

Prevalence of Hip Ossification and Related Clinical Factors in Cases With Spinal Cord Injury

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Background: Heterotopic ossification (HO) is a complication after spinal cord injury. There are limited studies evaluating hip ossification in Iranian patients with spinal cord injury.

Objectives: We designed this study to evaluate prevalence of HO in cases with spinal cord injury and clinical factors related to this finding.

Patients and Methods: In this study, 135 patients with traumatic spinal cord injury who were referred to a spinal cord injury clinic were enrolled. A structured questionnaire was used to collect data. Hip radiography was performed for all patients to evaluate hip ossifications. An expert radiologist assessed the obtained radiographs.

Results: Thirty one (23%) participants were women and 104 (77%) were men. The most common cause of injury was accident (66.7%) followed by falling (28.1%). HO was present in 51 (37.8%) cases, and hip X-ray was normal in 84 (62.2%). Duration of injury and bed sore were significantly higher in patients with HO. Logistic regression analysis considering HO as a dependent variable showed that only bed sore was an independent predictor of HO.

Conclusions: Evaluation for hip ossification should be considered in patients with spinal cord injury.

Keywords: Hip; Bone Formation; Spinal Cord Injuries

1. Background

One complication that can occur after spinal cord injury (SCI) is heterotopic ossification (HO). HO is the formation of a lamellar bone within the soft tissues surrounding peripheral joints (1). Its prevalence ranges from 10% - 78% (2, 3), and its exact etiology is unknown. Mesenchymal metaplasia, bone metabolism, and joint trauma have been considered to have roles in developing HO (4-6). HO can occur in any joint but most commonly occurs in the hip joint and sometimes occurs in the joints of the shoulders, knees, and elbows (7, 8). It will cause limitation of range of motion and ankylosis, which will negatively impact the rehabilitation processes (9). The exact etiology and pathogenesis of HO are unclear, but some clinical factors have been considered to contribute to development of HO such as sex, age, completeness of the injury, spasticity, and presence of pressure sores (8, 9).

2. Objectives

As studies evaluating hip ossification in Iranian patients with SCI are limited, we designed this study to evaluate

the prevalence of HO in cases with SCI and clinical factors related to this finding.

3. Patients and Methods

In this cross-sectional study conducted in Imam Hospital (affiliated hospital to Tehran University of Medical Sciences) between September 2012 and September 2013, 135 patients with traumatic SCI who were referred to a SCI clinic were enrolled. All patients were asked to complete informed consent forms before entering the study.

A structured questionnaire was applied to collect information regarding demographic data, level of injury, the American Spinal Injury Association (ASIA), complete or incomplete lesions, cause of injury, history of urinary tract infection (UTI), kidney and bladder stones, deep vein thrombosis (DVT), spasticity, and bed sore. Hip radiography was performed for all patients to evaluate hip ossifications. An expert radiologist assessed the obtained radiographs.

Spasticity of the limbs was assessed using the Ashworth scale. The scores range from zero (flaccid, F, or zero) to 4 (the affected joint is rigid in flexion or extension) (10).

Statistical analyses were performed using SPSS software version 18.0 (statistical product and service solutions, SPSS Inc., Chicago). Results are presented as mean \pm SD. The Student's t-test was used for continuous variables, and the Pearson χ^2 test and Fisher's exact test were applied for categorical variables. Logistic regression analysis was conducted by considering HO as a dependent variable. P-value < 0.05 was considered statistically significant.

4. Results

One hundred and thirty-five patients were enrolled in

this study. Thirty-one (23%) were women and 104 (77%) were men. The most common cause of injury was accident (66.7%) followed by a fall (28.1%) (Table 1).

Spasticity was reported in 60 (44.4%) of cases while bed-sore was found in 42 (31.1%). Grade of spasticity was 1 in 14 (23.3%), 2 in 33 (55%), 3 in 9 (15%), and 4 in 4 (6.7%). HO present in 51 (37.8%) patients and hip radiography showed normal results in 84 (62.2%) patients. Duration of injury and bed sores were significantly higher in patients with HO (Table 2). Logistic regression analysis considering HO as a dependent variable showed that only bed-sore was an independent predictor of HO (Table 3).

Table 1. Disease-related Variables in Patients ^a

Variables	Values
Asia	
A	77 (57)
B	28 (20.7)
C	26 (19.3)
D	3 (2.2)
E	1 (0.7)
Complete or incomplete lesions	
Complete paraplegia	74 (54.8)
Incomplete paraplegia	25 (18.5)
Complete quadriplegia	13 (9.6)
Incomplete quadriplegia	23 (17)
Level of injury	
Cervical	41 (30.4)
Thoracic	84 (62.2)
Lumbar	10 (7.4)
Immobility	
Yes	87 (64.4)
No	48 (35.6)
UTI	
Yes	80 (59.3)
No	55 (40.7)
Kidney stone	
Yes	17 (12.6)
No	118 (87.4)
Bladder stone	
Yes	12 (8.9)
No	123 (91.1)
DVT	
Yes	7 (5.2)
No	128 (94.8)
Spasticity	
Yes	60 (44.4)
No	75 (55.6)
Bed sore	
Yes	42 (31.1)
No	93 (68.9)

^a Data are presented as No. (%).

