

COMPARISON OF IN-HOSPITAL COMPLICATIONS FOLLOWING HYBRID VERSUS CEMENTLESS TOTAL HIP ARTHROPLASTY IN ELDERLY PATIENTS WITH OSTEOARTHRITIS

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The use of cementless total hip arthroplasty (THA) in elderly patients is associated with a higher risk of early periprosthetic femoral fractures, while cemented femoral components increase the risk of bone cement implantation syndrome. This study compared in-hospital complications following hybrid versus cementless THA in elderly patients with osteoarthritis. A retrospective review of cases from February 2012 to June 2023 was performed using data from the Hospital of Traumatology and Orthopaedics arthroplasty registry. Only primary THAs for osteoarthritis were included. A total of 773 (84.9%) patients underwent hybrid THA with cemented femoral fixation, while 138 (15.1%) underwent cementless THA. The hybrid group was older (median = 72.4 vs. 68.2 years, $p < 0.001$), had higher American Society of Anaesthesiologists (ASA) physical status scores (range 1–4 vs. 1–3, $p = 0.022$), more frequent walking aid use (46.4% vs. 21.7%, $p = 0.001$), more preoperative thromboprophylaxis (54.7% vs. 44.9%, $p = 0.034$), and longer operative times (median = 80 vs. 74 minutes, $p = 0.001$). The overall complication rate was higher in the hybrid group (56.9% vs. 47.1%, $p = 0.033$). Haemodynamic reactions during acetabular cup implantation occurred more frequently in the hybrid group (29.1% vs. 15.2%, $p = 0.001$).

Keywords: hybrid fixation, cementless fixation, bone cement implantation syndrome, haemodynamic reactions, elderly patients.

INTRODUCTION

Osteoarthritis of the hip is a common cause of chronic pain and functional disability (Wilson *et al.*, 1990). Reduced weight-bearing due to hip joint osteoarthritis frequently leads to secondary osteoporosis (Banaszkiewicz, 2014).

Total hip arthroplasty (THA) has become an effective and cost-efficient intervention for primary osteoarthritis, achieving revision rates below 5% at ten years (Learmonth *et al.*, 2007; Morshed *et al.*, 2007;). Technological advances have consistently improved implant longevity and functional outcomes. Cemented implants achieve fixation through mechanical interlock between bone and polymethylmethacrylate (PMMA) cement (Banaszkiewicz, 2014), while

cementless fixation relies on initial press-fit stability, with long-term fixation resulting from endosteal microfractures and bone ingrowth (Cheng *et al.*, 1995).

Several risk factors increase the likelihood of in-hospital complications following THA, including the type of fixation (cemented femoral stem or acetabular cup), cardiovascular and pulmonary comorbidities, thromboembolic history, BMI > 35 kg/m², use of walking aids, and advanced age (≥ 65 years) (Robert *et al.*, 2024).

The choice between cemented and cementless fixation in elderly patients is debated. Cementless fixation is associated with a higher risk of early periprosthetic femoral fractures, whereas cemented femoral components are linked to bone

Table 1. Baseline patient characteristics

Patient characteristics	Hybrid THA n = 773 (84.9%)	Cementless THA n = 138 (15.1%)	p-value
Age (years) – Me (IQR, range)	72.4 (68.6–77.1, 65.0–88.5)	68.2 (66.2–71.1, 65.0–79.3)	< 0.001
Sex – male / female	249 (32.2%) / 524 (67.8%)	72 (52.2%) / 66 (47.8%)	< 0.001
Side – right / left	433 (56%) / 340 (44%)	77 (55.8%) / 61 (44.2%)	0.962
BMI – Me (IQR, range)	28.4 (24.9–32.5, 16.0–45.8)	28.8 (25.8–32.5, 18.0–42.5)	0.245
ASA physical status – Me (IQR, range)	2 (2–3, 1–4)	2 (2–3, 1–3)	0.022

Values are presented as n (%) unless otherwise specified

cement implantation syndrome (BCIS), which arises when elevated intramedullary pressure drives medullary fat emboli into the circulation, potentially causing pulmonary embolism and systemic haemodynamic instability (Orsini *et al.*, 1987; Donaldson *et al.*, 2009; Segerstad *et al.*, 2019).

