

RESEARCH ARTICLE

Uncemented Hemiarthroplasty in Displaced Femoral Neck Fractures is associated with Higher Perioperative Surgical Complications but Lower Medical Complications: Analysis from the National Inpatient Database

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Abstract

Objectives: This study aimed to analyze and compare the perioperative outcomes of cemented and uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures by utilizing the data from the National Inpatient Sample database.

Methods: Data from the National Inpatient Sample Database was analyzed to identify patients who underwent hemiarthroplasty following a displaced femoral neck fracture (cemented and uncemented). Demographic data, comorbidities, length of stay, total charges, and perioperative complications were analyzed.

Results: 27390 patients were identified in the cemented group and 29406 in the uncemented group. The patients who underwent uncemented hemiarthroplasty demonstrated a higher incidence of prosthetic dislocation (Odds Ratio (OR) 3.348, $p < 0.001$), periprosthetic mechanical complications (OR 2.597, $p < 0.001$), wound dehiscence (OR 2.883, $p < 0.001$), superficial surgical site infection (OR 2.396, $p = 0.043$), deep surgical site infection (OR 1.686, $p < 0.001$), and periprosthetic fractures (OR 2.292, $p < 0.001$) as compared with patients who underwent cemented hemiarthroplasty. However, patients with uncemented fixation demonstrated a lower incidence of death (OR 0.567, $p < 0.001$), pulmonary embolism (OR 0.565, $p < 0.001$), deep vein thrombosis (DVT) (OR 0.746, $p < 0.001$), myocardial infarction (OR 0.772, $p = 0.025$) and blood loss anemia (OR 0.869, $p < 0.001$) as compared with cemented fixation.

Conclusion: Our study on displaced femoral neck fractures utilizing the National Inpatient database found that uncemented hemiarthroplasty was associated with a higher incidence of perioperative surgical complications. Cemented hemiarthroplasty, however, was associated with a statistically significant higher rate of death, pulmonary embolism, deep vein thrombosis, and myocardial infarction.

Level of evidence: III

Keywords: Cemented, Femoral fixation, Hemiarthroplasty, Peri-operative complications, Uncemented

Introduction

Elderly patients with displaced femoral neck fractures are most often treated with hemiarthroplasty of the hip, a procedure involving replacing the femoral head and the acetabulum with a prosthesis.^{1,2} Despite the ongoing study, there is still disagreement over whether to fixate the femoral

component with cement or without cement.

Previous studies have shown that cemented fixation of the femoral component is associated with better mobility recovery, less postoperative pain, and a lower risk of failure when compared to uncemented fixation.^{3,4} With the femoral stems cemented in place, several studies have

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shown a decreased risk of periprosthetic femoral fractures and reoperation rates.^{3, 5-7} Similarly, uncemented fixations have also been reported to have a decrease in time of surgery and also intraoperative blood loss.^{8,9} However, other studies have reported the use of uncemented increases the risk of periprosthetic fracture.¹⁰ Other studies have reported no statistically significant difference in 30-day inpatient mortality between the two groups, but among the cemented fixation group, there was a higher mortality rate during the first and the 10th postoperative day period, and a higher incidence of admission to intensive care and stroke.¹¹ Several studies have reported benefits and consequences for both techniques, and there is not a definitive answer to whether if cemented fixation or not is best.

We conducted this study to analyze and compare the hospital perioperative outcomes of cemented and uncemented hemiarthroplasty for displaced femoral neck fractures in elderly patients, utilizing the data from the National Inpatient Sample database.

Materials and Methods

Database Description

This study was conducted utilizing the data from the National Inpatient Sample (NIS) Database. The NIS database is a component of the Healthcare Cost and Utilization Project (HCUP)¹² which collects data from more than seven million hospital stays and it is the largest all-payer inpatient database in the United States. The NIS includes data from 20% of the hospitals in the United States. A quality assessment evaluation is utilized to verify this data by comparing the various data points to standardized normative values by an independent contractor.¹⁰

Demographics, duration of stay, payment method, hospital costs, discharge status, comorbidities, and in-hospital problems are among the data elements that were examined and analyzed. The International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System (ICD-10-CM/PCS) is used in the 2018 version.¹²

Data Acquisition

Since the data was de-identified and readily accessible to the public, this study was exempt from IRB approval. Using ICD-10 procedure codes, patients who underwent cemented and uncemented Hip hemiarthroplasty were identified. [Appendix]

