J Chin Med Assoc

ORIGINAL ARTICLE

The mid-term outcome of dialysis-dependent patients undergoing primary total knee arthroplasty and total hip arthroplasty: A retrospective study

I-Ning Lo[a,b], Shang-Wen Tsai[a,b], Po-Kuei Wu[a,b], Cheng-Fong Chen[a,b], Ming-Chau Chang[a,b], Wei-Ming Chen[a,b,*]

[a]Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; [b]Department of Orthopaedics, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC

Abstract

Background: Dialysis-dependent patients undergoing primary total knee and total hip arthroplasty have been associated with higher in-hospital mortality and complication rates. We investigated the mid-term implant survival, patient survival, and functional outcomes in these patients and reviewed our complications.

Methods: We retrospectively reviewed dialysis-dependent patients undergoing primary total knee or total hip arthroplasty in our hospital between November 2004 and January 2015, with a minimum follow-up of 24 months. Thirty-four patients with 39 total knee arthroplasties were included (M:F, 33.3%:66.7%, mean age: 68.8 years, mean follow-up: 55.9 ± 28.3 months). Twenty-seven patients with 31 total hip arthroplasties were included (M:F, 22.6%:77.4%, mean age: 62.3 years, mean follow-up: 55.8 ± 23.4 months).

Results: In the total knee arthroplasty group, there were two in-hospital mortality cases (3.5%) and two cases of implant failure (5.1%). The mean Knee Society Score was 84.0 ± 20.7. In the total hip arthroplasty group, there were three cases of implant failure (9.7%). The mean Harris Hip Score was 81.1 ± 23.9. The complications we encountered for both groups were instability and infection.

Conclusion: Dialysis-dependent patients who had undergone total joint arthroplasty are associated with high mortality rate. In our experience, satisfactory mid-term results can be achieved in these patients with manageable complications and low-implant failure rates.

Keywords: Complication; Hemodialysis; Total hip arthroplasty; Total knee arthroplasty

1. INTRODUCTION

Total joint arthroplasty is an effective treatment for advanced osteoarthritis and osteonecrosis.[1–3] Many dialysis-dependent patients develop osteoarthritis and osteonecrosis requiring arthroplasty surgeries.[4,5] However, surgeons are more cautious with renal failure patients owing to the high comorbidity and risk of complications.[6]

Dialysis-dependent patients undergoing primary total knee arthroplasty (TKA) and total hip arthroplasty (THA) have been associated with higher in-hospital mortality rates and greater overall complication rates.[7] McCleery et al. showed that renal failure and dialysis were independent risk factors for early infection and revision in primary TKA.[8] Case series have reported satisfactory functional results after primary total joint arthroplasty.[5,9,10] However, individual case series had been limited by small case numbers (<20 patients) and shorter follow-up time and were more focused on short-term complications and survival.[5,9,10]

We hypothesize that the mid-term outcome of dialysis-dependent patients who underwent primary TKA or THA will show satisfactory functional outcomes, low-implant failure rates, considerably higher complication rates, and high mortality rates.

2. METHODS

This retrospective single-center study used the database of the orthopedic department of a single medical center. We included patients who underwent primary TKA or THA between November 2004 and January 2015 and were on regular hemodialysis for at least 1 year before TKA or THA. Except for in-hospital mortality cases and patients who died within 24 months after surgery, all patients were followed for at least 24 months. Patients who were not dialysis-dependent for at least 1 year before the operation and patients who were lost to follow up within 24 months were excluded. The study was approved by the Institutional Review Board.

For the TKA group, we identified 49 patients who underwent a total of 57 primary TKA surgeries. Fifteen patients who were lost to follow up within 24 months were excluded from our

*Address correspondence: Dr. Wei-Ming Chen, Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, 201, Section 2, Shi-Pai Road, Taipei 112, Taiwan, ROC. E-mail address: wmchen@vghtpe.gov.tw (W.-M. Chen).

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

Journal of Chinese Medical Association. (2019) 82: 143-147.

