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ORIGINAL ARTICLE

The impact of reoperation after bipolar hemiarthroplasty for femoral neck fracture: A matched cohort comparison between septic and nonseptic causes

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ABSTRACT

Objectives: This study aims to compare the rates of medical complication and mortality following initial bipolar hemiarthroplasty (bHA) and reoperation procedures, as well as between different causes of reoperation (nonseptic *vs*. septic).

Patients and methods: The retrospective study included 118 patients undergoing reoperation after bHA for femoral neck fractures between January 2002 and December 2022. The primary outcomes included in-hospital complications, readmission, and mortality events, while secondary outcomes included length of hospital stay, transfusion rates, and estimated blood loss. These outcomes were compared between each patient's initial bHA and their subsequent reoperation procedure. The two cohorts were matched using propensity scores based on age, sex, and Charlson Comorbidity Index to compare outcomes between nonseptic and septic causes of reoperation.

Results: Of the 118 patients, 64 were male and 54 were female. The mean age was 77.8 ± 7.9 years, with a range of 61 to 98 years. The in-hospital complication rate was higher after reoperation than after initial bHA (15.3% *vs*. 1.7%, $p < 0.001$). Conversely, the readmission rate was higher after the initial procedure (60.2% *vs*. 23.7%, $p < 0.001$), mainly due to surgical complications. Patients undergoing reoperation had longer hospital stays, higher transfusion requirements, and more frequently received general anesthesia compared to the initial procedure ($p < 0.05$). In the matched cohort, septic group had higher in-hospital complication rates than the nonseptic group (23.5% *vs*. 3.9%, $p = 0.004$), while readmission and mortality rates were comparable.

Conclusion: Reoperations after bHA carry a higher risk of medical complications. This risk is particularly pronounced in cases related to septic conditions, underscoring the greater impact of reoperation and careful clinical attention.

Keywords: Complication, femoral neck fracture, hemiarthroplasty, infection, mortality, readmission, reoperation, revision hip arthroplasty.

Hip fractures, one of the most common osteoporotic fractures in the elderly, have a significant socioeconomic impact. The incidence is expected to increase by 240% to 310% by 2050, potentially affecting 7.3 to 21.3 million people worldwide.[1-3] Femoral neck fractures, a common type of senile osteoporotic hip fracture, are typically treated with hip arthroplasty procedures, including bipolar hemiarthroplasty (bHA) or total hip arthroplasty (THA), except for those with nondisplaced fractures or in younger patients.[4-8] Several studies have reported reoperation rates between 3.3% and 3.8% following bHA, mainly due to infection, periprosthetic fracture, and dislocation.[9,10] Although this rate is not considered high, the impact on elderly, fragile patients with multiple comorbidities can be significant. Many studies have validated the surgical outcomes of conversion THA for failed bHA, revealing satisfactory implant survival but an increased rate of surgical complications

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(e.g., periprosthetic joint infection, dislocation, and intraoperative calcar fracture) compared to primary THA.[11-16] However, these studies focused solely on conversion THA and did not consider other reoperations for surgical complications after the initial bHA, such as closed or open reduction for dislocation, fracture fixation for periprosthetic fractures around a well-fixed femoral stem, or debridement or resection for infection. Additionally, none of these studies examined the overall prospective of the impact of reoperation following the initial bHA on other important patient outcomes, including rates of in-hospital complications, readmissions, and mortality.[11-16]

The 30-day readmission rate following the initial procedure for hip fractures can be as high as 8.3% to 10.1%. Notably, readmissions for medical reasons were 13 times more frequent than for surgical reasons, including pneumonia, deep vein thrombosis, cardiovascular disease, and renal failure.[17,18] The readmission and medical complication rates might be higher following reoperation due to the impact of repeated anesthesia and surgical procedures.[19-22] Several studies have noted that the complexity and uncertainty of revision hip surgery can increase blood loss, transfusion needs, and hospital stay, and patients who require allogenic transfusion face added clinical and financial burdens.[20-22] Collectively, these factors may help explain the greater impact observed with reoperation. Magnuson et al.[23] included 91 patients who underwent conversion to THA for failed fixation of femoral neck fractures and intertrochanteric fractures, as well as failed bHA. The conversion group had higher rates of 90-day readmissions (14.3% *vs.* 3.2%) and medical complications (16.5% *vs.* 6.1%) compared to a matched control group with successfully treated hip fractures. However, the group with failed bHA consisted of only 12 patients.[23] Due to the lack of evidence specifically addressing this cohort, we conducted this study with two aims.

