Volume: 28, Issue: 3, July 2017 pp: 163-168 ORIGINAL ARTICLE

turkishspine

CLINICAL OUTCOMES OF CAUDAL EPIDURAL STEROID INJECTIONS UNDER ULTRASOUND GUIDANCE

H. Evren Eker Türk*,
Oya Yalçın Çok*,
Ahmet Yılmaz**,
Metin Özalay***,
Ümit Özgür Güler****

*Ass. Prof, Baskent University, Faculty of Medicine, Department of Anesthesiology & Reanimation, Discipline of Pain Medicine, Adana, Turkey

**Consultant, Adana Numune Eğitim ve Araştırma Hastanesi, Department of Anesthesiology & Reanimation, Discipline of Pain Medicine, Adana, Turkey

***Prof, Baskent University, Faculty of Medicine, Department of Orthopaedic Surgery, Adana, Turkey

**** Consultant, Baskent University, Faculty of Medicine, Department of Orthopaedic Surgery, Adana, Turkey

Address correspondence to:
H. Evren Eker Türk, MD
Baskent University, Faculty of Medicine, Dr. Turgut Noyan Teaching and Medical Research Center, Anesthesiology Department, Dadaloglu Mahallesi, Serinevler 2591 sk., No: 4/A
01250 Yuregir/Adana, Turkey
Tel: +90 322 3272727 ext: 1469
Fax: +90 322 327 1273
E-mail: evreneker@yahoo.com
Received: 11th March, 2017
Accepted: 23th May, 2017
Running Title: Caudal Epidural Steroid Injections Under Ultrasound Guidance

SUMMARY

Background Data: Caudal epidural steroid injections under fluoroscopy guidance have been used to relieve chronic low back pain due to lumbosacral nevre root compression. However the results of caudal epidural steroid injections under ultrasound guidance haven't been proven.

Purpose: To determine the clinical outcomes of caudal steroid injections in patients with spinal stenosis under ultrasound guidance.

Materials-Methods: A total of 298 patients with spinal stenosis scheduled to receive caudal epidural injections under ultrasound guidance. The patient characteristics were recorded. A linear array probe was used initially for each patient. The procedure was performed with a convex array probe if adequate ultrasound images could not be achieved with the linear array probe. The effect of BMI on the availability to visualize the sacral hiatus and to perform the caudal injection with either linear or convex probe was evaluated.

Results: The patients (221 women, 77 men) with mean age of 58.55±14.29 were included. Mean body mass index (BMI) was 30.99±4.29 kg/cm^2. The sacral hiatus was identified by ultrasound images using linear probe in 260 (87.24%) of patients and by convex array probe in 38 (12.76%) of patients. BMI of these patients were 30±3.6 and 37.8±1.21, respectively ($p<0.0001$). The initial NRS_0 scores, NRS scores after (NRS_1) and one month after (NRS_2) caudal epidural injection were 7.66±1.26, 3.65±1.3 and 3±1.29 ($p<0.0001$, $p<0.0001$, $p<0.0001$), respectively.

Conclusion: Ultrasonography is effective for guiding caudal epidural injection and convex array probe would be preferred in overweight patients if adequate images was not achieved with linear array probe.

Key words: Spinal stenosis, Caudal Epidural Steroid Injections, Ultrasound Guidance

INTRODUCTION

Lumbar spinal stenosis, intervertebral disc herniation, degenerative spondylolisthesis and post lumbar surgery syndrome are the most common diagnosis of low back and leg pain (7,11). Epidural injection of corticosteroids with local anesthetics is one of the most commonly used interventions for managing chronic spinal pain. Corticosteroids reduce inflammation and local anesthetics have anti-inflammatory effects as well (6).

Epidural injections are administered utilizing caudal, interlaminar and transforaminal approach. Caudal epidural injections are considered to be the least specific modality and require relatively high volumes to reach the pathologic location. However, it is the safest technique with minimal risks for inadvertent dural puncture (14). In the caudal approach, the epidural space is entered via the sacral hiatus and abnormalities and variations of the sacrum and sacral hiatus are challenges to locate the sacral hiatus in adults (15). Incorrect needle placement has been demonstrated in 20% to 38% of patients who have caudal epidural injections without fluoroscopy (12). Although fluoroscopy guidance has a failure rate of 2%, it is important to use fluoroscopy to confirm the correct needle position

and that medications are properly injected into the epidural space (5).

