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Original Article

Hemodynamic changes and recovery in unilateral spinal anesthesia using bupivacaine and bupivacaine + fentanyl combinations in outpatient inguinal hernia surgery

İlhan Ocak

Liver Transplant Intensive Care Unit, Başakşehir Çam and Sakura City Hospital, Istanbul, Türkiye

ABSTRACT

Objectives: The purpose of this study was to compare the hemodynamic changes and differences in recovery after bupivacaine and bupivacaine+fentanyl combinations in unilateral spinal anesthesia in patients to be undergoing outpatient inguinal hernia surgery.

Patients and methods: Between January 2004 and January 2005 a total 60 American Society of Anesthesiologists (ASA) I-II group patients (57 males, 3 females; mean age: 45.9±16.1 years; range, 19 to 76 years) who were scheduled for outpatient inguinal hernia surgery were included in the study. The patients were divided into three groups of 20 at random. All patients were given 7 mL/kg of Ringer's lactate solution for 30 min before the operation. Group 1 received 7.5 mg 0.5% hyperbaric bupivacaine (1.5 mL)+0.5 mL isotonic (0.5 mL), Group 2 received 7.5 mg 0.5% hyperbaric bupivacaine (1.5 mL)+25 mcg fentanyl (0.5 mL), Group 3 received 10 mg of 0.5% hyperbaric bupivacaine (2 mL) within 90 seconds. Sensory block levels of the patients in the groups were evaluated with a pin-prick test and motor block levels were evaluated with the Bromage scale.

Results: Age, height, weight, operation time, ASA physical status, systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), peak heart rate (HR), oxygen saturation among the groups, no statistically significant difference was found in terms of the maximum level of the sensory block on the side to be operated, the regression time of two dermatomes of sensory block were found to be significantly lower in Group 1 compared to Groups 2 and 3. No significant difference was found in terms of maximum sensory block level and motor block level on the contralateral side in all three groups. The time to the disappearance of motor block was significantly longer in Group 3 compared to Groups 1 and 2. In all three groups, there was no statistically significant difference in hemodynamic effects. Group 1 was inadequate in terms of perioperative anesthesia quality. During the operation, additional iv analgesia and sedation support were provided. The perioperative anesthesia quality of Group 2 and 3 was sufficient. Although recovery and standing time was shorter in Group 2 than in Group 3, urinary retention was found to be higher.

Conclusion: In outpatient inguinal hernia surgery, Group 1 with 7.5 mg 0.5% hyperbaric bupivacaine should not be preferred due to insufficient anesthesia quality, Group 2 with 25 mcg fentanyl added to 7.5 mg 0.5% hyperbaric bupivacaine and Group 2 with 10 mg 0.5% hyperbaric bupivacaine are alternatives to each other. However, we concluded that Group 3 was more advantageous because urinary retention was higher in the group with fentanyl supplementation.

Keywords: Bupivacaine, fentanyl, hemodynamic change.

One of the most dramatic changes in health care in recent years has been the shift away from surgical procedures that require long-term hospital care and toward outpatient surgery. This is also referred to as ambulatory surgery. Appropriate pain control is critical for outpatient surgery. Uncontrolled postoperative pain can cause delays in healing, interfere with physical activity, and increase the risk of postoperative pain.[1]

Regional anesthesia has advantages over general anesthesia, such as fewer changes in central nervous system functions, less postoperative pain, and fewer complications such as nausea, vomiting, and dizziness. Disadvantages include prolonged motor or sensory block, orthostatic hypotension, urinary retention, and headache.[2]

The increasing popularity of outpatient surgery has an impact on anesthesia practice. Many studies, new techniques, and anesthetic agents are tried for the anesthesia of such interventions,

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Correspondence: İlhan Ocak.
e-mail: ilhanocak.md@gmail.com

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and the most ideal is tried to be found. For spinal anesthesia, hyperbaric bupivacaine 0.5% is commonly used. However, bupivacaine may occasionally fail to prevent pain induced by peritoneal traction.[3] Fentanyl, a lipophilic opioid, has a rapid onset of action following intrathecal administration. The clinical efficacy of intrathecal opioids in relieving visceral pain has been well demonstrated. In the postoperative period, neuraxial opioids promote faster recovery from long-term analgesia and spinal anesthesia.[4-6]

The purpose of this study was to determine the hemodynamic changes and subsequent side effects in patients planned for outpatient inguinal hernia surgery and receiving bupivacaine or a bupivacaine-fentanyl combination under spinal anesthesia.

