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REPORTS OF ORIGINAL INVESTIGATIONS

Low-dose spinal bupivacaine for total knee arthroplasty facilitates recovery room discharge: a randomized controlled trial

Une faible dose de bupivacaïne intrathécale pour l'arthroplastie totale du genou facilite le congé de la salle de réveil: une étude randomisée contrôlée

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Abstract

Purpose *Regional anesthesia is the preferred technique for total knee arthroplasty to provide a bridge for early postoperative analgesia, reduce opioid consumption, and improve mobility and rehabilitation. Multiple patient and process factors must be weighed when choosing the appropriate technique to reduce morbidity and facilitate discharge. We hypothesized that a low-dose of intrathecal bupivicaine combined with regional block would facilitate discharge from the postanesthesia care unit (PACU) and reduce postoperative morbidity.*

Methods *Patients undergoing total knee arthroplasty under spinal anesthesia received either 5 mg (low-dose group) or 10 mg (standard-dose group) isobaric bupivacaine in a double-blind randomized controlled trial. The primary outcome measure was time to achieve eligibility for PACU discharge. Secondary outcome measures included time to recovery of S2 dermatome sensation, time to voiding, rate of bladder catheterization, and time required for nursing intervention in the PACU and after discharge to the surgical ward.*

Results *Forty-five of the 49 recruited patients completed the study. Patients receiving low-dose spinal anesthesia were eligible for PACU discharge earlier than those receiving the standard dose ($P = 0.0036$). Patients receiving the standard dose had significantly delayed recovery of S2 dermatome sensation ($P = 0.0035$). There was no difference between groups in the amount of time required for nursing intervention in the PACU, but patients receiving low-dose spinal anesthesia required more time for nursing intervention within the first four hours of their arrival on the ward ($P = 0.009$). None of the patients required intraoperative analgesic supplementation.*

Conclusions *In patients undergoing total knee arthroplasty, low-dose intrathecal bupivacaine (5 mg) combined with regional block is associated with a reduced time to achieve eligibility for discharge from the PACU.*

Résumé

Objectif *L'anesthésie régionale est la technique privilégiée pour l'arthroplastie totale du genou, car elle offre un pont vers une analgésie postopératoire précoce, réduit la consommation d'opiacés, et améliore la mobilité et la réadaptation. Il convient de soupeser de nombreux facteurs propres au patient et au processus lors du choix de la technique adaptée afin de réduire la morbidité et de faciliter le congé. Nous avons émis l'hypothèse qu'une faible dose de bupivacaïne en injection intrathécale, combinée à un bloc régional, faciliterait le congé de la salle de réveil et réduirait la morbidité postopératoire.*

Author contributions *Imad T. Awad* was involved in the design and conduct of the project. He drafted the article and reviewed the article critically for important intellectual content. *Jeffrey Cheung, Patrick Conroy,* and *Yaseen Al-Allaq* were involved in data acquisition. *Patrick Conroy* was involved in data analysis, and *Colin McCartney* reviewed the article for important intellectual content.

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Méthode *Des patients subissant une arthroplastie totale du genou sous rachianesthésie ont reçu soit 5 mg (groupe faible dose) ou 10 mg (groupe dose standard) de bupivacaïne isobare dans une étude randomisée contrôlée à double insu. Le critère d'évaluation principal était le temps jusqu'à l'admissibilité au congé de la salle de réveil. Les critères d'évaluation secondaires comprenaient le temps jusqu'au rétablissement de la sensation au niveau du dermatome S2, le temps jusqu'à la première miction, l'incidence de cathétérisme urinaire et le temps nécessaire aux interventions infirmières à la salle de réveil et après le transfert au département de chirurgie.*

Résultats *Quarante-cinq des 49 patients recrutés ont complété l'étude. Les patients recevant une rachianesthésie à faible dose ont été admissibles au congé de la salle de réveil plus tôt que ceux recevant la dose standard ($P = 0{,}0036$). Les patients recevant la dose standard ont démontré un rétablissement significativement retardé de la sensation au dermatome S2 ($P = 0{,}0035$). Aucune différence n'a été observée entre les groupes quant au temps requis pour les interventions infirmières en salle de réveil, mais les patients ayant reçu une rachianesthésie avec faible dose ont nécessité davantage de temps pour les interventions infirmières au cours des quatre premières heures suivant leur arrivée à l'étage ($P = 0{,}009$). Aucun des patients n'a requis de supplément d'analgésie pendant l'opération.*