Advocates of cemented femoral fixation highlight the increased risk of early revision linked to cementless fixation, particularly due to periprosthetic fractures and aseptic loosening (Troelsen *et al.*, 2013; Yang *et al.*, 2019), potentially escalating the burden of costly revision surgeries (Bozic *et al.*, 2009; Kurtz *et al.*, 2014). Additionally, studies suggest that poor bone quality may be underdiagnosed in elderly patients, compromising osseointegration and leading to subsidence and loosening (Delsmann *et al.*, 2021).

This study aimed to compare in-hospital complications associated with hybrid and cementless THA in elderly patients with osteoarthritis.

MATERIALS AND METHODS

A retrospective study was conducted on primary THAs performed due to hip osteoarthritis between February 2012 and June 2023. Patients were categorised into two groups according to fixation type: hybrid or cementless. Exclusion criteria included revision THA, Birmingham Hip Resurfacing (BHR) systems, and short femoral components. Eligible patients were identified via the HTO arthroplasty registry, and data on complications were extracted from medical records.

Preoperative, intraoperative, and postoperative data were collected for both groups, including diagnosis, sex, age, BMI, American Society of Anaesthesiologists (ASA) physical status, affected side, walking aid use, preoperative thromboprophylaxis, smoking status, regular alcohol consumption (2 units/day), and comorbidities (diabetes mellitus, immunosuppression, osteoporosis, chronic obstructive pulmonary disease, stroke, venous thromboembolism/pulmonary artery thromboembolism, and cardiovascular conditions such as hypertension, hypotension, hypercholesterolemia, atherosclerosis/coronary artery disease, chronic heart failure, heart valve disease, and atrial fibrillation).

Surgical data included operative time, blood loss, timing of antibacterial prophylaxis, and in-hospital complications.

The latter included length of stay, number of complications per patient, frequency of intraoperative hemodynamic reactions, and specific postoperative complications (e.g., dislocation, haematoma, infection, pneumonia, ileus, and pulmonary thromboembolism).

Categorical variables were reported as counts (n) and percentages (%). Pearson's chi-square (χ^2) test was used for categorical comparisons when expected frequencies exceeded five. The Shapiro–Wilk test assessed the distribution of quantitative variables. Due to non-normal distributions, quantitative variables were reported as medians (Me) and interquartile ranges (IQR) and compared between groups using the Mann–Whitney U test. A two-tailed *p*-value of < 0.05 was considered statistically significant. Where fewer than five cases were present per group, *p*-values were not calculated. All statistical analyses were performed using SPSS version 28 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 911 primary THAs were reviewed. The hybrid fixation technique, involving a cemented femoral component, was more frequently used than cementless fixation. Cementless THA was generally performed on younger patients (Me = 68.2 years, IQR: 66.2–71.1) compared to the hybrid group (Me = 72.4 years, IQR: 68.6–77.1) (*p* < 0.001). The hybrid group also had significantly higher ASA physical status scores (range 1–4 vs. 1–3, *p* = 0.022), indicating that these patients were older and had a greater burden of comorbidities. Other demographic characteristics were comparable between the groups (Table 1).

Walking aid use was significantly more common in the hybrid group than in the cementless group (46.4% vs. 21.7%, *p* < 0.001), likely reflecting the older age of the hybrid group. Preoperative thromboprophylaxis was also more frequently administered in the hybrid group (54.7% vs. 44.9%, *p* = 0.034). No significant differences were found in other preoperative risk factors (Table 2).

The hybrid group had significantly longer operative times (Me = 80 minutes, IQR: 70–90) compared to the cementless group (Me = 74 minutes, IQR: 63–86) (*p* = 0.001). Intraoperative blood loss was higher in the hybrid group (range 50–3500 ml) than in the cementless group (100–1500 ml),

