



The effects of sufentanil added to low-dose hyperbaric bupivacaine in unilateral spinal anaesthesia for outpatients undergoing knee arthroscopy

Günübirlik diz artroskopisinde tek taraflı spinal anesteziye düşük doz hiperbarik bupivakaine eklenen sufentanilin etkileri

Nezih SERTÖZ,¹ İnan AYSEL,² Meltem UYAR¹



Summary

Objectives: The aim of this study is to examine the effects of sufentanil added to low-dose hyperbaric bupivacaine in unilateral spinal anaesthesia for outpatients undergoing knee arthroscopy.

Methods: Sixty two patients (ASA I-II) aged 20 to 50 who were planning on undergoing a knee arthroscopy were enrolled in this study. Patients were randomly divided into two groups. Unilateral spinal anaesthesia with 1ml 0.5% hyperbaric bupivacaine was administered to Group B (n=33); and unilateral spinal anaesthesia with 0.5ml (2.5µg) sufentanil added to 1ml hyperbaric bupivacaine was administered to Group BS (n=29).

Results: There were no statistically significant differences observed between the groups in terms of demographic data, hemodynamic parameters, maximum sensorial, sympathetic and motor block levels, time to motor block resolution, and time of discharge (p>0.05). There were statistically significant differences between the groups in terms of two segments regression time (Group B=52 min., Group BS=59 min.), ambulation time (Group B=147 min., Group BS=157 min.) and urination time (Group B=136 min., Group BS=149 min.) (p<0.05). In this study, no itching was observed in Group B, whereas seven patients in Group BS were observed as having postoperative itching (p<0.05).

Conclusion: All patients were successfully given unilateral spinal anaesthesia with sufentanil added to low-dose hyperbaric bupivacaine for an outpatient knee arthroscopy, without affecting the time of discharge. However, for one-day interventions such as arthroscopy, it was concluded that administration of only low-dose hyperbaric bupivacaine was sufficient.

Key words: Bupivacaine; outpatient knee arthroscopy; sufentanil; unilateral spinal anaesthesia.

Özet

Amaç: Bu çalışmada günübirlik diz artroskopisi uygulanan hastalarda düşük doz hiperbarik bupivakaine sufentanil eklenmesinin tek taraflı spinal anesteziye etkilerinin incelenmesi amaçlanmaktadır.

Gereç ve Yöntem: 20-50 yaş arasında ASA fiziksel durumu I-II olan ve diz artroskopisi yapılması planlanmış 62 hasta çalışmaya dahil edildi. Hastalar iki gruba randomize edildi. 1 ml %0.5 hiperbarik bupivakain ile unilateral spinal anestezi Grup B'ye (n=33) ve 0.5ml (2.5µg) sufentanilin 1 ml hiperbarik bupivakaine eklenmesi ile yapılan unilateral spinal anestezi Grup BS'ye (n=29) uygulandı.

Bulgular: İki grup arasında sosyodemografik değişkenler, hemodinamik parametreler, maksimum duysal, sempatik ve motor blok seviyeleri, motor blok çözünme zamanı ve taburculuğa kadar geçen süre açısından istatistiksel anlamlı farklılık gözlenmedi (p>0.05). İki grup arasında iki segment gerileme zamanı (Grup B: 52 dk, Grup BS: 59dk), ambulasyon zamanı (Grup B: 147 dk, Grup BS: 157 dk) ve ürinasyon zamanı (Grup B: 136 dk, Grup BS: 149 dk) açısından istatistiksel anlamlı farklılıklar vardı (p<0.05). Bu çalışmada Grup B'de kaşıntı gözlenmezken, Grup BS'de yedi hastada ameliyat sonrası kaşıntı gözlendi (p<0.05).

Sonuç: Günübirlik artroskopi uygulanan tüm hastalara taburculuk süresini uzatmaksızın düşük doz hiperbarik bupivakaine sufentanil eklenmesi ile tek taraflı spinal anestezi başarıyla uygulanmıştır. Ancak, artroskopi gibi günübirlik girişimlerde, tek başına düşük doz hiperbarik bupivakain uygulamasının da yeterli olduğu sonucuna varılmıştır.

