



Management of Early Avascular necrosis of femoral head with Core Decompression and Platelet Rich Plasma infiltration

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ABSTRACT

Various modalities available for the treatment of AVN range from conservative modalities like observation and non-weight-bearing mobilization, various pharmacological agents like Bisphosphonates, Enoxaparin are shown to be useful in some studies, Hyperbaric oxygen therapy to Surgical modalities like femoral head preserving procedures (core decompression with or without additional procedure, i.e. bone grafting, biologic adjuvants – Platelet Rich Plasma, Stem cells etc. and rotational osteotomies) and replacement surgeries. 20 patients of Early AVN who met inclusion criteria and operated with core decompression and PRP infiltration were included in this study. Out of 20 patients, 2 patients (10%) had superficial infections which healed on its own without any intervention, 5 patients (25%) had restriction of movements and 3 patients (15%) required replacement surgery. The mean pre-operative Harris Hip Score of our study was 64.3, and the mean post-operative Harris hip score of our study was 80.2. Out of 20 cases, 6 patients (30%) showed limitation of the progression of the disease, 3 (15%) patients progressed to the further stages of the disease and 11 patients (55%) had remission of the disease. The final outcome, on the basis of Harris Hip Score in 5 patients (25%), was excellent, 7 patients (35%) was good, 5 patients (25%) was fair, and in 3 patients (15%) was poor. Our study concludes that Core decompression along with PRP infiltration can be used as a good alternative for or in addition with traditionally performed core decompression and bone grafting.

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INTRODUCTION

Avascular necrosis (AVN) of the head of a femur is a condition occurring due to reduced vascular supply to the affected part of the head of a femur which

ultimately leads to its death. Hence it is also called as a coronary disease of the hip. (Trueta and Harrison, 1953) The Head of a femur receives blood supply from 3 main sources – reticular branches from the lateral circumflex femoral artery (supplying the majority of the head), which anastomose with branches from the medial circumflex femoral artery (the supplying area around greater trochanter), and the third source is Obturator artery which gives rise to an artery of ligamentum teres which also contributes to the blood supply. (Weinstein and Buckwalter, 2005)

The condition usually involves patients in their early adulthood and middle ages, i.e. 30 to 40 years. Every year around 10 to 20 thousand newly diagnosed AVN cases occur in the United States, out of which approximately 10% undergo replacement surgeries. The condition is usually unilateral, but gradual pro-

gression to bilateral is seen in 3/4th of cases. (Meyers, 1985) In literature, it is seen that the etiopathology of AVN of the femoral head is varied and very confusing. But usually, the term Avascular Necrosis refers to the non-traumatic, non-infective or idiopathic etiologies. Broadly the term can be divided into 2 main groups, i.e. one group with directly identifiable causative factors and the other group without any directly identifiable causative factors. Excessive steroid usage for a longer duration and chronic alcoholism accounts for approximately more than 80 % of AVN cases. The exact pathogenesis of these varied etiologies is not yet established. Various studies are being undertaken to establish the exact steps in pathogenesis. (Khanuja et al., 2001)

Generally, the following factors are thought to be associated with the etiopathology of AVN – end effect of all etiologies lead to the disturbed vascular supply of the femoral head, which in term may be due to occlusion of the blood vessels supplying the femoral head, stenosis of the arteries supplying to the femoral head, atherosclerosis involving the arteries supplying femoral head, hypercoagulation states, increased intra-osseous pressure, mechanical forces disturbing blood supply to the femoral head (hip dislocations and displaced fracture neck of femur) or various metabolic diseases leading to the reduced blood supply to the femoral head. (Baksi, 1991)

Due to the variability of etio-pathogenesis, the clinical, histo-pathological and radiological pictures also vary. In literature, different staging systems are seen used to categorize various patients in groups and then to develop suitable management protocols for the groups. But there hasn't been a single ideal staging system for AVN till date. AVN is routinely diagnosed with the help of detailed clinical examination, which involves an in-depth assessment of the gait, bony palpation of hip and surrounding structures, presence or absence of deformities, limb length discrepancy. But clinical findings start to appear in the late stages of AVN, i.e. after the collapse of the femoral head. But after the collapse of the femoral head, the modalities meant for salvage of the femoral head don't work, and the patient will require replacement surgeries. (Mont et al., 2006)

