

Assessment of Vascularity of Femoral Head in Cases of Neck of Femur Fracture in Relation to Age of Patient and Duration of Fracture by Magnetic Resonance Imaging.

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Received: April 2019

Accepted: April 2019

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ABSTRACT

Background: Hip fractures are common and comprise 20% of the operative workload of an Orthopedic trauma unit. For diagnosis of neck of femur fracture, clinical examination along with skiagram is sufficient in most of the cases. But it does not give any data regarding probable prognosis of fracture fixation as it cannot comment about vascularity of femoral head. Non-invasive way to comment about vascularity of femoral head is contrast enhanced MRI. The purpose of this study is to quantify the perfusion of the femoral head using Gadolinium enhanced magnetic resonance imaging following neck of femur fracture taking in consideration-Age of the patient, and Duration of fracture. **Methods:** The present study has been conducted from January 2017 to June 2018 among 30 patients admitted to Burdwan Medical College and Hospital. The parameters studied were Vascularity of femoral head and in MRI film (Cortical distortion, Unusual hypoperfusion and Bone oedema) were also studied. **Results:** 67% of our study population presented to our institute within 1st 3 weeks from date of injury. Among them those who presented within 10 days has average highest vascularity, 66.25%. But taking these subjects individually we can say that age of the patient and fracture pattern are the two most important factors determining the loss of vascularity. In this study, it is applicable to both the duration of 0 to 10 days and for 11 to 20 days. Loss of vascularity curve is very steep from 41 to 50years group to 51 to 60years age group. It is also true in case of 1 to 10 days duration. Here steep rise of vascularity is seen in age group 71 to 80 years. **Conclusion:** Decrease or drop in vascularity of femoral head is more in older ones compared to the younger ones within a fixed duration of fracture.

Keywords: Vascularity, Fracture, Femur.

INTRODUCTION

Hip fractures are common and comprise 20% of the operative workload of an orthopedic trauma unit. Intracapsular femoral neck fractures account for 50% of all hip fractures. The lifetime risk of sustaining a hip fracture is high and lies within the range of 40% to 50% in women and 13% to 22% in men.^[1] Fractures of the neck of the femur occur predominantly in the elderly, typically result from low-energy falls, and may be associated with osteoporosis. Fractures of the femoral neck in the young are a very different injury and are treated in very different ways. Femoral neck fractures in

young patients typically are the result of a high-energy mechanism, and associated injuries are common.^[2] Surgical fixation of a femoral neck fracture is often associated with a high complication rate (non-union, osteonecrosis [ON] of the femoral head and late segmental collapse) and an increased reoperation rate. Previous studies have shown that hemarthrosis in the hip joint resulted in increased intracapsular pressure even in nondisplaced fractures of the femoral neck. An increased intra-articular pressure is thought to impinge on blood flow in the retinacular system; the major blood supply to the femoral head and further increase the risk for osteonecrosis.^[3] Despite marked improvements in implant design, surgical technique, and patient care, hip fractures continue to consume a substantial proportion of our health care resources and impart great financial burden to the family. It is important to understand the pathophysiology of the fracture of the neck of

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femur and the biomechanics of the implant used to manage the fracture and prevent the complications. For diagnosis of neck of femur fracture, clinical examination along with skiagram is sufficient in most of the cases. But it does not give any data regarding probable prognosis of fracture fixation as it cannot comment about vascularity of femoral head. Non-invasive way to Comment about vascularity of femoral head is contrast enhanced MRI. It gives information about perfusion. Many a times we sacrifice femoral head by arthroplasty when question arises about the viability of femoral head following neck femur fracture without knowing the actual perfusion status. The literature contains reports on various techniques of residual head vascularity assessment that have proved their efficacy. Routine application, however, in some cases (oxygen pressure measurement, or Doppler) raises both economic and practical issues. Choice favours Scintigraphy and MRI. In the light of the literature, scintigraphy appears to be both effective and highly sensitive. The patient is, however, exposed to radiation in the form of the injected radioactive isotope. Moreover, scintigraphy does not provide Morphometric analysis and requires expertise on the part of the nuclear physician. MRI is the great hope, looking at the literature, with surprising results that have stirred debate that may yet change therapeutic practice.^[4] Contrast-enhanced MR imaging may be useful for non-invasive evaluation of femoral head perfusion after fracture of the femoral neck. MR findings also may aid the clinician in deciding between joint-preserving therapy and hip arthroplasty.^[5]

