Medical Science

pISSN 2321–7359; eISSN 2321–7367

Core decompression with Bone Marrow Aspirate Concentrate (BMAC) - Halting the progression in early AVN head of femur

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To Cite:
Ganesh MT, Saravanan P, Natarajan AK. Core decompression with Bone Marrow Aspirate Concentrate (BMAC) - Halting the progression in early AVN head of femur. Medical Science, 2022, 26, ms43e1955.
doi: https://doi.org/10.54905/disssi/v26i120/ms43e1955

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Peer-Review History
Received: 20 November 2021
Reviewed & Revised: 24/November/2021 to 18/January/2022
Accepted: 20 January 2022
Published: 26 January 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Hip pain in young adults could be due to femoral head avascular necrosis which has an indistinct etiology. A delay in the diagnosis and treatment, around 70-80% of the hips progresses to secondary osteoarthritis. Various treatment modalities have been described in the literature for early AVN hip with variable outcome. Early diagnosis and appropriate intervention could halt the progression, hence preserving the hip joint. However, if the disease progress, the femoral head collapses leading to secondary degeneration, and the surgeon would be left with Total Hip Arthroplasty (THA) as the treatment option. THA in young patients may invariably require revision replacement surgeries future in their lifetime and hence a good treatment modality is essential for early AVN to delay the need for arthroplasty. This case report focuses on a 28 year old male patient who came with left hip pain for the past two months with no history of any significant trauma. A possibility of ANV was considered and MRI taken. MRI showed a vascular necrosis grade II of left femoral head. Core decompression (CD) followed by Bone Marrow Aspirate Concentrate (BMAC) was then carried out for the patient under image intensifier guidance. Earlier MRI imaging helped in early diagnosis and intervention to prevent progression of the disease. The addition of Bone Marrow Aspirate resulted in better osseous regeneration.

Keywords: Avascular necrosis, Bone Marrow Aspirate Concentrate, core decompression, hip pain

1. INTRODUCTION

Avascular necrosis of the hip joint (AVN hip) is a condition in whichaseptic death of a segment of the head of femur happens due to interruption in vascularity. The onset of AVN is insidious and the patient mostly presents with hip pain as an early symptom. The condition occurs commonly in males with a multifactorial etiology. A through clinical evaluation is essential to find out the possible cause. Alcoholic avascular necrosis occurs due to

dyslipidemia causing decrease in vascularity of the femoral head which results in ischemia and death of bone. The lack of blood supply may lead to poor bone turnover and it does not undergo renewal, and over a period of repetitive stress it collapses (Louis Solomon et al., 2014). Early stages of AVN may not be visible in plain radiographs. Therefore by the time the patient presents the lesion is often well advanced. Numerous studies have concluded MRI as the most accurate of all imaging modalities (Steinberg et al., 2001: Khanuja et al., 2001). Therefore the reliable method of picking up early signs of osteonecrosis is by MRI.

Once AVN hip is diagnosed at pre-collapse stage, the goal of intervention is to avert collapse and sustain normal hip function which would be a significant success in the treatment. A recent literature review on non-operative management for early AVN hip showed that treatment with bisphosphonates, anticoagulants and vasodilator therapy have shown to reduce pain and delay the progression of disease in early stages. However, sufficient data is not enough to show positive outcome in early AVN hip with regards to non-operative management. There are studies that show Core decompression with or without modification of technique as a safe option in the pre-collapse stage. Very few articles have shown the use of Bone Morphogenic Protein (BMP), Bone Marrow Aspirate concentrate (BMAC) and stem cells as an adjunct to core decompression. Even though, the use of vascularised cortical grafts had shown successful results, it is still not commonly due to technical difficulty and donor site morbidity. Hence augmenting the core decompression with BMAC may allow better osseous regeneration in the necrotic lesion site reducing the complexity of surgery.

2. CASE PRESENTATION

28-year-old male patient presented with a 2 month history of hip pain. Patient gives alleged history ofheavy alcohol consumption 500ml per day of hard alcohol of the past 8 years. Patient initially had mild left hip pain. Gradually over the course of two months pain increased in intensity and patient also developed difficulty walking. The patient did not sustain any fall or injury to the hip. Patient gives no h/o steroid intake. A plain radiograph of pelvis with both hips (fig-1) showed mild sclerosis in the left femoral head.

Figure 1 X-ray Pelvis with both hips showing mild sclerosis in left hip

On examination of the left hip, tenderness was present over the left hip joint line and flexion and internal rotation movement were painful and restricted terminally. Differential rotation or sectoral sign was positive in the left hip. MRI L hip was taken (fig 2), which showed grade II AVN changes, as per modified Ficat & Arlet classification (Ficat & Arlet, 1980).

