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A comparison of non-endoscopic and endoscopic adhesiolysis of epidural fibrosis

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Abstract

Low back and leg pain may be due to many causes, one of which is scarring in the epidural space. Epidural scarring may provoke this pain for many reasons: nerves may be trapped by scars, while veins in the epidural space press down upon the nerves and become enlarged, putting pressure on the nerves. Endoscopic and percutaneous epidural adhesiolysis allows one to eliminate the deleterious effects of scar formation, which can both physically prevent the direct application of drugs to nerve and provide relief in patients who have not responded to epidurals, physical therapy or medication. A search of the MEDLINE and Embase databases was conducted for the period between 1970 and 2014 using the search terms "adhesiolysis", "lysis of adhesions", "epiduroscopy", "epidural neuroplasty", "epidural adhesions", "radiofrequency lysis adhesion" and "epidural scar tissue" in order to identify articles relevant for this review. The purpose of this review is to describe the effectiveness and complications present in a comparison of non-endoscopic, endoscopic and pulsed radiofrequency endoscopic procedures in lysis of adhesions in epidural fibrosis.

Key words: adhesiolysis, pulsed radiofrequency, Racz, Raffaeli

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Low back and leg pain is due to many causes, one of which is scarring in the epidural space. Epidural scarring can cause this pain for many reasons: the nerves may be trapped by scars, while veins in the epidural space press down upon the nerves and become enlarged, putting pressure in the nerves [1]. The formation of scar tissue near the nerve root is a common occurrence after back surgery and is called epidural fibrosis [2]: scar tissue is a major cause of postoperative pain, commonly called failed back surgery syndrome (FBSS) [3, 4]. If a patient suffers from continued back pain and/or leg pain after discectomy or laminectomy surgery, a comprehensive physical examination and appropriate diagnostic imaging techniques can often reveal the cause of pain.

Signs and symptoms indicate the involvement of multiple nerve roots and include low back pain, radicular pain, tenderness, sphincter disturbances, limited trunk mobility, muscular spasm or contracture, as well as motor sensory and reflex changes. The pain is characterized as constant and burning. In some cases, the pain and disability are severe, leading to analgesic dependence and chronic invalidism. Typically, symptoms associated with epidural fibrosis appear at 6 to 12 weeks after back surgery. This is often preceded by an initial period of pain relief, after which the patient slowly develops recurrent leg pain or back pain. Although sometimes the improvement occurs immediately after back surgery, occasionally the nerve damage from the original pathology (the cause of the patient's pain) makes the nerve heal more slowly [5].

Adhesiolysis procedure is used to dissolve some of the scar tissue from around entrapped nerves in the epidural space of spine. Epidural adhesiolysis can be performed percutaneously, using a Racz catheter [6, 7]. The catheter may be manipulated in order to mechanically break up adhesions, while various agents, such as anesthetics, corticosteroids, hyaluronidase and hypertonic saline are injected [8, 9]. Using endoscopy guidance, a flexible catheter is inserted into the

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sacral hiatus in order to more precisely place the injection in the epidural space and onto the nerve root. Epiduroscopy with pulsed radiofrequency is a valid alternative to injections [10, 11]. Both endoscopic and percutaneous epidural adhesiolysis can eliminate deleterious effects of scar formation, which can physically prevent the direct application of drugs to the nerve and may provide relief in patients who have not responded to epidurals, physical therapy or medication.

The purpose of this review is to describe the effectiveness and complications present in a comparison of non-endoscopic, endoscopic and pulsed radiofrequency endoscopic procedures in lysis of adhesions in epidural fibrosis.

PROCEDURES

Epidural adhesiolysis may be performed percutaneously, using a needle to enter the epidural space at the level of the spinal column where adhesions are suspected. Adhesions are then disrupted using a catheter or solutions (e.g., hypertonic saline, enzyme) injected through the catheter [7].

The Racz procedure, percutaneous epidural adhesiolysis, involves the Racz catheter, that is a specialized catheter, x-ray contrast dye, and x-ray fluoroscopy in order to position the end of the catheter at the adhesions and near the affected nerve roots [7]. Once the catheter is in place, a local anesthetic, a corticosteroid, hyaluronidase, and a concentrated saline solution are delivered multiple times, followed by injections of a contrast medium in order to show whether the adhesions have opened, as well as to monitor the flow of the solution within the affected area. After the initial injection, additional treatments are given every 24 hours for 2–3 days [7].

