IRAQI Academic Scientific Journals
العراقية المجلات الأكاديمية العلمية
ISSN:1813-1638
The Medical Journal of Tikrit University
Journal Homepage: http://mjtu.tu.edu.iq
MJTU
The Medical Journal of Tikrit University

Assessment Autologous Bone Marrow Derived Cells with Core Decompression as Treatment Option for Avascular Necrosis of the Femoral H

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ABSTRACT

Background Another name for this condition is damage to the head of the femur caused by Death of the arteries. It gets worse over time and happens when the femoral head loses blood flow and pressure inside the bone rises. Several different procedures are available to control AVN in its initial stages, but the outcomes have reached an inadequate level. In most cases, the only option is to have a total hip arthroplasty choice that is long-lasting for pain alleviation and function restoration. One new therapy method that can be used to stop the disease from getting worse is to use a high concentration of stem cells in the necrose tissue, along with core decompression. Both patients and procedures : The overall number of patients in a single-arm trial that was conducted from October 2017 until February 2019 was ten, with five females and five males participating. The etiology of this condition includes the use of corticosteroids, sickle cell disease, systemic lupus erythematosus, and idiopathic causes. The ages of all patients ranged from 25 to 57 years. A decompression of the core and an infusion of bone marrow from the patient's own body -derived mononuclear cells are both components of the treatment that takes place inside the hip joint area. Results: The findings indicated that the Harris hip score of seven patients saw a significant improvement, going from 48.7±6.6 to 88.00±4.6 (p=0.001). via use of magnetic resonance imaging, which provides radiological evidence. Concluding notes: This one arm, short range experiment indicated an autologous bone marrow-derived cell therapy for core decompression is a treatment that is both safe and effective. The trial was conducted for a brief period. Additionally, it is a kind of minimum manipulation treatment, which implies that such treatment should be considered for use in bigger and longer-term studies.

Keywords: Avascular head necrosis, the bone's marrow derived cells, cell therapy, hip

DOI: http://doi.org/10.25130/mjotu.00.00.00

INTRODUCTION

When there is a disruption in the vascular supply to the head of the femur and an increase in the pressure within the osseous cavity, a pathological process known as femoral head the absence of blood vessels can develop.

The pathophysiology of non-vascular death is uncertain despite the efforts made to give a suitable blueprint. On the other hand, there are a number of known diseases and environmental irritants that can put individuals at risk for acute venous pulmonary hypertension (AVN). Traumatic causes include fracture head or neck of the femur, nontraumatic causes include sickle cell anemia, endocrine conditions like Cushing syndrome, auto immune disease like systemic lupus erythematosus, use of corticosteroids, alcoholism, organ transplantation and others. Some people believe that AVN is caused by a disorder that causes blood to clot or a genetic abnormality that causes abnormalities in the blood vessels. This is even though these variables may enhance the likelihood of a patient acquiring AVN. In idiopathic cases the underlying abnormality may be a coagulation factor gene defect.

The severity of symptoms might vary depending on the stage at which they are presented. Patients who are in the earliest stages of AVN may experience a gradual start of the discomfort that may not have a reason or occurrence that is obvious or provoking. Their range of motion is typically considered to be normal; nonetheless, this range of motion may be restricted due to discomfort, particularly when the hip is rotated internally. In the event that the sickness continues to worsen, it is likely that this slight ache in the hip will be preceded by a sudden start of severe pain. Disease in its latter stages is characterized by mechanical. difficulties with reduced motion and painful movements.The diagnosis of AVN is usually done by clinical and radiological signs; early-stage disease needs better resolution like in MRI (magnetic resonance imaging) or computed tomography. A simple X-ray can detect late-stage disease. To properly treat the condition, radiological characteristics are essential for staging the disease [1].

Patients ranging in age from 20 to 40 years old are often affected by AVN, because the typical age of appearance is 38 years old [2]. AVN in its initial stages can be controlled using a variety of procedures, including osteotomy, medicinal treatments, and core decompression nevertheless, the outcomes have been poor, with up to forty percent of patients proceeding to total hip arthroplasty. On the other hand, advanced stages three or more according to Steinberg categorization of AVN are more difficult to treat. [3] When it comes to providing long-term pain relief and restoring function, complete hip arthroplasty is frequently the only option that can be considered [4]. The utilization of the presence of a high quantity of stem cells in the necrosed tissue region in association with core decompression is one of the more recent therapy techniques that can be utilized to avoid the advancement of the illness[5].

Patients and Methods

Patient's characteristics:

Beginning in October 2017 and continuing through February 2019, single-armed research was conducted. A total of ten patients were present at the hospital, while the number of femur heads was 17. Female patients were 5 and male patients 5.