Table 2. Categorical Variables in Patients With and Without HO

Variables	With HO ^a	Without HO ^a	P Value
Age, y	36.9 ± 13.7	33.1 ± 12.9	0.1
Duration of Injury, mo	62 ± 59	45.9 ± 39.2	0.04
Level of injury			0.1
Cervical	16	25	
Thoracic	34	50	
Lumbar	1	9	
Immobility			0.4
Yes	31 (23)	56 (41.5)	
No	20 (14.8)	28 (20.7)	
UTI			0.7
Yes	31 (23)	49 (36.3)	
No	20 (14.8)	35 (25.9)	
Kidney stone			0.3
Yes	8 (5.9)	9 (6.7)	
No	43 (31.9)	75 (55.6)	
Bladder stone			0.7
Yes	5 (3.7)	7 (5.2)	
No	46 (34.1)	77 (57)	
DVT			0.2
Yes	4 (3)	3 (2.2)	
No	47 (34.8)	81 (60)	
Spasticity			0.9
Yes	23 (17)	37 (27.4)	
No	28 (20.7)	47 (34.8)	
Bed sore			0.006
Yes	23 (17)	19 (14.1)	
No	28 (20.7)	65 (48.1)	

^a Data are presented as No. (%) or mean ± SD.

Table 3. Logistic Regression Analysis Considering HO as a Dependent Variable

Variable	OR	95% CI	P Value
Immobility	0.6	(0.2 - 1.3)	0.2
UTI	1.1	(0.5 - 2.4)	0.7
Kidney stone	1.3	(0.4 - 4.3)	0.5
Bladder stone	0.8	(0.2 - 3)	0.7
DVT	1.6	(0.3 - 8.4)	0.5
Spasticity	1	(0.5 - 2.2)	0.8
Bed sore	3.1	(1.4 - 7)	0.004

5. Discussion

The current study found that prevalence of HO in cases with traumatic SCI is 37.8%, which is within the accepted range. In previous studies, prevalence of HO in cases with SCI was reported to be between 12% and 40% (8, 11-13). We also found that injury duration was significantly higher in cases with HO, and the presentation of HO has been correlated with pressure sores. These findings are compatible with the findings of Bravo-Payno et al. In their study, 13% of patients with SCI had HO, and presence of pressure sores significantly correlated with HO (8). Contrary to our findings, they found that complete spinal lesion and spasticity are correlated with HO presentation. In a previous study, Coelho and Beraldo found that spasticity, number of pressure ulcers, and time elapsed since the injury are independently associated with HO (9).

In other studies, patients with complete transverse spinal lesions were at a higher risk of developing HO than other patients (12, 14, 15), but our results did not confirm this finding. The only predicting factor for HO in the current study was pressure sore, which is compatible with previous studies (8, 14, 16). Pressure sores could occur before or after the onset of HO while it has been reported that HO occurs in the first two months after SCI below the level of injury (2). Some authors believe that rapid admission of a patient with SCI to a specialized hospital will reduce the risk of developing HO (6, 8). On the other hand, Bravo-Payno found that an increase in delay to reach a specialized hospital increased the number of pressure sores in cases (8). Additionally, they found that, if pressure sores occur during an early phase, it could influence the development of HO. It may be that a common etiology plays a role in developing both, HO and bed sores. Pressure, friction or muscular trauma, lack of special care, and tissue infection are among the common causes of bed sores (8) while hypercalcemia, tissue hypoxia, changes in sympathetic nerve activity, prolonged immobilization, and mobilization after prolonged immobilization are among risk factors for the development of HO (17). It may be that HO develops after the formation of pressure sores when the infection penetrates the deep tissues, up to the bone.

Special care after SCI may prevent the development of HO and bed sores. The other risk factor for HO development in previous studies was spasticity; however, our results did not confirm spasticity as a risk factor for developing HO.

In the study by Bravo-Payno et al. spasticity was 2 times higher in cases with HO than in cases without HO (8), and the odds of spasticity were 3.8 times higher in HO patients in a study conducted by Coelho and Beraldo (9). Lal et al. found spasticity in 84% vs. 54% of patients with SCI with and without HO (14).

Trauma, manipulations, and intense spasticity in patients with SCI may result in formation of hematomas and para-articular microhematomas. These formations will be calcified and ossify through metaplasia of the mesenchymal cells (8).

We also found that gender, level of injury, and presence of urinary tract complication and DVT are not significantly different in patients with and without HO, but injury duration is significantly higher in cases with HO, confirming Coelho and Beraldo's findings (9).

This article had some limitations. First, it was conducted in a tertiary hospital. Second, we used X-ray for HO diagnosis. Therefore, some patients in early stages may have been missed. Multi-centric studies with large sample sizes using CT scan as a diagnostic tool are recommended. Evaluation for hip ossification should be considered in patients with SCI.

Authors' Contributions

Seyede Zahra Emami Razavi: study idea, data gathering, article edition, Arvin Aryan: data gathering, article writing, Shahrbanoo Kazemi: data gathering, article writing, Abdolrahman Rostamian: data gathering, article editing, Mahsa Ghajarzadeh: study design, data analysis, article writing and editing.

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