Factors associated with prolonged length of stay following a total knee replacement in patients aged over 75

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Abstract

Purpose The aim of this study was to examine factors associated with a prolonged length of stay (LOS) in patients over 75 undergoing a total knee replacement (TKR).

Methods Patients over 75 undergoing a TKR at our institution from January 2008 to February 2009 were identified ($n=112$). Patient and operative factors previously shown to affect length of stay were identified. Patient notes were reviewed for details on each of these and data analysed for their effect on length of stay. Discrete data were analysed for their effect on post-operative length of stay using either the Mann-Whitney U test or the Kruskal-Wallis test and continuous data analysed with the Spearman's rank correlation coefficient.

Results The following factors were associated with length of stay at the 95 % confidence level: patient age, pre-operative mobility and the use of walking aids, BMI, whether the patient was able to mobilise within 24 or 48 hours of the surgery, the day on which the patient first walked ten metres and achieved 90° active knee flexion, pre and post-operative haemoglobin and the need for a blood transfusion.

Conclusions Pre-operative use of walking aids, peri-operative haemoglobin concentration, failure to mobilise early following the operation and post-operative complications (including the need for a blood transfusion) seem to be

the significant factors associated with a prolonged stay in hospital in the over 75 year olds.

Introduction

Osteoarthritis (OA) is the most common disease affecting joints around the world. Epidemiological studies show that there is radiological evidence of osteoarthritis in the majority of the people over 65 and in about 80 % of those over 75 [1]. With an aging population and an increasing lifespan, it is not difficult to imagine that the financial burden of OA on health services is likely to increase over the next few years. In the financial year 08/09, over 60,900 primary total knee replacements (TKRs) were performed in England alone and the trend over the last few years suggests this is likely to increase further [2]. With the current financial climate, the UK government is pledging to deliver £15–20 billion in savings in the health sector by 2013–14 [3]. This has resulted in an emphasis on streamlining services and in particular on reducing the length of stay (LOS) in hospital following surgical procedures. Indeed, reducing the LOS has been shown to have benefits that go beyond the economic benefits. Elderly patients are most prone to post-operative complications and in many cases are the candidates for major surgery such as joint replacement. Studies have also shown that this group of patients are at a greater risk of mortality associated with surgical site infection [4].

Following the recent introduction of an Integrated Care Pathway (ICP) for patients undergoing a total hip or knee replacement at our institution, the target for length of stay following a TKR was set at five days. There have been a number of studies that have addressed the possible factors affecting length of stay and outcomes following TKR, with some variability in the findings [5–7]. However, there has

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been no study specifically pertaining to the over 75 cohort. In view of the aging population and increasing willingness on the part of surgeons to operate on older patients, we feel that specific investigation into older populations is warranted. The aims of this study therefore were to investigate the factors that influence post-operative LOS in patients aged over 75, and how this compares with those aged 75 and under.

Patients and methods

Sample

A retrospective cohort analysis of 387 patients who underwent a primary TKR at our institution between January 2008 and February 2009 was carried out. Of these, 112 patients were over the age of 75 at the time of the procedure. Table 1 describes the characteristics of the sample. Medications including warfarin, anti-platelet therapy and non-steroidal anti-inflammatory agents that patients had been on were stopped pre-operatively. All TKRs were performed with a high thigh tourniquet and all the patients received post-operative thromboprophylaxis in the form of enoxaparin and TED stockings. The exclusion criteria were: revision knee replacement, simultaneous other joint replacement, medically unrelated confounding factors (e.g. coincidental diagnosis of a brain tumour in the post-operative period). Patients were included regardless of the indication for primary TKR (osteoarthritis, rheumatoid arthritis or other inflammatory arthropathy) or pre-operative comorbidity. Exclusion criteria were lenient in comparison with other studies [8] because the

authors wanted to assess the factors that affect LOS in normal clinical practice, rather than in a trial situation. Only two patients were excluded: one underwent a simultaneous bilateral TKR and the other was coincidentally diagnosed with a brain tumour in the post-op period.

Measurements

Length of stay was calculated as the number of days in hospital from the day of surgery to the day of discharge, with day of surgery being day 0. At our institution, patients are deemed fit for discharge if there is a consensual agreement between members of the multidisciplinary team (including the consultant, physiotherapist and occupational therapist) that the patient is medically stable and functional ability is sufficient to allow discharge to their home environment. All patients were discharged to their own pre-operative living quarters. While the ability to flex the knee to 90° was desirable at discharge, it was not a formal discharge criterion.

