Original Article

Spinal injuries admitted to a specialist centre over a 5-year period: a study to evaluate delayed admission

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Study design: Retrospective study of 432 patients admitted to our institution with a spinal injury over a 5-year period.

Objectives: To present epidemiological data relating to this spinal population, reporting specifically on delayed admission and length of hospitalisation.

Setting: Royal National Orthopaedic Hospital, Stanmore, UK.

Methods: A total of 432 traumatic spinal injuries admitted between March 1998 and March 2003 were analysed with respect to age, gender, mechanism of injury, level of bony injury, neurological level (complete, incomplete and intact), Injury Severity Score (ISS), date of injury, referral and admission independently and length of hospitalisation. The delays between injury and referral (>3 days) and between referral and admission (>7 days) were correlated to the length of hospitalisation. A detailed analysis of the cause of delay at both junctures was undertaken.

Results: There were 322 males (average age, 38.6 years) and 110 females (average age, 41.8 years) in our study. Classification of neurological severity disclosed 108 complete injuries, 115 incomplete and 209 intact. The average time between injury and referral was 5.5 days (range 0–94), and between referral and admission was 10.7 days (range 0–130). A total of 161 patients (37%) experienced a delay between injury and referral, of whom 59 (37%) were subsequently also delayed to admission. The principal reason for delay between injury and referral was the treatment of concurrent injuries. Even patients with complete injuries (15/43) experienced delayed referral. In all, 112 patients (26%) experienced a delay between referral and admission. Principal reasons included the provision of beds (*Intensive care*, acute and rehabilitation) and physiological stabilisation of other injuries particularly thoracic trauma.

Conclusions: Provision of beds remains the most common preventable reason for delay between referral and admission and is associated with increased hospitalisation. Early liaison with a designated spinal injuries unit, particularly those with cord injury remains vitally important.

Spinal Cord (2005) 43, 434–437. doi:10.1038/sj.sc.3101734; Published online 8 March 2005

Keywords: delayed admission; spinal injury; length of stay; spinal injuries units

Introduction

The Royal National Orthopaedic Hospital in Stanmore is one of 11 Spinal Injury Units (SIUs) within the UK, all of which are designated to treat spinal cord-injured patients. The unit comprises 24 beds (eight acute, 16 rehabilitation) with the capacity to treat upto 40 patients at any time. The British Association of Spinal Cord Injury Specialists recommend the efficient and early transfer of spinal cord-injured patients to such specialist units. Benefits include shorter hospitalisation times¹ and a reduced incidence of complications including pressure sores, contractures and bladder dysfunction.^{2–6} There are many advantages for overall patient-care of a multidisciplinary approach from a group of professionals, including neuro-urology, occupational therapy, physiotherapy, psychiatry, psychology, social services, rehabilitation and community liason, making efficient transfer to this environment vitally important. Complications and neurological recovery are not assessed as they have been previously well documented,^{7,8} and are better assessed in the remit of a prospective trial with well-matched patient populations.⁹ Our study aims to evaluate delay in two distinct stages in a broad group of patients, including those with no spinal cord injury.

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We report on the patient populations involved and the factors responsible for the delay.

Materials and methods

We undertook a retrospective review of 432 consecutive patients admitted to the Royal National Orthopaedic Hospital, Stanmore, UK between March 1998 and March 2003 for the management of a recent spinal injury. Patients were admitted principally from the south east of England, although referrals were accepted from the whole country and from abroad. Patients were admitted either for acute care or rehabilitation, with the aim of discharge back to their previous residence. Patients admitted with infective, discogenic and tumour-related conditions and patients still hospitalised at the time of data analysis were excluded. Patients treated and transferred back to the referring hospital for rehabilitation were excluded. The patient group was analysed with respect to age, gender, mechanism of injury, level of bony injury, neurological level (complete, incomplete and intact), Injury Severity Score (ISS), date of injury, referral and admission independently and length of hospitalisation. In order to analyse specific causes of delay, we defined delay between injury and referral (>3 days) and between referral and admission (>7 days). Delay from referral to admission was analysed in more detail to highlight specific deficiencies in our service.

T-tests and Mann–Whitney *U*-tests were carried out to investigate whether length of stay differed between early and late referral at both stages. A general linear model was applied to investigate the effects of delays after taking into account the neurological deficit and ISS.

