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NATIONAL INSTITUTE OF MALARIOLOGY, PARASITOLOGY AND ENTOMOLOGY

CLINICAL AND EPIDEMIOLOGICAL CHARACTERISTICS AND TREATMENT OUTCOMES AMONG PATIENTS WITH FEMORAL HEAD AVASCULAR NECROSIS IN HA TINH PROVINCE, (2022 - 2023)

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THESIS SUMMARY

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The thesis can be found at:

- Vietnam National Library;
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LIST OF ABBREVIATIONS

Abbreviation	Definition
ARCO	Association Research Circulation Osseous
BMD	Bone Mineral Density
BMI	Body Mass Index
CT Scan	Computed Tomography
CRP	C-reactive protein
DEXA	Dual Energy X-ray Absorptiometry
HA	Hemiarthroplasty
HHS	Harris Hip Score
IF	Internal Fixation
LOS	Length of Hospital Stay
Max	Maximum
Min	Minimum
MRI	Magnetic Resonance Imaging
QCT	Quantitative Computed Tomography
SD	Standard Deviation
THA	Total Hip Arthroplasty
WHO	World Health Organization
WTS	Waiting Time for Surgery

INTRODUCTION

Avascular necrosis of the femoral head is a type of osteonecrosis due to disruption of blood supply to the proximal femur, leading to the destruction of the femoral head. This process is often accompanied by necrosis of blood vessels supplying the femoral neck [1]. In recent years, the development of market economy and changes in unhealthy lifestyles result in increased obesity and abuse of alcohol, beer, and tobacco in young people, which contributes to the increased risk of avascular necrosis of the femoral head [2], [3].

There are approximately 10,000 to 20,000 new cases reported each year in the United States and among 250,000 patients who undergo hip surgery, up to 10% are caused by femoral head avascular necrosis [4], [5].

In Vietnam, femoral head avascular necrosis is the main cause of hip replacement at orthopaedic trauma centers in major hospitals in Hanoi [8]. Some studies in Vietnam show that the prevalence of femoral head avascular necrosis among patients with hip replacement is from 14.5% to 18% [9], [10], [11]. For patients with avascular necrosis of the femoral head, total hip arthroplasty is indicated for cases of severe hip pain, possibly with limited joint mobility, ineffective medical treatment, greatly affected motor function, and having deformity of the femoral head on X-ray and MRI images (stage IV, V, VI) [13].

There are about 300 cases of avascular necrosis of the femoral head undergoing hip replacement in Ha Tinh province each year. This number tends to increase; however up to now there has not been any research on the epidemiology or intervention for avascular necrosis of the femoral head. As a matter of urgency, we conducted the study: ***Clinical and epidemiological characteristics and treatment outcomes among patients with femoral head avascular necrosis at Ha Tinh TTH General Hospital (2022-2023)*** with the following objectives:

1. *Describe some clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital in 2022-2023.*
2. *Evaluate outcomes of total hip arthroplasty and some associated factors for femoral head avascular necrosis.*

THESIS STRUCTURE

The thesis consists of 125 pages divided into the following sections: Introduction (2 pages); literature review (37 pages); study subjects and methods (24 pages); study results (30 pages); discussions (32 pages); conclusions (2 pages); and recommendations (1 page). There are 50 tables, 15 figures, and 130 references.

NOVELTY AND SCIENTIFIC AND PRACTICAL SIGNFICANCE OF THE THESIS

This is the first time the study has been conducted in Ha Tinh province with a large sample size, standard scientific research designs which are currently widely applied in Vietnam and the world, and strict selection criteria. The methods of data entry and analysis are suitable for each research variable, therefore the study data are highly reliable. The study have outlined the picture of avascular necrosis of the femoral head, its clinical and epidemiological characteristics, and living habits of the patients with avascular necrosis of the femoral head in Ha Tinh and analyzed risk factors related to total hip arthroplasty outcomes for avascular necrosis of the femoral head. The references for the study are mostly updated with more than 25% of the references within the past 5 years. All above ensure the novelty, scientific and practical significance of the study.

Chapter 1:
LITERATURE REVIEW

Avascular necrosis of the femoral head is a condition that occurs when the blood supply to the femoral head is damaged, leading to the destruction of the femoral head. This process is often accompanied with necrosis of blood vessels which supply blood for the femoral neck. The necrotic area initially creates bone thinning, bone defects, later leading to subchondral fractures, eventually causing femoral head collapse, secondary degeneration and loss of hip function [1]. The development of market economy and unhealthy lifestyle changes in recent years has increased obesity and alcohol and tobacco abuse in young people, which contributes to the increased risk of avascular necrosis of the femoral head [2], [3].

In the United States, it is estimated that there are about 10,000 to 20,000 new cases of avascular necrosis of the femoral head each year, and among 250,000 patients undergoing hip replacement, up to 10% are caused by avascular necrosis of the femoral head [4], [5]. According to a survey in France, the prevalence of avascular necrosis of the femoral head in the community was about 1/1000 [6]. Another study by Chokotho in Japan showed that the estimated prevalence of avascular necrosis of the femoral head in the general population was 0.135% [7].

In Vietnam, the percentage of avascular necrosis of the femoral head among patients with hip replacement is from 14.5% to 18% [9], [10], [11]. Depending on the progression stage at diagnosis and other factors such as age, grade of injury, and associated risk factors, patients can be treated with many methods: medical treatment, core decompression, bone graft, or artificial hip replacement [12]. For patients with avascular necrosis of the femoral head, total hip arthroplasty is indicated for cases of severe hip pain, possibly with limited joint mobility,

ineffective medical treatment, greatly affected motor function, and having deformity of the femoral head on X-ray and MRI images (stage IV, V, VI) [13]. There are about 300 cases of avascular necrosis of the femoral head undergoing hip replacement in Ha Tinh province each year. This number tends to increase; however up to now there has not been any research on the epidemiology or intervention for avascular necrosis of the femoral head.

Chapter 2:
STUDY SUBJECTS AND METHODS

2.1. Study subjects

- *Inclusion criteria*: All patients diagnosed with femoral head avascular necrosis who underwent hip replacement and inpatient treatment at Ha Tinh TTH General Hospital, regardless of age and gender, and agreed to participate in the study; Patients diagnosed with grade III, IV femoral head avascular necrosis according to the ARCO classification; Patients with total hip arthroplasty for the first time.

- *Exclusion criteria*: Patients with mental illness; Patients with hip osteoarthritis not due to femoral head avascular necrosis.

2.2. Study location and duration

- Study location: Ha Tinh TTH General Hospital.

- Time of study*:* from January 2022 to June 2023.

2.3. Study methods.

2.3.1. Study design.

- For objective 1: Cross-sectional descriptive research method.
- For objective 2: Non-controlled intervention research method

2.3.2. Sample size

- *Sample size for objective 1*: We applied the formula for calculating minimum sample size for descriptive study:

$$n = Z^2_{1-\alpha/2} \frac{1-p}{p\varepsilon^2}$$

Where: n is the minimum sample size; p: is the estimated proportion of patients with femoral head avascular necrosis with hip pain, choose p = 0.87 (Bui Thi Lan Anh (2006), the proportion of hip pain is 87%; $Z_{1-\alpha/2}$: With a 95 percent confidence interval, the value of $Z_{1-\alpha/2}$ is 1.96; ε: Desired relative error, choose ε = 5.8%). With the selected values, the minimum sample size is 171. Our sample size was 180 patients.

- *Sample size for objective 2:* All patients diagnosed with femoral head avascular necrosis who were candidated for total hip arthroplasty at the objective 1 (n=180).

2.4. Research content

2.4.1. Describe the distribution characteristics among the study subjects

The patients with femoral head avascular necrosis were described by gender, age, occupation, working age, and geography.