Received March 3, 2018; accepted July 24, 2018.

doi: 10.1097/JCMA.0000000000000017.

study. Thus, we included 34 patients with a total of 39 TKA surgeries, of whom 13 were men (33.3%) and 26 were women (66.7%). The average age at surgery was 68.8 ± 9.0 years old (range: 51–90). The average follow-up time was 55.9 ± 28.3 months (range: 24–128, N = 35). As for the THA group, we also identified 30 patients who underwent a total of 34 primary THA surgeries. Three patients were lost to follow up within 24 months and were excluded. Thus, 27 patients with a total of 31 THA surgeries were included. Of these, seven were men (22.6%) and 24 were women (77.4%). The average age at surgery was 62.3 ± 16.7 years old (range: 28–83). The average follow-up time was 55.8 ± 23.4 months (range: 24–98, N = 31).The patient demographics are shown in Table 1.

2.1. Surgery and postoperative follow-up

All surgeries were elective. Careful history-taking was performed at the clinic. Individual examinations and consultations with specialists were arranged for patients with additional cardiovascular risks or underlying diseases of other organ systems. Consultation with nephrologists was arranged for every patient on admission to arrange dialysis plans during hospitalization. Patients with active infection or unstable hemodynamic conditions were precluded from surgery.

All patients underwent minimally invasive mid-vastus approach for cemented TKA procedures. Prior literature has reported conflicting results for the use of antibiotic-loaded cement in primary total joint arthroplasty, with some demonstrating decreased deep infection rates[11] and some showing no significant difference compared with controls.[12] In our series, we routinely used vancomycin-loaded cement for TKA owing to the high infection rate. The regimen is 1 g of Vancomycin in 40 g of bone cement. Modified Hardinge approach or posterolateral approach was performed for all cementless THA procedures. All patients who had undergone TKA were allowed immediate full weight-bearing without restrictions, with walking aids if necessary. Weight-bearing protocols following THA depended on bone quality and quality of the press-fit mechanism. The blood transfusion strategy was different for each operating surgeon. As a general principle, when the preoperative hemoglobin is <8 mg/dl or when substantial blood loss occurs during the operation, blood transfusion with packed red blood cells is performed during the operation. Hemoglobin is routinely checked on the first postoperative day. If the hemoglobin is <8 mg/dl or there is a substantial drop associated with anemic symptoms, blood transfusion is performed. In our series, the transfusion rate in the THA group was 66.7%, and 78.6% in the TKA group.

After discharge from the hospital, patients were regularly followed at our outpatient clinic at postoperative 2 weeks, 2 months, 12 months, and then annually, for wound assessment, radiographic evaluation, and functional evaluation. Additional visits for various reasons were also recorded.

2.2. Radiographic evaluation

Plain films were retrospectively reviewed by an attending doctor who had not participated in any of the surgery, and was blinded to the clinical results of the patients. All plain films were reviewed for episodes of dislocation, implant alignment, evidence of loosening, subsidence, implant wear, and periprosthetic fracture.

2.3. Implant failure

Implant failure was defined as persistent or recurrent instability with more than two episodes of recorded dislocation, implant loosening or wear requiring revision arthroplasty, or infection resulting in two-stage exchange arthroplasty. Other complications were also recorded.

2.4. Functional evaluation

The data for the functional evaluation were obtained at the last visit. We used Knee Society Score (KSS),[13,14] Knee Society Score-Function (KSS-F),[13,14] and the Western Ontario and McMaster Universities Arthritis Index (WOMAC)[15] to evaluate knee function in the TKA group. We used Harris Hip Score (HHS) to evaluate hip function in the THA group.

2.5. Data analysis

Kaplan-Meier survival analysis was used to determine implant and patient survival. Our primary endpoint was implant failure because of aseptic loosening, infection, or instability that required additional surgery. The endpoint for patient survival was any-cause mortality following total joint arthroplasty. SPSS 20.0 (SPSS Inc., Chicago, IL, USA) was used for all analyses.

