ACUTE CENTRAL CERVICAL SPINAL CORD SYNDROME— AETIOLOGY, AGE INCIDENCE AND RELATIONSHIP TO THE ORTHOPAEDIC INJURY[1]

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Abstract. A series of 99 cases of acute central cervical spinal cord syndrome is reviewed. This represents 25 per cent of all acute cervical spinal cord injuries (excluding stabs and gunshots), admitted to the Spinal Cord Injury Centre, Conradie Hospital during an 8-year period (November 1963 to December 1971). Aetiology, age incidence and relationship to injury is discussed.

Key words: Central cervical cord syndrome; Paraplegia

Material

DURING the period from November 1963 to December 1971, 955 new lesions were admitted to the Spinal Unit—mainly from the Cape Province. Three hundred and sixty-six cases were cervical orthopaedic injuries and of these 99 were acute central cord lesions (Table I).

There was one acute death in the series and this case was therefore excluded from the recovery figures.

The policy of the Spinal Unit is to admit patients as soon after injury as possible. The majority were admitted within 48-72 hours of injury. The main reason for admission delay was distance from the Spinal Unit. The average stay in hospital was 5·8 months (range 12 weeks to 2 years).

Age Incidence

The age incidence was distributed as shown in Table II. There is a definite peak in the age-group 21-30 years, with smaller peaks in the age-group 41-50 years and also in the age-group 51-60 years. The first peak coincides with a generally higher incidence of injury in the 21-30-year age-group. Of motor vehicle accidents, assaults and sport injuries most occur in this age-group.

Causes of Injuries

The aetiological factors are divided as in Table III. Most are due to falls followed closely by motor vehicle accidents involving drivers, passengers and pedestrians.

TABLE I

Total admissions 1963-1971	955	
Cervical orthopaedic injuries	366	38·3%
Central cord syndrome	99	10·4%

[1] Paper read by Dr A. Key.

TABLE II

Age incidence

Number Of Cases / Age In Years

13	25	14	17	18	10	2
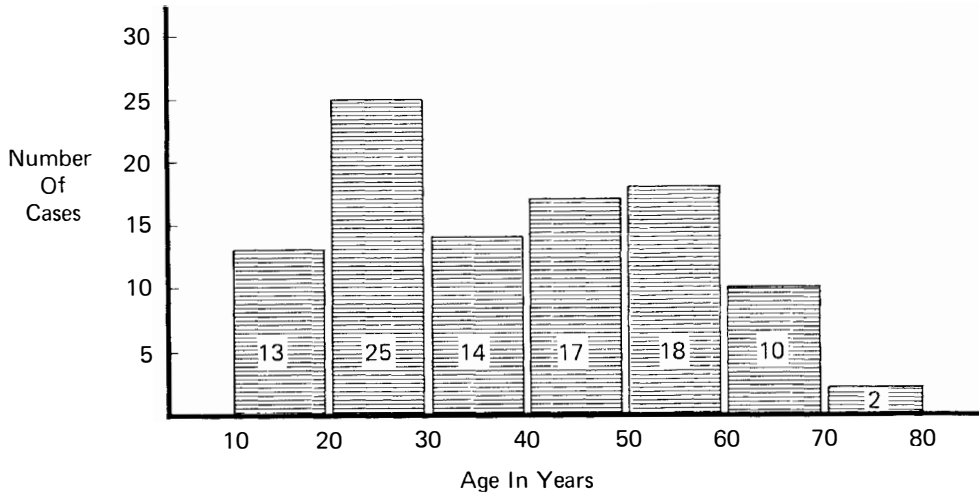
TABLE III

Age aetiology

Age	Total	Falls	M.V.A.*	Assaults	Diving	Sports	Falling objects
Up to 50 years	69	26	25	4	6	6	2
51 years and over	30	16	10	3	0	—	1
Total	99	42	35	7	6	6	3

* Motor vehicle accidents.

An interesting point is that in the cases over the age of 50 years there was a total of 16 falls, representing 53 per cent of the cases in this age-group in this series. If this is further analysed, of the 12 cases over the age of 60 years, 9 (75 per cent) were due to falls. This represents 21·4 per cent of all the falls (42) in this series.

There were 6 diving injuries—representing one third of all diving injuries admitted, and 6 other sport injuries—35 per cent of all sport injuries, other than diving, admitted. These occurred mainly in the under-30-year age-group.