Results

There were 322 males (average age 38.6 years) and 110 females (average age 41.8 years). Patients were classified according to level of bony injury and degree of neurological involvement (Table 1). A fall accounted for 58.6% of injuries (n = 253), road traffic accidents 35.9% (n = 155) and other injuries such as those of a

sporting nature and gunshot injuries accounting for 5.5% (n=24). The average time between injury and referral was 5.5 days (range 0–94) and between referral and admission was 10.7 days (range 0–130). The average length of stay was 79.9 days. A total of 161 patients (37%) experienced a delay between injury and referral. In all, 112 patients (26%) experienced a delay between referral and admission.

The reasons for delay at each stage are shown in Tables 2 and 3. Without access to medical records from referring hospitals, information relating to cause of delay between injury and referral was difficult to collate and was absent in 46 cases (28.6%). Patients without cord injury commonly experienced a delay between injury and referral. However, delay at any stage for this group of patients did not influence length of hospitalisation. Of the patients delayed between injury and referral, 69.8% complete, 42.9% incomplete and 14.5% intact in addition experienced a delay to admission. Delay between referral and admission commonly occurred in patients with complete injuries (52.7%). Stabilisation of concurrent injuries and provision of beds were clearly the most common reasons for delayed admission.

The distribution of length of stay did not differ between those who did or did not suffer delay between injury and referral (P = 0.44 by Mann–Whitney *U*-test). However, length of stay was influenced by delay between referral and admission (P < 0.001 by

Table 1Distribution of level of bony injury and neurologicalseverity

I evel hony iniury	Neurological severity			
Level bony injury	Complete	Incomplete	Intact	
C1–C6	44	39	73	
C7/T1	4	0	2	
T2–T11	47	27	33	
T12/L1	1	8	10	
L2–L4	13	42	90	
L5/S1	0	1	0	
S2–S5	0	0	0	

Table 2	Causes	of	delav	between	referral	and	admission
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Reason for delay between referral and admission	Complete $N = 59$	Incomplete $N = 29$	Intact $N = 24$
Physiological stabilisation/other injuries	67.8% (40)	24.1% (7)	24.1% (7)
Beds acute/rehabilitation	42.2% (25)	72.4% (21)	41.7% (10)
Fused and Instrumented at referring hospital	22% (13)	41.4% (12)	_ `
Intensive care beds	18.6% (11)	3.5% (1)	
MRSA positive	13.6% (8)		8.3% (2)
ITU cover	3.4% (2)		16.7% (4)
Transfer (helicopter/abroad)	3.4% (2)	6.9% (2)	4.2% (1)
Head injury	1.7% (1)	3.5% (1)	_
Psychiatric assessment		10.3% (3)	16.7% (4)
Other	3.4% (2)	3.5% (1)	25% (6)

Table 3 Causes of delay between injury and referral

Reason for delay between injury and referral	Complete $N = 43$	Incomplete $N = 42$	Intact $N = 76$
Other injuries	34.9% (15)	19% (8)	18.4% (14)
Fixed at referring hospital	27.9% (12)	21.4% (9)	
Delayed diagnosis		12.5% (3)	17.1% (13)
Injury abroad	23.3% (10)	_ ()	5% (4)
Subsequent neurological loss		16.7% (7)	
Initial conservative treatment		7.1% (3)	13.8% (9)
Delayed presentation	_		3.9% (3)
Transferred hospital	2.4% (1)	8.3% (2)	
Other		_ ()	2.6% (2)
No cause found	11.6% (5)	23.8% (10)	40.8% (31)



Figure 1 Box and whisker plot demonstrating distribution of length of stay by neurological severity of injury

Mann–Whitney U-test). Figure 1 demonstrates the distribution of length of stay for those with and without delay between referral and admission by neurological deficit. It can be seen that length of stay was generally longer for those who were delayed between referral and admission, especially for 'complete' and 'incomplete' injuries. In keeping with these findings, we found that the ISS significantly influenced length of stay (Spearman's 0.593, P < 0.001). This certainly relates to the weighted scoring of more severe spinal injuries. The general linear model fitted to length of stay found a highly significant effect of delay between referral and admission (P < 0.001), and neurological severity of injury (P < 0.001).

Discussion

We have shown that delay between injury and admission at two distinct stages in transfer is common. Comparison to previous studies is difficult with this being the first study reporting on time and causes of delay between injury and referral independently. Previous reports vary considerably in their definition of delay ranging between 24 h and 21days.^{1,10} Nevertheless, there are clear benefits of early admission to a designated spinal injuries unit and it remains our responsibility to ensure patients can benefit from the specialist services available.

