Thirty-day mortality following total knee arthroplasty over 7 years at a tertiary referral centre of orthopaedic excellence

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ABSTRACT

Total Knee Arthroplasty (TKA) is one of the most successful orthopaedic procedures. Around 100,000 TKAs are performed yearly in the United Kingdom. The aim of this study was to report the mortality rate within 30 days after a TKA in an Orthopaedic Centre of Excellence. We reviewed prospectively collected data of 7067 TKAs performed between April 2009–November 2016. All mortalities within 30 days of a TKA were recorded. Data such as age, sex, ASA, comorbidities and cause of death was recorded. There were 14 (0.198%) deaths within 30 days of TKA. There were eight male patients and six female patients who died. No statistical difference was demonstrated between gender. ($p = 0.37$). The mean age was 77.9 years (66–94 years). Means days to death from post-op were 9.6 days (2–30 days). One patient was ASA 1, six patients were ASA 2, six patients were ASA 3 and one patient did not have an ASA recorded. There was no statistical difference between the difference ASA groups. ($p = 0.27$). Cause of death documented was as follow: acute left ventricular failure-3; myocardial infarction-2; pneumonia-2; pulmonary oedema-1; gastrointestinal bleed-1 and multiorgan failure-1. Four patients did not have their cause of death recorded. The 30-day mortality rate after TKA in our institute is low and is comparable to other institutes. This emphasizes that primary TKA is a safe procedure. The predominant cause of perioperative mortality is cardiopulmonary disease.

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1. Introduction

The total number of primary total knee arthroplasty (TKA) in 2016 in the UK was 108,713.¹ TKA is a common operation and can improve quality of life in many patients. TKA is associated with risks with mortality being one of the risk of surgery. Over the years, obesity and chronic comorbidities are a rising issue.² Studies have looked at mortality using national registries which includes both primary TKA and unicompartmental arthroplasty, total hip arthroplasty and revision procedures.^{3–7} There is little evidence specifically looking at mortality post-TKA on its own. We wanted to explore the mortality rate of primary TKA at a high-volume tertiary referral centre of orthopaedic excellence in the UK.

As the population ages with ever increasing co-morbidities such as obesity. There will be an increase in the demand for TKA. TKA is commonly performed for osteoarthritis and is a successful

operation for pain relief.⁸ Wrightington Hospital is a Centre of Excellence in Orthopaedic Surgery and performs high volume arthroplasty surgery yearly. The aim of this study was to report the mortality rate within 30 days of patients undergoing elective primary TKAs in a high-volume centre of orthopaedic excellence.

2. Methods

A review of 7067 primary TKAs performed by multiple surgeons at our hospital was conducted. Data was collected prospectively on TKAs performed between April 2009–November 2016. All mortalities within 30 days were identified. Inclusion criteria were all TKA mortalities within 30 days. Exclusion criteria included intra-operative death or death beyond 30 days and all revision TKA. Data was collected on demographics as well as ASA, comorbidities and cause of death were obtained for mortalities identified. Data was obtained from notes, electronic systems and radiographs.

3. Results

In our series between April 2009 and November 2016 we had 7067 primary TKA. The average number of primary TKA per year in

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Wrightington was 932. There were 3865 (55%) females and 3202 (45%) males. The ASA gradings were classified as follows: ASA 1, 669 patients (9.1%); ASA 2, 4632 patients (66.5%); ASA 3, 1595 patients (22.3%); ASA 4, 10 patients (0.1%). There was no ASA grading available for 161 patients.

There were 14 (0.198%) mortalities within 30 days of a primary TKA over 7 years. The average number of mortality per year is 2. This gives Wrightington an average mortality rate of 0.198% per year. There were eight male patients and six female patients who died. There was no significant difference in mortality between males and females ($p = 0.37$). The mean age was 77.9 years (range: 66–94 years). The mean days to death from post-operative date were 9.6 days (range: 2–30 days). For the 14 mortalities, the comorbidities recorded were as follows: 11 patients had hypertension, 3 patients had angina, 1 patient had asthma, 2 patients had left ventricular failure, 2 patients had previous myocardial infarction, 5 patients had ischaemic heart disease, 2 patients had chronic renal failure, 2 patients had congestive heart failure and 2 patients were on long term anticoagulants.

