Journal of Orthopaedic Surgery 2000, 8(1): 39–44

Epidural steroid injection for sciatica: An analysis of 526 consecutive cases with measurements and the whistle test

Tony TT Loy
Consultant Orthopaedic Surgeon, St. Paul's Hospital, Causeway Bay, Hong Kong.

ABSTRACT

The effects of epidural injections of triamcinolone acetonide and bupivacaine in the treatment of sciatica were analyzed in a retrospective series of 526 consecutive cases with measurements. A new test (the whistle test) is described. There is a paucity of measureable parameters in reports on the subject in the literature, and many are not specific or symptom-oriented to sciatica. The procedure was performed by the same operator and reviewed one week post-operatively with measurements. 491 patients (93.35%) achieved excellent to good pain relief, backed by appropriate increases of straight-leg-raise measurements. But 17 patients (3.46%) of this group required surgery later. It is concluded that epidural steroid injection is a simple, cost-effective and minimally invasive treatment for sciatica, especially in the acute. It also serves as a method for crisis intervention and as a prognosticator.

Key words: *sciatica, epidural steroid, whistle test, rapid relief, cost-effective*

INTRODUCTION

The treatment of sciatica by epidural steroid injection was reported in 1953 by Lievre[35]. It has since been used widely in many countries and all continents with varying success as reported in the United Kingdom [3,18], America [10, 15, 20], India [36], Australia [13, 39, 48], New Zealand [24] and Europe [32]. It has also been included as an often-used orthodox therapy in an orthopaedic text of the gold standard class [9]. The most dreaded complication was epidural abscess [5, 11, 21] and localized infection of various forms [31,37], whereas complications such as meningitis[3,40] and arachnoiditis[27,34,45] occurred rarely [4, 13, 48] and only in subdural injections [28,30,39] or not at all [12, 17, 38]. Other rare forms such as retinal haemorrhage, myopathy and lipomatosis associated with Cushing's syndrome have also been reported. [1, 33, 47]

The present paper is aimed to present a single operator's experience with measurable parameters (straight leg raising test, spinal flexion and extension, percentage of improvement), which is believed to be uncommon [2,7,39] in the literature [10,15,49] A new test, the Whistle Test, is also described.

Sciatica is basically a nerve entrapment syndrome. As such, a local epidural steroid injection will reduce the soft tissue swelling, oedema, pressure,

Address correspondence and reprint requests to: Dr Tony TT Loy, Room 1818, East Point Centre, 555 Hennessy Road, Causeway Bay, Hong Kong.

inflammation and soft adhesions [16,18,48] on the nerve trunk[3, 20 48] as local steroid injections would do in other entrapment syndromes like carpal tunnel syndrome or ulnar tunnel syndrome . It is also subjected to the same limitations as in these sites. Low back pain was regarded as a more complex problem [26] and cases were thus not included in this study.

As compared with the recently developed percutaneous disc injections (e.g. chymopapain chemonucleolysis) and discectomy procedures (e.g. arthroscopic, epiduroscopic, laparoscopic, laser discectomy), epidural steroid injection has the advantages of simplicity, cost-effectiveness, minimal invasion and early relief of symptoms.[25]

MATERIALS AND METHODS

The aim was to deliver an aliquot of a small, adequate and precise dose of the appropriate medication, in the correct quality, quantity and concentration, to the site required or as near as possible.[3, 6, 22] It was judged important that the exact level of nerve compression, as decided after clinical and radiological examination, was injected. The L3/4 route, [9, 15, 41] being rarely the level of impingement (95% of lumbar disc protrusions were at the L4/5 level [9]), and the caudal route [2, 8, 43] both required a large [2,3,7] volume of fluid [23,41,42] injection to reach the affected site and were therefore not used.