Ultrasound guidance has been increasingly utilized in pain management for procedures that have been traditionally performed under fluoroscopy such as epidural injections (11,9). Ultrasonograhic guidance may also help to locate the sacral hiatus and sacrococcygeal ligament and identify the anatomic variations of the sacrum and sacral hiatus and may allow caudal epidural injections to be performed easily and safely (8).

In this study we evaluated the achievability to caudal epidural space with ultrasound guidance in patients with low back and leg pain due to lumbar spinal stenosis.

MATERIAL AND METHODS

The patients with low back pain and bilateral leg pain due to spinal stenosis aged between 20 to 87 years were included and managed at Baskent University Department of Pain Medicine in Adana, Turkey during a 4 years period. A total of 298 patients (221 women, 77 men) were enrolled into the study if they had low back pain and radicular pain in the lower extremities of more than 3 month duration with no response to conservative management. The patients were fully informed of the risks and expected benefits of caudal epidural injections and provided informed consent to the procedure. Exclusion criteria were as follows: symptoms requiring emergency surgery, coagulopathy, evidence of infection and inflammation, allergy to iodinated contrast or medications and pregnancy.

The patient characteristics including age, sex, body mass index, intensity and history of pain, pain symptom characteristics and duration, presence of neurologic symptoms, neurogenic claudication, previous pharmacotherapy and physiotherapy and amount of analgesics used were recorded. Patients were asked to use a numeric rating scale (NRS) to measure average pain intensity before (NRS_0), after (NRS_1), and 1 month after the procedure (NRS_2).

Ultrasound Guided Caudal Epidural Injection Technique

The procedure was performed with the patient placed in prone position. An ultrasound machine with a 6 to 13 MHz linear array probe was used initially for each patient. The procedure was performed with a convex array probe if adequate ultrasound images could not be achieved with the linear array probe (Fujifilm Sonosite, Inc. Bothell, WA 98021 USA). The ultrasound probe was covered with sterile plastic. A wide area of back skin was cleaned with povidone-iodine and covered with a sterile drape. The transducer is first placed transversely at the midline to view the sacral hiatus. The two sacral cornua were seen as two hyperechoic structures forming a reverse U shaped structures. Between the cornua, two hyperechoic band-like structures were identified, the sacrococcygeal ligament superiorly and the sacral surface inferiorly (Figure 1). The sacral hiatus was seen as a hypoechoic region between these two band-like structures. The transducer is rotated 90 degrees between the two cornua to obtain the longitudinal view of sacral hiatus. A 22- gauge spinal needle was placed in line with the transducer and advanced into the sacral hiatus longitudinally (Figure 2). The needle shaft, passage of the needle through the ligament and presence of the needle tip entered in the sacral canal was visualized. Once proper needle placement was achieved, a mixture of 16 mg dexamethasone+20 mg bupivacaine in 20 mL was injected and turbulence of the injected material was observed in the sacral canal under ultrasound guidance (Figure 3).

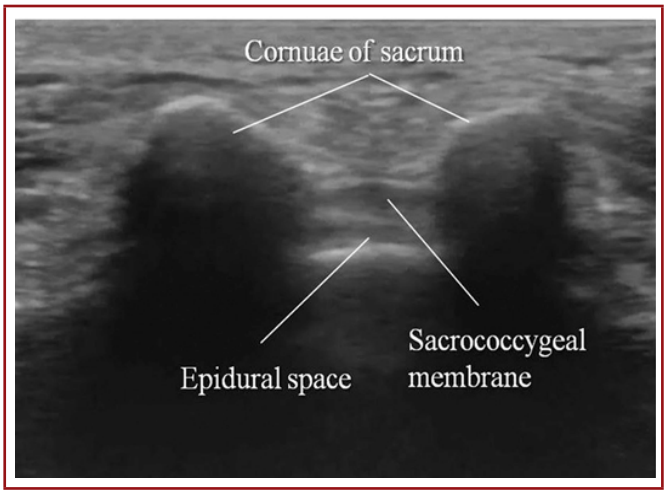

Figure 1. The view of sacral hiatus and U shaped bilateral cornua with USG probe placed transversly at the midline.

