Clinical Oncology: Case Reports

Case Report

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A Single Dose does Matter! An Interesting Case of Adjuvant Radiation Therapy in Heterotopic Ossification of the Bilateral Hip: A Clinical Case Report

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Abstract

Heterotopic Ossification (HO) is the formation of mature, lamellar bone in soft tissues where bone does not normally exist. HO is commonly seen following trauma or surgical intervention in periarticular soft tissue and is commonly associated with injury to the hip. The three primary causes can be classified into traumatic, neurogenic, and inheritable etiologies. Radiotherapy inhibits osteoprogenitor cell proliferation, hence its use as a prophylactic treatment to prevent the further development of calcifications. Radiation Therapy (RT) can also be used as adjuvant therapy after excision of the excessive bone. Here is an interesting case of a 20-year-old gentleman with bilateral hip heterotopic ossification. Adjuvant or postoperative administration of radiotherapy using a 10 Gy single dose delivered within 24 hours to 48 hours is effective and safe as a prophylactic treatment option to prevent further development of HO. Radiation therapy, along with surgery, helped improve the range of motion.

Keywords: Heterotopic bone; Radiotherapy; Single fraction; Adjuvant radiation therapy.

Introduction

Heterotopic Ossification (HO) also known as Myositis Ossificans, is the formation of mature, lamellar bone in soft tissues where bone does not normally exist. HO is commonly seen following trauma or surgical intervention in periarticular soft tissue and is commonly associated with injury to the hip. The three primary causes can be classified into traumatic, neurogenic, and inheritable aetiologies. Radiation Therapy (RT) inhibits osteoprogenitor cell proliferation, hence its use as a prophylactic treatment to prevent further development of calcifications. Radiotherapy can also be used as Adjuvant therapy post-excision of the excessive bone. Here is an interesting clinical case where RT is used in the immediate post-operative setting.

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Case Presentation

A 20-year-old gentleman presented with hard swelling over bilateral hips, and restriction of bilateral hip movements for 6 months to 7 months. He gives a history of trauma and fracture to his cervical vertebra 2 years ago; he underwent decompression with the fusion of the same.

Diagnostic Assessment: X-Ray pelvis (Figure 1) showing soft tissue ossification with little demarcation from surrounding soft tissues seen in the bilateral hip joints. A pelvic CT scan (Figure 2) revealed diffuse hyperdense area of bone attenuation (CTHU value 600) noted extending from the bilateral iliac bones, extending inferiorly upto lesser trochanter with bridging. On the right side measures 7.8 cm × 17.6 cm × 7 cm and on the left side measures 7.4 cm × 2.1 cm × 8cm. The iliacus muscles are seen superficial to this lesion. Grade 4 HO according to Brooker Staging Classification System [1].

Therapeutic Intervention: Patient underwent CECT RT planning from the umbilicus to midthigh before surgery.

Surgery 1: He underwent right hip heterotopic ossification excision.

Radiation Therapy: After counselling and consent regarding disease condition and treatment, the patient underwent CT simulation using a flat couch and wing board from the umbilicus to the midthigh. Preoperative and post-operative CT scans were fused and contouring (target volume delineation) was done using ONCENTRA planning system of our institution. Clinical Target Volume (CTV) included preoperative tumor volume + post OP bed and right hip and lateral compartment of the thigh, Planning Target Volume (PTV): CTV + 3 mm. The bilateral femoral head, prostate, seminal vesicle, urinary bladder, bowel bag, anorectum, penis, scrotum were contoured as organs at risk (OARs) as seen in (Figure 3). Radiation therapy was delivered using 6MV LINAC using the 3DCRT technique (5 beams) as seen in (Figure 4) to a dose of 10 Gy in 1 fraction to PTV given within

Figure 1: X -Ray of the pelvis.