3. RESULTS

3.1. Total knee arthroplasty

The 49 preexclusion patients (57 TKA surgeries) included two in-hospital mortality cases and two patients died within 24 months after surgery. The calculated overall in-hospital mortality rate was 3.5% (2/57). Causes of the two in-hospital mortality cases were pneumonia and subdural effusion after a fall during hospitalization. The other deaths included a patient with

Table 1

Patient demographics

	TKA	THA
Patient number/surgery	34/39	27/31
Gender		
Male	13 (33.3%)	7 (22.6%)
Female	26 (66.7%)	24 (77.4%)
Mean age at operation (range)	68.8 ± 9.0 (51–90)	62.3 ± 16.7 (28–83)
Comorbidity		
HTN	51.3%	29%
DM	30.8%	12.9%
CAD	10.3%	19.4%
Cancer	15.4%	6.5%
Stroke	10.3%	0%
SLE	0%	19.4%
HBV, HCV	5.1%	9.7%
Other heart disease[a]	5.1%	19.4%
Thyroid disease	7.7%	0%
Mean f/u time (range)	55.9 ± 28.3 months (24–128)	55.8 ± 23.4 (24–98)

[a]Other heart disease includes atrial fibrillation, heart failure, and valvular heart disease.
CAD = coronary artery disease; DM = diabetes mellitus; HBV = hepatitis B; HCV = hepatitis C; HTN = hypertension; SLE = systemic lupus erythematosus.

Table 2

Complications for total knee arthroplasty

Patient no.	Age	Gender	Comorbidity	Complication	Time to complication (months)	Implant failure	Management
4	51	F	Type I DM	Persistent dislocation	2	Yes	Close reduction twice, unsuccessful
8	74	F	CAD, stroke	Instability	1	Yes	Casting
25	74	M	Prostate CA, gout	Infection	20	No	Open arthrotomy and oral antibiotics for 8 weeks

CAD = coronary artery disease; DM = diabetes mellitus; Prostate CA = prostate cancer.

an arterio-venous fistula infection 4 months after surgery and a patient who developed pneumonia 20 months after surgery.

There were three cases of surgical complications (overall complication rate: 7.7%), which include a patient with persistent dislocation who remained wheelchair-bound, a patient with instability requiring casting, and a patient with periprosthetic joint infection requiring open arthrotomy at postoperative 20 months. The summary is shown in Table 2. The first two cases were regarded as implant failures (overall implant failure rate: 5.1%). The third patient received 8 more weeks of oral antibiotics and no further surgery was needed. He was followed for a total of 74 months with a final KSS of 95. The implant survival mean was 120.8 ± 5.0 months, while the implant survival rates for the first and fifth years were 94.3% and 94.3%, respectively. The mean patient survival time was 91.3 ± 9.1 months. The patient survival rates in the first, second, and fifth years were 90.3%, 87.5%, and 69.7%, respectively. The survival curve is shown in Figure 1.

The mean KSS score was 84.0 ± 20.7 (range: 0–95), the mean KSS-F was 56.3 ± 35.1 (range: 0–90), and the mean WOMAC score was 78.4 ± 20.7 (range: 15.9–96).

3.2. Total hip arthroplasty

The overall in-hospital mortality rate was 0%. There were four cases of complications (overall complication rate: 12.9%). One patient developed periprosthetic joint infection and underwent debridement surgery followed by implant resection at 24 months and revision arthroplasty at 28 months after the initial operation. The patient was followed for a total of 94 months, and had a good HHS score on the final visit. Two patients had recurrent dislocations, with the first episode occurring at postoperative 1 and 37 months, respectively. The other patient whose intraoperative wound culture yielded positive bacterial growth underwent oral antibiotic treatment for 6 months, and no further debridement surgery or revision arthroplasty was needed. She was followed up for 35 months with an excellent HHS score on the final visit. The summary is shown in Table 3. The first three cases were regarded as implant failures (overall implant failure rate: 9.7%). The implant survival mean was 89.9 ± 4.5 months, while the implant survival rates in the first, second, and fifth years were 96.8%, 93.5%, and 89.3%, respectively. The mean patient survival time was 79.8 ± 5.5 months and the median patient survival was 94.0 ± 7.8 months. The patient survival rates in the first, second, and fifth years were 100%, 96.8%, and 67%, respectively. The survival curve is shown in Figure 2.

The mean HHS score was 81.1 ± 23.9 (range: 22.5–98), with 70.6% of the patients having a good to excellent result.

