

Heterotopic Ossification after Acetabular Fractures: Prevention and Management

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Abstract

Background: Heterotopic ossification is a common complication after acetabular fractures that causes limitation of movements and functional disability. The aetiopathogenesis remains doubtful with various risk factors being described to be associated with it like associated brain injury, extensile approaches, male sex. The role of NSAIDs especially indomethacin and radiotherapy have been described for the prevention and management of heterotopic ossification. However there is no general consensus with few studies refuting their role. The purpose of this review is to discuss the prevention and management of heterotopic ossification and the associated side effects of indomethacin and radiotherapy.

Keywords: Heterotopic ossification, acetabular fractures, indomethacin, radiotherapy.

Introduction

Heterotopic ossification after acetabular fractures is one of the most common complications, the incidence being from 5% to 100%. (1-10) The occurrence of heterotopic ossification lead to severe restriction of range of motion that leads to severe decrease in the functionality of the patient.

Pathophysiology

Heterotopic ossification is divided into 3 types based upon the aetiology – (a) Neurological, (b) genetic and (c) traumatic (11). But the pathophysiology still remains doubtful. Numerous factors such as Prostaglandin activity, especially PGE-2, hypercalcemia, sympathetic dysfunction, prolonged immobilization and imbalance between PTH activity and calcitonin have been implicated contributing to the formation of heterotopic ossification. The primitive mesenchymal cells in the surrounding soft

tissues are converted into osteoblastic cells due to these factors (12). This differentiation of the mesenchymal cells into osteoblastic cells starts within 16 hours of surgery with peak at 32 hours after surgery (13). Since the exact aetiopathogenesis is still doubtful, various risk factors have been found to identify patients at risk for this complication (1-3, 5, 14-19). This risk factors are

1. The type of approach – Extended Iliofemoral approach – highest risk, Kocher-Lagenback approach – intermediate risk, Ilioinguinal approach – lowest risk. Complex approaches, trochanteric osteotomy and double exposures are also associated with increased risk of heterotopic ossification
2. Male sex
3. Associated traumatic brain injury or thoraco-abdominal injury
4. T – type acetabular fracture and associated injuries such as sciatic nerve injury, femoral head injury, intraarticular debris

5. Delayed surgery.

Recent articles have found conflicting results in terms of risk factors [20,21]. These studies reported that age, gender, injury severity score (ISS), presence of neurologic injury, occurrence of hip

dislocation, interval from injury to surgery, presence of comminution, femoral head impaction, debris in the joint, number of other fractures, and head and chest did not correlated with formation of HO. One study reported prolonged mechanical ventilation as a risk factor [21] while the other reported length of stay in intensive care and non-intensive care length of stay in the hospital [20] to significantly affect the HO rates. This may be because both these studies used either indomethacin and radiotherapy for prophylaxis which reduces the risk significantly even in presence of other risk factors.

Classification

Brooker et al (22) classified heterotopic ossification around hip into 4 types radiographically based upon AP view of pelvis with both hips (Table 1, Fig 1). Della Vale (23) modified the Brooker classification based upon routine AP pelvis with both hips x ray and additionally inlet and outlet Judet oblique views

- Grade A: absence of HO (may be ≥ 1 island of bone of < 1 cm in length)
- Grade B: presence of ≥ 1 islands of bone of at least 1 cm in length and bone spurs from the pelvis or femur. 1 cm distance between opposing surfaces of bone
- Grade C: bone spurs arising from the pelvis or femur with < 1 cm between opposing surfaces or apparent bone ankylosis.

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Grade I	Ossification islands around the hip
Grade II	Bone projection of pelvis or proximal femur with atleast 1 cm away from the opposite surface
Grade III	Bone projection of pelvis or proximal femur reducing space between opposite surface <1 cm
Grade IV	Hip ankylosis