PATIENTS AND METHODS

This study was conducted in the Anesthesiology and Reanimation Clinic at Haydarpaşa Numune Training and Research Hospital on 60 patients in the American Society of Anesthesiologists (ASA) I-II group (57 males, 3 females; mean age: 45.9±16.1 years; range, 19 to 76 years) who were planned for outpatient inguinal hernia surgery between January 2004 and January 2005.

The patients were divided into three groups of 20 at random. There were no premedicated patients. All patients were given 7 mL/kg of Ringer's lactate solution 30 min before the operation. The patients were positioned on their sides, with the to be operated side down. A 26-gauge Atraucan (B Braun Medical, Shanghai, China) spinal needle was inserted into the L3-4 or L4-5 interspaces from the middle line.

Group 1 received 7.5 mg 0.5% hyperbaric bupivacaine + 0.5 mL isotonic in a 2 mL volume, Group 2 received 7.5 mg 0.5% hyperbaric bupivacaine+25 mcg fentanyl in a 2 mL volume, and Group 3 received 10 mg 0.5% hyperbaric bupivacaine in a 2 mL volume.

Patients were placed in their side position for 15 min and then turned into a supine position. Until the patients were turned to the supine position, the maximum level of the sensory block on to be operated side, the times for sensory block to reach the T10 level, and sensory and motor block levels at the 3rd, 5th, 10th, and 15th min were all recorded. The level of sensory and motor block on the opposite side, the time for sensory regression of two dermatomes on the side to be operated on, and the time for the motor block to disappear were all recorded after the patients were turned to the supine position. The level of sensory block was assessed by the pin-prick test, and the level of motor block was assessed by the Bromage scale (0=no motor block, 1=hip flexion blocked, 2=Hip and knee flexion blocked, 3=complete block).

Side effects (nausea, hypotension, bradycardia, pruritus) were recorded during the operation. Complications such as urinary retention, headache, and neurological sequelae were recorded by calling patients on the 6th, 24th, and one week after the spinal block.

Statistical analysis was performed using the SPSS version 10.0 software (SPSS Inc., Chicago, IL, USA). When evaluating study data, descriptive statistical methods (mean, standard deviation) and quantitative data were compared; in parameters with normal distribution, the One-Way ANOVA test, and the Student's t-test were used; in parameters with non-normal distribution, the Kruskal-Wallis test and the Mann-Whitney U test were used. To compare qualitative data, the chi-square test was used. The results were within the 95% confidence interval; $p>0.05$ was statistically insignificant, $p<0.05$ was statistically significant, $p<0.01$ was statistically highly significant, and $p<0.001$ was considered statistically very highly significant.

RESULTS

The groups were compared in terms of age, height, weight, sex, American Society of Anesthesiologists (ASA) score, and operation time. There was no statistically significant difference found, as shown in Table 1. When the systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), and peak heart rate (HR) were examined, although there was no significant difference between the groups, the change over time was found to be significant within the groups, as shown in Tables 2-5.

A significant difference was found when the sensory block changes between the groups were

Table 1. Comparison of demographic characteristics of groups

	Group 1 (n=20)			Group 2 (n=20)			Group 3 (n=20)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			48.1±14.8			40.2±16.7			49.5±16.0	0.146
Height (cm)			173.4±6.5			171.4±7.0			168.8±7.6	0.133
Weight (kg)			74.5±12.7			71.3±8.9			74±13.6	0.656
Operation time (min)			65.7±20.2			82.4±34.1			82.7±21.5	0.07
Sex										1.000
Male	19	95		19	95		19	95		
Female	1	5		1	5		1	5		
ASA class										1.000
I	7	35		7	35		7	35		
II	13	65		13	65		13	65		

SD: Standard deviation; ASA: American Society of Anesthesiologists; p<0.05 is considered significant.

