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Prosthetic joint infection of the hip: does age affect outcomes?

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Abstract

Introduction: The number of revision arthroplasties being performed in the elderly is expected to rise. This study aims to determine whether when compared to a younger cohort they face an elevated risk of complications, treatment failure, or mortality following revision hip arthroplasty for PJI.

Methods: Patients undergoing one- or two-stage revision of a primary THA for PJI between January 2008 – January 2021 were identified. Age, sex, BMI, ASA score, Charlston comorbidity index, McPherson systemic host grade and causative organism were collated for all patients. PJI was classified as “confirmed”, “likely” or “unlikely” according to the 2021 EBJIS criteria. Primary outcomes were complications, re-operation, revision and successful treatment of PJI.

Results: Thirty-seven patients aged 80 years or older, and 120 patients less than 80 years of age were identified. The octogenarian group had a significantly lower BMI, and significantly higher Charlston comorbidity Index and MacPherson systemic host grades compared to the younger cohort. The majority of patients had planned to undergo two-stage revision, however a significantly higher proportion of the octogenarians did not proceed with the 2nd stage (38.7% *cf* 14.8%, p=0.003). Although there was some evidence of a lower complication rate in younger cohort, this did not reach statistical significance (p=0.065). A non-significant trend towards a lower re-operation (21.6% *cf* 25.0%, p=0.675) and revision rate (8.1% *cf* 16.7%, p=0.288) was identified in the octogenarian group. There was no difference in treatment success between groups (octogenarian = 89.2%, control = 82.5%, p=0.444).

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Conclusion: When compared to a younger cohort, octogenarians did not show a significant difference in complication, revision and treatment success rates. However, given they are less likely to be eligible to proceed with a 2nd stage revision, consideration to either single stage or use of an articulated spacer to maximise functional outcomes should be considered.

Introduction

Prosthetic joint infection (PJI) is a complex and challenging complication of total hip arthroplasty (THA), posing significant clinical and economic burdens on healthcare systems worldwide.[1,2] With the elderly now comprising an increasingly large proportion of the demographic, arthroplasty numbers are expected to rise in this group.[3] Primary THA has been shown to produce comparable outcomes in terms of pain relief and satisfaction in the elderly,[4] however when compared to a younger cohort there is an associated higher complication rate.[5] Octogenarians present different clinical considerations in the context of PJI management, given the increased likelihood of associated comorbidities and altered physiological responses. Consequently, the decision-making process for revision hip arthroplasty in this population requires a balance between the imperative to eradicate infection and the necessity to optimise overall patient outcomes. This study aims to assess the differences in baseline demographics between an octogenarian and a younger cohort presenting with PJI of the hip, and determine whether they face an elevated risk of complications, treatment failure, or mortality following revision hip arthroplasty.

Methods

Institutional approval was obtained for this study. Our prospectively collected database was analysed to identify patients undergoing revision of a primary THA for PJI between January 2008 – January 2021 to provide a minimum of two years follow-up. Patients with a previous revision or those undergoing a washout or debridement, antibiotics and implant retention (DAIR) procedure were excluded to minimise data heterogenicity. Patient demographics, including age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, Charlston comorbidity index [6] and McPherson systemic host grade [7] were collated for all patients. Infection as classified as acute, chronic or haematogenous. Acute PJI was defined as an infection occurring within one month of primary surgery, with a chronic infection occurring after one month. A joint was deemed to be infected by haematogenous spread if there was an obvious infective source elsewhere in the body, confirmed by clinical findings or/and positive blood cultures, with an infection in the prosthetic joint by a similar organism occurring within one month. PJI was further classified as "infection confirmed", "infection likely" or "infection unlikely" according to the 2021 European Bone and Joint Infection Society (EBJIS) criteria.[8] The causative organism, if identified, was recorded for all cases. The planned procedure (i.e. two stage or single stage) was noted, and reasons for any patients not proceeding to the planned second stage documented. All operations were performed by revision hip surgeons and antibiotic duration guided by microbiology and infectious diseases consultants. Follow-up occurred with a revision hip specialist for a minimum of two years, typically at three, six, nine, 12- and 24-months post-operative.