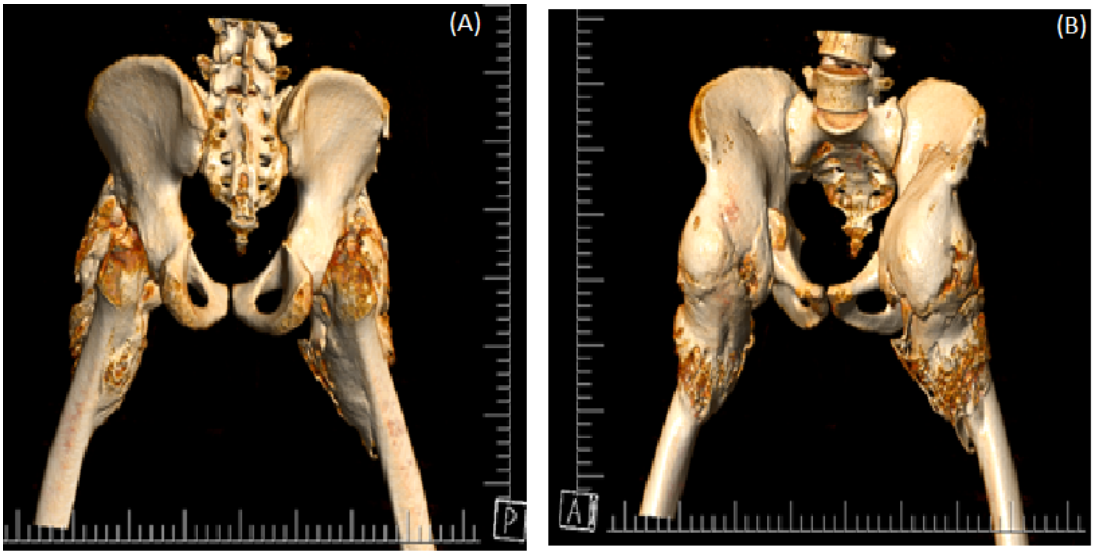

Figure 2: 3D CT reconstruction of the pelvis.

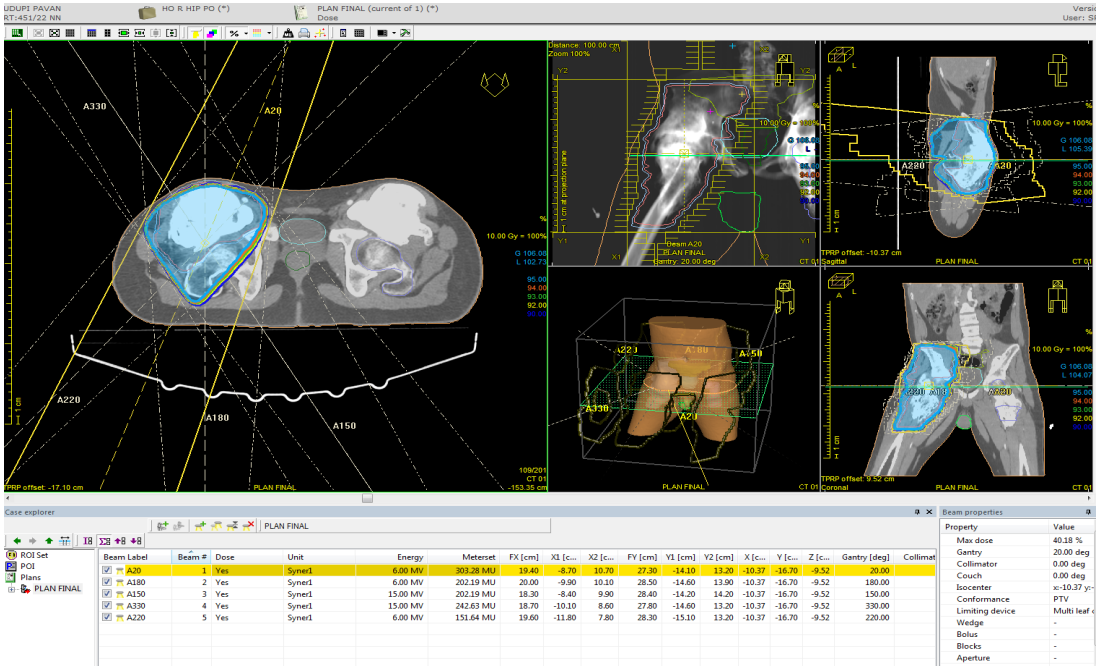

Figure 3: Right hip beam arrangement, 3DCRT technique.

24 hours post OP.

Surgery 2: He underwent a similar excision 2 weeks after the first surgery, followed by adjuvant RT with 10Gy in a single fraction on the left side hip using the 7-beam 3DCRT technique (Figures 5-7). OAR dose constraints were within normal limits. He tolerated radiation treatment well and did not report any acute adverse effects related to radiotherapy. He was advised to review after 1 month.

