A comparison of local intraarticular anesthesia versus general anesthesia for ambulatory arthroscopic knee surgery

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Abstract

Various anesthetic techniques including local, regional, and general anesthesia have been utilized for ambulatory arthroscopic knee surgery. The choice of anesthetic technique for this surgical procedure can have a significant impact on postoperative recovery, side effects, and patient satisfaction. The objective of this randomized, prospective study is to evaluate the efficacy of utilizing either intraarticular (IA) local anesthesia or general anesthesia (GA) for patients undergoing outpatient arthroscopic knee surgery. Patients assigned to the local anesthesia group were administered an IA injection of 30 mL of bupivacaine 0.25% approximately 20–30 min before surgery. Intraoperative sedation was provided with the administration of propofol. Patients assigned to the GA group were administered propofol and fentanyl for induction and maintained with sevoflurane combined with nitrous oxide in oxygen by laryngeal mask airway. The surgeon injected 30 mL of bupivacaine 0.25% through the arthroscope at the completion of the surgical procedure. This study demonstrates that IA anesthesia provides for improved pain relief, decreased postoperative opioid use, postoperative nausea and vomiting (PONV), time spent in the recovery room, and improved patient satisfaction with similar operating conditions comparable to general anesthesia in patients undergoing outpatient arthroscopic knee surgery. Although both groups received a similar dose of IA bupivacaine, administering the local anesthetic prior to surgery resulted in more effective analgesia. We currently believe that intraarticular local anesthesia fulfills all the criteria for the optimal anesthetic technique for outpatient arthroscopic knee surgery.

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Keywords: Knee arthroscopy; Intraarticular; Ambulatory surgery; Local anesthesia; Outcomes

1. Introduction

The optimal anesthetic technique for ambulatory arthroscopic knee surgery should be technically simple to administer, have minimal side effects, provide for rapid onset with a high success rate, allow for a timely discharge, be inexpensive, and provide postoperative analgesia [1–3]. General anesthesia (GA) may be associated with a higher incidence of side effects and unanticipated hospital admissions after outpatient surgery [4]. Regional anesthesia may be more preferable for ambulatory surgical patients because of the potential for improved postoperative analgesia, faster recovery times, and decreased incidence of side effects [4–6]. A variety of regional anesthetic techniques have been described for outpatient arthroscopic knee surgery. Peripheral regional techniques have included instillation of intraarticular (IA) local anesthetics [2,3,7–23], combined psoas compartment and sciatic nerve blocks [24], and femoral three-in-one nerve blocks [2,14,25]. Central neuraxial nerve blocks have included spinal, epidural, and combined spinal–epidural anesthetic techniques [1,22,26–28]. Due to concerns about possible back pain, spinal headache, transient radicular irritation, and prolonged hospital discharge, we no longer perform spinal or epidural anesthesia for outpatient knee arthroscopy. Although femoral three-in-one nerve blocks may provide ad-
equate anesthesia, they take considerable time to perform, have a high failure rate, and many anesthesiologists are not familiar or comfortable performing them.[29] Furthermore, the use of a femoral three-in-one block was shown to be no more efficacious than the IA administration of local anesthesia following outpatient knee arthroscopy.[2] At our institution, arthroscopic knee surgery has been successfully performed with IA local anesthesia (LA) for over a decade. For those patients refusing an IA local anesthetic block, we currently offer the option of general anesthesia. This study was designed to prospectively evaluate general and IA local anesthesia in patients scheduled for outpatient knee arthroscopy.[2]

By the use of a computer-generated table of random numbers, patients were allocated to receive either GA or IA local anesthesia. Patients assigned to the GA group were administered IV propofol 2 mg/kg and fentanyl 1.5 μg/kg for induction. General anesthesia was maintained with 0.5–2% sevoflurane (end-tidal concentration) combined with 60% nitrous oxide in oxygen by laryngeal mask airway. The surgeon injected 30 mL of 0.25% bupivacaine with 1:200,000 epinephrine through the arthroscope at the completion of the surgical procedure.

Patients assigned to the GA group were admitted to the Phase I postanesthesia care unit (PACU). Patients were transferred to the Phase II ambulatory surgical unit (ASU), after achieving a modified Aldrete score[30] of 10. Patients assigned to the IA group were given incremental doses of fentanyl 25 μg IV every 5 min for a VRS ≥ 3. Side effects including postoperative nausea and vomiting (PONV) were recorded. Ondansetron 4 mg IV was administered for nausea lasting longer than 5 min, on patient request, or when vomiting occurred. All assessments (pain, time to oral intake, nausea, vomiting, Aldrete, and PADSS scores) were recorded by an independent nurse-observer (HM) blinded to the analgesic treatment group.