Among the causes of this condition include corticosteroids, sickle cell disease, systemic lupus erythematosus, and idiopathic (non-specific).Patients may be as young as 25 years old or as old as 57 years old. The stage of the disease was early in 7 cases, 3 cases were advanced according to Steinberg score (table 1). Bilateral femoral head involved in 7 cases. Steinberg classification for avascular hip necrosis begins from stage zero with normal joints without pain or radiological evidence of necrosis, to stage 6 with advanced degenerative changes.

Table 1:Steinberg classification for avascular necrosis of the femoral head.

Stage	**0**
No symptoms	**Normal X-ray**
MRI non diagnostic	
1	
	Mild pain in the affected hip Pain with internal rotation Normal X-ray MRI diagnostic
2	
	worsening or persistent pain Increased sclerosis or cysts in the femoral head
3	
	Subchondral collapse producing a crescent sign
4	
	Flattening of the femoral head
5	
	Normal joint space Joint space narrowing with/without femoral head involvement
6	
	Advanced degenerative changes

Procedure:

Under general anesthesia after getting patient consent, a 2-3 mm incision is utilizing a bone marrow aspiration needle that is disposable and utilizing multiple site aspirations, about sixty centiliters of bone marrow extracted from the skin above the posterior iliac crest. This bone marrow is then condensed into six centiliters, which is ideal for one hip joint.

where the vastus ridge is located at the level, immediately the lesser trochanter is placed below the lateral section of the femoral is treated using an incision that is made right across it. The location of the avascular region was entered with a torcher measuring 6 millimeters, and a cannulated drill bit measuring 3.2 millimeters was used to drill the lesion under the screen. The torcher progressed using a guide wire measuring 3 millimeters. The 4 ml of bone marrow cells were injected to the site from anterior approach.

After the procedure, every single patient is sent home and given the opportunity to bear as much as they can while using crutches for a period of two weeks.

RESULTS

Table 2 showed the results of our study, clinical response was remarkable including lessening of discomfort & improvement in collaboration mobility early after the procedure, and one year from the start, the Harris hip score showed improvement in 7 out of ten (70%). The score increased from 48.7±6.6 to 88.00±4.6($p<0.001$).

Table 2. Patient's characteristics and response.

No.	Age	Sex	Dx	involvement	HH score
1	57 y	Male	idiopathic	unilateral	from 44 to 90
2	57 y	Female	SCD	bilateral	from 52 to 86
3	50 y	Male	steroids	bilateral	NS
4	35 y	Male	idiopathic	bilateral	from 43 to 86
5	30 y	Male	idiopathic	bilateral	from 53 to 85
6	48 y	Male	idiopathic	bilateral	from 45 to 85
7	30 y	Female	SLE	bilateral	NS
8	30 y	Female	idiopathic	unilateral	from 43 to 90
9	30 y	Female	SLE	bilateral	from 42 to 88
10	25 y	Female	SLE	unilateral	NS

Following an analysis, it was discovered that the AS scores for the Quality-of-Life Score that was associated with Chronic Hip Disease were as follows: 9. The score is 10 in normal and 1 in severe limitation. The MRI examination demonstrated a substantial correlation. As the lesion converted from Mitchell's grade C to grade B after the procedure by 6 months. When it comes to Chronic Hip Disease, scores obtained from the HHS or AS for the Quality-of-Life Index are both important. The cellular concentration was 1x10 8 bone marrow derived mononuclear cells in the whole product in a volume of 4-10 cc.

DISCUSSION

During the initial stages of the illness, we discovered that bone marrow-derived cell injection at an area of the head of the femur that has been affected by avascular necrosis resulted in a reduction in regard to the pain scale; eight to one. for each patient after the procedure and in seven patients at one year time. Marked MRI Improvement was observed in seven patients out of ten in 6-month time after the procedure. Mitchell's grade regressed from C to B in seven patients. It is a process that is both safe and successful to use autologous bone-marrow mononuclear cells for implantation. Our findings are supportive and are comparable to those of other research that was conducted on a smaller scale and compared the utilization of bones marrow derived cells in conjunction with separation of the center to the utilization of core decompression just by itself. When comparing the CDBM decompression of the core groups , it was clear that The Harrison Joint has improved [6-8]. A large review of 11 studies with 507 participants demonstrated that in addition to bone marrow cells, A Harrison joint score that is higher was achieved with the application of central decompress injection, which proved to be more effective than core decompression alone[9].

