Efficacy of Local Infiltration of Analgesics via Intra-articular Epidural Catheter vs Adductor Canal Block in Primary Total Knee Arthroplasty Surgery.

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Pain is believed to be a poorly understood phenomenon, which is mostly regulated by neural, cellular, hormonal & emotional components. Epidural analgesia is used for pain relief in patients undergoing primary total knee arthroplasty, though provides good pain control, many a time is associated with side effects such as hypotension, urinary retention and impaired mobility. The purpose of the current study is to compare the efficacy of ACB to local infiltration of analgesics by Intraarticular Epidural Catheter for primary total knee arthroplasty by comparing visual analog scale, knee flexion, and active SLRT on the day of surgery (POD-0), POD1-3, day of discharge, and 4 weeks after surgery. This study is prospectively randomized, the cases undergoing primary knee replacement were divided into two groups, which includes a minimum of 36 cases in each group. Group-1(36) patients received local infiltration of analgesics via IAEC and Group-2(36) patients received single shot ACB. As far as age, sex, BMI(kg/m2), pre-op VAS, mean pre-op flexion, mean pre-operative varus, mean pre-op KSS(Knee society score), duration of surgery and hospital stay is concerned no significant difference was noticed between the two groups. Group-1(LIA via IAEC) had significantly lower VAS on a postoperative day (POD) 1-3, lower tramadol consumption, better ROM (atPOD1-3), superior quadriceps recovery(active SLRT), earlier mobilization day, better KSS (at 4weeks) postoperatively, compared to Group-2(single shot ACB). LIAby IAEC for patients undergoing primary TKA is a better option compared to single shot ACB concerning to pain levels, narcotic usage, range of motion, quadriceps recovery and KSS (Knee society score).

Keywords: Adductor canal block; Epidural catheter; Intraarticular; Knee Arthroplasty; Local infiltration of analgesic.

Primary TKA procedures are usually associated with moderate to severe pain1-3. Pain management after TKA is always challenging and is believed to be a poorly understood phenomenon, which is mostly regulated by neural, cellular, hormonal & emotional components. A multimodal approach is always desirable to combat this complex phenomenon. The suggested efficacy of periarticular analgesics intraoperatively is inconsistent. Epidural analgesia is used for pain relief in patients undergoing primary TKA, though provides good pain control, many a time is
associated with side effects such as hypotension, urinary retention and impaired mobility. Apart from that, the risk of hematoma and infection in the epidural space are rare but dreaded complications associated with epidural analgesia. Hence the current study aims at exploring alternative modalities of analgesia. Many studies have demonstrated that adductor canal block (ACB) can provide adequate analgesia with a multimodal analgesic regimen\textsuperscript{4-6} with better functional outcomes post-operatively in comparison with a femoral nerve block (FNB)\textsuperscript{7,8}. It has been suggested in many studies that LIA (Local infiltration of analgesics) can provide superior postoperative analgesia and earlier mobilization compared to placebo\textsuperscript{9,10}, intrathecal morphine\textsuperscript{9}, epidural analgesia\textsuperscript{11,12} and FNB\textsuperscript{13-16}. Moreover, local infiltration of analgesics is cheap and relatively easy to perform than FNB, while providing good analgesia\textsuperscript{17-22}. We, therefore, compared the efficacy of IAEC vs ACB in primary TKA with respect to VAS, ROM, KSS and quadriceps recovery, in a prospective, randomized trial.

**MATERIAL AND METHODS**

The current study was done on patients undergoing primary total knee replacement at IMS & SUM Hospitals (IEC Letter No DMR/IMS/SH/SCA/792/2019), during the study period of March 2018 to April 2020. This study is prospectively randomized, the cases undergoing primary knee replacement were divided into two groups, which includes a minimum of 36 cases in each group. Group -1(36) patients received intra-articular epidural catheter (IAEC) and Group 2 (36) patients received ACB (adductor canal block). The postoperative pain was assessed in each patient through a pain chart. Patients undergoing primary TKR who satisfy inclusion criteria were included in the study. They were admitted and examined, randomly selected and post-operative pain management will be given according to the modified Caledonian protocol in Group1/LIA by IEAC and Group-2/adductor canal block. The patients were evaluated clinically and pain management protocol was followed accordingly during their stay after the surgery at our hospital. Pain control was assessed by VAS (Visual Analogue Scale) scores and outcomes in terms of ROM achieved on the day of discharge. All patients undergoing Primary unilateral TKA, patients with osteoarthritis of the Knee and those with TKA done under spinal anesthesia were included in our study. Patients undergoing bilateral TKR, Revision TKR and those with Rheumatoid arthritis, Neuromuscular deficit, History of cardiac disease or arrhythmia requiring special monitoring,
use of general anesthesia. Patients with severe renal insufficiency, uncontrolled diabetes mellitus, bleeding disorders, alcohol or drug abuse, allergy to local anesthetics were excluded from our study. Preemptive analgesia in the form of Celecoxib 200 mg, Pregabalin 75 mg (Omit pre-operative dose was omitted in patients with renal impairment) and Paracetamol 650mg, were given to all patients undergoing primary TKA, all a night before surgery. Combined Spinal and epidural anesthesia (Epidural only as intra-op backup). Post-operative analgesia was provided by peri-articular injection of 0.2% Ropivacaine solution followed by an infusion administered through a catheter placed under direct vision via a Touhy needle, inserted about 10 cm above the incision into the surgical field by outside-in technique at the end of surgery in group-1 (IAEC) and USG guided Adductor canal block by local anesthetic agents in group-2 (ACB).