Thirty-two demographic, pre-operative, intra-operative and post-operative factors were identified from the literature as having been previously investigated in relation to post-operative LOS following a TKR (Table 2). Patient notes were thoroughly examined for all the details on these factors and a database created. For each factor, the number of data sets available is indicated in Table 2. All the data was maintained on a Microsoft Excel spreadsheet (Microsoft Corp, Redmond, Washington). Comorbidities were weighted according to the Charlson score [9]. The comorbidities were summed and patient awarded a final comorbidity score.

Statistical methods

SPSS statistics (version 17.0, SPSS Inc., Chicago, Illinois) was used for all statistical analyses. The correlation between continuous data (age, comorbidity score, BMI, pre-operative Hb, pre-operative platelet count, tourniquet time, first post-operative Hb and platelet count, Hb drop and platelet count drop, volume of autologous blood reinfused, post-operative day on which the patient was able to achieve 90° of active knee flexion and able to walk ten metres) and post-operative LOS were analysed using Spearman's rank correlation coefficient as the variables were not found to be normally distributed in a Shapiro-Wilks test.

Discrete data were analysed for their effect on post-operative LOS using either the Mann-Whitney U test (variable had two categories) or the Kruskal-Wallis test (variables with greater than two categories). All tests were two-tailed. Results were considered statistically significant at the 95 % confidence level and highly statistically significant at the 99.9 % confidence level ($p < 0.001$).

Table 1 Pre-operative characteristics of the sample

Characteristics	Values
Age	Mean: 80.7 Range: 75–93
Sex	54 males (48 %) 58 females (52 %)
Marital status	4 % single 57 % married 35 % widowed 4 % divorced
Pre-operative mobility	35 % no walking aid 53 % walking stick(s) 12 % crutch(es), walking frame or wheelchair
ASA grade	Grade 1: 12 % Grade 2: 64 % Grade 3: 22 % Grade 4: 2 %

Table 2 Significance of patient, pre-, intra- and post-operative factors for length of stay

Factors	Available data	Statistical test	<i>P</i>	<i>R</i>
Patient age	112	Spearman's	0.0138	0.0215
Patient sex	112	MWU	0.075	
Marital status	112	KW	0.170	
Lives with (alone, live with someone)	112	MWU	0.045	
Support available on discharge	109	MWU	0.832	
Pre-op mobility (independent without aids, walking stick, crutches, frame, wheelchair)	109	KW	0.00941	
Comorbidity score	112	Spearman's	0.137	0.140
BMI	112	Spearman's	0.00839	−0.246
ASA grade	112	KW	0.400	
Other previous joint replacements	112	KW	0.422	
Pre-op Hb	112	Spearman's	0.000485	−0.301
Pre-op platelets	112	Spearman's	0.186	0.117
Type of anaesthetic (general vs. spinal)	112	MWU	0.84	
Use of a local nerve block	112	KW	0.395	
Tourniquet time	109	Spearman's	0.059	−0.181
Weekday of surgery	112	KW	0.142	
am vs. pm surgery	112	MWU	0.270	
Post-op Hb	112	Spearman's	0.000886	−0.287
Post-op platelets	112	Spearman's	0.560	0.052
Hb drop	112	Spearman's	0.560	0.051
Platelet drop	112	Spearman's	0.478	0.063
Need for post-op blood transfusion	112	MWU	1.15E−05	
Volume of autologous blood reinfusion	108	Spearman's	0.915	−0.010
ITU/HDU admission	112	KW	0.0597	
Day first shown exercises by the physiotherapist	112	KW	0.269	
Able to mobilise within 24 hours of surgery	112	MWU	0.0140	
Able to mobilise within 48 hours of surgery	112	MWU	0.00200	
Post-op complications	110	KW	5.40E−09	
Use of oral strong opioid analgesia	112	MWU	0.00318	
Mobility on discharge (discharged on crutches or a walking frame)	112	MWU	0.00173	
Post-op day mobilised 10 m	112	Spearman's	2.26E−06	0.420
Post-op day achieved 90° knee flexion	92	Spearman's	1.34E−13	0.677