Anahtar sözcükler: Bupivakain; günübirlik diz artroskopisi; sufentanil; tek taraflı spinal anestezi.

¹Department of Anesthesiology, Ege University Faculty of Medicine, Izmir, Turkey;

²Department of Anesthesiology, Emot Hospital, Izmir, Turkey

¹Ege Üniversitesi Tıp Fakültesi, Anesteziyoloji Anabilim Dalı, İzmir;

²Emot Hastanesi, Anesteziyoloji Bölümü, İzmir

Submitted (Başvuru tarihi) 15.08.2012 Accepted after revision (Düzeltilme sonrası kabul tarihi) 17.02.2014

Correspondence (İletişim): Dr. Nezih Sertöz. Ege Üniversitesi Anesteziyoloji ve Reanimasyon Kliniği, 35100 Izmir, Turkey.

Tel: +90 - 232 - 390 27 39 e-mail (e-posta): nezihsertoz@mynet.com

Introduction

Outpatient operations are increasingly becoming popular due to a reduction in costs through occupation of fewer hospital beds, minimizing the possibility of hospital-acquired infections; and for the positive effects on patient psychology.^[1,2] The main goal in surgical anesthesia for outpatients is to provide sufficient preoperative anesthesia, and postoperative early recovery. Therefore, spinal anesthesia is an acceptable option in surgery for outpatients, as it has a short anesthesia start time, provides an adjustable anesthesia level, postoperative analgesia and early recovery.^[3,4] In recent years, the “unilateral spinal anesthesia” method has been popular. This method reduces the required amount of anesthetic agent and the incidence of side effects that limiting sensory and motor block within the region requiring anesthesia.^[5,6] However, particularly in unilateral spinal anesthesia, insufficient spinal anesthesia was reported to occur when using low-dose local anesthetics. Addition of opioids to local anesthetic agents, due to their synergistic effect, results in enhancement of the quality of analgesia and anesthesia, extension of sensorial block and the reduction of local anesthetic requirement.^[7-9] Therefore, the combined use of low-dose local anesthetic and opioids is beneficial, concerning surgical anesthesia for outpatients.^[10,11] However, the addition of opioid to local anesthetic agents may impact the time of discharge and side effect incidence. Particularly, in the case of spinal opioid administration, itching was demonstrated at a high rate of 20% to 80%.^[12] Consequently, the advantage of adding opioid to a low-dose local anesthetic agent in spinal anesthesia is still disputable in short term interventions. The primary objective of current study was to enhance the quality of anesthesia by adding sufentanil to local anesthetic, Our secondary objective was by adding opioid to local anesthetic would shorten discharge time.

Materials and Methods

After obtaining approval from the local ethics committee and written, informed consent from each patient, 62 patients between the ages of 20 and 50, awaiting knee arthroscopy and from the ASA I-II group were enrolled in the study. Patients with psychiatric problems, bone deformity, infection or chronic skin problems on the knee's skin surface, pe-

ripheral neuropathy, diabetes, previously known local anesthetic allergy and coagulopathy, and patients who use an anticoagulant were excluded from the study.