Various techniques have been used for adhesiolysis during epiduroscopy, namely: mechanical [12–14], laser [15, 16], radiofrequency [17, 18] and chemical [19]. Most often steroids and local anesthetics are injected into the epidural space after adhesiolysis [12, 13, 20] while other substances such as clonidine [12], hyaluronidase [14, 19], ciprofloxacin [14] and ozone [14] have also been used.

The radiofrequency procedure (Raffaeli-Righetti) uses a Fogarty balloon in order to remove fat and/or mild fibrosis occluding the spinal canal, reducing by 50% the volume of the saline solution used in periduroscopy [17, 18].

In epidural pulse radiofrequency a different technique may be used, namely the PASHA catheter. At 60 cm long and 1.35 mm in diameter, it has two electrode segments of 3 mm each and situated 4 mm apart at the distal end of the catheter. The distal opening of the catheter is located between the two electrode segments [21].

Epiduroscopy involves the percutaneous insertion of a fiberoptic endoscope to view the epidural space that is inside the spinal canal [22]. Epidural lysis of adhesions involves injection of a normal saline to distend and decompress the epidural space and mechanical manipulations of a fiberoptic endoscope in order to cause the destruction of fibrosis, scar tissue, or adhesions [23].

Both endoscopic and percutaneous epidural adhesiolysis may involve the injection of anesthetics, steroids, hypertonic saline solutions, and/or hyaluronidase into the epidural space. The immediate effect is usually from the local anesthetic that was injected. However, the cortisone usually starts working in about 3 to 7 days whose effect can last for several days up to a few months.

These procedures have afforded patients a reduction in pain and neurologic symptoms without the expense and occasional long recovery period associated with repeat surgery.

EFFECTIVENESS

Epidural lysis of adhesions represents an important part of the interventional repertoire for the treatment of low back pain that has proven refractory to more conventional treatments such as epidural steroid injections. The success rates of epidural steroid injections in managing epidural fibrosis has been reported to be 59% and 58% at 1 and 2 years, considering an average of 4 and 5 procedures during this period [24]. The average period of pain relief after the procedure was about 6 weeks for the first 2 procedures and 13 weeks for any subsequent procedures.

Epidural injections with percutaneous adhesiolysis, showed an average period of pain relief after adhesiolysis of 12 weeks while 83% of the patients had a significant improvement in pain and function after 2 years, with an average number of 6 procedures during the period [25]. Significant improvement was reported in all the patients within 12 months [26]. Manchikanti *et al.* [27] presented significant pain relief in 90% of the patients at 1 month, 80% at 3 months, 56% at 6 months, and 48% at 12 months.

Table 1 shows studies examining the effectiveness of percutaneous non-endoscopic procedures [25–29].

Epiduroscopy may aid in the visualization of the anatomy and pathology of spinal structures; in particular, the cauda equine and epidural space.

Table 2 shows studies examining the effectiveness of endoscopic procedure's effectiveness, non-radiofrequency procedure [14–16, 30].

The employment of radiofrequency for the lysis of epidural adhesions may bring an additional benefit to the procedure [17, 18, 31, 32]. Table 3 shows studies examining the effectiveness of the endoscopic radiofrequency procedure.

COMPLICATIONS

The complications of percutaneous epidural adhesiolysis have been extensively reviewed [32–34]. Spinal endoscopic adhesiolysis is generally a well-tolerated procedure, with minimal and transient complications, including local-