BMI body mass index, *MWU* Mann-Whitney U test, *KW* Kruskal-Wallis test, *Spearman's* Spearman's rank correlation coefficient

Results

The mean LOS was 6.25 days with a range from one to 37 days. Twenty-five patients stayed ten to 20 days. Only one patient had a LOS greater than 20 days. This patient was 80 years old and had a LOS of 37 days. Their hospital admission had been complicated by slow post-operative mobilisation, a urinary tract infection and development of new onset left bundle branch block subsequently treated as acute coronary syndrome under the guidance of the cardiology department. One patient had a LOS of one day. This patient was a 75-year-old male with excellent pre-operative mobility. He had first mobilised on the day of operation, suffered no complications and was discharged on the first post-operative day.

There was no statistically significant association between the following and LOS: sex, marital status, the availability of support at home on discharge and interestingly, comorbidity score or ASA grade. There was no significant difference between patients operated upon on different days of the week or those operated upon in the morning compared to the afternoon. It was also found that the type of anaesthetic (spinal or general anaesthetic), the use of a femoral or combined femoral and sciatic nerve block and tourniquet time were not associated with LOS. Thirty-nine patients received a femoral or combined femoral/sciatic nerve block.

The following factors were found to have a statistically significant association with the LOS: pre and post-operative haemoglobin (Figs. 1 and 2) and the need for a blood

Fig. 1 The effect of pre-op Hb on mean length of stay (LOS)

transfusion, patient age, pre-operative mobility and the use of walking aids (Fig. 3), BMI, whether the patient was able to mobilise within 24 or 48 hours of the surgery, the day on which the patient first mobilised 10 m (Fig. 4) and achieved 90° active knee flexion (Fig. 5). Interestingly, the post-

operative drop in haemoglobin was not statistically significant. There were no bleeding complications secondary to use of thromboprophylaxis.

A poorer pre-operative mobility status was found to be associated with a greater LOS, with those independent with

Fig. 2 The effect of post-op Hb on mean length of stay (LOS)

Fig. 3 The effect of pre-op use of any walking aid on post-op length of stay (LOS)

no walking aids staying a mean of 4.89 days, compared with 6.14 days in those using a walking stick and 6.85 days in those having to use crutches, a walking frame or a wheelchair.

The results have shown that early post-operative mobilisation, as measured by the earliest day on which the patient was able to walk ten metres and achieve 90° of active knee flexion, is associated with a reduced LOS. Patients who were able to walk ten metres or achieve 90° active flexion on the first post-operative day had a mean LOS of 4.31 and 3.50, respectively. In comparison, those who walked ten metres on the third day had a mean LOS of 5.71 days, and those who only achieved 90° knee flexion on day 3 had a mean LOS of 5.38 days.

Discussion

Pre-operative and patient demographic factors that were found to be associated with increased LOS were increasing patient age, poorer pre-operative mobility and use of walking aids, and lower BMI. It is well-documented that obese patients undergoing TKRs are at greater risk of prosthetic infection [10] and wound complications; the association between lower BMI and increased LOS is not one that has been corroborated in previous studies. It could be explained here by the fact that slimmer and frailer patients, especially in the elderly population, may struggle with rapid mobilisation post-operatively and hence this may hinder their recovery, resulting in an

Fig. 4 Percent of patients versus the post-operative day that they were able to achieve mobilisation to 10 m

Fig. 5 Percent of patients versus the post-operative day that they were able to achieve knee flexion to 90 degrees

associated increased length of stay. There are, however, studies that have demonstrated no relation between BMI and LOS [5].

The association between poorer pre-operative mobility (i.e. walking unaided compared with walking with an aid or need for a wheelchair) and increased LOS is one that has been replicated in previous studies [5]. This could be explained in terms of differing gait patterns and increased muscular strength in those walking unaided and may suggest a role for aggressive pre-operative physiotherapy to improve the patients' mobility status prior to undergoing TKR.

