

Osteoporosis Following Spinal Cord Injury

Ali Otom MD*, (Moh'd Rami) Al-Ahmar MD*

ABSTRACT

Objective: To assess the extent of bone loss among 30 patients with Spinal Cord Injury at the Spinal Unit, King Hussein Medical Center.

Methods: A total of 30 patients with Spinal Cord Injury before one to 15 years and who completed their medical and rehabilitation program were included in this descriptive study during the period July 2003 to April 2010 at The Royal Jordanian Rehabilitation Center, King Hussein Medical Center. There were 25 males and 5 females. Bone Mineral Density was measured by Dual Energy X-ray Absorptiometry in the lumbar spine and femoral neck, patients were diagnosed to have osteoporosis according to World Health Organization criteria and their fracture's risk was described from this score using published data. Their spinal injuries were classified according to American Spinal Injury Association Criteria, ranging from A-D. Simple descriptive statistics (frequency, mean, percentage) were used to describe the study variables.

Results: Bone loss indicated by low bone mineral density revealed that femoral region is predominantly affected with relative preservation of the lumbar spine. Abnormal bone mineral density values were detected in 80% of patients.

A relation was noticed between the time following the injury and the degree of osteoporosis. Individuals with complete injuries showed lower bone mineral density values than those with incomplete lesions. Relation was found regarding their age and gender.

Conclusions: Spinal Cord Injury patients are at high risk of developing osteoporosis which can lead to significant morbidity, particularly lower extremity fractures without significant trauma.

Key words: Osteoporosis, Spinal Cord Injury, Complication, Bone Mineral Density, American Spinal Injury Association.

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Introduction

Osteoporosis is a condition characterized by low bone mass and deterioration of the skeletal micro architecture. ⁽¹⁾ It is a well known complication of Spinal Cord Injury (SCI). ⁽²⁾

The mechanism of bone loss in SCI is not completely understood. A significant portion of bone loss occurs during the first 4-6 month after injury and stabilizes between the 12th and 16th months. Bone mineral loss continues, however, to a

lesser degree in the pelvis and lower extremities over the next 10 years. Almost 50% of bone content in these regions is demineralised by the end of first year after the injury. ^(3,4)

The pathophysiology of SCI induced osteoporosis is rather a complex one and differs from those observed in patients with SCI after prolonged bed rest and in patients with other neurologic deficits. ⁽⁵⁾

SCI can cause immediate and in some regions permanent gravitational unloading which leads to disuse structural change.

*From the Department of Physical Medicine and Rehabilitation, Royal Rehabilitation Centre (RRC), King Hussein Medical Centre (KHMC), Amman-Jordan

Correspondence should be addressed to Dr. A. Otom, P.O Box 540585 Amman 11937 Jordan, E-mail: aliotom@hotmail.com

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Table I: Cause of Injury in spinal cord injured patients followed at KHMC from July 2003 to April 2010

| Traumatic | Non-Traumatic |
|-----------|---------------|
| 21 | 9 |
| 70% | 30% |

Table III: Distribution of BMD by SCI duration group

| Duration since the time patient sustained SCI | Number of Patients | Mean BMD g/cm ² |
|---|--------------------|----------------------------|
| Less than 5 | 11 | 0.751 |
| 5 to 10 | 11 | 0.631 |
| 11 or greater | 8 | 0.616 |

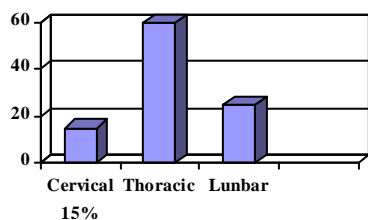
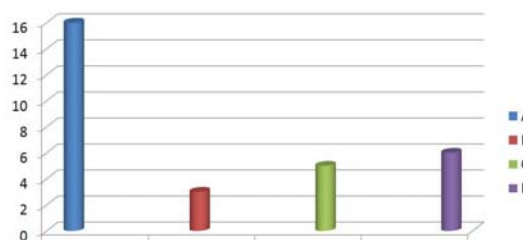


Fig. 2: Level of injury

Table II: BMD Values in spinal cord injured patients followed in KHMC from July 2003 to April 2010

| BMD Values | Number of Patients | % | Mean T-Score | Mean BMD g/cm ² |
|--------------|--------------------|----|--------------|----------------------------|
| Osteoporotic | 10 | 33 | -3.0 | 0.597 |
| Osteopenic | 14 | 47 | -1.53 | 0.788 |
| Normal | 6 | 20 | -0.01 | 0.919 |
| Complete | 16 | 53 | -2.61 | 0.618 |
| Incomplete | 14 | 47 | -1.89 | 0.756 |



Complete (ASIA A) 53% Incomplete (B, C, and D) 47%

Fig. 1: Extent of Injury (ASIA)



Fig. 3: Male to female ratio in spinal cord injured patients

The activity of both osteoblasts and osteoclasts is triggered by the SCI. Osteoblastic activity rise only slightly, while osteoclastic activity increases significantly, peaking at 10 weeks following injury with values 10 times the upper limits of normal.⁽⁶⁾

Hypercalciuria is 2-4 that of persons without SCI who undergo bed rest and reaches a peak 1-6 months post injury. This marked increase in urine calcium is the direct result of imbalance between bone formation and resorption.⁽⁷⁾

Acutely the parathyroid gland is relatively inactive with low parathyroid hormone levels observed until the first year following SCI.⁽⁸⁾

Complication from fractures and their treatment can lead to long term hospitalization, increased cost and increased disability.

