Retrospective Study

HEMIARTHROPLASTY IN THE ELDERLY FOR FEMORAL NECK FRACTURES: IS THERE STILL ROOM FOR UNCEMENTED STEM? A RETROSPECTIVE STUDY

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ABSTRACT

Femoral neck fractures (FNF) are among the most common fractures in the elderly. Choosing the appropriate treatment is essential to achieve the best outcomes and reduce associated mortality. Despite several guidelines suggesting that cemented stem fixation in hemiarthroplasty for medial FNF is highly effective, the use of uncemented hemiarthroplasty (UCHA) still plays an important role. Material and Methods: From January 2013 to May 2018, we conducted a monocentric study that collected data on elderly patients with FNF treated with UCHA. Patients were followed up clinically and via X-rays at 1, 3, 6, and 12 months. The group was analyzed for complications, operative time, blood loss, loosening, and prosthesis survival. Results: A total of 638 patients (654 hips) were identified, with a median follow-up period of 25 months. Over time, 270 patients (41.3%) died. The mean age was 84.9 ± 5.41 years. Four patients (0.5%) experienced intraoperative periprosthetic fractures, and 13 patients (2%) underwent a second surgery. Ten patients (1.5%) showed calcar resorption on X-ray. The mean surgical time was 55 minutes, with an average blood loss of 245 cc. No perioperative deaths were recorded (within 0-2 days postoperatively). The implant survival rate was 98.2% at 1 year, 97.7% at 3 years, and 96.7% at 5 years. Conclusion: UCHA remains an excellent alternative, particularly for patients where reducing surgical time and blood loss is crucial while considering their comorbidities

KEYWORDS: *femoral neck fractures, hemiarthroplasty, uncemented, cemented, prosthesis, hip, operative time, blood loss, femur, partial total hip*

INTRODUCTION

Fragility fractures are increasing globally and are expected to continue rising over time. Although in some studies, age-adjusted rates seem to decline, the overall impact of hip fractures, as a significant type of fragility fracture, is widely recognized as a major health issue due to their social and economic impact (1).

In the European series, hip-fractured patients have a 30-day mortality of more than 10% and 1-year mortality of 25–30%, and it is estimated that the incidence of femoral neck fractures (FNF) with a charge of lifestyle will grow from 1.66 million in 1990 to 6.25 million in 2050 in the world. Therefore, FNFs are a growing issue in aging populations and are associated with high morbidity and mortality (2).

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Nowadays, especially in the elderly population, hip arthro/hemiarthroplasty (HA) is accepted as the ideal treatment for displaced FNF. Total hip arthroplasty (THA) is generally considered a better option for mentally competent, active, and independent patients in terms of low revision rates and better mid-long period functional results; hemiarthroplasty should be considered an effective treatment option when facing older or geriatric patients. The aim of treatment of a displaced FNF is to enable patients to walk soon on a stable and painless hip (3). According to the implant fixation method, hemiarthroplasty can be divided into 2 different types: cemented and uncemented (4).

However, controversies still exist regarding both techniques, as they have distinct advantages and complications. On the one hand, with the use of cemented arthro/hemiarthroplasty (CHA), the polymethylmethacrylate (PMMA) bone cement creates a solid bone-implant interference medium with the potential advantage of having less postoperative mid-thigh pain, lower prosthetic loosening because the femoral stem is more firmly fixed within the femur. On the other hand, in several studies, CHA is related to perioperative fat-embolic events (complications secondary to the toxic effects of cement or pulmonary embolization of bone-marrow contents and PMMA particles), cardiovascular disturbances, higher rates of early postoperative mortality and longer operative time (5, 6).

Some surgeons prefer uncemented arthro/hemiarthroplasty (UCHA) techniques since they may reduce operation time, intraoperative blood loss, and perioperative complications. Indeed, hesitation exists in the use of bone cement due to the possibility of bone cement implantation syndrome (BCIS), which may cause cardiovascular disturbances, pulmonary embolism, and, at worst, death of the patient (6).