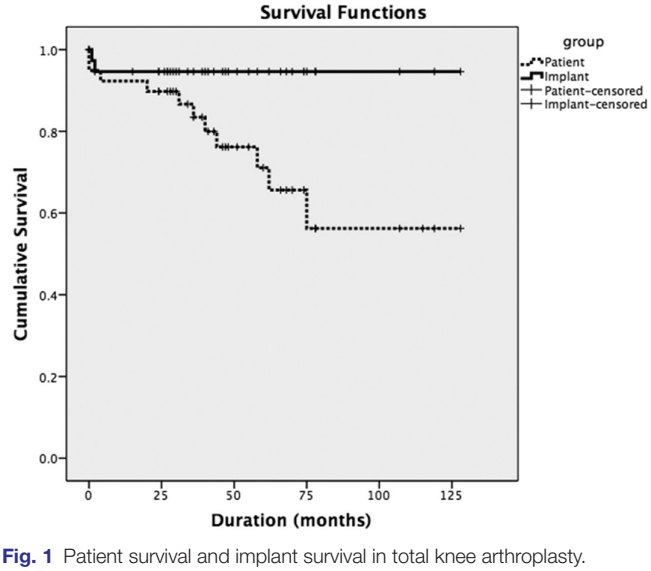

Fig. 1 Patient survival and implant survival in total knee arthroplasty.

4. DISCUSSION

Our study focused on mid-term implant survival, patient survival, and functional outcome. Our mean follow-up time exceeded 4 years for both groups. The mean age at TKA and THA was 68.8 and 62.3 years, respectively, which is comparable to that in prior literature.[7] Kaplan-Meier survival analysis showed a high implant survival rate, while the mortality rate was high. The general functional results were satisfactory, despite some complications.

Ponnusamy et al. found a higher in-hospital mortality rate in dialysis-dependent patients undergoing primary TKA and THA, with rates of 0.92% and 1.88%, respectively. The overall complication rates were also higher, with 12.48% and 9.98% for TKA and THA, respectively.[7] The registry study conducted by Miric et al. concluded that patients with chronic renal disease undergoing primary TKA and THA surgeries had significantly higher incidence of deep and superficial surgical site infection, higher rate of 90-day and any-time mortality, and 90-day readmission rate, compared with non-chronic renal disease patients.[6] In our study, there were two in-hospital mortality cases in the TKA group (3.5%) and none in the THA group. The rate is high but could be biased by our relatively small sample size. Our TKA group included three complications. One patient developed dislocation at postoperative two months and remained dislocated after two episodes of close reduction, being wheelchair bound since. The patient was a case of old septic arthritis with substantial bone loss over the lateral posterior femoral condyle. No evidence of active infection was noted during the operation; however, the bone loss may have misled the surgeon in determining femur rotation, resulting in a large mid-flexion gap. This complication could be mostly attributed to poor surgical technique. The preoperative and postoperative plain film of this patient is shown in Figure 3. The other patient developed instability at 1 month after the operation requiring casting with poor final functional outcome. Instability is not a commonly discussed complication after TKA in the comparison of dialysis and nondialysis patients. We suspect this could be due to generalized muscle atrophy, functional decline, and poor surgical technique. These two complications were categorized as implant failure owing to a lack of function and persistent pain. McCleery et al.[8] stated that renal failure is an independent risk factor for early infection and that renal dialysis is an

Table 3

Complications for total hip arthroplasty

Patient no.	Age	Gender	Comorbidity	Complication	Time to complication (month)	Implant failure	Management
7	28	M	HTN, MPGN	Infection	24	Yes	Total joint resection at 24 months, revision at 28 months
12	78	M	HTN, CAD	Recurrent dislocation	1 (first episode)	Yes	Close reduction
17	65	F	HTN	Recurrent dislocation	37 (first episode)	Yes	Close reduction
26	56	F	SLE, HCV, Af	Infection	1	No	Oral antibiotics for 6 months

Af = atrial fibrillation; HCV = hepatitis C; HTN = hypertension; MPGN = membranoproliferative glomerulonephritis; SLE = systemic lupus erythematosus.