At the completion of surgery, the primary surgeon (JS) was asked to assess surgical operating conditions on a five-point scale (1: excellent, 2: very good, 3: good, 4: moderate, 5: unacceptable). Postoperative pain scores, both at rest and with movement, were assessed using an 11-point VRS at 30 min, 60 min, and 24 h after surgery. Pain scores with movement were recorded immediately after the patient actively flexed the operative knee to 90°. Patients were instructed to take 1–2 acetaminophen 325 mg/oxycodone 5 mg tablets, every 3 h as needed for a VRS ≥ 3 while at home. Patients were contacted by telephone 24 h after surgery by the same blinded investigator (HM), and were asked about their pain score, time to first analgesic use, 24-h total use of analgesic tablets, incidence of nausea and vomiting, and to estimate their overall satisfaction with the entire perioperative experience on a five-point scale (1: very satisfied, 2: satisfied, 3: somewhat satisfied, 4: unsatisfied, 5: very unsatisfied). Analgesic duration was defined as the time...
from completion of surgery until the first postoperative use of fentanyl or acetaminophen/oxycodone.

2.1. Statistical analysis

Demographic data and times (duration of procedure, time to discharge, time to oral intake, and analgesic duration) were assessed by analysis of the variance. Pain scores, patient satisfaction, surgical operating conditions, amount of postoperative analgesics, and odansetron use were analyzed by the Kruskal–Wallis test. The incidence of nausea and vomiting were evaluated by contingency analysis and the chi-square test. If a significant result was obtained, the Mann–Whitney U-test was performed to determine between which groups there was significance; a Bonferroni adjustment was made for multiple comparisons. Significance was determined at the P < 0.05 level.

3. Results

Of the 104 patients accepting randomization, four were excluded from analysis (one required open arthrotomy, one required overnight admission because of IA bleeding, and two for protocol violations). There were no significant differences among the two study groups with respect to age, sex, weight, duration of surgery, or surgical procedures (Table 1). There were no differences in the surgeon rating of intraoperative conditions (Table 2) between the two groups. No patient in the IA local anesthesia group required intraoperative fentanyl or conversion to general anesthesia. Fourteen patients (28%) in the IA local anesthesia group required an additional IA injection of local anesthetic because of an intraoperative VRS pain score >3. Pain scores in the immediate postoperative period were significantly lower, both at rest and with movement in the IA group (Table 2). There were no differences in pain scores 24 h after surgery. Significantly, more patients required the administration of fentanyl in the PACU or acetaminophen/oxycodone use in the 24 h follow-up surgery (Table 2). Patients in the GA group had a higher incidence of PONV, anterometric use, and longer time to first oral intake compared to the IA group (Table 2). All patients in the IA local anesthesia group achieved a modified Aldrete score of 10 after leaving the operating room and were admitted directly to the ASU (Table 2). These patients spent less time in both the ASU and were discharged from the hospita sooner than patients receiving GA (Table 2). Analogic duration in the IA local anesthesia group was significantly longer compared to patients in the GA group (Table 2). More patients in the IA group reported higher satisfaction scores with their entire perioperative care compared to the GA group (Table 2).

Table 1

<table>
<thead>
<tr>
<th>Type of surgery (n)</th>
<th>IA local anesthesia</th>
<th>General anesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial medial meniscectomy</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Partial lateral meniscectomy</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Chondroplasties</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Loose body removal</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Diagnostic arthroscopy</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Lateral release</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Medial meniscal repair</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Lateral meniscal tear</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Synovectomy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Plica excision</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>21 ± 7</td>
<td>24 ± 6</td>
</tr>
<tr>
<td>Procedure used (mg)</td>
<td>58.8 ± 20.1</td>
<td>170.3 ± 69.8</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Surgical outcomes</th>
<th>IA local anesthesia</th>
<th>General anesthesia</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>50</td>
<td>50</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Intraoperative VRSa</td>
<td>2 (0–4)</td>
<td>0 (0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Postoperative VRSb</td>
<td>30 min (rest)</td>
<td>1 (0–2)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>60 min (movement)</td>
<td>2 (1–4)</td>
<td>4 (5–8)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>60 min (rest)</td>
<td>1 (0–2)</td>
<td>3 (2–6)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>60 min (movement)</td>
<td>1 (0–2)</td>
<td>3 (2–6)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Pain control (min)</td>
<td>24 h (rest)</td>
<td>2 (1–3)</td>
<td>NS</td>
</tr>
<tr>
<td>24 h (movement)</td>
<td>3 (2–5)</td>
<td>3 (2–6)</td>
<td>NS</td>
</tr>
<tr>
<td>PACU fentanyl use (µg)</td>
<td>0 ± 0</td>
<td>25.5 ± 36.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>24 h Percocet use (tabs)</td>
<td>4.6 ± 1.2</td>
<td>6.1 ± 1.1</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Vomitingc</td>
<td>0 (0)</td>
<td>8 (16)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Odansetron usec</td>
<td>0 (0)</td>
<td>10 (20)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Time to oral intake (min)d</td>
<td>0.7 ± 2.1</td>
<td>59.1 ± 12.6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Phase I PACU stay (min)d</td>
<td>0 ± 0</td>
<td>48.7 ± 11.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Phase II ASU stay (min)d</td>
<td>58.1 ± 12.2</td>
<td>138.5 ± 24.1</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Actual discharge time (min)b</td>
<td>112 ± 22</td>
<td>198 ± 36</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Analgesic duration (min)b</td>
<td>310 ± 42</td>
<td>64 ± 12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Surgical conditionc</td>
<td>3 (2–5)</td>
<td>3 (2–6)</td>
<td>NS</td>
</tr>
<tr>
<td>Good</td>
<td>2 (4)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>41 (82)</td>
<td>45 (90)</td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>7 (14)</td>
<td>5 (10)</td>
<td></td>
</tr>
<tr>
<td>Very satisfied</td>
<td>35 (70)</td>
<td>16 (32)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Satisfied</td>
<td>12 (24)</td>
<td>15 (30)</td>
<td>NS</td>
</tr>
<tr>
<td>Somewhat satisfied</td>
<td>3 (6)</td>
<td>19 (38)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Data are presented as median (range), unless noted.

