Total joint arthroplasty in nonagenarians –
A retrospective review of complications and resource use

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Increased age brings with it the potential for increased surgical risk. Assessment of specific age cohorts is necessary to plan future service provision and this is the case in hip and knee arthroplasty as the demand for these procedures is anticipated to increase.

We retrospectively reviewed the outcomes, including complications, length of stay and blood transfusion rate, in a cohort of 35 nonagenarians undergoing primary or revision total hip and knee arthroplasty. All patients were pre-assessed by anaesthetists before being deemed suitable to undergo surgery in the unit. The mean length of hospital stay was 13.7+/-10 days (range 2-56). Thirty-one percent of patients required a blood transfusion. Patients who underwent primary total hip arthroplasty reported improved joint specific functional scores.

In this appropriately selected group of nonagenarians, we found no evidence to suggest surgery be withheld on the basis of age alone. However, patients with multiple medical comorbidities warrant appropriate assessment and surgical intervention in an institution with appropriate support. Future planning needs to take into account the predicted increase in demand for arthroplasty surgery in this age group.

Keywords : hip arthroplasty ; knee arthroplasty ; nonagenarian.

INTRODUCTION

Total hip and total knee arthroplasty are well-established surgical treatments for a variety of painful disease states that result in pain, reduced mobility and potential loss of independence. The surgical volume is ever expanding and as the population globally ages the demand for these procedures is anticipated to rise also (*3,6,10*).

Elderly patients will increasingly present seeking surgical treatment for hip and knee arthropathy. We believe that two schools of thought are possible when managing this population : one suggests that these patients are frail and elderly and at high surgical risk ; the second proposes that they reached their tenth decade due to excellent general health and therefore constitute no more per-operative risk than a younger patient with similar comorbidities. A small number of studies including nonagenarians only have reported a combination of outcomes with

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Table I. — Key extracted data from the other studies assessing the outcomes of hip and knee arthroplasty
in the nonagenarian population

Authors	Number(s)	Clinical outcome	Early mortality	Complications	Length of stay	Conclusion
Pagano et al (14)	48 primary THA 18 revision THA	HHS – improved in both sub-groups	2 deaths in early post-operative period	Primary THA : 45% medical 8% surgical Revision THA : 66% medical 28% surgical	Mean 13 days (3-47) Mean 11.5 days (5-21)	THA reliable, durable and safe
Pagano et al (15)	44 primary TKA 7 revision TKA	Knee Society pain scores – improved in both groups	1 death in early post-operative period			TKA safe and effective
Alfonso et al (1)	18 primary TKA 1 revision TKA 5 primary THA 1 fist stage revision hip	HHS, KSS remain increased post-surgery in surviving patients	Nil	8% surgical, 65% medical		Higher risk of complication but equal pain relief as in younger patients
Joshi et al (7)	22 primary TKA (two had bilateral, staged procedures)	KSS improved significantly post-surgery	1 death within 90-days	25% medical 5% surgical	Mean 10.2 days (4-41)	Moderate improvement in function but excellent clinical improvement
Karupphia et al (8)	42 TKA	Improved WOMAC and KSS		25% medical	Mean 11 days (9-15)	Safe, beneficial and cost-effective
Belmar et al (2)	15 TKA (three bilateral)	Improved KSS		11 medical complications	Mean 14.8 days (3-25)	
Petruccelli et al (16)	14 primary THA 24 primary TKA	HHS/KSS improved by a mean of 42.3 points at 1 year	1 patient died after a cardiac event in hospital	25.6% medical	Mean 7.6 +/- 3.7 days	Primary TJA remains a viable and effective procedure
Gregory et al (5)	31 THA		2 early deaths	9% major medical		THA should not be discounted but anticipate a higher complication rate

THA – Total Hip Arthroplasty ; TKA – Total Knee Arthroplasty ; HHS – Harris Hip Score ; KSS – Knee Society Score ; TJA – Total Joint Arthroplasty ; LOS – Length of Stay (range appears in parentheses).

series focussing either solely on hip or knee arthroplasty or a combination of the two (1,2,5,7,8,14-16). The common theme though is that the functional improvements following either hip or knee arthroplasty supports their continued use (Table I).

The aim of this study was to report on our institution's experience in providing total hip and total knee arthroplasty to nonagenarians. Specifically we aimed to report the incidence of complication following surgery and determine what the resource requirements are in the form of High Dependency Unit (HDU) stay, total length of hospital stay and blood transfusion requirement. Secondary aims were to report on the functional

and quality of life improvement following total hip or knee arthroplasty.