On 1 and 3-month follow ups, he had improved range of motion and no disease recurrence.

Discussion

Heterotopic ossification (HO) also known as myositis ossificans, neurogenic osteoma, ossifying fibromyopathy, heterotopic calcification, is one of the non-malignant (benign), frequent disorder defined as ectopic, pathologic formation of mature lamellar bone in nonosseous soft tissues or in extraskeletal soft tissues. While HO is seen in rare genetic conditions, it is most prevalent after joint replacement surgery, traumatic brain injuries, spinal cord injuries and burns, blast trauma, elbow and acetabular fractures, and

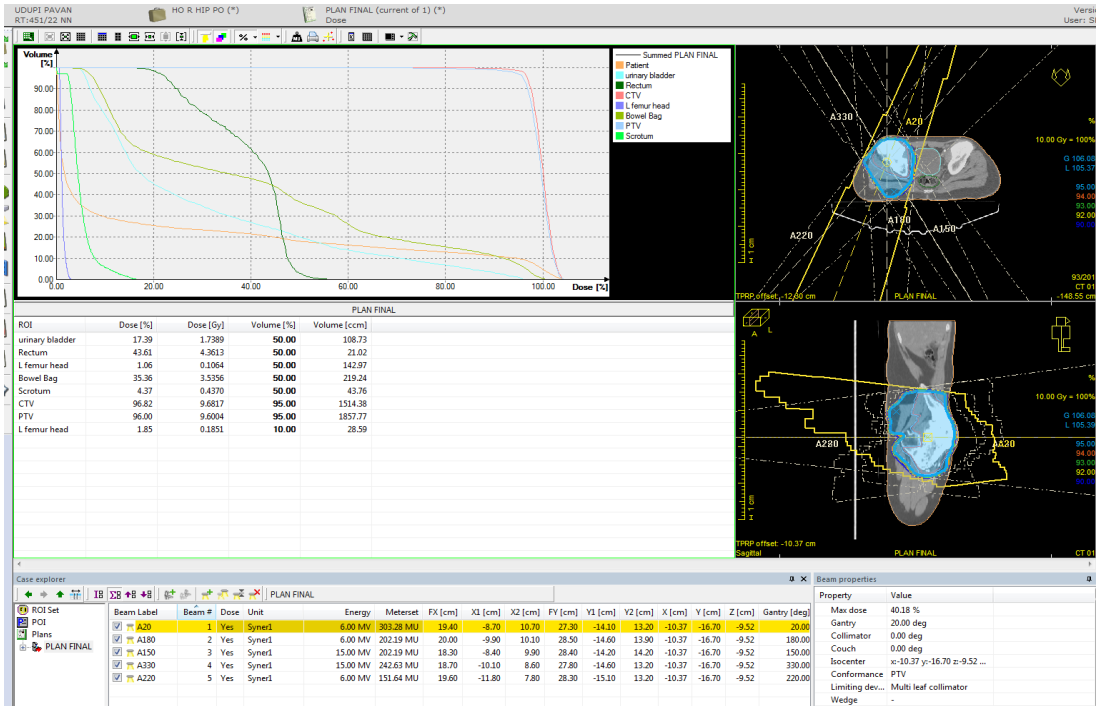

Figure 4: Right hip PTV 3DCRT with 5-beams and DVH, OARs.

