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Interventional pain therapy in cervical post-surgery syndrome

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Abstract

Fifteen percent to forty percent of patients present with persistent disabling neck pain or radicular pain after cervical spine surgery. Persistent pain after cervical surgery is called cervical post-surgery syndrome (CPSS). This

review investigates the literature about interventional pain therapy for these patients. Because different interventions with different anatomical targets exist, it is important to find the possible pain source. There has to be a distinction between radicular symptoms (radicular pain or radiculopathy) or axial pain (neck pain) and between persistent pain and a new onset of pain after surgery. In the case of radicular symptoms, inadequate decompression or nerve root adherence because of perineural scarring are possible pain causes. Multiple structures in the cervical spine are able to cause neck pain. Hereby, the type of surgery and also the number of segments treated is relevant. After fusion surgery, the so-called adjacent level syndrome is a possible pain source. After arthroplasty, the load of the facet joints in the index segment increases and can cause pain. Further, degenerative alterations progress. In general, two fundamentally different therapeutic approaches for interventional pain therapy for the cervical spine exist: Treatment of facet joint pain with radiofrequency denervation or facet nerve blocks, and epidural injections either *via* a transforaminal or *via* an interlaminar approach. The literature about interventions in CPSS is limited to single studies with a small number of patients. However, some evidence exists for these procedures. Interventional pain therapies are eligible as a target-specific therapy option. However, the risk of these procedures (especially transforaminal epidural injections) must be weighed against the benefit.

Key words: Post-surgery syndrome; Neck pain; Cervical epidural injections; Cervical interlaminar injections; Cervical transforaminal injections; Cervical facet joint pain; Cervical radiofrequency neurotomy; Facet joint nerve block; Epidural steroids; Local anesthetics

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Core tip: This review investigates the evidence for interventional pain therapy treatments for patients with

cervical post-surgery syndrome. Persistent pain after cervical surgery is a common problem. Interventional therapies are specific therapy options which are well investigated for patients with neck pain and radicular symptoms. Unfortunately, only single studies for patients with post-surgery syndrome exist. These studies, the different approaches (radiofrequency, facet joint nerve blocks, transforaminal and interlaminar epidural injections), and pain sources for patients after cervical surgery are discussed.

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INTRODUCTION

The indications for cervical spine surgery for degenerative findings are relatively well described as radiculopathy or myelopathy with compression of the nerve roots or spinal cord, or instability^[1,2]. The most common surgical interventions are intersomatic decompressions and fusion with a cage with or without additional anterior instrumentation^[2-7]. However, some patients who undergo spinal surgery continue to suffer pain. Persistent pain after cervical surgery is called cervical post-surgery syndrome (CPSS), and can incur increased costs to the healthcare system^[8]. CPSS occurs irrespective of the type of surgery and despite the best endeavors of the surgeon^[9]. CPSS is a cluster of clinical findings. The result fails to achieve the expected outcome of the surgery by both the patient and the surgeon^[8].

To develop therapeutic strategies for the patient with CPSS and for a specific treatment, it is important to define the source of postsurgical pain^[8,10,11]. Whether conservative management, interventional pain therapy or revision surgery are adequate depends on the cause of the pain. The rate of reoperations after the treatment of degenerative cervical spine disorders is 13.4%^[2]. Indications for revision surgery are pseudarthrosis, adjacent segment degeneration, inadequate decompression, instability, and deformity^[1,3]. If there is no indication for revision surgery or if there is a need to avoid surgery, interventional therapies are an option. Interventional pain therapy is a specific treatment for an expected pain source. Two different therapeutic approaches exist: (1) facet joint pain (the facet joints are the pain source) can be treated with medial branch blocks (MBBs) and radiofrequency (RF) neurotomy^[12-15]; (2) epidural injections are used to treat radicular pain and chronic neck pain of discogenic origin (a disc is the pain source). They are performed either by interlaminar or transforaminal approaches^[16].

While several studies about the prevalence and therapy modalities for the failed back surgery syndrome of the lumbar spine exist^[17,18], the literature about CPSS is

sparse. This review provides an overview of the available literature about interventional pain therapy for CPSS.

Prevalence

Fifteen percent to forty percent of patients after cervical spine surgery present with persistent disabling neck pain. Only two studies have revealed the prevalence of persistent neck pain in CPSS. In a study with 251 patients with persistent neck pain (45 post-surgery vs 206 nonsurgical), the prevalence of cervical facet joint pain was calculated after controlled, comparative blocks with local anesthetics with 80% pain relief as the threshold for a positive response. The positive response rate was 36%^[8]. This retrospective evaluation demonstrated a similar prevalence of facet joint pain in postsurgical and non-surgical patients. Another study of 242 patients with persistent neck pain after cervical spine surgery demonstrated a 13% prevalence of facet joint pain^[10], using a criterion of 80% pain relief after controlled MBBs as the criterion. The extent of surgery and a higher number of levels treated are risk factors for facet joint pain after surgery^[2,10].