2.4.2. Describe clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023.

The study identified the rate of functional and physical symptoms such as subclinical characteristics, percentage (%) of femoral head avascular necrosis patients with underlying diseases, use of corticosteroids, use of tobacco, alcohol...

2.4.3. Evaluation of total hip replacement outcomes

Postoperative evaluation until discharge: Evaluation criteria included: operative time (minutes); length of hospital stay (days); evaluation of clinical examination results according to Harris Hip Score, amount of blood transfused during surgery, postoperative X-ray images; percentage (%) of accidents and complications immediately after hip replacement surgery and before discharge; rate (%) of early mortality during and after hip replacement surgery

Evaluation at 1, 3, 6 months of total hip arthroplasty was based on the criteria of Harris Hip Score (HHS) with a scale of 100, specifically: 90 -100 as excellent; 80 -90 as good; 70 -79 as fair; 60 - 69 as average; and < 60 as poor.

Related factors were analyzed, including patient age; disease duration; associated diseases; preoperative condition; surgical technique, limb axis, postoperative limb deviation; operative time, postoperative complications, and blood loss.

2.5. Research variables

2.5.1 Variables for Objective 1: *Description of clinical and epidemiological characteristics of the patients with femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022 -2023.*

Preoperative variables included clinical and subclinical characteristics for diagnosis of femoral head avascular necrosis, age, gender, occupation, duration of injury, functional symptoms upon admission, medical history, alcohol use, tobacco use, corticosteroid use, BMI, MRI, X-ray, blood pressure, HB, total protein, albumin, urinary sugar, blood sugar, density (T-score), CRP, Urea, Creatinine, Sodium, Potassium, electrolytes...

2.5.2. Variables for Objective 2: *Evaluation of total hip arthroplasty outcomes and associated factors among the patients with femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023*

Variables included length of hospital stay, amount of blood transfused during surgery, accidents and complications during and after surgery, X-ray results, pain level, postoperative gait, walking distance, ability to sit in a chair, total range of motion after hip replacement, and outcome evaluation at 1, 3 and 6 months after hip replacement according to Harris Hip Score.

Table 2.5. Harris hip score

TT	Evaluation criteria		Points
1	Pain level	No pain	44
		Little pain	40
		Mild pain, use of aspirin	30
		Moderate pain, use of stronger pain killers than aspirin	20
		Severe pain, limited mobility	10
		Disability, complete loss of function	0

TT	Evaluation criteria		Points
2	Gait pattern	Normal	11
		Slight limping	8
		Moderate limping	5
		Severe limping	0
3	Assistive devices	None	11
		Use a stick when walking a long distance	7
		Use a stick most of the time	5
		Use one crutch	3
		Use two sticks	2
		Use two crutches or unable to walk	0
4	Walking distance	No limitation	11
		Mild limitation	8
		Moderate limitation	5
		Only stay at home	2
		Only stay in bed and chair	0
5	Ability to sit in a chair	Sit comfortably for 1 hour	5
		Sit comfortably for 30 minutes	3
		Uncomfortable to sit in any chair	0
6	Use of public transport	Able to use public transport	1
		Unable to use public transport	0
7	Ability to climb stairs	Climb normally without holding the railing	4
		Climb normally with holding the railing	2
		Have difficulty climbing stairs	1
		Unable to climb stairs	0
8	Ability to put on shoes and socks	Easy	4
		Difficult	2
		Unable	0
9	Limb deformity	Fixed contractures less than 30º	4
		Fixed form less than 10º	2
		Hip internal rotation in standing position less than 10º	1
		Limb length discrepancy less than 3.2 cm	0
10	Total range of hip motion	211º - 300º	5
		161º - 210º	4
		101º - 160º	3
		61º - 100º	2
		31º - 60º	1
		0º - 30º fixed	0

2.6. Techniques used in the study

- Clinical examinations

- Hip X-ray, pelvis MRI, determination of bone calcium density

Collected parameters were used to analyze and evaluate the disease

based on ARCO classification.

- Bone Mineral Density: T-score values were classified based on the World Health Organization criteria as follows: Normal (>-1.0); Low Bone Mineral Density (from -1 to -2.5); Osteoporosis < - 2.5.

- Laboratory tests to determine biochemical and hematological indices

Biochemical and hematological tests were performed with standard operating procedures in a hospital and according to WHO and US-CDC evaluation standards.

- ***Posterolateral (posterior) approach to the hip*:** Total hip arthroplasty was performed under spinal anesthesia or endotracheal anesthesia.

2.7. Data processing and analysis

Statistical analyses were performed using Stata version 2.0.

Descriptive study: Quantitative variables were expressed as mean and standard deviation (SD) while qualitative variables were reported as frequencies and percentages.

Analytical studies: For univariate analysis, Pearson's chi-square test or Fisher's exact test was used for categorical variables where appropriate. For continuous variables, Student's t-test or Pearson's correlation test was applied for variables with or without pre-determined cut-off points. Multivariate regression model was employed to analyze the effects of independent variables with potential associations (e.g., $p < 0.1$) in WTS or LOS. Categorical variables were generated from WTS and LOS for use in multivariate analysis. Significance was set at $p < 0.05$.

2.8. Errors and elimination of errors

Common errors in research are systematic errors and random errors. To eliminate errors, researchers must comply with research design; ensure inclusion and exclusion criteria to be adhered and ensure minimum sample size. Data must be cleaned and standardized before analysis. Data are entered and analyzed using an appropriate specialized software. Statistical analyses are used for appropriate types of indicators such as comparing the difference between 2 proportions using p-value, odds ratio OR to determine related factors...

2.9. Ethics in research

The study had been approved by the Scientific and Ethical Review Board of Ha Tinh TTH General Hospital according to Decision No. 18/QĐ-TTH recognizing scientific aspects and ethical concerns for the study: *Clinical and epidemiological characteristics and treatment outcomes among patients with femoral head avascular necrosis at Ha Tinh TTH General Hospital (2022-2023)* by MSc. Nguyen Quang. Patients received care and treatment for all postoperative complications and adverse events within the hospital's capacity. Their associated chronic conditions were also treated. There was a commitment between doctor and patient. And patients had the right to refuse to participate in the research whenever they did not want to.

Chapter 3:
STUDY RESULTS

The study was conducted on 180 patients with avascular necrosis of the femoral head at Ha Tinh TTH General Hospital from January 2022 to June 2023. The patients were examined, diagnosed and underwent total hip replacement with the results as follows:

3.1 Clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital in 2022-2023

Table 3.1. Distribution of the study subjects by age, gender and place of residence (n=180)

Distribution of the study subjects		Number	Percentage (%)
Age	< 40	19	10.6
	40 – 49	33	18.3
	50 – 59	63	35.0
	60 – 69	51	28.3
	70+	14	7.8
	Mean (min-max)	**54.7 (28-75)**	
Gender	Male	161	89.4
	Female	19	10.6
	Total	**180**	**100**
Residence	Urban	25	13.9
	Rural	155	86.1
	Total	**180**	**100**

The mean age of the study subjects was 54.7 years old. The age group from 50 to 69 years old accounted for the highest proportion (63.3%), and the age group under 40 and over 70 accounted for the low proportion (10.6 and 7.8, respectively). Males and rural residents outnumbered females and urban residents (89.4% and 86.1%, respectively).

Table 3.2. Distribution of the study subjects by occupation (n = 180)

Occupation		Number	Percentage (%)
Occupation	Farmer	103	57.2
	Fisherman	50	27.8
	Fishing diver	24	13.3
	Other	3	1.7
	Total	180	100

Most of the study subjects were farmers (57.2%), followed by fishermen (27.8%) and fishing diver (13.4%). Other occupations accounted for a very low proportion of 1.7%.