The patient was placed in the lateral decubitus foetal position with the hands holding the knees, lying on the side of the sciatica. Under full aseptic technique, the pre- determined disc level was again located by surface anatomy. No flouroscopy was used [8, 19, 43] 2 c.c. of 0.5% bupivacaine hydrochloride (Marcain) was infiltrated to the skin and subcutaneous tissues. An 18 gauge Tuohy type epidural needle (1.3 x 80 mm or 1.2 x 80 mm, either disposable or re-usable) was inserted at the midline of the back of the selected site with the bevel upwards and stylet in position.. After the interspinous ligament was pierced, a 5 cc glass syringe, the inside lubricated with 0.25 to 0.5 c.c. of 0.5% bupivacaine, was attached to the Tuohy needle after stylet removal. The needle was advanced slowly and tests for 'loss of resistance' were carried out at intervals. After the ligamentum flavum was pierced, the epidural space was entered and a positive 'loss of resistance' test was carried out. The major cause of generation of a negative pressure or a loss of resistance was the effect of 'coning' of the dura by the advancing needle point.[14]

An 'air injection test ' was then applied. This involved warning the patient first, and then 2–3 cc of air with a little bupivacaine left in the barrel was rapidly injected into the epidural space with the bupivacaine-lubricated glass syringe. This further confirmed that the epidural space (a potential space[14]) was entered. The patient might then cry out or wince as the sciatica was reproduced, signifying the correct placement of the needle point and that the nerve root was sensitive to the increase of pressure.

The Whistle Test

The Whistle Test started when 2–3 cc of air was injected with the air-injection test. The syringe was then disconnected from the needle. At this time, injected air in the epidural space gushed back through the nozzle of the epidural needle, moistened with bupivacaine, and producing a hissing whistle. The term 'Whistle Test' was coined for this phenomenon, which is believed not to have been described previously in the literature. This was a reproducible and repeatable test, and if positive, was a final confirmation of the correct placement of the needle, which was essential for a successful procedure. This was due to the fact that the epidural space[14] was a potential space normally kept closed by the existing combined tissue pressures of the cerebro-spinal fluid, intradural pressure, respiration and the arterial pulse pressure. This space was forced open by the air injection. As soon as the syringe was removed, the tissue pressure would force the engorged air out through the epidural needle nozzle, which, wetted with a small amount of bupivacaine, produced a characteristic whistle. The tone of the whistle was remarkably constant, though the exact pitch has not been determined as yet. The Whistle Test would be negative if the needle point was subdural, as the cerebro-spinal fluid rather than air would gush out. It would also be negative if the needle point was in the paravertebral tissue, as air will be difficult to be injected (with no loss of resistance) and even if injected inappropriately, would disperse rather than become pent-up and be pressed out. A visible bulge could be observed in the paraspinal area of the back except in the very obese. The Whistle Test was clearly positive in almost all the cases in the present series. A better whistle was produced in the all-metal epidural Tuohy needles as compared with the disposal ones with plastic rear fittings.

After the tests, 3 cc of 0.5% bupivacaine with 3 cc of triamcinolone acetonide (Kenacort A IA) were injected into the epidural space, with the nozzle of the epidural needle either remaining upwards or turned 180° downwards to face the affected nerve. The needle was quickly withdrawn and the injection site dressed. The patient was allowed to lie in a lateral position for a few moments and then transferred back to the ward

in a supine position. The procedure, from transfer of the patient in to out, averaged 15 minutes operating room time. The patient could choose to rest lying for a few hours in the hospital before discharge or go home with an escort as an outpatient [9, 44]. In the immediate post- operative hour, the patient might experience temporary parasthesia of the affected leg, and at times both legs, from the bupivacaine. Review was carried out at one week postoperatively and physical examination with measurements done again. The patient's subjective response was also recorded.

RESULTS

From June 1988 to June 1994, 526 consecutive cases of epidural steroid injection for the treatment of sciatica were included in the present reported series. All the procedures were performed by the same operator (TTL) in St. Paul's Hospital, Hong Kong using a standardized full aseptic technique in the operating room. All were private patients and workers-compensation cases numbered less than 1% . Only one epidural injection [9, 42, 46] rather than many [8, 10, 50] was given to each patient and the procedure was not repeated for the same episode.

All patients had preoperative physical examination, measurements, plain radiological examination performed, and for the indicated, haematological tests as well. Inflammatory, infective and neoplastic conditions were excluded. The pre-dominant nerve root involved giving rise to sciatica symptoms was determined on clinical evidence and plain radiological findings. Gradings were recorded for pre-operative pain, parasthesia, and weakness, and measurements taken for ipsi-lateral and contra-lateral straight leg raising tests, and spinal motion (flexion and extension). One week post-operatively, the patient was reviewed and the same parameters were recorded for comparison and analysis. Pain and parasthesia improvements expressed in percentages, as subjectively judged by patients, were also noted.

