

Fluoroscopically Guided Cervical Inter-Laminar Epidural Injections: Correlation Between Degree of Spinal Stenosis and Contrast Dispersal Pattern

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Abstract

Objectives: Cervical inter-laminar injections at C7-T1 have been routinely performed for many years as an effective means of palliating neck pain. The purpose of this study is to measure the extent of contrast spread following C7-T1 cervical inter-laminar epidural steroid injection (CIESI), and to correlate the upper extent of contrast spread with degree of cervical spinal stenosis.

Methods: We retrospectively identified 41 consecutive patients over a six months' time frame fulfilling the following inclusion criteria: (1) Had image guided CIESI at C7-T1, (2) Had PA and oblique epidurogram pre and post procedure, (3) Had procedural notes indicating the amounts injected and (4) Had an antecedent MRI. The epidurograms were reviewed for their extent of injectate spread. MRI studies were evaluated separately and blinded to the epidurograms. For each level the degree of cervical spine narrowing was noted. We correlated the extent of contrast spread with the level of maximal cervical narrowing.

Results: Maximal contrast spread was up to the skull base and down to T4-T5; minimal extent was C6-C7 to T2. We found statistically significant correlation (2-tailed Pearson correlation $r = 0.867$, $p < 0.001$) between the upper-most extent of contrast spread and the lowest level of significant central canal stenosis according to pre-procedure MRI.

Conclusion: Following CIESI injectate will spread up as far as the cranio-cervical junction or near the lowest level where there is moderate degenerative central stenosis.

Keywords: Cervical epidural spinal injections; Spinal stenosis; Fluoroscopy guided intervention

Introduction

Neck pain is a common disorder in adult population. Up to 30-50% of adults will experience neck pain in any given year [1] and recurrent pain may develop in 50-75% of those within 1-5 years [2].

CIESI (Cervical Inter-laminar Epidural Spinal Injections) are used to treat a variety of neck pain disorders such as, degenerative cervical radicular pain (discogenic or not), spinal stenosis, and non-specific, degenerative chronic neck pain [3,4]. The main rationale for corticosteroids epidural injections is believed to be the local anti-inflammatory effect [5]. In patients presenting with a multilevel pathology, inter-laminar route to the epidural space, allows a multilevel

spread of corticosteroids, thus enabling treatment. Inter-laminar injections are generally safely performed at C7-T1 or, in rare cases at C6-C7. At those levels, the posterior epidural space is the largest [6] (Figure 1). Attempted injection above that carries the danger of intrathecal injection or cord damage. As the rationale behind interventional steroid injections is maximizing efficacy by delivery of the injectate as close as possible to the site of disease, it is imperative to know what presumably will be the upper extent of the injectate be, and therefore, whether it reaches the suspected pain generating level.

Therefore, the purpose of this study is to measure the extent of contrast spread following C7-T1 inter-laminar injection, and to correlate the upper extent of contrast spread with degree of cervical spinal stenosis.

Methods and Materials

Patients

This is a HIPPA (Health Insurance Portability and Accountability Act) compatible study, which was reviewed by the IRB (Institutional Review Board) who waived the requirement for informed consent. The study cohort consisted of 41 consecutive patients who were referred for cervical pain management, had an image guided CIESI at C7-T1



Figure 1: Sagittal T1 weighted image at the midline showing the epidural fat (arrow) is evident posteriorly from C6 level and below.

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with epidurography. All patients had identical injection volumes and an antecedent MRI. The study group was collected over a six months' time frame.

Contrast spread

All CIESI procedures were performed by a neuroradiologist experienced in spine interventions. Fluoroscopic snap shot images were obtained at the time of needle entry into the epidural space and immediately after needle removal, at the conclusion of the study. Patients included in the study patients that had identical injection volumes of 2 cc of steroids (Betamethasone, 6 mg/ml, Schering AG, Germany) mixed with 5 cc of iodinated contrast (Isovue-200 Bracco Diagnostics, NJ). Neuroradiologist with more than 9 years of experience in spine interventions retrospectively recorded the upper and lower extent of contrast spread relative to vertebral bodies and disc spaces. MRI studies were performed on a 1.5T to 3T machines. Imaging consisted of at least sagittal T1 and T2 images as well as axial T2 and gradient echo images. Each cervical spine level was graded for stenosis on a scale from 0 (none) to 5 (severe) by an experienced neuroradiologist that was blinded to the epidurography grading. Effacement of the CSF around the cord with cord contact was defined as moderate (3/5) stenosis. The lowest level of the most significant stenosis was then correlated with highest level of contrast spread. Pearson correlation was used to correlate contrast dispersal with degree of stenosis using SSPS 16. P<0.05 indicated statistical significance.