Primary outcomes were complications, re-operation, revision and successful treatment of PJI. Re-operation was defined as any operation where the implant was retained, including interim debridement between the first and second stages. Revision was defined as any procedure involving implant removal or exchange following definitive implantation. PJI treatment success was based on the 2013 International Multidisciplinary Consensus,[9] and included 1) infection eradication, characterised by no clinical failure (healed wound without fistula or drainage and painless joint), and no infection recurrence caused by the same organism strain; 2) no subsequent surgical intervention after reimplantation surgery owing to infection, and 3) no death caused by a condition directly linked to PJI.

Statistics

Between group comparisons were performed on sex, BMI, Charlson index, McPherson grade, complications (yes or no), re-operation, and treatment success. Numerical data was tested for normality using Anderson-Darling tests and between group comparisons done using two-sample t-tests or Mann-Whitney test as appropriate. Associations between

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categorical variables were investigated using chi-squared tests. All analyses were done using Minitab (version 18) at a 5% significance level.

Results

One hundred and fifty-seven patients were identified who met the inclusion criteria; 37 patients aged 80 years or older, and 120 patients less than 80 years of age. Mean follow-up was 4.4 years in the octogenarian and 6.6 years in the younger group. This follow-up disparity is a result of a greater proportion of the octogenarian cohort being deceased at last follow-up (67.6% *cf* 20.8%). Baseline patient demographics are displayed in Table 1. The octogenarian group had a significantly lower BMI, a significantly higher median Charlston Comorbidity Index and ASA score, and were more likely to be MacPherson Systemic Host grade B or C compared to the younger cohort. The majority of infections were chronic in both groups: 91.8% in the octogenarian and 94.1% in the control. According to the EBJIS classification, 75.5% of the octogenarians and 86.7% of the control were Infection Confirmed, with the remainder being Infection Likely. The causative organisms are listed in Table 2.

Table 1: baseline demographics of the octogenarian and control groups.

	Octogenarians	**Control**	**p value**
Patients, n (%)	37 (24)	120 (76)	
Mean age, years (range)	83.1 (80 – 90)	63.8 (29 - 79)	
Sex (male:female)	1:1.6	1:1.07	0.263
Mean BMI (range)	25.5 (18.3 – 34.1)	30.2 (18.0 – 47)	<0.001
Median ASA (IQR)	3 (1)	2 (1)	0.0014
Median Charlston comorbidity index	5	3	<0.001
McPherson systemic host grade (n)	A = 0 B = 27 C = 10	A = 62 B = 54 C = 4	<0.001

BMI: body mass index, kg/m^2; ASA, American Society of Anesthesiologists; IQR, interquartile range

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Table 2: commonest organisms identified on culture in both groups.

Organism	**Octogenarian, n (%)**	**Control, n (%)**
Staphylococcus aureus	12 (32)	41 (34)
Polymicrobial	7 (19)	15 (12)
Staphylococcus epidermidis	5 (13)	14 (12)
Coagulase negative staphylococcus	0 (0)	9 (7)
Culture negative	4 (11)	8 (7)
Enterococcus faecalis	1 (3)	8 (7)
Group B streptococcus	1 (3)	4 (3)
Other	7 (19)	21 (18)

The majority of patients had planned to undergo two-stage revision (octogenarian = 83.8%, control 90%, p=0.375) compared to single-stage. However, not all patients had their 2nd stage implantation performed. These patients were left with either a spacer or excision arthroplasty. A significantly higher proportion of the octogenarians did not proceed with the 2nd stage (38.7% *cf* 14.8%, p=0.003). In both groups, the commonest reason for not proceeding with their 2nd stage was the patient being deemed not being fit for further surgery.

