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Outcome of cervical radiculopathy treated with periradicular/epidural corticosteroid injections: a prospective study with independent clinical review

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Abstract This prospective study with independent clinical review was set up to monitor the clinical outcome of patients when using serial periradicular/epidural corticosteroid injection techniques in managing cervical radiculopathy. Over a 10 year period, between 1986 and 1995, a consecutive series of 68 secondary referral patients presenting with cervical radiculopathy were entered into the study. There were 57 men (84%) and 11 women (16%) of average age 47 years (range 31–65 years). The average duration of symptoms prior to presentation was 2 months (range 1–12 months). All patients apart from one had neurological signs. Of the 64 patients (94%) who underwent imaging, relevant pathology thought to correlate with the clinical presentation was demonstrated in all but one patient. Serial periradicular/epidural corticosteroid injections were used to control pain; an average of 2.5 injections was administered per patient (range 1–6). Patients underwent a final clinical examination when their pain had remained satisfactorily under control for an average of 7 months (range 1–23 months). They subsequently were reassessed, by an independent clinician, at an average of 39 months (range 4–112 months) after initial presentation, via a telephone interview. Despite the fact that all 68 patients were potential surgical candidates, they all made a satisfactory recovery without the need for surgical intervention. Forty-eight patients (76%) did not experience any arm pain, and of the 15 patients (24%) who did, this improved from 10 to an average of 2 (range 1–4) on a 10-point pain scale. Thus, patients with cervical radiculopathy make a satisfactory recovery with serial periradicular/epidural corticosteroid injections without the need for surgical intervention.

Key words Cervical radiculopathy · Intervertebral disc herniation · Periradicular/epidural corticosteroid injection

Introduction

In a recent review of the literature, Ellenberg et al. [16] conclude that prospective studies evaluating the various treatment options would be of great benefit in guiding practitioners toward optimum cost-effective evaluation and care of the patient with cervical radiculopathy. They point out that, by using a variety of different treatments, radiculopathy usually improves without the need for surgery. Clearly the natural history of many cases of cervical radiculopathy is to resolve spontaneously. Yet much of the literature is concerned with the efficacy and relative merits of different surgical techniques [1, 3, 4, 7, 8, 12, 15, 18, 20, 26, 33, 34]. Surgery is not always successful [3, 7, 8, 15, 20, 33] and is not without complications [4, 7, 26].

Several controlled studies have demonstrated the efficacy of epidural corticosteroid injections in the management of lumbosacral radiculopathy [6, 9, 14, 29]. The use of such injections in managing a prospective series of 165 consecutive patients presenting with sciatica, resulted in 86% making a good recovery with only 14% requiring surgery [10].

Whilst some papers alluding to the use of cervical epidural corticosteroid injections have been published, these tend to be retrospective reviews [11, 13, 17, 27, 30, 32]. Furthermore, the reported injections were performed for a variety of fairly non-specific conditions [11, 13, 30, 32].

However, in reviewing 100 patients who underwent cervical epidural steroid injections Ferrante et al. [17] concluded that patients with radicular symptoms and signs had better pain relief than those with axial (neck) pain.

Clearly research is needed into this condition. The purpose of this prospective study was to monitor the clinical outcome of patients when using serial periradicular/epidural corticosteroid injection techniques in the management of cervical radiculopathy.

Materials and methods

Materials

Over a 10-year period, between 1986 and 1995, a consecutive series of 68 secondary referral patients presenting with cervical radiculopathy were entered into the study. There were 57 men (84%) and 11 women (16%) of average age 47 years (range 31–65 years). Most of these patients (55; 81%) had sedentary occupations.

Admission criteria

Patients were entered into the study if they presented with the following symptoms and signs, which are consistent with both nerve root irritation and compression:

1. Radicular pain affecting one arm as far as the forearm and with associated paraesthesia of either the thumb and/or certain fingers

2. Exacerbation of such pain by certain passive cervical movements (usually extension) and/or the adverse neural tension test

3. Positive neurological signs: either reduced sensation and/or reduced power and/or reduced or absent reflexes

Patients with signs of cervical myelopathy or alternative significant pathology were excluded from the study.

