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Short-term functional outcome of total hip arthroplasty for avascular necrosis of femoral head and influence of patient-related factors

Khoa V. Vu[1], Quang Nguyen[2], Lan T.P. Luong[3], Thieu Q. Nguyen[4], Loi B. Cao[5], Anh T. Le[6]✉

[1] Orthopaedic and Outpatient Clinic, Vietnam-Germany Friendship Hospital, Ha Noi, Vietnam
[2] Ha Tinh TTH Hospital, Ha Tinh, Vietnam
[3] University of Medicine & Pharmacy, Vietnam National University, Ha Noi, Vietnam
[4] National Institute of Malariology, Parasitology, and Entomology (NIMPE), Ha Noi, Vietnam
[5] National Institute of Malariology, Parasitology and Entomology, Ha Noi, Vietnam
[6] Vietnam Military Medical University, Ha Noi, Vietnam

Corresponding author: Anh T. Le, anh_lt@vmmu.edu.vn

Abstract

Introduction Avascular necrosis of the femoral head (ANFH) is a phenomenon vascular supply disruption lead to death of bone cells around the femoral head. The disease is a severe health issue all over the world. Within 2 years about 80 % to 85 % of symptomatic cases will result in collapse of the femoral head. Recovery of hip function after total hip arthroplasty (THA) may be influenced by many factors that vary among different racial/ethnic groups. Most findings in this field have been from Western developed nations, and not much information from developing Asian countries is available.

This study **aimed** to determine the six-month functional outcome and patient–related factors that predict functional recovery in patients with avascular necrosis of the femoral head (ANFH) undertaking total hip arthroplasty (THA).

Methods Between January 2022 and December 2023 there were 143 patients participating in this prospective study. Demographic, medical history and clinical findings were collected from their medical records. The six-month functional outcome was evaluated using the Harris hip score (HHS). The mean age of the participants was 55.90 ± 11.49 years, and the majority (86.7 %) were male. Most patients had excellent (43.4 %) or good outcome (51.7 %).

Discussion Our study had some limitations: the length of the follow-up after surgery is short (6 months), that hospital-related factors like the type and volume of the hospital have not been analyzed. Nonetheless, previous observations suggest that most of the improvement in physical function occurs during the first six months following surgery and remains the same for a long time. However, our sample has typical demographic and clinical characteristics of patients with THA for ANFH, suggesting that determinants of the 6-month functional outcome in the current study could apply to other patients undergoing this surgery.

Results The determinants of excellent outcome were a higher preoperative HHS (odds ratio (OR): 4.369, 95 % confidence interval (CI) =1.854 – 10.299; $p < 0.001$) and absence of comorbidity (OR: 2.440, 95 % CI = 1.071 – 5.557, $p = 0.034$). No demographic (age, gender, body mass index), medical history (using of steroids, alcohol consumption or smoking), or any other clinical parameter (stage or side of the affected hip, time until surgery) had a significant influence on functional outcome.

Conclusion Earlier surgery during functional decline and better management of comorbidity may help improve THA outcomes for patients with avascular necrosis of the femoral head.

Keywords: total hip arthroplasty, avascular necrosis of femoral head, functional recovery, Harris hip score, Vietnam

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INTRODUCTION

Avascular necrosis of the femoral head (ANFH) is a phenomenon vascular supply disruption lead to death of bone cells around the femoral head [1, 2]. The disease is a severe health issue all over the world. In the United States, about 10,000 to 20,000 new cases are reported each year [1]. In Japan, the mean ageadjusted incidence rate is 2.51 cases per 100,000 person-years [3]. The natural history of ANFH is progression to collapse of the hips [2]. Within 2 years about 80 % to 85 % of symptomatic cases will result in collapse of the femoral head [4]. When ANFH has reached this advanced stage, total hip arthroplasty (THA) is the treatment of choice and there are no other suggested procedures [2]. Click or tap here to enter text.. One of the most important outcomes of THA is function recovery which may be influenced by many factors [2]. These factors may vary in different racial/ethnic groups [5]. However, most findings in this field have been from Western developed nations, and not much information from developing Asian countries is available [6–8].