Within the mortalities, one patient was ASA 1, six patients were ASA 2, six patients were ASA 3 and one patient did not have a ASA recorded. There was no significant difference between ASA and number of mortality ($p = 0.27$). The cause of death documented was acute left ventricular failure in 3 patients, myocardial infarction in 2 patients, pneumonia in 2 patients, pulmonary oedema in 1 patient, gastrointestinal bleed in 1 patient and multiorgan failure in 1 patient. Four patients did not have their cause of death recorded. Of the 14 deaths, 13 patients had a cemented TKA and 1 patient had an uncemented TKA (Table 1).

4. Discussion

TKA is one of the most successful orthopaedic operation performed enabling a good quality of life for patients. TKA is performed to relieve pain and disability with the top indication for TKA being osteoarthritis. The reported survival of implants is as high as 98% at 20 years.⁹ There has been a substantial fall in mortality rate post TKA in the UK to 0.2% as reported in the UK national joint registry data from 2011. This could be due to improved surgical and anaesthetic techniques or possibly due to patients having TKA being fitter and less frail.³ In Hunt et al.,³ 14.5% of the patients were ASA 1, followed by 70.9% of patients being ASA 2, 0.01% of patients ASA 3 and 0.004% of patients ASA 4/5. Comparing these figures with our results, we had significantly more patients in higher risk ASA groups undergoing primary TKAs at our centre. In our sample, 22.4% of patients were ASA 3/4

compared with 0.014% reported in their study.³ This shows a trend of operating on higher risk patients at our centre which could be due to our centre being a tertiary referral centre. Despite this, we did not find any significant difference in mortality between lower and higher ASA groups. Our mortality rate of 0.198% was similar to the national registry rate of 0.2%. An American study looking at the incidence rate of 30-day mortality in 15321 patients reported a mortality rate of 0.18% which is comparable to our mortality rate. They too had patients from higher ASA groups but still maintains a low mortality rate. Fifty per cent of the patients in this study were ASA 3 or higher.²

There is a short-term increase in mortality post-operatively which then returns to baseline. It has been reported that older patients and male patients have higher mortality rates.⁶ We found no difference between males and females and mortality rate. The main cause of short term mortality is cardiac disease and thromboembolic events.⁶ Fifty per cent of the mortalities in our series were due to cardiac disease, however we had no deaths due to thromboembolic events. There is also an elevated risk of death from digestive system related causes. We found 1/14 (7.1%) of the mortality was due to a gastrointestinal bleed. Clinicians should be aware that there is a risk of early post-operative death due to gastrointestinal diseases and a high clinical suspicion is needed for problems such as perforations, obstructions and gastrointestinal bleeds. The use of nonsteroidal anti-inflammatories is commonplace in patients undergoing TKA. The use of proton pump inhibitors should be encouraged with the routine use of nonsteroidal anti-inflammatories.^{10,11}

The majority of the patients in our series died of cardiac comorbidities. Due to the small numbers of deaths, it is difficult to draw conclusions regarding the risk factors for mortalities. However, high incidence of cardiac disease and over 50% of our deaths were due to cardiac disease suggest that optimisation of cardiac health prior to surgery is of the upmost importance and a huge part of this would involve pre-operative optimisation in primary care.⁵ Cardiovascular disease is one of the most common causes of early post-operative death following TKA.¹² Singh et al. found pre-existing cardiac disease but not thromboembolic disease independently predicted a higher 90-day all-cause mortality rate. The odds of deaths were 3 times higher than patients without cardiac disease.⁵

The mortality rate in UK registry data was reported as between 0.37% to 0.18% between the years of 2003 and 2011, showing a reducing mortality rate over time.³ A more recent study looking at registry data from the UK looked at results from 2003 to 2012 found that 33.3% of deaths were due to circulatory system disorder

Table 1
Summary of results.