Pre-interventional clinical status

The average duration of symptoms prior to presentation was 2 months (range 1–12 months). Thus the patients' symptoms were reasonably well established and had not resolved spontaneously. Fifty-four patients (80%) were suffering from sleep disturbance due to the severity of their pain, but only 13 (21%) of those employed were not capable of working, at least in some capacity.

All patients had objective neurological signs, apart from one who had severe radicular pain with gross restriction of both active and passive cervical movements and a large posterolateral intervertebral disc herniation demonstrated on MR scan at the C6/7 level. Of these, 56 patients (82%) had reduced sensation, 51 patients (75%) had reduced power (usually of the triceps or elbow flexors) and 31 patients (46%) had reduced or absent reflexes (usually the triceps or biceps jerks). Thus, all but one patient had signs of nerve root compression and were therefore potential candidates for some form of surgical decompression. Indeed, several patients had been offered surgery by orthopaedic or neurosurgical colleagues.

Pre-interventional investigations

All patients underwent imaging, apart from four who did not wish to be imaged at an early stage of their treatment. They all responded well to the first simple injection and therefore imaging would not have influenced their further management. Of these, 12 patients (19%) had X-rays taken (including oblique views), 10 claustrophobic patients (16%) had CT scans, but the majority, 46 patients (72%), underwent MR scans.

Relevant pathology that was thought to correlate with the clinical presentation was demonstrated in all but one patient, whose neurological status could not be accounted for by the imaging (Fig. 1). Nerve root compromise was demonstrated at the C5/6 level in 27 patients (42%) and at the C6/7 level in 35 (55%). This was towards the left in 39 patients (61%) and towards the right in 25 (39%). The encroachment was thought to be predominantly bony in 19 patients (30%) and caused by an intervertebral disc protrusion or herniation in 45 (70%). Thus, of the 64 patients who underwent imaging, pathology apparently suitable for surgical intervention was demonstrated in all but 1 patient.

Interventions

Patients were treated with the use of three different injection techniques, the primary aim being to place corticosteroids in the vicinity of the compromised nerve root and thus control pain. Initially a simple technique, as for cervical plexus block, so beautifully described by Moore [23], or brachial plexus block, explicitly illustrated by Zenz et al. [35], was used. In essence, using a lateral approach, a 21-G 2-in. (5.1-cm) needle was introduced at the appropriate level until bony contact was made (the C7 transverse process is usually easy to palpate). After careful attempted aspiration to exclude blood or cerebrospinal fluid, 1 ml of 1% lignocaine hydrochloride with 1 ml of 40 mg triamcinolone acetonide was introduced. Patients were reviewed at monthly intervals, or earlier if their pain was not brought under reasonable control.

If this technique produced a significant degree of relief it was repeated, but if not, a 22-G 3½-in. (8.9 cm) spinal needle was introduced into the appropriate intervertebral foramen under X-ray image intensifier control. This technique is well described by Bard and Laredo [2], with the use of screening in the lateral, oblique and anteroposterior planes (Fig. 2). They experienced rather disappointing results, but it is noteworthy that they did not introduce contrast to confirm that the drug was tracking to the point of nerve root compromise. The drug may track distally if the needle is not far enough up the root canal. Alternatively, there are numerous blood vessels and venous sinuses that, if penetrated, serve to wash the drug away. Figure 3 illustrates this point, with contrast being washed away at C6, but appropriately placed at C7. Thus contrast was used in all cases to ensure that the drugs reached their intended destination, i.e. the point of nerve root compromise.