The main indications for primary cervical spine surgery are nerve root or spinal cord compression or instability^[1]. Excellent results can be achieved for this indications^[1]. However, if the indication for surgery is expanded to axial neck pain, the number of good to excellent results for fusion decrease to only 70%^[1,3]. Thus, cervical spine surgery for axial neck pain will fail more often. Most patients with CPSS will suffer from neck pain.

Pain sources

In cases of intra-operative complications, the problem, and therefore, the pain source is often known. Possible causes are dislocation of the cage or failure of the implant, inadequate decompression or iatrogenic instability or deformities (incorrect alignment, kyphosis)^[1]. These etiologies are the most frequent reasons for revision surgery^[1]. It is necessary to distinguish between complications and patients with complaints despite optimal surgery. Often, it is challenging to discover the pain sources in patients after unremarkable surgery.

To detect the etiology of the persistent or new pain after surgery, it is important to determine whether the pain differs from the preoperative pain or if the complaints are exactly the same as before surgery. It is also necessary to elucidate whether the patient experienced a pain-free interval after surgery or if the pain was persistent. The difference between radicular symptoms and axial pain, which are distinct entities^[19], is very important.

If there is persistent radicular pain after surgery, an inadequate decompression of the nerve root or nerve root adherence because of perineural scarring are possible causes^[1,3,8]. A recurrent disc herniation after complete removal of the disc and interbody fusion is not typical; however, retention of disc material or ligament and, of course, disc herniation in an adjacent level are

conceivable. In particular, in cases with radiculopathy (sensory loss or motor weakness) further diagnostics including magnetic resonance imaging are necessary. This also applies to the new onset of radicular symptoms or the new onset of a radiculopathy.

A common situation is excellent relief of the radicular symptoms but new or persistent axial pain. Multiple structures are able to cause neck pain, including the intervertebral disc, facet joints, ligaments, fascia, and muscles, which are capable of transmitting pain^[8,16]. The type of surgery and the number of segments treated are relevant. In a review of 900 patients, anterior decompression with fusion and anterior instrumentation in one or two levels showed the lowest revision rate (11%) compared with a 32% revision rate after multi-level corpectomy with posterior instrumentation^[2]. The influence of the fusion length on the revision rate was high^[2]. Similarly, the prevalence of facet joint pain in patients with CPSS was significantly higher after double level fusions compared to single level surgery^[10].

The anterior approach is most common^[1-7]. An alternative to an interbody fusion with or without anterior instrumentation is the implantation of a disc prosthesis. After interbody fusion, the so-called "adjacent level syndrome" (the pain source is located not in the level of surgery, but in the adjacent level above or below) is a possible pain source^[1,8,10]. There is no range of motion in the index level after fusion, which has to be compensated by an increase in motion at the adjacent segments^[20]. Therefore, the incidence of disc degeneration in adjacent levels is increased^[21-23], and changes in the load on the facet joints occur^[21]. Especially during extension the force in the adjacent joints increases significantly, for which reason the joint capsules are stretched whereby pain can be provoked^[24,25]. In contrast, after arthroplasty with implantation of a disc prosthesis, the range of motion in the index segment increases (most prosthesis use a ball-socket joint). The continuing movement in the index segment protects the adjacent segments from overload; however, the forces on the facet joints increase in the index level, especially if the center of rotation of the prosthesis is not in the ideal position^[10,26]. Many of these etiologies are interrelated and arise from biomechanical derangement at the facet joints^[8], potentiated by inflammation^[3].

Furthermore, degenerative alterations of the spine can often not be changed by surgery. Particularly, the degeneration of adjacent levels can remain a painful condition as the underlying degenerative disease progresses^[10]. Another reason for CPSS is poor decision making or an inadequate indication for surgery^[1].

INTERVENTIONAL THERAPY

Generally, two fundamentally different therapeutic approaches in interventional pain therapy for the cervical spine exist: Treatment of facet joint pain (MBBs and RF neurotomy) and epidural injections (transforaminal and interlaminar).

The rationale of cervical medial branch thermal RF neurotomy is to achieve pain relief by coagulating the medial branch, which conducts the pain, and, thereby, interrupting the nociceptive pathways^[10,27]. The only prerequisite is that the pain is mediated by a cervical medial branch. Therefore, the indication for RF neurotomy is analgesic response to comparative (or controlled) diagnostic MBBs^[12,27]. MBBs are a diagnostic procedure to test whether the pain is mediated by one or more of the medial branches^[28]. The nerve is anesthetized with a small volume of local anesthetic under fluoroscopic control. Sometimes, MBBs are used in a therapeutic intention; steroids are added to the local anesthetic to treat inflammatory processes^[10-12,29-31]. Cervical epidural injections are used to treat radicular pain from a herniated disc or a spinal canal stenosis, but also to treat chronic neck pain of discogenic origin^[3,10,32]. Either transforaminal or interlaminar approaches are used.

The recent literature about cervical interventions in patients with CPSS provides some evidence, but is limited to single studies with a small number of patients (Table 1).

