Lower-Dose Mepivacaine Plus Fentanyl May Improve Spinal Anesthesia for Knee Arthroscopy

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Abstract *Background:* Previous work indicates that 30 mg isobaric mepivacaine 1.5% plus 10 µg fentanyl produces reliable anesthesia for knee arthroscopy with a more rapid recovery profile than 45 mg mepivacaine. *Questions/Purposes:* This randomized controlled trial compared plain mepivacaine to three reduced doses of mepivacaine with 10 µg fentanyl for spinal anesthesia. *Methods:* Following written informed consent, subjects undergoing outpatient knee arthroscopy were prospectively randomized into one of four groups: mepivacaine 37.5 mg (M37.5); mepivacaine 30 mg plus fentanyl 10 µg (M30/F10); mepivacaine 27 mg plus fentanyl 10 µg (M27/F10); and mepivacaine 24 mg plus fentanyl 10 µg (M24/F10). The spinal was evaluated by the blinded anesthetist and surgeon. In the post-anesthesia care unit, sensory and motor block resolution was assessed. Subjects rated their satisfaction with the overall experience. *Results:* Group M30/F10 ($n=6$) had two “fair” anesthetics, and group M27/F10

($n=10$) had one “fair” and one “inadequate” anesthetic. Both groups were eliminated from further enrollment per study protocol. The recovery profiles showed little difference between groups M37.5 and M30/F10, except for motor block resolution (median (25th percentile, 75th percentile): 171 (135, 195) and 128 (120, 135), respectively). Groups M27/F10 and M24/F10 demonstrated recovery profiles that were faster than group M37.5. Patient satisfaction was 10/10 for all groups. *Conclusions:* Adding fentanyl 10 µg to a lower dose of mepivacaine 1.5% can lead to quicker recovery profiles. However, this advantage of a quicker recovery must be weighed against the likelihood of an incomplete anesthetic.

Keywords fentanyl · mepivacaine · spinal anesthesia · arthroscopy

Introduction

Isobaric mepivacaine has been used for outpatient spinal anesthesia due to its markedly lower incidence of transient neurologic symptoms and similar duration of action when compared with lidocaine [1]. Intrathecal isobaric mepivacaine (45 mg, 1.5%) results in a sensory block lasting 182 ± 38 min, but reducing the dose to 30 mg results in an incomplete anesthetic block in 28% of patients [11].

Multiple studies have demonstrated the advantage of adding fentanyl to other local anesthetics for spinal anesthesia [1, 2, 10]. The combination of 30 mg isobaric mepivacaine 1.5% plus fentanyl 10 µg produces reliable anesthesia for knee arthroscopy with a more rapid recovery profile than 45 mg plain mepivacaine [11]. However, sensory block averaged 118 min with this combination, and time to ambulation was 176 min [9]. For brief surgical procedures, a shorter duration would be preferable. Thus, this study was designed to determine an optimal dose of mepivacaine that, when combined with fentanyl 10 µg,

Level of Evidence: Level II: Therapeutic Study.

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results in the shortest recovery profile while reliably providing anesthesia for knee arthroscopy.

The primary aim of this study was to determine whether the addition of different doses of mepivacaine, when combined with fentanyl, affects the time from spinal injection until block regression to the S1 dermatome. The secondary aims were to assess other recovery milestones including times from spinal injection until ambulation, readiness for discharge, and actual discharge, opioid consumption, occurrence of side effects, and patient satisfaction.

