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Review Article

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A Review: Treatment of Acute Pain after Lumbar Discectomy

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Abstract

Discectomy is the most common spinal surgery performed. Opioids are conventionally used in the treatment of post-operative discectomy pain. But postoperative pain is not controlled adequately in many patients, a situation that increases the likelihood of post-operative complications, the length of hospital stay and, consequently, the cost of treatment. Moreover, opioid use may result in complications such as loss of consciousness, nausea, pruritus and respiratory depression. Multi-modal analgesia, the simultaneous use of various pain treatment methods, reduces side effects of the medications by reducing the dose of each. In addition, the impact of each drug improves pain management and reduces the need for opioids. This study aims to investigate different methods for relieving acute pain after discectomy.

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Introduction

Although 60% to 80% of the population has low back pain in their lifetime, only 0.5% of these sufferers need surgical treatment [1]. For those requiring it, discectomy is the most common spinal surgery for lumbar disc herniation [2,3]. Mixter and Barr first described lumbar disc surgery with the transdural approach in 1934 [4], and Love described the extradural procedure similar to today's method in 1939 [5]. It has since been widely used, so much so that the procedure was known as the standard discectomy. But in recent years, other methods, such as micro discectomy, endoscopic discectomy, and total disc replacement, have been attempted with the goal of improved outcomes and reducing side effects. It is interesting however, that the procedure itself has not changed much, and involves surgically removing a degenerated intervertebral disc.

In discectomy patients, postoperative pain is often not controlled optimally [3], and inadequate pain management leads to longer postoperative hospital stays, pulmonary complications, increased risk of thrombophlebitis of the lower limbs and venous thromboembolism. Postoperative pain is also a risk factor for developing chronic postoperative syndrome [6], which changes patients' perspectives on recovery [3].

Postoperative pain is the result of the activation of three different pain mechanisms-nociceptive, inflammatory and neuropathic [7]. Postoperative nociceptive pain results from damage to skin, muscles, intervertebral discs, vertebrae, facet joints [8-10], dura mater, and

sheaths surrounding nerves [10]. Stimulation of nociceptors and mechanoreceptors is strongly correlated with the number of vertebrae treated and the surgical procedure [8,9]. The surgical site is not important in this regard; in fact, the occurrence is identical in cervical thoracic and lumbar regions [10]. Innervation of these constructs is by posterior rami of spinal nerves and is related with sympathetic and para-sympathetic branches. Because of the cross-communicative nature of these nerves, radiating pain is common in these patients [10].

Inflammatory pain derives from injury to the surgical site. With the release of inflammatory substances, cell damage from surgical trauma causes local and systemic changes. Prostaglandins (PG) are among the most significant substances released, leading to pain, edema, and fever [11]. Prostaglandin release causes peripheral receptors sensitization and reduces the pain threshold; this is known as primary hyperalgesia [12]. The most important prostaglandins involved in this process are PG E2 and interleukin-6 [13]. Over time, long-term nerve impulses and the impact of interleukin on the central nervous system activate N-methyl-D-aspartate receptors, and the central nervous system becomes more sensitive to pain. This is known as central sensitization or secondary hyperalgesia [14]. Following these changes, PG synthesis is set at a higher level and, thus, prostaglandin synthesis also increases, which can lead to chronic pain [15].

When the illness or injury involves the central or peripheral nervous system, neuropathic pain can occur [16]. Following lumbar disc herniation, neuropathic pain may come about by mechanical compression of the nerve and the neuroinflammation it created. In this case, ectopic irritability occurs at or near the injury site as a result of the release of cytokines and inflammatory mediators, which are associated with pain. Then, dorsal root ganglion neurons and, possibly, high-level cortical neurons may also be sensitized and create pain signals [17]. Therefore, it is believed that neuropathic pain is a progressive disease in central nervous system (CNS) disorders [18], and neuropathic pains may continue for a long time despite removal of the cause of the symptoms, in this case, a damaged disc. Drugs such as morphine, antidepressants, clonidine, dexamethasone, ketoprofen and magnesium sulfate have been used for this purpose. Notably, antidepressants play a major role in the treatment of neuropathic pain [16].

Severe pain, especially in the first few post-operative days, is associated with spinal surgery. Proper pain control during this period not only improves functional outcomes and promotes more rapid patient mobilization, but it also results in shorter hospital stays and prevention of chronic pain after surgery [10]. Additionally, well managed pain treatment facilitates rehabilitation and reduces morbidity [19]. No specific pain-management strategy has been proven effective, and there is no gold standard in this regard [20]. The results were the same in most long-term studies in comparing the standard method of discectomy, microdiscectomy, and endoscopic discectomy. However, immediate postoperative pain and the duration of hospitalization were lower in the microendoscopic discectomy group [21-23]. In studies by Gotfryd., *et al*. [24] and Nellensteijn., *et al*. [25] comparing standard discectomy, microdiscectomy, and endoscopic discectomy, the hospital stays were shorter and bleeding was reduced in the microdiscectomy and endoscopic groups, but the results were not different. Neither did Arts., *et al.* [26] nor Ruetten*., et al*. [27] observe any differences between the two groups in their studies. Improved short term results from less invasive procedures may be related to diminished tissue damage and, consequently, less nociceptive pain.