Table 2. Comparison of intragroup and intergroup SAP

	Group 1	Group 2	Group 3	
SAP	Mean±SD	Mean±SD	Mean±SD	*p*
Baseline	135.0±18.3	148.1±22.5	142.2±19.5	0.130
1 min after the block	126.6±19.5†	131.7±15.9†	128.1±24.8†	0.715
3 min	121.1±21.1†	128.2±19.2†	126.3±27.3†	0.598
5 min	116.9±18.8†	127.2±24.8†	124.6±27.9†	0.376
10 min	118.9±19.5†	129.6±23.0†	125.4±29.3†	0.382
15 min	122.2±16.2†	133.4±19.6†	122.8±29.8†	0.221
20 min	122.6±19.4†	128.5±16.3†	128.9±25.8†	0.565
30 min	124.9±16.2†	124.5±13.9†	121.0±25.4†	0.773
40 min	125.0±17.1†	122.6±14.2†	125.1±25.1†	0.898
50 min	125.0±17.1†	124.2±13.7†	124.2±24.4†	0.987
60 min	127.2±14.1†	125.7±15.1†	128.5±24.0†	0.906
80 min	122.9±19.0†	128.7±15.9†	122.9±15.8†	0.594

SD: Standard deviation; SAP: Systolic arterial pressure; † In group comparisons; p<0.05 is considered significant.

Table 3. Comparison of intragroup and intergroup DAP

	Group 1	Group 2	Group 3	
DAP	Mean±SD	Mean±SD	Mean±SD	*p*
Baseline	77.6±12.9	86.5±14.1	86.6±13.8	0.066
1 min after the block	74.9±16.1	79.3±13.6†	81.3±15.4	0.399
3 min	72.9±18.6	77.7±15.8†	78.9±14.4†	0.470
5 min	72.7±15.3	76.8±14.3†	78.6±15.9	0.463
10 min	71.6±16.8†	78.6±14.2†	77.4±19.4	0.382
15 min	73.1±14.1	81.4±16.3†	76.1±16.3†	0.238
20 min	75.7±12.8	76.4±12.3†	80.1±18.7	0.598
30 min	76.6±7.1	73.6±11.8†	77.2±13.4†	0.550
40 min	76.6±7.9	75.9±11.0†	78.4±14.4†	0.767
50 min	76.0±8.9	74.0±11.2†	80.8±12.0	0.126
60 min	77.0±8.6	79.3±10.4†	76.4±13.9†	0.737
80 min	72.4±8.0	81.7±10.2†	78.5±10.6†	0.161

SD: Standard deviation; DAP: Diastolic arterial pressure; † In group comparisons; p<0.05 is considered significant.

Table 4. Comparison of intragroup and intergroup MAP

	Group 1	Group 2	Group 3	
MAP	Mean±SD	Mean±SD	Mean±SD	*p*
Baseline	98.6±15.8	104.5±19.0	105.0±13.8	0.392
1 min after the block	93.7±15.5	96.5±13.9†	97.2±17.0†	0.757
3 min	90.3±18.5†	95.7±15.6†	94.7±17.0†	0.564
5 min	87.3±14.9†	93.2±15.9†	93.9±20.3†	0.418
10 min	88.6±16.2†	97.3±16.7	94.3±22.8†	0.343
15 min	88.2±16.2†	97.9±15.5	93.1±19.7†	0.214
20 min	92.3±13.0	93.3±11.5†	95.6±19.9†	0.777
30 min	92.8±10.0	89.7±10.9†	92.3±18.6†	0.745
40 min	92.7±11.1	90.4±11.8†	93.2±17.5†	0.793
50 min	92.7±10.7	89.5±11.7†	94.7±15.6†	0.430
60 min	93.6±10.8	94.1±9.5†	94.6±15.4†	0.970
80 min	90.6±11.8	96.5±11.6†	90.9±13.4†	0.434

SD: Standard deviation; MAP: Mean arterial pressure; † In group comparisons; p<0.05 is considered significant.

