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Successful outcome after outpatient transforaminal decompression for lumbar foraminal and lateral recess stenosis: The positive predictive value of diagnostic epidural steroid injection

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ABSTRACT

Objective: To analyze the positive predictive value of diagnostic 1% lidocaine containing transforaminal epidural steroid injections (TESI) for successful outcome after outpatient endoscopic decompression for lumbar foraminal and lateral recess stenosis.

Patients and methods: A retrospective study of 1839 consecutive patients with an average mean follow-up of 33 months that underwent endoscopic transforaminal decompression at 2076 lumbar levels was conducted. The sensitivity, specificity, and positive predictive value of lidocaine containing diagnostic TESI at the intended surgical level were calculated based on the recorded frequency of > 50% VAS score reduction, intraoperatively visualized stenosis, and clinical outcomes assessed by Macnab criteria and VAS reduction.

Results: Of the 1839 patients, 1750 had intraoperatively visualized stenosis in the lateral recess at the surgical level and 89 patients did not. Analyzing recordings of diagnostic TESI responses in patients with visualized compressive pathology: true positive (1578); false negative (172); as compared with TESI responses in patients without visualized compressive pathology: false positive (26); and true negative (63) allowed for calculation of sensitivity (90.17%), specificity (70.79%), and the positive predictive value (98.38%) of preoperative lidocaine containing TESI in relation to successful clinical outcome of the subsequent endoscopic decompression surgery.

Conclusions: The expected VAS pain reduction (> 50%) from a lidocaine containing transforaminal epidural steroid injection renders it a valuable diagnostic tool in improving clinical outcome after lumbar endoscopic transforaminal decompression.

1. Introduction

Transforaminal epidural steroid injections (TESI) are commonly employed in the treatment of lumbar radiculopathy. The intent is to reduce sciatica-type symptoms related to spinal stenosis or herniated disc. TESI are increasingly employed by orthopaedic surgeons and neurosurgeons, rehabilitation and pain specialists, and interventional radiologists the world over. Many public health care systems mandate the use of lumbar epidural steroid injections prior to considering surgery for failed nonoperative treatment of spinal stenosis or herniated disc. In the United States, the 2018 United Health Care coverage guidelines deem surgical treatment of spinal stenosis or herniated disc medically unnecessary unless nonoperative treatment with physical therapy (PT), nonsteroidal anti-inflammatories (NSAIDs), and epidural steroid injections have been tried and proven unsuccessful [1].

The strength of the clinical evidence available on the effectiveness of lumbar epidural steroid injection has been graded by the *North American Spine Society* [2,3]. For spinal stenosis-related neurogenic claudication or radiculopathy symptoms, interlaminar epidural steroid injections (IESI) have been deemed appropriate to achieve short-term (2 weeks to 6 months) pain relief [2]. However, the evidence for long-term (21.5–24 months) efficacy was conflicting and graded fair (Grade B recommendation with Level II or III studies) [2]. The support for a multiple injection regimen fluoroscopically-guided TESI to produce medium-term (3–36 months) pain relief was graded as poor (Grade C recommendation with Level IV or V studies) [2]. In comparison, there was good evidence (Grade A recommendation with Level I) for TESI to treat lumbar radiculopathy due to herniated disc in the short-term (2–4 weeks), but insufficient evidence to support its use in the long-term [3].

This short-term benefit of TESI has been exploited as a diagnostic tool in patients whose imaging studies suggest multilevel lumbar neural compression but who complain of mono-radicular sciatica [4]. TESI

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lends itself as a target-specific technique to deliver medication to the foraminal and epidural space of the presumed symptomatic nerve root and its dorsal root ganglion (DRG) [5], where most of the clinically relevant pathology occurs [6,7]. In comparison to interlaminar or caudal epidural steroid injections, TESI requires the least amount of drug with a higher drug concentration to reach the symptomatic pathology [8]. Pain relief is achieved by anaesthetizing the target nerve root. The neural blockade leads to interruption of the nociceptive input and self-sustaining activity of the neurons [9]. The additional anti-inflammatory effect of steroid produces longer-term pain relief, primarily for radiculopathy [10]. Although TESI have been shown to ultimately not obviate surgical decompression [10], a correlation between responders to diagnostic TESI and successful surgical outcomes in patients with chronic lumbar radiculopathy has been reported [11].

Minimally invasive endoscopic transforaminal decompression techniques have become popular in spinal surgery due to technological advances, such as retractors designed for intermuscular plane mini-open incisional exposures [12–14] or tubular access retractors, which in the case of lumbar spinal endoscopy have been further miniaturized into working cannulas just large enough to accommodate an endoscope whose outer diameter may be less than 8 mm [15–19]. Less approach-related access trauma and reduced surgical pain in combination with an overall push by patients, insurance providers, and governmental review boards to transition simple lumbar decompression surgeries into a more cost-effective outpatient setting have facilitated a substantial increase of these types of procedures being carried out in an ambulatory surgery center (ASC) [20,21]. The advantages of endoscopic transforaminal decompression are: fewer postoperative complications, shorter interval for return to work and social reintegration, less postoperative narcotic independence, and an overall reduced utilization of pain killers [15,16]. The latter problem is of significance in lieu of the narcotic abuse epidemic in the United States [22–25].

