

## Periarticular Injection of Analgesia in Primary Total Hip Replacement- A Prospective Randomised Single Blind Study

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### ABSTRACT

Post-operative pain management after joint replacement surgery is important for patients' wellbeing. Various methods of pain control have been used following total hip replacement (THR) and total knee replacement (TKR). Multimodal intra-operative periarticular infiltration of anaesthetic mixture has shown promising results. We have prospectively looked at the outcome of infiltrating local anaesthetic mixture to THR patients. The results of two cohorts of patients who underwent THR under a single consultant from the 7<sup>th</sup> of November 2006 to the 1<sup>st</sup> of September 2009 were compared prospectively on the basis of visual analogue score (VAS) and the amount of morphine infused post-surgery using patient controlled analgesia (PCA). The first cohort of patients received the analgesic mixture of 4% ropivacaine and adrenaline (1: 200000) infiltrated into the periarticular tissue but the second cohort did not receive any injection therefore, was used as the control group. Out of a total of 48 patients, 20 received the injection intra-operatively. Comparing these patients with the control group, the pain score was significantly low in the early post-operative phase (within 2 hours) in patients who had received intra-operative injections. This result was not considered as part of the outcome as pain could have been influenced in the early phase (within 2 hours) by spinal anaesthesia. Though the pain score after two hours of surgery up to 48 hours and the morphine used till 48 hours was low in the group of patients who received the periarticular injection, there was no statistically significant difference. It is, therefore, difficult to conclude from our study that periarticular wound infiltration of local anaesthetic mixture using ropivacaine and adrenaline is beneficial for pain management to patients following total hip arthroplasty.

**Keywords:** Multimodal intra-operative analgesia, Patient controlled analgesia, Total hip replacement, Visual analogue score

### INTRODUCTION

There are various methods of pain management for patients who have had total hip replacement (THR).<sup>1</sup> Oral and intravenous analgesia, patient controlled analgesia, spinal and epidural injections and peripheral nerve block are few of the types of analgesia routinely used following THR.<sup>1</sup> The use of morphine only, in total knee replacement (TKR) and total hip replacement patients has been seen to complicate the post-operative period with nausea and vomiting for a longer period of time compared to the use of multimodal peri-operative analgesia.<sup>2-4</sup> Multimodal peri-operative analgesia with infiltration of local anaesthetics has also been reported to have given promising results in pain management for TKR patients post surgery compared to patient controlled analgesia using morphine.<sup>2,3,5</sup> Considering this evidence for TKR and THR patients,<sup>2,3,5,6</sup> we have therefore, done a prospective single blind study by injecting an anaesthetic mixture, periarticularly during total hip replacement and have compared it to a control group who did not receive the injection.

### METHODOLOGY

In this prospective study, patients who underwent total hip replacement under a single consultant between 7<sup>th</sup> November 2006 and 1<sup>st</sup> of September 2009 were reviewed post surgery. The patients were pre-operatively counselled individually and consented to be part of the study explaining that they may fall in either of the groups. Group A patients received 60ml of mixture of 4% ropivacaine and 1: 200000 adrenaline injected peri-articularly into the hip joint and its surrounding tissue during the surgery and Group B did not receive the injection. The patients were randomised into the two groups on the basis of the hospital number. The patients with the odd hospital number were injected with the mixture. The mixture was injected intra-operatively into three areas (posterior capsule, attachment of gluteus medius and subcutaneous tissues) of the hip. All the patients underwent total hip replacement using the Modified Harding's approach and had either a cemented or an un-cemented THR. Wound drains were not used. Patients of both sexes admitted consecutively for primary total hip replacement performed for osteoarthritis.

Patients with a history of stroke or major neurological deficit, major heart problems, renal insufficiency and significant liver disease and the following were excluded.