The principal reasons for delay between injury and referral in our study were the treatment of other injuries, fixation surgery in the referring hospital and a delay in diagnosis (intact group predominantly). It was surprising to find that 85 patients with cord injury experienced a delay to referral, regardless of other concurrent injuries. While this delay was not associated with increased hospitalisation, it highlighted a delay in communication between the referring hospital and our institution, especially considering a large proportion of these patients with complete and incomplete injuries, additionally suffered a delay between referral and admission.

Provision of beds, associated injuries, physiological stabilisation and technical aspects of transfer are common factors associated with delayed admission. With realisation of the increasing importance of helicopter services,¹¹ we postulate that physiological stabilisation of the patient should be considered the sole reason for delayed transfer. Nonetheless, early liaison with an SIU for advice on patient care and to facilitate faster overall transfer times remains crucial particularly in this group of patients.

Delayed admission of spinally injured patients to a recognised spinal injuries centre has been reported to lead to an increased incidence of complications and longer hospitalisation.^{1–6} All studies thus far, however, have been retrospective in nature and concerns regarding the comparability of groups at the baseline, suggests that the results of these studies should be viewed with caution. Our findings of longer hospitalisation for patients delayed between referral and admission, and in those with complete and incomplete injuries, are

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statistically significant and comparable to previous reports; however these data are also retrospective and a causal relationship is difficult to justify. Length of stay can be considered a measure of cost-effectiveness and therefore has implications for the individual organisations. It has been shown that delay is not cost-effective, with increased complications and longer hospitalisation being most significant.¹² However, it has been rightly suggested that the total length of stay may be influenced by other factors such as the patients housing circumstances and support at home, therefore time to medical fitness may be a more accurate outcome measure. Our data relating to length of hospitalisation need to be viewed with caution, although the principal aim of this study was to analyse delay qualitatively, to highlight areas where improvements could be made.

Carvell and Grundy¹¹ assessed the cause of delay specifically in those undergoing surgery at their spinal injuries unit. While the criteria for delay differed, they found that the complications resulting from surgery at the referring centre accounted for one-third of the delays. Other common reasons included other injuries and transfer problems relating to distance and multiple transfers. In contrast to our study, they did not find provision of beds to be a problem. Our analysis of delays between referral and admission revealed that provision of beds especially for patients with 'complete' injuries was the single worst preventable problem and highlights the need for urgent supraregional funding. Through raising awareness, it is hoped that outcome for this group of patients can be improved by early access to the multidisciplinary benefits provided by a designated SIU.^{1,11}

References

- 1 Oakes DD *et al.* Benefits of early admission to a comprehensive trauma center for patients with spinal cord injury. *Arch Phys Med Rehabil* 1990; **71:** 637–643.
- 2 Aung TS, el Masry WS. Audit of a British Centre for spinal injury. *Spinal Cord* 1997; **35:** 147–150.
- 3 Dalyan M, Sherman A, Cardenas DD. Factors associated with contractures in acute spinal cord injury. *Spinal Cord* 1998; **36:** 405–408.
- 4 Donovan WH *et al.* Incidence of medical complications in spinal cord injury: patients in specialised, compared with non-specialised centres. *Paraplegia* 1984; **22**: 282–290.
- 5 Richardson RR, Meyer PR. Prevalence and incidence of pressure sores in acute spinal cord injuries. *Paraplegia* 1981; **19:** 235–247.
- 6 Yarkony GM *et al.* Contractures complicating spinal cord injury: incidence and comparison between spinal cord centre and general hospital acute care. *Paraplegia* 1985; **23**: 265–271.
- 7 Tator CH *et al.* Neurological recovery, mortality and length of stay after acute spinal cord injury associated with changes in management. *Paraplegia* 1995; **33**: 254–262.
- 8 Kiwerski J, Weiss M. Neurological improvement in traumatic injuries of cervical spinal cord. *Paraplegia* 1981; **19:** 31–37.
- 9 Bagnall A-M *et al.* Effectiveness and cost effectiveness of acute hospital-based spinal cord injuries sevices: systematic review. *Health Technol Assess* 2003; **7:** 1–221.
- DeVivo MJ *et al.* Benefits of early admission to an organised spinal cord injury care system. *Paraplegia* 1990; 28: 545–555.
- 11 Carvell JE, Grundy DJ. Complications of spinal surgery in acute spinal cord injury. *Paraplegia* 1994; **32**: 389–395.
- 12 Tator CH *et al.* Complications and costs of management of acute spinal cord injury. *Paraplegia* 1993; **31:** 700–714.