# Regional Anesthesia and Pain

# Spinal anesthesia improves the early recovery profile of patients undergoing ambulatory knee arthroscopy

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Purpose: We compared the recovery profiles, postoperative complications, perioperative OR utilization times, and times to discharge of patients undergoing ambulatory knee arthroscopy under spinal anesthesia (SA) or general anesthesia (GA).

Methods: In this randomized, prospective study, 84 ASA I-II patients were randomized to receive either SA with 50 mg of 1% lidocaine, or a standardized GA. Postoperative pain, nausea and vomiting, sedation, OR utilization, postanesthesia care unit (PACU), and ambulatory surgical unit (ASU) recovery were compared.

Results: Patients in the GA group had more pain in the PACU than the SA group (61% *vs* 15%, $P < 0.01$), and a higher incidence of PACU analgesic use (59% *vs* 7.5%, $P < 0.01$). Patients in the SA group were able to drink and eat sooner than the GA group (83 ± 23 *vs* 95 ± 22 min, $P < 0.05$ and 88 ± 27 *vs* 105 ± 29 min, $P < 0.01$, respectively). The times to sit, walk, and void were similar. The length of PACU and ASU stay between the GA and SA groups were similar (67 ± 17 *vs* 60 ± 19 min, $P > 0.05$ and 122 ± 27 *vs* 127.9 ± 31 min, $P > 0.05$, respectively). The incidence of backache was higher in the SA group (35 *vs* 13.6%, $P < 0.05$) than the GA group. However, the incidence of sore throat was higher in the GA compared to the SA group (25% *vs* 2.5%, $P < 0.01$).

Conclusions: SA with 50 mg of 1% lidocaine provides an improved recovery profile for ambulatory knee arthroscopy. Discharge times were similar, and with the exception of backache and sore throat, the incidence of complications was similar.

*Objectif : Comparer les profils de récupération, les complications postopératoires, les temps d'utilisation périopératoire de la salle d'opération et le temps de séjour des patients qui subissent une arthroscopie du genou sous rachianesthésie (RA) ou anesthésie générale (AG).*

*Méthode : L'étude randomisée et prospective a porté sur 84 patients, d'état physique ASA I-II, qui ont reçu au hasard soit une RA avec 50 mg de lidocaïne à 1 %, soit une AG standard. La douleur postopératoire, les nausées et vomissements, la sédation, l'utilisation de la salle d'opération, la récupération en salle de réveil et à l'unité de chirurgie ambulatoire (UCA) ont été comparés.*

*Résultats : Les patients du groupe d'AG ont ressenti plus de douleurs à la salle de réveil que ceux du groupe de RA (61 % vs 15 %, $P < 0,01$) et y ont utilisé davantage d'analgésie postopératoire (59 % vs 7,5 %, $P < 0,01$). Les patients du groupe RA ont pu boire et manger plus tôt que ceux du groupe d'AG (83 ± 23 vs 95 ± 22 min, $P < 0,05$ et 88 ± 27 vs 105 ± 29 min, $P < 0,01$, respectivement). Le temps écoulé avant de pouvoir s'asseoir, marcher et avant la première miction a été similaire pour tous. Le séjour en salle de réveil et à l'UCA a été d'une durée similaire pour les patients des groupes AG et RA (67 ± 17 vs 60 ± 19 min, $P > 0,05$ et 122 ± 27 vs 127,9 ± 31 min, $P > 0,05$, respectivement). L'incidence de maux de dos a été plus élevée dans le groupe RA (35 vs 13,6 %, $P < 0,05$) que dans le groupe AG. Cependant, l'incidence de maux de gorge a été plus grande dans le groupe d'AG que dans le groupe RA (25 % vs 2,5 %, $P < 0,01$).*

*Conclusion : La RA réalisée avec 50 mg de lidocaïne à 1 % en chirurgie ambulatoire fournit un meilleur profil de récupération d'une arthroscopie du genou que l'AG. Mis à part les maux de dos et de gorge, le temps écoulé avant le congé et l'incidence des complications ont été similaires.*

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KNEE arthroscopy is a commonly performed ambulatory surgical procedure. Both general and spinal anesthesia (SA) are frequently performed anesthetic techniques for knee arthroscopy. Since the surgical procedure itself is minimally invasive and associated with relatively minor surgical trauma, the speed of recovery from anesthesia may significantly influence postoperative recovery and the time to discharge.