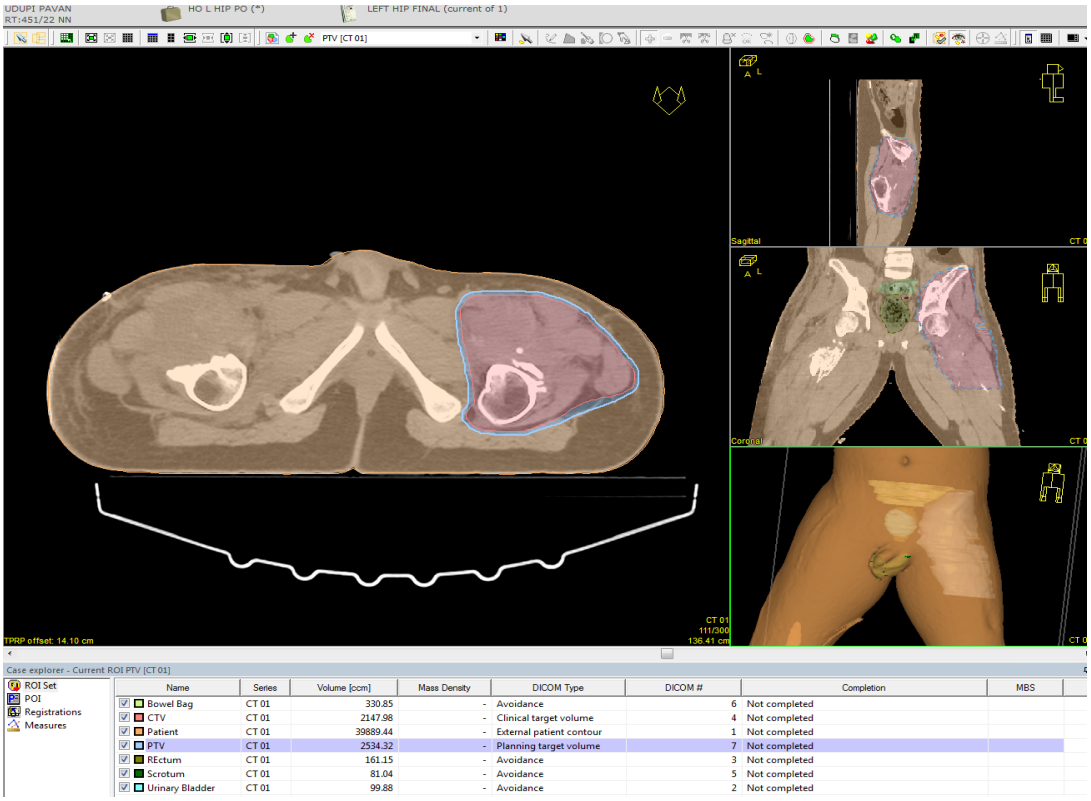

Figure 5: Left Hip volume, OARS.

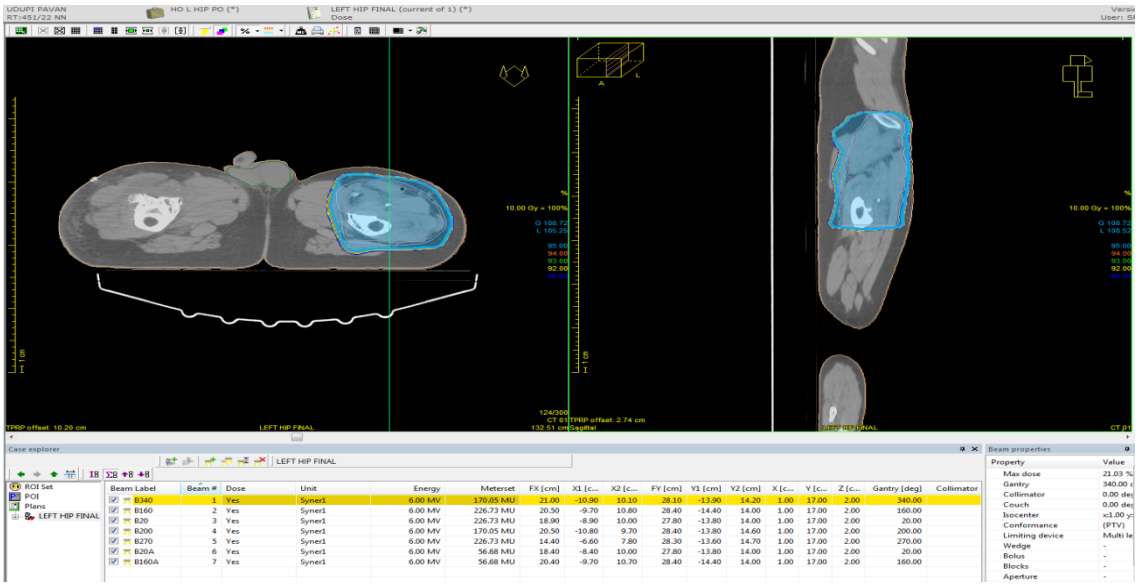

Figure 6: Left hip PTV showing 7-beams, 3DCRT.