- Patients with chronic neurogenic pain
- Patients with daily opioid consumption (regular use)
- Patients with Rheumatoid arthritis
- Psychological problems and unable to consent
- Patients with hypersensitivity to the drugs

The outcome was assessed on the basis of the visual analogue score (VAS) assessed from 0 to 100 (0-no pain; 100-severe pain) and the amount of patient controlled analgesia (PCA) used by the patient post surgery. The VAS of each patient was checked immediately in the recovery ward following surgery (within 2 hours of surgery), in the post-operative ward (2 to 6 hours of surgery), first post-operative day in the morning (18 to 24 hours after surgery), first post-operative day late afternoon (24 to 30 hours after surgery) and second post-operative day (40 to 48 hours after surgery). The amount of morphine used via PCA were documented based upon the amount (in milligrams) used between 0 to 8 hours, 8 to 16 hours, 16 to 24 hours and 24 to 48 hours also calculating the total amount used in 24 hours and the total used in 48 hours. Complications like nausea, vomiting, infection, dislocation, necessity to catheterize, necessity to stop PCA due to severe gastro-intestinal symptoms were noted and documented. Haemoglobin was checked at 48 hours following surgery. All of the data were collected on a proforma created for this study. The data from the proforma was thereafter transferred on to a SPSS data chart for analysis. The null hypothesis (peri-articular injection of ropivacaine and adrenaline has no effect on the visual analogue score and PCA used by the patient post-surgery) was analysed using the chi-square test, to calculate the p value considering  $p < 0.05$  as significant.

## RESULTS

A total of 48 patients who underwent total hip replacement were studied. Group A consisted of 20 patients and Group B of 28 patients. The male and female ratio in Group A was 1:1.2 whereas, in Group B was 1:1.6. The total hip replacements (THR) done in both the groups were cemented, un-cemented or hybrid (Table 1). The patients were usually operated under spinal anesthesia though general anesthesia was also used in some patients (Table 2). Femoral and Sciatic nerve blocks were only used in few patients (Table 3)

**Table 1:** Types of THR

Type of THR	Group A	Group B
Cemented	5	6
Uncemented	15	21
Hybrid	0	1

**Table 2:** Types of Anaesthesia

Type of Anaesthesia	Group A	Group B
Spinal	16	16
GA	3	9
Spinal and GA	1	3

**Table 3:** Number of patients who had nerve block

	Group A	Group B
Nerve Block given	3	4

**Table 4:** VAS score of the patients

VAS score assessment time intervals	Group A	Group B	P value
Recovery (within 2 hrs of surgery)	9.5	28.7	0.023
Post-op ward (2 to 6 hrs of surgery)	39.7	41.8	0.819
1 <sup>st</sup> post-op day morning (18 to 24 hrs of surgery)	43.8	43.9	0.989
1 <sup>st</sup> post-op day afternoon (24 to 30 hrs of surgery)	40.2	39.2	0.898
2 <sup>nd</sup> post-op day morning (40 to 48 hrs of surgery)	28.4	31.9	0.585

**Table 5:** Spinal level at recovery

SPINAL LEVEL AT RECOVERY	CODE OF STUDY		TOTAL
	A	B	
T5	1	0	1
T7	1	0	1
T8	1	2	3
T9	1	1	2
T10	4	8	12
T11	1	2	3
T12	1	3	4
L1	3	0	3
L3	4	0	4
Unable	0	1	1
TOTAL	17	17	34

Assessing the visual analogue scores post surgery it was evident that the difference in the scores, between the 2 groups was statistically significant only within the first 2 hours, showing that the Group A patients who received the ropivacaine and adrenaline injection perceived less pain compared to Group B within the first 2 hours only. Similar findings showing less perseverance of pain were also recorded in the other phases but were not statistically significant (Table 4). Before assessing the pain score, the spinal level for sensation was also assessed in the recovery (within 2 hours of surgery). It showed that seven out of 17 patients in Group A had a sensation level below T12 dermatome but none of the 17 patients in Group B were documented to have had sensation below T12 dermatome (Table 5)

Assessing the use of morphine (PCA) following surgery a variable picture was seen while comparing the two groups without any statistical significance. The use of morphine in the first 24 hours by Group A was marginally lower than Group B, with a similar finding even in the first 8 hours (Table 6). Contrarily, the use of morphine by Group A was greater compared to Group B in the 24 to 48 hours phase and cumulatively in 48 hours (Table 6)

It was also observed that the difference in the fall in haemoglobin, 48 hours after surgery (Figure 1) and the difference in the complication rate (Table 7) was not remarkable.