General anesthesia (GA) may be associated with postoperative nausea and vomiting (PONV), sedation and sore throat.[1,2] The incidence of adverse effects of GA have decreased with the use of newer anesthetic drugs and techniques, however, the occurrence of adverse effects may lead to unnecessary patient discomfort, delayed discharge from an ambulatory surgical unit (ASU), and delayed functional recovery of ambulatory surgical patients.[3]

SA using lidocaine has been advocated for ambulatory anesthesia due to its reliability, rapid onset and ease of performance.[4] SA is associated with a lower incidence of PONV, drowsiness, and postoperative pain when compared to GA.[2,4,5] These symptoms are the most frequently reported causes for delays in discharge time in ambulatory patients.[6] The use of low concentration and low dose lidocaine may minimize residual postoperative autonomic, sensory/motor deficits associated with the use of SA which may delay discharge of ambulatory patients from ASU.[7] One previous study showed that time to discharge was faster in patients who received spinal *vs* GA.[8]

We hypothesised that SA using 1% spinal lidocaine would lead to faster recovery and discharge times with a lower incidence of postoperative symptoms when compared to GA. We evaluated the recovery profiles, postoperative complications, perioperative OR utilization times, and times to discharge.

## Methods

Approval was obtained from the institutional ethics committee to enroll 84 ASA I-II patients between the ages of 18 to 60 yr of age who were undergoing unilateral ambulatory knee arthroscopy. Informed consent was obtained. Exclusion criteria included: previous failed SA, severe spinal deformity, previous back surgery, active neurological disease, spinal cord lesions, history of substance abuse, language barrier, a psychiatric history, sepsis, history of coagulopathy, allergy to local anesthetics, and morbid obesity (body mass index >35). The sample size was estimated using an effect size of 15 min, a standard deviation for duration of stay in PACU of 20 min, and an alpha of 0.05, and beta of 0.2 (one-tail); the minimum number of patients required per group was 30.

Patients were randomized to receive either spinal or GA. A block randomization was performed using random numbers generated by a computer program.

Preoperatively, baseline visual analogue scale (VAS) scores for pain, nausea, sedation and dizziness, were recorded. No pre-medication was administered.

Intraoperatively, routine monitors were applied, and an *iv* infusion of saline 0.9% was established through an 18G cannula. Both groups received volume expansion with 5 $ml \cdot kg^{-1}$ of saline 0.9% prior to anesthesia.

In the GA group, patients received propofol 2–4 $mg \cdot kg^{-1}$ and fentanyl 1–2 $\mu g \cdot kg^{-1}$ for induction. After laryngeal mask airway insertion, maintenance was achieved with a mixture of nitrous oxide and oxygen (60% : 40%), and isoflurane titrated for an end-tidal concentration of 0.5–1.5%.

In the SA group, SA was performed at the L2–L3, or L3–L4 interspace with the patient in the sitting position. After skin infiltration, dural puncture was performed with a 25G Whitacre needle inserted via an 18G introducer needle in a midline approach with the needle bevel parallel to the dural fibres. Upon free flow of cerebrospinal fluid (CSF) and aspiration of CSF, 50 mg of 1% lidocaine (1 ml of 5% hyperbaric lidocaine diluted with 4 ml of preservative free saline 0.9%) were injected at a rate of 10 $mg \cdot sec^{-1}$. The patient was then returned to the supine position and the height of the block was tested by pinprick. Technical failure of SA was defined as more than six unsuccessful passes of the needle at different sites. Midazolam (1 mg *iv*) boluses were administered for sedation as needed. If SA was inadequate for surgery, the patient was administered a GA. Breakthrough pain was treated with boluses of 50 µg fentanyl *iv*. All patients received intra articular bupivacaine (20 ml of 0.5%) at the end of the surgical procedure, according to usual clinical practice at our institution.

