

## Predicting Factors For Development of Heterotopic Ossification in Spinal Cord Injury Patients

Pabitrakumar Sahoo<sup>1</sup>, Mamatamanjari Sahu<sup>2</sup>, D K Singh<sup>3</sup>, S P Das<sup>4</sup>

### ABSTRACT

Heterotopic ossification (HO) is a frequent complication in spinal cord injury (SCI) that is often difficult to treat. The incidence ranges from 16-35%. Association of certain complications in spinal cord injury increases the incidence of HO. This is a cross-sectional study conducted at SVNIRTAR, Cuttack, Odisha from January 2009 to December 2014. Out of 132 SCI patients attended to OPD or admitted to SCI ward, HO at different site was diagnosed in 86 patients. A close observation was done on these patients with respect to their associated complications and their relation to development of HO is discussed.

**Key words:** Heterotopic ossification(HO), spinal cord injury (SCI), spasticity, pressure sore.

### Introduction:

Heterotopic ossification (HO) is the formation of true bone in ectopic sites often within the connective tissue of muscle surrounding peripheral joints in patients with neurologic disorders.. It is a frequent complication in spinal cord injury (SCI) patients where the incidence ranges from 16-35%. In non-traumatic myelopathies the incidence of HO seems less compared to traumatic SCI ranging somewhere between 6-15%. HO is less common in children than in adults with an incidence generally reported between 3 and 10%<sup>1,2</sup>.

According to Chalmers *et al*<sup>3</sup> three conditions must be met for the formation of ectopic ossification: the presence of osteogenic precursor cells, an inducing agent, and a permissive environment. Although the

precise causal mechanism for HO is still unknown, humoral, neural and local factors probably all play a role in its pathophysiology. There is either a migration of distant mesenchymal cells to the area involved, with subsequent transformation of these cells into osteoblasts, or a transformation of the local mesenchymal cells directly into osteoblasts<sup>4,6</sup>. Whether these cells migrate at random or in response to some chemotactic factor is still not known, but the importance of several factors has been suggested in the transformation of mesenchymal cells into osteoblasts<sup>6</sup>.

Microscopic study shows that it has four zones.

1. Innermost zone contains highly active zone with mitotic figures like malignant sacomatous cells.
2. Adjacent zone containing cells less active in appearance, but forming osteoid tissue.
3. Zone of trabecular organisation with osteoblasts and fibrous tissue.
4. Peripheral zone of fibrous tissue.

**The purpose of the study** is to find out possible associated factors which can be considered as predictors of development of HO in SCI patients. The data are compared with data of published literature.

### Materials and Methods:

This cross-sectional study was done during January 2009 to December 2014. All the patients attending OPD as OPD patient and patients admitted to SCI ward of SVNIRTAR, Olatpur, Cuttack were screened for HO. Patients were assessed clinically and radiologically.

#### Authors' affiliation:

<sup>1</sup> MBBS, DNB(PMR), DNB (PMR), Asst Professor

<sup>2</sup> MMPT, Senior PT cum junior lecturer

<sup>3</sup> MBBS

<sup>4</sup> MBBS, DNB (Ortho)

<sup>5</sup> MS (Ortho), DNB(PMR), Associate Professor

Physical Medicine and Rehabilitation Department, Swami Vivekananda National Institute of Rehabilitation Training and Research, Olatpur, Bairoi, Cuttack, Odisha

#### Cite as:

Pabitrakumar Sahoo, Mamatamanjari Sahu, D K Singh, S P Das. Predicting factors for development of heterotopic ossification in spinal cord injury patients. IJPMR, December 2015; Vol 26(4):90-3

#### Correspondence:

Dr Pabitrakumarsahoo, Asst professor (PMR), SVNIRTAR, Olatpur, Bairoi, Cuttack-754010, Odisha, India,  
E mail: pabitra2406@gmail.com

Received on 05/11/2015, Accepted on, 15/12/2015

Clinical diagnosis of HO was made in patients presented with unexplained, peri-articular swelling with local warmth, erythema, sometimes accompanied by a low-grade fever and pain in patients with incomplete lesion and sensory sparing, decreased joint range of motion to complete ankylosis of one or more large joints of body. X-ray of the affected joint was done to confirm the diagnosis. Radiological finding varies from an increased density of the peri-articular soft tissues to complete mature extra osseus cortical and trabecular new bone formation. Blood investigations like DC, TLC, ESR, CRP, serum alkaline phosphatase were done to support the diagnosis in radiological inconclusive cases and also to rule out conditions like infection, DVT or impending pressure ulcer. With these features, out of 132 SCI patients attended to OPD or admitted to SCI ward, HO at different site was diagnosed in 86 patients. Hence total no of patients included in the study were 86; 67(78%) were male and 19(22%) were female. Age group range 12-58 years with mean age of 32 years. Data were collected in relation to the following factors-

