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**Review Article**

# Interventional Modalities for Chronic Pain Management

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**ABSTRACT**
*Pain has been defined variously by varied authors. In present scenario, clinicians have realised that pain has psychological, social and cultural components, thus making it a biopsychosocial phenomenon. This calls for its multimodal and interdisciplinary management. Proper evaluation and discussion of the prognosis of various treatment modalities with the patient along-with setting of realistic goals for pain reduction, functional rehabilitation and mood elevation is the mainstay of therapy for chronic pain. Interventional pain management has been recognised as a sub-speciality of chronic pain management since 1996. Understanding of pathophysiological mechanisms underlying chronic pain has led to revolution in the development of various interventional pain management modalities. Various limitations of pharmacological therapy on one hand and surgical techniques on the other, have led to interest in use of interventional modalities for pain management. However, they have to be administered cautiously, weighing risks and benefits for each case. This account is an attempt to review various interventional modalities for chronic pain management.*
**Keywords:** *Chronic pain, pain management, prognosis, modalities.*

## INTRODUCTION

Pain has been defined by the international association for study of pain (IASP) as, "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage"[1]. The American society of anaesthesiologist (ASA) defines chronic pain as "extending in duration beyond expected temporal boundary of tissue injury and normal healing and adversely affecting the function or well being of the individual[2]. This outline of chronic pain given by ASA has been elaborated and modified as the pain sustaining beyond three to six months, which is regarded as a normal time taken for tissue healing[3]. Pain not only has a physical component, but also an attached psychological, social and cultural component to it. Moreover it has been described as a biopsychosocial phenomenon. The biopsychological concept of chronic pain, given

by Engel in 1959[4] describes the biological social and psychological factors influencing the chronicity of pain and its perception by the patient[5].This explains the existence of chronic pain much beyond the expected time of tissue healing or even without any physical or pathological cause[6]. This forms the basis of multi-modal therapeutic pain management strategies[5].

## MATERIAL AND METHODS

An extensive literature search was performed through Medline, Pubmed, Google scholar using the key words such as interventional pain management, guidelines for the pain management, analgesic ladder, pain strategy. Abstracts from potentially relevant publications were also studied. In this narrative review, we have discussed the various definitions and factors associated with chronic pain along with the role of anaesthesiologist in its management. We have highlighted the major interventional modalities for chronic pain management which include diagnostic and therapeutic nerve blocks, continuous catheter techniques and stimulation modalities. Few surgical interventions for pain management have also been briefed.

According to researchers, eleven million Americans were suffering from pain in year 2011 leading to an expenditure of about $ 560 to 635 billion per year. These inflated costs related to chronic pain are majorly the outcomes of low productivity of suffering individual due to adverse implications of pain on their health status as well as advent of newer techniques to diagnose and treat chronic pain[7].

Prevalence of chronic pain has been estimated to be about 20% to 60% by various researchers in different countries[8,9] with higher frequency in females and the elderly. Authors usually classify chronic pain as malignant and non malignant. Non cancer pain in turn include neuropathic, inflammatory and musculoskeletal pains[10]. Neuropathic pain are lacinating, shooting or burning in nature and it includes conditions like postherpectic neuralgia, complex regional pain syndrome (CRPS), phantom limb pain, diabetic neuropathy and human immunodefieciency virus neuropathy[11].

The Canadian pain society special interest group on neuropathic pain (NeuPSIG) has defined neuropathic pain as “pain arising as a direct consequences of a lesion or disease affecting the somatosensory system[12]. IASP defines it as a ‘ pain initiated by or caused by a primary lesion or dysfunction of nervous system[13]. The new definition by NeuPSIG differentiates neuropathic pain from cancer pain or pain caused due to lesions in other areas of nervous system, like central motor pathways lesion causing muscle spasm resulting in chronic pain[14].

Inflammatory pain usually involves the arthritic joints while musculoskeletal pain commonly involves the spine as in low backache. Malignant pain arises due to invasion of tumour into nerve plexus or surrounding nerves as well as due to effects of radiotherapy or chemotherapy[15].