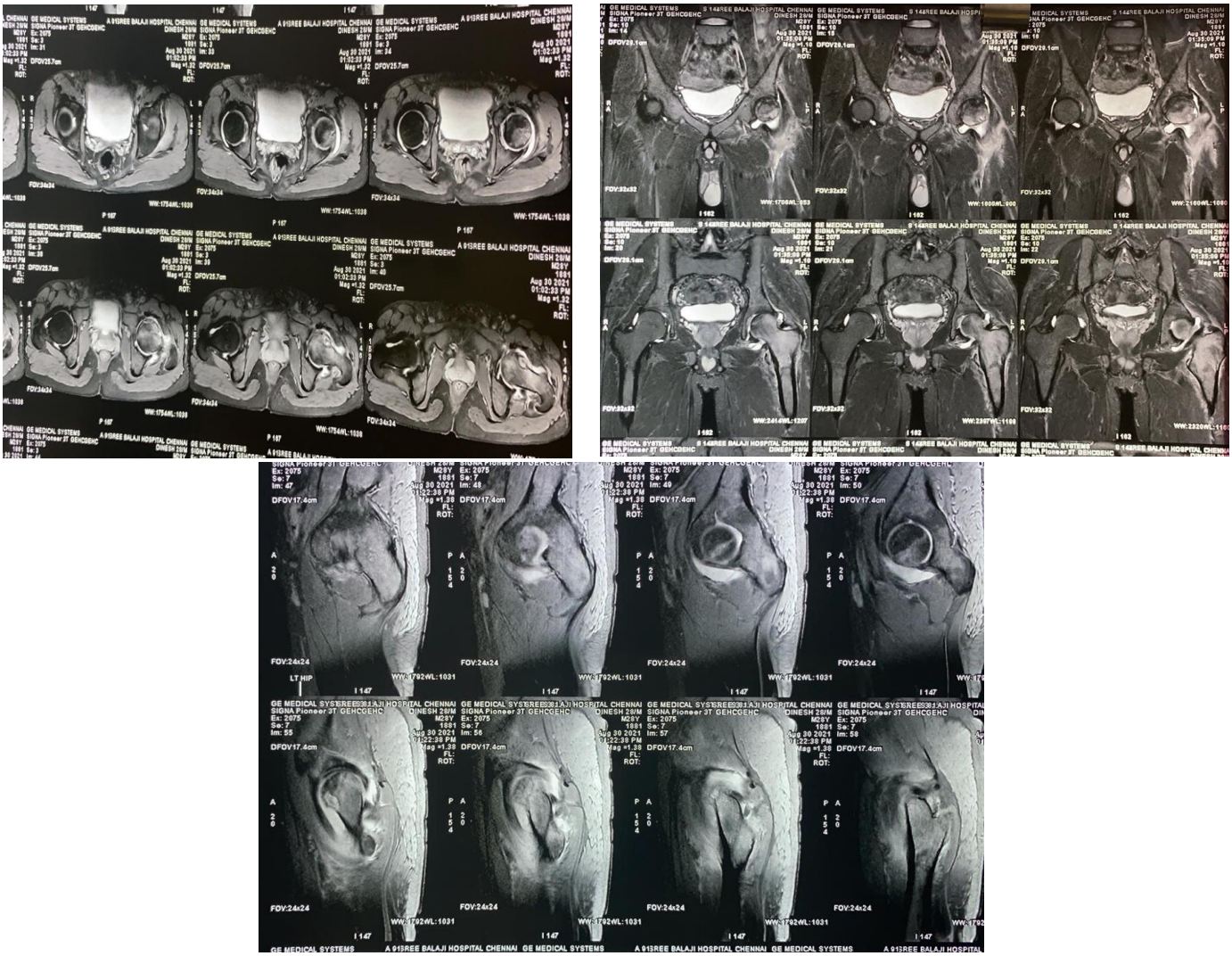

Figure 2 MRI-Left hip: shows grade II AVN changes

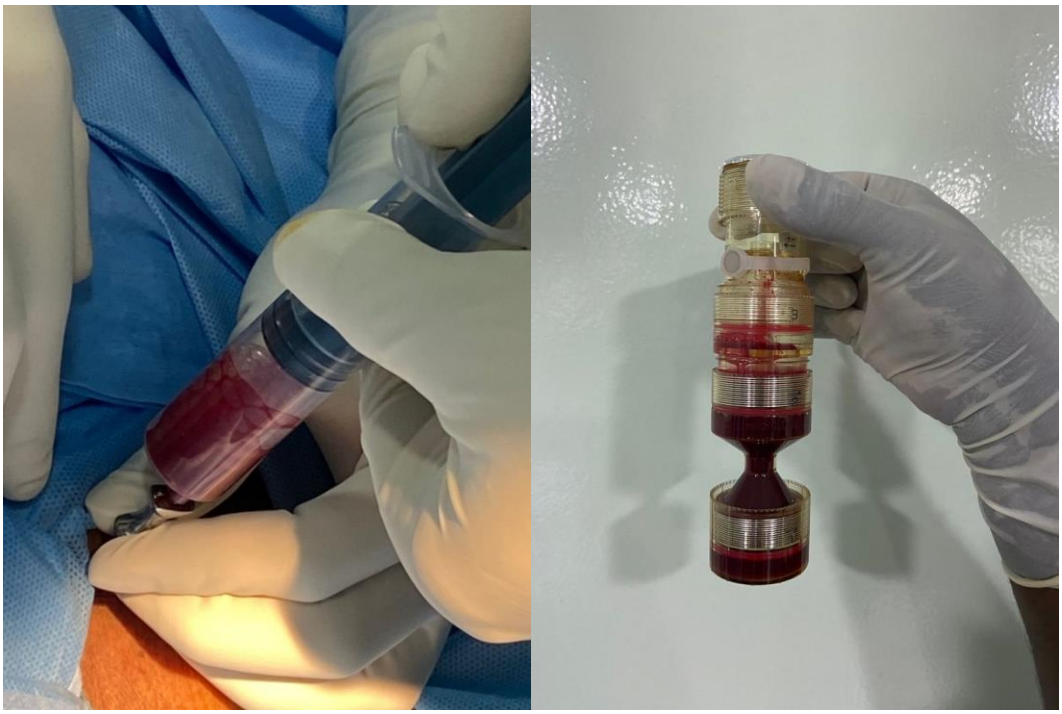

Figure 3 showing aspiration of bone marrow from iliac crest (a) & concentrated BMA after centrifuging (b)

Surgical Intervention

Left hip core decompression augmented with BMAC was planned for the patient considering the young age and AVN at pre-collapse stage. Pre-operative evaluation was done and anesthesia fitness was obtained. Under spinal anesthesia, with patient in supine position, a 5cm incision was made on the lateral aspect of the femur below lower end of the greater trochanter. Tissue dissection carried out to bone. Tensor fascia latasplit and muscle incised and retracted. Under image intensifier guidance, guide wire advanced up to the subchondral region of the femoral head. The position is confirmed by imaging. Then the center of femoral head was decompressed using an 8mm reamer. After reaming, the reamed space was filled with Bone Marrow Aspirate Concentrate (BMAC) from iliac crest (fig. 3). Wound was closed in layers and sterile dressing applied. The drill debris containing necrotic bone was sent for histopathological examination.