Patients and Methods

Patient Recruitment and Randomization

The study was approved by the Institutional Review Board (IRB) at Hospital for Special Surgery (#2012-040/11140) on November 8, 2011, and it was registered at <https://www.clinicaltrials.gov> (#NCT01701102) on January 4, 2012. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Patients were approached prospectively between December 1, 2011 and July 24, 2012. Exclusion criteria included the following: age <18 or >60 years, height >190 cm, daily use of opioids for greater than 1 week, and complex surgery such as ligament reconstruction or osteotomy. Following written informed consent, patients were randomized into one of four groups: mepivacaine 37.5 mg (M37.5); mepivacaine 30 mg plus fentanyl 10 µg (M30/F10); mepivacaine 27 mg plus fentanyl 10 µg (M27/F10); and mepivacaine 24 mg plus fentanyl 10 µg (M24/F10). Computer-generated block randomization was performed by a research assistant who was not otherwise involved with the study. Software-generated block randomization, with a block size of four, was used to randomize patients to the treatment groups. This guaranteed that after four patients were enrolled in the study, there would be one patient assigned to each of the four treatment groups.

All enrolled patients received the allocated interventions. There were no losses to follow-up, no discontinuations, and no exclusions from analysis (Fig. 1). Data were collected from December 1, 2011 to July 24, 2012. Patient characteristics were similar between groups, except for a higher percentage of males in the M27/F10 and M24/F10 groups (Table 1).

Anesthetic Procedures

Patients received O₂ via nasal cannula at 3 L/min and received routine monitors. Midazolam was titrated intravenously to achieve conscious sedation. Propofol was added if deeper sedation was desired. The spinal was performed at L3–4 or L4–5, in the sitting position, utilizing a 20-g introducer and a 27-g Whitacre needle, by an attending anesthesiologist with extensive experience in regional anesthesia (or a trainee under the direct supervision of such attending) who was unblinded to the group assignments. The spinal injectate was prepared using a 5-mL Luer-Slip syringe. The appropriate volume of mepivacaine 1.5% (Carbocaine® 1.5%,

Hospira Inc., Lake Forest, IL) was drawn up, followed by fentanyl 10 µg (fentanyl citrate 0.2 mL, Hospira Inc.) in the three fentanyl groups. Following injection, patients were placed supine, and preparation for surgery commenced.

The remainder of the anesthetic was managed by a different anesthesia provider (anesthesiologist, certified registered nurse anesthetist, or trainee) who was blinded to the spinal injectate. Additional propofol was used to maintain the desired level of conscious sedation. Up to 100 µg intravenous fentanyl was used only if needed due to incomplete anesthesia. All patients were given intravenous famotidine 20 mg, dexamethasone 4 mg, and ondansetron 4 mg following induction, as well as intravenous ketorolac 30 mg during closure.

Quality Rating of Anesthesia

At the completion of surgery, the blinded anesthesia provider rated the quality of the anesthetic as “perfect”, “good”, “fair”, or “inadequate”. “Perfect” was defined as no response to surgery, “good” as minimal response controlled with conscious sedation (including up to 100 µg fentanyl), “fair” as requiring deep sedation, and “inadequate” as requiring general anesthesia. The surgeon was blinded to the anesthetic group and rated the quality of the anesthetic as “perfect” (no response to surgery), “good” (minimal response that was acceptable), or “inadequate” (unacceptable operating conditions). A rating of “fair” or “inadequate” by the anesthesia provider, or “inadequate” by the surgeon, was considered a failed block. At the end of each day, an independent researcher was notified of enrollment progress. The trial protocol dictated that if two patients in any group had failed blocks, a new randomization schedule was created, thus eliminating that group from future enrollment.

Spinal Resolution, Sensory/Motor Tests, and Patient Satisfaction

In the post-anesthesia care unit (PACU), patients were assessed every 15 min for spinal resolution by a blinded research assistant. Sensory level was assessed by light touch to the skin with a toothpick, beginning at the lower extremities and proceeding cephalad, with the highest dermatome level at which the patient perceived a change from dull to sharp being the extent of blockade. Sensory block duration was defined as the time of testing at which the patient first perceived normal sensation on the lateral aspect of the foot, which was considered to be the sacral 1 (S1) level (time 0 represented spinal injection time). Motor block was evaluated using the modified Bromage scale (MBS): 0=able to move hips, knee, and ankles; 1=able to move two of three; 2=able to move only one of three; and 3=no movement. Once sensory and motor block resolved, attempts to ambulate the patient were made every 15 min, and successful ambulation was documented to calculate the time to first ambulation. Discharge criteria were the following: patient awake/alert/oriented/responsive, numerical rating scale (NRS) pain score <5/10, no parenteral narcotics within the past hour, stable vital signs, no active bleeding, minimal or no nausea, oxygen saturation >94%, and urination. Actual discharge was the time at which the patient was discharged from the hospital.