The primary aim of the study was to compare the in-hospital complication, readmission rates, and mortality between initial bHA and reoperation procedures within the same patients in the first core analysis. The secondary aim was to compare the rates of in-hospital complications, readmissions, and mortality between causes of reoperation (nonseptic and septic). Appropriate matching methods for these two cohorts were applied in the second core analysis. The hypotheses were as follows: (1) patients undergoing reoperation would exhibit higher rates of in-hospital complications, readmissions, and mortality for medical complications compared to initial bHA, and (2) patients undergoing reoperation for septic causes would have worse outcomes in terms of rates of in-hospital complications, readmissions, and mortality compared to those for nonseptic causes.

PATIENTS AND METHODS

This retrospective study was conducted at Taipei Veteran General Hospital, Department of Orthopaedics and Traumatology a tertiary referral hospital. One hundred thirty-six patients aged 60 years or older who underwent both an initial bHA for femoral neck fractures and a subsequent reoperation due to surgical complications from the bHA procedure between January 2002 and December 2022 were evaluated. Eligible patients were identified from our database using Taiwan's National Health Insurance procedure codes. First, patients who underwent bHA for femoral neck fractures (PCS-64169B) were screened. Second, records of these patients and identified those who underwent reoperation due to surgical complications of the initial bHA were reviewed. These reoperations included debridement (PCS-48006C), arthrotomy (PCS-64052B), resection arthroplasty (PCS-64198B), open reduction and internal fixation of peritrochanteric or femoral shaft fractures (PCS-64028C, PCS-64029B), revision bHA (PCS-64258B), revision THA (PCS-64201B), closed reduction (PCS-64073C), open reduction (PCS-64064B), or various combinations of these procedures. At the institution, the standard indication for bHA was for patients aged 60 years or above with a displaced femoral neck fracture. For patients of any age with a nondisplaced femoral neck fracture, or for those under the age of 60 years with a displaced femoral neck fracture, fracture reduction and internal fixation was the treatment of choice. Twelve patients who were lost to follow-up within one year postoperatively after either the initial or reoperation procedure and six patients aged under 60 years were excluded. In addition, three patients who underwent closed reduction under sedation in the emergency department were excluded from the reoperation cohort. In cases where closed reduction was unsuccessful, patients subsequently underwent open reduction under general anesthesia, which qualified as reoperation. The first core analysis addressed primary and secondary outcomes and perioperative demographics (anesthesia method and procedure time) of the same patient at different time points (initial bHA *vs.* the subsequent operation). The second core analysis analyzed metrics using propensity scores based on age, sex, and Charlson Comorbidity Index (CCI) to compare outcomes between nonseptic and septic causes of reoperation. The flowchart of the participants is shown in Figure 1. Informed consent was waived due to the retrospective nature of the study. The study protocol was approved by the Institutional Review Board of Taipei Veterans General Hospital (Date: 04.07.2024, No.: 2024-07-004BC). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical procedure and postoperative follow-up

The surgical procedures were performed under either spinal or general anesthesia using a transgluteal or posterolateral approach with the patient in a lateral decubitus position.[24] Perioperative intravenous tranexamic acid was administered to reduce blood loss. The choice between a cementless or cemented stem was determined by the surgeons, with most patients undergoing bHA with a cementless stem (n = 104, 88.1%). A Hemovac drain was inserted before wound closure. After the procedure, intravenous prophylactic antibiotics were administered for 24 h postoperatively, unless another source of infection was identified. After discharge from the hospital, outpatient follow-up visits were scheduled at two weeks, six weeks, three months, six months, and one year.

