

Percutaneous cervical cordotomy in cancer pain

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Abstract

The aim of this study was to review all published articles in the literature in English regarding percutaneous cervical cordotomy in cancer pain. Percutaneous cordotomy may be used to relieve unilateral pain below the level of the neck arising from a variety of causes. It is particularly indicated for unilateral chest pain associated with malignant disease. We searched for reports on MEDLINE and EMBASE using the terms 'percutaneous cordotomy', 'fluoroscopy', 'computed tomography', and 'cancer pain' up to and including 2013. Reports were also located through references of articles. This review leads us to conclude that percutaneous cervical cordotomy can be recommended even before considering the use of strong opioids.

Key words: cordotomy, cancer pain, fluoroscopy, computed tomography

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Despite the great progress made in the treatment of cancer pain, all patients cannot yet be treated satisfactorily. Nervous compression pain or pathological bone fracture can be difficult to control; pain in patients with cancer can be refractory to pharmacological treatment, and specific interventional pain management techniques can be an effective alternative for these patients [1, 2].

Pain treatment in cancer patients consists of a combination of analgesics according to the WHO-ladder and co-analgesics [3], and it is split into three steps. Step 1 advises the use of paracetamol or a non-steroidal anti-inflammatory drug if pain is not satisfactorily controlled. Step 2 includes the use of weak opioids, usually codeine. Patients with severe pain usually need Step 3 analgesia, the use of strong opioids. Morphine is the usual first-line Step 3 opioid. At any stage in the analgesic ladder, adjuvant analgesics can be used. Interventional management of cancer certainly allows for a reduction of systemic medication and its side effects [4, 5].

There are many benefits of interventional pain management in the palliative care setting; the greatest is that, with a single procedure, the patient can be afforded months of pain relief.

Percutaneous cordotomy for palliation of intractable pain is a procedure commonly applied for the relief of pain due to cancer: the amount of pain relief was 82–95% (bilateral cordotomy 95%, unilateral cordotomy 83%) and

immediate pain relief (defined as being pain free without the need for additional analgesics) has been achieved in 64–90% of treated patients [6, 7].

The aim of this review is to describe the efficacy of percutaneous cervical cordotomy (PCC) in palliative care medicine, fluoroscopy-guided versus computed tomographic-guided PCC, and unilateral versus bilateral PCC.

METHODS

In this review, we present all the work published about fluoroscopy-guided percutaneous cervical cordotomy (PCC) in cancer pain in the English language up to and including 2013. We looked for published reports using the Medline and Embase services, with the search terms 'percutaneous cordotomy', 'fluoroscopy', 'cancer pain', and 'computed tomography'. Reports were also located through references in the articles. Only objective findings outside the epidural space were included; subjective findings, such as patient or physician global assessments and pain following fluoroscopy-guided percutaneous cervical cordotomy, were not included.

PERCUTANEOUS CORDOTOMY

PCC is indicated in unilateral malignancies, lower extremity pathologies (unilateral/bilateral), failed back syndrome, chronic nociceptive painful conditions and cancer patients with a life expectancy of less than one year. It has

a special place in the treatment of a large group of patients suffering pain associated with primary lung cancer, including mesothelioma and Pancoast syndrome. Metastatic carcinoma could be treated too.

Percutaneous cordotomy is contraindicated in patients with coagulation disorder, severely reduced ventilator function ($FEV_1 < 12 \text{ mg kg}^{-1}$) [6], and if the patient is unable to co-operate. Other contraindications are severe pulmonary dysfunction, behaviour of the patient, and bilateral upper extremity pathologies.

PANCOAST SYNDROME, MESOTHELIOMA AND LUNG CANCER

The three main causes of pain in patients with advanced lung cancer are skeletal metastatic disease (34%), pancoast tumour (31%) and chest wall disease (21%) [8].

Ischia *et al.* [9] showed that 44% of patients with Pancoast syndrome were pain-free up to death as a result of cordotomy. Distortion of anatomy by the tumour may make the procedure difficult to perform safely.