Radiological staging is based on various radiological modalities like Plain radiographs (plain anteroposterior radiograph of pelvis with both hip joints and frog leg or lateral view), CT scans and MRI scans. There are more than 16 various classification and staging systems based of radiological modalities, out of which the 2 most commonly used are Ficat and Arlet classification and University of Pennsylvania

classification. Most of these imaging modality based staging systems take into account the exact site of the lesion, exact size and the extent of the lesion and presence or absence of sub-chondral fracture or collapse. The exact site of the lesion is best visualised using plain radiographs (cost-effective, simple and easily available but not useful in the early stages) exact size and extent of the lesion is best visualized with the help of an MRI scan (high sensitivity and specificity, modality of choice for screening), and sub-chondral fractures are best studied with the help of CT scan (most sensitive for sub-chondral fractures). There are various staging systems which consider all these radiological modalities. (Ficat, 1985) Although various studies have shown that histological staging done by taking a biopsy from the affected lesion helps in differentiating early-stage disease from late and is thus helpful in delaying the replacement surgeries. Histological changes start to develop after few weeks of the starting of the disease. Usually, a biopsy is done once the disease has been diagnosed. By that time, irreversible changes might have occurred in the femoral head. So early biopsy should be promoted. (Gardieniers, 1993)

Various modalities available for the treatment of AVN range from conservative modalities like observation and non-weight-bearing mobilization, various pharmacological agents like Bisphosphonates, Enoxaparin are shown to be useful in some studies, Hyperbaric oxygen therapy (all these non-surgical modalities are useful for early stages of AVN) to Surgical modalities like femoral head preserving procedures (core decompression with or without additional procedure, i.e. bone grafting, biologic adjuvants – Platelet Rich Plasma, Stem cells etc. and rotational osteotomies) and replacement surgeries. For such a complex disease with varied etiopathological factors and varied treatment modalities, a proper staging system is a must. The concept of core decompression in the treatment of Avascular necrosis is that it promotes the formation of new blood vessels in the head of the femur and thus delaying the progress of the disease, and that of platelet-rich plasma is that it promotes tissue healing and new vessels formation with the help of various growth factors present in it. (Fairbank et al., 1995)

So in our study, we have tried to evaluate the management of early AVN with core decompression and PRP infiltration, aiming to gain a deeper knowledge of this treatment modality and its role in delaying the progression of the disease and thus preservation of femoral head by preventing or delaying the replacement surgeries.

MATERIALS AND METHODS

20 patients of Early AVN who met inclusion criteria and operated with core decompression and PRP infiltration between the duration of August 2018 to November 2020 were included in this study. The study was a prospective interventional study. The study was performed at Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe) Wardha.

Aim

To study the outcome of Early Avascular necrosis of femoral head managed with Core decompression and PRP infiltration.

Objectives

1. To evaluate the results of Core decompression in the treatment of early avascular necrosis of the femoral head.
2. To evaluate the results of local PRP infiltration in treatment of early avascular necrosis of the femoral head.

Inclusion criteria

1. All the patients with early AVN of the femoral head coming to Orthopedic OPD of AVBRH Sawangi Wardha of any age group willing to participate in the study were included in our study.
2. Patients with AVN of the femoral head with Ficat and Arlet grade I, IIA and IIB only were included in our study. (Sultan *et al.*, 2019)

Exclusion criteria

1. Patients having AVN of the hip with Ficat and Arlet grade III and IV.
2. Patients not willing to participate in the study.

Pre-operative assessment of the patient

Details of the identification of the patients were noted with the help of pre-formed questionnaires. A detailed history was taken, including complaints, duration, progression of pain, restriction of movements of hip etc. History of associated illnesses was enquired (Diabetes mellitus type II, Systemic hypertension, Sickle cell disease etc.) and noted. Also, detailed past history was enquired and noted (history of chronic alcoholism, history of trauma prior to the development of symptoms, history of steroid intake). Detailed general and systemic examination of the patient was done and noted. A detailed local examination was done to ascertain the side and site

of AVN, detailed examination of the hip joint was done. Functional assessment of the hip was done with the help of the Harris Hip Score (HHS). (Söderman and Malchau, 1976) Plain anteroposterior and frog-leg lateral radiographs of the pelvis with both hips were done for all the patients. The site and extent of the necrotic area in the femoral heads was assessed and noted with the help of radiographs. Also, MRI of both the hip joints was done in all the patients to know the site and extent of the necrotic area, region of head involved, staging of the disease and ruling out the involvement of the contralateral side. Staging of the disease was done on the basis of the Ficat and Arlet staging techniques. Only patients with stages I and IIA and B were included in the study. Standard pre-operative workup was done, which included complete blood count, kidney and liver function tests, blood grouping, random blood sugar levels, Chest X-Ray and electrocardiograph and patients were operated as early as possible depending upon the fitness for surgery and the availability of the operation theatre.