3.1.2. Clinical and epidemiological characteristics of femoral head avascular

necrosis

- Functional symptoms

Table 3.3. Hip pain (n=180)

Hip pain		Number	Percentage (%)
With/Without pain	Pain	161	89.4
	No pain	19	10.6
Pain level (161)	Severe pain	125	95.7
	Moderate pain	29	18.0
	Mild pain	07	4.4
	No pain	19	11.8
Painful side (161)	Left-sided pain	62	38.5
	Right-sided pain	63	39.1
	Lateral pain	38	22.4
Frequency of pain (161)	Constant pain	139	86.3
	Pain upon moving the hip joint	15	9.3
	Intermittent pain	07	4.3
Radiating pain (161)	Only pain at hip joint	105	65.2
	Pain radiating around	56	34.8

The rate of hip pain was 89.4% (161/180), of which severe pain accounted for 95.7 (125/161) and constant pain accounted for 86.3% (139/161).

Table 3.4. Difficulty moving the hip joint (n =180)

Difficulty moving the hip joint		Number	Percentage (%)
With/Without difficulty moving the hip joint	With difficulty	173	96.1
	No difficulty	07	3.9
	Total	**180**	**100.0**
Levels of difficulty (173)	Extreme difficulty	123	71.1
	Much difficulty in walking 100-200m	27	15.6
	Difficulty in sitting for long, and walking more than 200 m	15	8.7
	No difficulty	08	4.7
	Total	**173**	**100.0**

The rate of hip joint movement difficulty was 96.1% (173/180), of which extreme difficulty accounted for 71.1%, much difficulty accounted for 15.6%, and no difficulty was only 4.7%.

- Clinical and epidemiological characteristics of femoral head avascular necrosis

Table 3.8. Characteristics of injury, time from injury to hospital admission (n=180)

Characteristics of hip joint injuries		Number	Percentage (%)
Injury side	Left side	69	38.3
	Right side	70	38.9
	Both sides	41	22.8

	Total	**180**	**100.0**
Time from injury to hospital admission	1 - 12 months	82	45.6
	13 - 24 months	48	26.7
	25 - 36 months	25	13.9
	37 - 48 months	12	6.7
	49 - 72 months	13	7.2
	Total	**180**	**100**
	Average (months)	19.70	

The median time from injury to admission was 19.7 months, and 45.6% of the study subjects went to hospital within 1 year from the time of injury.

Table 3.9. Muscle atrophy (n=180)

Muscle atrophy		**Number**	**Percentage (%)**
Hip muscle atrophy	Yes	180	100
	No	0	0
	Total	**180**	**100**
Grades of muscle atrophy	Mild (grade 1)	16	8.6
	Moderate (grade 2)	84	46.8
	Severe (grade 3)	80	44.8
	Total	**180**	**100.0**

100% of the patients had muscle atrophy and limited mobility, of which 44.8% suffered from severe muscle atrophy, 46.8% suffered from moderate muscle atrophy, and only 8.6% had mild muscle atrophy.

3.1.3. Subclinical characteristics of femoral head avascular necrosis

Table 3.12. WBC blood test results

Test results	**Min**	**Max**	**Average**	**SD**
WBC	4	26.5	10.03	1.439
Lympho	2	56	27.45	0.770
Mono	1	29	8.59	0.225
NEUTRO	17	89	59.98	0.921
Leukocytosis (≥ 10.000)	42 (23.3%)			

Leukocytosis occurred in 23.3% of the cases.

Table 3.13. Biochemical test results (n=180)

Test results	**Min**	**Max**	**Average**	**SD**
CRP (mg/dL)	0.14	84.01	6.54	0.79
Protein (g/dL)	16.21	89.20	71.38	0.61
Albumin (g/dL)	22.80	63.80	39.03	0.40
Glucose (mg/dL)	2.48	16.70	6.29	0.16
URE (mmol/L)	0.34	21.61	5.44	0.17
Creatinin (μmol/L)	15.20	170.46	78.32	1.28

Protein, albumin, urea, creatinine, and average CRP were all within the

normal range.

Table 3.14. Percentage of patients with abnormal biochemical test results (n=180)

Test results	**Number**	**Percentage (%)**
Decreased protein (< 6.0g/dL)	6/180	3.3
Decreased total albumin (< 3.5 g/dL)	36/180	20.0
Increased glucose (> any 200 mg/dL or > 126 mg/dL when hungry)	40/180	22.2
Increased CRP (> 10 mg/dL)	30/180	16.7
Increased urea (> 6.6 mmol/L)	35/180	19.4
Increased creatinine (> 120 μmol/L)	3/180	1.7

The rate of patients with increased glucose was 22.2%, followed by decreased total albumin 20.0%, increased urea 19.4%, and increased CRP 16.7%.

Table 3.15. Electrolyte test results (n=180)

Test results	**Min**	**Max**	**Average**	**SD**
Calcium (2.1 - 2.6mmol/L)	1.15	2.93	2.38	0.01
Na (135 - 145 mmol/L)	126	149	135.49	0.22
K (3.6 - 5 mmol/L)	2.6	5.59	3.74	0.03
Cl (95 - 107 mmol/L)	90.6	112.2	101.82	0.24

The results showed that the electrolyte test results were all within the normal range.

Table 3.16. Percentage of patients with abnormal electrolyte test results (n=180)

Test results	**Normal**		**Decreased**		**Increased**	
	Number	(%)	Number	(%)	Number	(%)
Calcium (2.1 - 2.6mmol/L)	159	88.3	6	3.3	15	8.3
Na (135 – 145 mmol/L)	117	65.0	62	34.4	1	0.6
K (3.6 – 5 mmol/L)	115	63.9	62	34.4	3	1.7
Cl (95 – 107 mmol/L)	166	92.2	8	4.4	6	3.3

The percentage of patients with decreased sodium and potassium was both 34.4%. Very few patients had these two indices increased. Changes in Calcium and Cl were insignificant.

Table 3.17. Test results for bone mineral density (n=180)

Bone mineral density	**Number**	**Percentage (%)**
Normal (T-score > -1)	51	28.3
Decreased (-2.5≤T-score≤ -1)	76	42.3

Osteoporosis (T-score < -2.5)	53	29.4
T-score ± SD	**– 1.74 ± 0.99**	

There were 42.3% (76/180) of the patients with decreased bone mineral density and 29.4% (53/180) had osteoporosis. The mean T-score was -1.74 ± 0.99.

Table 3.18. Imaging of injuries by MRI and X-ray

Grades of injury		**Number**	**Percentage (%)**
MRI	Grade I	0	0
	Grade II	0	0
	Grade III	103	57.2
	Grade IV	77	42.8
	Total	**180**	**100**
X-ray	Grade I	0	0
	Grade II	19	8.6
	Grade III	103	46.6
	Grade IV	99	44.8
	Total	**221**	**100**

On MRI images, ARCO grade III injuries accounted for the highest proportion of 57.2% (103/180), followed by grade IV (42.8%), without grade I and grade II.

Table 3.19. Preoperative Harris Hip Score (n=180)

Harris hip score	**Number**	**Percentage (%)**
Excellent: 90-100	0	0.0
Good: 80-89	0	0.0
Fair: 70-79	0	0.0
Average: 60-69	59	32.8
Poor: < 60	121	67.2
Mean score	**51.7 ± 5.59**	

Preoperatively, the mean Harris Hip Score of the study subjects was 51.7 ± 5.59, which was poor. The majority (67.2%) of the patients had poor hip score (< 60).

3.2. Evaluation of THA outcomes among the patients with femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022 - 2023

Of 180 patients, 139 patients underwent unilateral THA with 221 total hip replacements, and 41 patients underwent bilateral THA with ceramic head and PE liner. No cement made in the USA by Microport Orthopedics Inc. was used.

