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ORIGINAL ARTICLE

Cervical Spinal Cord Injury With And Without The Radiographical Evidence Of Trauma – A Retrospective Comparative Study In Adults

MAHMOOD N S *, RAJAGOPAL KADAVIGERE, RAMESH AK *****

ABSTRACT

Background : Spinal cord injury without the radiographical evidence of trauma (SCIWORET) is a well described entity in children. This phenomenon is not well described in the adult population. There has been no study till date that compares the prognosis of SCIWORET in adults to those with bony injury.

Aims: To compare the clinical and magnetic resonance imaging (MRI) findings of cervical spinal cord injury (SCI) with the conventional radiographical evidence of trauma to those with cervical SCI, without the conventional radiographical evidence of trauma (SCIWORET) and to study the importance of MRI and the prevalence of SCIWORET in adult cervical spine trauma.

Settings and Design:A retrospective study on patients who presented to the Department of Radiodiagnosis and Imaging with acute cervical spine trauma over a period of 5 years (between August 2002 and September 2007).

Methods: 50 patients with acute cervical SCI were divided into two groups. Group A included those without radiographical abnormality and Group B included those with bony injury. The epidemiological factors, the total motor scores on admission as well as on follow up, the recovery rate, the average extent of spinal cord oedema and the prevalence of ligamentous injury were compared in both groups.

Results: SCIWORET was associated with better motor scores and recovery rate when compared with SCI which is associated with bony injury. Ligamentous injuries were significantly more commonly associated with bony injury.

Conclusion: Cervical SCIWORET is not an uncommon phenomenon in adults. The overall outlook is better when compared to cervical spine trauma which is associated with bony injury, as SCIWORET is associated with better motor function and a lesser incidence of ligamentous injury.

Key Words : Adults, Magnetic resonance imaging; Spinal cord injury without radiological abnormality; SCIWORET; Trauma

Key Messages:

- SCIWORET is not an uncommon phenomenon in adults
- MRI plays an important role in the evaluation of adult SCIWORET
- Adult SCIWORET is associated with a better prognosis than that seen in those with bony injury

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Introduction

Spinal Cord Injury without the Radiographical evidence of trauma (SCIWORET) is a well documented phenomenon in the pediatric population [1],[2]. Ever since its first description by Pang and Wilberger [3], it has been increasingly reported in the pediatric literature. Not many reports are available in the adult literature and many consider it to be rare in this age group [4]. However some studies reveal that adult SCIWORET is in fact , not as rare as it was once thought to be [5],[6].

The importance of Magnetic Resonance Imaging (MRI) in the evaluation of SCIWORET has been highlighted in the literature and different spinal cord signal changes depicted by MRI have been shown to correlate well with the neurological recovery, with spinal cord oedema patients recovering better than those with cord contusion or haemorrhage [5],[7],[8],[9],[10].

However there is very little mention in the literature about any comparison between cervical SCIWORET in adults and those in whom the initial radiograph shows evidence of trauma.

In this study, we compared the clinical and MRI findings between these two groups, in addition to highlighting the importance of MRI and the prevalence of SCIWORET in adult cervical spine trauma.

Materials And Methods

This was a retrospective analysis of 50 patients chosen from a group of 63 who presented to the department of Radiodiagnosis and Imaging , Kasturba Medical College , Manipal, from August 2002 onwards , by selecting the first 25 patients with and without SCIWORET in a continuous manner to form two groups of 25 patients.

Patients were divided into two groups. Group A included 25 cases with cervical spinal cord injury and no conventional radiographical abnormality, whereas Group B consisted of the remaining 25 in whom cervical spinal cord injury was associated with radiographical evidence of bony injury such as acute fracture or vertebral subluxation or dislocation.

The epidemiological factors such as age and sex, aetiological data and clinical data such as the Spinal cord Injury (SCI) type using the ASIA (American Spinal Injury Association) [12],[13] Classification System, the total motor scores on admission as well as on follow up, the recovery rate, the average extent of spinal cord oedema and the prevalence of ligamentous injury were compared in both the groups.