Aims and objectives

The purpose of this study is to quantify the perfusion of the femoral head using gadolinium enhanced magnetic resonance imaging following neck of femur fracture taking in consideration-

1. Age of the patient.
2. Duration of fracture.

Review of literature

Femoral neck fractures occur most frequently in elderly female patients. They are uncommon in patients younger than 60 years. There is some racial variation in the incidence. They are less common in black races⁶ and more common in black females than in males.^[7] Currently, these fractures are most common in the white populations of Europe and North America.^[8] The incidence increases exponentially with age.^[9] The risk of a second hip fracture within 2 years approaches 10% in women and 5% in men.^[10,11] In patients who sustain a second hip fracture, it is the same type of hip fracture in over 70%.^[12] Epidemiologic studies have identified numerous risk factors associated with an increased risk of sustaining a hip fracture.^[13] Nonmodifiable risk

factors include increasing age, female sex, positive family history of osteoporotic fractures, and ethnic origin. Modifiable lifestyle risk factors increasing the risk of hip fractures include a low body mass index (<18.5), low sunlight exposure, low recreational activity, smoking, and alcohol abuse. Chronic disease in general tends to increase fracture risk. There is good evidence of increased hip fracture risk in association with diabetes mellitus (type 1 in particular), chronic renal disease, celiac disease, and primary hyperparathyroidism. Other conditions including depression, chronic liver disease, hypothyroidism, hyperthyroidism, and positive human immunodeficiency virus (HIV) status have also been linked to increased risk of hip fractures although the evidence is not as strong. Certain medications are associated with alteration of bone metabolism and increase fracture risk. Steroids are most commonly implicated, but other medications are also now well recognized risk factors. These include antiepileptic medication, certain antidepressants (selective serotonin reuptake inhibitor), proton pump inhibitors, and HIV medications.^[14-17] In the past, it was predicted that the worldwide incidence of these fractures would increase until 2050. More recent epidemiologic studies from Europe have reported that the incidence of osteoporotic fractures may have leveled off and there is even evidence that the incidence may be reducing.^[18-20] One study has even predicted that the incidence and absolute numbers of hip fractures will fall.^[21] Whether these changes in the incidence are due to preventive measures or other therapeutic modalities is uncertain.

MATERIALS AND METHODS

The present study has been conducted after obtaining clearance from institutional ethical committee and written informed consent from the participating patients.

Type Of Study

Single institution based non biased prospective, observational study.

Study Area

Burdwan Medical College and Hospital.
Department of Orthopaedics and Department of Radiodiagnosis

Study Population

Patients attending Orthopaedics OPD or emergency in Burdwan Medical College and Hospital with neck of femur fracture.

Inclusion Criteria

Patients presenting with fracture neck of femur.

Exclusion Criteria

- Patients with hemiplegia, paraplegia, or other severe general co-morbid conditions.
- History of any previous pathology in same hip joint.
- Allergy to Radiocontrast agents.
- Pregnant women.
- Claustrophobic patients.
- Patients with MRI non-compatible metallic implants anywhere in body.

Study Period

January 2017 to June 2018.

Sample Size

30 patients.

Parameters To Be Studied

- Vascularity of femoral head
- In MRI film the following criteria are looked for
 - Cortical distortion
 - Unusual hypoperfusion
 - Bone oedema

Considering the whole of femoral head as 100% or 360 degree in quadrant distribution, the area of Osteonecrosis is calculated in percentage. All axial, coronal, and sagittal T1FS (T1 weighted Fat Suppressed) sections are studied although mid-coronal sagittal T1FS is more helpful for quadrant and percentage evaluation of the area of head with well perfusion.

Study Tools

- History and clinical examination.
- Skiagram of Pelvis with both hip – AP, and affected hip – Lateral for confirmation of diagnosis.
- Gadolinium enhanced MRI to assess the vascularity of the head of the Femur.

Follow UP and Analysis of Data

All the patients have been evaluated at as single time as early as possible after presentation with gadolinium enhanced MRI and data collected has been analysed by appropriate statistical tests.