Complications are listed in Table 3. Although there was some evidence of a lower rate in younger cohort (64.9% *cf* 47.5%), this did not reach statistical significance (p=0.065). In contrast, a non-significant trend towards a lower re-operation (21.6% *cf* 25.0%, p=0.675) and revision rate (8.1% *cf* 16.7%, p=0.288) was identified in the octogenarian group. There was no difference in treatment success, as defined in the methods, between groups (octogenarian = 89.2%, control = 82.5%, p=0.444). The comparable rates of treatment success despite lower revision rates in the octogenarian groups results from a higher number of PJI related deaths in the octogenarian group. Comparing patients who had

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treatment success with treatment failure, no association was found with BMI, ASA, Charleston Comorbidity Index or McPherson Systemic Host Grade.

Table 3: Complications in both groups.

	Octogenarian, n (%)	**Control, n(%)**
Acute kidney injury	3 (8.1)	13 (10.8)
ARDS	0	1 (0.8)
Aseptic loosening	0	5 (4.2)
Atrial fibrillation	3 (8.1)	3 (2.5)
Death	3 (8.1)	2 (1.7)
Delirium	0	2 (1.7)
Dislocation	3 (8.1)	10 (8.3)
DVT	1 (2.7)	1 (0.8)
Heterotopic ossification	0	1 (0.8)
LRTI	3 (8.1)	2 (1.7)
MI	0	1 (0.8)
PE	0	1 (0.8)
Periprosthetic fracture	4 (10.8)	3 (2.5)
PJI recurrence	2 (5.4)	21 (17.5)
Pulmonary oedema	1 (2.7)	1 (0.8)
Spacer dislocation	1 (2.7)	4 (3.3)
Spacer fracture	0	2 (1.7)
Superficial wound infection	2 (5.4)	0
Upper GI bleed	0	1 (0.8)
UTI	4 (10.8)	7 (5.8)
Wound dehiscence	1 (2.7)	1 (0.8)

Discussion

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Prosthetic joint infection represents a disastrous complication following THA. Management requires a nuanced approach that takes into consideration patient, implant and infection factors. In the context of elderly patients, who are more likely to be comorbid and lack physiological reserve, complex surgery poses substantial risks that must be taken into consideration when planning management strategies. Understanding more precisely the influence of age on complications, mortality and ultimately success of revision surgery for PJI is therefore greatly beneficial, particularly given the continued expansion of this patient demographic. The purpose of this study, therefore, was to compare the outcomes of revision THA for PJI between patients aged ≥ 80 years of age to a younger cohort.

The current evidence relating to PJI in the elderly is limited. Despite increasing age being associated with a number of health conditions, it is uncertain whether PJI risk is similarly linked, with a number of conflicting studies on this topic. In a systematic review of 66 studies, Kunutsor et al [10] demonstrate being >65 years of age had no direct influence on the rate of PJI. Conversely, in a multicentre study comparing patients aged >80 to those <65, Ridgeway et al [11] demonstrated a 1.66-fold increased risk for PJI following hemiarthroplasty, primary and revision THA. Similarly, Wu et al [12] identified a 3.36 fold increase in PJI for patients aged 65–75 years compared with a group aged between 45 and 65 years following TKA and THA. This disparity between studies is possibly the result of differences in the populations being studied or the age categories examined. And so while it is established that many of the comorbidities associated with ageing are risk factors for PJI,[13] it remains uncertain whether age is in itself is an independent contributor to the development of PJI following THA.

Subsequent to the development of PJI, the influence of age on management remains unclear due to limited evidence. Whilst there are a number of studies investigating the outcomes of primary THA in the elderly [4-5,14] limited evidence exists on the outcomes of PJI in octogenarians. In an earlier study by Powers et al [15] the outcomes of both THA and TKA PJI in patients aged >60 years of age were described, with the authors noting both a low success rate (61%) and poor functional outcomes. A more recent case series of 33 THA PJI patients was reported by Karczewski et al [16] who found 72% of octogenarians were infection free at 2 years. This is lower than the 89% success rate identified in our study, although a greater proportion of our patients did not go on to 2nd stage reimplantation (38.7% *cf* 9%) which may influence these results. The spread of causative organism also differed between studies. In our series *S. Aureus* was the most commonly isolated bacteria, whilst Karczewski et al [16] identified coagulase-negative Staphylococci in nearly half of their cases. Interestingly, we did not identify any coagulase-negative Staphylococci in our elderly cohort. This highlights the need for local MDT input for antibiotic guidance to improve outcomes given differences in bacterial strains between regions.[17]