Neurology

There was the usual discrepancy between motor and sensory levels. The cases were thus all graded according to motor levels (*i.e.* the last completely normal motor level). There were 66 C4 lesions, 20 C5 lesions, 8 C6 lesions and 5 C7

lesions. The majority of lesions were therefore in the middle third of the cervical spinal cord.

The neurological classification suggested by Marar (1974) was more or less followed, but this has been rearranged according to a decreasing degree of involvement (Table IV).

An additional group has been added—that of only minimal sensory sparing below the level of the lesion, *e.g.* sacral sparing.

Essentially there were two large subdivisions of the 99 cases (Table V). The first subdivision of 74 consisted of those presenting *ab initio* with a central cord syndrome. These included Groups 4 and 6 of this series (Groups 2 and 4 of Marar's original classification).

The second but much smaller subdivision of 25 cases, were those presenting initially as a variant of one of the other groups, but commencing to recover within a variable period of time (average 20 days) in the classical manner.

Orthopaedic Lesions

These were classified into: (1) compression injuries; (2) flexion-rotation unilateral facet-dislocations; (3) flexion-rotation bilateral facet-dislocations;

TABLE IV

Neurological classification

1. Total motor and sensory loss below the level of the injury.
2. Complete motor loss with minimal sensory sparing below the level of the lesion—sacral sparing.
3. Complete motor loss in extremities with hypoaesthesia at level of lesion, but intact posterior columns.
4. Motor loss of variable degree, either in upper extremities only or in all four extremities, with patchy sensory loss.
5. A Brown-Sequard syndrome.
6. Motor-power weakness in all four extremities or the upper extremities only, with no sensory loss.

TABLE V

Neurological orthopaedic

Group	Total cases	Facet-interlocking	Compression	Hyperextension	Subluxation	Odontoid
1	5	2	1	2	—	—
2	6	1	3	2	—	—
3	12	6	3	3	—	—
4	62	12	11	28	10	1
5	2	—	—	1	1	—
6	12	5	2	3	1	1
	99	26	20	39	12	2

(4) extension-rotation injuries (hyperextension, Marar, 1974); (5) subluxation; and (6) odontoid fractures.

The first four divisions correspond to Groups 1-4 of Dall (1971*a* and *b*).

Subluxations were classified as a separate group although these may well have fitted into Group 2 of Dall. These were thought to be probably due to a flexion mechanism with no facet interlocking or with spontaneous reduction. The definition of Burke *et al.* (1971) applies: 'Subluxation occurs when the inferior facet of the upper vertebra has ridden up over the the superior facet of the lower vertebra, but has not locked in front of it.'

There were two odontoid fractures in this series in cases both under 50 years (Table VI). In the under-50-year age-group compression injuries and facet-interlocking injuries occur most frequently in association with this syndrome. However, if subluxation injuries are added to the facet-interlocking injuries, *i.e.* all flexion-type mechanisms, these would form, by far, the greatest majority in this age-group—34 cases (49·2 per cent). Seventy-six per cent of cases in the age-group over 51 years were due to hyperextension injuries. Only 13 per cent of cases in this age-group were due to flexion injuries.

Of the 39 hyperextension injuries, 24 cases (62 per cent) had definite signs (frontal abrasions) or radiographic evidence of a hyperextension mechanism. The remainder were assumed to have had this type of injury from their histories (fall down steps, etc.). Reduction was achieved in 11 (69 per cent) of the 16 cases with unilateral facet-interlocking, whereas 9 (90 per cent) of the 10 cases with bilateral facet-interlocking were reduced (Table VII). The remaining case was partially reduced to a unilateral locked facet.

Treatment

All cases were treated conservatively with immobilisation on a pack-bed for 12 weeks. Facet-dislocations were initially treated with halter or skull traction and if this was not successful, by closed reduction under anaesthesia within 72 hours of admission. There were no open reductions done in this series.

Neurological Recovery

Neurological recovery was divided into four grades (Table VIII). Neurological Groups 4 and 6 showed good recovery (Table IX), 84 per cent being in recovery Grades A and B. Of Group 4, three cases with recovery graded D were wheelchair dependent due mainly to age. Group 5, of which there were only two cases, had 100 per cent recovery.

