6 preoperatively bedridden patients, 3 started ambulating shortly after. At the 1-month follow-up, the mean preoperative Visual Analogue Scale score decreased from 9 ± 0.9 to 4 ± 2.7 ($p = 0.003$). Mean BPI pain severity and interference scores decreased from levels of 29 ± 4 and 55 ± 12 to 16 ± 12 ($p = 0.028$) and 37 ± 15 ($p = 0.043$), respectively. During the 1- and 3-month follow-up visits, 9/11 patients (82%) and 5/7 patients (71%) available for follow-up reported substantial pain relief. No patient reported worsening of pain during the study period. Neuropsychological analyses of 6 patients showed stable cognitive functions with a mild nonsignificant decline in focused attention and executive functions. Adverse events included transient confusion or mild apathy in 5 patients (38%) lasting 1-4 weeks.

The initial experience indicates that double stereotactic cingulotomy is safe and effective in alleviating refractory oncological pain [4].

Case series

Four MRgLITT bilateral cingulotomy procedures were performed in 3 patients. Two patients had a single MRgLITT procedure while the third had repeat ablation after pain recurrence. First time ablation coordinates were (medians): x = 7.9 mm (range, 6.9-8.6); y = 20.5 mm (range, 20-22); z = 6.9 mm

(range, 2.9-7.0) above the lateral ventricle roof. Median trajectory length was 85.5 mm (range, 80-90). Median ablation volume was 1.5 cm3 (range, 0.6-1.2). Median ablation time was 257 seconds (range, 136-338) per cingulum and power was 10.0 Watts (range, 10-11). Median preoperative pain severity (PSS) and interference scores (PIS) were 7.7 (range, 7.5-9.3) and 9.9 (range, 9.7-10.0), respectively. Median postoperative PSS and PIS scores were 1.6 (range, 1.0-2.8) and 2.0 (range, 0.3-2.6), respectively.

MRgLITT cingulotomy is well tolerated for treatment of cancer pain and can be easily performed framelessly for appropriate candidates [5].

Seven patients suffering from refractory OCD underwent stereotactic surgery and were followed for 12 months. The Yale-Brown Obsessive Compulsive Scale (Y-BOCS) was used to assess the efficacy. The test was taken before and 6 and 12 months after surgery.

The mean Y-BOCS scores decreased significantly from 32.9 ± 4.7 at baseline to 20.6 ± 5.3 after 12 months. Five out of the 7 patients showed a decrease of more than 35%. During the 12-month follow-up, the effective rate had increased from 28.6 to 71.4%. There were no significant adverse effects observed after surgery.

The BACI and BACA were effective for the treatment of refractory OCD, and no significant adverse effects on long-term follow-up were found [6].

Bilateral radiofrequency cingulotomy was performed in 10 patients. The technique involved stereotaxis using magnetic resonance guidance and local anesthesia, with the placement of a radiofrequency lesion (75 degrees, 60s). Of the 10 patients, 8 had metastatic lesions with musculoskeletal (6) or neurogenic (2) pain. Pain relief was judged excellent (4 patients), fair (1), poor (2) and excellent for 6 months poor in the last patient. The two benign lesions were neurofibromatosis with neurogenic pain and thalamic pain from an old stroke. Pain relief (with 1 year follow-up) in this group was judged excellent in one and poor in the other (thalamic pain) [7].

Forty-two patients out of 300 who had undergone bilateral stereotactic cingulotomies were studied by means of computerized tomography (CT). The appearance showed bilateral encephalomalacia, measuring on the average 5 X 7 mm2, located in the cingulate gyrus. These induced lesions had attenuation values similar to cerebrospinal fluid and did not enhance with contrast. CT is a useful technique for initial evaluation, management, and follow up of these patients [8].

Case reports

In end-stage cancer, oncologic pain refractory to medical management significantly reduces patient's quality of life. In recent years, ablative surgery has seen a resurgence in treating diffuse and focal cancer pain in terminal patients. The anterior cingulate gyrus has been a key focus as it plays a role in the cognitive and emotional processing of pain. While radiofrequency ablation of the dorsal anterior cingulate is well-described for treating cancer pain, MRI-guided laser-induced thermal therapy (LITT)

is novel. Allam et al. describes a patient treated with an MRI-guided LITT therapy of the anterior cingulate gyrus for intractable debilitating pain secondary to terminal metastatic cancer [9].

Huotarinen et al., found 1 patient alive who underwent subgenual cingulotomy in 1971 for obsessive thoughts, anxiety, and compulsions, diagnosed at that time as “schizophrenia psychoneurotica.” MRI showed bilateral subgenual cingulotomy lesions (254 and 160 mm3, respectively). The coordinates of the center of the lesions in relation to the midcommissural point for the right and left, respectively, were: 7.1 and 7.9 mm lateral; 0.2 mm inferior and 1.4 mm superior, and 33.0 and 33.9 anterior, confirming correct subgenual targeting. The patient reported retrospective satisfactory results.

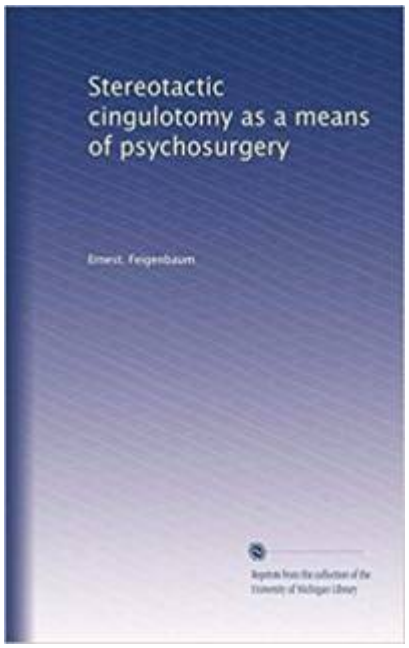
The lesion in this patient was found to be in the expected location, which gives some verification of the correct placement of Laitinen's subgenus cingulotomy target [10].

A case of debilitating thoracic wall pain due to malignant mesothelioma relieved by bilateral anterior cingulotomy is described and changes in dyspnoea investigated.

Improvements in pain, dyspnoea and the extent to which either symptom bothered the patient was seen for 2 months after surgery before disease progression led to death 5 months after surgery. Quality of life improvements were also seen for 2 months after surgery and pain relief was sustained from surgery to death. Arterial blood gas and lung function tests were unchanged by surgery, suggesting a reduction in pain and dyspnoea awareness by cingulotomy.

Bilateral anterior cingulotomy effectively relieved both pain and dyspnoea. The role of the anterior cingulate cortex in pain and autonomic control of respiration is discussed alongside the evidence for this palliative procedure for cancer pain [11].

Books



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