If this technique failed to control the patient's pain adequately, a formal cervical epidural injection was performed under X-ray control, again using epidurography to confirm placement and for safety reasons (Fig. 4). Five millilitres of triamcinolone acetonide (50 mg) with 2.5 ml of 1% lignocaine hydrochloride was then introduced.
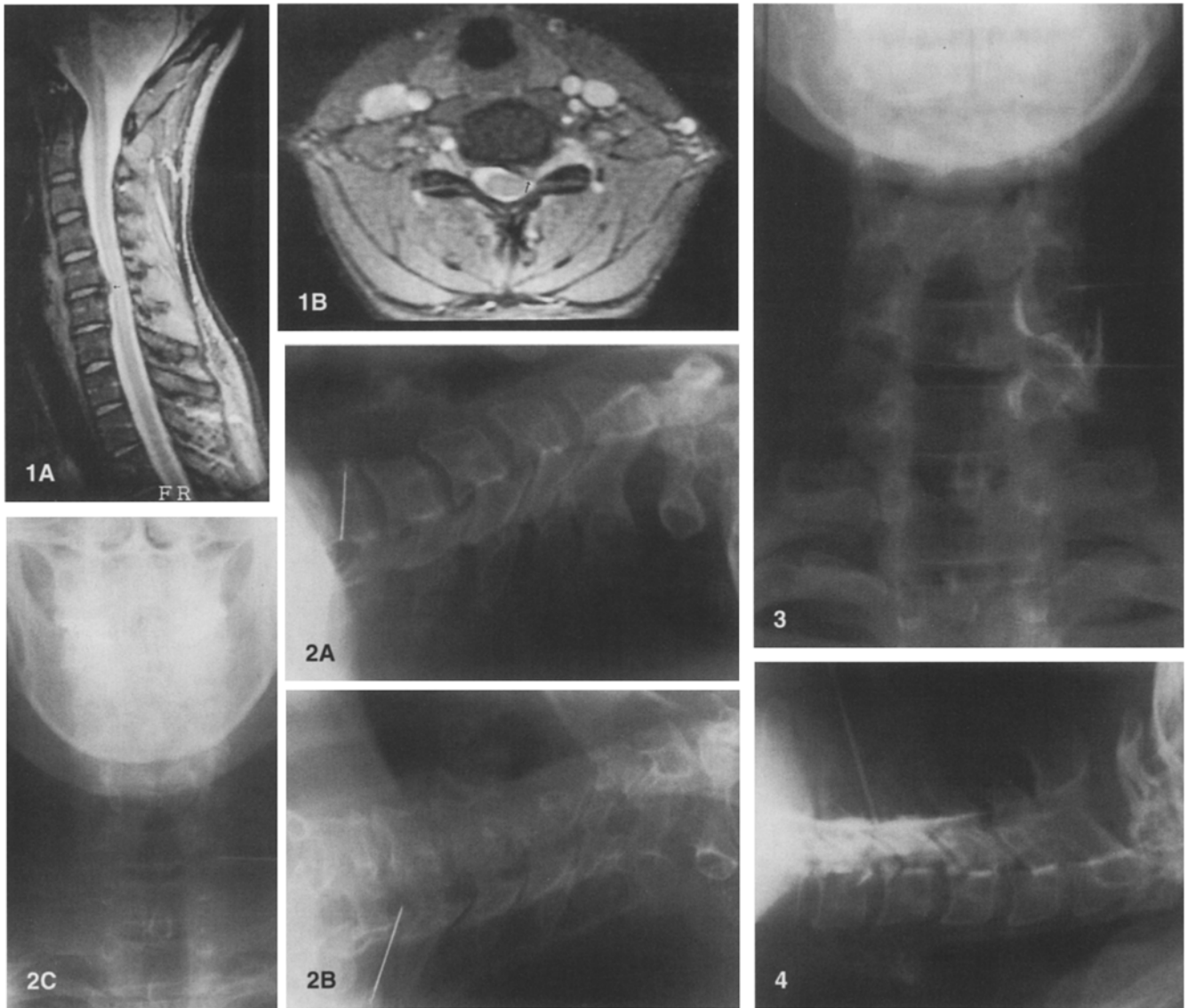
Fig. 1A, B MR image of a 35-year-old female patient presenting with severe left neck and arm pain with numbness of the thumb and 3/5 weakness of the biceps. A Sagittal image demonstrating a C5/6 intervertebral disc herniation. B Axial image demonstrating a posterolateral C5/6 intervertebral disc herniation towards the left

