Early Death Following Revision Total Knee Arthroplasty

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Abstract

All patients from our institution who underwent revision total knee arthroplasty (TKA) or were added to the waiting list for revision TKA between 2003 and 2013 were analysed to describe the timing and degree of excess early surgical mortality.

We measured the excess surgical mortality at 90-days for the revision TKA group compared to the waiting list group as 0.37% (95% CI 0.10%-0.65%, p=0.075;).

A larger sample size will be required to give a more accurate measurement and thus we encourage other authors with access to larger cohorts to use our methods to quantify excess mortality after revision TKA.

Keywords: Reoperation, Mortality, Knee Replacement, Arthroplasty

Introduction

Primary total knee arthroplasty (TKA) is a well-recognised treatment for debilitating arthritis of the knee. The number of procedures performed each year is increasing. The National Joint Registry (NJR) for England, Wales, Northern Ireland and the Isle of Man reported 73,560 primary TKA in 2010, rising to 96,364 in 2017, an increase of 31% [1]. The revision burden is increasing with a significant rise in the number of procedures expected over the next 15 years [2]. The most common indications for revision of a primary TKA are aseptic loosening (37%), infection (16%), instability (16%), pain (15%), implant wear (13%), progressive arthritis (11%) malalignment (7%) and stiffness (5%) [1] and can occur as a single stage or a two-stage procedure. The NJR reports a rise in the number of revision TKA, with 5,443 in 2010 and 6,357 in 2018. Given the lag that occurs with the recording of revision procedures, and with the peak number of revisions seen in 2016, this could represent a rise in revision procedures between 16% and 24%.

Mortality following revision TKA has been reported to be as high as 1.1% at 90-days [3,4]. This rate is affected by the indication for revision with the incidence higher in those undergoing revision for sepsis [5].

Our group has previously reported on early death rates at 30- and 90-days following primary TKA [6] and total hip arthroplasty (THA) [7] as well as revision THA [8] to account for the “well” patient phenomenon. This is the apparent protective effect and improved survival that arthroplasty surgery provides when death rates are compared to standardised death rates amongst the general population of age and sex matched populations. We compared early death rates of the surgical population to those awaiting the same procedure and showed a significantly increased mortality rate at 30-days for primary TKA and THA and revision THA and at 90-days for primary TKA and revision THA. Whether there is an excess mortality within 90-days of surgery for revision TKA remains uncertain.

The aim of this study was to use our previously described methodology to investigate the early excess mortality rate and cause of death of patients undergoing revision TKA at 30- and 90-days following surgery compared to a population of patients on the waiting list for the same procedure.

Materials and Methods

All patients undergoing revision TKA (n=627) in a regional elective orthopaedic unit formed the revision arthroplasty population for the study (Figure 1). Procedures were completed between April 2003 and August 2013 allowing sufficient time for death to be recorded. Details regarding patient age, sex and date of death where applicable, were recorded. Patients who underwent multiple revision TKA (n=80, 13%) procedures had their first procedure included and the subsequent procedures excluded.

A second data set was prepared comprising all patients added to the same unit's waiting list for revision TKA (n=1,102) (Figure 2). Patient demographics, date of removal from the waiting list and reason for removal were recorded. Exclusion criteria included those patients that could not be traced via the Demographics Batch Service through the National Health Service (NHS) and Personal Demographics Service (n=5, 0.5%), inadequate data for analysis (n=4, 0.4%), if they were removed from the waiting list without being admitted for an elective procedure (n=112, 10%) or if there were duplicate entries without an admission for a procedure (n=9, 0.8%). Due to the limitations of the retrospective study, reasons for removal could not be analysed.

Possible causes are as described. All patients were seen prior to their operation in a pre-assessment clinic. At this time, an assessment of comorbidity was performed at which stage medical reasons for exclusion from surgery were identified. Patients for whom surgery was deemed to carry excessive risk were removed from the waiting list and therefore, not included in either the waiting list group or the surgical group in this study. Patients who were on the waiting list but were admitted for an emergency procedure would have been removed from the elective waiting list and would therefore have been excluded from this study. Of those remaining (972 patients on the waiting list for revision TKA), patients who were on the waiting list for less than 30-days were excluded from the 30-day survivorship analyses. Those on the waiting list for more than 30- but less than 90-days were excluded from the 90-day analysis.