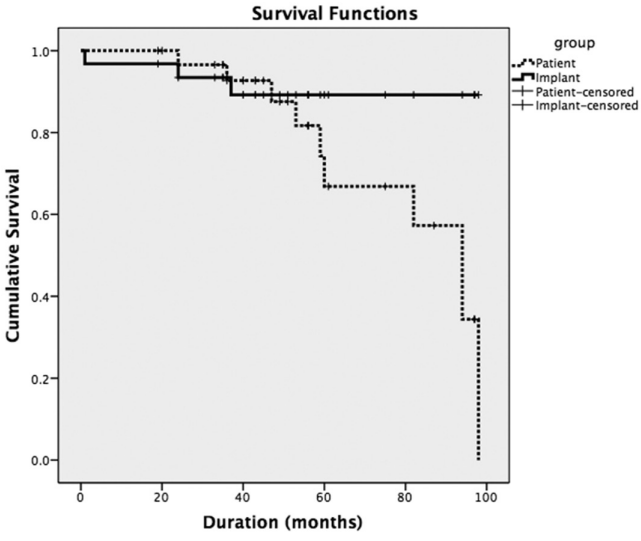

Fig. 2 Patient survival and implant survival in total hip arthroplasty.

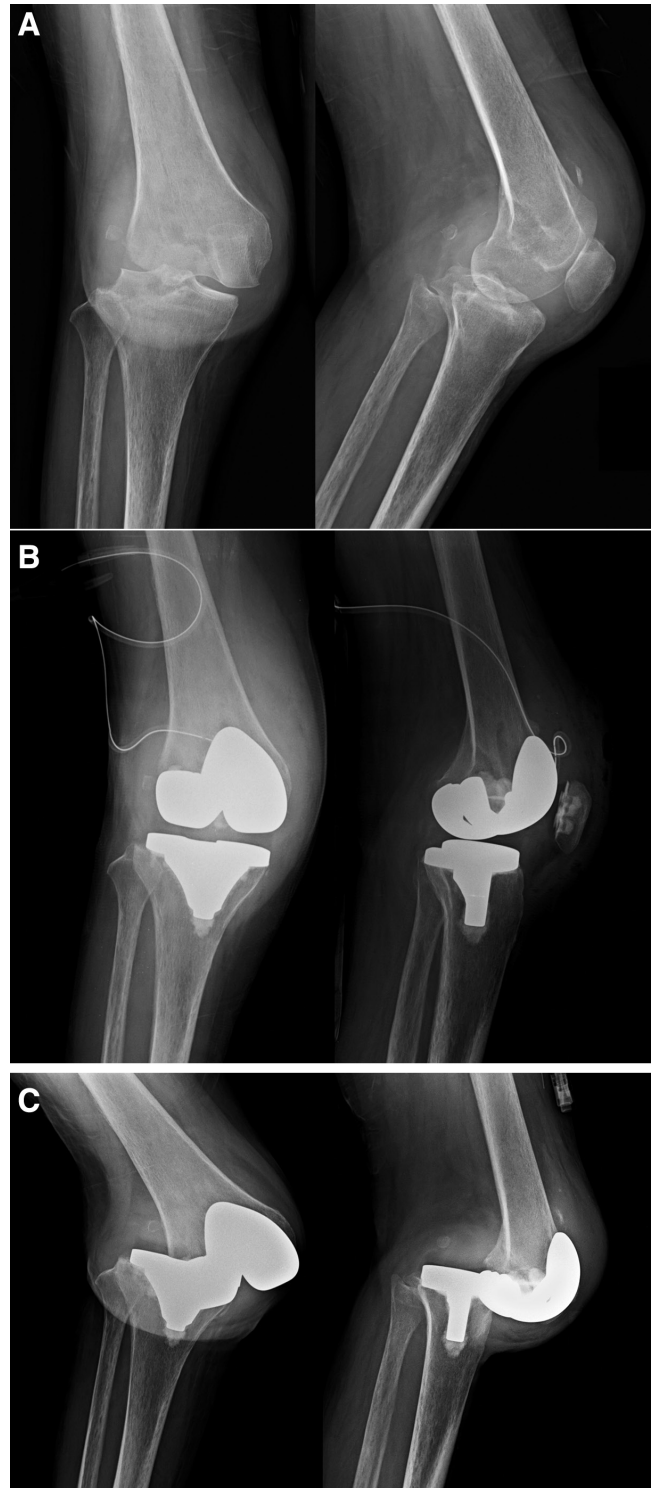

Fig. 3 This is a 51-year-old female patient with history of old septic arthritis of the right knee. A, Preoperative AP and lateral plain film shows severe bone loss over the lateral condyle; B, Postoperative plain film; C, Postoperative 3-month plain film shows persistent dislocation of the joint.

independent risk factor for early revision. In our study, there was one case of late infection and no cases that required revision surgery.