Total number of patients	7067
Males	3202
Females	3865
Mean age	77.9 (66–94)
Deaths at 30 days	14
Cause of death	
• LVF	• 3
• MI	• 2
• Pneumonia	• 2
• Pulmonary oedema	• 1
• GI Bleed	• 1
• Multiorgan failure	• 1
• Average mortality rate	• 0.2%

and malignant neoplasm respectively, 9.8% of deaths were due to respiratory system disorder and 5.3% of deaths were due to digestive system disorder in 29,802 TKA patients out of 384,291.⁶ Estimated relative death rates in the US ranged between 0.40 and 0.48 for the 1st post-operative year and 0.99 and 1.32 for up to 15 years post-surgery which is consistent with mortality studies in other populations.⁸

Lee et al. reported the 30-day mortality rate in Hong Kong to be 0.1%, which is lower than our reported mortality rate. However, they have suggested this is due to stricter criteria for operation. Also, the mortality rate of the general Hong Kong population is among the lowest in the world suggesting fitter patients for elective TKAs compared to our population.¹³

Parry et al. looked at early death following primary TKA at a single centre in the UK. They looked at 2695 patients undergoing primary TKAs between 2000 and 2007 and compared the mortality rate to 5857 similar patients who were on the waiting list for a TKA. The 30-day mortality rate in the post-surgical group was 0.371%. In the waiting list group, the mortality rate was 0.0683%, which suggests that surgery does increase risk of death at 30 days compared to those who did not have any intervention at all.

However, there is conflicting evidence to suggest that mortality after arthroplasty is lower than the general population.^{14,15} Kremers et al. found that overall age and sex adjusted mortality was significantly lower than the general population with a standardised mortality ratio of 0.80 (95% CI=0.75–0.86).¹⁴ Our mortality rate is much lower than the mortality rate of the operated patients described in the study by Parry et al. (0.198% vs 0.37%).¹⁶ This may be due to advances in surgical and anaesthetic techniques with time.

A study from Denmark found a 90-day mortality rate of 0.3% in hip and knee replacements combined. The main cause of death was due to pulmonary or cardiovascular complications.¹⁷ Perlas et al. looked at 30-day mortality after total hip and knee arthroplasty in patients undergoing general vs. spinal anaesthesia. The 30-day mortality rate in the general anaesthesia group was 0.8% vs. 0.19% in the spinal anaesthesia group.¹⁸ The majority of patients now have arthroplasty surgery under spinal anaesthesia and this may be a reason for low mortality rates.

Another study from the US, looked at the 1 year post-operative mortality rates in 10163 primary TKAs and found a standardised 1 year mortality ratio of 0.4 (95% CI=0.3–0.5), which means patients had a death rate of 60% lower than expected.¹⁹ At a single centre study in China, they looked at 30-day mortality post TKA in 1542 (2254 TKA) patients and found a mortality rate of 0.1%. They also found that cardiovascular complications were the most common cause of death.²⁰ Both these studies further show that mortality risk is low with TKAs. As we perform more TKAs in the future, we can do so by knowing that mortality risk remains low post-operatively. Reported mortality rates in the literature are between 0.08% and 0.37%.^{2,5,9,12,13,16,21} We found 0.198% deaths in our sample of 7067 patient and an average mortality rate of 0.2% per year.

There are limitations in this study. It is a single centre study, therefore provides information relevant to the local population. Practices at different institutions are different and whether varying practices affect mortality rate is difficult to determine as this was not the focus of the study. We only looked at mortality within 30 days and mortality beyond 30 days are not reported. The number of mortalities are low therefore it is difficult to conclude what risk factors increases risk of mortality in our patients. Further, large scale studies looking at risk factors that contribute to increase risk of mortality are required to enhance care.

Mortality after primary TKA at our centre is low. TKA is a safe procedure with a low mortality rate. This paper highlights a

modern result showing low mortality rate after primary total knee replacement in a single centre. The majority of the patients selected for surgery is ASA 2 but we also operated on many ASA 3/4 which is reflective of the increasing chronic comorbidities in the population of patients referred to a tertiary referral centre. The majority of our complications are due to cardiac disease and clinicians should be aware of potential mortality risks due to coexisting comorbidities including gastrointestinal disorders. Despite this, we still have a low mortality rate showing TKA is an effective safe procedure.

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