Vietnam is a developing country in South East Asia. The prevalence of ANFH in Vietnam remains unknown, but it is expected to be high due to the high rates of alcohol consumption or smoking, well-known risk factors of the disease [6–8]. Compared to those from developed countries, Vietnamese patients may have different demographic, clinical characteristics as well as anatomical parameters of the hip joint [11, 12]. Consequently, the outcome and factors correlated to the functional outcome of THA may be different from those in developed countries. There have been some preliminary works on results of THA in Vietnam [13], but little is known about factors that may have influence the functional outcome. Therefore, we carried out this research to determine functional outcomes and patient-related factors that predict functional results of THA for ANFH in Vietnamese patients.

MATERIAL AND METHODS

This prospective survey was conducted in a general hospital, Ha Tinh TTH hospital, between January 2022 and December 2023. It received ethical clearance from the review board of TTH hospital (18/QD-TTH). Written informed consent was obtained from all patients or their legal representatives after receiving an explanation of the study. This study is part of a thesis work for the degree of Doctor of Philosophy in Health Studies at the National Institute of Malariology, Parasitology, and Entomology (NIMPE) of Vietnam.

The inclusion criteria were patients with advanced ANFH, ARCO stages III or IV (ARCO, Association Research Circulation Osseous), who underwent primary cementless THA. Patients who were not medically fit for surgery or had a history of THA for more than 12 weeks were excluded. Patients' information including demographic (gender, age, body mass index (BMI), medical history (use of steroids, alcohol consumption or smoking), and clinical data (time of pain onset, the side and stages of hips affected, the preoperative function, comorbidity) were collected using a case record form. Comorbidities listed in this analysis included cancer, cardiac disease, endocrine disease (diabetes mellitus, thyroid disease), cardiovascular disease, gastrointestinal disease, hematologic disease, hepatobiliary disease, infectious disease, neurological disease, respiratory disease, joint disease, sciatica or chronic back problem as described elsewhere [7, 8].

A conventional protocol was applied to all participants. All comorbidities were treated before the surgery. In patients with both hips affected, staged bilateral THA was performed at an interval of 6–12 weeks. After the surgery, rehabilitation specialists instructed all patients to perform functional rehabilitation. The pre-operative and 6-month functional outcome was evaluated using Harris hip score (HHS).

Definition

Patients were categorized as underweight (< 18.5), normal weight (18.5–23), overweight and obesity (⩾ 23) based on Asian criteria for BMI (kg/m2) [14]. The time of pain to THA < 24 months was considered early surgery and >= 24 months was late [15]. The functional outcome was rated as excellent for HHS of 90–100 points, good for 80–90 points, fair for 70–79 points, and poor for lower than 60 [15]. For continuous variables such as age and preoperative HHS that did not have predefined cutoff values, the mean values were used as the cut point.

Data analysis

Statistical analysis was performed using SPSS statistical software version 16.0. Continuous variables were reported as means and standard deviations (SD) while frequencies and percentages were used to express categorical variables. To find out the factors predicting the excellent functional outcome Pearson's chi-square tests and, when appropriate, Fisher exact tests were used for univariate analysis. The independent variables with a significant association from univariate analysis were entered into a multivariable linear regression model. The p-value lower than 0.05 was considered significant in all analyses.

RESULTS

There were 143 patients with a median age of 55.90 years (range, 28–85 years) included in the study. Most of the patients (80.4 %) were between 41 and 70 years old. Among the participants, 4.27 % had one comorbidity. Sciatica (11.89 %), hypertension (11.19 %), and diabetes mellitus (DM; 4.90 %) were the most frequent comorbidities. Regarding the operation, 89.7 % of the patients underwent unilateral THA, and 68.5 % of them had early surgery.

The mean HHS observed at 6-month post-surgery was 89.22 %. Most patients (95.1 %) had excellent or good outcome (Table 2).