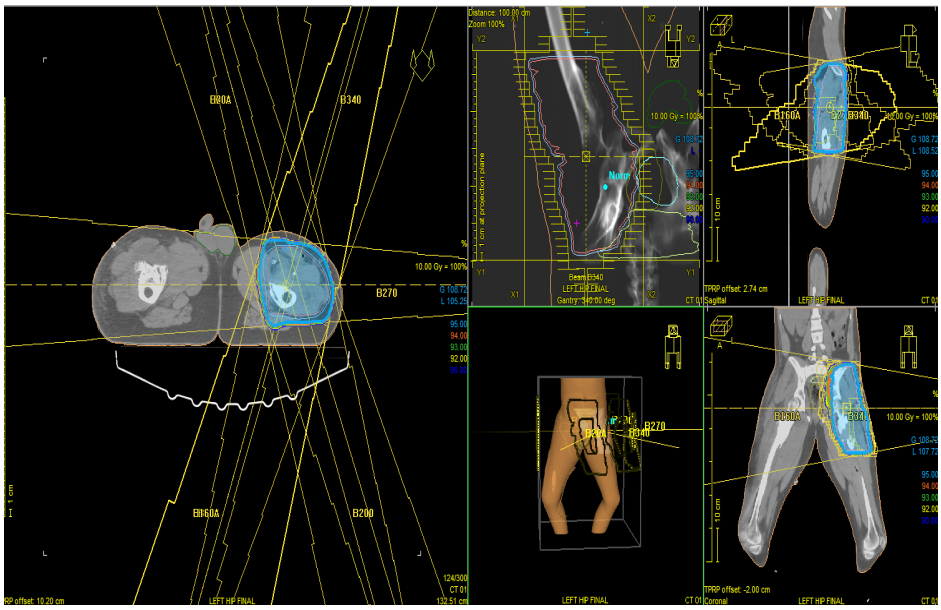

Figure 7: Left hip 7 beam 3DCRT planning.

thermal injury [2]. While the hip is the commonest site, it may also affect other sites including the elbow, shoulder, knee and temporo-mandibular joint. It is frequently asymptomatic in the early stages, evident on imaging only, but may progress to severe debility from pain to reduced range of movement at a nearby joint, to complete ankylosis. HO occurs in the presence of osteoprogenitor cells, which are pathologically induced by an imbalance of local or systemic factors. The transformation of progenitor cells into bone progenitor cells as a result of cell interactions with the local tissue environment is influenced by oxygen tension, pH, and micronutrient availability and mechanical stimuli leads to ossification. Two common methods of prevention are Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) and low-dose radiation therapy [3]. Recently, many novel prophylactic strategies have been investigated (e.g. pulsed electromagnetic fields, free radical scavengers and bone morphogenic protein inhibitors).

Numerous non-malignant diseases can be treated with radiation therapy. Radiotherapy has been proven as an effective prophylaxis especially for those patients with high risk of HO after THA [4]. To compare HO progressions with different radiotherapy strategies and explore an optimal radiation option. Of 87 identified studies, 10 randomized controlled trials including 1203 patients and 1268 hips were taken to this analysis. There was a statistically significant reduction in the prophylaxis of HO progression with multiple fractions as opposed to single fraction radiotherapy (p = 0.04). Hips

with preoperative radiation were no more likely to observe HO progression than those with postoperative radiotherapy (p = 0.43). Radiotherapy with medium dose (20 Gy ≤ BED ≤ 24 Gy) after THA is an effective dose for preventing HO. In the prophylaxis of HO, multiple fractions seem to be more effective than single fraction radiation [5]. Preoperative radiotherapy could prevent HO progression with the same efficacy postoperative.

Georhakopoulos I et al retrospectively analysed the outcome of therapeutic irradiation for the prevention of HO in 14 patients. They used radiation doses ranging from 7 Gy to 10 Gy in a single fraction for the prevention of HO after surgery. After a median follow- up of 126 months none of their patients developed HO. Impaired wound healing or other post-surgery complications were not observed. A single fraction of RT seems to be a sufficient, cost-effective and, safe treatment regimen [6]. In studies they report excellent results as none of their patients developed HO. Well-planned surgical excision can improve patient outcomes regardless of the joint involved or the initial cause of injury. Future therapeutic strategies are focused on the targeted inhibition of local factors and signaling pathways that inhibit ectopic bone formation.

Conclusion

Adjuvant or postoperative administration of radiotherapy using a 10 Gy single dose delivered within 24-48 hours is effective and safe as a prophylactic treatment option to prevent further development of HO. Radiation therapy and surgery helped improve the range of motion. To conclude single dose of RT matters and is a cost-effective modality of treatment to reduce and prevent extraosseous bone formation.

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