Common causes of reoperation included nonseptic and septic complications. Septic complications comprised surgical site complication and periprosthetic joint infection, while nonseptic complications commonly included dislocation, stem subsidence, aseptic stem loosening, periprosthetic

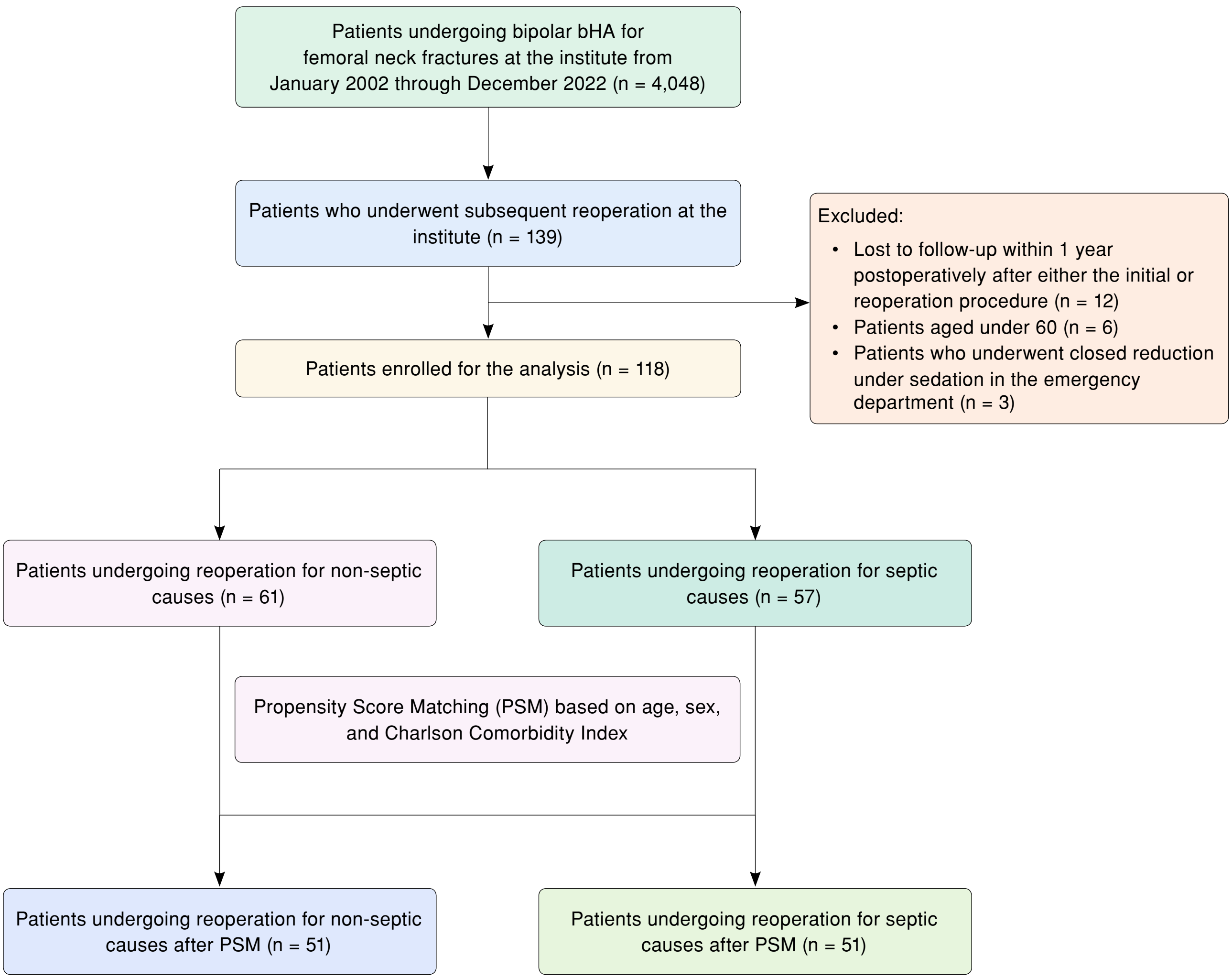

FIGURE 1. The flowchart of the study participants.
bHA, hemiarthroplasty.