Table 1

Baseline data of the study population (*n* = 143)

	Parameter	Value (N, %, CI 95 % or mean ± SD)
Demographics factors		
	Age (years)	55.90 ± 11.49
	Min – max	28 – 85
Gender	Male	124 (86.7)
	Female	19 (13.3)
BMI	Underweight	11 (7.69)
	Normal weight	93 (65.03)
	Overweight and obese	39 (27.28)
Medical history	Steroid use	102 (71.3 %)
	Alcohol abuse	104 (72.72)
	Smoke	95 (66.43)
Clinical data		
	Comorbidity*	49 (34.27)
	Time to surgery (months)	18.59 ± 15.38 (1 – 72)
	Early management	98 (68.5)
	Late manegement	45 (31.5)
Type of treatment	Unilateral THA	114 (89.7)
	Bilateral THA	29 (20.3)
Stage on MRI	III	69 (48.3)
	IV	74 (51.7)
	HHS	51.22 ± 3.39 (40 – 64)

* Morbidity: sciatica 17 (11.89 %), hypertension 18 (11.19 %), diabetes mellitus 7 (4.90 %), gout 5 (3.50 %), liver disease 5 (3.5 %), chronic obstructive pulmonary disease 1 (0.7 %), polyarthritis 2 (1.4 %), thyroid carcinoma 1 (0.7 %).

Table 2

Physical function at 6 months after total hip replacement (*n* = 143)

	Number/points	Percent
Excellent	62	43.4
Good	74	51.7
Fair	4	2.8
Poor	3	2.1
HHS (mean ± SD)	89.22	6.06
Min-max	66	100

The univariate analysis showed that age, concomitant morbidity, waiting time for surgery and pre-operative HHS significantly correlated with functional outcome. However, only higher pre-operative HHS (odds ratio (OR): 4.369, 95 % confidence interval (1.854 – 10.299); $p < 0.001$) and absence of comorbidity (OR: 2.440, 95 % CI = 1.071 – 5.557, $p = 0.034$) were the factors predicting excellent function on multivariate analysis. No significant association was found between other parameters and functional recovery (Table 3).

Table 3

Factors predicting excellent functional outcome at 6 months after total hip replacement ($n = 143$)

Factors		Univariate analysis		Multivariate analysis	
		OR (CI 95 %)	*p*	OR (CI 95 %)	*p*
Demographics factors					
	Age group*	2.266 (1.154 – 4.452)	0.019	2.050 (0.960 – 4.378)	0.064
	Gender†	1.366 (0.504 – 3.704)	0.624		
	BMI‡	1.089 (0.543 – 2.182)	0.861		
Medical history	Steroid use	1.562 (0.753 – 3.239)	0.265		
	Alcohol	0.653 (0.306 – 1.396)	0.344		
	Smoke	0.792 (0.391 – 1.604)	0.593		
Clinical findings	Stage‖	1.596 (0.820 – 3.106)	0.181		
	Time to surgery¶	3.957 (1.765 – 8.867)	< 0.001	2.249 (0.882 – 5.736)	0.090
	Type of surgery#	0.779 (0.344 – 1.765)	0.675		
	Pre-operative HHS**	5.483 (2.576 – 11.667)	< 0.001	4.369 (1.854 – 10.299)	< 0.001
	Comorbidity††	2.267 (1.093 – 4.702)	0.033	2.440 (1.071 – 5.557)	0.034

*, Age (⩽ 55 vs > 55 years); †, Gender: female vs. male; ‡, Underweight and normal ones compared to overweight patients, patients with normal BMI was the reference group; ‖, ARCO stages III vs. IV; ¶, early management compared to late management; #, unilateral THA vs bilateral THA; **, 50 vs. > 50 HHS; ††, patients without comorbidity vs. with comorbidity

DISCUSSION

Baseline characteristics

The present study was conducted at a general hospital in Ha Tinh province, a province in central Vietnam. The mean age of our sample was 55.90 years, and most patients were male (81.9 %) which agrees with distribution of age and gender in patients with ANFH [17, 18]. The average preoperative HHS was 51.22 (range, 40 – 64). In previous studies, THA is usually indicated for patients with HHS lower than 40 [18, 19]. However, others report THA for patients with an HHS of more than fifty as in our study [20, 21].

Functional outcome

The first aim of the current study was to investigate the functional outcome of primary THA in patients with AFHN in a Vietnamese cohort. Like many previous studies, our results demonstrate that THA had good outcomes with more than 90 % of patients rated as excellent or good recovery [19, 22]. The average post-operative HHS in our study (89.26) was also in the range of postoperative scores previously reported (from 85 to 93) [18, 19].