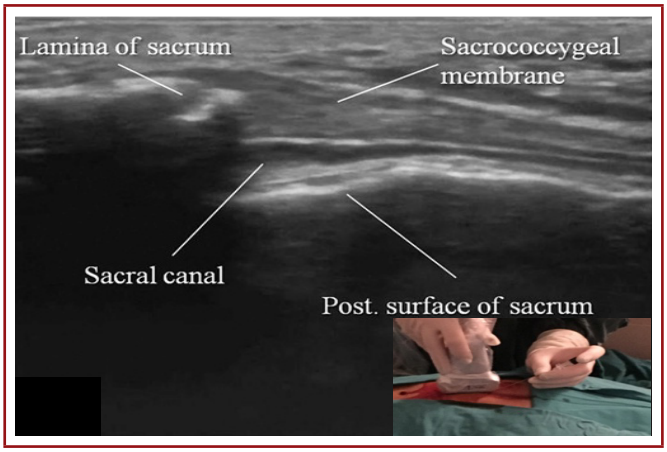

Figure 2. The longitudinal view of sacral hiatus with the transducer rotated 90 degrees between the two cornua.

Patient follow-up

An intravenous catheter was inserted into a vein of the forearm and midazolam 2 mg and fentanyl 50 µgr IV was given for sedation before caudal epidural injection and pulse oximetry

was placed for monitoring. Patients were observed for one hour after the injection in the pain clinic and adverse reactions were assessed. NRS scores were recorded and monitored for one month for both pain scores and unexpected complications.

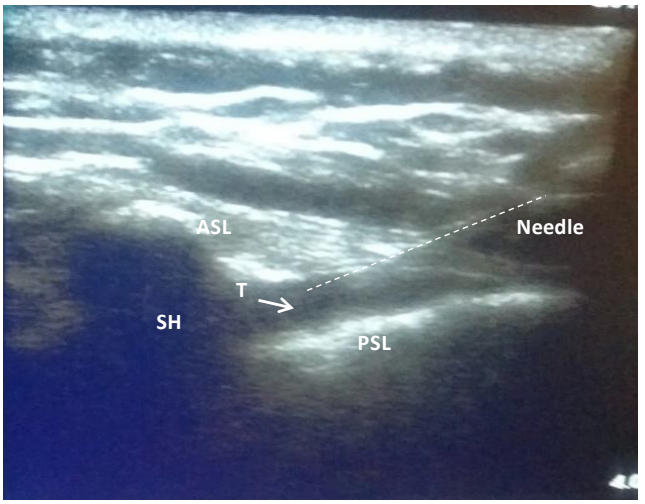

Figure 3. Proper needle placement and turbulence of the injected material in the sacral canal under ultrasound guidance SH: Sacral hiatus, T: Turbulence ASL: Anterior sacrococcygeal ligament, PSL: Posterior sacrococcygeal ligament

Statistical Analysis

Data were presented as means with standard deviation (SD) or numbers and percentages. Categorical data were analyzed with χ^2 test when appropriate. Differences between NRS were analyzed with paired sample t-test for repeated measures. The significance between BMI and the success of the procedure with each ultrasound probe were assessed by ANOVA. Data analyses were conducted using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL, USA). P<0.05 was considered statistically significant.

RESULTS

We included 298 patients (221 women and 77 men) with a mean age of 58.55±14.29 (range, 20-87 years). Mean body mass index was 30.99±4.29 kg/cm^2 (range, 18.5-41 kg/cm^2). According to the BMI categorization 56.4 % (n=168) of patients were overweight or obese (BMI > 25). The patient characteristics are listed in Table 1. The initial NRS_0 scores were 7.66±1.26 and pain durations were 13.21±19.05 months. Pain was constant in 72.1% (n=215) of patients. Neuropathic symptoms and neurogenic claudication were described in 73.8% (n=220) and 20.1%(n=60) of patients, respectively. The trajectory of nerve root pain due to spinal stenosis was determined for 1 level in 65 (21.8 %) patients, for 2 levels in 90 (30.2 %) patients and for more than 2 levels in 143 (48 %) patients.