Regarding pathophysiology it is known that within the intertrochanteric region of the osteonecrosis hip, there is an increase in the amount of fatty tissue that is present with a significant reduction in stem cell pool [10]. One of the main facts in the clinical outcome of the bone marrow procedure for avascular hip necrosis is the concentration of the bone marrow cells near the necrotic area; we observed

that in most procedures that were done they mentioned the use of 10 cc syringes with steady pressure aspirate [11]. We should point out the following facts that are important to gain the best cellular content:

1-High concentration of stem cells are usually yielded in the first few cubic centimeters aspirated, as more peripheral blood cells usually follow.

2-Multiple punctures with larger volume syringes are preferable than small volume ones with single site aspirates.

In our study we used a mean of 1x10 8 mononuclear cells in the total volume injected. Based on the findings, based on the findings, it was concluded that the average number of mesoderm neural stem cells (MSCs) that were found in a femur head per cubic centimeter was approximately 700 ± 264 cell units. It is possible to consider a thirty-five thousand in total mesenchymal stem cells (MSCs) to be a good roughly equivalent to the total amount of MSCs that are inside of a head of femur for example. This is because the volume of the femur head is around 50 cm3 on average[12]. It is a very important task to clarify the precise factors in the pathophysiology and healing process as there is a multitude of variables including type of cells (bone marrow or mesenchymal cells, osteoblasts or others) source (bone marrow, adipose, others) concentration, timing disease stage, and procedure that need to be discussed in future work[13].

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CONCLUSION

The findings of this short-term research with a single arm indicated that allogeneic bones marrow-derived cells in combination with central decompress treatment is a strategy that is not only safe but also successful. Additionally, it is a kind of minimum manipulation treatment, and we believe that it should be considered for use in bigger and longer-term studies.

CONFLICT OF INTEREST

No financial interest or any conflict of interest exists.

ACKNOWLEDGEMENTS

The researchers would like to thank the Baghdad Technical Medical Institute, Baghdad Teaching Hospital, and Dr. Abdul Majeed Alwan for their assistance in completing this research.

REFERENCES

[1] Houdek MT, Wyles CC, Martin JR, Sierra RJ. Stem cell treatment for avascular necrosis of the femoral head: current perspectives. Stem cells and cloning: advances and applications. 2014;7:65.

[2] Lavernia CJ, Sierra RJ, Grieco FR. Osteonecrosis of the femoral head. J Am Acad Orthop Surg. 1999; 7:250–261.

[3] Steinberg ME, Hayken GD, Steinberg DR. A quantitative system for staging avascular necrosis. J Bone Joint Surg Br. 1995; 77:34–41.

[4] Hungerford DS. Pathogenesis of ischemic necrosis of the femoral head. Instr Course Lect. 1983; 32:252–260.

[5] Hernigou P, Beaujean F. Treatment of osteonecrosis with autologous bone marrow grafting. Clin Orthop Relat Res. 2002; 405:14–23.

[6] Sen RK, Tripathy SK, Aggarwal S, Marwaha N, Sharma RR, Khandelwal N. Early results of core decompression and autologous bone marrow mononuclear cells instillation in femoral head osteonecrosis: a randomized control study. J Arthroplasty. 2012; 27:679–686.

[7] Mir Sadat-Ali, etal. Stem Cell Therapy for Avascular Necrosis of Femoral Head in Sickle Cell Disease: Report of 11 Cases and Review of Literature, international journal of stem cells: 2017, 1-5.

[8] Azam MQ, Sadat-Ali M. Early cement less total hip arthroplasty in young sickle patients 4-12 years follow up J Arthroplasty 2016;31:2536-2541.

[9] Xu S, Zhang L, Jin H, Shan L, Zhou L, Xiao L, Tong P. Autologous stem cells combined core decompression for treatment of avascular necrosis of the femoral head: a systematic meta-analysis. Biomed research internationally. 2017; 2017.

[10] Hernigou P, Beaujean F, Lambotte JC. Decrease in the mesenchymal stem-cell pool in the proximal femur in corticosteroid-induced osteonecrosis. J Bone Joint Surg Br 1999:81(2)349-55.

[11] Philippe Hernigou, etal. Stem Cell Therapy for the Treatment of Hip Osteonecrosis: A 30-Year Review of Progress, clinics in orthopedic surgery: 2016, 8, 1-8.

[12] Homma Y, Kaneko K, Hernigou P. Supercharging allografts with mesenchymal stem cells in the operating room during hip revision. Int Orthop. 2014;38(10):2033-44.

[13] Lebouvier A, Poignard A, Cavet M, et al. Development of a simple procedure for the treatment of femoral head osteonecrosis with intra-osseous injection of bone marrow mesenchymal stromal cells: study of their bio distribution in the early time points after injection. Stem Cell Res Ther: 2015, 6:68.

Abbreviations:

SCD=sickle cell disease, SLE=systemic lupus erythematosus, NS=non-significant.