Factors predicting functional outcome

The second aim of the current study was to identify factors that may predict excellent functional outcomes after THA for the treatment of ANFH. This study corroborates many previous studies showing no association between demographic parameters including age, gender, weight status and the functional outcome [20, 23]. Age and gender are patient-related factors that are useful for clinicians to determine the appropriate type of surgery [24]. It has been suggested that the optimal age for THA is about 60 to 75 years [25], but many investigators have found that the operation has good outcomes regardless of patients' age [26, 27]. Similarly, the lack of association between weight status and THA outcome in our sample follow the trend previously described [28, 29]. It is generally accepted that THA should not be withheld from patients who are overweight or obese [30, 31].

Regarding medical history variables, our results concur with studies suggesting that use of steroids, alcohol consumption and smoking have no influence on the functional outcome of THA [6, 32, 33]. Use of steroids is considered the leading cause of atraumatic ANFH [1]. In addition, patients with ANFH are more likely to be exposed to corticosteroid use [34]. Steroid use may result in a high rate of complications and reoperation of THA [35]. Nevertheless, functional outcome is similar to patients with no history of using steroids [35, 36]. Alcohol abuse is another common risk factor for atraumatic AVN, especially in younger patients [37, 38]. However, Johannson et al. (2011) found that alcohol abuse is not associated with poor THA outcomes [6].

Among the clinical findings, pre-operative HHS and comorbidity were independently associated with six-month functional recovery of our patients (Table 3). The strong association between pre-operative HHS and functional recovery has been addressed in many studies [21, 23, 31, 32]. Röder et al. (2007) reported a significant relationship between higher pre- and post-operative walking capacity and range of hip flexion when analyzing data from 12,925 patients (13,766 total hip arthroplasties) registered in the International Documentation and Evaluation System European between 1967 and 2002 [39]. In a recent review, the preoperative function is the determinant of THA outcomes with the highest amount of evidence [40]. Likewise, the association between comorbidity and THA outcome in our patients is supported by several earlier observations [8, 41, 42]. A recent review shows a significant negative association between comorbidity and functional outcome in patients undertaking THA in almost all studies under review (11/13 studies) [40].

In the present study, the influence of other clinical variables including the stage of the disease, the time to THA and the side of the affected hip on functional outcome is not significant. Yang et al. (2023) found that patients with ARCO stage III had a significantly shorter operative time, hospital stay length, and reduced intraoperative bleeding volume [25]. Still, there were no significant differences in postoperative HHS ($p = 0.062$) compared with patients with ARCO stage IV [25]. Jones et al. (2001) have shown that time until surgery did not affect function at 6 months among patients with THA [42]. The literature review shows that bipolar THA has similar results to unipolar THA [43]. In other words, evidence in our study suggests that earlier operation in the disease process and better management of comorbidity should be implemented to improve THA outcomes in patients with advanced ANFH [7, 41. 44].

Limitation

Our study had some limitations. Firstly, the length of the follow-up after surgery is short (6 months). Nonetheless, previous observations suggest that most of the improvement in physical function occurs during the first six months following surgery [8] and remains the same for a long time [17, 44]. The second limitation is that hospital-related factors like the type and volume of the hospital have not been analyzed. However, our sample has typical demographic and clinical characteristics of patients with THA for ANFH, suggesting that determinants of the 6-month functional outcome in the current study could apply to other patients undergoing this surgery.

CONCLUSION

This study suggests that total hip arthroplasty for the treatment of avascular necrosis of the femoral head in Vietnam has good outcome. There is a significant association between pre-operative function and comorbidity and functional outcome. This data may be useful both for providing a precise prognosis and a more adequate intervention strategy, e.g. early operation in the course of functional decline and better management of comorbidity for patients with this debilitating disease.

Conflict of interest *The authors declare that there were no conflicts of interest in this study and agree to submit the manuscript for possible publication in Genij Ortopedii.*

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Information about the authors:

Khoa V. Vu — MD, bskhoavd@gmail.com;

Quang Nguyen — MD, quangnguyendr@gmail.com;

Lan T. P. Luong — MD, phuonglanlt.ump@vnu.edu.vn;

Thieu Q. Nguyen — MD, PhD, thieunq@gmail.com;

Loi B. Cao — MD, PhD, Associate Professor;

Anh T. Le — PhD, MD, Associate Professor, anh_lt@vmmu.edu.vn, https://orcid.org/0000-0002-4919-1739.