Non-invasive artery pressure rates and heart rates (HR) of patients taken to the operating room prior to premedication were monitored through a Hewlett Packard, Viridia 24C monitor, and recorded at 5 minutes intervals during their operation. In all of the patients a vascular access was made available by 18 G branule from the adversary side of extremities to be operated, and an infusion of 10ml/kg 0.9% NaCl was started 15 minutes prior to the operation. Patients were divided into two groups randomly. Unilateral spinal anesthesia with 1ml 0.5% hyperbaric bupivacaine was administered to Group B (n=33); and unilateral spinal anesthesia with 0.5ml (2.5 µg) sufentanil added to 1ml hyperbaric bupivacaine was administered to Group BS (n=29). The patients in Group B or Group BS were injected within 40 seconds with 1 ml (5 mg) of 0.5% hyperbaric bupivacaine (Marcaïn 0.5% Heavy®, AstraZeneca) and 1 ml (5 mg) of 0.5% hyperbaric bupivacaine + 0.5 ml (2.5 µg) of sufentanil (Sufenta® 5 µg/ml, Janssen-Cilag), respectively. Two anesthesiologists took part in current study to ensure blindness. One of them administered the spinal anesthesia, the other one evaluated the study paramaters. Therefore neither the anesthesiologist who made the evaluation nor the patients were aware of the groups. All of the patients were laid down in the lateral decubitus position to have the side of which pathology remains beneath during spinal anesthesia, and the intervention was performed using a 25 G pencil-point spinal needle through L3-4 gap. The aperture of the spinal needle was turned to the side to be operated. All of the patients were back to supine position after being held in lateral decubitus position for 20 minutes. During the operation, the arterial blood pressure was considered as significant where it was lower than the initial systolic value with more than 30%; fluid replacement (250 ml of 0.9% NaCl, IV infusion in 5 minutes) was performed, and, if necessary, IV 5mg ephedrine was given until the arterial pressure reached normal values. In case of development of bradycardia (HR <45/min) IV 0.5 mg atropine sulphate was given. The period from the injection of local anesthetic to the surgical anesthesia (Level

Th12) was recorded as the time for the genesis of surgical anesthesia. Pinprick test was used for maximum sensorial block level assessment; whereas cold test tube and Bromage scale were used for maximum sympathetic block level assessment and motor block level assessment, respectively. Results were recorded individually at 5 minutes intervals. The time in which the sensory block goes two segments down, beginning from the maximum level was recorded as “two segments regression time,” and the time in which motor block was completely removed as “time of block resolution.” The time between local anesthetic administration and urinating without medical aid was recorded as “urination (micturition) time”, the time between local anesthetic administration and proper postoperative walking without dizziness and help as “ambulation time.” and finally, the time of discharge after local anesthetic administration [when reached 9-10 points as per (Postanesthetic Discharge Scoring System PADS)] as “time of discharge”.^[13] Where the patient had analgesic demand and having a VAS score of ≥ 5 , it was recorded as “first analgesic requirement” within the period from the end of the operation until the time of discharge. The patients with analgesia requirement were administered 75 mg of diclofenac sodium IM. The side effects were recorded. Patients were monitored in a postoperative care unit until they were discharged.

Statistical analysis

In current study our primary outcome was discharge time. Therefore to reach statistically significant difference between two groups; sample size was calculated by accepting an alpha risk of 5% and a power (1- β) of 80%. From this calculation 25 subjects in each group were found to be necessary for a significant difference.

In our study, Chi Square test was used to compare

hypotension development, additional fluid need, vasopressor need, and to compare maximum sensorial, sympathetic and motor block levels. The comparison of the onset time of surgical anesthesia, two segments regression time, motor block resolution time, urination time, ambulation and being home periods, additional requirement for analgesia, the incidence of side effects development were performed by using Student T-test. Variance analysis (Anova test) was applied for repetitive measurements of hemodynamic data. Paired comparisons of measurement times were performed using Bonferroni correction. $P < 0.05$ was accepted as significant.

Results

A total of 62 patients were included in the study. There was no statistically significant difference between groups in terms of demographic characteristics of the patients (Table 1).

The onset time of surgical anesthesia was determined as 11.1 ± 3.48 min. in Group B, while as 11.2 ± 3.22 min. in Group BS ($p > 0.05$). There were no statistically significant differences between groups in terms of sensorial, sympathetic and motor block levels ($p > 0.05$) (Table 2).

Three patients in Group B experienced tourniquet pain due to insufficient spinal anesthesia, and they were excluded from proceeding to general anesthesia, therefore 29 patients in Group BS and 30 patients in Group B were evaluated. There was no statistically significant difference between groups in terms of spinal anesthesia sufficiency ($p > 0.05$).

Although the patients were kept in lateral decubitus position for 20 minutes, seven patients in both groups (~23%) developed sensorial, sympathetic and motor blocks also on the non-operated side (bilateral) ($p > 0.05$) (Table 2).

