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Single-dose lidocaine spinal anesthesia in hip and knee arthroplasty

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ABSTRACT

Background: With the increasing interest in fast recovery and outpatient joint arthroplasty, short-acting local anesthetic agents and minimal narcotic use are preferred. Lidocaine is a fast-onset, short-duration local anesthetic that has been used for many years in spinal anesthesia. However, lidocaine spinal anesthesia has been reported to have a risk of transient neurologic symptoms (TNSs). The purpose of this study is to determine the safety and efficacy of single-dose lidocaine spinal anesthesia in the setting of outpatient joint arthroplasty.
Methods: We performed a prospective study on 50 patients who received lidocaine spinal anesthesia in the setting of outpatient hip and knee arthroplasty. All patients received a single-shot spinal injection, with 2% isobaric lidocaine along with titrated propofol sedation. We evaluated demographic data, length of motor blockage, time to ambulation, time to discharge readiness, patient-reported symptoms of TNS.
Results: Of the 50 patients studied, 11 had total hip arthroplasty, 33 total knee arthroplasty, 5 unicompartmental knee arthroplasty, and 1 underwent isolated polyethylene liner exchange in a total knee arthroplasty. The average total duration of motor blockade was 2.89 hours (range 1.73-5.17, standard deviation 0.65). Average time from postanesthesia care unit to return of motor function was 0.58 hours (range 0-1.5, standard deviation 0.48). None of the patients reported TNS.
Conclusions: Isobaric lidocaine spinal anesthesia appears to be a safe and effective regimen for outpatient hip and knee arthroplasty. All patients were discharged on the day of surgery with isobaric lidocaine spinal injection. There were no reports of TNSs.

Introduction

Spinal anesthesia has become increasingly popular in the setting of hip and knee arthroplasty. Several reports suggest that spinal anesthesia is associated with a lower risk of complications when compared with general anesthesia [1,2]. Furthermore, with the increasing interest in fast recovery, including same-day ambulation and even outpatient joint arthroplasty, short-acting local anesthetic agents and minimal narcotic use are preferred. Lidocaine is a fast-onset, short-duration local anesthetic that has been used safely since the 1940s as a spinal anesthetic. However, some reports have shown a higher risk of transient neurologic symptoms (TNSs) with the use of lidocaine, which has discouraged its use in the total joint population [3-6].

TNS is defined as transient buttock pain, radicular lower extremity pain, and dysesthesias that present within the first 24 hours following recovery from spinal anesthesia. Reported incidence of TNS after lidocaine spinal anesthesia has ranged up to 40%, but TNS is not unique to lidocaine and has been reported with the use of other spinal anesthetics [3,4,6,7]. Some believe that baricity of the anesthetic plays a role in the incidence of TNS, and many reports of TNS are associated with hyperbaric 5% solutions. Spinal anesthesia, with isobaric 2% lidocaine, is one of several regimens used at our institution. There has been a resurgent interest in lidocaine as an agent in spinal anesthesia for joint arthroplasty with the advent of same-day ambulation and outpatient joint arthroplasty. Faster return of motor function allows

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Table 1
Combined data set.

All patients	n	Mean	SD	Minimum	Maximum
Age	50	61.22	7.97	41.00	77.00
Height (in)	50	67.10	4.00	59.00	76.00
Weight (lb)	50	180.00	35.10	118.00	260.00
BMI	50	28.10	4.41	18.98	36.14
Time: Spinal-twitch motor[a]	31	2.54	0.54	1.62	4.33
Time: Spinal-full motor recovery	50	2.89	0.65	1.73	5.17
Time: PACU to motor	50	0.58	0.48	0.00	1.50
Time: PACU to ambulation	50	3.02	2.38	1.28	12.75
Time: PACU to discharge	50	5.84	2.66	1.87	11.17
Time: Block to PACU	50	2.31	0.45	1.15	3.75

BMI, body mass index; PACU, postanesthesia care unit.
[a] Time reported in hours.

patients to progress through physical therapy and meet criteria for discharge more quickly.

The purpose of this study is to determine the safety and efficacy of single-dose lidocaine spinal anesthesia in the setting of outpatient joint arthroplasty. Our hypothesis is that this method of anesthesia will not only be safe but also allow quick recovery of motor function and decreased time to ambulation and discharge, without increasing the incidence of TNS.