Preoperative preparation of patients

Patients were kept Nil By Mouth (NBM) for 6 hours prior to surgery. All the complications related with surgical procedures and anaesthesia were explained to the patient, and written consent was obtained. Required parts were prepared for surgery, i.e. entire lower limb and gluteal region. Injection Ceftriaxone 1000 gm IV was given to all the patients 30 minutes prior to surgery. All the patients were operated on preferably under Spinal anaesthesia.

Surgical technique

Core decompression

Under spinal anaesthesia, the patient was kept in a supine position on a radiolucent operating table. Patients were positioned using a traction table. The entire affected lower limb from buttocks to toes was scrubbed, painted and draped. In cases of bilateral AVN, both the sides were operated in a single sitting. All the surgeries were performed through a small incision approximately 2 to 3 cm over the base of the greater trochanter. The underlying soft tissue was dissected. Tensor fascia lata was incised in line with the skin incision, and underlying muscles were split with blunt dissection to reach the bone. The exact location of the necrotic area in the head of the femur was ascertained with the help of an MRI pre-operatively. It was again confirmed under fluoroscopic guidance. Firstly a guide wire is passed in the necrotic area in the affected quadrant of the head of the femur, and then decompression was done by creating a tunnel with an 8 mm coring reamer. Necrotic material collected from the tun-

nel was sent for histopathological examination. The surgical table was then tilted towards the unaffected side, and PRP was infiltrated in the tunnel created with of spinal needle. The tunnel created was closed with the help of a bone plug. The wound was closed in layers after ensuring meticulous hemostasis, and a sterile dressing was applied.

PRP preparation

PRP was prepared by STARS therapy method of PRP preparation. (Shrivastava *et al.*, 2016) PRP was prepared on the morning of surgery. The method uses freshly drawn 20 ml venous autologous blood. This blood is then transferred to 4 EDTA bulbs so that each contains 5 ml of blood. Blood is then centrifuged at 2000 revolutions per minute for 10 minutes. This will divide the venous blood in 2 parts, the upper part contains plasma, and the lower part contains Red Blood Cells. The upper part of the test tube, i.e. plasma, is collected in a separate test tube. This plasma is then again centrifuged at 1200 revolutions per minute for 10 minutes. By this second centrifugation, plasma gets divided in 2 parts. The upper part called a buffy coat and the lower part which is rich in platelets. From 20 ml of venous blood, approximately 2 to 4 ml of PRP in extracted.

Post-operative protocol

Patients were kept NBM for 6 hours post-operatively. Monitoring of vital was done post-operatively for 12 hours. Injection Ceftriaxone 1000 gm IV BD was given for 3 days followed by Tablet Cefixime 200 mg 1 tblet BD for 7 days. Oral analgesics were given as and when needed. Dressing of the surgical wound was done on the 2nd post-operative day. Patients were discharged on 3rd post-operative day. Patients were recalled on the 12th post-operative day for Suture removal were removed on the 10th or 12th post-operative day, depending upon the condition of the wound. Physiotherapy of the affected limb was started from 1st day post-operatively. Gradual increments in the intensity of physiotherapy was done. Static and dynamic Quadriceps and hamstring strengthening exercises, pelvic lifting exercises, along with knee and ankle mobilization, were started from 1st-day post-operatively or as tolerated by the patient. Non-weight bearing mobilization with the help of walker/crutches was started from the 2nd post-operative day or as tolerated by the patient.

Follow up

All the patients were followed up every monthly, i.e. 1st, 2nd and 3rd months post-operatively and then 6th months post-operatively. A clinico-radiological evaluation was done on every follow up as shown in

Figures 1 and 2. Partial weight-bearing walking was started from the 3rd month post-operatively, and full weight-bearing mobilization was started from the 6th month post-operatively. On 6 months follow up again, Harris Hip Score was recorded and compared with a pre-operative score. Final results were evaluated using Harris Hip Score grading (Grading of Harris hip score- <70=poor, 70-79=fair, 80-89=good, 90-100=excellent). Also, radiological evaluation was done on 6 months follow up with Radiographs and MRI. Maximum follows up was done till 1 year.



Figure 1: Shows post-operative radiograph of a case of bilateral AVN from our study.