Table 1. The effectiveness of percutaneous non endoscopic procedures

Author	Design	Subjects	Interventions	Results
Manchikanti *et al.* [26)]	Randomized, active-control	120 with post lumbar surgery syndrome	60 patients receiving 1-day adhesiolysis, 60 patients with caudal epidural. 12 months follow up	90% of adhesiolysis group had > 50% relief at 3 months and 73% did at 12 months 35% of caudal group had > 50 relief at 3 months and 12% did at 12 months. 77% of adhesiolysis group had > 40% improvement in ODI at 12 months compared to 13% of caudal group Average of 3.5 adhesiolysis procedures/ /year with an average relief/year of 4½ weeks
Manchikanti *et al.* [27]	Randomized, active-control	50 with spinal stenosis with radicular pain	25 patients receiving 1-day adhesiolysis. 25 patients with caudal epidural. Repeat procedures allowed at 3 months	76% of adhesiolysis group had > 50% pain relief at 12 months; 4% of caudal group did. 80% of adhesiolysis group had > 40% improvement in ODI at 12 months; 0% of caudal group did. Average of 3.5 adhesiolysis procedures/ year. Average pain relief was 12.3 weeks in adhesiolysis group and 3.2 weeks in caudal
Park *et al.* [25]	Observational, prospective	66 Symptomatic lumbar spinal stenosis	1 day adhesiolysis Protocol, 6 momths follow up	51% of patients reported no pain or much improved pain at 6 months Relief did not correlate with dural sac cross sectional area
Gerdesmeyer *et al.* [28]	Randomized double-blind	90 patients with chronic radicular	Three day trial Group I — subcutaneous catheterization and saline injections Group II — catheterization, adhesiolysis with local anesthetic, hyaluronidase, hypertonic saline, and steroid. 3 months follow up	Group II had greater improvements in pain and function Results maintained at 12 months
Choi *et al.* [29]	Retrospective assessment	78 patients with post lumbar surgery syndrome or spinal stenosis	Racz catheter	PA using a Racz catheter was more effective in patients with no previous lumbar surgery (OR 7.426; 95% CI: 1.820–30.302; $P = 0.005$) or root compression with HIVD or foraminal stenosis (OR 5.479; 95% CI: 1.137–26.391; $P = 0.036$). Other included factors were not related to PA effectiveness

ized pain and self-limited irritation of the nerve root [35]. Complications are shown in Table 4 [32–42].

DISCUSSION

Scar tissue formation is part of the normal healing process after spinal surgery. While scar tissue may be a cause of back pain or leg pain, in and of itself the scar tissue is rarely painful since the tissue contains no nerve endings [43]. Epidural fibrosis is scar tissue around the nerve root and there could be and adhesive arachnoiditis most commonly occurs as a complication of spinal surgery and may be included in the diagnosis of "failed back surgery syndrome" [44]. Arachnoiditis is most frequently seen in patients who have undergone multiple surgical procedures [45].

The incidence of complications from percutaneous adhesiolysis is low while the complications are generally minimal and self-limited. Similarly, endoscopic adhesiolysis is a generally safe procedure and one presenting the same complications [46]. Endoscopic adhesiolysis with pulsed radiofrequency (PRF) may be considered as a viable first-line, minimally invasive method, which can be easily repeated and has next to no side effects. Moreover, it is possible to apply a bolus of opioids in addition to the application of PRF [18, 31].

In our practice we treated our patients with adhesions by pulsed radiofrequency after a first line step with peridural steroids injection: no relevant complications were shown.

To avoid most complications, it is recommended to inject saline at less than 1 ml/second. The standard procedure when hypertonic saline is used is to wait about 30 minutes

Table 2. Effectiveness of endoscopic procedure's effectiveness, non-radiofrequency procedure

