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REVIEW / *Interventional imaging*

Pain management: The rising role of interventional oncology

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Pain relief

Abstract Patients with early or metastatic cancer may suffer from pain of different origins. The vast majority of these patients are not adequately treated by means of systemic analgesia and radiotherapy. Percutaneous neurolysis is performed using chemical agents or thermal energy upon sympathetic nervous system plexus for pain reduction and life quality improvement. Ablation and vertebral augmentation are included in clinical guidelines for metastatic disease. As far as the peripheral skeleton is concerned bone augmentation and stabilization can be performed by means of cement injection either solely performed or in combination to cannulated screws or other metallic or peek implants. This review describes the basic concepts of interventional oncology techniques as therapies for cancer pain management. The necessity for a tailored-based approach applying different techniques for different cases and locations will be addressed.

Up to 90% of patients with cancer will experience pain during the disease progress whilst approximately half of patients in advanced stage report at least moderate to severe pain [1]. Pain in cancerous diseases interferes with appropriate treatment, results in depression and reduces life quality [1,2]. Pain due to cancer can be caused by damage to the tissues (nociceptive type) or by damage or dysfunction in the nervous system (neuropathic type). In the vast majority of cancer patients, both types coexist up to a certain degree with the resulting pain being difficult to treat only by means of systemic analgesia [3,4]. In both early and metastatic cancer stage, 56% to 82.3% of patients are undertreated [3,4]. The

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three-step WHO analgesic ladder can be applied for cases of acute or chronic pain, and includes administration of non-opioids, analgesics and NSAIDs (step 1), addition of weak opioids to the treatment regime (step 2) and administration of methadone or strong opioids orally or trans-dermally (step 3). Radiotherapy achieves total pain reduction in approximately 1/3—1/4 of cancer patients whilst combining complete and partial increases pain reduction rate up to 60% of the patients [5].

Apart from systemic analgesia, surgery and/or radiation therapy, new therapies have emerged trying to improve life quality, to reduce pain and avoid unnecessary suffering and morbidity in oncologic patients. Additionally some of these new techniques intend to apply the principle of local tumor control in oligometastatic patients. The therapeutic armamentarium of Interventional Oncology techniques for cancer pain management includes neurolysis, ablation, bone and vertebral augmentation [6—13]. These minimally-invasive techniques either act indirectly (regional anesthesia from neurolysis) or directly upon the tumor.

The aim of this review is to describe the basic concepts of interventional oncology techniques as palliative therapies for cancer pain management and highlight the need for a tailored-based approach applying different techniques depending on the specific situation.

Percutaneous neurolysis

In cases of visceral pain percutaneous neurolysis of a specific sympathetic nervous system plexus can be chemical, using phenol or alcohol injection (i.e., chemical neurolysis), or thermal by radiofrequency or cryoablation (i.e., thermal neurolysis) [14,15]. Additionally, there is some evidence that supports application of pulsed radiofrequency offering pain reduction without causing significant damage to nervous tissue and without the risk of motor deficits and de-afferentation syndrome [14,16]. Ideally, neurolysis of sympathetic nervous system plexus should result in selective C and Aδ pain fibers damage, without interfering with sensory and motor function of the patient.

As far as cancer patients are concerned, the list of plexus-targets includes stellate ganglion, thoracic and lumbar sympathetic plexuses, celiac or superior hypogastric plexus and ganglion impar; peripheral nerves such as the trigeminal, the intercostals and the brachial plexus can serve as targets of neurolysis as well. Indications for stellate ganglion neurolysis include upper extremity pain due to pancoast or neck carcinoma; those for celiac plexus neurolysis include upper abdominal visceral pain due to splanchnic (pancreatic or hepatobilliary) or intestinal (up to ascending colon) cancers; neurolysis of superior hypogastric plexus and ganglion impar is indicated for visceral pelvic and perineal pain [1]. Contraindications include infection (local or systemic), coagulopathy and/or anticoagulants as well as local anatomic abnormalities precluding safe needle placement [1].

Correct cannula positioning should always be verified by image guidance, followed by specific confirmation. During thermal neurolysis, electrical stimulation should be performed prior to ablation including both sensory and motor stimulation. Successful electrical sensory stimulation results in pain triggering located in concordance with the distribution of the patient's usual pain. Motor stimulus is then performed; there should be no motor response in a threshold below 2.0 volts or below double the threshold value of the sensory test. The technique's efficacy is increased with the sensory testing whilst safety from motor impairment is ensured with motor stimulation. During chemical neurolysis contrast medium injection should be used to verify extravascular needle location and at the same time to illustrate potential dispersion of the neurolytic agent, which is difficult to control (Fig. 1) [17].

Throughout the literature case series, randomized controlled trials, systematic reviews and meta-analyses report significant pain reduction and life quality improvement post-percutaneous neurolysis in approximately 75% of the patients [1,18—25]. However up-to-date there are no data supporting impact of neurolysis upon patient survival [26]. As far as chemical neurolysis is concerned retrospective comparative studies between alcohol and phenol report no difference in pain outcomes and complications between

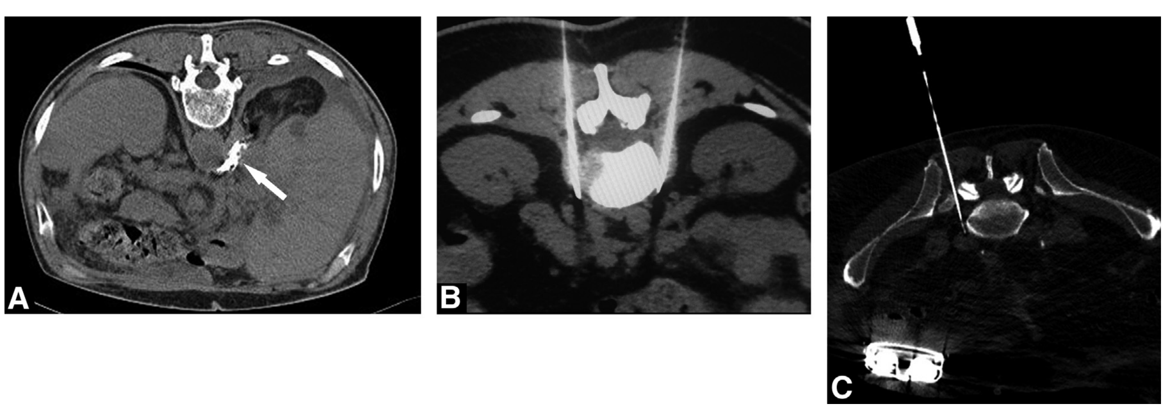

Figure 1. Computed tomography (CT) images obtained in a 65 year-old man suffering from celiac pain due to advanced pancreatic adenocarcinoma who underwent chemical neurolysis of celiac plexus. A. CT image shows presence of iodinated contrast material (arrow) that was injected percutaneously in order to verify the correct needle location and indicate potential dispersion of ethanol. B. CT image shows splanchnic nerves thermal ablation by means of continuous radiofrequency energy. C. CT image shows correct positioning of needle during neurolysis of superior hypogastric plexus using radiofrequency under CT guidance.

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