3.2.1. THA outcomes until hospital discharge

Table 3.20. Hip joint replacements and anesthesia methods (n=180)

Hip joint replacements and anesthesia methods		**Number**	**Percentage (%)**
Hip joint replacements	Unilateral hip replacement	139	77.2
	Bilateral hip replacement	41	22.8
	Total	**180**	**100**

Anesthesia methods	Spinal anesthesia	165	91.7
	Endotracheal anesthesia	15	8.3
	Total	**180**	**100**

Of 180 patients, 139 (77.2%) had unilateral hip replacement and 41 (22.8%) had bilateral hip replacement. There were 165 cases of spinal anesthesia, accounting for 91.7%, and 15 cases of endotracheal anesthesia, accounting for 8.3%.

Table 3.21. Operative time and blood volume transfused (n=221)

Operative time and blood volume transfused		**Number**	**Percentage (%)**
Operative time (minutes)	≤ 60	131	59.3
	61 – 90	71	32.1
	91 – 120	19	8.6
	Total	**221**	**100**
	58 minutes on average (Min: 40.5 mins; Max: 102 mins)		
Blood volume for transfusion (ml)	< 500	2	13.3
	500 - 1.000	12	80.0
	> 1.000	1	6.7
	Total	**14**	**100**

The median operative time was 58 minutes. A total of 14 cases required blood transfusion during surgery. The average amount of blood transfused was 512 ml/case. Those patients with blood transfusion volume from 500 to 1,000 ml accounted for the highest percentage of 80%.

Table 3.22. Length of hospital stay (n=180)

Time	**Time (days)**	**Number**	**Percentage (%)**
Length of hospital stay after surgery	2 – 7	117	65.0
	8 – 14	62	34.4
	15 – 19	1	0.6
	Median (Min-Max)	**7.24** (2 - 19)	
Total length of hospital stay	4 – 7	47	26.1
	8 – 14	131	72.8
	15 – 30	2	1.1
	Median (Min-Max)	**8.48** (4 - 30)	

Length of hospital stay after surgery ranged from 2 to 19 days, with the median time of 7.24 days. The patients who stayed in hospital for 2 - 7 days accounted for the highest percentage of 65.0%. The total length of hospital stay was 8.48 days on average, and the patients mainly stayed in hospital for 8 - 14 days (72.8%).

Table 3.23. Position of femoral stem shaft and leg length discrepancy after surgery

Research variables		**Number**	**Percentage (%)**
Femoral stem shaft	Intermediate	187	84.6
	Internal oblique	28	12.7
	External oblique	6	2.7

	Total	**221**	**100**
Leg length discrepancy	None or < 1 cm	159	88.3
	1 - 2 cm	21	11.7
	Total	**180**	**100.0**

X-ray images showed that there were 28 cases of internal axis deviation and 6 cases of external axis deviation. 88.3% (159/180) of the patients had leg length discrepancy < 1 cm; only 11.7% (21/180) had leg length discrepancy > 1 cm; and no cases of leg length discrepancy > 2 cm were found.

3.2.2. THA outcomes after 1, 3 and 6 months according to Harris Hip Score

In the study, postoperative complications were evaluated in no relation to other diseases.

Table 3.24. Postoperative complications

Complications	**Characteristics**	**Number**	**Percentage (%)**
Infection	Superficial	2	1.1
	Deep	0	0.0
Dislocation	In the first month	2	1.1
Death	In the first month	0	0.0
	In 2-3 months	0	0.0
	In 4-6 months	1	0.6

Two patients with superficial infection complications were treated cure and discharged from hospital. Two patients with dislocation during rehabilitation received chiropractic treatment and plaster cast, they also recovered and discharged from hospital. One case died in the 5th month after surgery due to a stroke.

Table 3.25. Postoperative pain level according to Harris Hip Score

Pain level	**1 month (1)**		**3 months (2)**		**6 months (3)**		**P value**
	Number	%	Number	%	Number	%	
No pain (44p)	0/180	0.0	0/180	0.0	15/179	8.4	
Mild pain (40p)	25/180	13.9	175/180	97.2	159/179	88.8	1-3<0.05
Use of moderate pain relievers (30 p)	142/180	78.9	5/180	2.8	5/179	2.8	1-3<0.05
Use of strong pain relievers (20p)	12/180	6.7	0/180	0.0	0/179	0.0	
Limited mobility (10p)	1	0.6	0	0	0	0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

After 6 months, most of the patients suffered from little or no pain. The number of patients requiring pain relievers was only 2.8%.

Table 3.26. Postoperative gait pattern according to Harris Hip Score

Gait pattern	**1 month**		**3 months**		**6 months**	
	Number	(%)	Number	(%)	Number	(%)
Normal gait (11đ)	0/180	0.0	81/180	45.0	81/179	45.3

Slight limping (8đ)	176/180	97.8	96/180	53.3	95/179	53.1
Moderate limping (5đ)	4/180	2.2	3/180	1.7	3/179	1.7
Severe limping (0đ)	0/180	0.0	0/180	0.0	0/179	0.0
Total	**180**	**100**	**180**	**100**	**179**	**100**

Normal gait at 3, 6 months was 45.0% and 45.3% respectively. Slight limp decreased from 97.8% at 1 month to only 53.3% at 3 months and 53.1% at 6 months.

Table 3.27. **Use of assistive devices in daily living after surgery according to Harris Hip Score**

Assistive devices	**1 month (1)**		**3 months (2)**		**6 months (3)**		**P**
	Number	(%)	Number	(%)	Number	(%)	
None (11 p)	0/180	0.0	79/180	43.9	170/179	95.0	2-3< 0.05
Use a stick when walking (7p)	168/180	93.3	101/180	56.1	9/179	5.0	1:2.3<0.05
Use a stick most of the time (5 p)	12/180	6.67	0/180	0.0	0/180	0.0	
Use one crutch (3 p)	0/180	0.0	0/180	0.0	0/180	0.0	
Use two sticks (2p)	0/180	0.0	0/180	0.0	0/180	0.0	
Use two crutches (0p)	0/180	0.0	0/180	0.0	0/190	0.0	
Unable to walk (0p)	0/180	0.0	0/180	0.0	0/180	0.0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

After surgery, the need for assistive devices in patients' daily living increased from 43.9% at 3 months to 95.0% at 6 months, $p < 0.01$.

Table 3.28. Postoperative ability to walk

Ability to walk	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	
No limitation (11p)	0/180	0.0	0/180	0.0	45/179	25.1	
Mild limitation (8p)	0/180	0.0	33/180	18.3	124/179	69.3	1: 3<0.05
Moderate limitation (5p)	160/180	88.9	147/180	81.7	10/179	5.6	2: 3<0.05
Only stay at home (2p)	20/180	11.1	0/180	0.0	0/180	0.0	
Only sit in a chair (0p)	0/180	0.0	0/180	0.0	0/180	0.0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

After 6 months, 25.1% of the patients had unrestricted walking ability; 69.3% had only mild walking limitations, and 5.6% had moderate walking

limitations. The change of walking ability was of statistical significance at all assessment time (p<0.05).

Table 3.29. Postoperative ability to climb stairs

Evaluation criteria	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	
Normal (4p)	0/180	0.0	69/180	38.3	154/179	86.0	1:2<0.05
Hold onto the railing (2p)	121/180	67.2	92/180	51.1	24/179	13.4	1:3<0.05
Others (1p)	59/180	32.8	19/180	10.6	1/179	0.6	2:3<0.05
Unable (0p)	0/180	0.0	0/180	0.0	0/179	0.0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

The proportion of patients with normal walking increased from 38.3% at 3 months to 86.0% at 6 months after treatment. The number of patients with a need of holding onto the railing decreased from 67.2% at 1 month to 51.1% at 3 months and 13.4% at 6 months. The change was statistically significant (p<0.05).

