ORIGINAL ARTICLE

Comparison of Efficacy of Intra Operative Periarticular Injection With That of Post Operative Epidural Analgesia for Pain Control Following Unilateral Total Knee Arthroplasty Under Spinal Anesthesia — A Prospective Randomized Controlled Trial

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Abstract

Objective: To compare the efficacy of intra operative periarticular injection with that of post operative epidural analgesia for pain control following unilateral total knee arthroplasty under spinal anesthesia with regard to benefits in postoperative pain at rest and during activity and postoperative range of motion.
Methods: Eighty patients undergoing TKA by a single surgeon were randomly assigned into two groups with the help of computer generated random numbers. One group received the local periarticular infiltration protocol containing 40 ml of 0.75% of Ropivacaine, 2 ml of ketoralac (30 mg/ml), 0.8 mg Morphine, 0.3 ml of Epinephrine (1:1000) and 16.9 ml of Normal saline. The other group underwent epidural analgesia with infusion pump. Both groups received the same operative procedures and rehabilitation protocol. The results were compared and the variables analyzed were postoperative pain at rest and activity (Visual analogue scale for pain), postoperative complications, range of motion and rescue analgesia.
Results: Periarticular injection was associated with significantly lower early postoperative pain at rest, better range of motion, less need for rescue analgesia and fewer complications.
Conclusion: The analysis of data obtained demonstrated that the periarticular infiltration of analgesic agents is significantly effective for pain control and functional recovery with fewer complications. Hence it may be used as a safe alternative to Epidural injections.

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Total knee arthroplasty is a frequently performed procedure, and its incidence is expected to increase 673% to 3.48 million procedures annually by 2030. Current literature confirms that TKR is an effective treatment for osteoarthritis with excellent outcomes[1]. Despite these results, current postoperative pain management may be insufficient

and prevent patients from sleeping, ambulating, and participating with physical therapy[2,3]. Numerous strategies have been devised to control postoperative pain and reduce opioid consumption, including neuraxial anesthesia and peripheral nerve blocks.

Epidural analgesia (ED) consisting of a local anesthetic agent and an opioid has been one regimen used for postoperative analgesia after total knee arthroplasty[4,5]. However, some investigators have indicated that the benefit of epidural analgesia must be weighed against the frequency of its adverse effects such as nausea, pruritus, hypotension, urinary retention, poor muscle control, delayed mobilization and anticoagulant induced spinal hematoma[5,6]. Epidural analgesia is much costlier when compared to other regional analgesia

Continuous femoral nerve blockade in particular, is associated with 1% to 2.5% incidence of muscle weakness, nerve damage, and local infection with 57% of catheters colonized at 48 hrs[4,5,7–9]. In addition to peripheral nerve blocks, parenteral narcotics continue to be a mainstay of postoperative pain management despite significant side effects[10–12]. Oderda et al demonstrated that opioid related adverse drug events following surgery were associated with significantly increased length of stay and hospitalization cost[13].

With the goal of decreasing these adverse drug events, multimodal pain pathway has been developed to block pain at its source. Furthermore a successful multimodal pathway should control pain but also maximize muscle control, promote rehabilitation and decrease venous stasis. Periarticular injection (PAI) as an adjunct to multimodal pain management pathways accomplishes both of these goals[14]. Hence in this study we compared periarticular injection with that of epidural analgesia for post operative pain management in total knee replacement.

Materials and Methods

The study participants included 80 patients who had undergone unilateral TKA between March 2015 and March 2016 for previously diagnosed osteoarthritis of the knee. All had written informed consent. Exclusion criteria were major psychological problems, previous drug dependency, allergies to any of the ingredients of the injection, renal insufficiency, and prolonged QT intervals on ECG. Randomized numbers were generated in the range from 0–80 by a computer software program. Patients with even numbers were allocated for treatment with epidural analgesia, and those with odd numbers were allocated for treatment with periarticular injection. Other perioperative interventions, such as spinal anesthesia, surgical techniques, knee prostheses, prophylactic antibiotics, and thromboprophylaxis are similar for all patients.

In the epidural analgesia group, an epidural catheter was placed at the L2-3 or L3-4 level at the time of administration of the spinal anesthesia. The catheter was connected to an infusion pump delivering continuous infusion (a flow rate of 5 ml/hr for 48 h) of 200 ml of 0.2% of ropivacaine (10 mg/hr) and 0.8 ml of 10 mg/ml of morphine hydrochloride hydrate (0.17 mg/hr). The flow rate of infusion pump stayed constant. The epidural infusion was start after wound closure. The epidural catheters were routinely removed 48 hours after starting the epidural infusion.