Fig. 1. CONSORT flow diagram. The numbers of approached, enrolled, and excluded patients are displayed in the flow diagram. Study group discontinuations are also highlighted.

Prior to discharge, patients were asked to rate their satisfaction with the operating room (OR) and PACU experience on a 0 to 10 scale (0=very dissatisfied, 10=very satisfied). NRS pain scores were collected every 15 min in the PACU and averaged. The highest score collected during the patient's stay in the PACU represented the worst pain score. Patients were also asked if they experienced nausea, vomiting, or itchiness, and opioid consumption in the PACU was recorded.

Statistical Analysis

Study data were collected and managed using Research Electronic Data Capture (REDCap), which is a secure web-

based application that is designed to support data capture for research studies [5].

The primary outcome was the duration of time from spinal injection until block regression to the S1 dermatome. We based estimates on reports utilizing 30 and 45 mg [11]. With an estimated mean (standard deviation) time to S1 regression of 180(65) minutes in the 37.5 mg mepivacaine (control) group, 16 patients would be needed in each of the four arms (M37.5, M30/F10, M27/F10, and M24/F10) to detect a difference of 60 min between each intervention and the control group with alpha level of 0.05 and 80% power. To allow for exclusions, we planned to enroll 20 patients per group. The Wilcoxon rank-sum test was used to compare duration of block, time to achieve recovery milestones, and

Table 1 Patient characteristics by study group

	M37.5 ^a (n=22)	M30/F10 ^a (n=6)	M27/F10 ^a (n=10)	M24/F10 ^a (n=18)	Total (n=56)
Age, mean (range), years	41 (19–55)	50 (42–57)	46 (27–60)	45 (19–61)	44 (19–61)
Gender (M/F), %	10/12 (45.5/54.5)	3/3 (50.0/50.0)	8/2 (80.0/20.0)	13/5 (72.2/27.8)	34/22 (60.7/39.3)
BMI ^b , mean (SD), kg/m ²	26.3 (3.8)	26.0 (4.3)	28.5 (5.6)	28.7 (4.8)	27.4 (4.6)
Race (Caucasian/non-Caucasian), n (%)	17/5 (77.3/22.7)	6/0 (100/0)	8/2 (80.0/20.0)	17/1 (94.4/5.6)	48/8 (85.7/14.3)
Procedure, n (%)					
Debridement	1 (4.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.8)
Meniscectomy	17 (77.3)	6 (100.0)	9 (90.0)	15 (83.3)	47 (83.9)
Plica	1 (4.5)	0 (0.0)	0 (0.0)	1 (5.6)	2 (3.6)
Chondroplasty	3 (13.6)	0 (0.0)	1 (10.0)	1 (5.6)	5 (8.9)
Removal of loose bodies	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.6)	1 (1.8)
Intraop meds, n (%)					
Midazolam patients (%)	22 (100.0)	6 (100.0)	10 (100.0)	18 (100.0)	56 (100.0)
Dose, mg, mean (SD)	5.1 (1.8)	4.0 (1.4)	4.4 (1.0)	4.4 (1.2)	4.6 (1.5)
Propofol patients (%)	22 (100.0)	6 (100.0)	10 (100.0)	17 (94.4)	55 (98.2)
Fentanyl patients (%)	3 (13.6)	2 (33.3)	1 (10.0)	3 (16.7)	9 (16.1)
Dose, µg, range	50	25–50	90	50–100	25–100