Table 3.31. Postoperative ability to sit in a chair

Ability to sit in a chair	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	
Sit comfortably for 1 hour	55/180	31.6	76/180	42.3	171/179	95.5	1:3<0.05
Sit comfortably for 30 minutes	123/180	68.3	104/180	57.7	8/179	4.5	1:3<0.05
Unable to sit comfortable in any chair	2/180	1.1	0/180	0.0	0/179	0.0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

The ability to sit in a chair changed significantly at all evaluation times (p < 0.01).

Table 3.32. Postoperative ability to get into a car

Ability to get into a car	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	
Able	119	66.1	180	100.0	179	100.0	1: 2 < 0.01
Unable	61	33.9	0	0.0	0	0.0	1: 3 < 0.01
Total	**180**	**100**	**180**	**100**	**179**	**100**	

After 1 month of surgery, only 66.1% of the patients were able to get in a car. However, after 3 and 6 months, 100% of the patients could get in a car. The difference was statistically significant between 3 and 6 months compared to 1 month (p < 0.05).

Table 3.33. Postoperative limb deformity

Limb deformity	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	

Fixed contractures less than 30º	167/180	92.8	176/180	97.8	179/179	100	1:2. 3>0.05
Fixed form less than 10º	98/180	54.4	154/180	85.6	177/179	98.9	1:2. 3<0.05
Hip internal rotation in standing position less than 10º	146/180	18.9	180/180	100	179/179	100	1:2. 3<0.01
Total	**180**	**100**	**180**	**100**	**179**	**100**	

The rate of fixed contractures < 30º at 1, 3 and 6 months was 92.8%, 97.8%, and 100.0% respectively. Postoperative limb deformity in the form of fixed spasticity < 10º increased from 54.4% after 1 month to 85.6% after 3 months and 98.9% after 6 months, the difference was statistically significant with $p < 0.05$. Postoperative limb deformity in the form of fixed internal rotation in straight position < 10º increased from 18.9% after 1 month to 100% after 3 months and 6 months, the difference was statistically significant with $p < 0.05$.

Table 3.34. Postoperative hip range of motion

Range of motion	**1 month (1)**		**3 months (2)**		**6 months (3)**		**p**
	Number	(%)	Number	(%)	Number	(%)	
211º -300º	0/180	0.0	0/180	0.0	17/179	9.5	
161º -210º	0/180	0.0	0/180	0.0	155/179	86.6	
101º -160º	32/180	17.8	162/180	90.0	7/179	3.9	1:2.3<0.05
61º - 100º	135/180	75.0	18/180	10.0	0/179	0.0	1:2 < 0.05
31º - 60º	13/180	7.2	0/180	0.0	0/179	0.0	
0º - 30º	0/180	0.0	0/180	0.0	0/179	0.0	
Total	**180**	**100**	**180**	**100**	**179**	**100**	

After 1 month of injury, 75% of the patients had a hip range of motion of 61º-100º. After 3 months, 90% of the patients had a hip range of motion of 101º-160º. After 6 months, 86.6% of the patients had a hip range of motion of 161º-210º. The range of motion of 61º-100º and 101º-160º was of statistically significance at 1, 3 and 6 months with $p < 0.05$.

Table 3.35. Postoperative Harris hip score

Month	**Number**	**Mean ± SD**	**Min**	**Max**	**Median**
Preoperative (1)	180	51.7 ± 5.6	37	67	50
1 month (2)	180	62.50 ± 5.8	45	78	62
3 months (3)	180	80.99 ± 6.4	63	88	79
6 months (4)	179	89.19 ± 5.9	66	100	87
P*	1: 2. 3. 4 < 0.05				

The mean Harris hip score increased significantly after surgery compared to before surgery. After 1, 3 and 6 months of treatment, the corresponding values were 62.5 points, 80.99 points, and 89.19 points compared to 51.7 points before surgery.

Table 3.36. Pre- and postoperative Harris Hip Score

Time	**Pre-operative**		**1 month**		**3 months**		**6 months**	
	Number	(%)	Number	(%)	Number	(%)	Number	(%)
Excellent (1)	0/180	0.0	0/180	0.0	0/180	0.0	74/179	41.3
Good (2)	0/180	0.0	0/180	0.0	82/180	45.6	96/179	53.6
Fair (3)	0/180	0.0	22/180	12.2	93/180	51.7	6/179	3.4
Average (4)	59/180	32.8	108/180	60.0	5/180	2.8	3/179	1.7
Bad (5)	121/180	67.2	50	27.8	0	0.0	0/179	0.0
Total	**180**	**100**	**180**	**100.0**	**180**	**100.00**	**179**	**100**
P	P(3.5:4)<0.05; P(2.3:3)<0.05; (1.2-3.4)<0.05							

Preoperatively, 67.2% of the patients had bad score, down to 27.8% after 1 month after surgery and 0.0% after 3 and 6 months of surgery. The patients with excellent score increased from 0.0% preoperatively to 41.3% after 6 months. Those with good score were 0.0% preoperatively, and increased to 53.6% after 6 months postoperatively.

3.2.3. Associated factors to treatment outcomes of femoral head avascular necrosis

During the follow-up, one patient passed away suddenly at the fifth month due to a stroke; therefore, only 179 patients continued for evaluation for 6 months.

***Table* 3.44. Results of multivariate analysis of factors associated with treatment outcomes (n = 179)**

Associated factors		OR [95%CI]	p
Age group	≥ 55 years old	2.20 [1.09 – 4.43]	0.028
	< 55 years old		
Pain duration	≥ 24 months	1.46 [0.60 – 3.59]	0.407
	< 24 months		
Short limb	≥ 1.5 cm	3.14 [1.56 - 6.31]	0.001
	< 1.5cm		
Corticosteroid use	≥ 5 months	3.05 [1.31 - 7.14]	0.010
	< 5 months		
Underlying medical conditions	Yes	2.39 [1.15 – 4.96]	0.019
	No		
Anemia	Yes	1.59 [1.26-1.97]	0.013
	No		

Multivariate analysis showed that factors related to treatment outcomes included age group ≥ 55 years old (OR=2.1898); short limb ≥ 1.5 cm (OR=3.141); prolonged corticosteroid use ≥ 5 months (OR=3.053); underlying medical conditions (OR=2.391); and anemia (OR=1.59).

Chapter 4:
DISCUSSION

4.1. Clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023

The median age of the study subjects was 54.7 years old. The age group from 50 to 69 years old accounted for the highest proportion (63.3%). The number of patients aged under 40 and over 70 was the smallest. Males outnumbered females (89.4% vs 10.6%). Most of the patients (86.1%) resided in rural areas. The study results were consistent with the study by Vo Thanh Toan on 30 patients with hip replacement at Thong Nhat Hospital in 2020, which showed that the median age of its study subjects was 53 years old (from 36 to 65), and the male/female ratio was 1.7 (19 males vs. 11 females). The male predominance may be explained by the fact that alcohol use and smoking in Vietnam is clearly higher in males than in females, and males commonly do more physically demanding jobs [44]. Tran Trung Dung's study on 44 patients who underwent double-motion hip replacement surgery to treat avascular necrosis of the femoral head in 2021 revealed that the median age was 43.7 (from 19 years old to 71 years old), of which the working age population (under 55) accounted for the highest percentage of 84.1%. This disease affects the working age population in society, causing difficulties in daily life and work; therefore, it has a negative impact on the economic situation of society [11].