This study was conducted to assess the extent of bone loss among 30 patients with Spinal Cord Injury at the Spinal Unit, King Hussein Medical Center.

Methods

A total of 30 patients with Spinal Cord Injury before one to 15 years and who completed their medical and rehabilitation program were included in this descriptive study during the period July 2003 to April 2010 at The Royal Jordanian Rehabilitation Center, King Hussein Medical Center. There were 25 males and 5 females. Bone Mineral Density was measured by Dual Energy X-ray Absorptiometry in the lumbar spine and femoral neck, patients were diagnosed to have osteoporosis according to World Health Organization criteria and their fracture's risk was described from this score using published data. Their spinal injuries were classified according to American Spinal Injury Association Criteria, ranging from A-D. Simple descriptive statistics (frequency, mean, percentage) were used to describe the study variables.

All study participants were medically stable upon

inclusion into the study and gave written informed consent. We included patients who had SCI for more than one year and presenting class A, B, C or D injuries (Fig. 1, 2) as defined by ASIA classification system.⁽⁹⁾(Table I)

Both female and male patients were included. All patients were submitted to initial clinical evaluation by direct patient and chart review.

Thirty patients fulfilled the inclusion criteria. There were 25 males and 5 females. The mean duration since the time they sustained the SCI was 8 years (range 1-15). Bone Mineral Density (BMD) was measured in all patients. (Fig. 3), the mean age of patients was 37 years (13-61).

BMD was measured by Dual Energy X-ray absorptiometry in the lumbar spine and femoral neck using Hologic-Delphi QDR series machine. Patients were diagnosed to have osteoporosis according to the World Health Organization (WHO) Criteria and their fracture risk calculation was based on data published in international studies.^(4,10)

Results

Twenty-four patients (80%) were found to have abnormal BMD values.

According to WHO criteria for osteoporosis, 10 patients (33%) were osteoporotic, 14 (47%) were osteopenic and 6 (20%) were normal.

A Positive relation was noticed between the time following injury and the degree of osteoporosis. Individuals with complete injuries showed lower BMD values than those with incomplete lesions suggesting an inverse relationship between BMD values and severity of SCI. No relation was found regarding the gender in this study (Table II, III).

Fractures after SCI had occurred among 5 patients (17%); the majority of these fractures (80%) involved the lower limbs without significant trauma.

Bone loss indicated by low BMD, T score and Z score showed a regional pattern affecting mainly the femoral region in comparison to lumbar spine which was less affected.

Discussion

Osteoporosis is considered to be one of the major complications in patients with SCI.

The recent progress in the management of SCI has prolonged the survival of patients. The incidence of secondary bone and joint disorders has also increased.⁽¹¹⁾

The advent of bone densitometry provided a means to measure bone mass and quantifies fracture's risk before a fracture occurred.⁽¹²⁾

In a cross-sectional study evaluating BMD in SCI, Szollar *et al* reported that bone loss was detectable by densitometry in all age groups by 12 months post injury.⁽¹⁴⁾

Bearing in mind the evaluation and particularities of the osteoporosis occurring in SCI patients, one should pay special attention to the time of injury. Intervention must ideally be introduced early as a large portion of bone loss occurs within 6 months, stabilizing at 12 to 24 months after SCI at values 60% to 70% of normal in the femoral neck and 40% to 50% in the proximal tibia.^(13,14)

It is known that fractures of the lower extremities from minor trauma are more prevalent in the SCI than in the non-SCI population, 2% compared to 1% per year.⁽¹⁵⁾

The result of our study showed evidence of both osteoporosis and low bone mass in SCI individuals 80% had less than normal BMD, 33% of them were osteoporotic.

Patients with osteoporosis were predominantly complete injuries suggesting more severe insult of the cord, and the duration of injury was longer.⁽³⁾

This corresponds with previous findings that hip BMD declines with increasing age and time after SCI.⁽¹⁶⁻¹⁸⁾ No relation was found regarding gender, probably because the majority were males and of relatively young age. (Median age 37 years).

The frequency of SCI patients who sustained fracture in this group was 17% which is higher than some reports in the literature of 1% to 6% of the patients, though another study by Lazo *et al* reported a much higher incidence of history of fractures (34% of patients).^(16,17)

It is important to note that the majority of these fractures occurred during transfer and regular activities of daily living that involve minimal trauma.

The regional pattern of bone loss as indicated by low BMD values predominantly in the femoral region while the lumbar spine was better preserved is in agreement with other studies and this could be due to the weight bearing role and impact through the lumbar spine during wheelchair activities and regular standing exercises.⁽¹⁸⁻²⁰⁾

Although our study is based on small number patients, it emphasized the importance of

recognizing osteoporosis as an important issue that needs to be addressed.

Prevention and treatment of reduced BMD is advocated to prevent additional functional impairment and morbidity in SCI individuals.

Conclusion

Spinal Cord Injury patients are at high risk of developing osteoporosis which can lead to significant morbidity, particularly lower extremity fractures without significant trauma.

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