In this context when contemplating endoscopic transforaminal decompression, a conclusive preoperative diagnostic work up of lumbar radiculopathy is particularly crucial as decompression is often limited to one affected neuroforamen and/or lateral recess presumed to cause the patient's symptoms even if the patient has multilevel lumbar neural compression due to spinal stenosis or herniated disc. In addition, a patient may display symptoms of a monoradiculopathy but may require two-level decompression due to a combined traversing and exiting nerve root compression syndrome. With the intent of validating the preoperative interventional work up with diagnostic transforaminal epidural steroid injection, the aim here was to analyze the positive predictive value of lidocaine containing TESI for successful clinical outcome after an outpatient lumbar transforaminal decompression procedure when done for spinal stenosis or herniated disc-induced sciatica-type leg and low back pain symptoms in an ASC.

2. Materials and methods

In 2006, the Center for Advanced Spine Care of Southern Arizona established an outpatient spinal surgery program for the treatment of lumbar herniated disc and spinal stenosis. The results presented here are based on a retrospective review of patients that were seen by the treating surgeon (KUL) between the years 2006 and 2015.

2.1. Patient population

All patients in this case series provided informed consent. This retrospective study included 1839 consecutive patients seen in our clinic who underwent percutaneous endoscopic foraminotomy and microdiscectomy at 2076 levels between 2006 and 2015. The mean follow-up was 33 months ranging from 24 to 85 months at the time this study was concluded. The inclusion criteria were: (1) clinical signs of unilateral lumbar radiculopathy, dysesthesia, and decreased motor function; (2) imaging evidence of foraminal or lateral recess stenosis (criteria described below) demonstrated on preoperative magnetic resonance images (MRI) and computed tomography (CT) scans; (3) unsuccessful nonoperative treatment including PT and TESI for at least 12 weeks; and (4) an age of 30–85 years. Patients exhibiting pain syndromes involving more than one dermatome or had bilateral symptoms, or showed segmental instability on preoperative extension flexion radiographs, or had severe central stenosis (less than 100 mm [2]) or both were excluded from this study [26]. A small subset of patients had combined Inclusion/exclusion criteria were used with the intent of minimizing the effect of other confounding factors. Patient's average age was 50.7 ± 18.8 years. Of the 1839 patients selected, 237 had another single level surgery at a different level (2076 total surgical levels). Of these patients with a second surgery for new-onset of a different-level unilateral mono-radiculopathy due to symptomatic adjacent segment disease were only included in this study after a minimum interval of two years had lapsed. The total study group was comprised of 1072 female and 767 male patients.

2.2. Preoperative work up and clinical follow-up

Radiographs, MRI, and CT images were obtained preoperatively for all surgical patients. Typically, patients returned for clinical follow-up at 6 weeks postoperatively, and at 3, 6, 12, and 24 months, respectively. After the two-year follow-up appointment, patients were seen on an annual or biannual basis. The long-term follow-up after 2 years was less reliable and available in only 81% of patients at 3 years, and 68% at 4 years, postoperatively. Therefore, results reported herein were computed from data obtained at 2-year follow-up. Primary clinical outcome measures were reductions in the visual analog score (VAS) for leg pain ranging from no pain (0) to worst pain (10) and the Oswestry Disability Index (ODI) both done by the patient and by the treating surgeon (KUL) using the Macnab criteria [27]. Briefly, follow-up results were classified as *Excellent* if the patient had little pain and returned to desired activities with few limitations. Outcomes were classified as *Good* if the patient reported occasional pain or dysesthesia with daily activities with minor limitations and did not need any pain medication. Patients were assigned to one of the two remaining categories if their pain improved somewhat, but they continued to need pain medication (*Fair*), or if their function worsened or they needed additional surgery to address their symptoms (*Poor*).

2.3. Radiologic evaluation of stenosis and classification

Lee's classification of foraminal and lateral recess stenosis was used to define the location of the offending pathology within the neuroforamen by dividing it from medial to lateral into entry (dura to pedicle; zone 1), middle (medial pedicle wall to center pedicle; zone 2), and exit zone (center pedicle to lateral border of the facet joint; zone 3) [28]. Foraminal and lateral recess stenosis were stratified according to the main offending pathology: extruded herniated disc, disc bulge, and disc bulge with concomitant bony stenosis. Disc herniations were further classified as upward, downward, migrated or centered around this disc space using Lee's four-zone classification [29]. In the entry zone, Lee described hypertrophy of the superior articular facet as the predominant pathology [28]. In the mid zone, it was often due to an osteophytic process underneath the pars interarticularis, and in the exit zone due to a subluxed and hypertrophic facet joint [28]. These classification systems have been previously applied by the author [15]. The height of the posterior intervertebral disc and lumbar foramina was evaluated according to Hasegawa [30], who described a lumbar neuroforaminal height of 15 mm or more as normal and reduced posterior intervertebral disc height of 3 to 4 mm as suggestive of spinal stenosis. Preoperative sagittal and axial MRI and CT images were used to assess the location and extent of foraminal stenosis. Only patients with stenotic lesions (whether due to bony stenosis, extruded disc herniation, or contained disc bulge) producing a neuroforaminal width of 3 mm or less