Table 5. Comparison of intragroup and intergroup peak HR

	Group 1	Group 2	Group 3	
HR	Mean±SD	Mean±SD	Mean±SD	*p*
Baseline	74.6±10.9	77.1±14.5	80.5±16.0	0.413
1 min after the block	73.9±11.6	79.5±12.3	84.0±17.1	0.080
3 min	75.8±11.0	80.2±10.3	83.9±19.1	0.202
5 min	75.0±11.4	79.8±12.0	87.0±23.0†	0.072
10 min	74.1±12.4	80.2±13.4	83.1±16.1	0.124
15 min	75.2±9.9	80.1±12.9	84.3±17.7	0.122
20 min	73.8±10.8	75.0±12.8	81.0±13.7	0.158
30 min	70.7±9.9	72.7±13.6	73.4±14.7f	0.796
40 min	67.5±8.4†	70.1±7.5†	74.9±15.4	0.111
50 min	67.8±13.6†	66.6±7.6†	68.1±11.2f	0.902
60 min	67.7±9.8†	67.2±7.6†	71.2±12.7	0.453
80 min	62.6±6.8†	63.1±9.2†	70.9±15.3	0.153

SD: Standard deviation; HR: Heart rate; † In group comparisons; p<0.05 is considered significant.

Table 6. Characteristics of sensory block levels among the groups

	Group 1	Group 2	Group 3	
Sensory block	Mean±SD	Mean±SD	Mean±SD	*p*
3 min	L2±l (L1-L3)	T12±2 (T10-L4)	Ll±l (T11-L4)	0.001*
5 min	T12±1(T11-L1)	Tl 1±1 (T8-L2)	Tl 1±1 (T9-L2)	0.002*
10 min	Tl 1±1 (T8-T12)	Tl 0±1 (T8-T12)	T10±l (T8-T12)	0.006*
15 min	T10±l (T7-T11)	T9±l (T6-T10)	T9±l (T6-T10)	0.001*

SD: Standard deviation; * p<0.05 is considered significant.

Table 7. Distribution of block duration among the groups

	Group 1	Group 2	Group 3	
	Mean±SD	Mean±SD	Mean±SD	*p*
Time to reach the T10 sensory block (min)	11.9±3.0	8.3±4.0	8.8±2.5	0.003*
Regression time of two dermatomes of sensory block	78.3±6.8	95.3±14.0	87.8 18.0	0001*
Duration of motor block (min)	172.5±22.2	178.4±22.4	200.8±28.3	0.001*

SD: Standard deviation; * $p<0.05$ is considered significant.

Table 8. Distribution of complications and side effects among groups in the first 6 h

	Group 1		Group 2		Group 3			
	n	%	n	%	n	%	χ^2	*p*
Nausea	2	10.0	1	5.0	1	5.0	0.536	0.765
Hypotension	2	10.0	1	5.0	4	20.0	2.264	0.322
Bradycardia	-	-	-	-	2	100	4.138	0.126
Urinary retention	-	-	5	25.0	-	-	10.909	0.004*
Headache	-	-	1	5.0	-	-	2.034	0.362
Pruritus	-	-	2	10.0	-	-	2.105	0.349

* $p<0.05$ is considered significant.

compared, as shown in Table 6. In all three groups, the duration of the block was significantly different, as shown in Table 7. Only urinary retention was different when the complications in the first 6 h were evaluated, as shown in Table 8.

DISCUSSION

In outpatient inguinal hernia surgery, regional anesthesia techniques are used as an alternative to general anesthesia. In the cases to be undergoing inguinal hernia surgery in our study, the unilateral spinal block obtained with 7.5 mg 0.5% hyperbaric bupivacaine (1.5 mL) + 25 mcg fentanyl (0.5 mL) was compared to 7.5 mg 0.5% hyperbaric bupivacaine (1.5 mL) + isotonic 0.5 mL and 10 mg 0.5% hyperbaric bupivacaine (2 mL) in terms of hemodynamics and postoperative compilation.