Pain intensity was assessed by a VAS on a verbal ordinal scale from 0 to 10 (0=no pain, 10=worst pain imaginable) at 15 min intervals, and the requirements for analgesics were recorded at the same time intervals. One to two milligrams morphine *iv* boluses or acetaminophen with 30 mg codeine, one to two tablets were administered as needed for pain. The time to first administration and the total doses of morphine or acetaminophen required were recorded.

PONV was assessed with a VAS for nausea (0=no nausea, 10=severe nausea) at 15 min intervals; the number of episodes of PONV and the treatment required were recorded at the same time intervals. PONV was treated with 25–50 mg dimenhydrinate *iv*. Sedation and dizziness were recorded at 15 min inter-

vals using a VAS scale from 0 to 10.

In the PACU, patients' Aldrete score[9] was assessed every 15 min until they achieved a score of 9 indicating fitness for discharge from PACU. In the ASU, patients were evaluated by the modified Post Anesthesia Discharge Scoring System (PADSS) until a score >9 was achieved, indicating eligibility for discharge from ASU.[10] One to two tablets of acetaminophen (325 mg) with 30 mg codeine were administered for analgesia, as needed.

Motor recovery was assessed at 15 min intervals with the Bromage scale,[11] return of proprioception in the big toe and plantar flexion of the foot. Once these parameters had returned to normal, patients were encouraged to ambulate. If the patient did not void after three hours and had signs of urinary retention, a catheter was inserted, the bladder drained, and the catheter removed prior to discharge. The time to sit, drink, eat, ambulate and void were recorded. Acetaminophen with codeine was prescribed for analgesia upon discharge.

To evaluate OR utilization, the perioperative period was divided into six intervals: Interval 1, time from entry of the patient into the OR until start of the anesthetic (defined as insertion of the *iv* line); Interval 2, (anesthesia induction) time from induction of anesthesia until the patient is ready for surgery; Interval 3, time from start of surgery until the end of surgery; Interval 4, time from end of surgery until the patient is ready to leave the OR; Interval 5, time from exiting OR until the patient is ready to leave the PACU; Interval 6, time of exiting PACU until the patient meets discharge criteria from ASU.

A standardized phone questionnaire was conducted by a research assistant at 24 hr and seven days after surgery. Patients were questioned about postoperative pain, nausea, sore throat, backache and its impairment of functional activities, Post Dural Puncture Headache (PDPH) and its impairment of functional activities, transient neurological symptoms (TNS) and its impairment of functional activities. TNS was defined as pain or dysthesia in the buttocks, thighs or calves occurring within 24 hr and resolving within 72 hr. Patient satisfaction with postoperative pain management and the overall experience with anesthesia was assessed by asking patients whether they would recommend the same anesthetic technique to their acquaintances.

The time to fulfilment of discharge criteria in PACU and ASU, duration of perioperative OR utilization, demographic data, time of first analgesic request, and total dose of analgesics were analysed using unpaired t tests. The VAS scores for pain, PONV and sedation, times to sit, drink, eat, ambulate and void were analysed using the Kruskal Wallis test. The incidences of PDPH, backache, TNS, and patient satisfaction were compared using Chi-square test. A $P$ value of <0.05 was considered significant.