3. DISCUSSION

AVN head of femur presenting in young patient at pre-collapse stage needs prompt management. If not treated at pre-collapse stage, the disease progresses leading to more aggressive surgeries like THA and might require revision surgeries in future. Our patient had presented with hip pain for a period of 2 months. The only significant history was heavy alcohol intake. Plain radiograph was taken and showed mild sclerosis. There can be a delay of 1-5 years between onset of symptoms and appearance of findings in plain radiographs (Stoica et al., 2009). MRI was therefore taken immediately and the patient was diagnosed with grade IIavascular necrosis. The patient was treated surgically with core decompression and BMAC instillation. Post-operatively patient reported relief of pain and mobility was restored. Non weight bearing was maintained for six weeks post op to prevent any collapse. Follow up at six weeks, 3 months and 6 months showed significant improvement both clinically and radiologically (fig. 4).

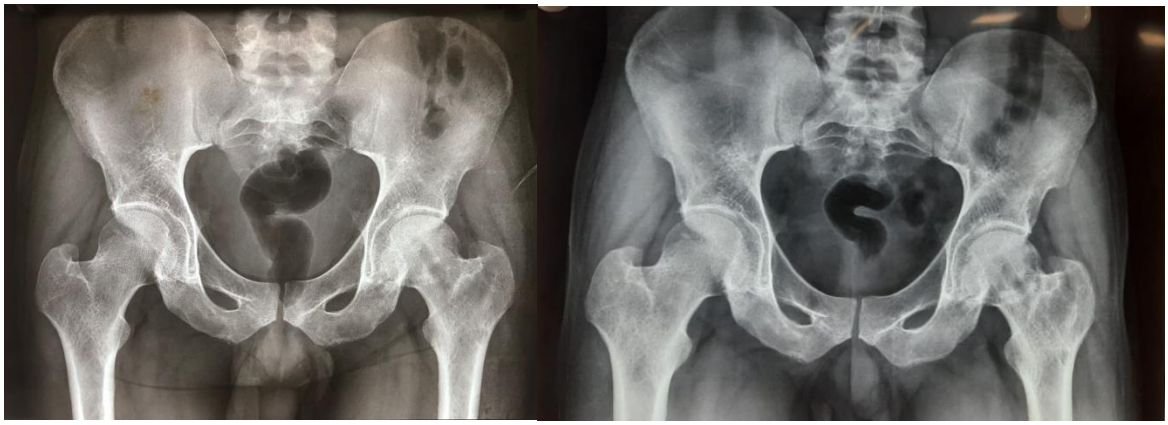

Figure 4 X-ray at immediate post-op and after 6 months. Pelvis with both hips AP view showing post-op changes after Core Decompression.