RESULTS**Table 1: Distribution of study population according to age group**

Years	Number of subjects	Percentage (%)
<20	3	10
21 - 30	1	3.33
31 - 40	2	6.67
41 - 50	5	16.67
51 - 60	9	30
61 - 70	7	23.33
> 70	3	10
Total	30	100

From [Table 1], it is evident that most of the people suffering from neck of femur fracture belongs to age group 51 to 70 years; 16 out of 30 subjects (53.33%). Among them 51 to 60 years' age group has 30% and 61 to 70 years has 23.33% subjects.

Table 2: Sex wise distribution of study population

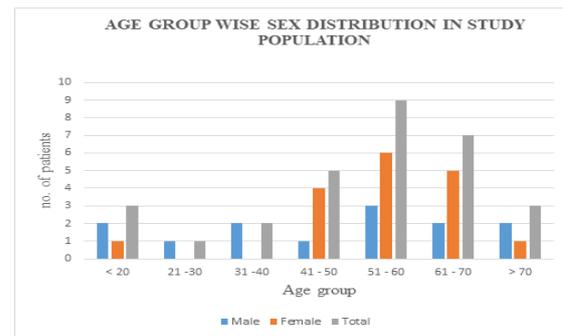
Sex	Count of Sex	Percentage
Female	17	56.67%
Male	13	43.33%
Total	30	100%

From [Table 2], 56.67% subjects are female and 43.33% subjects are male. So, in our study incidence of neck of femur fracture appears to be greater in females.

Table 3: Age and sex distribution in study population

Age group (years)	Male	Female	Total
< 20	2	1	3
21 -30	1	0	1
31 -40	2	0	2
41 - 50	1	4	5
51 - 60	3	6	9
61 - 70	2	5	7
> 70	2	1	3

From [Table 3], in younger age group Neck of femur fracture is more common in males. Whereas in older population females suffer most. Up to 40 years 83.33% subjects are male and in beyond 40 years of age, 53.33% subjects were female

**Table 4: Distribution of study population according to mode of injury**

MOI	Count of MOI	Percentage (%)
HV	6	20
LV	24	80
Total	30	100

LV = Low Velocity
HV = High Velocity
MOI = Mode of injury

From Table 4, we can conclude that most of the subjects had suffered low velocity trauma (80%). So, neck of femur fracture is usually a result of low velocity injury.

Table 5: Distribution of MOI in different age groups

Age group	MOI		Percentage (%)
	HV	LV	
0 - 20	3	0	10
21 - 30	1	0	3.33
31 - 40	2	0	6.67
41 - 50	0	5	16.67
51 - 60	0	9	30
61 - 70	0	7	23.33
71 - 80	0	3	10
Total	6	24	100

MOI = Mode of injury
HV = High Velocity
LV = Low Velocity

[Table 5] shows that High velocity trauma is a cause of neck of femur fracture in younger age group (<40 years).

Table 6: Distribution of study population according to type of fracture

Type of fracture	No.	Percentage
Displaced	27	90%
Undisplaced	3	10%
Total	30	100%

[Table 6] shows Displaced fracture is most common (90%) in our study population.

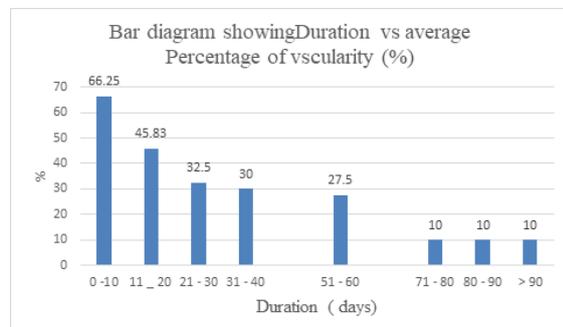
Table 7: Distribution of study population according to duration of fracture

Duration (Days)	No. of patient	Percentage (%)
0 - 10	8	26.67
11 - 20	12	40
21 - 30	2	6.67
31 - 40	2	6.67
41 - 50	0	0
51 - 60	2	6.67
61 - 70	0	0
71 - 80	2	6.67
81 - 90	1	3.33
> 90	1	3.33
Total	30	100

[Table 7] shows 40% patients presented between 11 to 20 days followed by 26.67% patients who presented in 1st 10 days. So in our study most of the patients (66.67%) presented in 1st 20 days.