Table 1. Demographic data

	Gender (Female/Male)	Age (year)	Weight (cm)	Height (kg)
	n	Mean \pm SD	Mean \pm SD	Mean \pm SD
Group B	16/14	37.6 \pm 8.9	74.1 \pm 13.8	166.6 \pm 8.6
Group BS	10/19	38.4 \pm 9.9	77.5 \pm 14.7	168.5 \pm 9.9

Table 2. Maximum sensorial block, sympathetic block and motor block levels of the groups

	Group B (n=30) operated side		Group B (n=7) non-operated side		Group BS (n=29) operated side		Group BS (n=7) non-operated side	
	n	%	n	%	n	%	n	%
Maximum sensorial block level								
Th 6 level	2	6.7	0	0	3	10.3	0	0
Th 8 level	4	13.3	0	0	5	17.2	0	0
Th 10 level	24	80	2	28	18	62.1	2	28
Th 12 level	0	0	4	57	3	10.3	5	72
L 1 level	0	0	1	15	0	0	0	0
Maximum sympathetic block level								
Th 6 level	1	3.3	0	0	0	0	0	0
Th 8 level	6	20	0	0	7	24.1	0	0
Th 10 level	17	56.7	0	0	13	44.8	3	43
Th 12 level	6	20	6	85	9	31.1	3	43
L1 level	0	0	1	15	0	0	1	14
Motor block degree								
1st degree block	0	0	3	43	0	0	4	57
2nd degree block	1	3.3	4	57	2	6.9	3	43
3rd degree block	29	96.7	0	0	27	93.1	0	0

There were no statistically significant differences between two groups in terms of hemodynamic parameters ($p>0.05$). One patient in Group BS experienced hypotension, requiring treatment during operation.

Two segment regression time, urination time and ambulation time were found to be longer, and as statistically significant, in Group BS than in Group B (59.1 ± 11.4 min, 52.3 ± 10.1 min; 149.8 ± 16 min, 136.5 ± 26.5 min; 157.6 ± 14.5 min, 147.5 ± 18 min, respectively) ($p<0.05$). But there were no statistically significant differences in terms of motor block reso-

lution and discharge times between groups ($p>0.05$, respectively, see Table 3).

When assessing side effects, three patients in Group BS and one patient in Group B were inserted a foley catheter due to urinary retention ($p>0.05$). Those four patients were assessed in terms of urinary retention, and excluded from statistics during urination time measurements. Including urticaria in one of the patients in Group BS, and light erythema in another, a total of seven patients (24.7%) experienced itching, and there was a statistically significant difference when compared with Group B ($p<0.05$). No

Table 3. Recovery parameters of the groups

	Group B (n=30)	Group BS (n=29)	p
	Mean±SD	Mean±SD	
Two segments regression time (min)	52.3±10.1	59.1±11.4	0.018*
Motor block resolution time (min)	121±21.1	129.8±16.1	0.077
Urination time (min)	136.5±26.5	149.8±16	0.028*
Ambulation time (min)	147.5±18	157.6±14.5	0.022*
Discharge time (min)	220±24.1	224±30.2	0.579

* $p<0.05$

Table 4. Side effects

	Group B		Group BS	
	n	%	n	%
Itching	0	0	7	24.7*
Urinary retention	1	3.3	3	10.3
Respiratory depression	0	0	0	0

*p<0.05

patient's itching reached at a level to require medication or to develop extreme disturbance, except one. In Group B, two patients needed additional analgesia, but there was no statistical significant difference between groups in terms of additional analgesic need ($p>0.05$). No respiratory depression developed in either of the groups (Table 4).

Discussion

In current study, a sufficient anesthesia level without any problems was achieved at a rate of 90% by 5 mg bupivacaine alone in unilateral spinal anesthesia for outpatients undergoing knee arthroscopy, and also a sufficient anesthesia was provided for all of the patients without elongating the discharge time when 2.5 µg sufentanil is added to 5 mg bupivacaine.