Conclusion *Chez les patients subissant une arthroplastie totale du genou, la bupivacaïne intrathécale à faible dose (5 mg) combinée à un bloc régional est associée à un temps réduit jusqu'à l'admissibilité au congé de la salle de réveil.*

Total knee arthroplasty is a well-established treatment to restore physical function in patients with osteoarthritis; however, it remains an expensive procedure.[1,2] Health care providers are under constant pressure to improve efficiency and reduce costs. Regional anesthesia is a well-established technique for total knee arthroplasty to provide a bridge to early postoperative analgesia, reduce opioid consumption, and improve mobility and rehabilitation.[3,4] The most widely used techniques are femoral nerve block (FNB), with or without sciatic nerve block (SNB), together with intrathecal anesthesia.[5] Several strategies involving regional anesthesia for joint arthroplasty have been designed to contain the cost of the surgery and secondary treatments and to decrease the economic burden on the health care system.[6-8] Williams *et al.* showed that preoperative regional analgesia for orthopedic surgery was associated with a shorter anesthesia-controlled time and a lower sum of anesthesia-controlled time plus turnover time than general anesthesia performed in the operating room.[9] Such strategies have led to the design of new clinical pathways, which, along with the combination of different anesthetic techniques, have helped to shorten hospital stays for total knee arthroplasty and decrease costs.[10,11]

When intrathecal anesthesia is used in total knee arthroplasty in the presence of other risk factors associated with this type of surgery (age, intraoperative fluid intake $>$ 750 mL, and prolonged surgery), there is an increased likelihood of complications, such as urinary retention, hypotension,[12] bradycardia, and cardiac arrest.[13,14] Such complications increase patients' morbidity and can delay discharge from both the postanesthesia care unit (PACU) and the hospital. One way to expedite PACU discharge of patients having knee surgery under regional anesthesia is to administer an optimal dose of spinal anesthetic that is limited to provide surgical anesthesia on the operative side (surgery site).[15] Optimally titrated unilateral spinal anesthetic can reduce the incidence of intraoperative hypotension to within 5% of cases.[16] Low-dose spinal anesthesia also reduces the incidence of urinary retention and improves early mobilization and rehabilitation. Several studies have examined the impact of different doses of local anesthetics on regional block characteristics, micturation problems, and discharge time for patients receiving spinal anesthesia. Nevertheless, most of these studies involved younger patients undergoing ambulatory lower limb operations.

We hypothesized that patients who receive a low dose (5 mg) of intrathecal isobaric bupivacaine for elective total knee arthroplasty would meet the criteria for discharge from the PACU sooner than patients who receive a standard dose (10 mg) of isobaric bupivacaine. By way of secondary outcomes, we compared low-dose *vs* standard-dose intrathecal bupivacaine with respect to supplemental analgesic requirements, time to recover sensation at the S2 dermatome, reduced time to first voiding, and number of nursing interventions in the PACU and during the first four hours on the surgical ward.

Methods

After obtaining ethics approval from the Sunnybrook Research Ethics Board on January 26th 2009 and written informed consent, we enrolled patients in this randomized controlled double-blind study who were aged 40-80 yr, American Society of Anesthesiologists physical status I-III, and undergoing elective total knee arthroplasty. Exclusion criteria included patients with pre-existing neurological deficits, cognitive deficits, or anatomical abnormalities of the vertebral column, patients with language barriers, and

patients with pre-existing bladder dysfunction (e.g., benign prostatic hyperplasia, stress incontinence, prostatic cancer, or bladder prolapse).

On the day of surgery, patients were premedicated one to two hours before surgery with oral gabapentin 600 mg *po* (300 mg in patients aged > 70 yr), celecoxib 400 mg *po*, and acetaminophen 1,000 mg *po*. Patients were asked to void prior to their transfer to the block room.

In the block room, Ringer's lactate solution was started for hydration; no more than 500 mL were given before the patient was transferred to the operating room. Midazolam 1-2 mg *iv* was given for anxiolysis. Standard monitoring included electrocardiography, noninvasive arterial blood pressure monitoring, and pulse oximetry.