The patients were drawn from the same population. Therefore, many of the patients in the revision TKA population were included in the waiting list population if they had been on the waiting list for 30-days or more. Following exclusion, 832 patients in the revision TKA waiting list group were available for the 30-day survivorship analysis and 568 patients for the 90-day analysis. In the revision TKA group, 547 patients were available for the 30- and 90-day survivorship analysis.

Retrieval of information pertaining to death was completed as previously described [7]. Using the Demographics Batch Service through the NHS Connecting for Health, the details of the two populations were traced against the national Personal Demographics Service which stores information regarding demographic characteristics of all users of the NHS within the United Kingdom (UK). It was possible to identify patients who had died within each group as well as the date of death. In each group, patients who died within 90-days either after the operation or after being listed for the operation were identified. Death certificates for these patients were retrieved from the UK General Register Office, and the cause of death was identified.

In the population of patients undergoing revision TKA, surgical technique was at the discretion of the operating surgeon and could include all-component revision, liner revision, patella resurfacing or arthrotomy and prosthesis removal. The method of anaesthesia was at the discretion of the anaesthetist. All patients received prophylactic antibiotics as per hospital protocol. All patients were fitted with graduated compression/anti-embolism stockings at the time of surgery and were advised to wear them for 6-weeks after surgery unless contraindicated. Any other chemical or mechanical thromboprophylaxis was prescribed according to the hospital policy at the time of the procedure.

Mortality rates were calculated on the basis of cutoff points of 30- and 90-days following the date of surgery or the date of listing for the reasons listed above. Confidence intervals (CI) were calculated with the score method [9]. A chi-squared test was used to compare the proportions of patients who died between the waiting list and the revision arthroplasty groups. Data distribution was checked with a D'Agostino and Pearson normality test. Where data were not normally distributed, central tendency is described with the median and inter-quartile ranges (IQR). Where data were normally distributed, central tendency was described with the mean and standard deviation. Normally distributed data comparison was performed with parametric tests and non-normally distributed data with non-parametric tests (Mann–Whitney test). For illustrative purposes, patients in each group were stratified according to age and the mortality rate and day-by-day mortality were calculated. A multiple regression model was used to determine if age or gender influenced the risk of death in the waiting list or revision arthroplasty groups at 90-days.

Results

There was no significant difference in age (Table 1) or gender distribution (Table 2) between the two groups in the 30- and 90-day comparisons.

No patients died in the first 30-days following being added to the waiting list to undergo revision TKA (95% CI 0.000%-0.460%), nor in the first 30-days following revision TKA (95% CI 0.000%-0.697%).

No patients died in the first 90-days following being added to the waiting list to undergo revision TKA (95% CI 0.000%-0.672%), which compared to two patients following revision TKA. The OR could not be calculated as the mortality of the waiting list group was zero. The excess surgical mortality at 90-days was 0.366% (95% CI 0.100%-0.651%; p=0.075).

The multiple regression model was only applied if more than one death occurred in the group of interest. There were no deaths in the revision TKA waiting list group at 90-days. In the revision TKA surgical group, neither age (p=0.06) nor gender (p=0.20) were shown to have a statistically significant association with the risk of death at 90-days.

The day-to-day 90-day mortality of patients placed on the waiting list for revision TKA and those undergoing revision TKA is shown in Figure 3.

Death certificates were available for all of those patients who died within 90-days of revision arthroplasty or being added to the revision arthroplasty waiting lists. The cause of death as detailed on the death certificate in each population is shown in Table 3. The dominant cause of death was a cardiovascular event.