Although unilateral spinal anesthesia is applied intensively in knee arthroscopy, there remains ongoing debate on the optimal local anesthetic dose.^[5,6,14-16] In studies by Casati et al.^[14,17] 5-8 mg of 0.5% of hyperbaric bupivacaine was reported to be sufficient, and 60-80% successive unilateral spinal anesthesia was reported at those doses, and a spinal block was reported to be provided for 50-120 minutes at Th10 level. It has been shown that 7.5 mg 0.5% hyperbaric bupivacaine, levobupivacaine, ropivacaine along with 5 mg 0.5% hyperbaric levobupivacaine may be used in knee arthroscopy.^[6,15] In this study, unilateral spinal anesthesia was performed using 5mg of 0.5% hyperbaric bupivacaine as a low-dose local anesthetic. We provided sufficient anesthesia to Group B patients at a rate of 90% and Group BS patients at a rate of 100%.

Kuusniemi et al.^[18,19] compared the effects of low-dose 0.5% isobaric bupivacaine (1.2 ml=6 mg) and 0.18% hypobaric bupivacaine (3.4 ml=6.1 mg) and,

although they used a different volume, they did not find any significant differences on the expansion and duration of sensorial and motor blocks. Their study resulted in similar motor and sensorial blocks, with bupivacaine again in low doses and in various volumes and concentrations, and they have explained this finding with the fact that patients were kept in the lateral position for 20 minutes. In our study, patients were kept in the lateral position for the same time period, and low-dose bupivacaine was used in the same dose in different volumes. Consequently, there were no statistically significant differences between groups in terms of sensorial, sympathetic and motor block levels.

In the literature, there are also studies indicating that reducing the local anesthetic dose increases the incidence of unsuccessful unilateral spinal anesthesia. Valanne et al.,^[16] in their study involving 106 patients, found insufficient blocks in two patients to whom 4 mg hyperbaric bupivacaine was administered, and in one patient to whom 6 mg hyperbaric bupivacaine was administered. Also, in our study, three of the patients in Group B to whom no opioid was added had insufficient spinal anesthesia and general anesthesia was therefore administered. There was no statistically difference was found in terms of sufficient spinal anesthesia in our study between the two groups. But since insufficient anesthesia was not observed in any of the patients with 2.5 µg sufentanil, this showed us that a dose of 2.5 µg sufentanil was sufficient, but that a higher dose of sufentanil was not necessary due to itching.

In our study we preferred sufentanil because it is more lipophilic than both morphine and fentanyl and it penetrates rapidly into the spinal cord, and provides an excellent segmental analgesia in short term surgical implementations.^[20,21]

In a number of studies in the literature, it has been indicated that better anesthesia conditions have been provided when adding sufentanil to local anesthetics. Waxler et al.^[22] have achieved problem-free anesthesia in all patients by adding 10 µg sufentanil to IT low-dose (15 mg) lidocaine. Qian et al.^[23] also determined better perioperative conditions and short recovery time by adding 5 µg sufentanil to IT low-dose (10 mg) ropivacaine in caesarean operations, and anesthesia was proven to be sufficient in all of the participating patients. Olofsson et al.^[24] in their study determined better hemodynamics and lower vasopressor need by adding 5 µg sufentanil to IT low-dose (7.5 mg) bupivacaine, in older patients to whom total hip replacement was applied and they reported that sufficient anesthesia levels were reached in all patients. However, in those studies, there were differences between local anesthetic doses which were used alone, and in combination with sufentanil (local anesthetic alone versus local anesthetic + sufentanil). In sufentanil added groups hemodynamic stability and reduced recovery time, were more likely due to decreased local anesthetic dose. In our study, identical doses of local anesthetics were used in both groups, and sufentanil caused no statistically significant differences either in hemodynamics or in recovery parameters.

