Assessment of Different Approaches to Resolve Positioning Pain Before Spinal Anesthesia in Hip Fractures

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Abstract

Aim Currently, the population in the world is rapidly increasing due to technological developments and convenient access to health services. Due to comorbidities in elderly patients, hip fractures are frequently observed after exposure to environmental trauma. To reduce pain during positioning in spinal anesthesia, fascia iliaca compartment block (FICB) can be applied easily and reliably. Material and Method Our study included 100 patients undergoing operations due to hip fracture and administered spinal anesthesia after FICB. The group with FICB accompanied by ultrasound (USG) had the blockage needle advanced to the compartment under the fascia iliaca and 15 mL bupivacaine + 10 mL 2% lidocaine was administered. Sitting position was given for spinal anesthesia 20 minutes later and procedure duration and NRS scores were recorded. In the group with FICB completed with the landmark method (LAND), the spina iliaca anterior superior (SIAS) and pubic tubercle were connected with a line. The same amount of local anesthetic was administered to the external 1/3 portion of this line with the double pop technique. Procedure durations and NRS scores were recorded. Results There was no statistically significant difference between the groups in terms of NRS scores ($p>0.05$). There was a statistical difference found in terms of FICB administration durations ($p<0.05$). Conclusion FICB administered both with USG and using the anatomic landmark method provides sufficient analgesia for the positioning stage of spinal anesthesia at similar levels. However, imaging of structures with ultrasound will provide more reliable blockage when there is access to the device and no time problems.

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ABSTRACT

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Results

There was no statistically significant difference between the groups in terms of NRS scores ($p>0.05$). There was a statistical difference found in terms of FICB administration durations ($p<0.05$).

Conclusion

FICB administered both with USG and using the anatomic landmark method provides sufficient analgesia for the positioning stage of spinal anesthesia at similar levels. However, imaging of structures with ultrasound will provide more reliable blockage when there is access to the device and no time problems.

Key words: regional anesthesia, fascia iliaca compartment block, hip fractures

İnformation (What is already known about this topic? What does this article add?)

FICB has been used for a long time for pain relief in hip fractures and for its analgesic effect after total hip arthroplasty. It is also used to resolve positioning pain in hip fracture surgeries. FICB can be easily performed with both ultrasonography(USG) or an anatomical approach with double pop technique.

In our study, we plan to compare the analgesic efficacy and application times of Fasia iliaca compartment blocks applied with Usg-assisted or anatomical methods in reducing the pain that will occur while positioning when we need to apply spinal anesthesia to hip fracture operations. We aim to provide the patient with a shorter and more effective analgesia by looking at whether there is a significant difference between the two methods in terms of analgesia and application times.

Introduction:

Hip fractures linked to causes like trauma and/or falls affect nearly 1.6 million people in the world in general. Due to the numerical increase in the geriatric population, it is considered this rate will rapidly increase within the next 30 years (1). In 2009, 24 thousand hip fractures were reported in Turkey, while it is estimated that in 2035 this number will reach 64 thousand per year (2).

Systemic diseases, reduced reflexes and suddenly-developing situations like cerebrovascular events occurring in the advanced age patient group expose these patients to more environmental trauma and cause this population to have more hip fractures. Additionally, the reduced bone union in this age group is another cause increasing the incidence of fracture development (3). In the elderly, hip fracture is the most commonly observed fracture type after distal radius fracture. Of these fractures, 90% are in patients over 65 years.

The anesthetic approach in hip fractures is linked to the patient's hemodynamics, physiological status and comorbidities present. General anesthesia represents a risk in patients with severe respiratory disorders and central blockers are chosen considering advantages like reduced thromboembolism risk, less blood loss, reduced cognitive disorders, and shorter hospitalization. However, regional anesthesia should be avoided as position cannot be given linked to pain in the fracture. As the location of our hospital is within a region with high geriatric population, hip fracture operations are completed frequently and spinal anesthesia is chosen most often due to comorbid diseases. In this situation, there is a need to suppress the feeling of pain forming linked to the fracture during positioning of the patient. To reduce pain occurring during the positioning stage for hip fractures, it is necessary to block the femoral and lateral femoral cutaneous branches of the lumbar plexus and if required the obturator nerves.

Psoas compartment block (PCB), lumbar plexus block (LPB), fascia iliaca compartment block (FICB) and femoral nerve block (FNB) are among blocks with analgesic efficacy after total hip arthroplasty (4). These methods are used to resolve positioning pain in hip fracture surgeries. FICB can be easily performed with both ultrasonography(USG) or an anatomical approach with double pop technique. FICB may offer superiority compared to other peripheral block techniques due to low complication risk linked to reasons such as no mandatory use of neurostimulators during the procedure and the injection region being distant from neurovascular structures (5). Specifically, the femoral, lateral femoral cutaneous and obturator nerves can be blocked with local anesthesia (LA) injected under the fascia of the iliac muscle (6).

The primary aim in our study is to compare the analgesic efficacy and administration duration of FICB administered with ultrasound assistance (USG) or with the anatomic landmark method (LAND) for pain that may occur during positioning of patients who will be operated under spinal anesthesia due to hip fractures linked to falls and/or trauma. Our secondary aim is to emphasize that due to resolution of pain occurring during spinal anesthesia administration in geriatric patients with FICB the procedure may be both easily and successfully completed.

Material and Method

This study received permission from HSU Okmeydanı Education and Research Hospital Clinical Research Ethics Committee (Ethics Committee: document no. 48670771-514.10) and was completed in Health Sciences University Sultan Abdulhamid II Han Education and Research Hospital Anesthesiology and Reanimation Clinic from March 2019 to November 2019.