Discussion

The aim of this study was to provide a more reliable means of assessing the excess early surgical mortality rate for those patients undergoing revision TKA by using the early mortality rate of those added to the waiting list for the same procedure as a comparator group. In previous studies using the same methodology [6–8], we demonstrated that there was a significant excess mortality rate at 30-days for primary and revision THA and primary TKA and a significant excess mortality rate at 90-days for primary TKA and revision THA. These studies yielded results with a probability of the null hypothesis being correct of under 5%. Our current study is concurrent with those in that it also shows an excess in mortality at 90-days compared to controls, but yields a 7% probability of the null hypothesis being correct. We had no deaths before 30 days and therefore cannot draw any meaningful conclusions on 30-day mortality.

The number of primary TKA procedures performed annually is increasing [1] and with the relative revision burden remaining constant [2], this will lead to an increase in revision TKA. There has been a recent secular decline in the short-term mortality rate in primary TKA; the 45-day mortality rate for primary TKA in England and Wales reduced from 0.37% in 2003 to 0.20% in 2011[10]. However, there is a paucity of literature reporting the current early mortality rates of revision TKA. For revision TKA, we exhibited a crude 90-day mortality rate of 0.366% which is consistent with the study by Fehring et al. who reported a mortality rate at 3-months of 0.3% [3]. Our 90-day mortality rate was a third of the rate seen in the Medicare population [4]. However, a recent publication in the

Lancet by Hunt et al. [10] showed that excess mortality after knee replacement is probably confined to about the first 45-days after surgery and thus some of the differences between our cohort and the Medicare population may be due to differences in baseline mortality. Furthermore, Hunt et al. demonstrated a marked secular decline in mortality after both primary hip [11] and primary knee replacement [10], if this is also true for revision surgery, it would explain the differences between our study and the Medicare study, which was conducted earlier.

Using the same methods and cohorts of a similar size to examine mortality after revision hip replacement, we demonstrated a larger absolute risk of mortality and larger excess mortality (0.863%, $p = 0.045$) than in our current study of revision knee replacement [8]. This is unsurprising as revision THA is performed on older and sicker patients than revision TKA [1,12]. Another explanatory factor could be that more stringent selection criteria are applied for patients undergoing revision TKA than those undergoing revision THA, due to the substantial clinical difficulties in managing failing TKA [13]. Preoperative assessment with the identification and optimization of patients with significant risk factors for poor outcomes has also been shown to reduce surgical mortality [14] which may have impacted on the results we have shown for excess surgical mortality rate for revision TKA. However, this is unlikely as the patients were assessed within the same unit as those undergoing revision THA in our previous study [8].

The main cause of death in this study was a cardiovascular event. This is in keeping other studies investigating early mortality in TKA [6,15].

Conclusion

Early mortality after knee arthroplasty is rare [3,5] and is undergoing a strong secular decline [10], thus a very large sample is needed to accurately measure excess mortality. With the strong secular decline the sample size needed will increase with time. We thus urge researchers with access to larger samples to use our method to quantify excess mortality after arthroplasty. This data will aid in the future counselling of patients when making the decision to undergo these surgical procedures.

Blinded Conflict of Interest

- Speakers bureau/paid presentations by DePuy and Heraeus (money paid into University administered research fund
- Research support as Principal Investigator by DePuy (research grant for consumables)
- Travelling fellowship from Zimmer administered by the BOA. Stryker.
- Research support from Stryker as principal investigator.

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Tables

Table 1: 30- and 90-day comparison of the age (median and interquartile range) of patients in the waiting list group compared to the revision arthroplasty group.

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	Waiting List Group	**Revision Arthroplasty Group**	**p Value**
30-day TKA Comparison	70 (63-76)	71 (63-77)	0.122
90-day TKA Comparison	70 (63-76)	71 (63-77)	0.152

Table 2: 30- and 90-day comparison of the gender distribution (male:female, %) of patients in the waiting list group compared to the revision arthroplasty group.

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	Waiting List Group	**Revision Arthroplasty Group**	**p Value**
30-day TKA Comparison	47.0 : 53.0	45.3 : 54.7	0.546
90-day TKA Comparison	47.4 : 52.6	45.3 : 54.7	0.499

Table 3: Cause of death as detailed on the death certificates of patients who died within ninety days after undergoing revision total knee arthroplasty (TKA).

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Cause of Death	**No of Deaths**
Ischaemic Heart Disease	1 (50%)
Cerebrovascular event	1 (50%)

*The percentages are based on the total number of deaths in the group.