4.1.2 Clinical, subclinical and epidemiological characteristics of femoral head avascular necrosis

Our study results showed that 42.8% of the patients had accompanying osteoarthritis. By MRI imaging, left-sided injuries were determined more common than right-sided injuries. There were 41 cases with bilateral injuries (22.8%). The time from injury to hospitalization was from 1 to 72 months (19.7 months on average). 45.56% of the patients went to hospital within one year of injury, taking the highest percentage. 100% of the patients had symptoms of muscle atrophy and limited mobility. There were 118 cases (65.56%) with short limbs, in which 102 cases (56.7%) had limbs shorter than 0.5 cm. With regard to clinical characteristics, studies by many researchers indicated that the patients had sudden pain in the hip joint, often when moving or changing a posture at the onset. The pain increased when moving, and decreased when resting. Clinical examinations showed few physical symptoms. In the later stage, the patients had symptoms of a chronic hip joint disease with mechanical pain, and the pain could spread to knee joints. The pain often appeared during movement, and increased when coughing or exerting themselves, causing them to limp. Clinical examinations showed signs of paradoxical motion of hip joints: limited rotation-adduction but normal flexion-extension. When complications occurred, the patients had clear limitations of movement. Physical symptoms were no longer specific with limited rotation-adduction and flexion-extension. About 50% of the patients, especially the older patients had sudden onset with symptoms of hip joint pain. The pain was mechanical, and increased at night in some patients [92]. [93].

4.1.2.2. Subclinical characteristics

Our study results revealed that hemoglobin, mean corpuscular volume and

mean platelet volume were all within the normal range. The rate of anemia was not different between two genders. Protein, albumin, urea, creatinine, and CRP were all normal. The average T-score in the study subjects was -1.74 ± 0.99. Only 51 patients (28.33%) had normal bone mineral density, the others had decreased density or osteoporosis. Our findings are consistent with many studies in the world showing that age, gender, especially osteoporosis and mechanical impact are related to avascular necrosis of the femoral head.

In Vietnam: The rate of osteoporosis in the elderly is from 50.0% to 90.0%. This was confirmed by Nguyen Trung Hoa (2014) and Duong L.T et al. (2023). Nguyen Trung Hoa (2014), measuring bone mineral density by DXA (*Dual Energy X-ray Absorptiometry*) in Ho Chi Minh City, indicated that 100.0% of the elderly study subjects had osteoporosis and low bone mineral density, in which osteoporosis was 65.1% and low bone mineral density was 34.9% [94]. Duong L.T et al. (2023), a study on 194 postmenopausal women with osteoporosis, showed that the overall rate of osteoporosis was 83.0%, in which osteoporosis at the lumbar spine was 59.8% and at the femoral neck was 23.2% [95].

In the world: The prospective cohort study by Johannesdottir F et al. (2011) showed that the circumferential variation in cortical thickness of the femoral neck was a risk factor for fracture in the elderly. Analysis of femoral cortical thickness in the quadrants of the anatomy revealed that the higher region of the femoral neck was a stronger predictor of hip fracture than the lower region, especially in males. In multivariate analysis, the risk of femoral neck fracture in the anterior quadrant was significant in both females and males, and it remained a significant predictor after adjusting FN in BMD area (aBMD, g/cm², like DXA), ($p = 0.05$ and $p < 0.0001$, respectively). Cortical thinning is almost certainly relevant to hip fracture [32].

4.1.2.3 X-ray and MRI imaging

On MRI images, most of the cases had grade III injury according to ARCO classification (57.2%) without grade I or grade II cases. Of 180 patients, 41 patients suffered from bilateral avascular necrosis of the femoral head, resulting in a total of 221 X-ray films. On X-ray images, there were 103 grade III cases, accounting for the largest proportion of 46.6%, and 19 grade II cases, accounting for 8.6%.

According to studies, radiography performed quite well in general compared to histopathology in detecting osteonecrosis, but both false negative and false positive results were still found to occur. For the early detection of osteonecrosis, MRI is often performed for patients with unexplained hip pain, usually when there are risk factors for osteonecrosis. As osteoarthritis progresses, both radiologists and pathologists have difficulty distinguishing arthritis from osteonecrosis. It can be difficult to distinguish stage III osteonecrosis from spontaneous subchondral fractures, especially with the presence of osteoarthritis. For osteonecrosis, there exist zigzag borders on both X-ray and CT images; and subchondral fractures may also have these borders. A bowl-shaped border rather than zigzag borders as often seen in subchondral fracture is more diagnostic of fracture than osteonecrosis [43] [51].

4.2. THA outcomes for femoral head avascular necrosis at Ha Tinh TTH

General Hospital, 2022-2023

4.2.1. THA outcomes

In the total of 180 patients, there were 139 cases of unilateral hip replacement and 41 cases of bilateral hip replacement, accounting for 22.8%. The average time between the second hip replacement and the first one was 36 days. 100% of the patients had a posterolateral incision with an average length of 8.6cm. Our findings were different from the study by Hoang Thanh Tung, which was conducted on 67 patients aged under 40 at Viet Duc Friendship Hospital, showing that 115 femoral heads had avascular necrosis. Of 115 femoral heads had avascular necrosis, 48 patients suffered from bilateral lesions, accounting for 71.6%; no difference was found between the left and right femoral heads [97]. According to Mai Dac Viet, the percentage of bilateral avascular necrosis of the femoral head was 90% [98]. According to Mont., 75% of primary avascular necrosis of the femoral head were bilateral [99]. There were 165 patients using spinal anesthesia for surgery, accounting for 91.7%, 15 patients received endotracheal anesthesia, accounting for 8.35%. Total hip replacement is a major surgery with prolonged operative time and greater blood loss. Therefore, anesthesia in total hip replacement always needs to be carefully prepared and performed to ensure maximum safety for the surgery.

4.2.2. Operative time, length of hospital stay and blood volume transfused

The operative time of a Total Hip Arthroplasty depends on many factors, including degree of deformity of patient's hip joint and surgeon's level of expertise and experience, which are the two most important factors; surgical instruments, design of artificial joint, and patient's general condition during operation. The study by Tran Le Thang on a group of patients aged under 30 years old with indication for hip replacement showed that 68.2% of the patients had femoral head necrosis; 29.4% suffered from secondary degeneration; the average length of incision was 9.1 ± 0.5cm; operation lasted for 74.88 ± 7.5 minutes on average; and the patient was transfused an average blood volume of 381.5ml. No long-term complications were found, and 2.4% had short-term complications of superficial infection [100. 30]. According to the study by Le Ngoc Hai (2012), the average operative time of a Total Hip Arthroplasty without cement and with a minimally invasive posterior approach was 71.2 minutes, which is shorter than that of Total Hip Arthroplasty with cement according to the study by Carling et al., which was 113 minutes [8]. [101].

In our study, 180 patients underwent surgery with the maximum operative time of 102 minutes and the minimum time of 40.5 minutes, median time of 58 minutes ± 10.9 minutes. Our findings are consistent with Blomfeldt R (2005) [102]. There were a total of 14 patients requiring blood transfusion during surgery with an average blood amount of 512 ± 125 ml. Those patients with the blood transfusion amount from 500 - 1000 ml accounted for the highest rate of 80%.

According to our study, the average length of hospital stay was 8.48 days, in which 72.18% of the patients stayed for 7 to 14 days. This result can be explained by the fact that the patients in the study were not too old, they did not suffer from any accompanying internal diseases, and the operation went smoothly. In addition,

most patients were instructed to practice some basic movements in bed right after returning to the care room, and they actively began early rehabilitation exercises from the third day after surgery. This helped the patients recover faster, minimized complications, and shortened the hospital stay. Wizerstad studies have demonstrated that patient strength decreases by 4% per day of immobilization if no postoperative exercise is performed. And according to Munin, active rehabilitation from the third day brings better treatment outcomes than the group starting rehabilitation on a later day [101].[102]. However, there were still 4 cases in the study with the hospital stay of more than 2 weeks. The initial cause of dislocation was thought to be due to the patient's weak soft tissues along with the anterior angle of artificial acetabular cup being outside the safe range. After one month of follow-up, no signs of recurrent infection were found [103].