The patients ages ranged from 19 to 88 years, with a mean of 46 years. There were 231 female patients and 295 male patients. The duration of preoperative symptoms was from less than one to 200 weeks, the mean being 15 weeks. Patients with symptoms less than 3 weeks of onset were regarded as acute (183/526, i.e. 35%) and the rest (343/526, i.e. 65%) were chronic. Occupations of the patients were sedentary 39 % (204/526), manual labouring 32% (167/526) and housework 29% (155/526).

The pre-dominant nerve root involved was the L5 root 89% (468/526). S1 root was involved in 9% (45/526) and indeterminant 2% (13/526). This was determined on clinical grounds with plain radiological confirmation. CAT scans, MRIs, myelograms, epidurograms, discograms, etc. were taken into account if available but were not primarily sought. Symptom-wise, preoperative pain was classified into mild (Grade 1, 0 cases), moderate (Grade 2, 326 cases = 61.6 %), and severe (Grade 3, 202 cases = 38.4 %). Preoperative parasthesia was recorded as nil (Grade 0, 448 cases = 85.17%), mild (Grade 1, 4 cases = 6.76 %), moderate (Grade 2, 66 cases = 12.55%), severe (Grade 3, 8 cases = 1.52 %). Preoperative treatment included medication in 322 cases, physical therapy in 68 cases and others.

ANALYSIS

1. **Complications.** Complications occurred in 9 cases (1.7%). All were accidental intra-dural punctures and not injections. Most had temporary headaches responding to bedrest, oral fluids and paracetamol.
2. **Spinal motion improvements.** Increase of spinal flexion was recorded from 0° to 70°, with a mean increase of 32°. Extension increase ranged from 0° to 30 ° , with a mean increase of 11° .
3. **Parasthesia improvement.** 59 out of 78 cases (75.64%)with parasthesia had symptomatic improvement.
4. **Post- operative muscle weakness improvement.** A total of 12 cases of muscle weakness (extensor hallicis longus for L5 root or flexor hallicis longus for S1 root) were present. No improvement was recorded. Five out of the 12 cases eventually needed surgery.
5. **Post- operative ipsi-lateral (affected side) and contra-lateral SLR increase**. The results are presented in Tables 1 and 2. The percentage of increase (actual increase in degrees/normal SLR of the particular patient) is more relevant due to individual SLR variations. The mean increase of ipsi-lateral SLR was 29% (24º).
6. **Pain improvement.** The results were divided into 4 groups. 491/ 526 cases (93.35 %) were in the good and excellent categories, but even then, 17/491 cases (3.46 %) in this group required surgery later (Table 3).
7. **Additional treatments prescribed at one week post-operation**. Muscle relaxants were given in 221 cases, nothing more in 132 cases, surgical corsets in 75 cases, physical therapy in 70 cases, NSAIDs in 3 cases. Surgery was required in 33 cases, and these were regarded as failures in the assessment of the efficacy of the procedure.

8. **Sick leave following procedure.** The range was from 0 to 30 days, averaging 4 days.
9. **Return to regular sports.** Of the 41 cases who had taken part in pre-operative, regular sports, return was recorded at a range of 0 to 4 weeks , with a mean of 2.3 weeks.

DISCUSSION

It has been said, 'When you can measure what you are speaking about, and express it in numbers, you know something about it '.[29] This concept was introduced to the author early in his training in orthopaedic surgery by the late Professor A.R. Hodgson. An attempt was thus made to apply this concept to the common problem of sciatica, as a symptom-related study, with a few measurable parameters. Most of the reports in the literature were either 'mixed bags' [9,23,49], of intra[48] and extra durals, sciatica with back pain[19,32,38] and spinal stenosis; measurable parameters were few [30, 42] .

The treatment of epidural steroid injection in sciatica is by no means a permanent cure, though quite a few patients had no more recurrences in their lifetime. Only spinal fusion operations can claim permanency in their effects.

The issue of the short follow-up of one week calls for some clarification. All 526 cases were private practice patients. As the effects of the steroid injection were to be felt a few days after the procedure, one week post-operative follow-up assessment was deemed mandatory. A second follow-up assessment after a further three weeks (four weeks post-operation) was suggested if symptoms remained worrisome to patients; this was on a patient-initiated demand basis, was not enforced and thus not included in this study.