To control post-operative lumbar discectomy pain, various treatment methods are used alone or in combination, and each has its own advantages and disadvantages. These methods fall into three categories: preoperative, intraoperative, and postoperative.

Pre-operative measures

As mentioned above, pain mechanisms that follow tissue damage are the onset of inflammatory reactions, and primary and secondary sensitization. Preemptive treatment is effective in the prevention and reduction of tissue-damage-related pain [11]. A variety of drugs and methods have been used for this purpose. Riest., *et al*. [28] found that when COX-2 inhibitors like parecoxib are started preoperatively and continued postoperatively, surgical outcomes improve and the need to prescribe narcotics after surgery is reduced. This therapeutic approach works by preventing the activation of pain-associated neural cascades, thus averting hypersensitivity to painful stimuli [29]. A study by Spreng., *et al*. [30] revealed that prescribing a single 150 mg dose of pregabalin before surgery leads to a clinically

significant decrease in postoperative pain and reduces the need to administer narcotic substances postoperatively, without any increase in complications.

Pregabalin is an antiepileptic drug that acts as a membrane stabilizer and plays an anxiolytic role. Rivikan., *et al*. [31] found that preoperative administration of 1-2g of acetaminophen significantly reduced pain and the need for morphine. According to Massel., *et al*. [11], concurrent administration of 200 mg celecoxib, 75 mg pregabalin, 500 mg acetaminophen, and 10 mg extended-release oxycodone one hour before surgery reduces postoperative pain throughout the recovery. In a study by Reuben., *et al*. [32] administration of celecoxib one hour before surgery and 12 hours to five days after surgery was shown to significantly decrease pain and reduce the need for postoperative narcotic use.

Nonsteroidal anti-inflammatory drugs (NSAIDs) affect inflammatory pathways by blocking the cyclooxygenase enzyme and subsequently impairing synthesis of PG, and this class of drugs can also be used in children. The effect of these drugs in relieving postoperative pain has been proven [33,34], and there is ample evidence that concomitant use of narcotics and NSAIDs produces better analgesia than prescribing both drugs individually [35,36]. Platelet dysfunction and the risk of bleeding, stomach irritation, and kidney problems are some potential side effects of these drugs. Selective COX-2 inhibitors such as celecoxib do not adversely affect the function of platelets and gastric mucosa with their selective impact and, thus, are better-tolerated. In patients who cannot use NSAIDs due to bleeding problems, asthma and/or kidney failure, the addition of paracetamol is appropriate, and its intravenous consumption can be effective, safe and economical for alleviating postoperative pain [10]. This drug alone may be ineffective in postoperative-pain management, but its concomitant use with narcotics will reduce the need for the latter [37].

Intraoperative Measures

Most patients with lumbar disc herniation undergo surgery with general anesthesia [38]. A change in anesthesia method may help patients reduce pain. Patients undergoing such surgery with regional anesthesia or analgesia experience less postoperative pain [39,40]. Khajavi., *et al*. [38] studied the simultaneous use of general and epidural anesthesia, finding that it was effective and resulted in fewer complications in postoperative pain control. In all surgical procedures of the spine, such as scoliosis correction, discectomy, microdiscectomy and endoscopic discectomy, epidural analgesia can be used [41]. However, some surgeons do not recommend it due to increased risk of infection and nerve damage. Moreover, use of this method is costlier.

Intraoperative intravenous administration of some drugs may be associated with beneficial results. In a study conducted by Aminmansour., *et al*. [42], administration of 40 mg dexamethasone during surgery produces a significant reduction in pain and in the need for narcotics. Gottschalk., et al.'s study [6] found that administration of one dose of methadone during multi-level spinal surgery reduced pain and led to decreased demand for narcotics in the 72-hour post-operative period. In a study by Karst., *et al.* [43] the administration of 20-80 mg intravenous dexamethasone during surgery has produced useful results in reducing postoperative pain. Numbing the incision site with local anesthetics at the end of the surgery may have a pre-emptive analgesic effect and prevent nervous system sensitization to ensuing painful stimuli. In an investigation by Kadir., *et al.* [44], wound infiltration with lobovicaine led to a reduction on postoperative pain.