Material and methods

After the institutional review board approval, we performed a prospective study of 50 patients who received lidocaine spinal anesthesia in the setting of outpatient hip and knee arthroplasty. Inclusion criteria for this study included patients aged over 18 years who underwent single-dose lidocaine spinal anesthesia in conjunction with total or partial knee or hip arthroplasty performed by the senior author and same anesthesiologist. We enrolled 50 consecutive patients who were undergoing planed outpatient total joint arthroplasty (TJA) with the senior author when the included anesthesiologist was coving his cases.

All patients received a single spinal injection of 2% isobaric lidocaine along with titrated propofol sedation. Data were collected through hospital and clinical chart records. We evaluated demographic data, length of motor blockage, time to ambulation, time to discharge readiness, and patient-reported symptoms of TNS; TNS symptoms were monitored before discharge, and each patient was followed up for TNS symptoms through telephone interviews for 7 days. All patients were required to meet specific criteria before discharge. These criteria include (1) medically stable, (2) able to void, (3) well-controlled pain, (4) able to tolerate regular diet, (5) independently navigate from bed to chair and chair to ambulation, (6) independently walk with or without an assist device 100 feet, and (7) ascend and descend a full staircase. Means, ranges, and standard deviations were calculated for this data and stratified according to the procedure performed. Given the sample sizes of the individual procedure cohorts, comparative analysis was not performed because it would have been underpowered. All descriptive statistics were calculated using Stata (College Station, Texas). We also recorded any need for supplemental anesthesia other than the single isobaric lidocaine injection and titrated propofol sedation.

Results

Of the 50 patients studied, 11 (22%) had total hip arthroplasty (THA), 33 (66%) total knee arthroplasty, 5 (10%) unicompartmental knee arthroplasty, and 1 (2%) underwent polyethylene exchange. The average age was 61.2 years (range 41-77, standard deviation [SD] 7.97), and 52% were female with an average body mass index 28.1 (range 19.0-36.1, SD 4.41; Table 1).

The average duration of motor blockade was 2.89 hours (range 1.73-5.17, SD 0.65) from administration of the spinal anesthesia. Average time from admission to postanesthesia care unit (PACU) to return of motor function was 0.58 hours (range 0-1.5, SD 0.48). Average time from admission to PACU to ambulation was 3.02 hours (range 0.67-7, SD 2.38) (Table 1). Averages for each outcome were further divided according to the procedure and were similar between groups (Tables 2-4).

None of the patients reported TNS during their hospitalization or after discharge. No patients required intubation, redosing of lidocaine during the procedure, or any additional intervention. All patients were discharged home on the day of surgery as planned. Time from PACU admission to discharge averaged 5.84 hours postoperatively (range 1.87-11.17, SD 2.66). There were 2 early complications including 1 deep infection, and 1 patient with back pain requiring emergency department evaluation.

Discussion

Perioperative pain management and intraoperative anesthesia have become areas of increasing interest in joint replacement surgery. The rise in short-day arthroplasty, same-day ambulation, and even outpatient arthroplasties has only enhanced this interest. Furthermore, the shift of health-care policy shifts from volume-centric to value-based reimbursement encourages decreased costs of care, improved clinical pathways, decreased length of stay, and a reduction in postoperative complications [8-11].

Significant effort has been put toward optimizing anesthesia, and there has been a shift away from general anesthesia toward neuropil anesthesia [2,12]. Whether neuraxial anesthesia results in improved outcomes in joint arthroplasty has been debated [13]. Some authors have reported no difference in surgical complications [13-15]; yet others have demonstrated a lower risk of complications, improved pain control, and decreased operative cost associated with neuraxial anesthesia [1,12,14]. Despite lack of consensus, neuraxial anesthesia continues to grow in popularity, particularly in the outpatient setting [16-18].

Zaric et al. [3] performed a Cochrane review on TNS following spinal anesthesia in 16 randomized control trials consisting of 1479 patients. They showed that lidocaine has a significantly higher relative risk of developing TNS compared to other agents (bupivacaine, prilocaine, mepivacaine, procaine, ropivacaine and levobupivacaine, and 2-chloroprocaine) regardless of baricity. Fourteen percentage of the patients receiving spinal anesthesia with lidocaine developed TNS. The risk of TNS was not dose dependent nor was there an association with baricity. No patient, regardless of anesthetic, reported permanent neurologic deficit. The majority of reported TNS symptoms resolved between the second and fifth postoperative day, and only one study reported symptom duration extending to postoperative day 10. Similarly, when comparing

Table 2
Total hip arthroplasty.