## INTERDISCIPLINARY MANAGEMENT OF CHRONIC PAIN

The need for an interdisciplinary management of chronic pain was first understood by John J. Bonica and was brought into practice in 1960[10]. Various guidelines have been published from time to time regarding chronic pain management.

World Health Organisation (WHO) in 1986 developed an “analgesic ladder” or a stepwise framework of guidelines for treating cancer pain[16]. This helped clinicians around the world to become aware for effective treatment of cancer pain[17]. In 1997 these guidelines were further revised and helped to understand the pathophysiology, proper assessment and choice of treatment according to the ladder[17,18]. Presently it has been estimated to be helpful in treating 70-80% of cancer patients[19]. The addition of fourth step of interventional modalities in the WHO analgesic ladder has led to the extension of its scope into acute and chronic non cancer pain management as well as pain relief in paediatric patients[20,21]

Guidelines stated by ISAP in 2002[22], Canadian pain society[23], American society of anaesthesiologists in 1997 and updated in 2010 [24], neuropathic pain special interest group (NeuPSIG) of IASP guidelines for pain assessment [25]in 2011 and European federation of neurological societies (EFNS) guidelines for neuropathic pain assessment published in 2004 [26] have stressed upon the need of multidisciplinary approach to treat pain. The multimodal and multidisciplinary models have been proved to be very beneficial and cost effective methods by a metaanalysis conducted by Gatchel R et al in 2006. According to authors, the monomodal approaches like pharmacological treatment alone lead to major expenditure borne by the patients[27]. Also missing the psychological element from a so called physical etiology or eliminating physical element out of a presumed psychogenic pain may not lead to desired treatment results[28].

Multiple specialities and therapists including anaesthesiologists, psychologist physical and occupational therapists, neurologist and nursing staff are roped in as a team for assessment and management of chronic pain[10]. After assessment the prognosis of the disability or dysfunction as well as degree of relief can be discussed with patients and more realistic goals like reduction of pain, functional improvements and mood elevation can be set for rehabilitation of the patient[27]. National pain strategy is a set of latest recommendations by American Academy of Pain Medicine[28]. According to Dr. Sean Mackey, the goals is providing individualised interdisciplinary care to patients with acute or chronic pain, using specially designed tailored treatment plans by pain specialists[29]. In addition, the researchers at Stanford System Neuroscience and Pain Laboratory study the emotional and cognitive factors influencing pain and use neuroimaging for helping assessment and management of pain[29,30].

## PSYCHOLOGICAL FACTORS

Proper behaviour analysis along with assessment of pain intensity using various scoring systems and questionnaire is essential. Depressive disorders, drug abuse and other contributing environmental factors play an important role in evaluation of patient with chronic pain. Authors have quoted that physical and psychological distress are both the responses to pain as well as contribute to the pain experience[31]. This behavioural and cognitive therapy along with relaxation techniques play a vital role in pain management especially chronic headaches, rheumatic pain mand non specific backache[27]

**Physical therapy** includes adopting a regular exercise, routine improving fitness and mobility which may help to improve symptoms of pain, disability and fear[32]. **Occupational therapy** includes educating, motivating and conditioning of patients for work[33]

## ROLE OF ANAESTHESIOLOGIST IN PAIN MANAGEMENT

Anaesthesiologists play an essential role as a part of multidisciplinary team of pain therapists. They steer the patients treatment regimen towards a multimodel therapy due to their extensive knowledge of pharmacology along with technical expertise in regional anaesthesia skills. Also anaesthesiologist monitors the new problems or comorbidities along with the physical assessment of the patient. Important role of motivation and education to the patient about various treatment options is done by the anaesthesiologist efficiently.

## INTERVENTIONAL MODALITIES

Interventional pain management refers to diagnosis and treatment of pain using various interventional technique for chronic intractable persistent pain alone or along with other trearment modalities[34]. Understanding of the pathophysiol-ogical mechanisms underlying the chronic pain conditions have led to revolution in the development of interventional pain management techniques[35].

Inter ventional pain management was recognised as a subspeciality of chronic pain management by

Dr. Waldman in 1996[36]. Presently the organisations like Society for Pain Practice Management and American Society of International Pain Physicians are working in this field[37,38].