^a M37.5 mepivacaine 37.5 mg only, M30/F10 mepivacaine 30 mg plus fentanyl 10 µg, M27/F10 mepivacaine 27 mg plus fentanyl 10 µg, M24/F10 mepivacaine 24 mg plus fentanyl 10 µg; ^b BMI body mass index

NRS scores between groups. The incidence of complications was compared between groups with Fisher's exact test. Differences between proportions are reported as point estimates along with continuity-corrected Wilson score intervals [8]. *P* values <0.05 were considered statistically significant. All statistical analyses were performed with SAS Version 9.3 (SAS Institute, Cary, NC).

Results

Based on pre-determined criteria, groups M37.5 and M24/F10 each had one failed anesthetic. Groups M30/F10 and M27/F10 each had two failed anesthetics (Table 2) and were eliminated from further enrollment as per study protocol, resulting in the total enrollment of 56 patients rather than 80 patients as initially planned. All enrolled patients, including the six failures, were included in the data analysis.

Block regression to the S1 dermatome was assessed in the PACU. There was a difference in time from spinal injection to block regression to the S1 dermatome between the M37.5 and M27/F10 ($p=0.024$) or M24/F10 groups ($p=0.006$). However, the time from spinal injection to block regression to the S1 dermatome was not different between M37.5 and M30/F10 groups (Table 3).

Other recovery profiles are shown in Table 3 and Fig. 2. The duration of motor block when compared with the M37.5 group was shorter in all three mepivacaine/fentanyl groups. The time to first P.O. intake and first urination was decreased only in the M24/F10 group compared to the M37.5 group. There was no evidence of a difference in time to first ambulation, ready for discharge, or actual discharge between M30/F10 and M37.5 groups; however, these times were shorter in the M27/F10 and M24/F10 groups compared to the M37.5 group.

Opioid consumption was similar in all groups. Pruritus did not occur in the M37.5 group, whereas it occurred in 16.7, 10.0, and 11.1% of patients in the M30/F10, M27/F10, and M24/F10 groups, respectively (Table 4). No patients required treatment for pruritus. Nausea occurred in 31.8%

of the patients in the M37.5 group, compared to only 5.6% in the M24/F10 group (difference 26.3% [95% CI −3.1 to 49.9]; $p=0.054$). Similarly, vomiting was present in 18.2% of patients in the M37.5 group and only 5.6% of patients in the M24/F10 group (difference 12.6% [−14.1 to 36.1]; $p=0.356$). None of the patients in the M30/F10 and M27/F10 groups experienced nausea or vomiting (Table 4).

Patient satisfaction was similarly high in all groups, with the median (25th percentile, 75th percentile) of 10 (10, 10) in all arms. Furthermore, all six patients with a failed block reported a satisfaction score of 10 (Table 4).

Average and worst pain scores through the PACU stay were also collected. Groups with lower doses of mepivacaine plus fentanyl 10 µg did not show a difference in worst pain compared to the M37.5 group. However, the M30/F10 and M27/F10 groups had lower average pain compared to the M37.5 group (Table 3).

The six patients with a failed block did not appear to differ from the others with respect to age (mean 44 vs. 44 years old; difference 0 years [95% CI: −14 to 13]), body mass index (mean 26.3 vs. 27.6 kg/m²; difference −1.3 kg/m² [95% CI: −5.0 to 2.3]), time between induction end and start of surgery (median [25th percentile, 75th percentile]: 13 min [11, 13] vs. 13 min [11, 16]) or surgical procedure (100.0% vs. 84.0% meniscectomy; difference 16.0% [95% CI: −33.0 to 29.7]). These spinals were administered by 5 experienced attendings; no surgeon or anesthesiologist was overly represented in the failures.