We collected preoperative variables including age, sex, race, diabetes, and tobacco use disorder using ICD 10 codes. Post-operative medical and surgical outcomes were identified from the NIS database using ICD 10 codes. [Appendix] Medical complications included postoperative anemia, acute renal failure, hypotension, pulmonary embolism, deep vein thrombosis, myocardial infarction, pneumonia, cardiac arrest, blood transfusion, and mortality. Surgical complications included wound dehiscence, superficial surgical site infection (SSI), deep SSI, intraoperative complications, prosthetic infection, prosthetic dislocations, and periprosthetic fracture. We also examined the information on stay duration and expense. ICD 10 codes were used to identify comorbidities such as diabetes, CKD,

obesity, and tobacco use disorder. [Appendix]

Statistical Analysis

SPSS 27.0 was used to conduct the statistical analysis (IBM; Armonk, NY, USA). Demographic information about the patient was examined using descriptive statistics. When examining numerical variables, T-tests were employed. When assessing binomial variables, chi-squared or Fischer Exact tests were applied. A *P-value* of 0.05 or lower was regarded as statistically significant for all tests. Medical and surgical complication odds ratios and their accompanying 95% confidence intervals were presented for the cemented and uncemented groups.

Results

Patient demographic characteristics

There were 27,390 patients in the cemented group and 29,406 in the uncemented group. A significantly larger proportion of patients in the uncemented group were more likely to have elective admissions (11.3%) in comparison to the cemented group (7.3%, $P < 0.001$). There was no statistical difference between the two groups with respect to age, gender, average length of stay, and total charges for the entire episode of care [Table 1].

Table 1. Demographic details of inpatients undergoing hemiarthroplasty

	Cemented (n=27390)	Uncemented (n=29406)	<i>P-value</i>
Age in years ± SD	80.80± 9.696	78.70± 10.305	0.65
Female	69.5%	66.1%	0.079
Length of stay Days ± SD	5.78± 4.525	5.49± 4.280	0.151
Total charges in dollars (USD)	82283.80	79720.30	0.307
Elective admissions (%)	2052 (7.5%)	3328 (11.3%)	< 0.001

Note: SD - standard deviation; bold values indicate statistical significance

A significantly higher number of patients undergoing uncemented hemiarthroplasty were found to be obese and used tobacco as compared with patients undergoing cemented hemiarthroplasty [Table 2].

Table 2. Pre-operative risk factors for inpatients undergoing hemiarthroplasty

	Cemented	Uncemented	<i>P-value</i>	Odds ratio	95% Confidence interval
Obesity	1441	2011	0.01	1.322	1.233 - 1.417
Diabetes without complications	2134	2606	0.372	1.151	1.084 - 1.222
Tobacco related disorders	2270	2734	0.027	1.131	1.070 - 1.202

Note: Bold values indicate statistical significance

Perioperative medical and surgical complications

Patients undergoing uncemented hemiarthroplasty had a lower incidence of death (OR 0.567 [95% CI 0.496 - 0.647], $P < 0.001$), pulmonary embolism (OR 0.565 [95% CI 0.468 - 0.682], $P < 0.001$), deep vein thrombosis (DVT) (OR 0.746

[95% CI 0.623 - 0.893], $P < 0.001$), myocardial infarction (OR 0.772 [95% CI 0.615 - 0.969], $P = 0.025$) and blood loss anemia (OR 0.869 [95% CI 0.839 - 0.900], $P < 0.001$) as compared with patients undergoing cemented hemiarthroplasty [Table 3].

Table 3. Peri-operative medical complications for inpatients undergoing hemiarthroplasty

	Cemented (n=27,390)	Uncemented (n=29,406)	P-value	Odds ratio	95% Confidence interval
Death	583 (2.13%)	358 (1.22%)	<0.001	0.567	0.496 - 0.647
Blood loss anemia	9505 (34.70%)	9288 (31.59%)	<0.001	0.869	0.839 - 0.900
Blood transfusion	3238 (11.82%)	3409 (11.59%)	0.396	0.978	0.929 - 1.029
Acute renal failure	4127 (15.07%)	4065 (3.82%)	0.428	0.904	0.863 - 0.948
Hypotension	251 (0.92%)	227 (0.77%)	0.052	0.829	0.686 - 1.002
Pulmonary embolism	289 (1.06%)	176 (0.60%)	<0.001	0.565	0.468 - 0.682
DVT	269 (0.98%)	216 (0.73%)	<0.001	0.746	0.623 - 0.893
Myocardial infarction	169 (0.62%)	145 (0.49%)	0.025	0.772	0.615 - 0.969
Pneumonia	954 (3.48%)	957 (3.25%)	0.131	0.932	0.851 - 1.021
Stroke	19 (0.07%)	13 (0.04%)	0.759	1.117	0.550 - 2.267
Cardiac arrest and Ventricular fibrillation	14 (0.05%)	16 (0.05%)	0.864	1.065	0.519 - 2.181
Intestinal obstruction	8 (0.03%)	10 (0.03%)	0.748	1.164	0.459 - 2.951