Moreover, UCHA relies on the primary press-fit stability, with long-term stability occurring secondary to endosteal microfractures at the time of preparation and subsequent bone ingrowth. However, some authors report a higher rate of perioperative fractures and implant revisions due to subsidence, periprosthetic fractures, and lower postoperative functional scores (7, 8). Whereas other studies conclude that good results can be achieved using both techniques (8).

The National Institute for Health and Care Excellence guidelines in the UK (9) and the American Academy of Orthopedic Surgeons recommendations (10), as well as a Cochrane review (11), support the use of cemented fixation when performing arthroplasties for hip fractures in elderly patients.

A recent independent systematic meta-analysis and review, after having compared CHA and UCHA, concluded that ‘there remains a need for methodologically sound, large multi-center RCT comparing modern cemented and cement-less hemiarthroplasty stems in the medium and long term, not only focusing on mortality and complications but also on patient-reported outcome measures (12). However, data suggests that these guidelines are inconsistently followed in many parts of the world, and the effects of that need to be better characterized (13-15).

MATERIAL AND METHODS

In this mono-centric retrospective study, all patients referred to our Orthopedic and Trauma Department (Santa Maria delle Croci Hospital, Ravenna – Italy) for displaced FNFs and treated with UCHA from January 2013 to March 2018 were enrolled.

Inclusion criteria were displaced FNF (Garden classification type III-IV), patients aged >65 years old, and no concurrent joint disease or previous hip fracture. Exclusion criteria were patients having undisplaced or minimally displaced intracapsular hip fractures (Garden I–II), previous treatment to the same hip for a fracture, and those having rheumatoid arthritis or symptomatic osteoarthritis. We also excluded patients deemed unsuitable for surgical procedures by the anesthesiologist. The inclusion and exclusion criteria adopted in the patient selection for this study are shown in Table I.

Table I. *Inclusion and exclusion criteria.*

Inclusion criteria	Exclusion criteria
Displaced intracapsular hip fracture (Garden III-IV)	Age < 65
Age >65 yo	Previous treatment to the same hip for a fracture
No current joint disease	Diagnosis of rheumatoid arthritis or symptomatic osteoarthritis
Suitable for surgical procedures by the anesthesiologist	Unsuitable for surgical procedures by the anesthesiologist

Since 2010, our surgical team has routinely used UCHA, relying on the theoretical advantages of a shorter operative time and avoiding the specific cardiovascular complications related to the cementing technique.

All the patients were elderly, ranging from 65 to 105 years old, unfit for total hip arthroplasty because of preexisting comorbidities associated with low life expectancy and/or low functional demand and autonomy status or both. Two types of femoral stems were used over the years: the Zweymuller Alloclassic Zimmer stem and the Korus one.

Physical examination and radiographs were performed at the first access in the Emergency Department. All patients received perioperative antibiotic prophylaxis with Cefazolin 2g. All surgical procedures are performed through the recommended posterior-lateral approach. We always applied subfascial surgical drains. After 48 hours the drain was removed and the patient began the rehabilitation process, maintaining the sitting position on the first day and on the following day, starting with walker-supported walking. Patients' clinical and X-ray follow-up was after surgery at 1, 3, 6, and 12 months and then for any complications or clinical problems. All postoperative X-rays were performed in our hospital and recorded in the same database so we could easily check all further controls that were prescribed, such as the radiographic evolution of the affected hip. Standard views (anteroposterior and axial) were performed in X-ray control. We analyzed iatrogenic fractures, osteolysis area, and radiolucent lines in the stem region according to Vresilovic criteria (16). Calcar resorption, stem correct fitting, and heterotopic ossification were also assessed.

All data, including age, gender, type of treatment, intraoperative bleeding volume, intervention time, and mortality rate (during surgery until discharge), was collected in our surgical registry database, compiled after each operation, and sent to the RIPO regional register. The latter allowed us to monitor any postoperative complications that required revision surgery. The overall survival of the implant was further analyzed using the Kaplan-Meier method.

The main endpoint is the failure of any prosthetic component. The end of follow-up was December 2018, or if the patient's death date is before this date. Verbal and written informed consent was obtained from all patients before the beginning of the study. The present study was carried out in accordance with the approved guidelines.