Discussion

In this dose-response study, we compared mepivacaine (plain) to three reduced doses of mepivacaine with 10 µg fentanyl for spinal anesthesia. The specific aims were to assess (1) the time from spinal injection until block regression to the S1 dermatome, (2) the times from spinal injection to other recovery milestones, including ambulation, ready for discharge, and actual discharge, (3) opioid consumption

Table 2 Rating of block

	M37.5 (n=22)	M30/F10 (n=6)	M27/F10 (n=10)	M24/F10 (n=18)	Total (n=56)
*Rating of block by anesthesiologist, n (%)					
Perfect	15 (68.2)	3 (50.0)	7 (70.0)	14 (77.8)	39 (69.6)
Good	6 (27.3)	1 (16.7)	1 (10.0)	3 (16.7)	11 (19.6)
Fair ^b	1 (4.5)	2 (33.3)	1 (10.0)	1 (5.6)	5 (8.9)
Inadequate ^b	0 (0.0)	0 (0.0)	1 (10.0)	0 (0.0)	1 (1.8)
Rating of block by surgeon, n (%)					
Perfect	15 (68.2)	4 (66.7)	6 (60.0)	15 (83.3)	40 (71.4)
Good	6 (27.3)	0 (0.0)	2 (20.0)	3 (16.7)	11 (19.6)
Inadequate ^b	1 (4.5)	2 (33.3)	2 (20.0)	0 (0.0)	5 (8.9)
Failed blocks ^b , n %	1 (4.5)	2 (33.3)	2 (20.0)	1 (5.6)	6 (10.7)
Patient satisfaction with anesthesia, PACU ^c experience, median (Q1, Q3) (0=worst, 10=best)	10 (10, 10)	10 (10, 10)	10 (10, 10)	10 (10, 10)	10 (10, 10)

^a Anesthesiologist's rating: perfect, no response to surgery; good, minimal response controlled with conscious sedation including up to 100 µg fentanyl; fair, requiring deep sedation; inadequate, requiring general anesthesia. Surgeon's rating: perfect, no movement or patient response; good, minimal movement; inadequate, unacceptable movement

^b Blocks that were rated "fair" or "inadequate" by the anesthesiologist, or "inadequate" by the surgeon, were considered to be "failed" blocks

^c Post-anesthesia care unit (PACU)

Table 3 Block characteristics by study group

	M37.5 (n=22)	M30/F10 (n=6)	P (vs. M37.5)	M27/F10 (n=10)	P (vs. M37.5)	M24/F10 (n=18)	P (vs. M37.5)
Time [min], median (Q1, Q3) from induction end to:							
^a Anesthesia end	39 (35, 45)	35 (32, 41)	0.156	45 (36, 48)	0.356	39 (31, 50)	0.935
Surgery start	13 (12, 18)	15 (9, 19)	0.978	13 (12, 15)	0.792	13 (11, 15)	0.393
Sensory block regression to dermatome level S1	203 (165, 231)	195 (175, 210)	0.867	156(135, 180)	0.024*	159 (135, 194)	0.006*
MBS of 0	171 (135, 195)	128 (120, 135)	0.046*	120 (60, 135)	0.003*	90 (75, 120)	<0.001*
First P.O. intake	125 (104, 133)	104 (86, 130)	0.290	97 (87, 139)	0.246	86 (73, 95)	0.002*
First ambulation	236 (192, 250)	208 (195, 234)	0.543	180 (162, 192)	0.004*	182 (159, 209)	0.002*
First urination (>100 mL)	223 (198, 255)	224 (200, 245)	0.978	195 (177, 214)	0.060	196 (162, 220)	0.014*
Ready for discharge	240 (205, 261)	231 (205, 254)	0.824	193 (179, 224)	0.014*	198 (174, 225)	0.004*
Actual discharge	252 (230, 296)	249 (239, 265)	0.868	218 (212, 241)	0.041*	227 (193, 248)	0.011*
NRS pain score, median (Q1, Q3) (0=none, 10=worst)							
Average	2 (1, 2)	0 (0, 1)	0.018*	1 (0, 1)	0.033*	0 (0, 3)	0.181
Worst	2.5 (1, 3)	0.5 (0, 1)	0.050	1.5 (0, 2)	0.078	2 (0, 5)	0.603

*P values less than 0.05

^aTime at which patient care was transferred from the anesthesiologist to the post-operative care unit nurse

and the occurrence of side effects, and (4) patient satisfaction.