The results have shown that early post-operative mobilisation is associated with a reduced LOS. Studies have shown that flexion rehabilitation regimes show a better outcome than extension regimes, with patients not only being discharged earlier, but also showing greater range of movement at six-week follow up [11]. The results highlight the importance of early and aggressive post-operative mobilisation and physiotherapy. The benefits of early mobilisation go beyond mobility, as early post-operative mobilisation has been shown to reduce the risk of venous thromboembolism as well [12]. With the increasing popularity of integrated care pathways for patients undergoing TKRs, joint replacement after care is becoming increasingly standardised. It is currently a widely held standard that patients receive physiotherapy on the first post-operative day but some studies have already shown that aggressive physiotherapy and mobilisation on the day of surgery has reduced LOS following a TKR [13, 14]. There is also evidence to suggest that there is no change in the rate of complications following a TKR if mobilisation is initiated on the first post-operative day [15], thus highlighting the benefit of early and aggressive post-operative mobilisation.

Pre-operative haemoglobin and the first post-operative haemoglobin were both found to be negatively correlated with LOS. Interestingly, there was no association between the haemoglobin drop and LOS, suggesting that it is not the absolute blood loss, but rather the patients' starting point that influences

LOS. Since significant blood loss in joint replacement surgery can be anticipated and is a recognised complication, many measures are already in place as standard in order to address this, including application of a tourniquet and peri-operative blood salvage and autologous blood reinfusion. Since these results show that it is indeed the patients starting haemoglobin that is associated with LOS, this would suggest an added role for boosting patients' haemoglobin pre-operatively, especially in anaemic patients, in addition to employing these blood conservation techniques. Studies have shown a role for pre-operative erythropoietin and iron supplementation in mildly anaemic patients undergoing surgery in which significant blood loss may be anticipated [16]. Other techniques that have been investigated in order to minimise blood loss include the use of intra-operative tranexamic acid and intra-articular epinephrine [17]. There is some evidence to indicate that it is possible to predict the need for blood transfusion following a TKR [18, 19], which would allow the above supplementary techniques to be employed in those patients, deemed to be at higher risk of requiring transfusion.

There are also some important negative findings. In our study, there was no relation between weekday of surgery and length of stay. This finding may be explained by the fact that physiotherapy is available Monday to Saturday at our centre. By contrast, other groups have shown that there is a difference and have attributed this largely to the lack of physiotherapy over the weekends [5]. We also found that there was no difference in length of stay between those patients operated upon in the morning compared to the afternoon. This finding is supported by other groups [5] and can be explained by the fact that all patients tend to be seen by the physiotherapists on the first post-operative day regardless of whether they have been operated upon in the morning or afternoon.

We also found that there was no difference in LOS between patients receiving a single shot femoral or combined femoral-sciatic nerve block and those who did not. This finding has

been supported by many other studies [20, 21]. However, there are studies that have demonstrated that those receiving a single-shot femoral nerve block are able to ambulate earlier and are discharged earlier than those receiving a placebo [22].

Most studies have demonstrated that women tend to stay in hospital longer than men following a TKR in patients of all ages [5, 7, 23]. However, we found that in patients aged over 75 there was no significant difference in LOS between the male and female patients. This finding has been supported by a few other studies [24, 25]. Interestingly, we also found that in patients over 75, increased comorbidity did not correlate with increased length of stay. It is noteworthy however, that in patients of all ages, we found that comorbidity and ASA grade are both positively correlated with LOS. Other groups have replicated this finding [5].

While the finding that previous arthroplasty is not associated with increased LOS has been supported by some [24], others have demonstrated an inverse relationship between previous arthroplasty and LOS, postulating that by virtue of their previous experience, patients may gain greater benefit from the rehabilitation programme [7].

Our study does have a few limitations. First and foremost, since it was a retrospective study, there was a great dependence on the accuracy and the completeness of documentation in the medical notes. Second, since we have investigated such a large number of factors, there is an increased risk of a type 1 statistical error. However, even after Bonferroni correction for multiple statistical tests, the following factors were still found to be significant: pre-operative haemoglobin, post-operative haemoglobin, requirement for blood transfusion post-operatively, post-operative complications, post-operative day on which the patient was able to walk ten metres and achieve 90° active knee flexion. It is also possible that even though the discharge criteria used by each consultant are similar, there may be some subtle differences, resulting in slightly different discharge criteria depending on the consultant in charge.

In conclusion, it can be seen that the above factors are associated with post-operative length of stay in patients over the age of 75 undergoing TKR. Further investigation is warranted in order to determine the relative contributions of these factors to extended length of stay and propose a predictive model.

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