fracture, and pain. For periprosthetic joint infection, we adopted Tsukayama classification,[25] as it incorporates the timing from the index procedure, the underlying pathogenesis, and the clinical features. If the infection was acute or a delayed acute infection, the primary treatment choice was debridement, antibiotics, and implant retention. A two-stage exchange arthroplasty was considered when the infection was chronic or involved a loosened implant. For dislocation of bHA, the primary approach was closed reduction under anesthesia, with open reduction considered if closed reduction failed. Revision bHA or conversion to THA with a cemented primary stem or cementless revision stem was the treatment choice for stem subsidence or aseptic stem loosening. The decision to perform fracture fixation or revision arthroplasty in patients with a periprosthetic fracture was based on the stability of the femoral stem, consistent with the treatment algorithm of the Vancouver classification.[26] An extended course of intravenous antibiotics was administered for prophylaxis or treatment following reoperation. Routine intraoperative cultures were obtained, and antibiotic therapy was continued according to institutional protocol until culture results were confirmed negative. An infectious disease specialist was consulted if cultures were positive or if periprosthetic joint infection was clinically suspected, despite negative culture results. Outpatient follow-up visits were similar to those of the initial bHA, except for patients with surgically treated periprosthetic joint infections. These patients required regular follow-up every two weeks at both orthopedic surgery and infection diseases clinics.

Outcome domains

The primary outcomes of this study were as follows: (1) the in-hospital complication rate after each procedure, (2) the 90-day readmission rate and reasons for readmission (medical or surgical complications) after each procedure, and (3) the 90-day and one-year mortality rates following the reoperation procedure. The secondary outcomes of the study were as follows: (1) estimated blood loss,[27,28] (2) transfusions, and (3) length of stay.

Readmissions were adverse events that developed after discharge and resulted in an emergency department visit or rehospitalization within 90 days. Overall complications were defined as the total number of complications associated with each individual surgery within 90 days, as reported in each study, excluding mortality. These complications encompassed surgical, perioperative, wound-related issues, and medical complications, including neurologic,

TABLE I
Patient demographics of patients during hospital admission of initial bHA procedures (n = 118)

	n	%	Mean ± SD	Median	Range	IQR
Age (year)			77.8 ± 7.9		61-98	
Sex						
Female	54	45.8				
Male	64	54.2				
Height (cm)	64	54.2	160 ± 9.4		130-180	
Weight (kg)			60.3 ± 11.6		39-93	
Body mass index (kg/m^2)			23.5 ± 3.7		16.1-31.7	
Age-adjusted CCI						
2	6	5.1				
3	22	18.6				
4	35	29.7				
5	21	17.8				
6 or above	34	28.8				
Interval between index and reoperation procedure (month)				3		1-11
Interval between index and reoperation procedure						
< 1 year	92	78				
≥ 1 year	26	22				

bHA, bipolar hemiarthroplasty; SD, standard deviation; IQR, interquartile range; CCI, Charlson comorbidity index.

cardiovascular, pulmonary, infectious, venous thromboembolic, renal, cerebrovascular, and gastrointestinal events. The mortality events were recorded during the follow-up period of one year. Pneumonia, urinary tract infection, sepsis, coronary artery disease, congestive heart failure, delirium, and gastrointestinal bleeding were common medical complications during hospitalization or readmission. Common surgical complications during readmission included surgical site complication, periprosthetic joint infection, dislocation, periprosthetic fracture, subsidence, and aseptic stem loosening. The readmission rate was calculated as the numbers of readmissions for each index admission, allowing the impact of patients with multiple readmissions to be evaluated.