Patients were randomly allocated to one of two treatment groups: continuous femoral nerve block (CFNB) + SNB + 5 mg of intrathecal isobaric bupivacaine (low-dose group, $n = 25$) or CFNB + SNB + 10 mg of intrathecal isobaric bupivacaine (standard-dose group, $n = 25$). Treatment groups were randomly generated using a block randomization methodology of five blocks of ten patients. The randomized treatment allocation numbers were placed within sealed envelopes that were numbered sequentially to assign patients to treatment groups. A research nurse not involved in patients' treatment enrolled participants and assigned participants to the appropriate intervention. Research assistants (J.C., Y.A.) performed the assessments following the treatment intervention.

In both groups, CFNB was performed using a stimulating catheter set (17-G Tuohy needle, Arrow International, Reading, PA, USA). When either a quadriceps twitch or a sartorius twitch was elicited at a current of 0.4-0.6 mA, a stimulating catheter was threaded 5-7 cm beyond the needle tip. A bolus of 0.5% plain ropivacaine 20 mL was given through the femoral catheter. The SNB was performed using the posterior subgluteal approach.[17] A bolus of 0.5% plain ropivacaine 20 mL was injected once a plantar flexion twitch was elicited at a current of 0.4-0.6 mA. In the low-dose group, spinal anesthesia was performed in the lateral decubitus position with the operative knee uppermost. These patients received an intrathecal injection of plain isobaric bupivacaine 5 mg plus fentanyl 10 μg at the level of L3-4 or L4-5 via a midline approach. In the standard-dose group, patients received spinal anesthesia in the sitting position with isobaric bupivacaine 10 mg and fentanyl 10 μg. Immediately following intrathecal injection, all patients were positioned in a lateral position with the operative side (surgery site) uppermost for 20 min, and then they were placed in a supine position. A blinded observer assessed the following variables in the block room: (i) sensory block on both sides and the maximum height of the block on the operative side at 20 min using cold sensation with ice; and (ii) blood pressure and heart rate measured every five minutes.

Following patient transfer from the block room, a second attending anesthesiologist blinded to the patient's study group assignment managed the patient in the operating room. Patients were sedated intraoperatively with propofol 50-100 $\mu g \cdot kg^{-1} \cdot min^{-1}$. The maximum amount of intraoperative fluid administered to each patient was 15-20 $mL \cdot kg^{-1}$. Blood pressure and heart rate were monitored every five minutes until the end of surgery. Events of bradycardia (defined as a heart rate < 50 $beats \cdot min^{-1}$ were treated with glycopyrrolate 0.2 mg *iv*. Hypotensive events (defined as a decrease in mean arterial pressure < 70 mmHg) were treated with either ephedrine 5 mg *iv* or phenylephrine 40 μg. Supplemental analgesia with intravenous fentanyl was to be administered if any patient experienced pain at any time during the procedure. General anesthesia would be induced if intravenous fentanyl supplementation was insufficient. The need for supplemental intravenous fentanyl and any conversion to general anesthesia were recorded.

At the end of the surgical procedure, a blinded observer assessed each patient's PACU discharge eligibility using our institutional modified Aldrete PACU discharge criteria (Appendix). Sensory dermatome levels and motor power were evaluated every ten minutes until the patient was deemed suitable for discharge from the PACU. Upon recovery of pinprick sensation in the S2 dermatome bilaterally, a bladder ultrasound was performed to assess prevoid bladder volume using a commercially available bladder ultrasound (Bladderscan BV12500; Diagnostic Ultrasound Corp., Kirkland, WA, USA). Subjects were then asked to void spontaneously. If voiding was unsuccessful, subsequent attempts were repeated at 15-min intervals until this end point was achieved or until postoperative urinary retention was assessed (defined as inability to void at a bladder volume of ≥ 600 mL following S2 recovery). Patients with postoperative urinary retention were catheterized. For patients who were able to void successfully, a post-void residual bladder volume was recorded.

Postoperative nursing interventions were measured continuously both in the PACU (postanesthesia phase 1) and up to four hours after PACU discharge on the surgical ward (postanesthesia phase 2) using commercially available intervention recording software (GRASP® Systems, Richmond Hill, ON, Canada).[A] This is a validated method to measure nursing workload, allowing quantification of nursing care requirements in hours of patient care to facilitate system planning decisions related to nursing.

The primary outcome measure was the time to achieve PACU discharge eligibility. Secondary outcome measures included time to recovery of sensation at the S2 dermatome

[A] GRASP healthcare workload management software. Available at: http://www.graspinc.com (accessed November 2012).