Table 1
Preoperative ipsilateral SLR test status

SLR range in degrees	Number of patients	% of total
SLR 15°–30°	110	20.91%
SLR 35°–60°	288	54.75%
SLR 65°–90°	128	24.33%

SLR Mean = 53°
Positive Lasègue Sign = 447 patients (84.98%)

Table 2
Postoperative improvement in straight leg raising test in all groups

	Ipsilateral SLR increase in degrees	Ipsilateral SLR increase in range in %	Contralateral SLR increase in degrees	Contralateral SLR increase in range in %
Range	0°–60°	0–75%	0°–60°	0–69%
Mean	24°	29.1%	7°	8.5%

Percentage of SLR increase = postop increase in SLR/contralateral postop SL (taken as normal for patient)

Table 3
Postoperative pain improvement

Improvement in groups	% of pain improvement	Number of cases	% of patient population	Number of cases needing surgery
Group 1 — Poor	0–25%	15	2.85%	12/15
Group 2 — Moderate	26–50%	20	3.8%	4/20
Group 3 — Good	51–75%	52	9.89%	5/52
Group 4 — Excellent	76–100%	439	83.46%	12/439
Total		526	100%	33/526

Even then, a very small number of patients (less than 0.5%) did default on the one week post-operative follow-up visits and were therefore excluded in the present series. They were usually picked up subsequently when presenting with a different pathology years later.

A longer follow-up, e.g. six months, may indeed add to the information gained. However, the nature of the procedure catered more towards crisis intervention and rapid relief of acute symptoms. It was also felt that non-compliance would be high if patients were requested to return 6 months later, especially if they were symptom free. Thus a longer follow-up was not practised on a regular basis.

CONCLUSION

1. Epidural steroid injection is a simple, cost-effective and minimally invasive treatment for sciatica, especially in the acute cases [6, 23, 25].
2. The site, route, and volume of medication given should be direct, specific and appropriate. One correct injection would suffice.
3. The complications are negligible and temporary.
4. It is highly useful in patients who desire quick relief or whose circumstances dictate so (crisis intervention)[25].
5. It also serves as a ' water-shed ' procedure and a prognosticator. Patients with poor response will most likely require surgical solutions [42] as these indicate severe mechanical compression beyond local inflammation, swelling, oedema and adhesions.
6. A new test, the Whistle Test , is described.
   It is felt that the spinal surgeons who treat the patients, perform surgery and are conversant with the spinal anatomy and anaesthesiologists well-versed in the procedure, should be the operators to perform the epidural injections.

ACKNOWLEDGEMENTS

The author is indebted to Professor John CY Leong for his valuable advice, Dr Christopher CH Tse for the computer analysis of the data, and Dr Clement TH Loy for reference research.