Periarticular injection cocktail was prepared by adding 40 ml of 0.75% of Ropivacaine, 2 ml of ketoralac (30 mg/ml), 0.8 mg Morphine and 0.3 ml of Epinephrine (1:1000). This was made to 60 ml by adding 16.9 ml of Normal saline.

Total knee arthroplasty was done through a standard medial parapatellar approach. Once the tibial and femoral bone cuts are made, about 10 ml of solution was injected to the area of the ACL femoral attachment, PCL tibial attachment, into the posteromedial capsule and posterior attachment and into the residual middle and anterior residual rim of the medial meniscus. About 10 ml of cocktail was injected into the posterolateral capsule along the residual posterior rim of lateral meniscus and posterior capsule attachment and into the residual rim of the middle and anterior portion of the lateral meniscus.

In our study group all patients had posterior stabilizing implant. While the cement was curing 20 ml of cocktail was injected to the quadriceps tendon and suprapatellar pouch. The remaining 20 ml was injected into fat pad and into the region of the medial femoral condyle in the region of Hunter's canal.

In both treatment groups, injection tramadol 100 mg was given four hours after complete resolution of spinal anesthesia. From the day after surgery, oral tramadol 50 mg + Paracetamol 500 mg was given three times a day. For rescue analgesia 50 mg of Diclofenac sodium suppository was used. Antibiotics and thrombo-prophylaxis were same for all patients. In both groups, all patients received spinal anesthesia with 2.0 to 2.8 ml of 0.5% bupivacaine without opioid. A pneumatic tourniquet and drain were used in all subjects.

Outcome Assessment

Pain score was measured using a Visual analog scale (VAS). The VAS score ranged from 0 mm to (indicating no pain) to 100 mm (indicating extreme pain) in 10 mm increments. Time zero was defined as the time of complete resolution of spinal anesthesia[15]. The VAS score at rest was recorded every two hours from four to twenty four hours from time zero, when the patient was awake. There after the VAS score was recorded every

Table 1. Comparison of Visual Analogue Scale during Rest.

	PAI (N=40)	ED (N=40)	p - value
0 HR	0.15 ± 0.36	1.40 ± 0.50	0.000
2 HR	0.30 ± 0.61	1.55 ± 0.55	0.000
4 HR	0.38 ± 0.63	1.38 ± 0.67	0.000
6 HR	0.85 ± 0.74	1.20 ± 0.41	0.005
8 HR	0.80 ± 0.69	1.45 ± 0.71	0.000
10 HR	0.63 ± 0.74	1.70 ± 0.85	0.000
12 HR	0.53 ± 0.60	1.50 ± 0.68	0.000
14 HR	0.53 ± 0.64	1.53 ± 0.78	0.000
16 HR	0.65 ± 0.53	1.38 ± 0.77	0.000
18 HR	0.68 ± 0.57	1.38 ± 0.70	0.000
20 HR	0.63 ± 0.70	1.28 ± 0.51	0.000
22 HR	0.58 ± 0.64	1.35 ± 0.48	0.000
24 HR	0.63 ± 0.70	1.18 ± 0.45	0.000
32 HR	0.33 ± 0.80	1.00 ± 0.00	0.000
40 HR	0.10 ± 0.30	1.00 ± 0.00	0.000
48 HR	0.03 ± 0.16	0.88 ± 0.33	0.000
56 HR	0.00 ± 0.00	0.63 ± 0.49	0.000
64 HR	0.00 ± 0.00	0.48 ± 0.51	0.000
72 HR	0.00 ± 0.00	0.23 ± 0.42	0.002

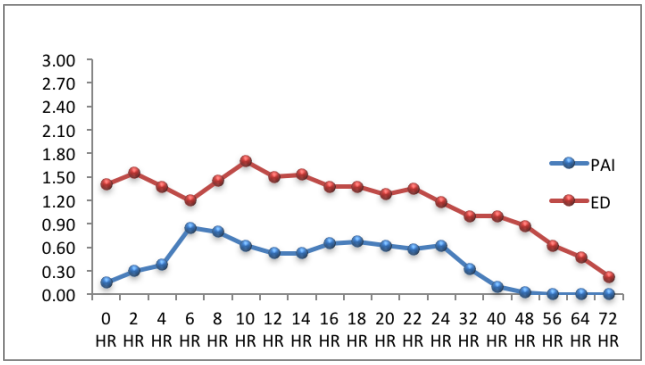

Figure 1. Comparison of visual analogue scale during rest.