(which is required for successful voiding), time to first voiding, number of episodes requiring vasopressor and/or glycopyrrolate administration, analgesia supplementation, and number of nursing interventions in the PACU and during the first four hours on the surgical ward.

Statistical considerations

For the primary outcome measure of time to achieve PACU discharge eligibility, the mean time and standard deviation (SD) to achieve PACU discharge eligibility in a pilot study was 35 (19) min. To capture a hypothesized decrease in the primary outcome measure to 15 (18) min, a sample of 32 patients (16 per group) would provide a two-sided Wilcoxon rank sum test with 80% power at an alpha of 0.05. To account for potential loss to follow-up and enable greater statistical power for secondary analyses, the sample size was increased to 50 patients (25 per group).

Descriptive statistics were calculated for all variables of interest. Continuous measures are summarized using means and SDs, whereas categorical measures are summarized using counts and percentages. Numerical variables were examined for normality using a Shapiro-Wilk test. The results of this test determined if parametric tests (i.e., Student's *t* tests) or non-parametric tests (i.e. Wilcoxon rank-sum tests) would be carried out. The primary outcome, time to readiness for PACU discharge eligibility, was analyzed using a two-sample Wilcoxon rank-sum test. The secondary outcomes of voiding and vasopressor/glycopyrrolate use were analyzed using the Chi square and Fisher's exact test, respectively, and the secondary outcome of time to recovery of S2 sensation was analyzed using a two-sample Wilcoxon rank-sum test. All analyses were carried out on a per protocol basis using SAS® version 9.1 (SAS Institute, Cary, NC, USA).

Results

Forty-five of the 49 patients enrolled completed the study. Four patients (three from the low-dose group and one from the standard-dose group) were excluded after enrolment because of protocol violations. Two of the excluded patients were electively catheterized preoperatively, and there was inadequate time to complete the planned peripheral nerve blocks as per the study protocol for the other two patients.

Demographic data are shown in Table 1. There were no differences between the groups in intraoperative blood pressure, vasopressor use, or chronotrope use; however, patients in the low-dose group had a lower intraoperative heart rate than patients receiving the standard dose ($P = 0.04$). No difference was observed in the percentage of patients requiring vasopressor administration ($P = 0.42$) or in the amount of intravenous fluids administered.

Table 1 Demographic information of patients receiving spinal anesthesia with a low or standard dose of isobaric bupivacaine

Characteristics	Low-dose group (5 mg) ($n = 21$)	Standard-dose group (10 mg) ($n = 24$)
Age (yr)	66 (7.7)	66 (13.3)
Sex (M / F)	8 /13	11 /13
Baseline mean arterial pressure (mmHg)	99 (11)	102 (13)
Baseline heart rate (beats·min^{-1})	64 (16)	72 (9)
Body mass index (kg·m^{-2})	29.4 (4.8)	30.0 (5.4)
Surgical duration (min)	66.2 (14.3)	70.1 (20.6)
Total fluid intake (mL)	1,081 (282)	1,108 (354)

Data are presented as mean (standard deviation), except for data on sex

On admission to the PACU (time 0), patients in the low-dose group were eligible for discharge sooner than patients in the standard-dose group (Table 2). Also, S2 dermatome sensation was recovered significantly earlier in the low-dose group, enabling 81% of patients in this group to void spontaneously *vs* 52% in the standard-dose group. The bladder was also more distended in the standard-dose group than in the low-dose group before either catheterization or spontaneous voiding (661 mL *vs* 510 mL, respectively).

The groups were similar with respect to the nursing intervention time required in the PACU (Table 2); however, following discharge to the ward, patients who received low-dose spinal anesthesia required more nursing intervention time than patients in the standard-dose group. Interventions in the low-dose group requiring five minutes of extra nursing time were unrelated to bladder care or pain management and included: (i) dealing with medical conditions, such as blood glucose monitoring (three patients); (ii) administration of blood products (four patients); (iii) administration of routine medications for other medical conditions; and (iv) greater frequency of "no-nursing intervention" and "patient hygiene". No patient in either group required intraoperative fentanyl supplementation or conversion to general anesthesia.