RESULTS

Over five years, 638 patients (sixteen treated bilaterally for 654 implants) with FNF in Santa Maria delle Croci Hospital (Ravenna, Italy) underwent UCHA. 185 (28.3%) were men, and 469 (71.3%) were female. The mean duration of follow-up was reported to be almost 2.1-year follow-up (0-6 years range). The mean age was 84.9 during the surgery (range 65-105). 270 patients (41.3% of the whole) in total 272 prostheses died by the end of follow-up. 389 were type III hip fractures according to Garden classification, and 265 were type IV. We registered 4 cases of periprosthetic fractures (0,5%) (2 A and 2 B1 according to Vancuver classification) treated with cerclage wire or plate and screws. 13 patients (2%) had postoperative complications which required a second surgery: 3 patients (0.5%) suffered from cotyloiditis; 3 (0.5%) reported a dislocation of the implant and 3 cases (0,5%) had non-specific problems (focused pain in the operated limb, Trendelemburg limp or snapping sensation). Four patients (0,5%) developed septic loosening of the implant: 3 underwent debridement and prosthetic replacement, and 1 was treated with implant removal, antibiotic therapy, and revision implant at infection-index normalization (Table II).

Table II. *Intraoperative and postoperative total complication rate in uncemented group*.

Complications	*Number*	*Percent*
Cotyloiditis	3	0.5%
Primary instability	-	-
Dislocation	3	0.5%
Septic loosening	4	0.5%
Intraoperative fracture	4	0.5%
Calcar resorption	10	1.5%
Other	3	0.5%
Total	27	4.1 %

We noticed calcar resorption in 10 patients' X-ray controls (1,5%). The survival curves were calculated using the Kaplan-Meier method at 1, 3, and 5 years. Our population's implant survival rate is 98.2% at 1 year, 97.7% at 3 years,

and 96.7% at 5 years. The mean intervention time was 55 minutes (45 to 70 minutes), and the mean intraoperative bleeding volume was 245 cc. Among our patients, we registered no perioperative deaths (0–2 days postoperatively).

DISCUSSION

The debate regarding the relative merits of UCHA versus CHA hips continues today as vehemently as it has since their introduction. With the trends of global aging, FNF has become an increasingly serious problem, especially for elderly patients (2). Comparisons between surgical techniques favored CHA fixation because of its superior pain relief, better postoperative hip functionality, and fewer loosening prostheses and periprosthetic fractures (17).

However, many hip-fractured patients endured significant cardiovascular and cerebral comorbidities with little functional reserve. In these frail patients, some surgeons prefer to apply the UCHA technique because they believe it may reduce the operation time and the intraoperative blood loss. Indeed, considerable evidence suggests that cementing has potential adverse physiological side effects. For example, cardiorespiratory collapse and cardiac arrhythmia, which occasionally occur upon cement application, are caused by the embolism of marrow contents forced into circulation or by the direct toxic effects of the cement (18).

Pitto et al. (19) showed severe embolic events and intraoperative pulmonary impairments during fixation of the cemented femoral component in total hip arthroplasty. In contrast, fixation without cement demonstrated lower risks of embolism. The use of cement in arthroplasty also raises concern regarding the relatively rare but significant complication known as BCIS. Although there is no standardized definition of BCIS, it is generally characterized by a collection of cardiopulmonary symptoms, including hypoxia, hypotension, arrhythmia, and cardiac arrest associated with fat and bone marrow embolization that may occur during femoral reaming and cementation (19).

Due to the spectrum of symptoms that encompass BCIS, the true incidence of this syndrome is difficult to identify (6). Therefore, guidelines minimizing the risk for bone-cement implantation syndrome both by surgeons and anesthesiologists have been published (20). In literature, mid-thigh pain is more prevalent in uncemented prostheses. However, the reported incidence differs tremendously (21).

Several factors can influence postoperative mid-thigh pain, including sizing, design, and prosthetic stiffness. Major doubts regarding UCHA in the literature have been generated by the propensity for intraoperative and postoperative periprosthetic fractures. Late postoperative periprosthetic fractures and revisions caused by failure of osteointegration are known risks when using uncemented stems in elderly patients (22).