Results

The study group consisted of 41 patients, 27 females, 14 males, with mean age of 59 years. Epidurography showed injectate extending up

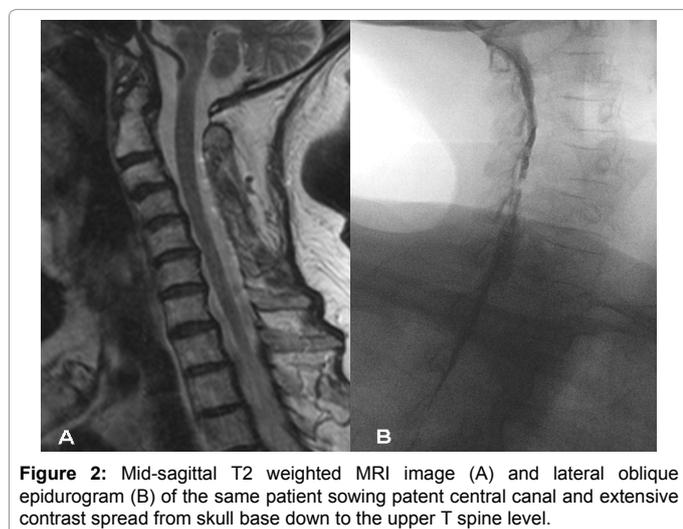


Figure 2: Mid-sagittal T2 weighted MRI image (A) and lateral oblique epidurogram (B) of the same patient showing patent central canal and extensive contrast spread from skull base down to the upper T spine level.

to the skull-base and down to T4-T5 at its maximal extent (Figure 2). The minimal injectate spread was between C6-C7 and T2. On average, the injectate spread over 5.5 vertebral bodies (i.e. between C4-C5 and T3). In cases where the injectate did not reach the upper cervical spine/craniocervical junction, it was blocked at the lowest level of significant central canal narrowing, plus or minus one level (Table 1 and Figure 3). There were 15 cases in which there was no significant central canal narrowing (defined as central canal narrowing rated 2 out of 5 or less on the pre procedure MRI), in 13 out of the 15 cases, the injectate reached the upper cervical spine. Using 2 tailed Pearson correlation we found statistically significant strong positive correlation ($r=0.867$, $p<0.001$) between the upper extent of contrast spread and the lowest level of significant stenosis.

Discussion

CIESI have been routinely performed for many years for palliating neck pain. It is a common procedure, performed as an out-patient service in many pain clinics and services [3,6]. The rationale of interventional pain injections is to maximize the local corticosteroid effect by delivering them to the pain generators; it is therefore optimal to inject the steroids close to the pain generating level. The small size of the cervical epidural space, proximity to the cervical spinal cord and the devastating results of inadvertent cord injury necessitate that the procedure will be performed under fluoroscopic guidance and at C7-T1 or C6-C7 levels [6].

Many studies until now have evaluated the efficacy of CIESI in the management of neck pain. In a recent review, Benyamin et al. showed moderate evidence for CIESI as a treatment for cervical radiculopathy and indeterminate in the management of neck pain [3]. However, this review is based on studies that did not use fluoroscopic guidance. Few studies evaluated CIESI with fluoroscopy guidance. Kwon et al. showed short term efficacy of fluoroscopy guided CIESI in the treatment of neck pain and radiculopathy [7]. In their study the most important outcome predictor for treatment response was the cause of neck pain with herniated disc having the most favorable outcome. Manchikanti and colleagues showed efficacy for fluoroscopically guided cervical epidural inter-laminar injections of local anaesthetic with or without steroids for chronic discogenic neck pain without disc herniation [4].

In this study we show that injectate spread maybe limited by disc bulge causing at least moderate stenosis. As the previous studies did not specify the degree of spinal stenosis and given our results, it is possible that patients the benefited the most from CIESI had localized one level disease. Additional studies with documentation of contrast spread, grading of cervical stenosis and measurements of patient's response to treatment, are needed in order to find the patients that will benefit the most from CIESI.

The extent of medication spread following CIESI was not

Lowest level of significant canal narrowing	Number of patients	Upward contrast extension from injection site (in vertebral segments, average \pm SD)	Deviation from level of significant stenosis* (average \pm SD)
C4-C5	4	3	0 \pm 0
C5-C6	6	2.33 \pm 0.82	0.66 \pm 0.52
C6-C7	16	1.43 \pm 0.51	0.43 \pm 0.51
No significant stenosis **	15	4.4 \pm 1.05	0.6 \pm 1.05

* For the group without cervical canal narrowing the target level was considered to be C2-C3 and above.

** No significant stenosis was defined as mild or no stenosis in all cervical levels.

The table shows the lowest most stenotic level considered to be significant (first column), the upward extension of contrast spread (3rd column) and the deviation of the upper extent of contrast spread from the lowest most stenotic level (4th column). In all significantly stenotic levels, contrast spread was up to the significantly stenotic level \pm one vertebral segment. In the group of patients without significant stenosis, contrast spread was a little more variable, but reached the upper C spine in about 87% of cases.

Table 1: Correlation between degenerative cervical canal narrowing and extent of contrast spread.