Discussion

The main finding of this study is that intrathecal isobaric bupivacaine 5 mg combined with regional block achieves a significant reduction in the time to meet eligibility criteria for PACU discharge when compared with intrathecal isobaric bupivacaine 10 mg. Furthermore, no patient in the low-dose spinal group required intraoperative analgesic

Table 2 Between-group differences after spinal anesthesia

Variable	Low-dose group (5 mg) ($n = 21$)	Standard-dose group (10 mg) ($n = 24$)	*P* value	Mean difference (95% CI)
Spinal block level at 20 min, median [IQR]	10.5[10-11.0]	10.0[8.0-10.0]	0.057	1.0 (−0.5 to 2.4)
Patients requiring vasopressors and/or chronotropes	2/21 (9.5%)	5/24 (20.8%)	0.42	−11.3% (−31.8 to 9.2)
Time to recovery of S2 dermatome (hr: min) shown as median [IQR]	2:25 [2:10-3:05]	3:27 [2:55-4:03]	0.0035	−0:56 (−1:32 to −0:20)
Bladder volume immediately pre-voiding or pre-catheterization (mL), mean (95% CI)	510 (408 to 612)	661(561 to 761)	0.03	−151 (−290 to −12)
No. of patients failing to void postop, i.e., no of patients catheterized (%)	4/21 (19%)	10/24 (41.6%)	0.10	−22.6% (−48.5 to 3.3)
Time from S2 sensation recovery to spontaneous voiding postop (hr: min), shown as median [IQR]	1:09 [0:15-2:30]	1:05 [0:15-1:35]	0.62	0:28 (−0:38 to 1:33)
Bladder residual volume after voiding (mL) mean (SD)	216 (132)	244 (241)	0.70	−29 (−168 to 111)
Time to achieve PACU discharge eligibility, minutes shown as median [IQR]	0.0 [0.0-5.0]	10.0 [5.0-25.0]	0.0036	−0:17 (−0:29 to −0:06)
Nursing intervention time in PACU (min), mean (SD)	24 (2)	24 (4)	0.31	0.0 (−1.9 to 1.9)
Nursing intervention time on surgical ward (min), mean (SD)	21 (7)	16 (6)	0.009	5.2 (1.3 to 9.2)

Data are presented as number (percentage), 95% confidence interval (CI), median [interquartile range, IQR], or mean (standard deviation, SD) as appropriate; PACU = postanesthesia care unit

supplementation. We chose time to eligibility for PACU discharge as our primary outcome rather than actual PACU discharge time because the former variable more accurately reflects the effect of the local anesthetic dose on patient recovery time. The time to actual discharge is often confounded by extraneous organizational factors, such as staffing issues, workload variability, and coordination of inter-ward transfer.[18]

The validation of the efficacy of an intrathecal dose of isobaric bupivacaine as low as 5 mg for total knee arthroplasty is a novel finding. This lower dose necessarily reduces the duration of the spinal block and thereby accelerates postoperative recovery and lowers the incidence of clinically important hemodynamic change.[19,20] Furthermore, it is important to point out that no patient in our study required intraoperative analgesic supplementation or conversion to general anesthesia. This factor is always a concern for practicing anesthesiologists. With the combination of FNB and SNB, the need for a large dose of intrathecal local anesthetic is unnecessary, as only a small "bridging" dose of intrathecal bupivacaine is required.

Patients in the low-dose group had lower intraoperative heart rates, but even at baseline, there was a tendency for the low-dose group of patients to have a lower resting heart rate. We did not screen patients for preoperative use of calcium-channel or beta-blockers, which may have been a factor. Mean intraoperative blood pressure values and vasopressor/chronotrope utilization were similar between the two groups.

Spinal anesthesia is a known risk factor for postoperative urinary retention, with a mean incidence of 23% (95% confidence interval [CI] 21.6 to 24.3) among diverse surgical populations.[21] The reported incidence of postoperative urinary retention after joint arthroplasty varies widely (10.7-84%) depending on the specific agents used and the surgical context.[21] The incidence of retention increases with the use of longer-acting intrathecal local anesthetics and hydrophilic neuraxial opioids.[22,23] Local anesthetics block the parasympathetic innervation of the bladder via both the pelvic nerves (S2-S4), which promote detrusor contraction and bladder neck relaxation, and the pudendal nerves (S2-S4), which innervate the external sphincter of the bladder. The sympathetic innervation of the bladder from the spinal cord (between T10 and L2) is also at least partially blocked; this has an inhibitory effect on detrusor activity and an excitatory effect on the bladder neck. Intrathecal fentanyl was also used in this study. This lipophilic opioid has been shown to prolong the duration of spinal anesthesia sensory block with short-acting and long-acting local anesthetics, but it has been shown not to affect the ability to void.[24,25]