PATIENTS AND METHODS

Our institution is a stand-alone elective orthopaedic hospital with general wards and a High Dependency Unit (HDU). Eighteen different surgeons, all of whom practice trauma care and run outpatient services at alternative sites, perform lower limb arthroplasty procedures. As the unit has an HDU but no Intensive Care Unit (ICU) all patients that are assessed by the Anaesthetic service and deemed to require the higher level of post-operative care undergo surgery in their index hospital – this provides a degree of selectivity in this cohort.

We performed a retrospective chart review from 2002 to 2012 at our institution. All hip and knee arthroplasty procedures were searched using the electronic database (Bluespiers) for patients 90 years of age of older at the time of surgery. Both primary and revision cases for any reason were included. Medical records were reviewed to attain basic demographic information, details on pre- and post-operative comorbidities, orthopaedic complications and laboratory values. New post-operative comorbidities were recorded as complications. Pre- and post-operative creatinine and haemoglobin were recorded and the number of patients undergoing blood transfusion was recorded.

Since 2006, outcome scores have been recorded electronically – WOMAC as a joint specific score and the SF-36 as a general quality of life score (9,18). Where available these were recorded. An effort was made to contact all patients to ascertain the function of their prosthesis and whether they had needed revision surgery. Where the patient was uncontactable an effort was made to contact the patient's family physician or next of kin to determine whether or not he/she was still alive.

The Charlson Index was used to assess the effect of undergoing a major operative intervention on the subsequent life expectancy and hence potential implant survival (4). This score is based on 19 defined comorbid conditions each of which are assigned a score of 1-6. The index is the sum of the weights ranging from 0 to 33 and based on this an estimate is produced of the probability of 10-year survival.

All data was tabulated in an Excel database and simple descriptive data are presented throughout the results. Unless otherwise specified the mean is reported+/-standard deviation. A paired t-test has been used to assess for a significant change in the clinical outcome scores.

Table II. — Pre-existing medical comorbidities prior to undergoing hip or knee arthroplasty

Comorbid condition	Number (%)
Renal impairment	9 (26)
Chronic Obstructive Pulmonary Disease	3 (9)
Congestive Heart Failure	2 (6)
Ischaemic heart disease	1 (3)
Atrial fibrillation	1 (3)

RESULTS

We identified 35 patients aged 90 years or older at the time of their surgery (mean 92+/-2.2 years ; range 90-102 years). Twenty-two underwent primary total hip replacement, 8 primary knee replacement, 4 revision total hip replacement and one revision total knee replacement. The mean ASA grade was 2.4+/-0.6 and existing pre-operative comorbidities are noted in Table II. The mean length of hospital stay was 13.7+/-10 days (range 2-56). Twenty eight percent of patients required admission to the HDU following surgery and the mean length of stay was 0.7 +/-1.1 days (range 0-4). There was no 30-day mortality.

The mean pre- and post-operative haemoglobin was 11.9 g/dL and 9.19 g/dL respectively with a mean drop of 2.9+/-1.49 g/dL. Eleven patients (31%) required a transfusion of packed red cells in the post-operative course. The decision to transfuse is typically made by the attending anaesthetic team based on threshold haemoglobin – this depends on patient comorbidity and symptoms. On average 0.6 units were required for each patient. The mean creatinine did not change to a significant level following surgery (100 mmol/L pre-operative ; 101 mmol/L post-operative) even though a number of patients had renal impairment recorded as a pre-existing comorbidity. Intra- and post-operative complications are shown in Table III. The intra-operative femur fracture occurred during a THA – this was managed with circular cabling at the time and the patients post-operative rehabilitation tailored to allow fracture healing. The cases of cellulitis were of the leg, away from the surgical site and were treated initially with intravenous antibiotics until clinical resolution allowed change to a

Table III. — Medical and orthopaedic complications sustained by the patient cohort in the post-operative period

Medical Complications	Number (%)
Urinary Tract Infection	3 (9)
Cellulitis	2 (6)
Myocardial infarction	1 (3)
Lower respiratory tract infection	1 (3)
New onset A.fib	1 (3)
Orthopaedic Complications	
Intra-operative femur fracture	1 (3)
Dislocation	1 (3)

per oral regimen. The Charlson Index based on pre-surgical status gave an average chance of 10-year survival of 18+/1%. This did not change to any significant degree primarily due to the nature of the medical complications. The single patient who sustained a myocardial infarction had a 10-year life expectancy reduced to 2%.

Pre- and post-operative outcome scores are demonstrated in Table IV. Just over 50% of patients had outcome scores electronicically recorded available for analysis. Clinical scores are recorded at 6 months post-operatively. There was a statistically significant improvement in the WOMAC score in those undergoing total hip arthroplasty (p = 0.01). The other outcome scores failed to change to a statistically significant level. Although the functional score also improved for those undergoing a primary total knee arthroplasty the SF-36 either essentially remained static, for those undergoing primary THA, or disimproved in those undergoing primary TKA.