According to various authors less than half of patients with chronic pain are relieved with conventional pharmacological therapy[39,40]. Various limitations of surgical modalities like spinal fusion to relieve pain as well as drawbacks of chronic opioids use in non malignant pains have lead to interest in interventional modalities[41,42].

Moreover, 10-20% patient with malignancies on treatment with pharmacological agents are unresponsive to therapy or in cases where side effects of opioids are not tolerable, interventional modalities are highly beneficial to cut off pain signals from periphery to the brain. Also these techniques may not be visualised as the fouth step of WHO analgesic ladder, but can be considered at any of the steps according to the needs of the patient[43]. Thus a lot of evidence based guidelines are available for interventional modalities to treat chronic pain[44-52].

However, a word of caution to be asserted at this point is that risks of interventional techniques and their benefits must be weighed for each case. According to a prospective study, about 8% cancer patients may need nerve blocks and 3% of them require neurolytic and neuraxial blocks each[53]. Interventional pain modalities have been classified in different ways - diagnostic or therapeutic, destructive or non destructive.

## DIAGNOSTIC INTERVENTIONAL BLOCKS

According to researches, history, examination, imaging and nerve conduction studies can lead to diagnosis of only 15% cases of nonradicaular spinal pain[54], while 85% of the patients can be diagnosed for cause of spinal pain by use of diagnostic interventional blocks[35]. Facet joint blocks, selective nerve root blocks, sacroiliac joint blocks and provocation discography are some of the diagnostic techniques with good efficacy[35,54,55]

## DESTRUCTIVE VS NON DESTRUCTIVE INTERVENTIONAL TECHNIQUES

Destructive techniques are irreversible, causing physical damage to the nervous tissue thus disrupting the conduction of pain impulses. Non destructive methods cause reversible conduction block by use of various drugs or procedure repeatedly or using infusions or by electrical stimulation. Non destructive procedures are usually done prior to the destructive ones, in order to provide indications to source of pain and likely prognosis of the following destructive procedure. Agents commonly used for nerve destruction includes 50-100% alcohol and 3-12 % phenol. Radiofrequency ablation by conventional continuous radiofrequency, where radiofrequency needle is heated to 80-90˚c for 60 -90 seconds or by pulse radiofrequency in which pulses of alternating current are used to heat the needle less than 43˚c is also method for disrupting the axonal transmission. Surgical disruption of the neural tissues is rarely performed[43]. It may be performed if symptoms are refractory to conservative and interventional therapies[56].

## DIAGNOSTIC NERVE BLOCKS

Nerve blocks are commonly used to diagnose the pathological cause for pain as well as have a prognostic importance. They are valuable to understand the neural origin of a particular pain and also to differentiate between somatic and autonomic causes of pain. Various diagnostic blocks are used in clinical practice for headache, low back pain, neuropathic pain and complex regional pain syndromes. They include sacroiliac joint injections[57], facet joint and medial branch blocks[58], spinal nerve blocks, occipital nerve blocks, trigger point injections and sympathetic blocks[59].

However, diagnostic blocks have various limitations in clinical practice as shown by systemic reviews of literature[57,58,59]. This could be mainly due to differences in the pain perception by different people as stated in the biopsychosocial interpretation of pain and also

due to effects of local anaesthetic on different types of fibres in a single nerve or plexus[59]. Still these diagnostic procedures may be helpful in predicting outcome of the definitive management by observing the analgesia and side effects. They have a good prognostic value[60].

## THERAPEUTIC INTERVENTIONAL PROCEDURE

**Nerve blocks for cancer pain**: Interventional therapy is the fourth step of the analgesic ladder prescribed by WHO [61] although it is used in only minority of patients. The candidates for interventional management of cancer pain include patients in whom pharmacologic treatment has failed or intolerable side effects of systemic drugs appear[10]. Thoracic splancnic, celiac, lumbar sympathetic, hypogastric plexus blocks as well as ganglion impar block may be used for abdominal and pelvic visceral pain in cancer patients as a part of palliative treatment[62]. Celiac plexus block is useful for management of intractable pain in pancreatic, liver and gastric cancer. Authors recommended use of fluoroscopy, ultrasono-graphy or computed tomography for identification of celiac ganglion, which are located retroperitonially at the level of L1 vertebrae[63]. Destruction of the ganglion may be done using 50-100% alcohol or 7-12% phenol [64]. Diagnostic block using local anaesthetic injection usually precede the final destruction block to observe the analgesia as well as side effects[65].