The sacral hiatus was identified by ultrasound images using linear probe in 260 (87.24%) of patients. In the remaining patients (38, 12.76%), ultrasonographic view with linear probe failed to confirm proper sacral hiatus images due to the inadequate depth of probe view. In these patients convex array probe was used and adequate visualization of sacral hiatus was achieved. In these patients BMI was 37.8±1.21 (36-41) whereas BMI of the patients whose sacral hiatus were visualized successfully with linear array probe was 30±3.6 (18.5-35.9)(p<0.0001).

The NRS scores immediately (NRS_1) and one month after (NRS_2) caudal epidural injection were 3.65±1.3 and 3±1.29, respectively and were significantly lower than NRS_0 scores (p<0.0001, p<0.0001, respectively). Neuropathic symptoms were completely resolved in 64.1% (n=191) of patients. Medical therapy was continued in 26.8% (n=80) of patients. Neuropathic symptoms, analgesic consumption and physiotherapy requirements were significantly decreased 1 month after caudal epidural injection (p<0.0001, p<0.0001, p<0.0001, respectively). Fourteen patients (4.7%) underwent surgical treatment due to unrecovered symptoms of spinal stenosis after caudal epidural injection.

Table-1. Patient characteristics

	n (%)
Neuropathic symptoms	220 (73.8%)
Neurologic deficit	51 (17.1%)
Neurogenic claudication	60 (20.1%)
Physiotherapy	112 (37.6%)
Surgery	52 (17.4%)
Pain	
Continuous	215 (72.1%)
With motion	76 (25.5%)
During rest	7 (2.3%)
Analgesic therapy	
No	77 (25.8%)
NSAIDs, n (%) of patients	107 (35.9%)
Adjuvants, n (%) of patients	38 (12.7%)
NSAIDs + Adjuvants, n (%) of patients	166 (55.7%)

NSAIDs: nonsteroidal anti-inflammatory drug

DISCUSSION

Caudal epidural injections in patients with spinal stenosis with low back and lower extremity pain provide significant pain relief and improvement in functional status (2). Caudal injections although are not superior to either interlaminar or transforaminal, may provide equal effectiveness (4). Fluoroscopic real-time guidance has been used to confirm

proper needle position in the sacral canal for caudal epidural injection and approximately a total volume of 20 mL is injected to sufficiently fill the epidural space up to the lumbar vertebras with a descending degree (6).

Ultrasound could also be an effective guidance during caudal injection without the risk of radiation. It is appropriate for both monitoring the needle insertion and advancement into the caudal epidural space, the turbulence of injected volume and it's proximal spread through the sacral canal. The success rate of caudal epidural injection under ultrasound has been reported 95.8% and 96.6% in two studies (13,1). In these studies body landmarks were assessed with linear-array probes and the high success rates were correlated with detecting the bilateral sacral cornua, apex of the sacral hiatus, anterior and posterior walls of the sacral canal and sacrococcygeal ligament clearly.

In our study, all caudal epidural injections could be performed under ultrasound guidance. However, with linear-array probe the sacral hiatus was identified in 87.24% of patients. In 12.76% of patients, linear probe failed to confirm proper sacral hiatus images due to the inadequate depth of view. In these patients adequate visualization of sacral hiatus was achieved with convex array probe. The main significant difference between these patients was BMI. The BMI of patients whose sacral hiatus were visualized successfully with linear array probe was 30±3.6 (18.5-35.9) and with convex array probe was 37.8±1.21 (36-41).

In previous studies the procedure was performed with high success rates and the BMI were 27.18±4.8 and 27.19±6.7, respectively (13, 1). In another study, clear ultrasound images of the sacral hiatus was obtained in patients with a BMI range of 23-27 kg/cm^2 (3). In our study, mean BMI of patients was higher than these previous studies and, linear-array probe was sufficiently used in patients with a maximum BMI of 35.9 kg/cm^2. However, in patients with a BMI ≥36 kg/cm^2, the anatomical details of the sacral hiatus was invisible due to excessive fat tissue overlying the sacrum. Then we changed the linear probe with convex array to achieve an adequate dept of view and obtain clear ultrasound images of sacral hiatus. Also, in another study, ultrasonography was failed to identify the sacral hiatus with linear probe in one of 30 patients who had a BMI, 46 kg/cm^2 (1).