a V alues are numbers and percentages [% (%)].

b Graded from 1 (excellent) to 5 (unsatisfactory).

c Graded from 1 (very satisfied) to 5 (very unsatisfied).

d Graded from 1 (very good) to 5 (very poor).

e Graded from 1 (very good) to 5 (very unsatisfactory).

Data are presented as mean ± S.D.; n, number in each group.

* P < 0.001.
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significant impact on postoperative recovery, side effects, and patient satisfaction. Local anesthetic techniques fulfill
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cost-effective technique [19–21], many institutions continue
to utilize general, spinal, or epidural anesthesia for arthro-
scopic knee surgery. Some physicians have expressed con-
cerns about adequacy of surgical conditions for operative arthroscopy or certain patient populations [14,22,33]. Our
present study revealed that a wide variety of knee procedures
could be successfully performed utilizing local anesthesia with sedation. We found this to be a safe, practical, and reli-
able technique that resulted in high patient satisfaction. Op-
erative surgical conditions were rated very good to excellent
in the majority of patients and similar to those patients re-
ceiving general anesthesia. The majority of patients in the
local anesthesia group reported either no or mild (VAS ≤ 3)
intraoperative pain.

In contrast to our findings, Swedish surgeons assessed “technical difficulties” and patients’ pain as “more intense” with the use of local anesthesia compared to spinal or gen-
eral anesthesia for arthroscopic knee surgery [22]. The rea-
sons for the improved surgical conditions observed in our
study may be several-fold. Firstly, it has been observed that the “success of local anesthesia/sedation techniques is also
dependent upon the skills of the surgeon” [5]. Some ortho-
pedic surgeons believe that there is a larger “learning curve”
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of propofol (< 60 mg) for the duration of the surgical proce-
dure. This provided for optimal surgical conditions while still
allowing patients the opportunity to view the video monitor.
We have found that allowing patients to view their surgery is
beneficial in facilitating the explanation and understanding of
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of the knee is not altered after IA anesthesia [34], the retained
ability of the patient to voluntarily move his or her knee during
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Another factor, which may affect surgical conditions, is the
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four times to achieve an even distribution of the local anes-
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the use of either intravenous opioids or general anesthesia.
Similarly, Eriksson et al. [11] reported that 22% of patients
undergoing arthroscopic knee surgery required an additional
IA injection of local anesthesia and none required conversion
to general anesthesia.

IA anesthesia also provided for enhanced perioperative
analgesia while obviating the need for intraoperative ad-
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We believe the use of IA local anesthesia for arthroscopic
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None of the patients in the IA group required either parenteral
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dose of IA bupivacaine, the timing of local anesthetic admin-
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4. Discussion

Arthroscopy of the knee joint is one of the most com-
monly performed orthopedic surgical procedures performed
in the United States. In an attempt to decrease cost, an in-
creasing number of these procedures have been performed
over the past decade on an outpatient basis. The choice of
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istration may have contributed to the difference in analgesic
efficacy. Patients in the IA group were administered bupivacaine 20–30 min before surgery, whereas those in the GA group received an IA injection at the conclusion of the arthroscopic procedure. The enhanced analgesic effect in the IA group may be related to a preemptive analgesic effect of IA bupivacaine [39]. We have previously demonstrated that IA bupivacaine is a more effective analgesic when administered prior to rather than at the conclusion of arthroscopic knee surgery [40]. Alternatively, the IA administration of bupivacaine at the conclusion of arthroscopic knee surgery may have not provided sufficient analgesia until well after the patients were admitted to the PACU. It has been demonstrated that the optimal analgesic effect derived from bupivacaine is not observed until at least 20 min after its IA injection [39].

In conclusion, IA anesthesia provides for improved pain relief, decreased postoperative opioid use, PONV, time spent in the recovery room, and improved patient satisfaction with similar operating conditions comparable to general anesthesia in patients undergoing outpatient arthroscopic knee surgery. Although both groups received a similar dose of IA bupivacaine, administering the local anesthetic prior to surgery resulted in more effective analgesia. We currently believe that intraarticular local anesthesia fulfills all the criteria for the optimal anesthetic technique for outpatient arthroscopic knee surgery.

References