4.2.3. Evaluation of femoral shaft position and leg length discrepancy after surgery

After surgery, the patients were clinically examined by a specialist. The length of both limbs was measured using a specialized measuring instrument (cm) in order to determine the leg length discrepancy. The results were as follows:

X-ray imaging of 221 replaced hips showed that 187 hips had the stem shaft in the intermediate axis position (84.6%), 28 hips of internal axis deviation (12.7%) and 6 hips of external axis deviation (2.7%). Phan Ba Hai's study also revealed that the intermediate axis was the correct standard position, accounting for the highest rate of 76.7%; whereas internal axis deviation was 20% and external axis deviation was 3.3% [81]. According to Dao Xuan Thanh's study, the intermediate axis was most commonly found with 78.3%, while internal axis deviation was 18.1% and external axis deviation was 3.6% [65]. According to Ho Man Truong Phu, the angle of stem shaft axis was 1.16 ± 1.17 [104]. According to Van der Wal, the deviation of the stem shaft was calculated from 3º or more compared to the femoral axis; and in 64 patients, the intermediate shaft accounted for 68.8%, internal deviation was 29.7%, external deviation was 2% with no significant changes during the follow-up [105]. In Schmidutz's study of 2 types of stem shafts: short shaft and intermediate shaft; 24% had internal deviation, 18% had external deviation [105]. In the types of deviation, external deviation is considered an undesirable posture. According to Kutzner, with the follow-up of 216 cementless hip replacements over 2 years, Harris hip score showed no difference; however, the stem shaft with external deviation was significantly related to femoral stem subsidence. Hence also assumed that the stem shaft with external deviation did not have direct contact with hard bone wall, causing instability of the stem shaft [106].

After surgery, 88.3% of the patients had no limb shortening or limb shortening of less than 1 cm, only 21 patients (11.7%) had leg length discrepancy of more than 1 cm, and no patients had leg length discrepancy of more than 2 cm. A small leg length discrepancy after surgery does not greatly affect the patient's quality of life, not only in terms of physical aesthetics but also in the motor function of the lower limbs. Leg length discrepancy is also one of the main problems that patients complain about immediately after surgery. The bigger discrepancy, the more difficult it will be for the patient to walk, especially during rehabilitation,

thereby affecting the recovery results. In addition, leg length discrepancy affects the bearing capacity of the two hip joints, making one side bear more or less pressure than the other. Furthermore, limping gait due to leg length discrepancy also causes the entire body's center of gravity to fall more on one side, leading to sacroiliitis and low back pain [107] [108].

Leg length discrepancy after hip arthroplasty can be predicted preoperatively through the template process and intraoperative control by using measuring instruments as well as exercise tests. According to many other studies, the leg length discrepancy of more than 2cm has a significant effects on the patient's quality of life [109].

4.2.4. Evaluation of THA outcomes after 1, 3, and 6 months of surgery according to Harris Hip Score

After 1, 3, and 6 months, the patients were discharged from hospital for rehabilitation at home. At 1, 3, and 6 months after discharge, the patients were re-examined by specialists to assess the condition of hip joint after surgery. The results were as follows:

4.2.4.1 Postoperative complications after 1, 3, and 6 months

There were 02 patients with postoperative infectious complications, both of which were superficial infections. Two hip joints were dislocated during rehabilitation, and one patient passed away suddenly within 06 months.

Postoperative infection is a dangerous complication and leaves persistent and severe consequences for patients. If the infection is superficial under the skin or muscle layer, it can still be treated with dressing changes combined with antibiotics. But if the infection is deep, empty spaces created around hip joints and artificial materials are favourable for bacterial growth, leading to a long lasting treatment, even multiple surgeries or removal of artificial joints [110]. [111]. [112]. According to Hwang, the average time for deep infection treatment after artificial hip replacement was 9 months. In our study, two cases suffered from postoperative infection, which is different from the finding by Dao Xuan Thanh and Mai Dac Viet with no cases of infection. This can be explained by the large sample size of 221 joints; however, all postoperative infections were well managed after 1 month of treatment [65] [98].

There are many causes of infection such as improper/inadequate sterilization of operating room and instruments, failure to ensure surgical asepsis, operative time, antibiotic usage, postoperative care, underlying diseases, and associated risk factors [113] [114]. A study by Yong Chan Ha was conducted on 105 patients (113 femoral heads) who had underwent transtrochanteric anterior rotational osteotomy for treatment of femoral head necrosis and were followed up for an average of 51.3 months after surgery. Radiographic failure was defined as secondary collapse or osteochondral changes. Multivariate analysis was performed to evaluate factors associated with secondary collapse and osteophyte formation. The Kaplan-Meier product-limit method was used to estimate survival rates. Results showed that secondary collapse occurred in 27 hips (24%), and 14 hips (12%) were converted to total hip arthroplasty. The survival rate after 110 months was 63.4% with total hip arthroplasty [115]. Korkmaz MF et al. (2014) studied 100 cases of avascular

necrosis of the femoral head who underwent surgery, revealing the cure rate of 78%. Three patients died before discharge (one death due to pulmonary embolism, two deaths due to cardiac arrest) and five patients died of unrelated medical conditions within the first 3 months of follow-up [116].

4.2.4.2. Assessment of patients' pain and gait after hip replacement according to Harris Hip Score

The number of patients with hip pain accounted for 89.44% (161/180), of which severe pain was 95.65 (125/161); constant pain was 86.34% (139/161); and radiating pain was 34.78%. The results in Table 3.4 showed that hip movement difficulty was a typical functional symptom, namely 96.11% (173/180), of which extreme difficulty was 71.10%, much difficulty was 15.60%, and no difficulty was only 4.73%.

Hernandez NM et al. (2018) studied total hip arthroplasty after repair of minimally displaced hip fractures in elderly patients. Results showed that the survival rate was 97% at 5 years, and Harris hip score improved from 35-85 ($p < 0.01$). The researcher concluded that conversion to hip arthroplasty was associated with clinical improvement, few complications and good implant stability. The risk of loosening, dislocation and periprosthetic fractures can be minimized by appropriate surgical strategies and surgical management [119].

No patients had a normal gait after 1 month of surgery. Patients' gait improved significantly after 3 months. However, from the 3rd to the 6th month, little change was found in the patients' gait. Normal gait at 3, 6 months was 45.0% and 45.3%, respectively. Mild limping gradually decreased from 97.8% at 1 month to only 53.3% and 53.1% after 3 and 6 months. Moderate limping had little change after 1, 3 and 6 months. The number of patients with no need of assistive devices in daily life increased from 43.9% at 3 months to 95.0% at 6 months. After 1 month, most patients had to use a walking stick (93.3%). This number decreased to 56.1% after 3 months, and 5.0% after 6 months. The difference was statistically significant ($p < 0.01$).

4.2.4.3. Postoperative Harris hip score

Harris hip score was mostly average after 1 month of treatment, fair and good after 3 months, and good and very good after 6 months. The difference was statistically significant ($p < 0.001$).