- Diagnosis of HO from day of injury
- Nature of lesion -- complete / incomplete
- Site of lesion -- cervical / thoracic / lumbar
- Surgery -- non-operated / spinal stabilisation surgery
- Pressure sore -- grading
- Urinary tract infection -- symptomatic/ asymptomatic
- Spasticity -- MAS grading
- Large joints affected

SCI patients with pressure sore of grade III and grade IV were included for data collection. As per European Urological Association criteria of diagnosing UTI, SCI patients presenting with fever, suprapubic pain, turbid urine, haematuria and leucocytes in urine of >40 leucocytes/mm<sup>3</sup> were included as symptomatic UTI.

Modified Ashworth scale was used for spasticity grading. Pressure sores present over various pressure bearing areas like sacrum, trochanter and ischium were graded by standard grading fixed by National Pressure Ulcer Advisory Panel(NPUAP).

### Results:

Average duration of diagnosis of HO from date of injury is 5 and 1/2 months ranging from 2 months to 9 months. On clinical evaluation 54 cases(62.7%) showed complete injury and 32 cases(37.3%) showed features of incomplete injury (Fig 1). Radiological site of lesions are- cervical-31(36%); thoracic 49 (60%) and lumbar 6 (7%) cases (Fig 2). 34 cases (39.5%) had undergone surgery for spinal fixation, 52 cases (60.5%) had not undergone any form of spinal fixation. Pressure sore of grades III and IV were present in 52 cases (60.5%). Eighty cases(93%) had indwelling catheter and 21cases (24%) of them had features of urinary tract infection. All the cases with HO presented with spasticity of different grade as per modified Ashworth scale. Moderate to severe spasticity of MAS 2, MAS 3grade was marked in 56 cases (65%). HO was found around most of the large joints like hip in 48cases (56%) (Fig 3), knee 25cases (29%)(Fig 4) and around elbow in 13 cases(15%) (Fig 5).

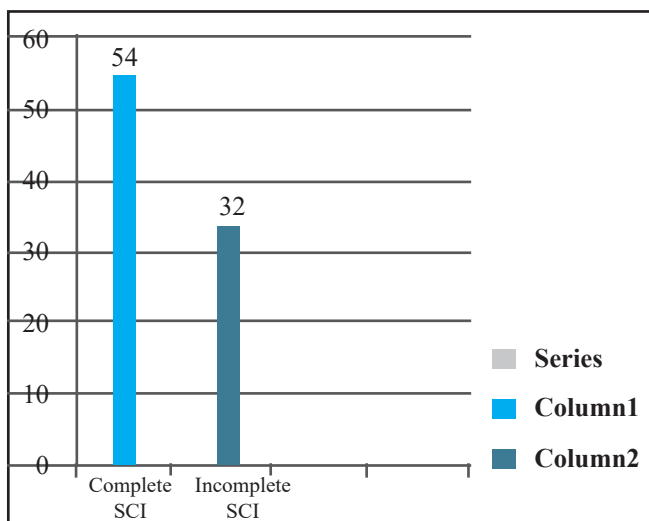


Fig 1: Nature of Injury

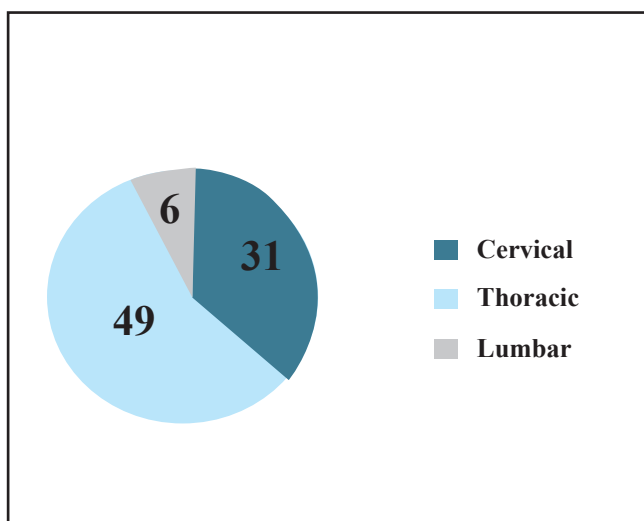
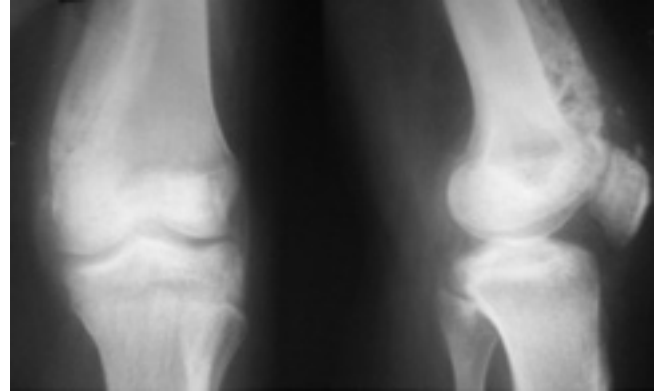