Table 2. Patient risk factor

Risk factors	Hybrid THA n = 773 (84.9%)	Cementless THA n = 138 (15.1%)	p-value
Use of walking aids	359 (46.4%)	30 (21.7%)	< 0.001
Preoperative thromboprophylaxis	423 (54.7%)	62 (44.9%)	0.034
Routine anticoagulants / antiaggregants	226 (29.2%)	42 (30.4%)	0.776
Smoking	98 (12.7%)	16 (11.6%)	0.723
Regular alcohol consumption (2 units/day)	15 (2.0%)	2 (1.5%)	–
Diabetes mellitus	144 (18.6%)	28 (20.3%)	0.646
Immunosuppression	8 (1.0%)	4 (2.9%)	–
Osteoporosis	19 (2.5%)	5 (3.6%)	0.431
Chronic obstructive pulmonary disease (COPD)	32 (4.1%)	4 (2.9%)	–
Stroke	37 (4.8%)	0	–
Venous thromboembolism / Pulmonary thromboembolism	13 (1.7%)	1 (0.7%)	–
Number of cardiovascular diseases – Me (IQR, Range)	1 (1–3, 0–6)	1 (1–3, 0–5)	0.202
Arterial hypertension	623 (80.6%)	108 (78.3%)	0.526
Arterial hypotension	3 (0.4%)	0	–
Hypercholesterolemia	36 (4.7%)	9 (6.5%)	0.352
Atherosclerosis / Coronary artery disease	328 (42.4%)	51 (37.0%)	0.229
Chronic heart failure	270 (34.9%)	39 (28.3%)	0.127
Heart valve disease	25 (3.2%)	1 (0.7%)	–
Atrial fibrillation	84 (10.9%)	19 (13.8%)	0.321

Values are presented as n (%) unless otherwise specified

Table 3. Surgical characteristics

Surgical characteristics	Hybrid THA n = 773 (84.9%)	Cementless THA n = 138 (15.1%)	p-value
Duration of operation (minutes) – Me (IQR, range)	80 (70–90, 60–187)	74 (63–86, 50–139)	0.001
Blood loss (mL) – Me (IQR, range)	400 (300–500, 50–3500)	400 (300–500, 100–1500)	0.980
Antibacterial prophylaxis timing (minutes) – Me (IQR, range)	48 (39.0–57.0, 11–98)	49 (41.5–56.5, 12–116)	0.247

Values are presented as n (%) unless otherwise specified

although this difference was not statistically significant ($p = 0.980$) (Table 3).

The hybrid group experienced a slightly longer hospital stay, but this difference did not reach statistical significance. The hybrid group also had a higher overall complication rate (56.9% vs. 47.1%, $p = 0.033$). The median number of intraoperative haemodynamic reactions was higher in the hybrid group (Me = 1) than in the cementless group (Me = 0) ($p = 0.011$) (Table 4).

Haemodynamic reactions during acetabular cup implantation occurred significantly more frequently in the hybrid group (29.1% vs. 15.2%, $p = 0.001$). The difference in haemodynamic reactions during femoral stem implantation was not significant (36.9% vs. 34.1%, $p = 0.527$) (Table 4).

Three periprosthetic femoral fractures were documented: two in the hybrid group and one in the cementless group. Other complications, including dislocation, haematoma, in-

fection, pneumonia, ileus, and pulmonary thromboembolism, were rare and did not differ significantly between groups.

DISCUSSION

This study found a higher proportion of younger patients in the cementless group, consistent with the findings of Schmidt-Braekling *et al.* (2019), who reported that cementless THA is typically preferred for younger, more active individuals. Cementless fixation is favoured in this demographic due to its potential for superior biological integration, lower risk of cement-related complications, and longer implant survival.

The lower ASA physical status scores observed in the cementless group are attributable to the younger age and better overall health of these patients. ASA classification is integral to perioperative decision-making, influencing

Table 4. In-hospital complications after surgery

Complications	Hybrid THA n = 773 (84.9%)	Cementless THA n = 138 (15.1%)	p-value
Length of hospital stay (days) – Me (IQR, range)	6 (5–8, 3–39)	7 (5–9, 3–17)	0.133
Number of complications per patient – Me (IQR, range)	1 (0–1, 0–4)	0 (0–1, 0–2)	0.003
Number of complications per group	440 (56.9%)	65 (47.1%)	0.033
Intraoperative haemodynamic reactions – Me (IQR, range)	1 (0–1, 0–2)	0 (0–1, 0–2)	0.011
Haemodynamic reaction during acetabular cup implantation	225 (29.1%)	21 (15.2%)	0.001
Haemodynamic reaction during femoral stem implantation	285 (36.9%)	47 (34.1%)	0.527
Periprosthetic fracture around femoral stem	2 (0.3%)	1 (0.7%)	–
Dislocation of total hip	23 (3.0%)	2 (1.5%)	–
Haematoma	24 (3.1%)	1 (0.7%)	–
Periprosthetic infection	1 (0.1%)	0	–
Pneumonia	2 (0.3%)	0	–
Ileus	1 (0.1%)	0	–
Pulmonary artery thromboembolism	1 (0.1%)	0	–

Values are presented as n (%) unless otherwise specified

prosthesis selection, choice of fixation technique, and anticipated operative duration. These factors also guide preoperative preparation, patient counselling, and resource planning.