All three groups were given 7 mL/kg of Ringer's lactate solution before the block. Hypotension developed in two patients (10%) in Group 1, one (5%) patient in Group 2, and four (20%) patients in Group 3. These values were found to be consistent with the findings of Casati et al.,[7,8] and Esmaoğlu et al.[9,10]

In the study by Vaghadia et al.,[11] using unilateral spinal anesthesia, there was no change in oxygen saturation, and oxygen saturation in all patients remained above 95% throughout the operation, despite the fact that no patient received oxygen support during the operation.[3] Casati et al.[12] administered oxygen to patients via a face mask only when necessary, rather than on a regular basis, in all of their studies involving unilateral spinal anesthesia.[4]

In our study, no statistically significant difference in HR values was found between the groups. Only two (10%) patients in Group 3 developed bradycardia. These values were found to be consistent with the results of Casati et al.[7] However, after the 40th min of the operation, HR values in all three groups decreased significantly compared to the beginning. We attributed this to the vagal reflex caused by peritoneal retraction during the operation.

Patients in our study were not routinely given oxygen. Throughout the operation, all patients' oxygen saturation levels remained above 96%. These values were found to be consistent with the results of Vaghadia et al.,[11] and Casati et al.[7,8]

In patients to be undergoing arthroscopic knee surgery, Fanelli et al.[12] used unilateral spinal anesthesia with 8 mg 0.5% hyperbaric bupivacaine. They found the maximum sensory block level to be T9, the maximum sensory block formation time to be 16 min., and the regression time of two dermatomes of sensory block to be 99±28 min using a pin-prick test on the to-be-operated side.

In a study using 8 mg 0.5% hyperbaric bupivacaine in unilateral spinal anesthesia in a similar patient group, Casati et al.[7,8] found the maximum sensory block level at T10 (L1-T2) on the operated side, the maximum sensory block formation time of 20 min (5-30), and the regression time of two dermatomes of sensory block to 80 min (30-135).

In our study, in unilateral spinal anesthesia, the maximum level of the sensory block on to be operated side and the regression time of the two dermatomes of the sensory block were; T10±1, 78.30±6.79 min in Group 1, T9±1, 87.8±79.9 min in Group 3. These values were found to be compatible with Fanelli et al.[12] and Casati et al.[8] The maximum sensory block level was found to be significantly lower in Group 1, and the regression time of two dermatomes was significantly shorter than in Group 3. Accordingly, adequate perioperative anesthesia could not be achieved in Group 1, necessitating the use of additional intravenous analgesia and sedation. We presume that the time to initiate postoperative analgesia would be longer in the fentanyl group because the regression of sensory block was delayed in our study.

Pruritus was observed at a rate of 60% in the group in which Vaghadia et al.[11] combined fentanyl with local anesthesia, while no pruritus was observed in the group in which only local anesthetic was used. In a similar study by Ben-David et al.,[13] pruritus was observed at a rate of 12% in the group to which they added fentanyl. In our study, mild pruritus was observed in two patients (10%) in the group in which we added fentanyl to local anesthesia. These values were found to be consistent with the findings of Ben-David et al.[13] There was no pruritus in any of the patients in the other two groups, where only local anesthetic was used.

In a study by Chan et al.,[14] 7% of patients developed urinary retention after receiving 0.75% hyperbaric bupivacaine, and a urinary catheter was inserted into them. In Casati et al.'s[7,8] unilateral spinal anesthesia study using 8 mg 0.5% hyperbaric bupivacaine, only one (3.33%) patient developed urinary retention. Urinary retention developed in seven (17%) patients in Gupta et al.'s[15] study of spinal anesthesia technique in inguinal hernia surgery by adding 6 mg and 7.5 bupivacaine and 25 mcg fentanyl in 40 patients, and a urinary catheter was inserted in them.

In our study, urinary retention developed in five (25%) patients in Group 2 with fentanyl, and a urinary catheter was inserted. It was observed that urinary retention improved in the patients whose urinary catheter was removed at the 6th h.

In conclusion, due to insufficient anesthesia quality, Group 1 with 7.5 mg 0.5% hyperbaric bupivacaine should not be preferred in outpatient inguinal hernia surgery. Group 2 with 25 mcg fentanyl added to 7.5 mg 0.5% hyperbaric bupivacaine and Group 3 with 10 mg 0.5% hyperbaric bupivacaine may be alternatives, but we concluded that Group 3 was more advantageous because urinary retention was higher in the fentanyl-administered group.

Ethics Committee Approval: The study protocol was approved by the Haydarpaşa Numune Training and Research Hospital Ethics Committee (2003). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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