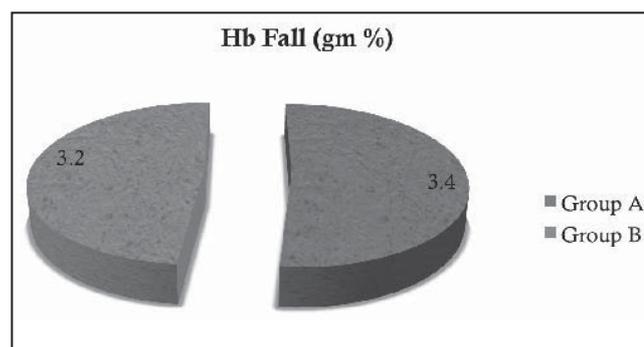


Figure 1: Fall in haemoglobin

## DISCUSSION

Total hip replacement is a common surgical procedure in the UK with over 700, 000 primary total hip replacements and 80, 000 revision total hip replacements done in a period of 11 years (1<sup>st</sup> April 2003 to 31<sup>st</sup> December 2014).<sup>7</sup> Post-operative pain management is important as pain is most severe on the first and the second day.<sup>8</sup> Pain management for THR can be considered on the basis of sensory innervations of the hip. Sensory nerves to the hip are supplied by the femoral, obturator and accessory obturator nerves arising from the lumbar plexus and the sciatic, superior gluteal and nerve to quadratus femoris arising from the sacral plexus.<sup>9</sup> Therefore, a lumbar and sacral plexus block given in combination has been recommended as the appropriate pain management technique for hip surgeries.<sup>10</sup> However, Orthopaedic surgeons are

Table 6: Use of Patient controlled analgesia (morphine)

PCA assessment time intervals	Group A	Group B	P value
Morphine used within 8 hrs of surgery (mean)	16.2mg (CI: 11.1 to 21.2)	19.1mg (CI: 14.0 to 24.2)	0.419
Morphine used 8 to 16 hrs of surgery (mean)	8.1mg (CI: 3.8 to 12.4)	8.4mg (CI: 3.9 to 12.9)	0.926
Morphine used 16 to 24 hrs of surgery (mean)	7.5mg ( CI: 3.2 to 11.7)	6.1mg (CI: 3.5 to 8.6)	0.538
Total morphine used within 24 hrs (mean)	31.7mg (CI: 23.1 to 40.3)	33.5mg (CI: 24.0 to 43.0)	0.781
Morphine used 24 to 48 hrs of surgery (mean)	5.6mg (CI: 0.1 to 11.1)	2.0mg (CI: 0.5 to 3.4)	0.128
Total morphine used within 48 hrs (mean)	37.3mg (CI: 24.8 to 49.8)	35.5mg ( CI:25.8 to 45.1)	0.809

Table 7: Complications of surgery

Group	Nausea	Vomiting	Infection	Dislocation	Catheter	Other	PCA stopped due to nausea
A	11	9	0	0	4	0	4
B	17	12	0	0	6	2	3

not usually been using this technique as this would delay mobilisation.<sup>11</sup> Intermittent epidural has been seen to be a good alternative for maintaining analgesia and also helping in early mobilisation but it is a labour intensive procedure.<sup>11</sup> Therefore, alternatives like Multimodal analgesia have been considered by many.<sup>2,3,5,6</sup> The outcome of multimodal analgesia in TKR patients has been studied with intra-operative periarticular injections, using a mixture of ropivacaine, ketorolac and adrenaline,<sup>2,12</sup> and with an addition of epimorphine to the same mixture.<sup>5</sup> Some have even used a mixture of morphine, ropivacaine, adrenaline and betamethasone injected into the periarticular tissue.<sup>3</sup> In our practice we have been using a mixture of ropivacaine and adrenaline only, injected into the periarticular tissue intra-operatively. Ropivacaine was used instead of Bupivacaine as it is longer acting and less toxic to the cardiac and central nervous system.<sup>13,14</sup> It has also been observed that high doses of ropivacaine injected into the periarticular tissue do not elevate it in the serum,<sup>5</sup> above the toxic level.<sup>15</sup> Adrenaline was added to localize the mixture to the specified region, thus reducing toxicity.<sup>16</sup> Assessing the number of patients in each cohort, male and female ratio, types of total hip replacements, types of anaesthesia used and the use of nerve blocks, it was noted that each group had similar number of patients with respect to the variables discussed, thus expressing an equal comparison and decreasing bias. The study therefore has shown that pain perceived by the patients who received the injection after total hip replacement was significantly lower, only in the first two hours. The pain perceived from two hours to 48 hours after surgery was less in the group of patients who received the injection but significant difference was not confirmed. This finding has also not been supported by the amount of PCA used in different phases of time (up to 48 hours) as although more morphine was documented to have been infused to the patients who did not receive the periarticular injection, statistical significance was not seen.