There are several limitations to this study. The injectate was drawn up by the physician administering the spinal anesthetic. Using a 5-mL syringe with 0.2-mL gradations, the syringe was first filled with the volume of mepivacaine 1.5% that represented the group assignment. Then, in the three fentanyl groups, 0.2 mL of fentanyl was added. It seems likely that the actual doses of both drugs could differ

slightly from the exact assigned amount. Perhaps this variation (e.g., 8 µg rather than 10 µg of fentanyl) could be enough to affect the resultant neuraxial block. We elected to use this methodology because it is the way that spinal injectates are generally drawn up in clinical practice. Furthermore, early discontinuation of the M30/F10 and M27/F10 arms decreased our power to detect differences in outcomes between each of these groups and the M37.5 arm. Thus, any comparisons involving either of these two

Fig. 2. Box plots showing outcomes by study group. The durations from spinal injection to S1 dermatome sensory resolution, modified Bromage scale of 0, ambulation, first urination, ready for discharge, and actual discharge are presented for each group. The diamond indicates the mean. The bottom area and top area of each filled box indicate the first and third quartiles, respectively. The horizontal line within the box indicates the median, and the lines extending out of the bottom and top represent the minimum and maximum values that lie within 1.5 times the interquartile range below and above the first and third quartiles, respectively. The small hollow circles represent outliers. *P<0.05 vs. M37.5.

Table 4 Post-operative analgesics and side effects

	M37.5 (n=22)	M30/F10 (n=6)	<i>P</i> (vs. M37.5)	M27/F10 (n=10)	<i>P</i> (vs. M37.5)	M24/F10 (n=18)	<i>P</i> (vs. M37.5)
Opioids ^a (5/325 mg), <i>n</i> (%)	21 (95.5)	4 (66.7)	0.107	8 (80.0)	0.224	13 (72.2)	0.073
Nausea, <i>n</i> (%)	7 (31.8)	0 (0.0)	0.288	0 (0.0)	0.069	1 (5.6)	0.054
Vomit, <i>n</i> (%)	4 (18.2)	0 (0.0)	0.549	0 (0.0)	0.283	1 (5.6)	0.356
Pruritus, <i>n</i> (%)	0 (0.0)	1 (16.7)	0.214	1 (10.0)	0.313	2 (11.1)	0.196

^aOpioids include hydrocodone/acetaminophen (5/325 mg) and oxycodone/acetaminophen (5/325 mg)

groups are likely subject to a type 2 error. Enrolling more patients would have increased our statistical power, but this would be at the risk of more patients with inadequate anesthesia. Finally, the extent of motor and sensory blockade considered acceptable will vary between anesthesiologists and surgeons, and what is acceptable for knee arthroscopy may not be generalizable to other surgeries.

The primary aim of this study was to determine if lowering the dose of mepivacaine, when combined with fentanyl 10 µg, would result in a faster anesthetic resolution. There was a significant difference in time from spinal injection to block regression to the S1 dermatome between the M37.5 group and M27/F10 or M24/F10 groups, but not between M37.5 and M30/F10 groups. The only other study to investigate the combination of mepivacaine 30 mg and fentanyl 10 µg found a shorter time to S1 resolution when compared to mepivacaine 45 mg alone [9], but 37.5 mg mepivacaine was not studied. There are no other studies evaluating the lower doses used in the present study.