Patients were contacted for review at an average of 5.5+/-2.8 years. The patient or the family physician was contactable in 22 cases. Thirteen patients were alive (37%) – one who had a primary THA had pain in the operated groin. Nine patients were confirmed deceased (26%) while the other 13 patients were uncontactable (37%). No patient contacted had undergone revision surgery.

DISCUSSION

Nationally the proportion of the population aged over 85 years has increased from 0.8% in 1991 to 1.2% in 2011 (*3*). Naturally we can expect the demand for arthroplasty of the hip and knee to increase as the prevalence of degenerative joint disease also rises (*11*). Suitable analysis of resource demand is necessary to understand the potential future burden on the health service (*17*).

We aimed to determine the impact of this age cohort on specific resources – specifically the length of total hospital stay, length of stay in the HDU and the requirement for blood products. The mean LOS in hospital for this cohort was almost two weeks. This is an increase above the average for patients undergoing primary or revision hip and knee arthroplasty in our institution by approximately seven days based on recent (2011) unpublished audit figures. This increased LOS is consistent across other reports with most studies reporting a mean of at least 10 days in hospital (*1,2,7,8,14-16*). This finding supports appropriate planning for this aged cohort – they clearly have a different post-operative recovery pathway to a younger arthroplasty patient with or without medical co-morbidity.

Table IV. — Pre- and postoperative WOMAC and SF-36 scores for the patient cohort according to procedure carried out. Results in bold indicate that the difference in pre- and post-operative scores attained statistically significant level

Procedure	Number	WOMAC Pre-op	WOMAC Post-op	SF-36 Pre-op	SF-36 Post-op
Primary THR	11	**64.9+/-10.9**	**50.8+/-17.3**	47.2+/-19.9	48.9+/-20.1
Primary TKR	5	40.6+/-23.7	36.8+/-30.8	51.4+/-25.1	45.9+/-21.1
Revision THR	3	34	22	49.4	28.6
Revision TKR	–	–	–	–	–

The length of stay within the HDU was surprisingly short and not even one third of the cohort required this facility. This we acknowledge may reflect appropriate patient selection for our institution as those deemed likely to require an ITU level of care following surgery were operated on elsewhere. Due to this selection bias and the fact that our institution functions a as stand-alone elective orthopaedic facility, our findings are unique and offer an insight to what can be achieved in this patient cohort.

In this cohort 31% required a transfusion of packed red cells in the post-operative period – a decision based on clinical assessment and a predetermined threshold in the case of some individual patients. This is in contrast with the report by Petruccelli *et al* who reported a transfusion rate of 67% in their cohort of nonagenarians undergoing total joint arthroplasty (*16*). Pagano *et al* also reported a higher rate of transfusion in those undergoing a primary hip arthroplasty (68%) and an even higher rate again for those undergoing revision (78%) (*14*). Finally, Belmar *et al* reported that all patients in their series of 15 TKA in 12 patients received a transfusion but there was no predetermined transfusion point (*2*). Those with a low preoperative haemoglobin are more likely to need a transfusion and this is likely to prolong hospital stay (*12*). The lower rate of transfusion seen in our cohort again likely represents the institution set-up and appropriate patient selection for the unit although we acknowledge that there are no definitive guidelines for managing transfusion in this advanced age group. It is usual practice in our institution to transfuse at a lower threshold in patients with a significant cardiac history.

Recently Memtsoudis *et al* have reported that advanced age is an independent risk factor for increased post-operative mortality following hip or knee arthroplasty (*13*). We did not find any case of early mortality in our institution and others have shared this experience (*8*). However, others have reported early death from a variety of causes and this needs to be borne in mind when discussing the option of TJA with these patients and their relatives (*1,5,14,16*).

We acknowledge that a key to interpreting this study is the nature of our situation – a stand-alone elective orthopaedic facility with HDU but not ICU level post-operative care. This needs to be borne in mind when interpreting the findings – outcomes from a unit that is able to support surgical intervention in patients of greater anaesthetic and surgical risk will potentially be less optimal. Patients with multiple medical comorbidities need appropriate risk stratification and have their surgery performed in a facility with the necessary support services. The other major weakness of any retrospective study is reliance on the accurate documentation of detail by others – unfortunately this is unavoidable and the best efforts can only be made to extract the necessary data from what is available.

In conclusion, we have found that this appropriately selected nonagenarian cohort undergoing either primary or revision total hip or knee arthroplasty require a longer stay in hospital. Accepting that the patients were appropriately selected for the level of post-operative support available, clinical outcome is positive and other resource demands are not significantly greater than in other cohorts. With appropriate pre-operative counselling and planning, hip and knee arthroplasty can be safely managed in the nonagenarian.

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