Comparing Intraarticular vs Intramuscular Drug injection in Total Knee Arthroplasty

W Loo, S Yeo, N Lo, K Yang

Citation

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Abstract

Periarticular injection with a multimodal protocol provides excellent pain control and functional recovery following total knee arthroplasty. We performed a retrospective study to compare intraarticular versus intramuscular injection of multimodal drugs versus a control group to provide analgesia following TKA. 150 patients undergoing TKA were divided into an intraarticular arm (Group 1, n=50), intramuscular arm (Group 2, n=50) and a control group 3 (n=50). Outcome measures include postoperative pain control and morphine consumption. Group 1 and Group 2 were similar in visual analog scores (p=0.99) and they were statistically significantly lower (p<.001) than the control group. Total morphine consumption was lower in the 2 groups when drugs were administered perioperatively (p<.001). Patients who received perioperative drug injections reported better visual analogue scores and required less patient controlled analgesia than patients in the control group. There appears to have no difference when we compare the intraarticular and intramuscular groups.

INTRODUCTION

Good perioperative pain relief in total knee arthroplasty has been shown to facilitate rehabilitation[1], reduce hospital stay and improve patient satisfaction. Multiple modalities of analgesia have been described in the literature and each has its own advantages and risks. They include perioperative local drug infiltration[23] and postoperative analgesia with parenteral opioids or epidural analgesia.

The use of parental opioids or epidural analgesia is associated with side effects, including nausea and vomiting, respiratory depression, drowiness, reduced gut motility and urinary retention[456]. Busch[7] reported that intraoperative periarticular injection with multimodal drugs can significantly reduce the requirements for patient- controlled analgesia. Parvatanei[89] showed that periarticular injection with a multimodal protocol provides excellent pain control and functional recovery and can be substituted for conventional pain modalities. This mode of preemptive analgesia with soft tissue and intraarticular injection of long-acting local anesthetic with epinephrine and morphine has been shown to provide better pain control in the immediate postoperative period, decreases blood loss , and decrease the need for rescue narcotics and reversal agents[10].

To our knowledge, there is a paucity in the literature comparing the intraarticular and intramuscular drug injection in total knee arthroplasty. We performed a retrospective review to compare intraarticular versus intramuscular injection of multimodal drugs to provide analgesia following total knee arthroplasty and included a control group to establish that periarticular injection is safe and efficacious.

METHODS AND MATERIALS

We retrospectively reviewed one hundred and fifty patients who underwent unilateral total knee arthroplasty. Date were retrieved via case notes and radiographs of the patients and analysed . They were grouped into 3 groups of fifty patients each. Group 1 and 2 consist of patients who received intraarticular and intramuscular injections respectively. Group 3 is a control group who received no injection into the joint or periarticular tissue.

Inclusion criteria consisted of an age of less than eighty five years, a weight of 45 to 120 kg and an ability to provide informed consent. Exclusion criteria were revision total knee surgery, primary total knee with more than 20 degrees deformity or requiring extensive soft tissue release, primary total knee with significant boss loss that requires augmentation or stem, major psychological problems, allergies to any of the ingredients of the injection and previous drug dependency.

Operative anesthesia was either general or regional. The

knee arthroplasty was performed through a standard medial parapatellar approach. The drug injection consisted of 30 ml of 0.5% bupivacaine[11] with adrenaline of 1:200,000, 40 ml of normal saline, 10 mg of morphine and 30 mg of non-steroidal anti-inflammatory drug (ketorolac). At the onset, 15ml of the mixture was drawn for subcutaneous injection. Before cementing the prosthesis, 15ml of the mixture was injected into the posterior capsule. For the intra-muscular arm, 42ml of the mixture was infiltrated in the quadriceps tendon, pes anserinus area and lateral aspect of the knee. This was performed before the closure of the muscle to ensure the needle was in the soft tissue during the injection and hence reduced the wastage. For the intra-articular arm, 42ml of the mixture was injected directly into the joint after the closure of the muscles & joint capsule. For the control arm, no injection was injected into the joint or periarticular tissue.

The main outcome measure was that of postoperative pain control, which was estimated by the patient using a visual analogue scale[12]. The visual analog scales for pain ranged from 0 mm (indicating no pain) to 100 mm (indicating extreme pain) in 10-mm increments. The level of pain control was assessed at 4 hours after the surgery and for the first four postoperative days. The amount of morphine consumption was measured with the patient-controlled analgesia pump at six-hourly intervals for thirty hours.

The range of movement of each knee was documented daily by the physiotherapist using a goniometer. Other parameters included the length of time required to perform straight leg raises (as a measure of the recovery in muscular strength) and walk independently, duration of hospitalization and the decrease in hemoglobin level.