Statistical analysis

The analyses were conducted using IBM SPSS version 25.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed for all available data. Categorical variables were compared using the chi-square test or Fisher's exact test where appropriate. The paired samples t-test was employed to compare continuous demographic variables of the same patient between the initial bHA and the reoperation procedure. The independent samples t-test was used to compare all other continuous variables between the initial and reoperation procedures. To mitigate potential confounding bias in this observational study comparing patients undergoing reoperation for nonseptic and septic causes, propensity score matching was applied to rigorously adjust for differences in measured baseline characteristics between the two groups, simulating the attributes of a randomized controlled trial within an observational study design.[29,30] Propensity scores were estimated using multiple logistic regression analysis with confounding covariables including age, body mass index (BMI), and age-adjusted CCI scores. After estimating propensity scores, a 1:1 propensity score matching was conducted with the restriction of a caliper width equal to 0.2 of the standard deviation of the logistic of the propensity score. One-to-one matched pairs were formed using nearest neighbor matching,[31] minimizing the difference between the propensity scores of the paired patients. The significance level (alpha) was set at 0.05.

RESULTS

Finally, 118 patients (64 males, 54 females; mean age: 77.8 ± 7.9 years; range, 61 to 98 years) were enrolled in the analysis. The mean height, weight, and BMI before the initial bHA were 160 ± 9.4 cm, 60.3 ± 11.6 kg, and 23.5 ± 3.7 kg/m^2, respectively. Most patients had an age-adjusted CCI score of 4 (n = 35, 29.7%), 5 (n = 21, 17.8%), or 6 and above (n = 34, 28.8%). Demographic data were similar between the same patients during hospital admission of the initial bHA and reoperation procedures (Table I).

The median interval between the initial bHA and the reoperation procedure was three months (interquartile range: 1-11). A higher proportion of patients underwent reoperation within one year after the initial bHA (n = 92, 78%). Causes of reoperation included periprosthetic joint infection (n = 44, 37.3%), periprosthetic fracture (n = 30, 25.4%), stem subsidence (n = 17, 14.4%), aseptic stem loosening (n = 10, 8.5%), dislocation (n = 6, 5.1%), surgical site complications (n = 8, 6.8%), and pain (n = 3, 2.5%). The procedures performed for these causes are listed in Table II.

The in-hospital complication rate was higher following the reoperation procedure compared to

TABLE II
Causes and procedure types of reoperation following bHA (n = 118)

Causes and procedures for reoperation	n	%
Periprosthetic joint infection	44	37.3
Arthrotomy and implant retention	33	28
Resection arthroplasty	11	9.3
Periprosthetic fracture	30	25.4
ORIF	17	14.4
Revision bipolar + ORIF	6	5.1
Revision bHA	4	3.4
Revision total hip arthroplasty + ORIF	3	2.5
Stem subsidence	17	14.4
Revision total hip arthroplasty	7	5.9
Revision bipolar + ORIF	6	5.1
Revision total hip arthroplasty + ORIF	3	2.5
Revision bHA	1	0.8
Aseptic stem loosening	10	8.5
Revision total hip arthroplasty	6	5.1
Revision bHA	3	2.5
Revision total hip arthroplasty + ORIF	1	0.8
Dislocation	6	5.1
Open reduction	6	5.1
Surgical site complication	8	6.8
Wound debridement	8	6.8
Pain	3	2.5
Arthrotomy	3	2.5

bHA, bipolar hemiarthroplasty; ORIF, open reduction and internal fixation.