Patients in the hybrid group were older and had a greater burden of comorbidities compared to those in the cementless group. Common comorbidities included arterial hypertension, atherosclerosis/coronary artery disease, chronic heart failure, diabetes mellitus, atrial fibrillation, previous stroke, and chronic obstructive pulmonary disease (COPD). These conditions increased perioperative risk and necessitated more extensive pharmacological management.

Preoperative thromboprophylaxis was more common in the hybrid group, likely due to their higher risk of venous thromboembolism (VTE) related to advanced age, limited mobility, and cardiovascular comorbidities. These findings underscore the hybrid group's more complex medical profile, highlighting the need for multidisciplinary perioperative management.

Haemodynamic reactions were more frequent in the hybrid group, particularly during acetabular component implantation. This may be due to the patients' older age and higher comorbidity burden. Anaesthesiologists closely monitored these patients and implemented timely interventions to manage haemodynamic instability effectively. Consequently, during femoral component implantation, haemodynamic responses were comparable between the groups.

These results align with prior research indicating that elderly, medically complex patients undergoing cemented fixation may be at higher risk for intraoperative haemodynamic fluctuations (Donaldson *et al.*, 2009; Olsen *et al.*, 2014).

Although other complications did not reach statistical significance or were too rare to analyse statistically, the litera-

ture suggests distinct complication patterns associated with different fixation methods (Lindberg-Larsen *et al.*, 2020).

CONCLUSIONS

Elderly patients with osteoarthritis who undergo hybrid THA experience a higher rate of in-hospital complications compared to those receiving cementless THA. Hybrid THA is specifically associated with an increased risk of haemodynamic reactions during acetabular cup implantation.

ETHICS

The study was approved by the Ethics Committee of the Hospital of Traumatology and Orthopaedics.

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STACIONĀRO KOMPLIKĀCIJU SALĪDZINĀJUMS PĒC HIBRĪDA UN BEZCEMENTA TOTĀLĀS GŪŽAS LOCĪTAVAS ENDOPROTEZĒŠANAS GADOS VECĀKIEM PACIENTIEM AR OSTEOARTRĪTU

Bezcementa totālā gūžas locītavas endoprotezēšana (TGLEP) gados vecākiem pacientiem saistīta ar paaugstinātu agrīnu periprotēzes augšstilba kaula lūzumu risku, savukārt cementētas augšstilba komponentes palielina kaulu cementa implantācijas sindroma risku. Šajā pētījumā salīdzinātas stacionāra komplikācijas pēc hibrīdas un bezcementa TGLEP gados vecākiem pacientiem ar osteoartrītu. Veikta retrospektīva datu analīze no 2012. gada februāra līdz 2023. gada jūnijam, izmantojot Traumatoloģijas un ortopēdijas slimnīcas endoprotezēšanas reģistra datus. Iekļautas tikai primārās TGLEP osteoartrīta dēļ. Kopumā 773 (84,9%) pacientiem veikta hibrīda TGLEP ar cementētu augšstilba komponenti, bet 138 (15,1%) pacientiem — bezcementa TGLEP. Hibrīda grupas pacienti bija vecāki (mediāna = 72,4 pret 68,2 gadiem, $p < 0,001$), ar augstāku Amerikas Anesteziologu biedrības (ASA) fiziskā stāvokļa novērtējumu (1–4 pret 1–3, $p = 0,022$), biežāku palīgīdzekļu izmantošanu staigāšanai (46,4% pret 21,7%, $p < 0,001$), biežāku preoperatīvo tromboprofilaksi (54,7% pret 44,9%, $p = 0,034$) un ilgāku operācijas laiku (mediāna = 80 pret 74 minūtēm, $p = 0,001$). Kopējais komplikāciju biežums bija augstāks hibrīda grupā (56,9% pret 47,1%, $p = 0,033$). Hemodinamiskas reakcijas acetabulārā komponenta implantācijas laikā biežāk novērotas hibrīda grupā (29,1% pret 15,2%, $p = 0,001$).