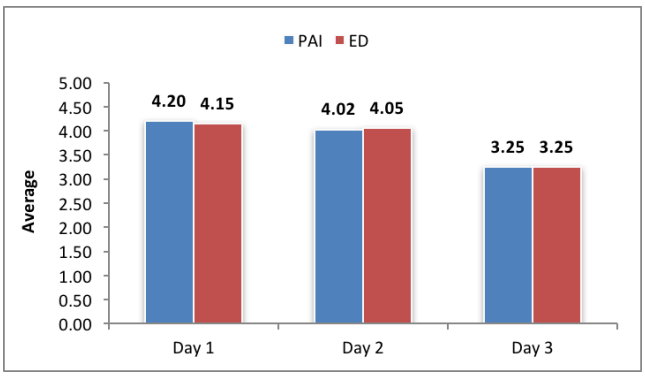

Figure 2. Comparison of visual analogue scale during activity.

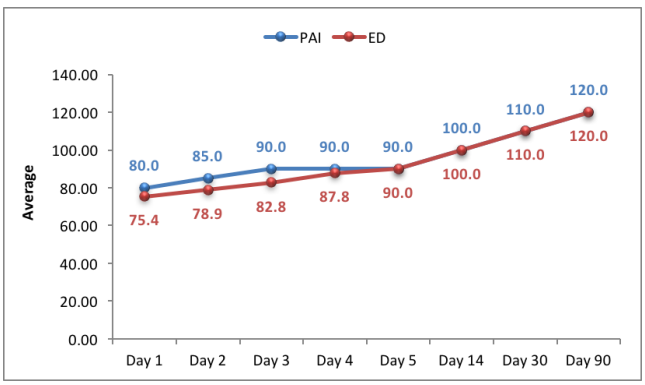

Figure 3. Comparison of range of motion.

eight hours until seventy two hours from time zero. The postoperative pain level during activity was estimated on a VAS pain scale score once a day until postoperative day 3. The strongest pain experienced during physical therapy exercise on a particular day was recorded as the VAS score during activity.

Range of motion was recorded by a physical therapist. The data was collected 1st to 5th day after surgery during the hospital stay. The data was also collected during regularly scheduled postoperative visits. (at one and three months after surgery). The use of diclofenac sodium suppository as rescue analgesia was recorded. Any complications occurring during the course of the trial was recorded with particular emphasis on wound complication, surgical site infections and opioid related adverse effects.

Results and Outcome

To analyze the pain during rest, the area under the curve of the VAS pain scores at rest was calculated by plotting it on the time scale. The comparisons between groups were made using the Student t test.

Comparison of visual analogue scale during rest was analyzed using independent sample t-test. The table shows that visual analogue scale during rest was significantly higher in ED compared to PAI.

The table shows that visual analogue scale during activity was almost same in ED and PAI. There was no significant difference in VAS pain score during activity.

The table shows that range of motion were significantly higher in PAI compared to ED.

The table shows that proportion of rescue analgesia was significantly higher in ED (42.5%) compared to PAI (20.0%). The use of diclofenac sodium suppository as rescue analgesia was higher in epidural groups.

Out of the total 40 epidural patients 20 (50%) had vomiting while in the periarticular group of 40 only 5 (12.5%) had vomiting.

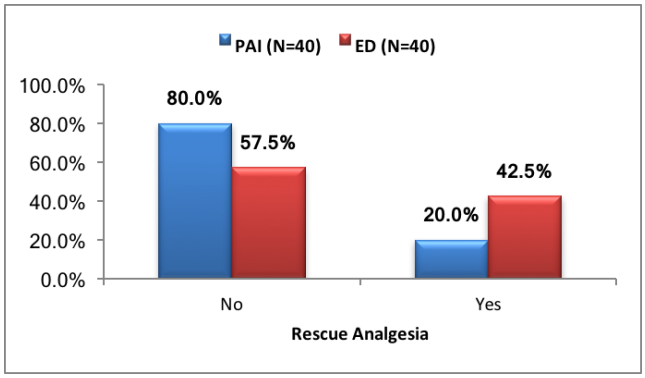

Figure 4. Comparison of rescue analgesia between PAI and ED.