Itching, unfortunately, is a well-known side effect of IT opioid. There is a correlation between itching and the sufentanil dose used.^[25,26] Demiraran et al.^[25] have used three different doses of sufentanil, 1.5, 2.5 and 5 µg, and they have determined 4%, 24%, and 32% rates of itching, respectively. Dahlgren et al.^[26] have found the incidence of itching in the group that received 2.5 µg sufentanil as 35%, and in the group that received 5 µg sufentanil as 45%; most of the patients in the group that received 5 µg sufentanil required medical treatment. In our study, we have also used IT 2.5 µg sufentanil, and similarly to the literature, we have determined an itching rate of 25%. We believe that the relatively lower itching rate is due to the low dose of sufentanil.

Another side effect in our study was urinary retention. However the rate of urinary retention was very low and there was no statistically significant difference between groups.

Consequently, low dose (5 mg) bupivacaine in combination with 2.5 µg sufentanil provided sufficient anesthesia in unilateral spinal anesthesia in knee arthroscopy. However reduced local anesthetic dose did not serve an advantage in terms of discharge time. In addition, addition of sufentanil caused significant itching.

Considering side effects, further research is required to demonstrate the advantages and disadvantages of sufentanil added to low dose bupivacaine in unilateral spinal anesthesia for outpatients undergoing orthopedic surgery.

Conflict-of-interest issues regarding the authorship or article: None declared.

Peer-review: Externally peer-reviewed.

References

1. Burden N. Outpatient surgery: a view through history. *J Peri-anesth Nurs* 2005;20(6):435-7. [CrossRef](#)
2. Warner MA, Shields SE, Chute CG. Major morbidity and mortality within 1 month of ambulatory surgery and anesthesia. *JAMA* 1993;270(12):1437-41. [CrossRef](#)
3. Liu SS, Strodtbeck WM, Richman JM, Wu CL. A comparison of regional versus general anesthesia for ambulatory anesthesia: a meta-analysis of randomized controlled trials. *Anesth Analg* 2005;101(6):1634-42. [CrossRef](#)
4. Urmey WF. Spinal anaesthesia for outpatient surgery. *Best Pract Res Clin Anaesthesiol* 2003;17(3):335-46. [CrossRef](#)
5. Esmoğlu A, Karaoğlu S, Mizrak A, Boyacı A. Bilateral vs. unilateral spinal anesthesia for outpatient knee arthroscopies. *Knee Surg Sports Traumatol Arthrosc* 2004;12(2):155-8. [CrossRef](#)
6. Cappelleri G, Aldegheri G, Danelli G, Marchetti C, Nuzzi M, Iannandrea G, et al. Spinal anesthesia with hyperbaric levobupivacaine and ropivacaine for outpatient knee arthroscopy: a prospective, randomized, double-blind study. *Anesth Analg* 2005;101(1):77-82. [CrossRef](#)
7. Dahl JB, Jeppesen IS, Jørgensen H, Wetterslev J, Møiniche S. Intraoperative and postoperative analgesic efficacy and adverse effects of intrathecal opioids in patients undergoing cesarean section with spinal anesthesia: a qualitative and quantitative systematic review of randomized controlled trials. *Anesthesiology* 1999;91(6):1919-27. [CrossRef](#)
8. Karaman S, Kocabas S, Uyar M, Hayzaran S, Firat V. The effects of sufentanil or morphine added to hyperbaric bupivacaine in spinal anaesthesia for caesarean section. *Eur J Anaesthesiol* 2006;23(4):285-91. [CrossRef](#)
9. Skak C, Rasmussen A, Kirkegaard P, Secher NH. Cerebral oxygen saturation and blood flow during liver transplantation. *Anesth Analg* 1997;84(4):730-3. [CrossRef](#)
10. Ben-David B, DeMeo PJ, Lucyk C, Solosko D. A comparison of minidose lidocaine-fentanyl spinal anesthesia and local anesthesia/propofol infusion for outpatient knee arthroscopy. *Anesth Analg* 2001;93(2):319-25. [CrossRef](#)
11. Vaghadia H, McLeod DH, Mitchell GW, Merrick PM, Chilvers