The pain due to mesothelioma is often poorly localised with respect to the primary tumour site. In mesothelioma pain resulting from local infiltration of the intercostal nerves may become a prominent feature. Therefore intercostal nerve blocks can be very effective in certain patients. Percutaneous cordotomy, as a more aggressive anaesthetic intervention, may be required. Kanpolat *et al.* [10] controlled local pain due to malignant mesothelioma by CT-guided PCC.

Bekar *et al.* [11] described computer tomography-guided high level percutaneous cordotomy used unilaterally or bilaterally for the treatment of localised intractable pain involving the left side of the chest, axillary region, and shoulder in a patient operated for small cell lung cancer. This pain was relieved completely after the first cordotomy procedure, but after four days he complained of severe unilateral chest pain as bad as the initial pain.

METASTATIC CANCER

Reddy *et al.* [12] showed that percutaneous cordotomy using CT guidance is safe and effective in reducing pain in paediatric patients suffering from metastatic medulloblastoma.

Kopell *et al.* [13] described CT-guided percutaneous cordotomy in a patient who presented with disseminated neurofibromatosis with evidence of neuromas throughout the entire cervical spinal neuroaxis.

THE PROCEDURES

FLUOROSCOPY-GUIDED PERCUTANEOUS CORDOTOMY

Percutaneous cordotomy for palliation of intractable pain is a procedure performed at the high cervical level. It

is principally based on the lesioning of the lateral spinothalamic tract, which carries pain and temperature sensation. It reduces the sensation of touch and temperature in addition to pain. Spinothalamic fibre decussates in the spinal cord; for this reason, the procedure is performed contralaterally to the pain site. It interrupts the spinothalamic tract at the C1/C2 level, causing contralateral loss of pain sensation [7, 14]. Fluoroscopy-guided percutaneous cordotomy is performed using a local anaesthetic and the patient is given sedation prior to the procedure. It has to be performed using two needles. One needle is inserted into the subarachnoid space between the first and second cervical vertebrae, as seen under lateral fluoroscopy. Before removal of the spinal needle, a second needle with a stylet is introduced 1–2 mm ventral to this ligament, at a right angle to the spinal cord, where the lateral spinothalamic tract is situated. After removal of the stylet, a thermocouple electrode is introduced and connected to a lesion generator. Motor stimulation, producing contractions of the ipsilateral trapezius and neck muscles, and sensory stimulation, producing contralateral thermal sensations, ensure that the tip of the electrode is situated in the right position.

COMPUTED TOMOGRAPHY (CT)-GUIDED PERCUTANEOUS CORDOTOMY

Computed tomography-guided PPC offers the advantage of superior topographical orientation in the spinothalamic tract. The procedure can be repeated on the other side a minimum of one week later [15]; the second side appears to be similar to the first side, with a low complication rate for both procedures.

UNILATERAL AND BILATERAL PERCUTANEOUS CORDOTOMY

Bilateral cordotomy has opened new doors to pain-alleviating procedures in the management of intractable cancer pain, but this procedure is associated with a higher rate of complications than the unilateral procedures [9, 16, 17] using conventional techniques. Rosomoff *et al.* [14] reported ataxia in 34% of cases, bladder dysfunction in 17%, paresis in 10%, hypotension in 4%, and respiratory problems in 4%. Ischia *et al.* [9] reported mortality rates ranging from zero to 9% in unilateral versus 11% in bilateral procedures. Sindou *et al.* [18] reported rates as high as 50% after bilateral cordotomy. Bilateral cordotomy under CT guidance is safer than bilateral cordotomy using conventional techniques [11, 19, 20].

COMPLICATIONS

Serious side effects are extremely rare, affecting less than 1% of patients. The main risk is of weakness of the leg contralateral to the side of the pain through damage to the corticospinal tract and, rarely, in the arm; mild effects

are seen in up to 8-10% in the first few days, but prolonged effects are reported in only 1–2% [7, 21, 22]. Weakness usually improves within 48 hours, but occasionally can take up to a month to settle and, very rarely, becomes permanent.

Painful dysesthesia occurs in about 5% of cases [6].