Fig. 2A–C C7 dorsal root ganglion block illustrating appropriate needle position. A Lateral view; B oblique view; C postero-anterior view

Fig. 3 C6 and C7 dorsal root ganglion blocks with 0.5 ml Iohexal 300 having been introduced at both levels. The C7 root canal is well outlined with spread of contrast into the epidural space. However, the contrast at C6 has been washed away because the needle is intravenous and its position therefore needs to be adjusted to achieve placement of drugs at the intervertebral disc/nerve root interface

Fig. 4 C5/6 cervical epidurogram illustrating the quite extensive spread of just 3 ml Iohexol 300

Thus a graduated regime of interventions was instituted, the object being to place corticosteroids on the sensitive nerve root and dura. Clearly the simple 'blind' technique did not always achieve this end. However, precise periradicular placement of corticosteroid could be achieved with the aid of X-ray image intensification and contrast. In patients where there was a more central component to the posterolateral disc herniation, the central interlaminar epidural approach proved to be necessary.

A positive response to the injections was expected within 1 or 2 weeks. If this was significant and the pain was still not adequately controlled or if pain control was not maintained, the technique was repeated at intervals ranging from a few weeks to a few months. If satisfactory pain control was not achieved, a more sophisticated technique was employed (i.e. periradicular or epidural injection under X-ray control with the use of contrast). Had these injections ultimately proved not to be efficacious, the patients would have been referred for surgery. Finally, there were no significant complications following the injections.

Table 1 Telephone questionnaire

1. Do you have any arm pain?
2. If yes: (worst pain before injection) 10 9 8 7 6 5 4 3 2 1
   0 (no pain)
3. Do you have any numbness or pins and needles in the arm or hands?
4. Do you have any weakness of that arm?
5. Do you believe that the injections helped to relieve your pain?
6. Have you had any arm pain of note since the injections?
7. Does your arm or neck interfere with your capacity to work?
8. Does your arm or neck interfere with your active recreations or sporting activities?

Assessment

Patients were regularly reviewed at monthly intervals and treated until their pain was satisfactorily controlled. They were then given a final examination and discharged from care. The examination included self-assessment of their pain on a visual analogue scale and a neurological examination. They were told to return if they experienced a recurrence of pain and informed that in due course they would be contacted by an independent colleague and interviewed over the telephone. The questions addressed are set out in Table 1.

Results

The radiological and neurological status of the patients is outlined in Table 2. All patients made a satisfactory recovery without the need for surgical intervention. On average they required 2.5 injections (range 1–6). Twenty patients (29%) responded to simple injection techniques alone, whilst 42 (62%) required periradicular injections under X-ray control, because they failed to respond to the simple injection technique, and 11 patients (16%) required formal epidural injections under X-ray control, because they failed to respond to the periradicular injections under X-ray control. Had patients failed to respond adequately to these interventions they would have been referred for surgery, but this was not necessary.

The average time to discharge was 7 months (range 1–23 months). At this time the average pain on the visual analogue scale was 0.6 (range 0–5), assuming 10 to represent the pain at its worst. All patients were coping with their work and sporting commitments. There was no sign of neurological recovery in four patients (6%). However, there was partial recovery in 32 patients (47%) and full recovery in 31 patients (46%).

A number of patients were lost to final review due to international travel or death from other causes. However, 63 patients (93%) were interviewed at an average of 39 months (range 4–112 months) after initial presentation. Forty-eight (76%) of these patients did not experience any arm pain. Of the 15 patients (24%) who did, the average pain score was 2 (range 1–4), assuming 10 to represent the pain on presentation. Fifty-four patients (86%) did not experience any paraesthesia. Forty-six patients (73%) did

not experience any weakness. All but four patients felt that the injections had been of benefit. Fifty-one patients (81%) had not experienced any further episodes of arm pain. Fifty-three patients (84%) did not feel that their neck or arm symptoms interfered with their capacity to work. Forty-one patients (65%) did not feel that their neck or arm symptoms interfered with their sporting capacity.