RESULTS

1. Out of 20 patients of early AVN, 15 (75%) were males and 5 (25%) females.
2. The mean age of all the patients was 33.4 years (range 18 to 54 years), with maximum patients from the age group 30 to 40 years (66%).
3. Out of 20 patients, 4 patients (20%) had bilateral affection. So out of a total of 24 hips, 16 patients (66.66%) had right-sided affection, and 8 patients (33.33%) had left-sided affection.
4. Out of 20 patients, in 16 patients (80%), the causative etiology was non-traumatic, while in 4 patients (20%), it was traumatic. Out of 16 patients with non-traumatic etiology, 8 patients (50%) had sickle cell disease, 5 patients (31.25%) due to steroid intake, and 3 patients (18.75%) were chronic alcoholism.
5. Out of 24 hips, according to the Ficat and Arlet scoring system, 15 hips (62.5%) had grade IIA disease, 5 hips (20.83%) had grade IIB disease, and 4 patients (16.667%) grade I disease. All

Table 1: Showing details of patients in our study.

	Number	Percentage
Mean Age	33.4 years	
Gender		
Male	15	75
Female	5	25
Side affected		
Right	16	66.6666667
Left	8	33.3333333
Etiology		
Non-Traumatic	16	80
Sickle cell disease	8	50
Steroid intake	5	31.25
Alcoholism	3	18.75
Traumatic	4	20
Ficat and Arlet Staging		
I	4	16.6666667
IIA	15	62.5
IIB	5	20.8333333

Table 2: Showing the distribution of final outcome in the patients of our study

Final outcome	Number	Percentage
Excellent	5	25
Good	7	35
Fair	5	25
Poor	3	15

these details regarding the patient are shown in Table 1.

- There were no major complications seen in our study. Out of 20 patients, 2 patients (10%) had superficial infections which healed on its own without any intervention, 5 patients (25%) had restriction of movements and 3 patients (15%) required replacement surgery in follow up period.
- The mean pre-operative Harris Hip Score of our study was 64.3, and the mean post-operative Harris hip score of our study was 80.2. So improvement in the mean Harris Hip score was 15.9. When pre and post-operative Harris Hip scores were compared using Paired T-test, the p-value was seen to be <0.001, suggesting significant improvement.
- Out of 20 cases, 6 patients (30%) showed limitation of the progression of the disease, 3 (15%) patients progressed to the further stages of the disease and 11 patients (55%) had remission of the disease.

- The final outcome, on the basis of Harris Hip Score in 5 patients (25%), was excellent, 7 patients (35%) was good, 5 patients (25%) was fair, and in 3 patients (15%) was poor as shown in Table 2.

DISCUSSION

We have compared our study with (Soni et al., 2019), in which 25 patients of early AVN were treated with core decompression and PRP infiltration and with (Patel et al., 2015) in which 39 patients with of early AVN were treated with core decompression and PRP infiltration.

- Age - The mean age of our study was 33.4 years when compared to 35.5 years in Soni et al. and 30.4 years in (Patel et al., 2015)
- Gender - 75% of cases in our study were males and 25% females when compared to 88% males and 12% females in (Soni et al., 2019) and 80% males and 20% females of (Patel et al., 2015)



Figure 2: Showing the post-operative clinical evaluation of a patient in our study at final follow up (2A: No limb length problem, 2B: Flexion, 2C: Patient able to sit cross-legged, 2D: Patient able to squat normally)

3. Site of affection - In our study, 20% of patients had bilateral affection, when compared to 52% of [Soni et al. \(2019\)](#) and 46% of [Patel et al., 2015](#))
4. Etiology - In our study, 80% of patients had non-traumatic etiology while 20% had traumatic as compared to 60% non-traumatic and 40% traumatic in [Soni et al., 2019](#))
5. Staging - In our study, 62.5% of hips had grade IIA disease, 20.83% had grade IIB disease and 16.667% grade I disease. In [Soni et al., 2019](#)), there were 73% with grade II and 27% with grade I disease. In [Patel et al., 2015](#)), there were 53.33% grade IIA, 30% grade IIB and 16.66% grade I.
6. Harris Hip Score - The mean pre-operative Harris Hip Score of our study was 64.3, and the mean post-operative Harris hip score of our study was 80.2. In [Soni et al., 2019](#)), it was 73.1 pre-operative and 83.2 post-operative, while in [Patel et al., 2015](#)), it was 61.81 pre-operative and 79.73 post-operative.
7. Outcome - Final outcome in our study was, on the basis of Harris Hip Score in 5 patients (25%) was excellent, 7 patients (35%) was good, 5 patients (25%) was fair, and in 3 patients (15%) was poor. In 10.5% cases.
8. So all the parameters of our study are comparable with other similar studies.

CONCLUSIONS

Our study concludes that Core decompression along with PRP infiltration can be used as a good alternative for or in addition with traditionally performed core decompression and bone grafting. The procedure is a good modality in terms of delaying or halting the course of AVN of the femoral head and reducing the need for replacement surgeries, improvement of post-operative functional outcome of hip, pain reduction, easy to perform, low complications

rate.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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