Drains were not used for all the patients in the study. All patients were then placed on patient controlled analgesia (PCA) pump and the morphine consumption recorded. Continuous passive movement was given from 1st post operative day (POD) and patients were monitored daily for the pain score and morphine consumption. Complications like swelling, bruising, vascular compromise were also monitored.

Statistical analysis was performed with SPSS statistical software (version 11.0; SPSS, Chicago, Illinois) using one-way analysis of variance (ANOVA). Post hoc comparisons were performed using Bonferroni's comparison test. The significance level considered in all tests was 0.05.

RESULTS

Demographic data were similar in both the control and study groups (Table 1).

Figure 1

	Intraarticular	Intramuscular	Control
Average age	68 (49-80)	66(46-84)	67(46-81)
Body mass index	27.82 (17-39.5)	27.73 (19.3-38.9)	27.68 (18-37.2)
Site of surgery	29 R: 21 L	27 R: 23 L	24 R: 26 L
Anaesthesia	21 RA: 29 GA	21 RA: 29 GA	18 RA: 32 GA
Length of stay(days)	6.62	6.36	8.1
Mean Hb drop (g/dL)	2.3	2.44	3.216

Table1. Demographic data of the 3 groups. R = right. L= left. RA = regional anaesthesia. GA = general anaesthesia.

Group 1 (intraarticular arm) and Group 2 (intramuscular arm) were similar in visual analog scores and they were statistically significantly lower ($p<0.001$) than the control group (Fig 1). The hypothesis that perioperative drug infiltration can reduce pain can also be supported by findings shown in Fig 2 where the total morphine consumption and interval morphine consumption are lower in the 2 groups when drugs were administered perioperatively ($p<0.001$). There was no difference in VAS and morphine consumption between the IA and IM groups ($p=0.99$).

Figure 2

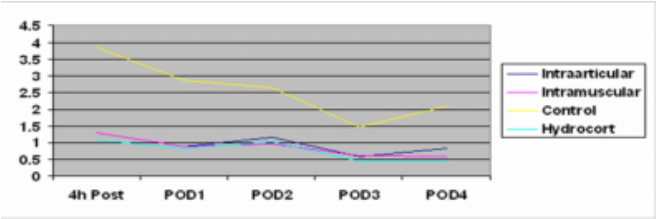

Fig 1. Visual analog scores (VAS) are lower in both IA and IM groups compared to the control group at all times ($p<0.001$). 4h Post= four hours postoperatively; POD 1, POD 2, POD 3, POD 4 = one, two, three, four days postoperatively.

Figure 3

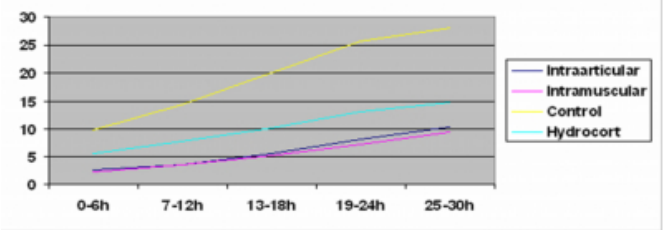

Fig 2. Morphine consumption over thirty hour (patient controlled analgesia) is lower in both IA and IM groups compared to the control group at all intervals ($p<0.001$).

Both IA and IM groups also exhibit better active range of motion postoperatively. This was statistically significant on POD1($p=0.014$) and POD 4 ($p=0.014$). Patients who received perioperative drug injection were able to perform

straight leg raises at 2.8 days (IA group) and 2.6 days (IM group) after the operation as compared to the control group who performed the same task at 2.3 days postoperatively (p=0.14).The control group was able to ambulate at 2.52 days postoperation and both IA and IM groups were able to walk at 2.69 days after the operation. This difference was not significant with the numbers studied (p=0.885).

We also studied if there was a difference between the average length and mean haemoglobin drop postoperatively between the 3 groups. The average LOS for group 1, 2 and 3 were 6.62, 6.36 and 8.1 days while the mean Hb drop was 2.3, 2.44 and 3.216 respectively (Table 1). P values were 0.007 and 0.001 respectively.

Figure 4

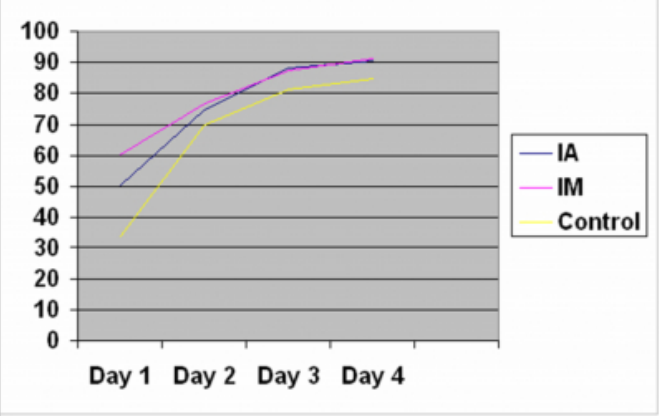

Fig 3. Active range of motion on post operative day 1,2, 3 and 4. The p values are 0.014, 0.351, 0.081 and 0.014 respectively.