Figures

Figure 1. Flowchart demonstrating the preparation of the revision TKA group.

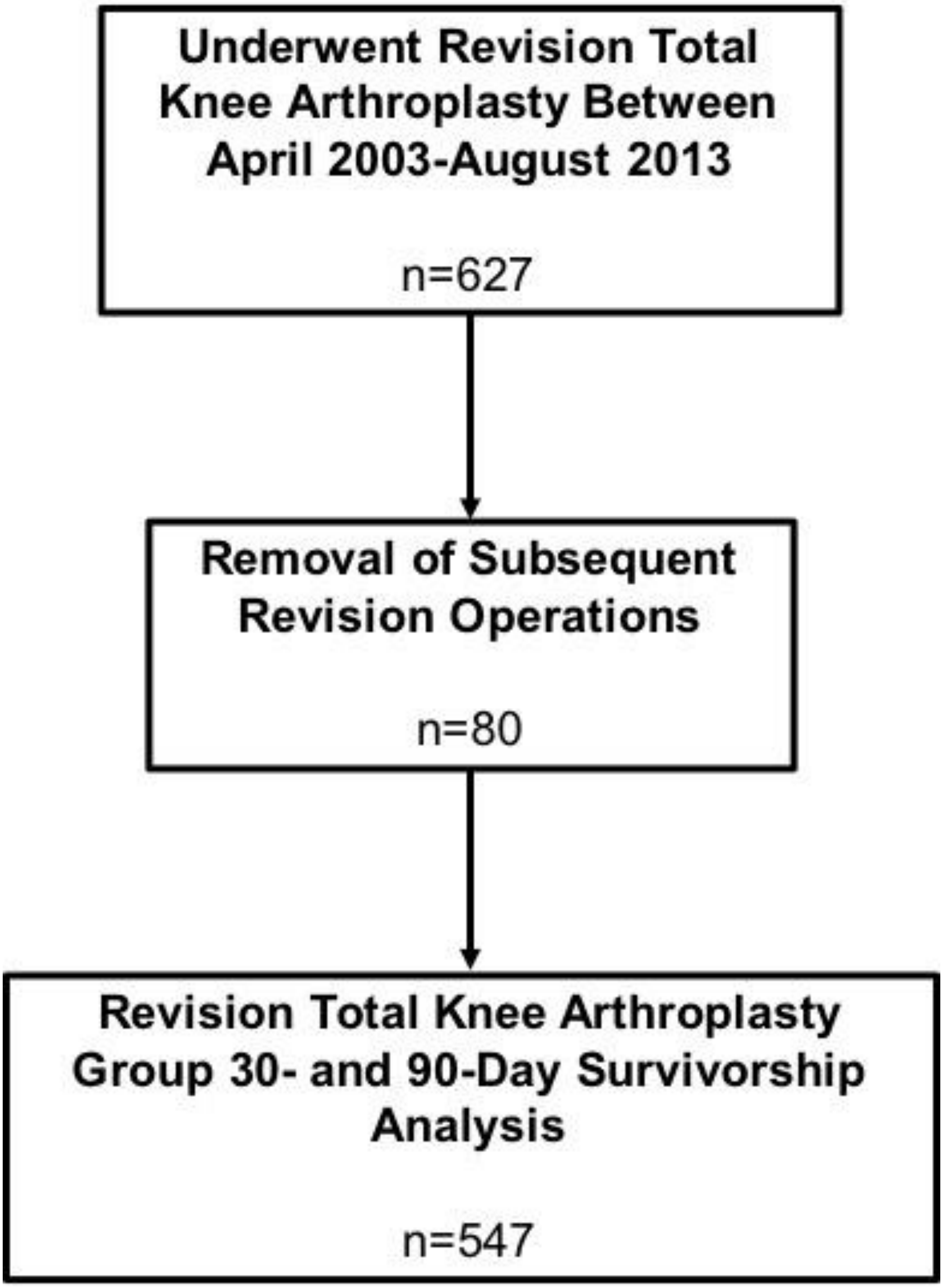

Figure 2. Flowchart demonstrating the preparation of the waiting list group.