TABLE VI

Age/orthopaedic

	Facet-interlocking	Compression	Hyperextension	Subluxation	Odontoid
Under 50 years	24	17	16	10	2
Over 51 years	2	3	23	2	0
	26	20	39	12	2

TABLE VII

Neurological/facet-interlocking

Group	Total cases	Unilateral		Bilateral	
		Total	Reduced	Total	Reduced
1	2	—	—	2	1
2	1	1	1	—	—
3	6	4	2	2	2
4	12	8	6	4	4
5	—	—	—	—	—
6	5	3	2	2	2
	26	16	11	10	9

Remaining bilateral (Group 1) only partially reduced.

TABLE VIII

Levels of recovery

Grade A: Virtually full return; independent (hands slightly involved).
Grade B: Walking with stick; hands more involved.
Grade C: Crutches with/without calipers.
Grade D: Minimal functional return; wheelchair.

TABLE IX

Recovery

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Total
Grade A	1	1	3	33	2	10	50
Grade B	1	1	7	18	—	2	29
Grade C	1	2	1	4	—	—	8
Grade D	2	2	1	6	—	—	11

Discussion

The age incidence is similar to that of previous authors (Barnes, 1948; Taylor, 1951; Schneider, 1956; Rand, 1962). In the older age-group there is a high incidence of hyperextension injuries associated with the central cord syndrome (only one case under the age of 30 years). The highest incidence (49 per cent) of cases of central cord syndrome in the under-50-year age-group was due to flexion-rotation injuries. In Schneider's series (1956) all his fracture-dislocations and compression injuries (with one exception) were 40 years and younger. The hyper-extension injuries in his series were all over 50 years.

As in most series, falls were the commonest cause of injury, especially in the older age-groups. Rand and Crandall (1962) stated that as with other spinal cord injuries, the process of central cord damage is not static and that for a period of several hours to a few days, it often becomes worse. This will probably explain the other neurological groups (25 cases) in this series. Due to delay in admission for various reasons (distance, etc.) the cord lesion had probably temporarily deteriorated. This could apply particularly to the complete lesions (Group 1) and those with sacral sparing only (Group 2).

The neurological recovery showed generally that the more severe the initial neurological picture, the poorer the recovery. Of Group 1 (complete lesion), 40 per cent became wheelchair dependent. Of Group 2, 33 per cent were wheelchair dependent. Of Group 4, only 10 per cent were wheelchair dependent and, of these, three (5 per cent) were wheelchair dependent due to age, not their neurological deficit. Only 5 per cent of this group were therefore wheelchair dependent because of their neurological deficit.

The relationship of orthopaedic to neurological lesion on admission (Table V) followed the findings of other authors. Of the cases presenting as central cord syndrome (Group 4 and 6), hyperextension injuries predominated, followed closely by fracture dislocation injuries (inclusive of subluxation) and to a lesser degree by compression fractures. Both odontoid fractures fell into the group presenting as a central cord syndrome (Marar, 1974). The above relationship is also reflected in the total number of cases in each group of orthopaedic lesions—hyperextension injuries (39 per cent), fracture-dislocations including subluxation (38 per cent) and compression injuries (20 per cent). However, as stated above, the majority of orthopaedic injuries in the under-50-year age-group were due to flexion type injuries and in the over-50-year age-group were hyperextension injuries. With facet-dislocation, especially bilateral, reduction is important whether by traction or closed reduction under general anaesthesia. Ninety per cent of bilateral facet-dislocations in this series were reduced (Table VII). Two of this group presented as complete neurological lesions.

Treatment in all cases was conservative and no open reductions were performed.

SUMMARY

It has been shown that there is a higher percentage incidence of falls associated with hyperextension injuries in the older age-group resulting in the central cervical spinal cord syndrome.

In the younger age-group (less than 50 years) presenting with this syndrome, flexion rotation injuries associated with falls and motor vehicle accidents predominate.

The degree of recovery is directly proportional to the initial neurological picture.

It would appear that in facet-dislocations, early reduction may well be a factor in promoting more favourable neurological recovery.

RÉSUMÉ

On a montré que chez les personnes agées il y a une incidence plus élevée de chutes associées aux blessures d'hyperextension; ce qui résulte au syndrome de la moelle épininière cervicale et centrale.

En ce qui concerne les patients moins agés (moins de 50 ans) les blessures de flexion rotation associées aux chutes et aux accidents d'automobile prédominent.

Le degré de guérison correspond directement à la situation neurologique initiale.

Il paraît qu'une rédaction dans la première période des luxations—facettes peut bien contribuer à une plus favorable rétablissement neurologique.