TABLE III

Outcome comparison between initial bHA and reoperation

	Initial procedure (n = 118)						Reoperation (n = 118)						
	n	%	Mean ± SD	Range	Median	IQR	n	%	Mean ± SD	Range	Median	IQR	*p*
Anesthesia method													**< 0.001**
Spinal	95	80.5					54	45.8					
General	23	19.5					64	54.2					
Procedure time (min)			96.9 ± 33.6	35-240					107.2 ± 51.4	30-300			0.070
Estimated blood loss (mL)			605.8 ± 401.8	77-2354.5					623.4 ± 439.8	100-2736.2			0.758
Transfusion	33	28					61	51.7					**< 0.001**
In-hospital complication*	2	1.7					18	15.3					**< 0.001**
Pneumonia	1	0.8					2	1.7					
Urinary tract infection	0	0					6	5.1					
Sepsis	1	0.8					7	5.9					
Congestive heart failure	0	0					1	0.8					
Gastrointestinal bleeding	0	0					2	1.7					
Length of stay (day)			7.7 ± 4.7	2-45					25.5 ± 31.6	2-222			**< 0.001**
90-day mortality (%)	-	-					4	3.4					-
1-year mortality (%)	-	-					6	5.1					-
Interval between reoperation procedure and mortality (day)					-	-				69	61-120		-
90-day readmission	71	60.2					28	23.7					**< 0.001**
Medical complications	7	5.9					14	11.9					0.110
Delirium	1	0.8					2	1.7					
Pneumonia	2	1.7					4	3.4					
Urinary tract infection	3	2.5					5	4.2					
Sepsis	1	0.8					2	1.7					
Coronary artery disease	0	0					1	0.8					
Surgical complications	64	54.2					14	11.9					**< 0.001**
SSC	8	6.8					3	2.5					
PJI	27	22.9					4	3.4					
Dislocation	4	3.4					2	1.7					
Periprosthetic fracture	17	14.4					3	2.5					
Subsidence	4	3.4					1	0.8					
AIL	1	0.8					1	0.8					
Pain	3	2.5					0	0					

bHA, bipolar hemiarthroplasty; SD, standard deviation; IQR, interquartile range; SSC, surgical site complications; PJI, periprosthetic joint infection; AIL, aseptic implant loosening; * In-hospital complications included both surgical and medical events. No surgical complications occurred during the in-hospital period.

the initial bHA (15.3% *vs.* 1.7%, $p < 0.001$). The overall 90-day readmission rate was higher after the initial bHA (60.2% *vs.* 23.7%, $p < 0.001$), primarily due to higher rates of surgical complications (54.2% *vs.* 11.9%, $p < 0.001$). However, the 90-day readmission rates for medical complications were not different between the two groups. The 90-day and one-year mortality rates following the reoperation procedure were 3.4% (n = 4) and 5.1% (n = 6), respectively.

A higher proportion of patients who underwent reoperation procedures received general anesthesia compared to the initial bHA (54.2% *vs.* 19.5%, $p < 0.001$). The reoperation procedure was associated with a higher transfusion rate (51.7% *vs.* 28%, $p < 0.001$) and a longer length of stay (25.5 ± 31.6 days *vs.* 7.7 ± 4.7 days, $p < 0.001$). The mean procedure time and estimated blood loss were not different between the two procedures (Table III).

The patient demographics for the nonseptic and septic cohorts prior to matching are shown in Table IV. Propensity score matching was performed using age, BMI, and age-adjusted CCI scores. In the matched cohort, patients who underwent reoperation for septic causes had a higher in-hospital complication rate (23.5% *vs.* 3.9%, $p = 0.004$) and an increased length of stay (41.4 ± 41.5 days *vs.* 11 ± 7.2 days, $p < 0.001$) compared to those with nonseptic causes. There were no significant

TABLE IV
Demographics of patients undergoing reoperation for non-septic and septic causes

	Non-septic causes (n = 61)				Septic causes (n = 57)				
	n	%	Mean ± SD	Range	n	%	Mean ± SD	Range	*p*
Age (year)			79.2 ± 8.1	61-98			78 ± 8.4	62-94	0.412
Sex									0.299
Female	30	49.2			24	42.1			
Male	31	50.8			33	57.9			
Height (cm)			157.1 ± 9.2	130-179					**0.003**
Weight (kg)			58.5 ± 11.6	39-91.2			60.8 ± 11.2	40-93	0.307
Body mass index (kg/m²)			23.7 ± 3.9	16.2-31.6			23.0 ± 3.4	16.6-32.3	0.357
Age-adjusted CCI									0.888
2	3	4.9			3	5.3			
3	9	14.8			8	14			
4	18	29.5			15	26.3			
5	12	19.7			14	24.6			
6 or above	19	31.1			17	29.8			

SD, standard deviation; CCI, Charlson comorbidity index.