Discussion

All of the patients in this series presented with mono-radiculopathies and they were all potential candidates for some form of surgical intervention. Yet all made a satisfactory recovery without the need for surgical intervention. Seventy-six percent were completely asymptomatic, which compares favourably with the results of surgical series [1, 3, 4, 7, 8, 12, 15, 18, 20, 26, 33, 34].

In reviewing the literature, Ellenberg et al. [16] suggest that cervical radiculopathy usually improves without the need for surgery. Thus, there is a tendency for the condition to resolve spontaneously. The indications for surgery are unremitting pain despite a full trial of non-surgical management, progressive weakness, or new or progressive myelopathy. In our series, pain was satisfactorily controlled with appropriate injection techniques. No patient experienced progressive weakness, but several patients with signs of cervical myelopathy on presentation were excluded from the study and referred for surgical decompression.

Radhakrishnan et al. [28] report a 26% incidence of surgery in reviewing the records of 561 patients presenting with cervical radiculopathy. The fact that none of our patients required surgery would seem to indicate that the injections were efficacious over and above the natural history of the disease. In applying the same philosophy to the management of 165 patients with sciatica [10], we were only able to achieve an 86% success rate, with 14% of patients ultimately requiring surgery. The prognosis of cervical radiculopathy with the use of injection techniques therefore seems to be better than that of lumbosacral radiculopathy.

There is much research to support the rationale for the use of corticosteroid injections in the management of sciatica [19, 24, 25, 31]. In particular, Olmarker et al. [24] demonstrated that the introduction of nucleus pulposus into the epidural space does produce changes within nerve roots. Furthermore, they demonstrated that this reaction is blocked by the application of corticosteroid [25]. Additionally, Johansson et al. [19] demonstrated that corticosteroid application blocks transmission in the normal nociceptive C fibres. Presumably these principles apply to the cervical as well as the lumbosacral spine.

Several studies have demonstrated the regression of lumbosacral intervertebral disc herniations [5, 10, 22, 31]. Maigne and Deligne [21] claim to be the first to demon-

Table 2 Patients' radiological and neurological status (*X* X-ray, *MR* MR scan, *CT* CT scan, *BE* bony encroachment, *D* posterolateral disc protrusion or herniation, *EF* elbow flexion, *WD* wrist dorsiflexion, *EE* elbow extension, *WP* wrist palmarflexion, *BJ* biceps jerk, *TJ* triceps jerk)

Radiology			Neurology on presentation			Time to discharge (months)	Neurology on discharge		
Type	Level	Findings	Reduced sensation	Power[a]	Reduced/ absent reflex[b]		Reduced sensation	Power	Reduced/ absent reflex[b]
X	5/6	BE	yes	EF 4 / WD 4		23		5 / 5	
MR	5/6	D	yes	EE 3	TJ	2		5	TJ
MR	6/7	D	yes	EE 3 / WP 3		10		4 / 4	
MR	6/7	D	yes	EE 3	TJ	6		4	
MR	6/7	D	yes	EE 3 / WP 3		2	yes	3 / 3	
MR	6/7	D	yes	EE 3	TJ	12		5	TJ
CT	6/7	BE		EE 3	TJ	3		4	TJ
MR	6/7	D	yes	EE 2	TJ	6		3	TJ
X	5/6	BE	yes		BJ	15			BJ
X	6/7	BE	yes	EE 4		13		5	
MR	6/7	BE	yes	EE 4	TJ	2		5	TJ
MR	5/6	D	yes			5			
MR	6/7	D	yes	EE 2		1		3	
MR	6/7	BE	yes	EE 3	TJ	13		4	TJ
X / MR	5/6	BE	yes		BJ	1	yes		BJ
MR	6/7	D	yes	EE 3	TJ	6		5	TJ
MR	6/7	D	yes			1	yes		
MR	6/7	D	yes	EE 4		5		5	
MR	5/6	BE	yes	EF 4 / WD 4	BJ	11		5 / 5	BJ
MR	5/6	D	yes	WD 3	BJ	1		5	
MR	5/6	D	yes	EF 3 / WD 3	BJ	5		5 / 5	
MR	6/7	BE	yes	EE 3	TJ	12		4	TJ
MR	5/6	D		WD 3		3		4	
MR	6/7	D	yes	EE 2	TJ	9		4	TJ
X	6/7	BE	yes	EE 3 / EF 3 / WD 3	TJ	10 / 4 / 3		5 / 4 / 4	TJ
CT	6/7	BE		EE 4		10		5	
X / MR	5/6	D	yes	WD 3	BJ	12		5	
CT	6/7	BE	yes	EE 3		1		5	
X / MR	6/7	D		EE 3		2		4	
			yes			6			
CT	6/7	D	yes	EE 3	TJ	14		4	TJ
X	5/6	BE	yes	EE 4		20	yes	4	
CT	5/6	D	yes		BJ	2			BJ
X / MR	6/7	D		EE 3		3		5	
CT	6/7	D	yes	EE 4		1		5	
MR	5/6	BE	yes	EF 3 / WD 3	BJ	12	yes	3 / 3	BJ
MR	6/7	D / BE		EE 3		2		5	
MR	5/6	D	yes		BJ	1			
CT	6/7	D		EE 3	TJ	12		4	