Thermal RF neurotomy and MBBs

Different forms of RF for spinal pain exist and can be confused with medial branch thermal RF neurotomy. Some techniques are not anatomically valid and do not produce effective thermal lesions, others use different techniques like pulsed-RF^[15]. A recent review about cervical thermal RF lesions^[15] has taken these differences into account; comprising only the indication and technique as described in the guidelines of the International Spine Intervention Society^[27,28]. Earlier studies validated the technique and became the basis for the guidelines^[33-35]. Thermal medial branch neurotomy is only done if the facet joint pain is diagnosed definitively by comparative MBBs. The face validity, construct validity and predictive validity has been demonstrated^[36-38] for comparative MBBs. Engel *et al*^[15] included six observational studies^[14,33-35,39,40] and two explanatory studies^[41,42]. Evidence shows that 63% of patients are pain-free 6 mo after RF and 38% are pain-free at one year. This effectiveness is dependent on the type of RF procedure and cannot be generalized for different techniques^[15].

Only one study (Table 1) exists evaluating the effectiveness of thermal RF neurotomy in patients with CPSS^[10]; overall, 32 patients were treated. Facet joint pain was diagnosed with single MBBs and 80% pain relief as a positive response. Here, 59% of the treated patients achieved at least 50% pain relief and 25% of the patients complete pain relief with a mean follow-up time of 15 mo. It has to be taken into account that patients might have different pain sources at the same time after surgery. Therefore, 59% satisfying pain relief is important for patients with a diagnosis for which there are few specific therapy options^[10].

Although MBBs are actually a diagnostic tool, facet joint nerve blocks are sometimes used in a therapeutic intention^[10-12,29-31], because some studies show en-

Table 1 Studies of patients with cervical post-surgery syndrome treated with interventional therapies

Ref.	Interventions	Outcome measures	Number of patients	Follow-up period	Positive results
Klessinger ^[10]	Thermal radiofrequency neurotomy	Pain relief \geq 50%	32	15 mo	59% of patients \geq 50% pain relief
Klessinger ^[11]	Facet joint nerve block	Pain relief \geq 80% or satisfied patient	104	6 mo	53% satisfying result
Manchikanti <i>et al</i> ^[3]	Interlaminar, epidural	Pain relief \geq 50% Improvement in functional status	56	1 yr	71% of patients local anesthetic 64% of patients local anesthetic with steroid

couraging results^[29,30]. A recent study^[31] reveals Level II evidence for the long-term effectiveness of facet joint nerve blocks in managing cervical facet joint pain. In a single study (Table 1) of 104 patients with CPSS, 53% of the patients treated with facet joint nerve blocks, using local anesthetic and a steroid, reported a satisfying result after single injection^[11].

Epidural injections

The evidence for cervical epidural injections is a subject of debate and depends on, whether an interlaminar or a transforaminal approach was chosen. For the interlaminar approach, a recent review^[43] including eight randomized controlled studies^[3,44-50] was performed. The evidence for the management of a cervical disc herniation, discogenic pain, or spinal canal stenosis is Level II (evidence from at least one relevant high quality randomized controlled trial or multiple relevant moderate or low quality randomized trials)^[43]. For the transforaminal approach, the review of Engel *et al*^[51] found six primary papers^[52-57] presenting the effectiveness of transforaminal injections. The evidence was found to be of low quality^[51]. The outcome in the different studies shows moderate effectiveness. However, the number of reports of severe complications (spinal cord infarction, cerebral ischemia, quadriplegia, seizures) increases^[51]. Therefore, cervical transforaminal injections are not strongly recommended. When comparing the interlaminar and the transforaminal approach, better evidence and less reports of severe complications make the interlaminar approach superior^[43,51]. The main advantage of the transforaminal approach is the selection of a single nerve root which. Therefore, the result after transforaminal injection can be helpful for the decision, which level is eligible for surgery.

Patients with CPSS are sporadically included in studies about the effectiveness of epidural injections^[35,47,48,58]. Only one trial (Table 1) evaluated the effect of interlaminar epidural injections explicitly in patients after surgery^[3]. The randomized, double-blind study with a one-year follow-up of 56 patients with CPSS demonstrated a minimum pain relief of 50% and improvement in functional status in 71% of patients receiving local anesthetic only and in 64% of patients receiving steroids and local anesthetic. The average duration of pain relief was 12 to 15 wk after two initial injections. The evidence for CPSS is assessed as Level III (evidence from one nonrandomized trial with multiple observational studies)^[43].

CONCLUSION

Persistent pain after cervical spine surgery is a frequent problem. Interventional pain therapies are eligible as a target-specific therapy option. Both, facet joint interventions and epidural injections are used. Some evidence exists for these procedures. However, the risk of these procedures (especially transforaminal epidural injections) must be weighed against the benefit. Patients with CPSS are sporadically included in evaluations about the effectiveness of cervical injections. In addition, regarding thermal RF neurotomy, therapeutic MBBs, and interlaminar epidural injections only single studies exist that specifically follow-up CPPS patients. Further studies focusing on CPPS patients are necessary.

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