Table 1. Patient Demography

<table>
<thead>
<tr>
<th></th>
<th>IAEC(n=36)</th>
<th>ACB(n=33)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(yrs)</td>
<td>69±7.08</td>
<td>66±6.56</td>
<td>0.081</td>
</tr>
<tr>
<td>Gender</td>
<td>M:F=12:24</td>
<td>M:F=11:22</td>
<td>0.609</td>
</tr>
<tr>
<td>BMI</td>
<td>26.56±4.12</td>
<td>27.48±2.86</td>
<td>0.076</td>
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<tr>
<td>Pre-op VAS</td>
<td>7.5±2.27</td>
<td>7.7±2.34</td>
<td>0.467</td>
</tr>
<tr>
<td>Mean Pre-op flexion</td>
<td>100.4</td>
<td>102.0</td>
<td>0.66</td>
</tr>
<tr>
<td>Mean Pre-op Varus deformity(degrees)</td>
<td>12.5</td>
<td>13.0</td>
<td>0.63</td>
</tr>
<tr>
<td>Mean Pre-op KSS</td>
<td>32.6</td>
<td>31.4</td>
<td>0.54</td>
</tr>
<tr>
<td>Duration of surgery(Minutes)</td>
<td>110.24±21.65</td>
<td>120.54±25.23</td>
<td>0.124</td>
</tr>
<tr>
<td>Hospital Stay(Days)</td>
<td>5±0</td>
<td>5.22±0.28</td>
<td>0.088</td>
</tr>
</tbody>
</table>

Table 2. Visual Analogue Scale (VAS)

<table>
<thead>
<tr>
<th></th>
<th>IAEC</th>
<th>ACB</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD-0</td>
<td>2.26±1.28</td>
<td>3.65±2.24</td>
<td>0.018</td>
</tr>
<tr>
<td>POD-1</td>
<td>2.5±2.2</td>
<td>5±3.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>POD-2</td>
<td>2.3±1.4</td>
<td>4.6±1.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>POD-3</td>
<td>2.1±1.6</td>
<td>4±1.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Day of Discharge</td>
<td>1.6±1.5</td>
<td>3.4±2.1</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3. Knee Flexion in Degrees

<table>
<thead>
<tr>
<th></th>
<th>IAEC</th>
<th>ACB</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD-3</td>
<td>96.5±10.9</td>
<td>84.2±16.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Day of discharge</td>
<td>112.6±8.4</td>
<td>92.6±12.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>4weeks post-op</td>
<td>126.8±6.3</td>
<td>119.4±9.7</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 4. Active Straight Leg Raise Test

<table>
<thead>
<tr>
<th></th>
<th>IAEC (n=36)</th>
<th>ACB (n=33)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day of discharge</td>
<td>32(88.8%)</td>
<td>15(45.45%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2weeks post-op</td>
<td>34(94.44%)</td>
<td>29(87.87%)</td>
<td>0.496</td>
</tr>
</tbody>
</table>

Table 5. Knee Society Score

<table>
<thead>
<tr>
<th></th>
<th>IAEC Group</th>
<th>ACB Group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative</td>
<td>32.6</td>
<td>31.4</td>
<td>0.54</td>
</tr>
<tr>
<td>6weeks</td>
<td>90.46±12.6</td>
<td>79.5±10.9</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
No drains were used. Ropivacaine 0.2%, 10 mL bolus was given 8 hourly and 10 ml before removal of the catheter while doing Pod 1 dressings, a top-up dose of 10 ml if severe pain complained in Group1 (IAEC). 0.5% levobupivacaine 20 ml was injected after ensuring the correct placement of the needle under USG guidance in Group2 (ACB).

**Intra-articular Epidural Catheter Placement (IAEC) Adductor canal block (ACB)**

The patients were made to mobilize on the same day of surgery and Physiotherapy was continued thereafter. The patients were discharged, once they could move independently and their pain was controlled with oral analgesics.