A major permanent complication observed is urinary retention, occurring in 11.1% of cases [7]. Weakness of bowel and bladder control is generally more common if the procedure is done on both sides [23]; hemiparesis is found in 11.1% of cases (partial paresis of the ipsilateral leg [6, 9]).

Lukas *et al.* [24] described a case history of a patient with adhesive arachnoiditis after PCC. Arachnoiditis is an inflammatory reaction of the pia-arachnoid membranes. It results in a progressive fibrosing process with myelopathy and syrinx formation. The actual incidence of adhesive arachnoiditis after PCC is unknown.

Mirror-image pain (5.6%) could be adequately treated with analgesics [9]. There will be some change in sensation on the side of the body where the pain is experienced. The diminished touch perception suggests involvement of the anterior spinothalamic tract in the lesion. The lesions of nearby anterior spinocerebellar (mediating proprioception), reticulospinal (mediating autonomic outflow) and cerebrospinal (mediating voluntary movement) tracts results in ataxia, disturbed co-ordination or autonomic or motor dysfunction [25].

Some patients may experience a headache for the first 48 hours following the procedure [6].

Lahuerta *et al.* [25] described respiratory dysfunction syndrome after cervical cordotomy for lesions involving the region of the anterolateral funiculus in the C2 segment containing fibres activated from the second to the fifth thoracic dermatomes, but in recent studies that used more accurate ablation techniques, no respiratory dysfunction occurred [26]. Nevertheless, procedure-related mortality (1–6%) is mainly due to respiratory dysfunction [25].

Sexual sensitivity in the analgesic area may be impaired or lost [27]. Although the absence of sensation in the penis is a known side effect, erectile dysfunction is not; this is more frequent in diabetic patients [25].

Since percutaneous cervical cordotomy is usually proposed for patients with a limited life expectancy of less than six months, objective quantification of the long term effects is lacking. Meeuse *et al.* [28] described effects five years after the procedure. Sensory dysfunction was observed on the left side of the body after PCC on the right side, but no motor neurone or autonomic dysfunction was observed. Pain and temperature sensations were most affected, but touch and vibration sense were also abnormal. Long lasting decreases in nociception and temperature sensation, without major side effects, were shown.

DISCUSSION

Ablative surgical methods retain a significant place in the treatment of chronic pain, particularly when non-invasive methods have failed to provide adequate relief. In these cases, the indication of a destructive method requires a detailed evaluation of each patient. In the cases where pain is localised and is predominantly unilateral, the application of percutaneous cervical cordotomy can be valuable [8].

Kanpolat *et al.* [10, 29, 30] described more than 200 patients with intractable pain with pulmonary carcinoma, mesothelioma and Pancoast tumours, and Yequel *et al.* [15] described CT-guided percutaneous cordotomy as a useful procedure for the treatment of severe unilateral cancer pain syndromes. Conventional percutaneous cordotomy with X-ray visualisation is a much less invasive procedure, allowing safe unilateral operations at the high cervical level, but bilateral lesions high in the cervical spinal cord involving the anterior portion of the lateral spinothalamic tract have been associated with sleep-induced apnoea due to bilateral destruction of the ventrolateral reticulospinal tract [16, 17, 30, 31]. Computerised tomography-guided percutaneous cordotomy uses a needle electrode system and visualises the lateral spinothalamic tract: cordotomy performed with CT guidance may be used to treat bilateral pain [30].

Earlier applications of interventional pain management techniques can be recommended before considering the use of strong opioids, even if epidural and intrathecal medication administration allow the reduction of the daily oral or transdermal opioid dose.

Percutaneous cordotomy is not recommended if life expectancy is less than three months, but it is recommended if it is less than six months, although its popularity has decreased considerably due to the availability of oral and transdermal analgesic therapy and continuous spinal infusion techniques. CT-guided percutaneous cordotomy, in particular, is an effective procedure that should be used in the treatment of cancer-related pain problems, preferably as soon as possible for patients who fail to respond to classic analgesic therapy, and for patients with bilateral pain.

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