Note: Data displayed as N (%), bold values indicate statistical significance

Patients undergoing uncemented hemiarthroplasty following displaced femoral neck fractures had a higher incidence of prosthetic dislocation (OR 3.348 [95% CI 2.935 - 3.818], $P < 0.001$), periprosthetic mechanical complications (OR 2.597 [95% CI 2.077 - 3.248], $P < 0.001$), wound dehiscence (OR 2.883 [95% CI 1.958 - 4.246], $P < 0.001$),

superficial surgical site infection (OR 2.396 [95% CI 1.001 - 5.737], $P = 0.043$), deep surgical site infection (OR 1.686 [95% CI 1.468 - 1.936], $P < 0.001$), and periprosthetic fractures (OR 2.292 [95% CI 2.062 - 2.547], $P < 0.001$) as compared with patients undergoing cemented hemiarthroplasty [Table 4].

Table 4. Peri-operative surgical complications for inpatients undergoing hemiarthroplasty of the hip

	Cemented (n=27,390)	Uncemented (n=29,406)	P-value	Odds ratio	95% Confidence interval
Prosthetic Dislocation	290 (1.06%)	1017 (3.46%)	<0.001	3.348	2.935 - 3.818
Periprosthetic mechanical complications	105 (0.38%)	291 (0.99%)	<0.001	2.597	2.077 - 3.248
Wound complications -Dehiscence	34 (0.12%)	105 (0.36%)	<0.001	2.883	1.958 - 4.246
Superficial Surgical site infection	7 (0.03%)	18 (0.06%)	0.043	2.396	1.001 - 5.737
Periprosthetic infection/ Deep Surgical site infection	322 (1.18%)	578 (1.97%)	<0.001	1.686	1.468 - 1.936
Other Intraoperative complications	35 (0.13%)	23 (0.08%)	0.573	1.164	0.686 - 1.976
Periprosthetic fractures	500 (1.83%)	1202 (4.09%)	<0.001	2.292	2.062 - 2.547

Note: Data displayed as N (%), Bold values indicate statistical significance

Discussion

The best way to restore the femoral component in hemiarthroplasty after femoral neck fractures are still up for debate. Our study revealed that while the uncemented fixation of the femoral stem is statistically significantly more likely to cause surgical complications such as prosthetic dislocations, surgical site infections, wound dehiscence, and periprosthetic fractures, it is also more likely to result in fewer deaths and lower incidences of DVT, pulmonary embolism, and myocardial infarction.

A study by Ogawa *et al.*, showed no statistically significant differences in the 30-day in-hospital mortality between the cemented and the uncemented hemiarthroplasty groups.¹¹ However, they found that the one to ten postoperative day mortality was significantly higher in the cemented fixation group and this association was weaker with the progression of the postoperative period.¹¹ The incidence of ICU admission and stroke was also found to be higher among the cemented fixation group.¹¹ Similarly, our study found higher mortality among the cemented group during the early postoperative period. In addition, a systematic review and meta-analysis of five randomized controlled trials (RCTs) including 950 patients comparing the outcomes of cemented and uncemented hemiarthroplasty for displaced femoral neck fractures in elderly patients found that the uncemented stems were associated with more implant-related complications as compared with the cemented stems but the operating time was shorter for uncemented stems.¹³ However, our study did not find any statistically significant differences between the two methods of fixation.

In contrast to previous studies, our study demonstrated a statistically significant higher rate of death, pulmonary embolism, deep vein thrombosis, and myocardial infarction with the cemented group. A meta-analysis of RCTs in 2021 found that the cemented stems were associated with lower reoperations rates and lower implant-related complications.¹⁴ This study also didn't find any statistically significant difference between the cemented and uncemented groups with respect to major systemic complications, minor local complications, length of stay, blood loss, operative times, and Harris Hip score.¹⁴

A recent meta-analysis of eight RCTs involving 1577 hips found statistically significant longer operative time with cemented hemiarthroplasty as compared to an uncemented hemiarthroplasty.¹⁵ The authors of this study did not find any statistically significant difference with respect to blood loss, Harris hip score, one-year mortality, and hospital stay.¹⁵ Similar to our results, periprosthetic fractures, prosthetic loosening, and subsidence were significantly higher in the uncemented group. Cemented hemiarthroplasty group patients had a higher incidence of pulmonary embolism but there was no difference in deep venous thrombosis (DVT), cardiovascular complications, pneumonia, reoperation rate, and dislocation.¹⁵ However, our study showed that there was a higher incidence of both pulmonary embolism and DVT in the cemented group.