Epidural injection of certain medications may help relieve postoperative pain and reduce the need for narcotic substances. For this purpose, local anesthetics, narcotics and steroids, or a combination thereof, can be used. Various approaches have been used to deliver substances to the epidural space, among which are washing or splashing medication during surgery or making a catheter and delivering drugs intermittently or continuously to the epidural space. Steroids are the most important drugs used for this purpose. It is believed that steroids reduce inflammation and formation of fibrous tissue and, thereby, help reduce pain. This anti-inflammatory effect reduces phospholipase A2 on the dorsal root ganglion, resulting in reduction of substance P, the main transmitter of pain in dorsal root ganglia [45]. The other beneficial mechanism of epidural steroids their inhibition of nerve-pain transmission in C fibers [46]. Washing the wound with dexamethasone during microdiscectomy also reduces pain, the need for narcotics, and length of hospital stay [30,47]. Administration of steroids during discectomy also provides the benefits just mentioned-but with no long-term impact [48]. Intradural injection of

steroids during surgery provides beneficial results as well [49], but dural puncture-related complications should be also considered in this case.

Gurbet., *et al*. [50] showed in their review that a surgeon's numbing of the involved nerves with a topical anesthetic spray at the end of the operation has a greater impact than local anesthesia. They found that injecting lobovicaine into muscles around the operation site alone or with methylprednisolone has been associated with beneficial results. Adding methylprednisolone and bupivacaine at the same time in one-sided discectomies has also been associated with beneficial results [51]. Lidocaine patches have been used in endoscopic discectomy to reduce postoperative pain [52], also with good results. The important complication of this method is respiratory depression that may occur due to delayed release of the medication to higher levels.

Postoperative Measures

Narcotics are widely used to relieve postoperative pain. These drugs are quite effective in doing so, but side effects such as respiratory depression, nausea and vomiting, itching and their potential for dependence limit their use. Intravenous or intramuscular administration will lead to sufficient analgesia. Patient-controlled analgesia (PCA) is preferred for its effectiveness and ease of use compared to intermittent drug administration [10]. In addition, it has been proven that the addition of NSAIDs to opioids leads to better management of postoperative pain [53,54]. Among narcotics, morphine is the first choice in the absence of contraindication [10].

An important consideration in these cases is that patients have likely been treated with analgesics for acute or chronic preoperative pains, and incision pain often intensifies the need for analgesics. When opioid administration begins, antiemetics can be provided simultaneously to reduce the risk of nausea and vomiting. Anti-seizure drugs (e.g., pregabalin) and/or alpha-2 agonists (e.g., clonidine, dexamethasone, and ketamine) either alone or in combination with opioids have been associated with better outcomes [55,56]. The chemical structure of gabapentin is analogous to that of gamma-aminobutyric acid, and it is more effective at a daily dose of 1800 mg than is naproxen for managing resistant post-surgical pain. This effect is more on radicular leg pain than the low back pain [57] that affects with regulating the direction on calcium channels.

Administration of gabapentin or pregabalin is useful in preventing the development of chronic pain after surgery, which is an adverse effect of spinal surgery [58]. It is particularly challenging to address pain is those who have a history of drug dependence. These patients should be given additional short-acting opioids along with the daily dose of gabapentin or pregabalin, or local anesthetics and NSAIDs [59]. These patients may be resistant to opiates. According to studies carried out by Loftus., et al. [60] administering ketamine, an N-methyl-D-aspartate (NMDA) antagonist, during surgery can reduce postoperative pain and improve outcomes in these patients. Additionally, ketamine is also useful in relieving postoperative pain due to its direct analgesic effect and its capacity to prevent sensitization of nociceptive pathways [10]. Because ketamine is an NMDA receptor antagonist, it reduces or reverses narcotics resistance in opioid-dependent patients.

Nonpharmacological Methods

The use of other methods, such as electrical stimulation of the skin around the wound after surgery [61] and acupuncture [62] may have a role in relieving postoperative pain. In minor surgeries like microdiscectomy, the use of stimulating electrodes may be sufficient [41]. Concurrent administration of diclofenac and tramadol reduces pain with no increase in side effects in these patients [63]. Physiotherapy can be started four to six weeks after surgery, providing slight radicular pain relief, but it also improves function and increases tolerance to activity without increasing the risk of complications [64].

Conclusion

There is no gold-standard method for treating postoperative lumbar discectomy pain. However, adequate control of postoperative pain improves surgical results. The use of minimally invasive surgical methods results in reduced tissue damage, and administration of multi-modal analgesia preoperatively, intraoperatively and postoperatively will improve the outcome and reduce side effects.

In summary, the following points should be considered:

- Less invasive methods should be used whenever possible to reduce the amount of pain caused by inflammation and subsequent tissue damage.
- Anti-pain and anti-inflammatory drugs should be started before surgery.
- The administration of drugs with differing mechanisms of actions, before, during and after surgery reduces the required dosage of each drug and brings about improved outcomes.

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