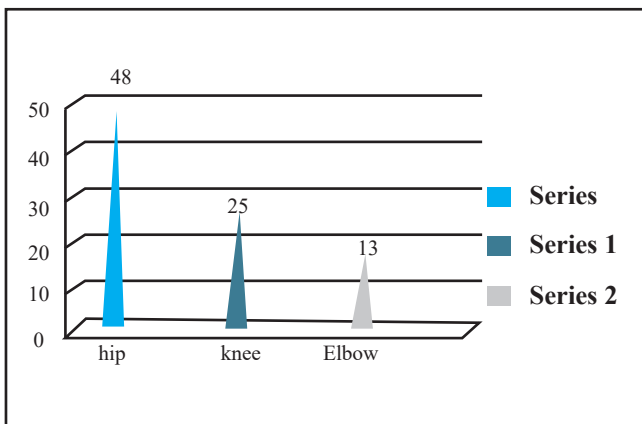
Fig 2: Pattern of Injury



**Fig 3: Heterotopic Ossification Around Both Hip Joint**



**Fig 4: Heterotopic Ossification Around Knee Joint**



**Fig 5: Major Joints of Body Involved with Heterotopic Ossification**

### Discussion:

The clinical presentation of HO in SCI patients ranges from an incidental finding on x-ray to severe restriction of joint range of motion. Peri-articular swelling with red and induration of the part may be noticed due to interstitial oedema of the soft tissues in acute cases associated with low grade fever with local rise of temperature. In patients with sensory sparing, the first symptom may be pain in the affected area. Although HO may develop even several years after SCI, it is generally diagnosed between 1 and 6 months post-injury with a peak incidence at 2 months<sup>7-12</sup>. HO always occurs below the level of the SCI, most commonly at the hip (70-97%)<sup>13-16</sup>, 56% of cases of HO was seen around hip in this study. Although Catz *et al*<sup>17</sup>. did not find a relationship between radiologically diagnosed HO and the severity of the motor deficits. Several authors have reported that complete transverse SCI is more commonly associated with HO than incomplete SCI. This study shows 54 cases (62.7%) of HO in complete spinal injury patients. SCI patients with lumbosacral or cauda equine lesion

less frequently reported with HO<sup>18</sup> which is comparable with this study of 6 cases(7%). An area of soft tissue damage due to pressure ulceration with subsequent oedema may predispose to the development of HO<sup>19</sup>; 60.5% of cases presenting with HO had pressure ulcer of grade III or grade IV. An infected urinary tract could serve as a source of antigenic material precipitating an immune response that triggers subsequent HO<sup>20</sup>. However this study shows only 24% cases HO had features of UTI although 97% cases had bladder with indwelling catheter. Controversy also exists regarding the possible association between HO and spasticity. In some studies HO is more commonly seen in SCI patients with spasticity and more extensively in those with severe spasticity<sup>21-23</sup> which is seen in 65% cases in this study.

### Conclusions:

Since the pathophysiology of HO is poorly understood, the only preventive treatment possible is the early identification and adequate treatment of the possible risk factors. With adequate nutrition and nursing management, the incidence of urinary tract infections, decubitus ulcers may be reduced, and thereby, the risk of developing HO. Although in the early literature, aggressive passive physiotherapy has been recommended to improve joint mobility and to counteract ankylosis in the case of contractures, it is now generally accepted that SCI patients profit from early, regular, and cautious joint mobilisation. More rigorous exercises with the risk of (micro) trauma to the peri-articular tissues better to be avoided. When gentle passive movements of the large peripheral joints are started and maintained from the day of the injury, the joint capsules are kept as supple as possible, muscles will not easily shorten and contractures will not readily develop, so that HO may be prevented.

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