This study demonstrated faster recovery in the M27/F10 and M24/F10 groups than in the M37.5 group. (The 2 of 10 failures in the M27/F10 group makes meaningful comparisons to that group difficult.) This is consistent with O'Donnell's results [9] and with studies evaluating the addition of fentanyl to low-dose lidocaine [1] and bupivacaine [2] for spinal anesthesia. Time to actual discharge was decreased by 30 min in these two groups. Actual time to discharge is affected by factors other than spinal anesthetic resolution. Time to being ready for discharge differed by about 40 min. It is possible that with nursing and physical therapy staff adjusting their expectations to shorter block resolution, the discharge times could be even shorter.

No significant differences in the numbers of patients who took opioids post-operatively between the M37.5 and combination groups were observed, although a greater number of patients who received mepivacaine alone took opioids. A greater percentage of patients in the M37.5 group reported nausea and vomiting compared with those in the combination groups. The observed decreases in nausea and vomiting in the mepivacaine-fentanyl combination groups may be due to fewer opioids in the PACU, a lower proportion of females, or a dose-dependent effect of intrathecal mepivacaine on nausea and vomiting. The current study was underpowered to investigate this phenomenon. Another well-known complication of intrathecal opioids is pruritus [7]. It did not occur in any of the patients in the M37.5 group, whereas four patients in the combination groups experienced itchiness. This incidence and severity did not significantly affect recovery.

It is well known that for a given spinal injectate, there is a large variation in spinal block extent and duration. The response most closely correlates with the volume of lumbosacral cerebrospinal fluid and cannot reliably be predicted from patient demographics [3, 6]. In our study, all groups had at least one failed spinal anesthetic. The three fentanyl groups had a combined incidence of 5/34 (14.7 and 95% CI 2.8 to 26.2) [4]. We observed only one such failure out of 18 patients in the lowest dose group, M24/F10, compared to two failures in each of the higher dose combination groups, M27/F10 and M30/F10. This difference between groups was not statistically significant. The observation that the lowest dose group had the highest success rate may have been skewed by the effects of our pre-determined criteria that resulted in lower sample sizes of the higher dose groups. The six patients with a failed anesthetic all rated the overall perioperative experience perfect (10/10), as did all groups. It is most probable that the attractiveness of the facility, interactions with staff, no recollection of pain in the OR due to deep sedation and amnesia, and attentive care in the PACU all contributed to a level of satisfaction that was as high as the other patients in the study. So what is the disadvantage of a failed spinal anesthetic? It requires more intervention on the part of the anesthesia provider and could put the patient with a full stomach or difficult airway at increased risk. In addition, the operative conditions could be affected by the patient's movements.

The faster recovery profile comes at the expense of 15% of patients having a failed anesthetic. Of the blocks that met our criteria for success, 13–29% were rated as “good” rather than “perfect” by the anesthesia provider. Furthermore, eight of the successful anesthetic patients in the combination treatment groups (M30/F10, M27/F10, M24/F10) had an MBS of 0 or 1 when first evaluated in the PACU, suggesting the motor block was incomplete during the surgical procedure. Thus, the advantage of a quicker recovery must be weighed against the likelihood of a partial or failed block in some patients.

In summary, adding fentanyl 10 µg to low-dose isobaric mepivacaine 1.5% can facilitate a more rapid recovery. However, one has to accept the not uncommon incidence of incomplete anesthesia that will result when using the doses of mepivacaine and fentanyl evaluated in this study.

Disclosures

Conflict of Interest: Richard L. Kahn, MD, Jennifer Cheng, PhD, James J. Bae, MSc, Kara Fields, MS, John G. Muller, MD, John D. MacGillivray, MD, Howard A. Rose, MD, Riley J. Williams III, MD, and Jacques T. YaDeau, MD, PhD have declared that they have no conflict of interest.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed Consent: Informed consent was obtained from all patients for being included in the study.

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Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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