REFERENCES

1. **Boonen S, Van Distel G, Westhovens R, Dequeker J**. Steroid myopathy induced by epidural triamcinolone injection. *Br J Rheumatol* 1995 Apr; 34 (4):385–6
2. **Berman AT, Garbarino JL Jr, Fisher SM, Bosacco SJ**. The effects of epidural injection of local anesthetics and corticosteroids on patients with lumbosciatic pain. *Clin Orthop*. 1984 Sept 188:144–151.
3. **Bogduk N**. Spine update — Epidural Steroids. *Spine* 1995;7:845–8.
4. **Bradley KC, Corrigan AB, Ingpen ML**. Letter to editor. *Med J Aust*. 1982 Jan 9:11–12.
5. **Bromage PR**. Extradural abscesses. Comment. *Br J Anaesth* 1993 Apr.70 (4): 387–8.
6. **Brown FW.** Management of diskogenic pain using epidural and intrathecal steroids. *Clin Orthop*. 1977 Nov-Dec (129): 72–8.
7. **Bush K, Hillier S.** A controlled study of caudal epidural injections of triamcinolone plus procaine for the management of intractable sciatica. *Spine* 1991;16:572–5.
8. **Bush K, Cowan N, Katz DE, Gishen P.** The natural history of sciatica associated with disc pathology. A prospective study with clinical and independent radiologic follow-up. *Spine* 1992 Oct;17 (10):1205–1212.
9. **Campbell's Operative Orthopaedics** 7th Ed. 1987 Crenshaw AH Vol 4: 3293–4. The C.V. Mosby Co., St. Louis, USA.
10. **Carette S, Leclaire R, Marcoux S, Morin F,. Blaise GA, St.-Pierre A, Truchon R, Parent F, Levesque J, Bergeron V, Montminy P, Blanchette C**. Epidural Corticosteroid Injections for Sciatica Due to Herniated Nucleus Pulposus. *N Eng J Med* 1997;336:1634–40
11. **Chan ST, Leung S**. Spinal epidural abscess following steroid injection for sciatica. Case report. *Spine* 1989 Jan;14 (1):106–8.
12. **Cicala RS, Turner R, Moran E, Henley R, Wong R, Evans J**. Methylprednisolone acetate does not cause inflammatory changes in the epidural space. *Anesthesiology* 1990 Mar; 72 (3): 556–8.
13. **Corrigan AB, Carr G, Tugwell S**. Intraspinal cortico-steroid injections. *Med J Aust* 1982;1:224–5.
14. **Cousins MJ, Bromage PR**. 'Epidural neural blockade'. In *Neural Blockade*, Cousins MJ, Bridenbaugh, PO, ed. Ch. 8. JB Lippincott Co.1988, 253–273.
15. **Cuckler JM, Bernini PA, Weisel SW, Booth JR Jr, Rothman RH, Pickens GT.** The use of epidural steroids in the treatment of lumber radicular pain. *J Bone Joint Surg.*, 67A63–6, 1986.
16. **Davis R, Emmons SE**. Benefits of epidural methylprednisolone in a unilateral lumbar discectomy: A matched controlled study. *J of Spinal Disorders*. 1990 3 (4):299–307.
17. **Delaney TJ, Rowlingson JC, Carron H, Butler A.** Epidural steroid effects on nerves and meninges. *Anesth-Analg* 1980 Aug; 59 (8): 610–4.