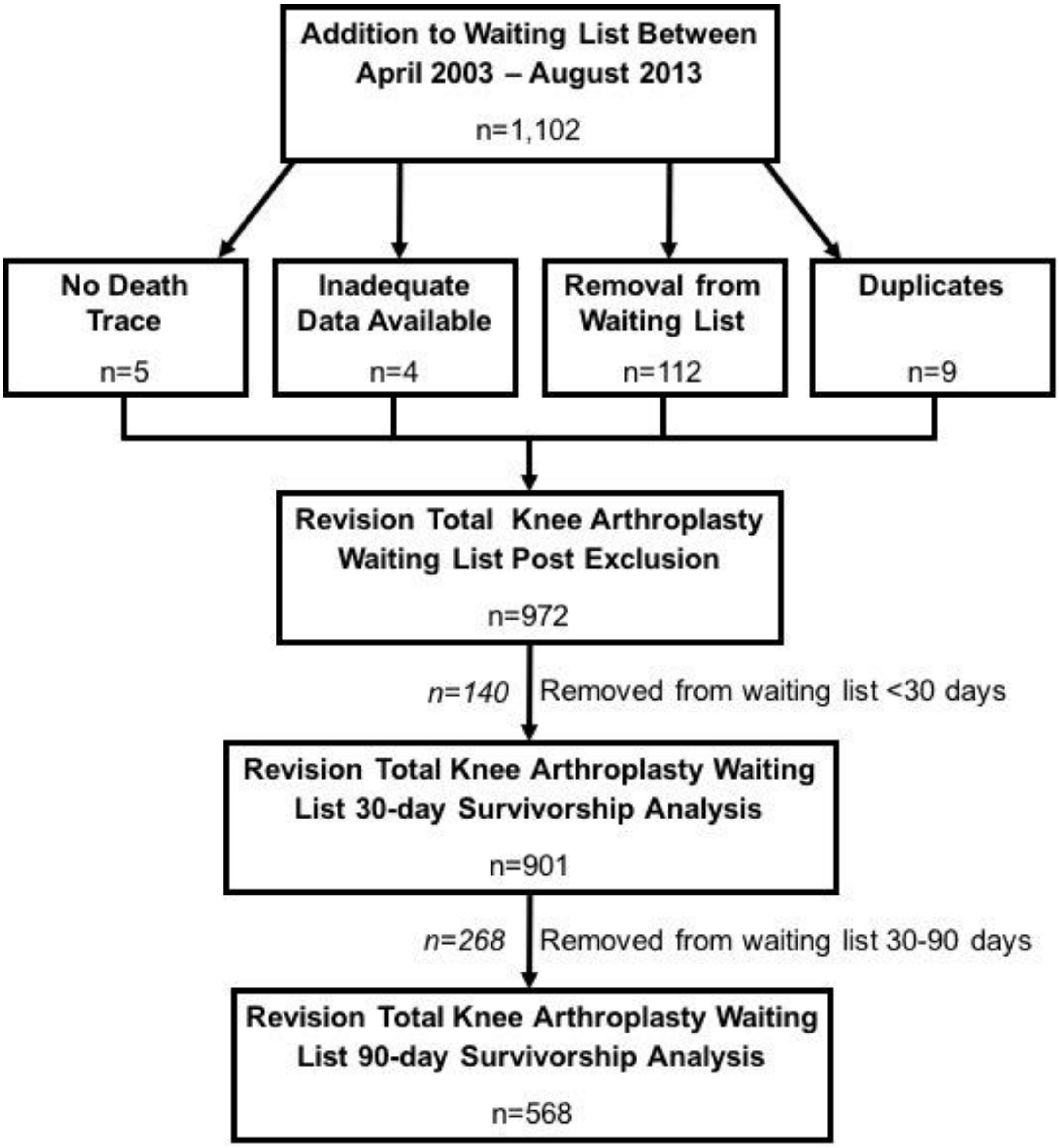

Figure 3. Ninety-day mortality for patients undergoing revision TKA compared to those remaining on the waiting list for the same procedure.