Table 1: Brooker classification of Heterotopic ossification

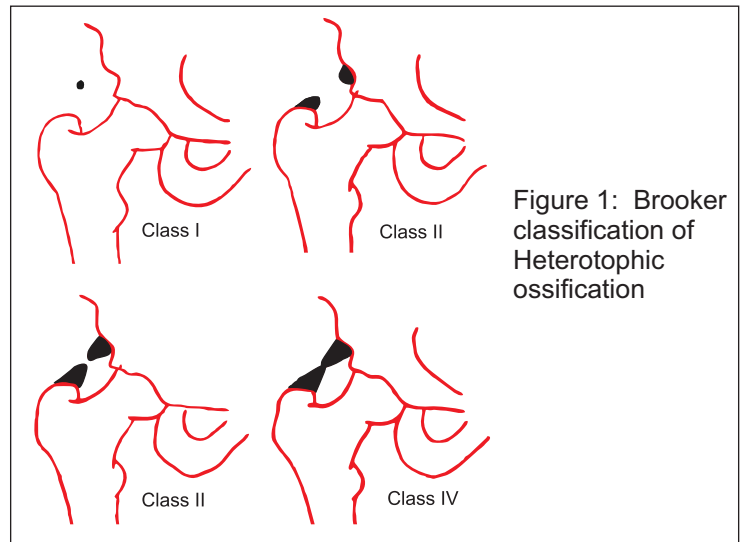


Figure 1: Brooker classification of Heterotopic ossification

Prevention

Prophylactic indomethacin (13,14,20) and sProphylactic indomethacin (15,16,24) and single dose radiotherapy(25,26) have been used for the prevention of heterotopic ossification.

1. Indomethacin is used in dose of 25mg three times a day or 75mg sustained release immediately after surgery usually within 24-48 hours for 7 -14 days. Amongst all the NSAIDS, only indomethacin has been found to have evidence in prevention of heterotopic ossification(22). Sagi et al (27) compared the efficacy of indomethacin given for 3 days,7 days and 6 weeks versus placebo in prevention of heterotopic ossification and found best results in indomethacin given for 7 days and worst results when indomethacin was given for 6 weeks. But Karunakar et al in their double blinded RCT found no significant difference in the formation of heterotopic ossification between the placebo group and indomethacin group(7). They suggested risk stratification and improved surgical technique will be enough to bring down the HO rates.

Mechanism of action: Inhibition of PGE-2 mediated bone remodeling and differentiation of osteoprogenitor cells (28,29).

Side-effects: prolonged bleeding time, gastro-intestinal irritation, impaired fracture healings, renal toxicity (29).

2. Radiotherapy in form single dose of 700 to 800 Cgy is given prophylactically for prevention of heterotopic ossification(30).

Mechanism of action: prevent formation of heterotopic ossification by disrupting the mesenchymal cells (25,30).

Side-effects: Increased risk of malignancy, oligospermia, high cost(31).

The surgical technique also plays a role in the

prevention of heterotopic ossification.

Roult and Swiontkowski recommended debridement of necrotic gluteus minimus muscle to reduce the risk of heterotopic ossification (17). Other have suggested that gluteus minimus debridement with single dose of radiation will be enough to bring the HO rates to minimum [32]. Careful surgical technique in form of protection of abductors, debridement of necrotic gluteus minimus and digastric slide osteotomy may also reduce HO rates [33]. Combined approach using radiation and Indomethacin has been used in high risk total hip replacement but its use in acetabular surgery in not reported. Combined use of improved surgical techniques and reduce dose of radiation/indomethacin may be the best combination, but requires further investigation. Radiation has been reported to be safer than Indomethacin but cost is much higher [34]

Management

The initial management consists of investigating for other sources of pain such as infection, neuroma, post traumatic arthritis followed by physiotherapy for improving the range of motion and NSAIDs. The NSAIDs provide relief from pain and reduce inflammation but do not prevent or inhibit new bone formation. Finally, the only treatment option of already formed heterotopic ossification is delayed surgical excision of the ossified mass which is usually done after 6 months postoperatively when it is encapsulated followed by secondary prophylaxis to prevent recurrence(35). Recent article by Wu et al [36] based the surgical excision on alkaline phosphatase (ALP) level and not on duration after

fixation. They believe ALP to be much more sensitive indicator of HO maturity. They suggested early surgical removal of HO [surgery > 3 months and ALP levels normal] rather than waiting for 9-12 months. The surgery itself has complication like femoral neck fracture, sciatic nerve injury, AVN and around 33% recurrence rate was reported by them. Thus proper selection of patient and assessment of risk – benefit ratio should be taken into account before undertaking surgical exercise.

Conclusion

Enough evidence exist to justify routine usage of prophylaxis to prevent heterotrophic ossification in surgical management of acetabular fracture. Although randomised trial exists but superiority of either of the methods viz indomethacin or radiation therapy is not firmly established and either can be used as per availability, surgeons preference or institute protocols. Optimised surgical technique and debridement of necrotic gluteus minimus will help in further reducing the incidence

Clinical Message

HO is a common occurrence but mild to moderate HO may not significantly affect outcome. A risk assessment of HO and appropriate prophylaxis plan using either Indomethacin or radiation will prevent severe HO in most patients. Improved surgical technique and safe tissue handling will further reduce the incidence. In case with established HO, surgical excision is an option if the assessment of risk benefit ratio is favorable.

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