Our THA group included four complications, including two cases of infection, one resulting in joint resection and revision arthroplasty (overall infection rate: 6.5%, revision rate: 3.3%), two cases of recurrent dislocation (overall dislocation rate: 6.5%), and no case of aseptic loosening. In our study group, cementless THA was routinely used. Traditionally, cemented THA is more advocated in dialysis-dependent patients owing to considerations for the poor bone quality. However, past literature has shown conflicting results, with high loosening rates for cemented implants.[16–18] In contrast, more recent series with relatively shorter follow-up time have reported good outcomes with cementless THA.[19,20] At present, it may not be possible to draw a conclusion as to which fixation method is more suitable for this patient group. Nevertheless, no implant loosening was observed in our retrospective series. Lieu et al.[10] found a revision rate of 2.6% at 12 months and 16.3% over the study period, and a dislocation rate of 6.5% for hemodialysis patients after THA. Our dislocation rate was comparable, while our revision rate was lower. According to past literature, TKA and THA are associated with an increased risk of deep infection, early revision, and mortality. In our experience, the cases of deep infection have been successfully managed with antibiotics and surgery.

We examined the patient survival curve and implant survival curve. In the TKA group, 28.2% patients expired during the course of follow up. All implant failure cases occurred within the first year postoperatively, resulting in a high implant survival rate. In the THA group, 32.3% patients expired during the course of follow up. The implant survival rates in the first, second, and fifth years were 96.8%, 93.5%, and 89.3%, respectively, showing a consistent decline, but still remained relatively high. Causes of late complications requiring revision surgery such as implant wear and loosening were not observed during follow up. It is arguable that these complications may take longer to develop. However, the low physical demand of dialysis-dependent patients may also contribute to the low-implant wear rate. Moreover, poor bone quality associated with dialysis-dependent patients did not translate into increased implant loosening. Nevertheless, late infections can pose a threat to implant survival, and should be managed with extra caution.

In a series of 15 TKA surgeries, Lizaur-Utrilla et al. reported a KSS score of 87.9, KSS-F of 81.3, and WOMAC of 78.4,[5] while Chen et al. reported a KSS score of 79 and KSS-F of 81 in a series of 18 TKA surgeries.[9] Our KSS and WOMAC results were comparable; however, the KSS-F score (mean: 56.3) was significantly lower. In a review article, Lieu et al.[10] reported an HHS of 65.6 after the THA surgery, with 45.9% of the patients receiving a good to excellent result. Our average HHS score was higher, with a greater percentage of patients receiving a good or excellent result. The majority of our patients do benefit from the operation in terms of functional improvement and pain relief. However, the KSS-F in our TKA patients

was significantly lower than in the aforementioned studies. Moreover, three patients in the THA group had a poor HHS score.

Upon reviewing the questionnaire, we found nine patients who scored 40 or less in the KSS-F section. Six patients had no or minimal pain after the operation and could ambulate, but were household-bound due to general health conditions, thus resulting in a low score. The other three patients had moderate to severe pain and could not ambulate at all. One of these was the patient with persistent dislocation who we mentioned earlier. The other two patients had a history of coronary artery disease and stroke and had poor ambulatory function. As this particular group of patients had high comorbidity rates and low physical demand, a low KSS-F score may not necessarily translate to a low satisfaction rate for surgery or quality of life.

The strength of our study lies in the larger case number compared to that in past series and longer mean follow-up times. Moreover, we were the first to tentatively provide a survival curve for this patient group. However, this was a retrospective study. Although we included all patients in our hospital matching these criteria, those who were lost to follow up within 2 years were excluded, which could bias our results. In addition, we did not have preoperative functional scores, hindering us from providing data on the relative improvement after surgery. Fortunately, most of our patient demographics and study results were comparable to those of past literature. Future studies with larger case numbers and longer follow-up times are needed to better understand the long-term functional outcomes, quality of life, and complications in this challenging patient group.

In conclusion, we present our case series of dialysis-dependent patients undergoing primary TKA and THA surgery. The complications encountered in TKA were persistent dislocation, instability, and infection; those in the THA group included recurrent dislocation and infection. The infection cases were successfully managed with antibiotics and surgery. There were no cases of loosening or severe implant wear. The implant survival rate was high in both groups and the functional results were generally good. Considering the relatively low physical demand and high mortality rate, we believe that total joint arthroplasty can achieve satisfactory mid-term results with manageable complications and low-implant failure rates in dialysis-dependent patients.