Author	Design	Subjects	Interventions	Results
Takeshima *et al.* [30]	Randomized	28 with FBSS	Epiduroscopy, follow up 6 months	In patients in whom only the epidural space was separated by adhesiolysis, there was a significant improvement in the Roland-Morris disability questionnaire (RDQ) score until 12 weeks after adhesiolysis, but the score gradually returned to the preoperative value thereafter. Among patients in whom the nerve root responsible for radicular pain was separated, there was a long-term improvement in the RDQ, Oswestry disability index 2.0 (ODI), and Japanese Orthopedic Association Assessment of Treatment (JOA) scores. Among patients in whom both the epidural space and the nerve root responsible for pain were separated, there was a 12 week improvement in the RDQ score and 24 week improvements in the ODI and JOA scores
Di Donato *et al.* [14]	Randomized prospective	350 patients with chronic low back pain attributable to FBSS, spondylolisthesis, stenosis, or hernia	Epiduroscopy with the injection of ozone and ciprofloxacin Follow up 60 months	Short-term follow-up revealed significant pain relief in all patients and a ODI of < 40% in 79% of cases; at 60 months, 65% had significant pain relief with a ODI < 40% in 78% of patients. Epiduroscopy with adhesiolysis and targeted hyaluronidase, ozone is effective in providing pain relief and improvement in disability in the short and long-term treatment of chronic spinal low back pain
Richter *et al.* [16]	Randomized	154	Laser epiduroscopy	There was a significant improvement in disability caused by low-back and/or leg pain as measured by the RMQ. The postoperative level of pain improved from 7.5 to 3.4. By the MacNab scale, success was achieved in 82%. Overall, the patients demonstrated significant clinical recovery and improvement in both quality of life and overall pain levels
Kim *et al.* [15]	Prospective, active-control	109 patients with refractory chronic low back and radicular pain	2 treatment groups: Group1 endoscopy Group 2 laser endoscopy Both groups received a local injection of triamcinolone Follow up 6 months	The mean VAS for Group 1 went from 8.5 to 4.6 at one month and then 6.1 at 6 months. Group 2 went from 7.6 to 4.9 at one month and then 3.6 at 6 months Both groups had significant relief, but the laser procedure provided lasting relief, while epiduroscopy alone had loss of relief over time

Table 3. Effectiveness of endoscopic radiofrequency procedure

Authors	Design	Subjects	Interventions	Results
Raffaeli *et al.* [18]	Randomized	14 with secondary FBSS, follow up 6 months	Epiduroscopy fibrolysis using a radio-freqeuncy device named "RResablator Epiduroscopy"	93% of patients reported a general improvement. Pain is reduced by 90% in 8 patients, by 60–70% in 5, and by less than 30% in 1
Pereira *et al.* [31]	Prospective study	24 with postoperative fibrosis andd persistent of recurrent symptoms	Radiofrequency catheter	A pain relief over 50% was achieved in 71% of the patients at 1 month, 63% at 3 and 6 months, and 38% at 12 months. Disability scores significantly improved for around 6 months. Mean patient satisfaction rates were 80% at 1 month, 75% at 3 months, 70% at 6 months, and 67% 1 year after intervention. Only 1 transient postprocedural complication was detected

after the injection of local anesthetic in order to ensure that no subarachnoid or subdural block is present [47]. One possibility is to avoid using hypertonic saline during the endoscopy in order to remove the risk of the injection of subarachnoid hypertonic saline. Van Boxem *et al.* [48] note that aside from retinal complications, the complications of spinal endoscopy are similar to those associated with percutaneous adhesiolysis. The possibility of reducing saline in the pulsed radiofrequency procedure may reduce the complications.

Table 4. Complications off endoscopic and non-endoscopic adhesiolysis

	Puncture	Catheter/endoscope	Injections/other procedures	Epidural infection
Non-endoscopic (Percutaneous epidural adhesiolysis Racz procedure)	Pain at the site of the procedure/low back pain	Shearing and catheter retention in the epidural space [28]	Spinal cord compression following rapid injections into the epidural space (may increase intraspinal pressure): vision loss, retinal hemorrhages [28]	It is a rare possibility due to the procedure itself and due to the procedure. Meningitis [40] and abscess [41]
Endoscopic procedures (epiduroscopy)	Dural puncture [31], subarachnoid block Pain at the site of the procedure/low back pain Dural puncture headache and cerebrospinal fluid leak	Withdrawing or manipulating the endoscope resulted in resolution of the vascular uptake without any negative consequences	Severe visual impairment Bilateral retinal hemorrhage and blindness in an 80-year old with macular degeneration [15] In case of laser-assisted spinal endoscopy: motor paralysis resulting from thermal damage to nerve roots [16]	Infections [31], no meningitis
And hypertonic saline neurolysis injections	Unintended subarachnoid or subdural puncture with injection of hypertonic saline [35, 36, 28]. Percutaneous adhesiolysis with hypertonic saline injection	Hypertonic saline: cardiac arhytmias, myelopathy, paralysis and loss of sphincter control [28] Arachnoiditis [38]	Sensitivity reaction to hyaluronidase [35]. Neck pain [42] S1 sensory deficit [42]	

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