TABLE I Patient characteristics

| | *GA* *(n=44)* | *SA* *(n=40)* |
|---|---|---|
| Sex (M / F) | 32 / 12 | 30 / 10 |
| Age (yr) | 43 ± 13 | 42 ± 11 |
| Weight (kg) | 81 ± 13 | 84 ± 18 |
| Height (cm) | 173 ± 9 | 174 ± 10 |

Values are expressed as mean ± SD

TABLE II Anesthesia and surgical durations

| | *GA* *(n=44)* | *SA* *(n=40)* |
|---|---|---|
| Induction of anesthesia | 7.2 ± 3.8* | 11.2 ± 3.2 |
| Surgery | 22.0 ± 7.5 | 20.0 ± 7.7 |
| End of surgery –readiness to leave the OR | 6.0 ± 2.0* | 4.0 ± 1.0 |
| Total OR time | 56.0 ± 10.0† | 62.0 ± 9.0 |
| Time in PACU | 67.0 ± 17.0 | 60.0 ± 19.0 |
| Readiness for discharge from ASU | 122 ± 27.0 | 127.9 ± 31.0 |

Values are minutes expressed as mean ± SD
*$P$ <0.001 *vs* SA group
†$P$ <0.05 *vs* SA group

## Results

The demographic data were similar with respect to sex, age, height, weight, and surgical times between the two groups (Table I). The subarachnoid space could not be identified in one patient randomized to SA, thus a GA was given, and this patient was excluded. When comparing OR utilization times, the anesthesia induction times were shorter in the GA than in the SA group (7.2 ± 4 *vs* 11.2 ± 3 min, $P$ <0.01). However, the time from completion of surgery to readiness to leave the OR was faster in the SA than in the GA group (Table II). There were no differences in lengths of PACU and ASU stays between the GA and SA groups (67 ± 17 *vs* 60 ± 19 min, $P$ >0.05 and 122 ± 27 *vs* 127.9 ± 31 min, $P$ >0.05, respectively).

Patients in the SA group were able to drink and eat sooner than those in the GA group (83 ± 23 *vs* 95 ± 22 min, $P$ <0.05 and 88 ± 27 *vs* 105 ± 29 min, $P$ <0.01 respectively; Figure 1). There were no differences in the times to sit, walk, and void (Figure 1).

Postoperatively, patients in the GA group experienced pain more frequently (61% *vs* 15%, $P$ <0.01; Figure 2), had higher VAS pain scores (2.1 ± 2 *vs* 0.3 ± 0.7, $P$

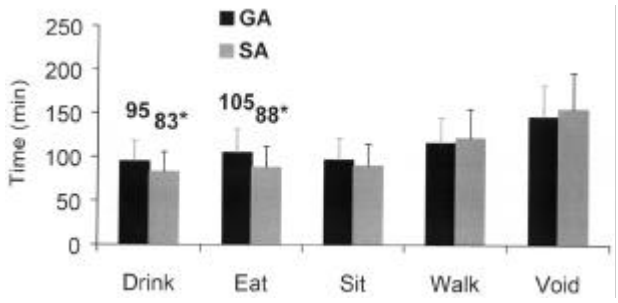


FIGURE 1 ASU recovery profile. Black bars: patients receiving GA; gray bars: patients receiving SA. *$P$ <0.05.

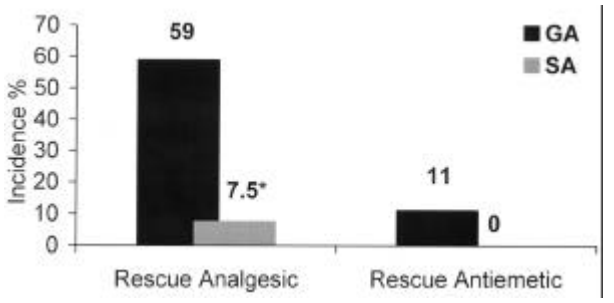


FIGURE 3 PACU recovery profile. Black bars: patients receiving GA; gray bars: patients receiving SA. *$P$ <0.01.