It is difficult to confirm if the difference in outcome of the two cohorts, particularly significant pain relief in the first two hours after surgery, among the patients who received periarticular infiltration of local anaesthetic have been influenced by spinal anaesthesia and nerve blocks. It was however observed that seven out of 17 patients who received the injection had their sensory level below T12 dermatome and none of the patients who did not receive the injection had their sensory level below the same, two hours following surgery. This has shown that more pain was perceived by the patients who did not receive the injection despite none of these patients perceived sensation around the operative site. This does support the previous findings that the periarticular infiltration of the mixture did help in pain management in the early phase. However, considering the possibility of influence of analgesia up to three hours

following spinal anaesthesia for THR,<sup>17,18</sup> the VAS results portrayed in the first two hours were not included. Comparing our study to other previously published literature,<sup>2,5,6,19</sup> it is contradictory to other studies which have shown significant response to multimodal analgesia following total hip or knee arthroplasty upto 24 to 48 hours. Multimodal periarticular wound infiltration analgesia was developed by Lawrence Kohan and Dennis Kerr from Sydney, Australia. The protocol advised was to infiltrate 150ml of a mixture of 300mg ropivacaine, 30mg of ketorolac and 0.5mg of adrenaline. A catheter was left in-situ connected to the joint operated, to inject more of the mixture, if required in the evening of the surgery or usually the next morning when the catheter was also removed.<sup>6,19</sup> Similarly, a single intra-operative infiltration following total knee arthroplasty using 400mg of ropivacaine, 30mg of ketorolac, 5mg of epimorphine and 0.6ml of epinephrine (1:1000) have shown satisfactory results to control pain and improve function without any toxic effects and limiting the serum level below the toxic level too.<sup>5</sup> It is therefore suggestive of our study to have weaknesses. The dose of ropivacaine used in the two studies<sup>5,6</sup> was higher than the amount used in our study. We did not use ketorolac or epimorphine and did not inject the analgesic mixture through a catheter in the post-operative phase.<sup>2,3,5,6</sup> The dose and the composition of the mixture may have been an influencing factor. It is also possible that the number of patients included in the study was not adequate, as no power study was done. Therefore, a type 2 error could have influenced the outcome of the study. Our study, therefore, has not shown any significant pain relief in the post-surgery phase, in the patients who received the injection. However, it has shown that the mixture injected was safe and no difference in complications was noted between the two cohorts neither was there any definite complexity caused by the procedure like nerve damage or infection. There was also no difference in blood loss comparing the two cohorts, assessed by the drop in haemoglobin post surgery. On the basis of this finding an enhanced recovery programme was developed in our hospital which included pre-operative oral analgesia and pre-gabalin, intra-operative ropivacaine and adrenaline and post-operative pre-gabalin and analgesia.

It is therefore, difficult to conclude that peri-articular injection of a local anaesthetic mixture is sufficient for pain relief in total hip arthroplasty patients as the effect of the injection can only be made to last for 36 hours provided an appropriate local anaesthetic (Ropivacaine) was used, with a top-up of the local anaesthetic in the post-operative phase using an intra-articular catheter.<sup>6</sup> However, it has the potential to be used in conjunction with other modalities for giving the patient pain relief,<sup>5,6</sup> and hence early mobilisation, early discharge and reduction of hospital acquired complications.<sup>6</sup> It is therefore advisable to use the recommended dose of ropivacaine and adrenaline with the appropriate mixture.<sup>5,6</sup>

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