MRI was performed in all cases using 'SIGNA CONTOUR 'of Wipro- GE medical systems , with a super conducting K4 magnet of 0.5 T field strength.

Phased array coils were used for cervical spine with 4 mm slice thickness for sagittal images and 5 mm thickness for axial images and 240 or 280 mm Fields of View. Sagittal T1- weighted images (WI) were obtained with a spin echo (SE) sequence (TR/TE = 500 /15 msec); Number of excitations (NEX) = 3; matrix = 256 / 224). Sagittal T2-weighted images (WI) were obtained with a spin echo (SE) sequence (TR/TE = 5000 /100 msec); Number of excitations (NEX) = 3; matrix = 256 / 224). Transaxial T1W SE sequences were obtained (TR/TE = 750 / 15 msec; NEX = 4; matrix = 256/192). T2W transaxial images were obtained by means of a gradient recalled acquisition sequences (TR /TE =750/15; 256 /128 matrix; flip angle 25 ^{o}.

The signal changes on the T1WI and the T2WI as given by S Ramon et al was used to differentiate the patterns of spinal cord injury on MRI [11] and the length of the spinal cord oedema was assessed by tabulating the number of vertebral segments involved.

The ligamentous injury defined by MRI, as the hyperintensity of the corresponding ligament on the T2W images or the discontinuity of its hypointense signal, was noted and tabulated for each patient in both groups. The number of levels of injury for each Anterior longitudinal ligament (ALL) , Posterior longitudinal ligament (PLL) , Interspinous ligament (ISL) ,Ligamentum flavum (LF) , Supraspinous ligament (SS) , traumatic disc injury (TDI) and disc herniation(TDH) were noted and compared in both groups.

The motor function using the manual muscle test [12] as well as the neurological status status defined by the ASIA Grade and the Motor score of each patient, was noted from the patient records.

The motor recovery (RR) was calculated from the motor scores using the formula given by Lucas and Ducker [14].

The Motor index score (MIS), ASIA Grade and the RR as obtained from the patient records were then compared for both groups and were statistically analysed.

Statistical Methods

The statistical analysis was performed using the software SPSS Version 10.0 for Windows.

The paired t test was used to compare the differences in the initial total motor scores, the final total motor scores and the mean recovery rates between both the groups .

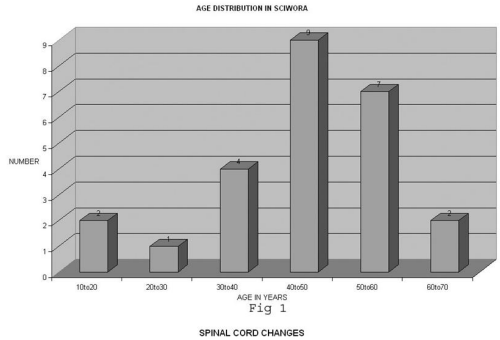
Results

A total of 50 patients with acute cervical SCI were studied. These were divided into two groups. Group A consisted of patients in whom there was no radiographical abnormality, whereas in Group B, the initial radiograph had shown evidence of bony injury either in the form of fracture or vertebral misalignment.

Epidemiology

Group A

Group A consisted of 25 patients, which included 24 males and one female with a mean age of 45 years and standard deviation (S.D) of 12.8 (range 12 to 64 years). A majority of the patients were between 40 to 50 years [Table/Fig 1] (Fig 1.) The most common cause of injury was Motor Vehicle accidents in 13 patients (52%) followed by fall from height in 10 patients (40%).



(Table/Fig 1) Showing The Age Distribution In SCIWORET.

Complete SCI was seen in 4 patients (16%), with Brown Sequard syndrome in 2 patients (8%). The remaining 19 patients (76%) had non classifiable symptoms on presentation.