Celiac plexus block may also be administered during laparotomy or endoscopy of the patient for different reason [66]. As concluded by various randomized controlled trials (RCT's), celiac plexus block has been found to be beneficial regarding the reduction in pain and use of opioids. In addition, patients having pelvic tumours may be aided by use of superior hypogastric ganglion, ganglion impar and lumbar sympathetic ganglia. Rectal cancer patients may benefit from intrathecal neurolysis[62].

In thoracic tumours like advanced lung cancer, intrathecal or epidural neurolysis and in case of rib metastasis, intercostal nerve neurolysis may be helpful for pain relief[67]. Neurolysis by alcohol is better than by phenol due to its longer duration of pain relief which is for 3 to 6 months by alcohol and 2 to 3 months by phenol. A word of caution for neurolytic blocks is regarding patient positioning, alcohol being hypobaric and phenol being hyperbaric[10]. The advantage of neurolysis in patients in the advanced malignancies can be justified due to reduced opioid use, improved pain scores and very less possibility of repeated injections[68].

## NERVE BLOCKS FOR NON-MALIGNANT PATIENTS

Neuroablative procedures in patients having chronic non malignant pain is a matter of further research. However, radiofrequency ablation and cryoneurolysis at the facet or sacroiliac joints are recommended by various researchers[69]. Systemic reviews and RCTs however do not favour the use of destructive interventional procedures for long term relief in non malignant patients [70,71]. Some authors have advocated use of radiofrequency ablation using pulsed electrical current for cervical radicular pain[72].

Various craniofacial pain syndromes like trigeminal neuralgia may respond to radifrequency thermoablation of gasserian ganglion. Other modalities include injection of phenol or percutaneous balloon compression of the trigeminal ganglion[73]. Cluster headache, refractory migraine and sphenopalatine neuralgia may respond to methods like sphenopalatine block or pulsed radifrequency ablation of the ganglion[74]. Pulsed radiofrequency is also useful in treating glossopharyngeal neuralgia, occipital neuralgia and branches of trigeminal nerves[73].

Clinicians recommend facet joint or zygapophyseal joint injections or radifrequency thermo ablation of medial branch of posterior nerve, but studies have shown no convincing long term benefits[70,71]. Injections into sacroiliac joints, trigger points or occipital nerve blocks also have shown not to be long lasting[60,75]. Percutaneous

fusion modalities of these joints have been recently introduced[56]. Epidural injections of local anaesthetics and steroids are frequently used for radicular pain of back and neck[76] which provide only short term pain relief as shown by various RCTs. Hence, should be used after careful patient selection[77]. However pulsed radiofrequency may be give satisfactory pain relief[78]. According to studies, intervertebral disc is responsible for about 39% of low backache[35]. Various interventional modalities for this type of pain include transforaminal radiofrequency annuloplasty, denervation of annulus fibrosus using special devices, cooled radifrequency and directional field radifrequency. Percutaneous disc decompression is useful in cases of herniated intervertebral disc[56].

Epidural fibrosis or adhesions may be responsible for lumbar or cervical canal stenosis. Epidurolysis or lysis of adhesions through insertion of a catheter may provide some pain relief [56]. Vertebroplasty or kyphoplasty are vertebral augmentation techniques which are useful in vertebral fractures.

Phantom limb pain is a very challenging situation for a pain therapist. Both preoperative or postoperative nerve blocks have been shown to provide unsatisfactory analgesia for phantom limb pain[79].