Studies have evaluated the usefulness of BMP enhanced bone graft in stopping disease progression in early AVN hips. A significant decrease in mesenchymal stem cells in AVN has been documented (Hernigou et al., 1999). Mont et al., (2003) instilled BMP enriched bone graft substitute using a trap door technique. They showed good clinical results in 86% hips at a 36 months follow-up. However, this procedure is technically difficult and requires extensive dissection compared with core decompression. Lieberman et al., (2004) reviewed the results of early AVN hips operated with core decompression with an allo-implant composite, antigen-extracted, autolyzed fibular graft perfused with human BMP and non-collagenous proteins. Their study concluded that core decompression outcome may be enhanced with osteoinductive factors.

A study by Eric Larson et al., (2018) showed that better results of the current interventions for early AVN hip to date is core decompression along with use of Bone Marrow Aspirate Concentrate which enhances the healing potential of the femoral head. Currently there are no Indian studies in the literature demonstrating core decompression procedure combined with BMAC for early AVN hip, however there are studies that have reviewed of use of other methodologies in AVN management. A recent systematic review and meta-analysis showed no added benefits of doing CD and BMAC when compared to CD alone in post collapse advanced AVN cases (Jindal et al., 2021).

Earlier MRI taken on the first presentation to the hospital resulted in an earlier diagnosis of avascular necrosis. MRI is a sensitive and specific method for diagnosing femoral head necrosis at an early stage (Kalunian et al., 1989). Early diagnosis and intervention with head preserving procedures like core decompression is crucial in preserving the femoral head and obviating or postponing

head replacement procedures (Todd et al., 2015). Augmenting the primary procedure Core decompression (CD) with BMAC increases the efficacy of treatment. Head preserving procedures earlier in the course of avascular necrosis can aid in decreasing the morbidity and mortality from the disease. In our patient, only a history of alcohol consumption was favorable towards AVN, also plain radiograph showed mild sclerosis. Based on high index of suspicion MRI was taken which resulted in diagnosis of the disease atan early stage and Core Decompression (CD) with BMAC was performed. This underscores the need for early magnetic resonance imaging even in cases of with minimal plain radiograph findings; Avascular necrosis is such a disease that if it is not diagnosed early on plain radiographs and diagnosis later in the course of the disease results in replacement procedures which come with high morbidity and mortality and potential need for revision arthroplasty surgeries if done in young patients (Garino et al., 1997).

Core decompression along with a modification of the technique is a successful technique with good literature evidence in the early AVN femoral head. The use of osteoinductive material like Bone Morphogenic Protein and Bone Marrow Aspirate Concentrate may reinforce core decompression (Sen, 2009).

5. CONCLUSION

Avascular necrosis should be suspected in patients with persisting hip pain with heavy alcohol intake even with a normal x-ray. As plain radiographs cannot diagnose avascular necrosis in early stages, a MRI scan is indicated. In our patient MRI scan revealed a grade II avascular necrosis at pre-collapse stage, early intervention with core decompression and BMAC was done. An MRI scan taken at a later stage could have resulted in progression of avascular necrosis and resulted in further procedures like total hip arthroplasty which would not have preserved the femoral head and would have increased the morbidity and mortality for the patient and might necessitate arthroplasty considering the age of the patient. There is no standard treatment for AVN at pre-collapse stage. Though literature may show case studies which advocate the use of non-operative and operative treatment for early AVN, not one of them have found to be superior to the other. This case report shows better result when Core Decompression (CD) is combined with BMAC injection in early AVN hip at a pre-collapse stage. Long term follow up for 5-10 years is needed to know more about the outcome. Further case series or randomized control trail may be needed to set a standard treatment modality.

Acknowledgement

We thank the participant who was consented to be part of this case report. We would like to thank our clinical laboratory, radiology & pathology team of Sree Balaji medical college and Hospital, for their contributions towards diagnosis & management.

Author Contributions

Saravanan P contributed towards treatment protocol for the patient and the use of bone marrow aspirate concentrate (BMAC) injection. Ganesh M T contributed in preparing the case report and patient follow up. Arvind Natarajan contributed editing, drafting case report and collecting radiological data for the patient.

Informed consent

Written & Oral informed consent was obtained from the participant included in the study.

Funding

The study did not receive any external funding.

Conflict of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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