Group B

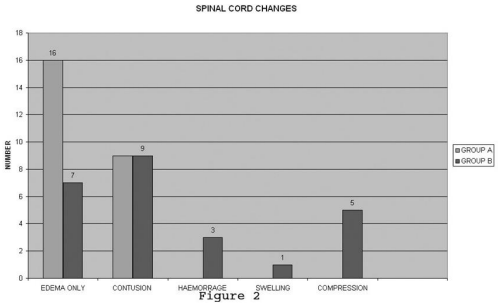
Group B consisted of 25 patients, which included 23 males and 2 females with a mean age of 39 years and standard deviation (S.D) of 16 (range 17 to 80 years). The most common cause of injury was fall from height in 13 patients (52%) followed by Motor vehicle accident in 9 patients (36%).

Complete SCI was seen in 12 patients (48%), with Central Cord syndrome in 1 patient (4%). The remaining 12 patients (48%) had non classifiable symptoms on presentation.

SPINAL CORD CHANGES AND ASIA GRADE.

Group A

16 patients in this group had only spinal cord oedema on MRI and the remaining had shown evidence of cord contusion as well [Table/Fig 2] . In none of the cases was the spinal cord normal on MRI.



(Table/Fig 2) Showing Spinal Cord Changes Seen In Group A And Group B On MRI.

Complete SCI (Grade A) was seen in only 4 (16%) patients, whereas the majority (12 patients accounting for 48 %) had minimal deficit (Grade D) on admission [Table/Fig 3].

(Table/Fig 3) ASIA Grade On Admission

ASIA*	*Group A (n=25)*	*Group B (n=25)*
A	4 (16%)	12 (48%)
B	1 (4%)	3 (12%)
C	8 (32%)	3 (12%)
D	12 (48%)	7 (28%)

***- American Spinal Injury Association**

Group B

In this group, a majority of the patients had cord contusion (seen in 9 patients). The other patterns of spinal cord injury are as shown in [Table/Fig 2].

In this group, a majority of the patients (12 patients accounting for 48%) had shown complete SCI (Grade A) on admission [Table/Fig 3].Grade D was seen in only 7 patients (28%).

Motor Index Score And Recovery Rate.

As shown in [Table/Fig 4] . The initial total motor score on admission , motor score on follow up and the recovery rate were greater in those without radiographical abnormality (Group A) when compared to those with bony injury (Group B). However this was of statistical significance only for the follow up motor score ($p < 0.05$).

(Table/Fig 4) Motor Index Score And Recovery Rate

		Total	Minimum	Maximum	Mean	S.D	P
MIS* ADM	Group A	25	0	92	43.80	29.99	N.S
	Group B	25	0	93	32.56	32.22	
MIS † FOLL	Group A	25	0	100	57.84	30.07	<0.05
	Group B	25	0	100	38.00	35.22	
RR ‡	Group A	25	-0.15	1.00	.3225	.3359	N.S
	Group B	25	-1.19	1.00	.1574	.4383	

***MIS ADM - Motor Index Score on admission**
†MIS FOLL –Motor Index Score on follow up
‡ RR – Recovery rate

Length Of Oedema

The mean length of cord oedema was 5.84 segments in Group A with S.D of 5.17 (Range 0 to 19), whereas in Group B, the mean length was 8 segments with SD of 7.54 (Range 0 to 22). The difference was not of statistical significance ($p = 0.19$).

Recovery Rate With In The SCIWORET Group

Within the SCIWORET group, patients in whom MRI had shown only cord oedema were associated with a better mean recovery rate (RR= 0.423) when compared to those with cord contusion (RR = 0.144), the difference being statistically significant ($p = 0.028$)

Ligament and Disc injury

Ligament Injury

The incidence of ligamentous injury was significantly more in Group B when compared to Group A [Table/Fig 5] .