REFERENCES

1. Bachmeier CJM, March LM, Cross MJ, Lapsley HM, Tribe KL, Courtenay BG, et al. A comparison of outcomes in osteoarthritis patients undergoing total hip and knee replacement surgery. *Osteoarthritis Cartilage* 2001;**9**:137–46.
2. Nilsdotter AK, Lohmander LS. Age and waiting time as predictors of outcome after total hip replacement for osteoarthritis. *Rheumatology (Oxford)* 2002;**41**:1261–7.
3. Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Simonsen O, et al. A randomized, controlled trial of total knee replacement. *N Engl J Med* 2015;**373**:1597–606.
4. Abbott KC, Bucci JR, Agodoa LY. Total hip arthroplasty in chronic dialysis patients in the United States. *J Nephrol* 2003;**16**:34–9.
5. Lizaur-Utrilla A, Martinez-Mendez D, Collados-Maestre I, Marco-Gomez L, Lopez-Prats FA. Elective total knee arthroplasty in patients with end-stage renal disease: Is it a safe procedure? *J Arthroplasty* 2016;**31**:2152–5.
6. Miric A, Inacio MC, Namba RS. Can total knee arthroplasty be safely performed in patients with chronic renal disease? *Acta Orthop* 2014;**85**:71–8.
7. Ponnusamy KE, Jain A, Thakkar SC, Sterling RS, Skolasky RL, Khanuja HS. Inpatient mortality and morbidity for dialysis-dependent patients undergoing primary total hip or knee arthroplasty. *J Bone Joint Surg Am* 2015;**97**:1326–32.
8. McCleery MA, Leach WJ, Norwood T. Rates of infection and revision in patients with renal disease undergoing total knee replacement in Scotland. *J Bone Joint Surg Br* 2010;**92**:1535–9.
9. Chen JH, Kuo FC, Wang JW. Total knee arthroplasty in patients with dialysis: early complications and mortality. *Biomed J* 2014;**37**:84–9.
10. Lieu D, Harris IA, Naylor JM, Mittal R. Review article: Total hip replacement in haemodialysis or renal transplant patients. *J Orthop Surg (Hong Kong)* 2014;**22**:393–8.
11. Wang J, Zhu C, Cheng T, Peng X, Zhang W, Qin H, et al. A systematic review and meta-analysis of antibiotic-impregnated bone cement use in primary total hip or knee arthroplasty. *PLoS One* 2013;**8**:e82745.
12. Kleppel D, Stirton J, Liu J, Ebraheim NA. Antibiotic bone cement's effect on infection rates in primary and revision total knee arthroplasties. *World J Orthop* 2017;**8**:946–55.
13. Asif S, Choon DS. Midterm results of cemented Press Fit Condylar Sigma total knee arthroplasty system. *J Orthop Surg (Hong Kong)* 2005;**13**:280–4.
14. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res* 1989;**248**:13–4.
15. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee injury and osteoarthritis outcome score (KOOS)--development of a self-administered outcome measure. *J Orthop Sports Phys Ther* 1998;**28**:88–96.
16. Naito M, Ogata K, Shiota E, Nakamoto M, Goya T. Hip arthroplasty in haemodialysis patients. *J Bone Joint Surg (Br)* 1994;**76**:428–31.
17. Toomey HE, Toomey SD. Hip arthroplasty in chronic dialysis patients. *J Arthroplasty* 1998;**13**:647–52.
18. Lieberman JR, Fuchs MD, Haas SB, Garvin KL, Goldstock L, Gupta R, et al. Hip arthroplasty in patients with chronic renal failure. *J Arthroplasty* 1995;**10**:191–5.
19. Li WC, Shih CH, Ueng SW, Shih HN, Lee MS, Hsieh PH. Uncemented total hip arthroplasty in chronic hemodialysis patients. *Acta Orthop* 2010;**81**:178–82.
20. Nagoya S, Nagao M, Takada J, Kuwabara H, Kaya M, Yamashita T. Efficacy of cementless total hip arthroplasty in patients on long-*term* hemodialysis. *J Arthroplasty* 2005;**20**:66–71.