Zusammenfassung

Es hat sich bewiesen, dass der Prozentsatz bei dem zentralen cervikalen Cord syndrom, als Folgen von Sturz höher ist als Hyperextension Verletzung in der älteren Alters-gruppe.

In der jüngeren Alters-gruppe (unter 50 Jahren) ist dieses Syndrom meistens mit Flexion Rotation Verletzung nach Sturz oder Autounglück verbunden.

Der Grad der Genesung ist dementsprechend proportionell in Vergleich zu der ursprünglichen Erscheinung.

Es scheint, dass in Facett-Subluxation frühe Reduktion höchstwahrscheinlich ein Faktor zur erhönter neurologiochen Erholung ist.

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General Discussion

DR A. ROSSIER (*U.S.A.*). Could I ask you, in your very last series did you observe complete sensory loss in incomplete motor lesion. It is extremely rare, but we have twice found similar cases and I and my colleagues would corroborate this. Did you have the chance to observe this?

DR A. KEY (*S.A.*). Do you mean complete motor sparing or good motor return?

DR ROSSIER. Good motor return.

DR KEY. One case of motor car accident who had marked sensory loss but very minimal motor involvement.

DR I. PERKASH (*U.S.A.*). It seems from your group of patients that you have included the posterior cord syndrome and Brown-Sequard and I was wondering whether they should really fit in when we are really discussing the central cord syndrome. What was your reason to include them as central cord syndrome?

DR KEY. My friend Dr Shrosbree included them in this series because their neurological picture presented a loss of power in the upper extremities with return in the lower, initially presented as a more typical Brown-Sequard or just posterior column sparing and not as a true central cord syndrome. Groups 4 and 6 presented as a true central cord syndrome initially, the others developed into a central cord syndrome having presented as something else.

DR PERKASH. Could you elaborate on the recovery pattern of the patients who presented the posterior cord syndrome in this group, if you know. What was the recovery pattern of the patients with posterior cord syndrome, did they recover like central cord syndrome?

DR KEY. Yes, they did.

DR PERKASH. That's rather unusual.

DR FRANKEL (*G.B.*). Could you clarify for me what evidence you have that early reduction of the unilateral locked facets gives a more favourable neurological result.

DR KEY. This is just a feeling from these cases. We try and reduce them as early as possible within the first 24 hours and Dr Shrosbree put this in as a feeling that because of so large a group there were only 25 of them that did not fall into the central cord syndrome initially, but the recovery in those reduced seemed to be significant. I haven't got any statistics of the bilaterals that were not reduced.

DR HARDY (*G.B.*). I would like just to say that this expression central cord syndrome and indeed all expressions relating to this type of lesion are merely anatomical designations of a pathological lesion. It is my belief that apart from total transection all the cord lesions pathology begin as central cord lesions but they are asymmetrical, and if it is more to the back then you talk about the posterior cord syndrome, if it is more to the front you talk about the anterior cord syndrome. Dick Schneider first coined the phrase central cord syndrome simply to denote that the pathological lesion was in the centre of the medulla and he associated it with pure extension injuries and later he pointed out that it could appear in other orthopaedic lesions as well, and Dr Key has illustrated that and indeed in the Sheffield series we have shown that there are central lesions symmetrical or asymmetrical which are caused by any spinal cord injury.

SIR LUDWIG GUTTMANN (*G.B.*). If you compare the first paper with the second you will agree with me that this means damage occurring in the central part of the grey of the spinal cord and the distinction between central cord lesions and other lesions is rather more academic than it is really in practice. I would like to ask Dr Key who reported in that excellent paper astounding good results following conservative treatment, how long did you observe the patients and did you get certain neurological progression in later stages say after 6 months, 8 months or a year, because that is now the important point. We have been very interested to see in recent years a number of cases with progressive symptoms a long time after initial injury. The interesting thing is that these new symptoms are mainly or almost entirely confined to the loss of spinothalamic sensibility and sometimes of posterior column sensation produced by cystic degeneration of the spinal cord within the posterior horn and partly posterior column of the spinal cord.

DR KEY. Sir Ludwig, to answer your question about follow-up, we have admitted to the Spinal Cord Injuries Centre in Cape Town close on 1700 cases to date so these 955 admissions go back a few years and our follow-up period was at least 3 years. So, yes, there were cases that recovered later but on the whole amongst this 99 in the series the recovery to that of a neurological picture of a central cord syndrome was reasonably soon after admission, but there were a few that were delayed, and our follow-up was about 3 years.