Another meta-analysis by Liu *et al.*, included 15 RCTs (uncemented -1015 patients; cemented -1037 patients).¹⁶ This study again demonstrated that the cemented hemiarthroplasty had a longer operating time. Additionally, they also found that cemented hemiarthroplasty patients had less postoperative pain, lower mortality at 1 year, and fewer implant-related complications than the uncemented group.¹⁶ This was one of the few studies to show that one-year mortality was lower in cemented hemiarthroplasty patients based on fixed effect meta-analysis.¹⁴ In contrast, we found that there was a significantly higher incidence of mortality in the cemented group in comparison to the uncemented group.

Our study has several limitations, which are primarily inherent to the use of the NIS database. First, as is the case with any sizable database, there may be discrepancies and misclassification in the coding and documentation. Second, because the NIS database only keeps track of information that occurs while a patient is in the hospital, long-term outcome data and negative outcomes that happen after discharge could not be analyzed. Third, only the variables that are documented within the database can be assessed. There could be other potential issues with the surgical procedure which are not captured in the database but may affect the outcome of the surgery. Our study's key strength is the comparison of a sizable sample of two distinct methods of femoral stem fixation in hip hemiarthroplasty. The primary findings were that cemented hemiarthroplasty may be associated with more implant-related and mechanical complications, while uncemented fixation is associated with increased mortality and medical complications.

Conclusion

There is no consensus regarding the method of fixation of the femoral stem during the treatment of displaced femoral neck fractures in elderly patients. Our study utilizing the National Inpatient database found that uncemented hemiarthroplasty was associated with a higher incidence of perioperative surgical complications including prosthetic dislocations, periprosthetic fractures, and wound infections. Cemented hemiarthroplasty, however, was associated with a statistically significant higher rate of death, pulmonary embolism, deep vein thrombosis, and myocardial infarction.

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Appendix. ICD codes used

Comorbidities codes	Medical complication codes	Surgical complications codes	Hip hemiarthroplasty ICD 10 Procedure codes
Obesity E660 E6601 E6609 E661 E662 E668 E669 Z6830 Z6831 Z6832 Z6833 Z6834 Z6835 Z6836 Z6837 Z6838 Z6839 Z6841 Z6842 Z6843 Z6844 Z6845	Acute renal failure N170, N171, N172, N178, N179 Myocardial infarction I2101, I2102, I2111, I2113, I2114, I2119, I2121, I2129, I21A1	Peri-prosthetic fracture T84010A, T84011A, T84012A, T84013A, T84018A, T84019A, M9665, M96661, M96662, M96669, M96671, M96672, M96679, M9669, M9701XA, M9702XA, M9711XA, M9712XA Peri-prosthetic dislocation T84020A, T84021A, T84022A, T84023A, T84028A, T84029A Peri-prosthetic mechanical complications T84090A, T84091A, T84092A, T84093A, T84098A, T84099A Peri-prosthetic Infection T8450XA, T8451XA, T8452XA, T8453XA, T8454XA, T8459XA Superficial SSI T8141XA Deep SSI T8142XA Wound Dehiscence T8130XA, T8131XA, T8132XA	Cemented Hemiarthroplasty 0SRR019, 0SRR0J9, 0SRS019, 0SRS0J9 Uncemented Hemiarthroplasty 0SRR01A, 0SRR0JA, 0SRS01A, 0SRS0JA
Diabetes without complications E119 Diabetes with complications E1169 Tobacco-related disorder Z87891	D62 Pneumonia J189, J159, J22 Blood transfusion 30233N1 Pulmonary embolism I2602, I2609, I2692, I2699 DVT I82401, I82402, I82403, I82409, I82411, I82412, I82413, I82419, I82421, I82422, I82423, I82429, I82431, I82432, I82433, I82439, I82441, I82442, I82443, I82449, I82491, I82492, I82493, I82499, I824Y1, I824Y2, I824Y3, I824Y9, I824Z1, I824Z2, I824Z3, I824Z4		