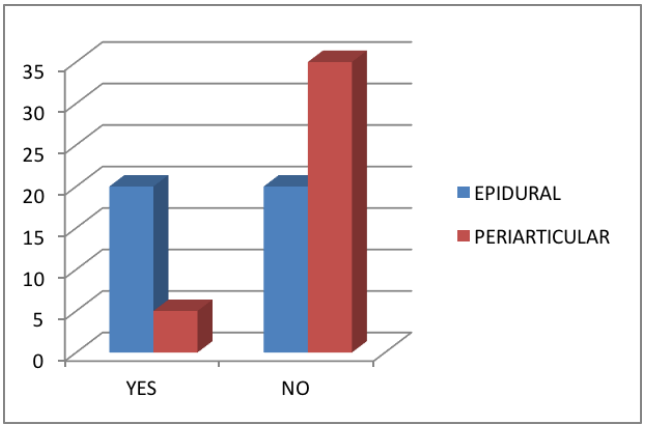

Figure 5. Comparison of nausea/vomiting.

Table 2. Comparison of complications.

Complications	Periarticular group	Epidural group
Vomiting/Nausea	5	20
Hypotension	0	1
Peroneal nerve palsy	0	0
Infection	1	1
Cardiotoxicity	0	0
Neurotoxicity	0	0

In the periarticular group almost 85 % were free of complications and in the epidural group only 55% developed complications. Vomiting or Nausea was the most common complication in both groups.

Discussion

In this study, we evaluated the efficacies of single administration of a multimodal periarticular injection and epidural analgesia for pain control after unilateral knee arthroplasty. Periarticular injection was associated with significantly lower early postoperative pain at rest than epidural analgesia which was comparable to other studies [16–18]. Comparison of visual analogue scale during rest was analyzed using independent sample t-test which was found to be statistically significant in our study. Comparison of visual analogue scale during activity showed that there was no significant difference in VAS pain score during activity.

Flexion angle was also better in the periarticular injection group until two days after total knee arthroplasty in our study. Comparison of range of motion was analyzed using independent sample t-test and showed that range of motion was significantly higher in PAI compared to ED.

No cardiac or central nervous system toxicity was observed in our periarticular group which was same as results got by Busch et al[17]. Studies by Sachiyuki Tsukada et al[16] also supported the absence of cardiac or central nervous system toxicity in periarticular injections.

Nausea and vomiting was common in Day1 post-operative period in epidural analgesia group when compared to periarticular injection group. In the periarticular group, almost 85% were free of complications. Vomiting was the most frequent complication with an incidence of about 12%. Infection occurred in only 3%. In the epidural group, 45% did not develop any complication. In this group also, the most common complication was vomiting which was seen in 50%. 2% had hypotension while 3% developed infection.

Jiang et al[19] also found that periarticular group patients had a much lower rate of nausea and vomiting. Randomized study by Parvathaneni et al[20] found similar results as ours with less opioid related side effects in periarticular group.

There was no transient peroneal nerve palsy in our study. Cost of periarticular injection is cheaper than epidural analgesia and the time consumption for giving periarticular injection is very less when compared to epidural analgesia. These results suggest that periarticular injection may be preferable to epidural analgesia, at least for patients similar to those enrolled in our study.

An important limitation of our study was that the patients and caregivers were not blinded. Blinding was also not done for the assessors. Since the scoring on VAS pain scale during the early postoperative period was difficult to do alone for patients who had had a total knee arthroplasty, the nurses in the ward had to help. Hence, to obtain proper blinding, the nurses also had to be blinded.

Though the chance of transient peroneal nerve palsy was high in periarticular injection group, it can be prevented by avoiding excessive infiltration in the area of the common peroneal nerve during injection into the posterior aspect of capsule.

Conclusion

The periarticular multimodal drug injection had better postoperative pain relief than epidural analgesia at rest, and better early postoperative flexion angle. Though not better than epidural, VAS scores at activity were also low. Complication rates on average were very low. Nausea, which is the most frequent complication of epidural analgesia was rare in the patients who had periarticular injection. Cardiogenic complication of hypotension was totally avoided in the PAI group. Infection rates were same in both the groups. Though research papers suggest peroneal palsy as a complication, in our study we did not have any cases.

With its better outcomes and tolerable complications, PAI may be used as a safe alternative to epidural injections, at least in the patients with similar cardiac and neurologic profile as ours; as also in those who have no known allergy to drugs in our study.

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