Post herpetic neuralgia may respond to epidural or intrathecal steroids, according to some RCTs[80]. Use of sympathetic blocks of cervicothoracic or lumbar sympathetic chain in post herpetic neuralgia and complex regional pain syndrome is commonly advocated but evidence from RCT's is lacking[81]. Some studies have demonstrated short term effects[80]. However, some authors have recommend percutaneous sympatholysis for long term effects, in case non-destructive local anaesthetic blocks are effective. Superior hypogastric neurolysis is also recommended by some authors for pelvic pain syndromes[82].

**INTRATHECAL/ EPIDURAL CONTINUOUS CATHETER TECHNIQUE**

These include use of programmed implantable or external pumps, reservoir systems and exterior tunnelled catheters. External pumps along with tunnelled or non-tunelled catheters is most comm-only used for palliative cancer pain therapy[43].

Advantage of intrathecal catheters is especially when pain is diffuse, since it causes extensive and homogenous spread of drug[43]. It requires low volumes of drugs, better catheter control, less displacement, minimal infections, hence giving a benefit of long term therapy[10]. Morphine or hydroxymorphone alone or combined with drugs like clonidine, bupivacaine and ziconotide are used in intrathecal pumps[83].

Epidural catherters, on the other hand, have advantage when pain is localised to limited number of dermatomes so that pain relief is provided without affecting functions of other dermatomes[43]. However disadvantages include inhomogenous distribution of drug, high volumes absorbing systemically and risks of infection[84].

Some reports are available showing use of continuous catheter techniques in cancer pains,[84] mostly with low backache patients, using morphine, hydromorphone, beclofen or ziconotide intrathecally. However, these studies have shown that complications like catheter obstruction, infections, urinary retention and granuloma formation are high in non malignant pain patients and their efficacy over other techniques is not proved[84,85]

**STIMULATION MODALITIES**

These include spinal cord stimulation (SCS), transcutaneous electrical stimulation (TENS) and acupuncture. SCS, although not authenticated by may RCTs, has been recommended for complex regional pain syndrome, neuropathic pain, radiating spinal pain after surgery and ischaemic pain of extremities[56,86]. However some authors suggest its usefulness in few selected patients with failed back surgery syndrome or complex regional pain syndrome, but no controlled trials are

available[87]. Recent advancements in this modality include high frequency SCS and burst SCS, have an advantage of alleviating pain more effectively without producing any parasthesias[56]. TENS is easy to administer, so is used widely in rheumatoid arthritis, osteoarthritis, although trials have not validated its efficacy [88]. Acupuncture is a popular invasive technique used in chronic pain patients. However, various systemic reviews report it to be a non-effective method in cancer as well as non-cancer pains[89,90,91].

**PERCUTANEOUS CERVICAL CORDOTOMY**

In this technique, radiofrequency is used to create a lesion in lateral spinothalamic tract at C1/C2 level of spinal cord opposite to the side of pain. This interrupts the pain pathways alleviating pain and temperature sensations. This has been found to be effective in pain below C4 dermatome level[43]. According to a sudy, in 83% patients, opioid doses were reduced after percutaneous cervical cordotomy and 38% could completely stop the opioids [92]

**MIDLINE MYELOTOMY**

This method comprises of surgical division of the spinal cord in sagittal plane to interrupt the spinothalamic tracts. Mainly used in intractable pelvic pains as the last resort as it leads to paralysis of lower limb and loss of spinothalamis tract[43].

**PERCUTANEOUS VERTEBROPLASTY/KYPHOPLASTY**

This technique is used in vertebral fractures, due to osteoporosis or malignancies. Bone cement is injected under fluoroscopic guidance into the vertebral bodies. It helps in pain relief by stabilisation of the vertebra as well as heating effect of the bone cement. Kyphoplasty involves inflating a balloon introduced into the vertebral body and creating a cavity. Bone cement is injected into this cavity and vertebral height is restored[43]. Complications like cement leakage have an incidence of 8.6% while cement embolism is life threatening[93].

**CONCLUSION**

Interventional pain management modalities are an interplay between risks and benefits to the patients with chronic pain. Interdisciplinary management and multimodal therapies along with careful patient selection after history, physical examination, psychosocial and cognitive assess-ments are helpful in success. Guidelines based on systemic reviews and meta-analysis are best to provide the right direction to pain physicians.

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