18. **Dilke TF, Burry HC, Grahame R.** Extradural corticosteroid injection in management of lumber nerve root compression. *Br Med J* 1973 Jun 16; 2 (867)): 635–7.
19. **el-Khoury GY, Ehara S, Weinstein JN, Montgomery WJ, Kathol MH**. Epidural steroid injection: a procedure ideally performed with fluoroscopic control. *Radiology* 1988 Aug; 168 (2): 554–7.
20. **Feffer HL.** Regional use of steroids in the management of lumbar intervertebral disc disease. *Orth Clin of N Am* 1975 6 (1):249–253.
21. **Goucke CR, Graziotti P.** Extradural abscess following local anaesthetic and steroid injection for chronic low back pain. *Br J Anaesth* 1990 Sep;65 (3):427–9.
22. **Green PWB, Burke AJ, Weiss CA, Langan P.** The role of epidural cortisone injection in the treatment of discogenic low back pain. *Clin Orthop.* 1980 Nov-Dec 153:121–5.
23. **Heyse-Moore GH**. A rational approach to the use of epidural medication in the treatment of sciatic pain. *Acta Orthop Scand.* 1978 Aug; 49 (4): 366–70.
24. **Hickey RF.** Outpatient epidural steroid injections for low back pain and lumbarsacral radiculopathy. *NZ Med J* 1987 Sep 23; 100 (832): 594–6.
25. **Jackson DW, Rettig A, Wiltse LL**. Epidural cortisone injections in the young athletic adult. *Am J Sports Med* 1980 Jul-Aug, 8 (4): 239–43.
26. **Jamison RN, VadeBoncouer T, Ferrante FM**. Low back pain patients unresponsive to an epidural steroid injection: Identifying predictive factors. *Clin J Pain* 1991 Dec;7 (4):311–7.
27. **Johnson A, Ryan MD, Roche J**. Depo-Medrol and myelographic arachnoiditis. *Med J Aust.* 1991 July 1, 155:18–20.
28. **Katz JA, Lukin R, Bridenbaugh PO, Gunzenhauser L. Sudural** Intracranial air: An unusual course of headache after epidural injection. *Anesthesiology.* 1991 Mar; 74 (3): 615–8.
29. **Kelvin WT** (1824–1907) British mathematician and physicist, introduced the Kelvin scale, or absolute scale, of temperature.
30. **Kepes ER, Duncalf D**. Treatment of backache with spinal injections of local anesthetics, spinal and systemic steroids. A review. *Pain* 1985 22:33–47.
31. **Knight JW, Cordingley JJ, Palazzo MG**. Epidural abscess following epidural steroid and local anaesthetic injection. *Anaesthesia* 1997 Jun;52 (6):576–8.
32. **Koes BW, Scholten RJ, Mens JM, Bouter LM.** Efficacy of epidural steroid injections for low-back pain and sciatica: a systematic review of randomized clinical trials. *Pain* 1995 Dec;63 (3):279–288.
33. **Kushner FH, Olson JC**. Retinal hemorrhage as a consequence of epidural steroid injection. *Arch Ophthalmol* 1995 Mar;113 (3):309–313.
34. **Latham JM, Fraser RD, Moore RJ, Blumbergs PC, Bogduk N**. The pathologic effects of intrathecal betamethasone. *Spine* 1997 Jul 15;22 (14):1558–1562.
35. **Lievre JA, Bloch-Michel H, Attali P**. L'injection tran-sacrée: étude clinique et radiologique. *Bull Mem Soc Méd Hôp Paris* 1957; 73:1110–7.
36. **Mam MK**. Results of epidural injection of local anaesthetic and corticosteroid in patients with lumbosciatic pain. *J Indian Med Assoc* 1995 Jan;93 (1):17–8.
37. **Mamourian AC, Dickman CA, Drayer BP, Sonntag VK**. Spinal epidural abscess: three cases following spinal epidural injection demonstrated with magnetic resonance imaging. *Anesthesiology.* 1993 Jan 78 (1):204–7.
38. **Maxwell DC**. Letter to editor. *Med J Aust.* 1991 Mar 18 154:428–9.
39. **National Health and Medical Research Council**. Epidural use of steroids in the management of back pain. Canberra: *Commonwealth of Australia, National Health and Medical Research Council,* 1994.
40. **Nelson DA**. Dangers from methylprednisolone acetate therapy by intraspinal injection. Comments in: *Arch Neurol* 1989 Jul;46 (7): 718–91, 719–2, 721–2, 1989 Nov;46 (11):1167–8.
41. **Oudenhoven RC**. The role of laminectomy, facet rhizotomy, and epidural steroids. *Spine* 1979 4 (2):145–7.
42. **Power RA, Taylor GJ, Fyfe IS**. Lumbar epidural injection of steroid in acute prolapsed intervertebral discs: A prospective study. *Spine* 1992 Apr;17 (4):453–5.
43. **Renfrew DL, Moore TE, Kathol MH, el-Khoury GY, Lemke JH, Walker CW**. Correct placement of epidural steroid injections: Fluoroscopic guidance and contrast administration. *Amer J Neuroradiology* 1991 12 (5);1003–7.
44. **Ridley MG, Kingsley GH, Gibson T, Grahame R.** Outpatient lumbar epidural corticosteroid injection in the management of sciatica. *Br J Rheumatol* 1988 Aug;27 (4):295–9.
45. **Roche J.** Steroid-induced arachnoiditis. *Med J Aust,* 1984 Mar 3, 281–4.
46. **Rosen CD, Kahanovitz N, Bernstein R, Viola K.** A retrospective analysis of the efficacy of epidural steroid injections. *Clin Orthop* 1988 Mar;228:270–2.
47. **Roy-Camille R, Mazel C, Husson JL, Saillant G**. Symptomatic spinal epidural lipomatosis induced by a long-term steroid treatment. Review of the literature and report of two additional cases. *Spine* 1991 Dec. 16 (12): 1365–71.
48. **Ryan MD, Taylor TK**. Management of lumbar nerve root pain by intrathecal and epidural injections of depot methylprednisolone acetate. *Med J Aust.* 1981 Nov 14; 2 (10): 532–4.
49. **Watts RW, Silagy CA**. A meta-analysis on the efficacy of epidural corticosteroids in the treatment of sciatica. *Anaesth Intensive Care* 1995 Oct;23 (5):564–9
50. **White AH, Derby R, Wynne G**. Epidural injections for diagnosis and treatment of low-back pain. *Spine* 1980;5:78–86.