TABLE V
Outcome comparison between propensity-matched cohorts of patients undergoing reoperation for non-septic and septic causes

	Non-septic causes (n = 51)				Septic causes (n = 51)				
	n	%	Mean ± SD	Range	n	%	Mean ± SD	Range	*p*
Estimated blood loss (mL)			686.2 ± 526	150-2736.2			561.8 ± 334.8	240-1684.8	0.157
Transfusion	34	66.7			21	41.2			**0.01**
In-hospital complication	2	3.9			12	23.5			**0.004**
Length of stay (day)			11 ± 7.2	4-49			41.4 ± 41.5	4-222	**< 0.001**
90-day mortality	1	2			3	5.9			0.308
1-year mortality	1	2			5	9.8			0.205
90-day readmission	17	33.3			9	17.6			0.069
Medical complications	10	19.6			4	7.8			0.084
Surgical complications	7	13.7			5	9.8			0.539

SD, standard deviation. Propensity score matching based on age, body mass index, and age-adjusted Charlson Comorbidity Index.

differences between the two cohorts in terms of overall 90-day readmission rate, readmission for medical or surgical complications, or 90-day and one-year mortality rates (Table V).

DISCUSSION

This study revealed that the in-hospital complication rate was higher following the reoperation procedure (15.3% *vs.* 1.7%, $p < 0.001$) compared to the initial bHA, whereas the 90-day readmission rate for medical complications were not different (5.9% *vs.* 11.9%, $p > 0.05$). Additionally, the 90-day and one-year mortality rates following reoperation were 3.4% and 5.1%, respectively. Furthermore, patients who underwent reoperation for septic causes had a higher in-hospital complication rate (23.5% *vs.* 3.9%, $p = 0.004$) compared to those with nonseptic causes. The rates of readmissions and mortality were not different between these groups.

In the study, all types of reoperations after bHA were included. The most common indications for reoperation were periprosthetic joint infection (37.3%), periprosthetic fracture (25.4%), and stem subsidence (14.4%). The reoperation rate was about 3.0%, similar to the registry data from Leonardsson et al.[9] (3.8%). These indications differ significantly from those reported in series that investigated the outcomes of conversion to THA for failed hemiarthroplasty, where acetabular erosion and aseptic stem loosening were the most common reasons. These latter complications represent a different patient population.[11,12,14,15] Lizaur-Utrilla et al.[17] prospectively evaluated 732 patients over the age of 65 years who were surgically treated for hip fractures. The 30-day readmission rate was 8.3%, with 56% of these occurring within two weeks. Readmissions for medical reasons were 13 times more frequent than for surgical reasons, with pulmonary disease, deep vein thrombosis, congestive heart failure, and renal failure being the most common causes. In patients with a failed initial bHA, reoperation can may have a significant impact on this elderly and fragile population due to repeated anesthesia and surgery.[19-22] However, there is little evidence validating this hypothesis. The present study included a larger number of patients (n = 118), with outcomes recorded both after the initial bHA and reoperation procedure on the same patients. This served as a more ideal comparison group. Additionally, procedure types were included instead of limiting the analysis to only conversion to THA. This approach provided a more comprehensive perspective on the outcomes of patients undergoing reoperation. A higher proportion of patients who underwent reoperation received general anesthesia (54.2% *vs.* 19.5%) and transfusions (51.7% *vs.* 28%) due to the increased complexity and longer duration of certain reoperation procedures, such as revision hip arthroplasty or resection arthroplasty. The rates of in-hospital complications and length of stay following the reoperation were approximately nine times (15.3% *vs.* 1.7%) and three times (25.5 days *vs.* 7.7 days) higher, respectively, compared to the initial procedure. The 90-day and one-year mortality rates were 3.4% and 5.1%, respectively, which were relatively low compared to other studies.[17,23,32] For patients who underwent bHA for hip fractures, van den Bekerom et al.[32] reported one- and five-year mortality rates of 28% and 63%, respectively. There was a high in-hospital mortality rate (22.9%) among patients who were readmitted after the initial bHA, mostly due to medical complications.[17] In a previous study analyzing patients who underwent conversion to THA for failed hip fractures, the mortality rates at six months, 12 months, and 24 months after the operation were 7.7%, 11%, and 14%, respectively.[23] This discrepancy might be due to variations in hospital levels, healthcare systems, and patient characteristics, such as BMI and medical comorbidities, which could have an impact on mortality in the early postoperative period.[33,34] The in-hospital complication rate in the reoperation group of our study was 15.3%, which was comparable to that reported in a previous study on failed bHA undergoing revision surgery (16%).[35] Notably, the rate was higher than that observed in a recent study using the database of American College of Surgeon's National Surgical Quality Improvement Program to analyze patients receiving revision total joint arthroplasty (TJA) procedures.[36] The results showed relatively low complication rates of 7.4% for revision THA and 4.7% for revision total knee arthroplasty.[36] These differences may be attributed to variations in patient populations, particularly between those undergoing TJA and those treated for hip fractures. Unlike patients undergoing TJA procedures, who were typically carefully selected, individuals with hip fractures often presented with multiple comorbidities and increased frailty, placing them at greater risk for postoperative complications.