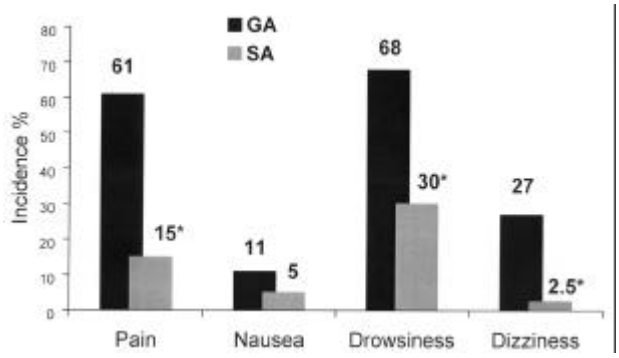


FIGURE 2 PACU recovery profile. Black bars: patients receiving GA; gray bars: patients receiving SA. *$P$ <0.01.

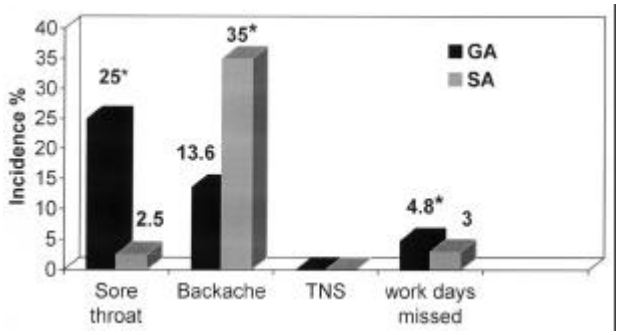


FIGURE 4 Postoperative complications. Black bars: patients receiving GA; gray bars: patients receiving SA. *$P$ <0.05.

TABLE III 24 hr questionnaire

| | *GA (n=44)* | *SA (n=40)* |
|---|---|---|
| Pain scale* | 3.4 ± 3.1 | 2.5 ± 2.3 |
| Analgesic use | 22 / 44 (50%) | 15 / 40 (37.5%) |
| Satisfaction with pain control | 38 / 44 (86%) | 34 / 40 (85%) |
| Nausea | 5 / 44 (11%) | 0 |

*Values are expressed as mean ± SD

<0.01), and required more analgesics (59% *vs* 7.5%, $P$ <0.01; Figure 3) in the PACU. As well, more patients had drowsiness in the GA than in the SA group in the PACU (68% *vs* 30%, $P$ <0.01; Figure 2). The incidence of dizziness was also higher in the GA than SA group in the PACU (27% *vs* 2.5%, $P$ <0.01; Figure 2). The incidence of nausea was low in both groups (Figure 2).

At 24 hr, there were no differences in pain scores, analgesic use, satisfaction with pain control, and nausea (Table III). There were no PDPH or TNS reported in either group. However, the SA group had a higher incidence of backache (35% *vs* 13.6%, $P$ <0.05) than the GA group (Figure 4). The incidence of sore throat was higher in the GA group (25% *vs* 2.5%, $P$ <0.01). The number of days of work missed was higher in the GA than in the SA group (4.8 ± 3.7 *vs* 3.0 ± 2.4 days, $P$ <0.05). Overall, patient satisfaction with anesthesia was high in both the SA and GA groups (92.5% *vs* 89%, $P$ >0.05), respectively.

## Discussion

The early postoperative recovery profile was improved in patients undergoing ambulatory knee arthroscopy under SA with 50 mg of 1% lidocaine. These patients had less pain and analgesic requirements in PACU than patients who had GA. The administration of intra articular bupivacaine may have made any differences in the incidence of pain and pain scores less striking between the two groups. However, our results are

consistent with a previous study comparing spinal, epidural or propofol anesthesia for ambulatory knee arthroscopy,[12] and another study comparing spinal and GA for patients undergoing orthopedic surgery.[4]

Patients in the SA group had less drowsiness and dizziness in the PACU, thus were able to eat and drink earlier than patients who received GA. As well, the incidence of sore throat was lower in the SA group. The times to ambulate, void and discharge from the ASU were similar between the two groups.

