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Original Article

Enhanced recovery principles applied to revision hip and knee arthroplasty reduces length of stay and blood transfusion

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ABSTRACT

Introduction: This is the first study reporting the application of Enhanced Recovery Principles (ERP) to revision arthroplasty.
Method: Retrospective series of 132 revision hip and knee replacements treated with ERP.
Results: Infiltration was associated with reduced LOS in knees (6 vs 8.5 days), lower PCA usage and incidence of transfusion in knees (2 vs 3 days) and hips (1 vs 6 days). Revisions for infection had a longer LOS (5.4 vs 11.5 days p = 0.001), a greater use of PCA and a higher incidence of transfusion (5 vs 0) in both knees and hips.
Discussion: The application of ERPs to revision arthroplasty is safe. Infiltration appears to be an important factor in improving outcome measures.

1. Introduction

Studies have demonstrated a steady increase in the number of primary and revision hip and knee replacements performed worldwide, with a predicted 6-fold increase in the need for revision total knee replacement in the US by 2030.[1] Revision surgery can be complex, lengthy and costly, particularly in the presence of bone or soft tissue loss, infection and patient co-morbidities. It is crucial, therefore, to ensure that every measure is taken to minimize the burden to the patient and the health service of revision surgery.[2–5] This can be achieved by educating and optimizing the patient preoperatively, reducing the perioperative physiological insult, minimizing the need for blood transfusion, and ensuring that pain is minimised to enable early mobilisation and rehabilitation.[6–9]

Following their success in colorectal surgery, the application of Enhanced Recovery Principles (ERP) to primary arthroplasty has become commonplace.[9–12] Different modes of ERP have been described but these all hinge around 5 principles of: departmental ethos, patient education, effective pain control, blood management and early physiotherapy.[13–17]

ERPs are well documented to reduce postoperative pain, enhance patient satisfaction and reduce hospital stay, without compromising the quality of care.[18–20] Infiltration of the surgical field with LA has been shown to be of high importance in ERPs, reducing length of stay, postoperative pain, vomiting and opioid consumption.[22,23] Additionally, older patients may have the most to gain from an ERP, which is perhaps more relevant in revision surgery.[21] However, there is a paucity of information relating to the application of ERP to revision arthroplasty cases, where perhaps there is a greater need to ensure the physiological, personal and financial burden is kept to a minimum for the patient and the healthcare provider alike.[1,9,12]

An ERP has been in place in our institution for revision arthroplasty patients since 2010. As the treatment evolved, there were changes particularly in the constituents of the infiltrate, which in 2012 was changed to include high volume, low concentration local anaesthetic 100 150 mls 0.2% Naropin (LA), Ketorolac, adrenaline and tranexamic acid (TA). Latterly a cohort of revision knee patients also received staged postoperative administration of LA via a temporary intra-articular catheter.

The aims of this study are to present the outcomes of the application of ERP to revision arthroplasty, in particular length of stay (LOS), incidence of blood transfusion, drop in haemoglobin and the rate of patient controlled analgesia (PCA) use.

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Table 1
Indications for revision and procedure performed.

	Hip		Knee
Infection	11	Malrotation	26
Periprosthetic fracture	4	Infection	19
Lysis/Loosening	24	PFJ Problem	6
Instability	5	Instability	6
Metal on Metal	11	Loosening/Lysis	6
Other	10	Stiffness	3
		Uni – Total	1
All Components	34	All Components (TC3/RHK)	39
Acetabular Component	22	Patella	6
Femoral Component	3	DAIR/Liner change	7
Fracture Fixation	1	1st Stage Insertion of Spacer	4
DAIR/Head Liner Exchange	2	2nd Stage All Components	10
1st Stage Spacer Insertion	3		

2. Patients and methods

All patients undergoing revision hip or knee replacement between 2010 and 2014, with the senior author (PY) as the primary surgeon were identified. The reason for and nature of the revision was recorded. All patients had undergone a preoperative education programme, were admitted on the day of surgery, and were mobilised with a physiotherapist on the day of, or the day after surgery. All patients received prophylactic antibiotics, were given oral TA one hour preoperatively and were administered appropriate prophylaxis for venous thromboembolism. Spinal anaesthetic (fentanyl or morphine and heavy Marcaine) was used in the majority of cases (113/132), with a fentanyl PCA, regular Paracetamol and slow and long release oral opiate preparations. All knee revisions except one were carried out under tourniquet. All patients were allowed to fully weight bear post operatively.