No previous studies have compared the outcomes of patients who underwent reoperation of bHA for septic versus nonseptic causes. However, in a similar but different cohort, patients who underwent revision TJA for septic causes have been reported to have worse outcomes regarding mortality, recurrent infection, and implant survival compared to those who underwent the procedure for nonseptic causes.[37-40] In a single-center study of 1,254 patients conducted by Matar et al.,[38] those who underwent septic revisions consistently had worse patient survivorship compared to those who underwent aseptic revisions at five years (77.6% *vs.* 89.5%), 10 years (68.7% *vs.* 80.2%), and 17 years (66.1% *vs.* 75.0%). Similarly, Montalti et al.[37] identified a higher risk of mortality (adjusted hazard ratio: 1.42) in patients who underwent septic revisions. In this study, we focused on early postoperative outcomes in patients who underwent reoperation for bHA, including in-hospital complications, readmissions, and mortality. Notably, after matching for age, BMI, and age-adjusted CCI scores, patients who underwent reoperation for septic causes had more than six times higher in-hospital complication rates (23.5% *vs.* 3.9%) and nearly four times longer lengths of stay (41.4 days *vs.* 11 days) compared to those with nonseptic causes. Nocon et al.[41] reported that a higher proportion of patients who underwent revision TJA for septic failures were considered to have malnutritional status and required nutritional consultation compared to those with aseptic failures (49.0 *vs.* 26.7%, $p < 0.001$). Both malnutritional status (adjusted odds ratio: 2.286) and revision for septic failures (adjusted odds ratio: 1.717) were risk factors for 90-day readmissions.[41] In contrast to identifying nonmodifiable factors such as age, BMI, and age-adjusted CCI scores at the time of reoperation, the importance of modifiable factors, including postoperative nutrition and rehabilitation for older patients with hip fractures, were also emphasized.[42] Further investigation is needed to evaluate the outcomes and potential benefits of implementing a protocol for assessing and intervening in cases of suboptimal nutritional status and encouraging postoperative rehabilitation.

Several limitations of this study should be mentioned. First, our inclusion criteria involved patients who underwent both the initial bHA and the reoperation procedure at our hospital. Second, due to the low incidence of reoperation following the bHA procedure, the number of patients in our study was limited. Nonetheless, the study remains the only series to validate the perspective on the impact of reoperation for bHA on medical complications and mortality. Third, this was a retrospective study, which is inherently subject to heterogeneity and potential confounders that could influence outcomes, including the absence of functional or clinical outcome scores and the lack of subgroup analyses. These factors include procedures performed by multiple surgeons with different surgical approaches and techniques, as well as variations in perioperative care protocols.

In conclusion, reoperations after bHA for femoral neck fractures was associated with higher rates of in-hospital complications and prolonged hospital stays. The elevated risk is particularly pronounced in cases related to septic conditions, underscoring the greater impact of reoperation and the need for careful clinical attention.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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