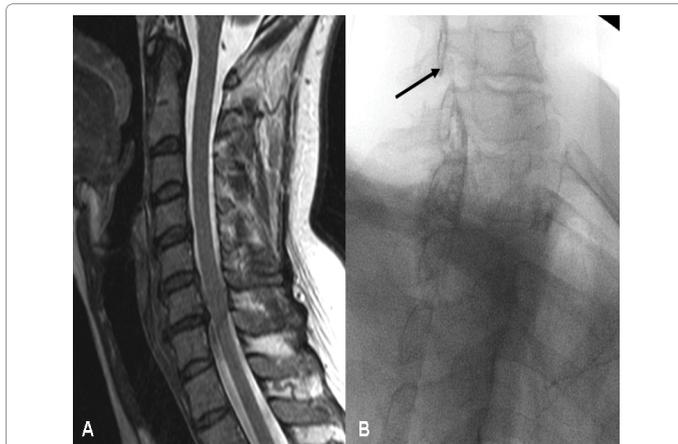


Figure 3: Mid-sagittal T2 weighted MR image (A) showing disc bulge at C6-7 with moderate central canal narrowing. Oblique view epidurogram of the same patient during CIESI (B) shows contrast spread up to the level of moderate narrowing (arrow).

systematically evaluated before. Kim et al. evaluated the pattern of contrast spread following midline approach at C6-C7 [8]. The indications for CIESI were symptoms and signs of cervical radiculopathy with one of the following magnetic resonance imaging findings: herniated nucleus pulposus, spinal stenosis, or degenerative changes. They found that contrast spread correlated with amount of injectate and was maximally 4 segments in the cephalad position and 3 segments caudate. Ventral spread was shown in up to 93% of patients. However, those authors did not review the patients' MRI for correlation. We used the same amount of injectate for all patients; therefore, there is no bias in degree of contrast spread due to this factor. Stojanovic et al. showed average contrast spread of 3.14 vertebral bodies and up to 6 vertebral bodies [9]. They found that the most significant parameter for wider contrast spread was no history of prior surgery. In their study there was no correlation with MRI findings including spinal stenosis. There were operated patients in our study group, but contrast dispersal was the same as with non-operated patients. In our study there was a wider degree of contrast spread compared to both studies. Likely this is due to a larger amount of injectate and different patients' population. In Stojanovic's study the degree of spinal stenosis was not noted, therefore the discrepancy between his results and ours could also result from different definition of spinal stenosis. Almost all patients without significant central canal narrowing had contrast spread up to the upper cervical spine. In this population, patients may benefit from CIESI even when the pain generator level is upper C spine. Two patients without significant central canal narrowing had contrast

spread only up to C5-C6 level. This could be related to inflammatory changes involving the epidural space.

Our study is limited by the heterogeneity of the study group and by the fact that we did not record the clinical response. However, our aim was to evaluate efficacy of getting medication to possible target site. Our results show that medications may not reach levels above the lowest most area of moderate central stenosis. The question of how to target those levels remains open and a subject for future studies. Both prospective and randomized controlled studies are needed in order to determine the clinical efficacy of the CIESI.

Conclusion

Cervical inter-laminar steroid injections performed at C7-T1 are effective in delivering injectate to multiple discs throughout the cervical spine. The injectate will spread as far as the cranio-cervical junction or up to the lowest level where there is cord contact due to disc pathology and moderate central stenosis.

References

1. Hogg-Johnson S, Vander Velde G, Carroll LJ, Holm LW, Cassidy JD, et al. (2008) The burden and determinants of neck pain in the general population: Results of the bone and joint, Decade 2000-2010, Task force on neck pain and its associated disorders. *Spine* 33: S39-S51.
2. Linton SJ, Hellsing AL, Hallden K (1998) A population based study of spinal pain among 35-45 year old individuals. *Spine* 23: 1457-1463.
3. Benyamin RM, Singh V, Parr AT, Conn A, Diwan S, et al. (2009) Systematic review of the effectiveness of cervical epidurals in the management of chronic neck pain. *Pain Physician* 12: 137-57.
4. Manchikanti L, Cash KA, Pampati V, Wargo BW, Malla Y (2010) Cervical epidural injections in chronic discogenic neck pain without disc herniation or radiculitis: Preliminary results of a randomized, double-blind, controlled trial. *Pain Physician* 13: E265-278.
5. Boswell MV, Trescot AM, Datta S, Schultz DM, Hansen HC, et al. (2007) Interventional techniques: Evidence-based practice guidelines in the management of chronic spinal pain. *Pain Physician* 10: 7-111.
6. Johnson BA, Schellhas KP, Pollei SR (1999) Epidurography and therapeutic epidural injections: technical considerations and experience with 5334 cases. *AJNR Am J Neuroradiol* 20: 697-705.
7. Kwon JW, Lee JW, Kim SH, Choi JY, Yeom JS, et al. (2007) Cervical interlaminar epidural steroid injection for neck pain and cervical radiculopathy: effect and prognostic factors. *Skeletal Radiol* 36: 431-436.
8. Kim KS, Shin SS, Kim TS, Jeong CY, Yoon MH, et al. (2009) Fluoroscopically guided cervical interlaminar epidural injections using the midline approach: an analysis of epidurography contrast patterns. *Anesth Analg* 108: 1658-61.
9. Stojanovic MP, Vu TN, Caneris O, Slezak J, Cohen SP, et al. (2002) The role of fluoroscopy in cervical epidural steroids injections: An analysis of contrast dispersal patterns. *Spine* 27: 509-514.