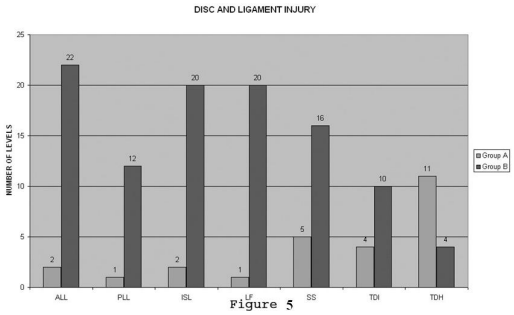


Figure 5

(Table/Fig 5) Showing Incidence Of Disc And Ligament Injury In Both Groups (ALL – Anterior Longitudinal Ligament , PLL – Posterior Longitudinal Ligament , ISL- Interspinous Ligament, LF- Ligamentum Flavum, SS- Supraspinous Ligament, TDI – Traumatic Disc Injury, TDH – Traumatic Disc Herniation).

Disc Injury And Herniation

10 out of the 25 patients (accounting for 40 %) in Group A had traumatic disc Herniation [Table/Fig 6] . However the differences in the incidence of TDI or TDH between both groups was not of statistical significance.

Figure 6

(Table/Fig 6) T2W Sagittal Image In A 24 Year Old Male In Group A ,Who Sustained A Motor Vehicle Accident Showing Traumatic Disc Herniation At The C5-C6 Level (Long White Arrow)Narrowing The Spinal Canal. The Cervical Spinal Cord Shows Hyperintense SignalSuggestive Of Edema. The Conventional Radiograph Of This Patient (Not Shown) Revealed No Abnormality.

Discussion

SCIWORET is a well documented phenomenon in the paediatric population [1],[2].

In the paediatric spine, it is a reflection of the inherent elasticity of the soft tissues which causes immediate spontaneous reduction after considerable intersegmental displacement.

This elasticity of the spine reduces with age and hence, the incidence of SCIWORET is considered to be less in adults [4]. However, some studies reveal that adult SCIWORET is infact not as rare as it was once thought to be [5],[6]. Our study supports the latter view. A vast majority of the patients with SCIWORET in our study were found to be adults (23 out of 25 patients) . This incidence is quite high when compared to other similar studies on adult SCIWORET [9],[10].

Another important difference noted in the present study when compared to others, was the predominant age group which was affected. While most studies[9],[10] have documented adult SCIWORET to be more common under 40 years of age and rare above this age group, in our study the predominant age group affected was between 40 and 50 years of age.

Motor vehicle accidents were the most common cause of cervical SCIWORET in our study, which is similar to the observation by SK Gupta et al [10].

In our study the prognosis for patients with SCIWORET seemed to be better than those

with associated bony injury as evident from the higher admission and follow up motor scores and recovery rate. However the difference between the two groups was statistically significant for only the follow up motor scores. Hence according to our study patients with bony injury on the conventional radiograph have a worser prognosis than those with SCIWORET.

Though the mean length of spinal cord oedema was less in SCIWORET when compared to those with bony injury, it was not of statistical significance. The different patterns of spinal cord injury as depicted by MRI has been shown to correlate well with the neurological recovery [5],[7],[8],[9],[10].

The incidence of ligamentous injury was significantly more in patients with bony injury than in those with SCIWORET. This warrants the use of MRI in patients with bony injury to look for associated ligamentous injury .

The present study also had a high incidence of traumatic disc herniation within the SCIWORET group (40 %). This is much higher than reported previously in literature by Benzel et al.[15]. Hence, MRI is especially useful in the this group to look for traumatic disc herniation , which may at times cause spinal cord compression , so that early surgery can prevent neurological sequelae.

Conclusion

Cervical SCIWORET is not an uncommon phenomenon in adults. It may be seen commonly even above the age of 40. The overall outlook is better when compared to cervical spine trauma which is associated with bony injury, as SCIWORET is associated with better motor function and a lesser incidence of ligamentous injury. MRI plays an important role in its evaluation to assess the spinal cord injury, as well as to look for any traumatic disc herniation which are quite commonly seen in this group.

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