THA	n	Mean	SD	Minimum	Maximum
Age	11	57.18	8.10	41.00	69.00
Height (in)	11	66.45	4.20	59.00	71.00
Weight (lb)	11	172.82	35.93	118.00	222.00
BMI	11	27.86	5.77	19.08	36.10
Time: Spinal-twitch motor[a]	11	2.38	0.37	1.67	2.83
Time: Spinal-full motor recovery	11	2.95	0.41	2.25	3.83
Time: PACU to motor	11	0.70	0.33	0.33	1.43
Time: PACU to ambulation	11	2.37	0.91	1.37	4.10
Time: PACU to discharge	11	6.83	2.64	2.58	10.87
Time: Block to PACU	11	2.25	0.34	1.67	2.75

BMI, body mass index; PACU, postanesthesia care unit.
[a] Time reported in hours.

Table 3
Total knee arthroplasty.

TKA	n	Mean	SD	Minimum	Maximum
Age	33	61.33	7.43	44.00	74.00
Height (in)	33	67.06	3.93	60.00	76.00
Weight (lb)	33	183.48	35.24	122.00	260.00
BMI	33	28.56	4.15	18.98	36.14
Time: Spinal-twitch motor[a]	15	2.82	0.54	2.25	4.33
Time: Spinal-full motor recovery	33	2.93	0.74	1.73	5.17
Time: PACU to motor	33	0.52	0.52	0.00	1.50
Time: PACU to ambulation	33	3.04	2.26	1.28	12.67
Time: PACU to discharge	33	5.21	2.42	1.98	10.50
Time: Block to PACU	33	2.41	0.44	1.15	3.75

BMI, body mass index; TKA, total knee arthroplasty; PACU, postanesthesia care unit.
[a] Time reported in hours.

lidocaine with bupivacaine, Pollock et al. [6] demonstrated a significantly higher risk of TNS in the lidocaine group (16%) compared with the bupivacaine group (0%). They also noted that there was no difference in the incidence of TNS when comparing hyperbaric and isobaric lidocaine. The question of whether hyperosmolarity may contribute to TNS has been explored by others. Hampl et al. [4] performed a prospective double-blinded study to evaluate if high osmolarity hyperbaric 5% lidocaine may contribute to TNS, and they compared 3 anesthesia treatments: 5% lidocaine in 7.5% dextrose, 0.5% bupivacaine in 8.25% dextrose, and 5% lidocaine in 2.7% dextrose. They showed no difference in symptoms between the 2 different lidocaine osmolarities, with reported incidence of TNS being 33.3% with lidocaine in 7.5% dextrose and 30.8% with lidocaine in 2.7% dextrose, compared to 0% in the bupivacaine group. The mean duration of symptoms ranged from 1.2 to 1.4 days.

Our study shows that 2% isobaric lidocaine spinal anesthesia is safe and effective in the setting of outpatient joint arthroplasty. The advantages of this agent include the quick onset of action and short duration. Our results suggest that using lidocaine spinal anesthesia does allow for improved postoperative recovery and discharge. Motor function in our study returned at an average 2.89 hours after spinal injection, allowing ambulation and discharge at their respective means of 3.02 and 5.84 hours after admission to PACU. Ali Hassan et al. [16] showed similar results when comparing lidocaine to bupivacaine in fast-track knee arthroscopy. The authors demonstrated a faster time to ambulation (3.6 minutes) in the lidocaine group compared to the bupivacaine group (160 minutes). Time to discharge was also shown to be faster in the lidocaine group (153 minutes) compared to the bupivacaine group (184 minutes). It should be noted that knee arthroscopy has moved largely to the outpatient setting at present, compared to TJA which still remains predominantly an inpatient procedure. The Center for Medicare and Medicaid does not currently have an outpatient designation for TJA, limiting those performed to private insurers or payers. Morisaki et al. [19] prospectively evaluated the incidence of TNS in 1045 patients undergoing anorectal surgery under spinal anesthesia with 3% lidocaine in 8.2% glucose. Only 4 patients (0.4%) developed symptoms, and all resolved within 5-7 days.