**Post-operative Assessment**
- VAS at 12hr, 24hr, 48hr, and 72hrs & at the time of discharge.
- ROM at POD-3, at the time of discharge & at 4wks
- Early Functional Recovery- Active SLRT, Maximum Flexion at the time of discharge.
- Power of Quadriceps muscle

![Chart 1. Knee flexion](image1)

![Chart 2. Visual Analogue Score](image2)
• Opioid Consumption
• Pt discharged POD
• Follow up of all patients till 6 weeks to rule out any drug-related side effects & complications post-surgery (Infection)

RESULTS

As far as age, sex, BMI (kg/m²), pre-op VAS, mean pre-op flexion, mean pre-op varus, mean pre-op KSS (Knee society score), duration of surgery and hospital stay is concerned, no significant difference was noticed between the two groups (Table 1). The visual analog scores suggested that the average pain scores were significantly lower in the IAEC group as compared to the ACB group[chart-2] (Table2). The active knee flexion at POD#3, at the time of discharge and 4 weeks after surgery, was greater in the IAEC group[chart-1] (Table 3). The active SLRT showed

![Chart 3. Active Straight Leg Raise Test](chart3.png)

![Chart 4. Knee Society Score at 6wks](chart4.png)
significantly superior at the day of discharge in the IAEC group\(p<0.001\) compared to the ACB group, but at 2 weeks following surgery, there was no significant difference\(p>0.05\) between the two groups\[chart-3\](Table-4). The average knee society score (KSS) at 6 weeks follow-up was significantly higher in the IAEC group(90.46+-12.6) compared to ACB group79.5+-10.9\[Table5\](Chart-4). All the data were analyzed using SPSS20 software.

**DISCUSSION**

ACB can be delivered as single-shot injections or by continuous adductor canal catheter infusion and was initially recommended as ‘pure sensory’ nerve blocks without associated motor weakness. Single-shot ACB has been recommended as an efficient measure to control pain and improved rehabilitation.23-29 Among the other modalities like, sciatic nerve block or femoral nerve block (FNB), ACB has been associated with a lower incidence of motor weakness following surgery, thus aiding faster recovery and rehabilitation.23,26 Many studies have suggested the use of ACB over FNB to avoid motor weakness and to achieve faster recovery and rehabilitation.30-33 Tofdahl et al14 in their study have shown that peri- and intra-articular analgesia following total knee arthroplasty has superior analgesic effects and achieved faster rehabilitation as compared to continuous FNB. Andersen et al25 found that peri and intra-articular infusion of ropivacaine improved analgesia as compared to epidural infusions. In their study, Smith et al37 reported lower VAS for patients receiving intra-articular bupivacaine infusion as compared to periarticular liposomal bupivacaine injection. Many studies have suggested that intraoperative periarticular injection following primary total knee arthroplasty has significantly reduced the amount of postoperative analgesia required10,34,18,35 with relatively lower pain scores10,4,35. The visual analog scale suggested that the average pain scores were significantly lower in the IAEC group, compared to the ACB group (chart-2). In our study, VAS on IAEC placement patients was significantly lower on the day of surgery, POD 1-3 and on the day of discharge when compared with the ACB patients (Table 2). Acute pain, even if of short duration, if not addressed appropriately may result in sensitization of the nervous system, causing chronic pain.36,37 This could be the reason why low pain levels were recorded in the IAEC group as compared to the ACB group at the time of discharge. The active knee flexion at POD-3, at the time of discharge and 4 weeks post-surgery, was significantly greater in the IAEC group as compared to the ACB group [chart-1] (Table 3). Because of better pain relief in the IAEC group, encouraged early mobilization and facilitate physiotherapy following the surgery. The number of patients, who were able to do active SLR, was significantly higher in the IAEC knee compared with the ACB knee at the time of discharge [chart-3] (Table-4). Although the difference was not significant at 2weeks post-op. Average knee society score (KSS) at 6 weeks follow-up was significantly higher in the IAEC group compared to the ACB group \[Table5\](Chart-4). In their study Feibel et al38 showed an increased incidence of falls following surgery in patients receiving continuous femoral nerve block. Adductor canal block can also result in motor deficit because of the proximal spread of the drugs.29,26 But the incidence is very low. In the current study, none of our patients had experienced falls, at any time following the procedure.

**CONCLUSION**

The current study suggests that Local infiltration of analgesics by IAEC (Intraarticular Epidural Catheter) for patients undergoing primary TKA is a better option compared to single shot adductor canal block, as far as pain levels, opioid usage, range of motion, quadriceps recovery and KSS (Knee society score) is concerned. Because of better pain relief in the IAEC group, it encouraged early mobilization and facilitates physiotherapy following the surgery. Moreover, IAEC is a rather easier procedure to perform, when compared to that of single shot ACB, which requires an experienced anesthesiologist.

**ACKNOWLEDGEMENT**

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Conflict of Interest
The Authors declare there is no conflict of interest.

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REFERENCES