The anatomic variations of the sacral hiatus are the main predictors of the success of caudal injections. In anatomic studies, the sacral hiatus is usually described using two measurements, the distance between the sacral cornua tips and the diameter of the canal at the apex of the hiatus. The anatomic variations of these landmarks are suggested to change the safety and success rate of the caudal injections based on radiologic or cadaveric measurements (10). Additionally, the optimal angle of needle insertion and the depth of the caudal space are mainstays of anatomical landmarks.

According to our results, except anatomical variations or substantial closed sacral hiatus, BMI of patients indirectly effected the success rate of the procedure under ultrasound guidance due to excessive sacral fat tissue. This would not be the cause of difficulty or unsuccessfulness of the procedure under fluoroscopy guidance. However, to obtain adequate depth of caudal space view with sacral hiatus images under ultrasound guidance, convex array probes should be used instead of linear probes.

CONCLUSION

Ultrasonography is effective for guiding caudal epidural injection and we suggest that convex array probe would be the first option if the patient's BMI is greater than 36 kg/cm^2 or would be changed to if adequate image was not achieved with linear array probe due to the depth of caudal space.

REFERENCES:

1. Blanchais A, Goff BL, Guillot P, Berthelot JM, Glemarec J, Maugars Y. Feasibility and safety of ultrasound-guided caudal epidural glucocorticoid injections. Joint Bone Spine 2010;77:440-444.
2. Chen CP, Tang SF, Hsu TC, et al. Ultrasound guidance in caudal epidural needle placement. Anesthesiology 2004;101:181-184.
3. Chen CP, Wong AM, Hsu CC, et al. Ultrasound as a screening tool for proceeding with caudal epidural injections. Arch Phys Med Rehabil 2010;91(3):358-363.
4. Conn A, Buenaventura R, Datta S, Abdi S, Diwan S. Systematic review of caudal epidural injections in the management of chronic low back pain. Pain Physician 2009;12:109-135.
5. el-Khoury GY, Ehara S, Weinstein JN, et al. Epidural steroid injection: a procedure ideally performed with fluoroscopic control. Radiology 1988;168:554-557.
6. Ghai b, Kumar K, Bansal D, Dhatt SS, Kanukula R, Batra YK. Effectiveness of parasagittal interlaminar epidural local anesthetic with or without steroid in chronic lumbosacral pain: A randomized, double-blind clinical trial. Pain Physician 2015;18-237-248.
7. Katz JN, Harris MB. Clinical practice. Lumbar spinal stenosis. N Engl J Med 2008; 358:818-825.
8. Klocke R, Jenkinson T, Glew D. Sonographically guided caudal epidural steroid injections. J Ultrasound Med 2003;22:1229-1232.
9. Lewis MP, Thomas P, Wilson LF, Mulholland DC. The 'whoosh' test. A clinical test to confirm correct needle placement in caudal epidural injections. Anaesthesia 1992;47(1):57-58.

10. Macchi V, Porzionato A, Morra A, Stecco C, De Caro R. Radiologic anatomy of the sacral canal. Acta Neurochir Suppl. 2011;108:5-8.

11. Manchikanti L, Cash KA, McManus CD, Pampati V, Fellows B. Results of 2-year follow-up of a randomized, double-blind, controlled trial of fluoroscopic caudal epidural injections in central spinal stenosis. Pain Physician 2012;15:371-384.

12. Manchikanti L, Cash KA, Pampati V, et al. Evaluation of fluoroscopically guided caudal epidural injections. Pain Physician 2004;7:81-92.

13. Nikooseresht M, Hashemi M, Mohajerani SA, Shahandeh F, Agah M. Ultrasound as a screening tool for performing caudal epidural injections. Iran J Radiol 2014;11(2):e13262.

14. Parr AT, Manchikanti L, Hameed H, et al. Caudal epidural injections in the management of chronic low back pain: A systematic appraisal of the literature. Pain Physician 2012; 15:E159-E198.

15. Yoon JS, Sim KH, Kim SJ, et al. The feasibility of color doppler ultrasonography for caudal epidural steroid injection. Pain 2005;118:210-214.