Table 8: Distribution of study population according to Duration and Percentage of vascularity

Days	Average Percentage of vascularity (%)
0 -10	66.25
11 - 20	45.83
21 - 30	32.5
31 - 40	30
51 - 60	27.5
71 - 80	10
80 - 90	10
> 90	10



[Table 8] shows average percentage of vascularity of femoral head is the highest in 0 to 10 days of duration (66.25%) followed by 11 to 20 days (45.83 %). We can also appreciate declining trend of vascularity with increasing duration.

Table 9: Loss of vascularity in different age groups for fracture duration 0 – 10 Days

Age group (years)	Loss of vascularity (%)
11 - 20	15
41 - 50	25
51 - 60	47.5

[Table 9] shows loss of vascularity of femoral head in 1st 10 days is more in older age group compared to younger age group. Maximum loss of vascularity occurred in age group 51 - 60 year while minimum loss occurred in 11 – 20 year. line diagram shows a steep rise of loss of vascularity after fracture with increase in age.

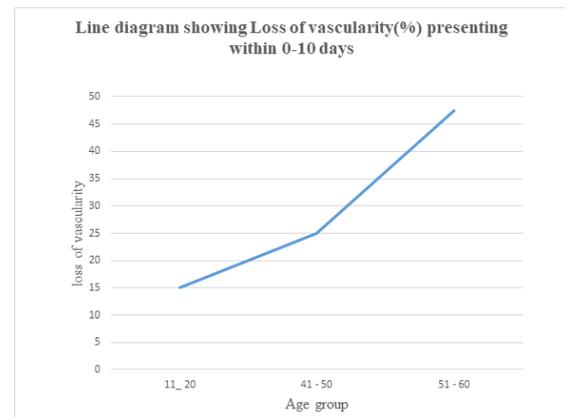
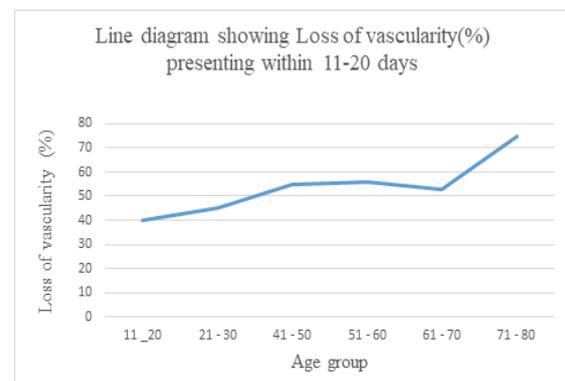


Table 10: Loss of vascularity in different age groups for fracture duration 11 – 20 Days

Age group (years)	Average Loss of vascularity (%)
11 - 20	40
21 - 30	45
41 - 50	55
51 - 60	56
61 - 70	53
71 - 80	75

[Table 10] shows loss of vascularity of femoral head in 11 - 20 days is more in older age group compared to younger age group. Maximum loss of vascularity occurred in age group 71 - 80 year while minimum loss occurred in 11 – 20 year. line diagram shows a gradual rise of loss of vascularity after fracture with increase in age, though from 61 – 70 year the slope increased.



DISCUSSION

From our study we can conclude that most of the patients belong to older age group, with most of the patient belonging to more than 50 years of age (63.33%). It coincides with the global data as per the publication of Gallagher JC, Melton LJ, Riggs BL, Bergstrath E. Epidemiology of fractures of the proximal femur in Rochester, Minnesota. Clin Orthop Relat Res. 1980 Jul-Aug;(150):163-71. "An estimate of the number of proximal hip fractures occurring in the United States suggests that approximately 113,000 women and 34,000 men older than 50 years of age will suffer a hip fracture each year."

17 out of 30 subjects are female and 13 out of 30 subjects are male in this study. So, we can easily observe more preponderance of neck of femur fracture in females. This is corroborated by "Rates of hip and wrist fractures tended to be higher in women." from the study Piirtola M1, Vahlberg T, Isoaho R, Aarnio P, Kivelä SL. Incidence of fractures and changes over time among the aged in a Finnish municipality: a population-based 12-year follow-up. Aging Clin Exp Res. 2007 Aug;19(4):269-76. Same conclusion is also by Cummings SR1, Black DM, Nevitt MC, Browner W, Cauley J, Ensrud K, Genant HK, Palermo L, Scott J, Vogt TM. Bone density at various sites for prediction of hip fractures. The Study of Osteoporotic Fractures Research Group. Lancet. 1993 Jan 9;341(8837):72-5.