- CR. Small-dose hypobaric lidocaine-fentanyl spinal anesthesia for short duration outpatient laparoscopy. I. A randomized comparison with conventional dose hyperbaric lidocaine. *Anesth Analg* 1997;84(1):59-64. [CrossRef](#)
12. Szarvas S, Harmon D, Murphy D. Neuraxial opioid-induced pruritus: a review. *J Clin Anesth* 2003;15(3):234-9. [CrossRef](#)
 13. Chung F, Chan VW, Ong D. A post-anesthetic discharge scoring system for home readiness after ambulatory surgery. *J Clin Anesth* 1995;7(6):500-6. [CrossRef](#)
 14. Casati A, Fanelli G, Cappelleri G, Aldegheri G, Berti M, Senatore R, et al. Effects of speed of intrathecal injection on unilateral spinal block by 1% hyperbaric bupivacaine. A randomized, double-blind study. *Minerva Anestesiol* 1999;65(1-2):5-10.
 15. Cappelleri G, Casati A, Fanelli G, Borghi B, Anelati D, Berti M, et al. Unilateral spinal anesthesia or combined sciatic-femoral nerve block for day-case knee arthroscopy. A prospective, randomized comparison. *Minerva Anestesiol* 2000;66(3):131-7.
 16. Valanne JV, Korhonen AM, Jokela RM, Ravaska P, Korttila KK. Selective spinal anesthesia: a comparison of hyperbaric bupivacaine 4 mg versus 6 mg for outpatient knee arthroscopy. *Anesth Analg* 2001;93(6):1377-9. [CrossRef](#)
 17. Casati A, Albertini A. Unilateral spinal block: Highlight in Regional Anaesthesia, XIX Annual ESRA Congress Rome, 2000. p. 20-3.
 18. Kuusniemi KS, Pihlajamäki KK, Pitkänen MT, Korkeila JE. Low-dose bupivacaine: a comparison of hypobaric and near isobaric solutions for arthroscopic surgery of the knee. *Anaesthesia* 1999;54(6):540-5. [CrossRef](#)
 19. Kuusniemi KS, Pihlajamäki KK, Pitkänen MT. A low dose of plain or hyperbaric bupivacaine for unilateral spinal anesthesia. *Reg Anesth Pain Med* 2000;25(6):605-10. [CrossRef](#)
 20. Fournier R, Weber A, Gamulin Z. Intrathecal sufentanil is more potent than intravenous for postoperative analgesia after total-hip replacement. *Reg Anesth Pain Med* 2005;30(3):249-54. [CrossRef](#)
 21. Henderson CL, Schmid J, Vaghadia H, Fowler C, Mitchell GW. Selective spinal anesthesia for outpatient laparoscopy. III: sufentanil vs lidocaine-sufentanil. *Can J Anaesth* 2001;48(3):267-72. [CrossRef](#)
 22. Waxler B, Mondragon SA, Patel SN, Nedumgottil K. Intrathecal lidocaine and sufentanil shorten postoperative recovery after outpatient rectal surgery. *Can J Anaesth* 2004;51(7):680-4. [CrossRef](#)
 23. Qian XW, Chen XZ, Li DB. Low-dose ropivacaine-sufentanil spinal anaesthesia for caesarean delivery: a randomised trial. *Int J Obstet Anesth* 2008;17(4):309-14. [CrossRef](#)
 24. Olofsson C, Nygård EB, Bjersten AB, Hessling A. Low-dose bupivacaine with sufentanil prevents hypotension after spinal anesthesia for hip repair in elderly patients. *Acta Anaesthesiol Scand* 2004;48(10):1240-4. [CrossRef](#)
 25. Demiraran Y, Ozdemir I, Kocaman B, Yucel O. Intrathecal sufentanil (1.5 microg) added to hyperbaric bupivacaine (0.5%) for elective cesarean section provides adequate analgesia without need for pruritus therapy. *J Anesth* 2006;20(4):274-8. [CrossRef](#)
 26. Dahlgren G, Hultstrand C, Jakobsson J, Norman M, Eriksson EW, Martin H. Intrathecal sufentanil, fentanyl, or placebo added to bupivacaine for cesarean section. *Anesth Analg* 1997;85(6):1288-93. [CrossRef](#)