Figure 5

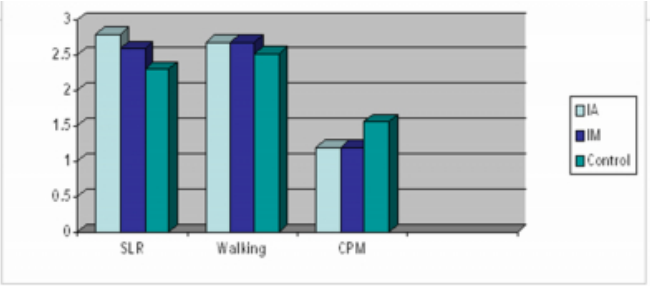

Fig 4. No of days required to perform straight leg raising(SLR) and walking and tolerate CPM to 90⁰. There is no difference for SLR (p=0.14) and walking (p=0.885), but the control group takes longer to tolerate CPM to 90⁰ (p=0.005).

DISCUSSION

Following total knee arthroplasty, moderate to severe pain has been reported as high as 60-90% of patients[13]. The postoperative pain from knee arthroplasty may be a result of trauma to the soft tissue or bone or of hyperperfusion following tourniquet release[14] .Various papers have described periarticular injections of anesthetic concoctions with improved postoperative pain control[1015]. Some authors reported improved pain scores and decreased narcotics use with soft tissue injection of local anaesthetic agents[789] while others did not find a reduction in narcotics consumption after intraarticular injections of local anaesthetics[1617].

The four ingredients used in our study include bupivacine, adrenaline, morphine and ketorolac. Studies have shown that opioid receptors are present in peripheral inflamed tissues[18] and they are expressed within hours after surgical trauma[19]. They are thought to be responsible for afferent sensory input to the central nervous system[20]. Ketorolac, a non steroidal anti-inflammatory drug, inhibits both cyclo-oxygenase and lipo-oxygenase enzymes thereby preventing the synthesis of both prostanglandins and leukotrienes, and may also release endogenous opioids[2122]. Bupivacine blocks the generation and the conduction of nerve impulses and thus inhibits afferent nociceptive activity[2324]. It has been demonstrated to be effective in patients after knee arthroscopy[25]. The addition of epinephrine to the injection helps to reduce the toxicity of bupivacine by keeping it localized to the area of injection[26].

Numerous studies have elucidated the benefits of periarticular drug injection during total knee arthroplasty with no signigicant adverse outcome. Heard compared intraarticular injection of bupivacaine versus intraarticular morphine after arthroscopic knee surgery and reported prolonged analgesia provided by the former but that there is no significant prolonged analgesia provided by intraarticular morphine[27]. Laurent concluded that after knee arthroscopy, no additional analgesic effect was afforded by the addition of morphine to intra-articular bupivacaine[28]. Other papers reported excellent results after multimodal drug concoction was administered periarticularly after total knee arthroplasty[789]. However, there is little data is available in the literature which compares whether intraarticular is more effective than intramuscular injection as a mode of administration of the multimodal drug concoction.

In our study, we found that patients who received perioperative injections of ketorolac, bupivacaine, morphine and epinephrine, reported better visual analogue scores and required less patient controlled analgesia than patients in the control group, which was statistically significant. However, there appears to have no difference when we compare the intraarticular and intramuscular groups. In addition, both IA

and IM groups had a better active range of motion postoperatively, had a shorter hospitalization stay and a smaller decrease in hemoglobin levels than the control group. No statistical difference was noted between the IA and IM groups.

We conclude that periarticular multimodal drug infiltration is an effective means of analgesia to the patient following total knee arthroplasty and that there is no difference whether the drug concoction is delivered intraarticularly or intramuscularly.

CORRESPONDENCE TO

Wee Lim Loo Blk 2 St George's Rd #12-51 Singapore 320002 email: looweelim@yahoo.com

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Author Information

Wee Lim Loo, MBBS, MRCS(Ed), MMed(Ortho)
Resident, Department of Orthopaedic Surgery, Singapore General Hospital

Seng Jin Yeo, MBBS, FRCS(Ed)
Consultant, Department of Orthopaedic Surgery, Singapore General Hospital

Ngai Nung Lo, MBBS, FRCS(Ed)
Consultant, Department of Orthopaedic Surgery, Singapore General Hospital

Kuang Ying Yang, MBBS, FRCS(Ed)
Consultant, Department of Orthopaedic Surgery, Singapore General Hospital