In younger age group Neck of femur fracture is more common in males. Whereas in older population females suffer more, probably due to the fact that "neuromuscular and visual impairments, as well as femoral-neck BMD, are significant and independent predictors of the risk of hip fracture in elderly mobile women," - Dargent-Molina P1, Favier F, Grandjean H, Baudoin C et al. Fall-related factors and risk of hip fracture: the EPIDOS prospective study. Lancet. 1996 Jul 20;348(9021):145-9. And also the Road traffic accident is more common in younger male may be the cause.

Taking into consideration whole of the population, it can be concluded that neck of femur fracture is more prevalent in females but mostly in older age. This can be due to post menopausal osteoporosis and decreased BMD. In this study, female preponderance is not that much. We have >56% female patients in our study population. And this also includes young males.

In our study, left side involvement was for 63.33% of the sample size. Among older age group left side is more significantly involved than the right side. Probably this may be due to the fact of right dominant people are more in our society and BMD is higher in right side compared to left in them. It is corroborated by the study Rao AD1, Reddy S, Rao

DS. Is there a difference between right and left femoral bone density? J Clin Densitom. 2000 Spring;3(1):57-61.

Most common type of fracture neck femur in our study is Garden's type III, followed by type IV. So, displaced fractures are more common than non-displaced ones. Though inter observer bias is a problem of this classification, our study results corroborate with Campbells Operative Orthopedics, 13th Edition and also Rockwood and Green's Fractures in Adult 8th ed.

67% of our study population presented to our institute within 1st 3 weeks from date of injury. Among them those who presented within 10 days has average highest vascularity, 66.25%. But taking these subjects individually we can say that age of the patient and fracture pattern are the two most important factors determining the loss of vascularity. Other factors like High velocity trauma or low velocity trauma does not seem to have significant role in determining vascularity of femoral head. In our study population 6 subjects having high energy trauma have mean vascularity of 56.66% which is contrastingly higher than average vascularity of low energy trauma subjects, 40%. And this is corroborating with the Rune Hedlund, Dr. Urban Lindgren. Trauma type, age, and gender as determinants of hip fracture. First published: 1987

<https://doi.org/10.1002/jor.1100050210>.

Furthermore, the decrease or drop in vascularity of femoral head is more in older ones compared to the younger ones within a fixed duration of fracture. In this study, it is applicable to both the duration of 0 to 10 days and for 11 to 20 days. Loss of vascularity in the following age groups 11 to 20 years, 41 to 50 years, 51 to 60 years are 15%, 25% and 47.5% respectively in 1st 10 days. So, there is more loss of vascularity of femoral head in elderly irrespective of other factors. Loss of vascularity curve is very steep from 41 to 50 years group to 51 to 60 years age group. It is also true in case of 11 to 10 days duration. Here steep rise of vascularity is seen in age group 71 to 80 years.

CONCLUSION

From our study we can conclude that femoral head loses its vascularity following neck of femur fracture and the amount of loss of vascularity depends on several factors. Decrease or drop in vascularity of femoral head is more in older ones compared to the younger ones within a fixed duration of fracture. In this study, it is applicable to both the duration of 0 to 10 days and for 11 to 20 days. Loss of vascularity in the following age groups 11 to 20 years, 41 to 50 years, 51 to 60 years are 15%, 25% and 47.5% respectively in 1st 10 days. So, there is more loss of vascularity of femoral head in elderly irrespective of other

factors. Loss of vascularity curve is very steep from 41 to 50years group to 51 to 60years age group. It is also true in case of 11 to 10 days duration. Here steep rise of vascularity is seen in age group 71 to 80 years.

Limitations

1. It is an epidemiological study. So, more the number of patients, more is the accuracy, even though a significant number of patients (n=30) were included in this study.
2. Data was collected from a tertiary health care centre and thus cannot be extrapolated to total population.

Recommendations

1. Randomized controlled, multicenter study may give better outcome.

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How to cite this article: Chatterjee B, Halder TC, Mondal B, Paul P. Assessment of Vascularity of Femoral Head in Cases of Neck of Femur Fracture in Relation to Age of Patient and Duration of Fracture by Magnetic Resonance Imaging. Ann. Int. Med. Den. Res. 2019; 5(3):OR13-OR19.

Source of Support: Nil, **Conflict of Interest:** None declared