Latterly, as our ERP regimen evolved, based on evidence from their application in primary arthroplasty, where possible all patients received infiltration of the surgical field, with the volume depending on the patient's weight and LA use elsewhere. In hips, infiltrate was distributed into the deep and superficial tissues after implantation. In knees, infiltrate was distributed into the posterior capsule, collaterals, synovium and superficial tissues.

The following data were collected: the anaesthetic administered, LOS (days), drop in Hb level (g/dl), incidence of blood transfusion, use of surgical field infiltration, use of an intrarticular catheter, PCA usage (ml/kg/h) and complications, readmissions and reoperations. Patient co-morbidities were quantified using the Charlson Index.[27]

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) v20. Mean values for normally distributed continuous data were compared using two-tailed student *t*-tests. Median values for non-normally distributed continuous data were compared using Mann Whitney U Tests, Chi Square tests were used to analyse nominal variables. A *p*-value of <0.05 was considered significant.

3. Results

One hundred and thirty-two revisions were identified, in 112 patients, (67 revision knees, 65 revision hips). Mean patient age was 64.5 years for hips and 66.4 years for knees. 113 procedures were carried out under spinal anaesthetic. 51 patients received infiltration, and 19 knee patients received additional LA via a catheter. 12 patients (8 knees, 4 hips) received a preoperative adductor canal or femoral nerve blocks. Table 1 shows that the most common indication for hip revision was loosening/lysis (36%) and the majority of revisions involved all components (52%). The most common indication for knee revision was malrotation (38%) with an all component revision accounting for 73% of procedures. 5 patients underwent two-stage procedures for infection, accounting for 10 admissions. All patients with the exception of 4 were discharged home (one died in hospital and 3 were transferred to other facilities for ongoing rehabilitation).

The average Charlson Index was 0.55 (0.66 for hips, 0.44 for knees), with a range of 0–4 and a mode of 0, indicating that overall the patients had no or very minimal co-morbidities.

3.1. Infiltration

Infiltration of the surgical field was undertaken in 15 hips (23%) and 36 knees (53%). Table 2 shows that these patients had a smaller drop in haemoglobin and a lower incidence of transfusion (especially in hip revisions) than patients without infiltration. Infiltrated knees had a lower LoS. PCA usage was similar in each group.

3.2. Infiltration in the absence of infection

Tables 2 and 3 show that drop in haemoglobin, and the incidence of transfusion were lower in patients that received infiltration, but this was not significant. LoS was lower in infiltrated knees, PCA usage was similar in both groups, the number of transfusions was lower in infiltrated hips ($p > 0.05$). Table 5 shows none of the 36 aseptic knees required a transfusion and the drop in haemoglobin, length of stay and PCA usage were all lower in the infiltration cohort but this was not significant ($p > 0.05$).

3.3. Infection

Tables 4 and 5 show that differences between infected and non-infected cases were more apparent in revision knees, with a

Table 2
Comparison of outcomes with and without surgical field infiltration.

	Hip		*p-value*[*]	Knee		*p-value*[*]
	Infiltration	No Infiltration		Infiltration	No Infiltration	
Number of patients	15	50		36	31	
Age (mean)	67	64		68	68	
Gender						
Male	5	20		13	17	
Female	10	30		23	14	
Haemoglobin difference (g/L)	24.5	26.0	0.809	23.9	26.6	0.580
Number of patients receiving transfusion	1	6	0.559[+]	2	3	0.522[+]
Length of stay (days)	5.7	5.2	0.702	6	8.5	0.113
PCA use (mL/kg/h)	0.020	0.018	0.975	0.015	0.017	0.399

[*] p-value calculated with Mann-Whitney *U* test unless stated.
[+] p-value calculated with Chi-Square test.