Table 2 (continued)

Radiology			Neurology on presentation			Time to discharge (months)	Neurology on discharge		
Type	Level	Findings	Reduced sensation	Power[a]	Reduced/ absent reflex[b]		Reduced sensation	Power	Reduced/ absent reflex[b]
CT	5/6	BE	yes	EF 3	BJ	14		5	
MR	5/6	D	yes	WD 3	BJ	15		5	
			yes	EE 2	TJ	10		5	
X } MR }	6/7	BE	yes	EE 2	TH	7		5	
X	6/7	BE	yes			11			
X	6/7	BE	yes	EE 4		2		4	
CT	6/7	BE	yes	EE 1	TJ	4		5	
MR	6/7	D	yes			3			
CT	5/6	D		WD 4		3		5	
MR	5/6	D	yes		BJ	11			
MR	6/7	D	yes	EE 2		10		5	
MR	5/6	D	yes		BJ	5			
			yes	EE 3		3	yes	5	
MR	5/6	D	yes			6			
MR	4/5	D	yes			4			
MR	5/6	D	yes			9			
MR	6/7	D	yes	EE 3	TJ	5		4	TJ
MR	6/7	D	yes	EE 4	TJ	6	yes	5	
MR	5/6	D	yes			7			
MR	6/7	D		{ EE 3 WP 4	TJ	5		{ 5 5	
MR	6/7	D	yes	EE 3		6		4	
MR	6/7	D	yes			12			
MR	5/6	D				5			
MR	6/7	D	yes	EE 4		6		5	
MR	5/6	D	yes	WD 3		2		4	
MR	5/6	D	yes	WD 3	BJ	6		4	BJ
MR	6/7	D	yes	EE 3		2		3	

[a] Graded 0–5 on the MRC, with 0 indicating not a flicker, 3 being equivalent to gravity and 5 indicating normal power
[b] Tested with reinforcement

strate this with follow-up CT of the cervical spine. We also noted regression of disc herniations when performing repeat MR scans of the cervical spine, and this is the subject of a further paper. Thus, if the pain can be suitably controlled with serial injections, a tolerable life style can be achieved while nature takes its course.

Rather than comparing the efficacy of one surgical technique with another [12, 18], perhaps further prospective research is required in comparing surgery with injection techniques, as a less invasive form of treatment.

Conclusions

With the use of corticosteroid injection techniques to control pain, almost all patients with cervical monoradiculopathy will make a satisfactory recovery without the need for surgical intervention. Indeed, surgery would seem to have little role to play other than in patients with signs of cervical myelopathy. At the least, these techniques increase the chance of the disease following its natural history towards spontaneous resolution. Clearly much more research, controlled studies in particular, is required in this area.

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