The incidence of backache after SA with non-cutting needles has been reported to range from 2–38%.[13] The etiology is unknown, but may be secondary to direct trauma of the interspinous ligaments by the spinal or introducer needle.[4] However, backache has been reported after all types of anesthesia, including GA.[14] Despite the higher incidence of backache in patients receiving SA, the backache was mild and transient, and did not require additional treatment. As well, patient satisfaction remained high (92.5%) in the SA group.

None of our patients experienced PDPH, thus confirming the low incidence of PDPH (0.7–2%) with 25G Whitacre spinal needles which had been reported previously.[13,15]

There were no reports of TNS in our study. In this study, we investigated a low dose of 1% lidocaine because this was the highest safe concentration established from *in vitro* animal data.[16] The incidence of TNS has been reported to range from 4–33% in previous prospective randomized studies.[17] Our results conflict with a previous randomized study of 109 ambulatory knee arthroscopy patients in which dilution of lidocaine was found to have no effect on the incidence of TNS.[18] In this study, the incidence of TNS was 15.8% with 2% lidocaine, 22.2% with 1% lidocaine, and 17.1% with 0.5% lidocaine. Lidocaine, the lithotomy position, knee arthroscopy, and outpatient status have been implicated as risk factors for TNS.[19,20] In a large prospective study involving 1,045 consecutive patients undergoing anorectal surgery in the jackknife position, the incidence of TNS was found to be low (0.4%) when 30–45 mg of hyperbaric 3% lidocaine was administered, suggesting that lower doses of lidocaine may be associated with a lower incidence of TNS.[21] The etiology of TNS is unclear, and it has been suggested that the symptoms of TNS might be more appropriately attributed to musculoskeletal, or myofascial pain.[22] Clearly, further studies are required to determine the etiology and significance of TNS.

Rapid, smooth recovery from anesthesia is important for ambulatory surgical centres. In our study, the anesthetic technique did not affect discharge times from ASU. A retrospective comparison of spinal *vs* GA for patients undergoing vaginal hysterectomy found no difference in OR utilization, but longer PACU stays in patients who received SA.[23] However, the local anesthetic type and dosage was not specified, and full recovery of motor block was required in this study. Times to readiness for discharge were similar in a study of patients undergoing orthopedic surgery under general or SA.[12] As well, another trial found that patients who had SA were discharged sooner than patients who had GA.[8]

Personnel costs in the PACU have been shown to account for the majority of costs postoperatively.[24] In this study, we did not assess patient eligibility for "fast-tracking" but, as more patients in the SA group had less pain, drowsiness, and dizziness in the PACU, more patients may have been able to bypass the phase I PACU, and be transferred directly from the OR to the phase II ASU. Bypassing the PACU by "fast-tracking" patients who have undergone regional anesthesia could lead to cost savings by reducing labour costs.[25]

One of the limitations of our study is the use of isoflurane in the GA group. The use of a shorter acting inhalational agent may have resulted in faster emergence and recovery from GA. Another limitation was the use of diphenhydramine for nausea, which may result in sedation and delayed recovery.

In conclusion, SA with 50 mg of 1% lidocaine provides superior postoperative analgesia in the early postoperative period, contributing to an improved recovery profile for ambulatory knee arthroscopy, compared to GA. Although the time required to induce anesthesia was longer in the group receiving SA, the time to readiness to leave the OR was shorter compared to the GA group. We were unable to demonstrate a decrease in times to fulfil discharge criteria for the SA group in PACU and the ASU. With the exception of backache in the SA group, and sore throat in the GA group, there were few adverse effects or complications. Further studies on the potential cost savings associated with bypassing phase I PACU after SA are warranted.

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