Given that TNS by definition occurs within the first 24 hours of surgery and that lidocaine has been shown to be more effective than other anesthetics in decreasing time to ambulation, it has been suggested that early ambulation may increase the incidence of TNS. Talakoub et al. [20] performed a randomized clinical trial of 60 patients undergoing lower abdominal surgery which demonstrated that early ambulation did not increase the incidence of neurologic complications after spinal anesthesia with lidocaine. Lindh et al [21] prospectively evaluated 107 patients undergoing hernia surgery with hyperbaric lidocaine spinal anesthesia, reporting a 23% incidence of TNS and no association with ambulation before or after 12 hours. With regards to orthopaedic surgery, Silvanto et al. [22] studied 120 patients undergoing knee arthroscopy with 2% lidocaine, reporting a 16% incidence of TNS and no association with early ambulation, ambulation at 6 hours, or late ambulation. In a prospective, randomized double-blinded study of 79 patients undergoing outpatient arthroscopic procedures, Pawlowski et al. [23] demonstrated that time to ambulation was faster with isobaric 2% lidocaine than 2% mepivacaine, with no episodes of TNS in either group. No patients in our study experienced TNS, and our average time to ambulation was 2.53 hours, which similarly suggests that early ambulation in not a risk factor for TNS.

This study has several limitations. First, although these data were prospectively collected, there is no comparison cohort of patients receiving a different spinal anesthetic. Given the various protocols at our institution and also in the general orthopaedic population, determining an appropriate control group is challenging. Furthermore, there is no gold-standard anesthesia protocol and there is extensive variation in both the anesthetic and perioperative pain management protocols. While we looked at 50 patients, we acknowledge that this study may be underpowered because of low numbers. Specifically, we realize that the subgroups are not sufficient in number to make specific recommendations based on surgical procedure. Despite these limitations, the purpose of this study was to address the safety and efficacy of singe-dose lidocaine spinal anesthesia, and although we do not have adequate numbers to sufficiently power the study, there were no reported adverse effects from the anesthesia. Furthermore, these were not highly selective cases; we enrolled 50 consecutive patients who were undergoing planed outpatient TJA with the senior author when the included anesthesiologist was coving his cases. Moreover, this cohort includes a sample of partial and total knee arthroplasties, THA, and 1 revision hip arthroplasty for polyethylene and head exchange, demonstrating the safety profile remains regardless of procedures. Because primary and revision THAs were performed in the lateral decubitus position and knee arthroplasties were performed in the supine position, we can show that there does not need to be an association with the patient's position.

All anesthesia performed during this study was done so by the head of regional anesthesia at a major academic medical center. As such, the administration of anesthesia remained consistent. Furthermore, such consistency in dosing, technique, monitoring, and perioperative protocols may reduce the potential for developing adverse outcomes including TNS. In addition, all cases were performed in the hospital and not at an ambulatory surgery center. While we see no reason why the results of this study could not be extrapolated to an ambulatory surgery center outpatient model, it is important to differentiate the environment.

Choosing the correct anesthetic is challenging for several reasons. Each health-care system has its own protocols, and using a short-acting agent may not be possible because of these

Table 4
Unicompartmental knee arthroplasty.

UKA	n	Mean	SD	Minimum	Maximum
Age	5	68.00	7.65	60.00	77.00
Height (in)	5	69.20	4.55	65.00	76.00
Weight (lb)	5	174.00	40.16	134.00	236.00
BMI	5	25.26	2.12	22.30	28.20
Time: Spinal-twitch motor[a]	4	2.17	0.44	1.62	2.65
Time: Spinal-full motor recovery	5	2.57	0.34	2.17	3.00
Time: PACU to motor	5	0.60	0.40	0.00	1.08
Time: PACU to ambulation	5	4.65	4.64	1.48	12.75
Time: PACU to discharge	5	7.69	3.53	1.87	11.17
Time: Block to PACU	5	1.97	0.36	1.60	2.42

BMI, body mass index; UKA, unicompartmental knee arthroplasty; PACU, postanesthesia care unit.
[a] Time reported in hours.

systems-based constraints. For example, institutions that administer neuropil anesthesia preoperatively may not be able to use short-acting agents if there is significant variability in turnover time. In addition, surgeon technique remains essential, and high variation in surgical time may not make the use of short-acting anesthetics feasible. Our institution has performed outpatient TJA for many years, and experienced anesthesiologists and surgical staff allow perioperative efficiencies that may not be replicable in all institutions. Also, we have a robust preoperative screening protocol to ensure that appropriate patients are selected for the outpatient arthroplasty, and we acknowledge the potential sample bias that needs consideration when making inferences to the general population.

Conclusions

Isobaric lidocaine spinal anesthesia appears to be a safe and effective regimen for same-day ambulation, short-stay TJA, and even outpatient hip and knee arthroplasty. In this prospective small cohort of consecutive patients, all patients were discharged on the day of surgery with rapid return of motor function and time to ambulation. There were no reports of TNS. Further study is necessary to differentiate the risks of TNS between arthroplasty procedures.

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