Our study findings are similar to those by domestic researchers such as Pham Ba Hai. According Pham Ba Hai, 97.5% of his study subjects had good and very good treatment outcomes after a follow-up of over 12 months. There were 3 cases of average outcomes, and no poor outcomes [81]. According to Dao Xuan Thanh, the average Harris score before and after surgery was 43.18 ± 22.69 and 98.61 ± 4.59, respectively. The proportion of patients with good and very good treatment outcomes was 96.7%, with 3.6% of average score [65]. In the study by Ho Man Truong Phu, the Harris score after 30 months was 90.8 ± 3.6139 [104]. According to Mai Dac Viet, very good score was 94.5%, good score was 5.5%, no average and poor results [104]. Tran The Anh's study showed that hip function assessed by Harris Hip Score with an average follow-up time of 12 months reached 91.50 ± 3.33, corresponding to 100% of cases with good and very good hip function [120].

The patient's Harris score reached a good level at the 3rd month with an average score of 82.16 ± 2.05 and reached a very good level after 2 years with an average score of 95.86 ± 0.85 [12]. This finding is not much different from other studies in the world such as: Martz (2016) and Assi (2018) with no cases of dislocation or loose hip joints detected [29] [55].

4.2.4.4. Associated factors to treatment outcomes for femoral head avascular necrosis

There was an unexpected death of a patient after 4 months of treatment, and the cause of the sudden death was confirmed to be a stroke. Therefore, only 179 patients were followed up after 6 months. Multivariate analysis showed that related factors to treatment outcomes included age group > 55 [2.198 (1.091 - 4.429), $p < 0.05$]; short limb ≥ 1.5 cm [3.141 (1.564 - 6.3)]; prolonged use of corticosteroids ≥ 5 months [3.053 (1.306 - 7.141), $p < 0.01$]; having underlying medical conditions [2.391 (1.153 - 4.959), $p < 0.05$]; suffering from anemia after surgery [1.59 (1.26-2.97), $p < 0.05$].

With regard to the relationship between age and treatment outcomes, we found the correlation between two age groups: under 55 years old and 55 years old and over and treatment outcomes. Our study results showed no relationship between osteoporosis and the extent of injury on MRI with treatment outcomes with OR = 1.733 (0.900-3.338) and 95%CI = 1.671 (0.917 - 3.047). Some studies revealed that in the group of patients with stage IV injuries, long-term disease progression made patients painful and limit mobility, resulting in weak and atrophied muscles. With regard to the relationship between treatment outcomes and history of prolonged corticosteroid use ≥ 5 months and underlying medical conditions, scientific studies in the world and medical literature show that other internal medical factors such as dyslipidemia are considered a risk factor for osteonecrosis because increased blood lipoprotein causes narrowing of the lumen and arteriosclerosis, leading to reduced blood supply to bones, causing osteonecrosis. Patients with obesity, increased cholesterol, high triglycerides are at risk of avascular necrosis of the femoral head. Hypercholesterolemia is clearly related to the pathogenesis of primary avascular necrosis of the femoral head[26]. Multivariate analysis indicated that the age group of > 55, short limb, corticosteroid use, and underlying diseases are related to treatment outcomes with OR > 1, $p < 0.05$. This finding is consistent with the assessment by scientists because avascular necrosis of the femoral head lasts silently over time, and only manifests when accumulating many risk factors. Research by scientists around the world has shown factors like age, gender, especially osteoporosis and mechanical impact are also related to avascular necrosis of the femoral head [128] [130].

CONCLUSION

The study was conducted on 180 patients with avascular necrosis of the femoral head who underwent total hip arthroplasty in the period of 2022-2023. The results were as follows:

1. Clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023

- The mean age of the study subjects was 54.7 years old (28-75), in which the patients aged 50 to 69 accounted for the highest proportion (63.3%). Males outnumbered females (89.4% vs 10.6%), and most of the patients (86.1%) resided in rural areas. Most of the study subjects were farmers (57.2%), fishermen (27.8%) and fishing diver (13.3%).

- Unilateral injury accounted for 77.2%. The time from injury to hospitalization was from 1 to 72 months, 19.7 months on average. 45.56% of the patients went to hospital within one year of injury, taking the highest proportion. 89.4% of the patients suffered from pain, 100% had muscle atrophy and limited mobility, and 65.6% had short limbs.

- There were 72.2% of the patients smoking, 76.1% using alcohol, 75.6% taking corticosteroids, and 39.4% having underlying medical conditions, especially hypertension (53.3%).

- On MRI images, most of the patients suffered from grade III injury according to ARCO classification (57.2%) with no grade I or grade II cases. On X-ray images, there were 103 cases of grade III injury, accounting for the highest rate of 46.6%; 19 grade II cases accounted for 8.6%.

2. THA outcomes for femoral head avascular necrosis and associated factors

- There were 139 cases of unilateral hip replacement (77.2%) and 41 cases of bilateral hip replacement (22.8%). The mean operative time was 58 minutes. The average length of hospital stay after surgery was 7.24 days. There was 01 case of death in the 5th month after surgery due to a stroke.

- Evaluation of Total Hip Arthroplasty outcomes according to Harris's criteria was as follows: After 1 month, 78.9% of the patients had to use painkillers; however, after 6 months, only 2.8% of the patients had to use them. Patients' gait improved significantly after 3 months. In the first month, 93.3% of the patients had to use a stick when walking. This number decreased to 43.9% after 3 months, and 5% after 6 months. With regard to walking limitations, after 1 month, 100% of the patients had walking limitations with varying degrees. After 3 months, most patients (81.7%) still had moderate walking limitations. After 6 months, 5.6% of the patients had moderate walking limitations. With regard to range of motion, 75% of the patients had hip range of motion of 61º - 100º after 1 month. After 3 months, most patients (90%) had hip range of motion of 101º - 160º. After 6 months, 86.6% had hip range of motion of 161º - 210º. Thus, according to Harris Hip Score 60.0% of the patients had average score after one month, increasing to fair and good scores after 3 months, and after 6 months, good score accounted for 41.34%, and excellent score was 53.63%.

Factors related to treatment outcomes included age group ≥ 55 (OR=2.20); short limb ≥ 1.5 cm (OR=3.14); prolonged corticosteroid use ≥ 5 months (OR=3.05); underlying medical conditions (OR=2.39); and postoperative anemia (OR=1.59).

RECOMMENDATIONS

The following recommendations were drawn from the study:

Men of working age, with occupations of fisherman or fishing diver should come for examination when having symptoms of hip pain to early detect avascular necrosis of the femoral head and avoid surgery. People who have the habit of using stimulants, alcohol, tobacco, corticosteroids or have accompanying diseases such as high blood pressure, musculoskeletal system... should go for examination when having symptoms of thigh muscle atrophy, limited hip movement to early rule out avascular necrosis of the femoral head and avoid hip replacement.

Medical staff should perform an MRI to early detect avascular necrosis of the femoral head when examining patients with hip pain, thigh muscle atrophy, or limited hip movement.

Late stage avascular necrosis of the femoral head (grade III, IV) can be treated with total hip arthroplasty for good outcomes and can return to work as normal.

LIST OF PUBLICATIONS

1 Nguyen Quang, Cao Truong Sinh, Nguyen Quang Thieu, Hoang Dinh Canh (2024), A study on some clinical and epidemiological characteristics of femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023, *Journal of Community Medicine*, Volume 65(7), pp.283-290.

2 Nguyen Quang, Cao Truong Sinh, Nguyen Quang Thieu, Hoang Dinh Canh (2024), Evaluation of total hip arthroplasty outcomes of femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023, *Journal of Community Medicine*, Volume 65(7), pp.284-296.

3 Nguyen Quang, Cao Truong Sinh, Nguyen Quang Thieu, Hoang Dinh Canh (2024), Description of associated factors to the prognosis of total hip arthroplasty for femoral head avascular necrosis at Ha Tinh TTH General Hospital, 2022-2023, *Journal of Community Medicine*, Volume 65(5), pp.134-139.