After regression of the sensory block to S2-S3, the detrusor strength starts to return to normal, allowing the patient to void.[26] Patients receiving the standard dose of bupivacaine took longer to recover sensation in the S2 dermatome and thus developed a more distended bladder. As the two groups did not differ significantly in terms of the volume of fluids administered, this difference in

bladder distension and rate of catheterization appears to be attributable solely to the longer recovery time for S2 sensation resulting from the use of the standard dose of bupivacaine. Thus, reducing the incidence of postoperative urinary retention by using lower doses of local anesthetic should also reduce the need for invasive bladder catheterization. This could avoid potential catheterization-related complications, such as urethral trauma, prostatitis, and patient discomfort. Catheterization also introduces the risk of catheter-related infections, including the possibility of hematogenously transmitted infection in the setting of a freshly implanted prosthesis.[27]

Both Song and Williams *et al*. have observed the phenomenon of an increased number of interventions in phase 2 recovery.[8,28] They have recognized that shortening phase 1 recovery time simply transfers the workload to phase 2 recovery; however, the extra interventions in the low-dose spinal group were not related to pain management or bladder management.

In patients receiving the low dose of intrathecal bupivacaine, we performed the spinal anesthetic in the lateral position and kept patients in that position for 20 min. This positioning strategy has a greater likelihood of achieving a more unilateral block, albeit using isobaric bupivacaine and thereby potentially restricting the extent of the block on the bladder nerve supply and the contralateral sympathetic outflow. Nevertheless, even when unilateral spinal anesthesia is achieved, others have found that bladder innervation will still be compromised to an extent similar to that observed with bilateral spinal block.[29] Furthermore, isobaric bupivacaine spreads to affect both sides once patients are turned supine from an initial lateral position. On the other hand, when low-dose (5-8 mg) bupivacaine is used, ten to 15 min in the lateral position (we used 20 min in this study) can be adequate to prevent clinically relevant migration of spinal blockade after patients are turned to the supine position.[30-32]

In conclusion, we have shown that low-dose (5 mg) intrathecal isobaric bupivacaine combined with regional block facilitates earlier eligibility for PACU discharge after total knee arthroplasty when compared with standard-dose (10-mg) intrathecal isobaric bupivacaine. Although this time difference was statistically significant, clinically, a time difference of ten minutes would not have a large impact on clinical practice. The findings also confirmed our hypothesis that patients receiving the lower dose of bupivacaine would have a lower incidence of urinary retention, although the impact on hemodynamic events and nursing intervention is minimal.

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Competing interests None declared.

Appendix: Criteria for discharge from the postanesthesia care unit (PACU) of Sunnybrook Health Sciences Centre

Level of consciousness scores	
Awake, follows commands	2
Rousable, follows commands	1
Obtunded or persistently somnolent	0
BP Score	
Blood pressure 15% of baseline MAP value	2
Blood pressure 15%-30% of baseline MAP value	1
Blood pressure 30% below baseline MAP value	0
Respiratory effort scores	
Able to cough involuntarily or on command	2
Able to cough involuntarily but not on command	1
Dyspnea or apnea	0
Pulse oximetry scores	
SpO_2 - 95% on room air	2
SpO_2 - 95% with face mask or nasal cannula	1
$SpO_2 < 95\%$	0
Intrathecal anesthesia	
1. Patients should have sensory dermatome level of at least T8	☐
2. All patients should experience a sensory block recession of at least one dermatome level	☐
Qualification for discharge following intrathecal anesthesia	
The minimum score to qualify for PACU discharge is $\geq 7 +$ intrathecal boxes should be checked, and patients should not require interventions for pain, PONV, shivering, or pruritis.	
Or The minimum score to qualify for PACU discharge is $\geq 7 +$ if patients were admitted to the PACU with a sensory block at dermatome T10 or below, then with motor power of the lower extremity and patients should not require interventions for pain, PONV, shivering, or pruritis.	

PACU postanesthesia care unit,*BP* blood pressure, *MAP* mean arterial pressure, *PONV* postoperative nausea and vomiting

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