A significantly higher proportion of the elderly group did not progress to their planned 2nd stage reimplantation. The commonest cause for this was the patient being deemed not fit for further surgery. As such, many patients were left with a resection arthroplasty. Given the poorer outcomes associated with this treatment compared to 2 stage revision [18] consideration should be given to using an articulated spacer in case the patient is subsequently unable to proceed with further surgery. Indeed, in their review of the custom made articulating spacer (CUMARS) technique, Tsung et al noted 45% of patients had their 2nd stage postponed indefinitely.[19] Alternatively, a single stage if appropriate could be considered, particularly given the improved early functional outcomes with this technique [20] may be preferential in a patient group with a comparatively shorter life expectancy.

This study highlighted the morbidity associated with the management of PJI. In both cohorts, the complication rate was high - 64.9% in the octogenarians and 47.5% in the younger group. Many of these complications were non-surgical, which a high proportion of patients suffering from AKI, AF, LRTI and UTI post-operatively. There remained a sizable proportion of surgical complications, however, including dislocation, periprosthetic fracture and aseptic loosening. Interestingly, there were only cases of aseptic loosening in the younger cohort, which likely represents their greater longevity. This confirms with a previous meta-analysis on the modes of failure following PJI, whereby rates of revision for aseptic loosening were comparable to that of recurrent PJI.[21] Whilst eradication of PJI will naturally be the focus of revision surgery, consideration should be given to this equally high cause of failure.

The perioperative mortality rate in this study was not insubstantial – 8.1%. Whilst higher than that noted by Karczewski et al (3%),[16] it is more comparable with the data presented by Jamakorzyan et al (6.5%) who identified mortality as the only differing outcome when comparing combined TKA and THA PJI patients aged >80 to those <80.[22] This highlights the challenges of managing these patients in the perioperative period. Indeed, other studies have demonstrated that in-hospital mortality rates for PJI patients are higher than a number of other surgical procedures, including coronary, carotid and renal transplant interventions.[23] Similarly, Yilmaz et al demonstrated that when admitted to intensive care for PJI, 28% of patients aged >80 will not survive.[24] As such, consideration should be given to antibiotic suppression in certain patients who are particularly high risk for peri-operative morbidity and mortality. A number of papers have investigated the outcomes of this treatment strategy in the elderly, demonstrating reasonable outcomes.[25-27] It is important for surgeons and patients to be cognisant of the statistics for differing approaches so that effective management strategies tailored to the patient can be implemented.

There are limitations to this study. Firstly, the sample size was not high in the octogenarian group. Whilst this is the largest series of THA PJI patients in this age group, it nonetheless limits the conclusions that can be drawn. We also only described the outcomes of patients managed with a staged revision. This was done in order to limit the heterogeneity of including other forms of management, such as DAIR, washout and antibiotic suppression. However, we are therefore only reporting on one potential management option which may not be relevant to all patients presenting with PJI. Furthermore, there were baseline differences between the two groups other than age which may have affected the results obtained, including lower BMI and higher median Charlston comorbidity index in the octogenarian group. This reflects the nature of studying cohorts with different age groups and matching all aspects of the groups would have further diminished the sample size. Additionally, the aim of this study was not to determine whether age in isolation was an independent risk factor, but rather compare the characteristics and management outcomes between two different patient cohorts.

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Conclusion

Managing prosthetic joint infection in patients aged older than 80 years presents a complex clinical scenario that requires a nuanced and multidisciplinary approach. Understanding the specific epidemiological trends, risk factors, diagnostic challenges, treatment strategies, and long-term outcomes is crucial for providing optimal care to this vulnerable population. As the elderly population continues to grow, further research is needed to refine the management of PJI in this age group and improve the overall quality of care and patient outcomes.

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