Nonetheless, our results and findings were similar to those of DeAngelis et al. regarding intraoperative periprosthetic fractures in randomized controlled trials of 130 patients with 1-year follow-ups, which indicated that uncemented stems could be used for elderly patients with osteoporotic FNF without a high risk of periprosthetic fractures (8).

Based on our results, there are more advantages of using a UCHA: less intraoperative bleeding and a shorter duration of surgery. In our study, the mean operation time was 55 minutes, and the mean bleeding volume was 245cc, according to several studies in the literature. Also, Carpintero et al. and Klestil et al. showed that the mean time of surgery and bleeding volume were higher in the cemented group (23, 24).

More recently, Inngul and colleagues (25) conducted a randomized clinical trial among 141 patients undergoing arthroplasty for FNF in Sweden and found cemented fixation to be associated with fewer periprosthetic fractures, as well as better outcomes as measured by the Harris Hip Scale, Short Musculoskeletal Functional Assessment, and EuroQol-5D scores. The specific reasons for the improved outcomes observed among patients undergoing CHA have not been definitively elucidated. However, one theory is that cemented fixation may better resist periprosthetic fracture among patients with risk factors such as advanced age, osteoporosis, and/or a history of falls (26).

Despite these recommendations, most hemiarthroplasties performed in the US continue to use uncemented fixation. Among patients with hip fracture treated with hemiarthroplasty in a large US integrated health care system, uncemented fixation, compared with cemented fixation, was associated with a statistically significantly higher risk of aseptic revision. These findings suggest that US surgeons should consider cemented fixation in the hemiarthroplasty treatment of displaced FNF in the absence of contraindications (27).

In an analysis of 2017 data from the American Joint Replacement Registry, for example, uncemented stem designs were still used in 60% of all hemiarthroplasties performed. There are many possible explanations for the continued use of UCHA fixation in the US. On the one hand, some surgeons may be concerned regarding the risks of bone cement implantation syndrome; on the other hand, the cemented fixation takes more time, and if a revision surgery is needed in the future, cement removal can be difficult, so they may not feel as comfortable implanting a cemented prosthesis. This poses a paradox in which common practice does not reflect the available evidence. It is unclear why surgeons worldwide

are making this choice. Still, it is likely related to multiple factors, including the historical concern for "cement disease" (which describes osteolysis attributed to the cement, leading to implant loosening and failure), surgeon bias and training practices (28).

Compared to modern uncemented femoral stem designs, cemented stems yield lower rates of periprosthetic fracture requiring re-operation without increasing the risk of all-cause mortality. Tapered-wedge stems had similar re-operation rates due to periprosthetic fracture as reamed uncemented stems (29). The survival curves were calculated using the Kaplan-Meier method at 1, 3, and 5 years. In our population, the implant survival rate was 98.2% at 1 year, 97.7% at 3 years, and 96.7% at 5 years, and this result can be considered highly satisfactory.

There are earlier studies in the literature reporting increased early postoperative mortality in patients treated with cemented HA. These numbers may include deaths due to BCIS; nonetheless, this could not be confirmed as we did not have access to the cause of death. However, this difference vanished after adjusting data for age, gender, and ASA class, suggesting that the difference was not due to cementing (30). Among our patients, we found no perioperative deaths (0-2 days postoperatively). In the registry studies from Australia and the UK, there has not been an increase in early postoperative mortality when comparing cemented and uncemented implants. Cementing may still be a safe option in both elective and hip fracture arthroplasty. However, in the most fragile HA patient group, caution is needed during cementation (30).

CONCLUSIONS

Although cemented arthroplasty is considered the gold standard in literature for the treatment of displaced FNF in the elderly, many surgeons like us prefer to go on with uncemented technique since the postoperative mortality appears to be similar for UCHA and CHA.

Our study showed that uncemented implant survival is remarkable for 5 years, and there was a low number of re-operations among people who completed the follow-up. Furthermore, using the uncemented stem can still be an excellent alternative, especially for those patients who need it to reduce surgical time and blood loss. Consequently, the choice of whether to cement the stem remains open.

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