This single-center, prospective clinical study included 100 patients undergoing surgery due to hip fracture linked to falls and/or trauma with spinal anesthesia after FICB administration, in the ASA I-III patient group aged 65-90 years and with Standardized Mini Mental Test (SMMT) score of 23 and above. Patients were included after signing the 'Informed Volunteer Consent Form'. Cases were randomly divided into 2 groups with FICB administered using the landmark method (LAND) (n=50) and with the ultrasound method (USG) (n=50).

Exclusion criteria for the study were age younger than 65 years or older than 90 years, ASA physical status classification IV, contraindications or situations which would cause relative contraindications for block administered to the inguinal region and spinal anesthesia, lack of consent by themselves or legal heirs, without cooperation-orientation, with peripheral neuropathy, known allergy to amid-type local anesthetics, bleeding diathesis, moderate or severe kidney and liver function disorder and patients who did not accept FICB administration.

Preoperative assessment for all patients, with no solid or liquid food intake for 10 hours before surgery, noted name-surname, age, sex, date of surgery, height-weight values, and ASA classification before entering the operating room and all patients had the SMMT performed with the aim of assessing neurocognitive functions. No case in the study was identified to have SMMT score <23 so no psychiatric consultation was requested and no patient was excluded for this reason. After patients were taken into the operating room, standard monitoring was applied by the anesthesia team (ECG, noninvasive arterial blood pressure taken every 5 minutes, peripheral oxygen saturation). The inguinal region on the operation side was washed with 10% povidone iodine for sterilization and covered with a green cover under sterile conditions.

In the group with FICB administered with ultrasound (USG), after sterilizing the procedure region, the USG was covered for sterility and then the fascia iliaca was imaged (Picture 1), and after 2 mL 2% prilocaine was administered to the skin-subdermal, a 22 G 50 mm block needle was advanced to the compartment below the fascia iliaca and previously-prepared 25 mL local anesthetic (0.5% bupivacaine (Marcaine flacon, Astra Zeneca İlaç, İstanbul) 15 ml + 2% lidocaine (Aritmal amp, Osel Medicine, Istanbul) 10 ml) was administered to this region. The duration was recorded from the start of the imaging procedure to administration of local anesthetic and removal of the block needle. After waiting 20 minutes, sensorial block was assessed by cold application to the anterior (femoral nerve), medial (obturator nerve) and lateral (lateral femoral cutaneous nerve) faces of the two thighs. Then sitting position was given to administer spinal anesthesia and the Numerical Rating Scale (NRS) score was measured and recorded.

In the group with FICB administration using the landmark method (LAND), after sterilizing the procedure region, a line was drawn from the spina iliaca anterior superior (SIAS) to the pubic tubercle on the same side. The line was divided into three equal parts and the join between the middle and external 1/3 sections was marked and an entry point 2 cm below this point was determined (Picture 2). In this region, after administration of 2 mL 2% prilocaine (Citanest©) skin-subdermal, subdermal entry was performed with a 22 G 50 mm block needle. When advancing the needle, a pop sensation was felt 2 times due to resistance loss on passing the fascia lata and fascia iliaca and negative aspiration was performed. Then 25 mL previously

prepared local anesthetic (0.5% bupivacaine (Marcaine flacon, Astra Zeneca İlaç, İstanbul) 15 ml + 2% lidocaine (Aritmal amp, Osel Medicine, Istanbul) 10 ml) was administered to this area. The duration from the beginning of the anatomic marking procedure to administration of local anesthetic and removal of block needle was recorded. Similarly, sensory block was assessed after 20 minutes and the NRS score was measured and recorded during the procedure.

After these procedures, patients with appropriate sterilization had the subarachnoid interval entered at the L3-L4 interval with a 25 G Quinke spinal needle and 15 mL 0.5% hyberbaric bupivacaine (Marcaine® spinal heavy, Astra Zeneca) was administered. The patient was laid on the operating table. After development of sensory nerve block reaching the T10 dermatome, appropriate position for surgery was given.

At the end of surgery, patients were transferred to the postoperative care unit. Patients with class 0-1 on the Bromage scale and Aldrete score 9-10 were transferred to the wards on trolleys.

Statistical analysis

Descriptive statistics for data used mean, standard deviation, median, minimum, maximum, frequency and percentage values. The distribution of variables was measured with the Kolmogorov Smirnov test. Quantitative independent data analysis used the independent samples t test, and Mann-Whitney U test. Dependent quantitative data analysis used the Wilcoxon test. Qualitative independent data analysis used the chi-square test. Analyses used the SPSS 26.0 program.

Results

The study was completed with a total of 100 patients, of whom 51 were women and 49 were men. When demographic data, ASA class distribution and SMMT results are compared, there was no statistically significant difference found between the LAND (n=50) and USG (n=50) groups ($p>0.05$).

The median NRS score values when patients were placed in sitting position for spinal anesthesia were recorded in both groups and there was no significant difference in terms of statistics between the groups ($p>0.05$). Additionally, the FICB administration duration was median 174 s in the USG group and 72 s in the LAND group and statistically there was a significant difference between the two groups ($p<0.05$) (Table 1).

When the LAND and USG groups were compared in terms of variations before, after and during the procedure, heart rate (HR) values, systolic-diastolic and mean arterial pressure (MAP) did not show significant differences ($p>0.05$) (Table 2; Figure 1). As a result, after blockage, the variation in hemodynamic variations supporting pain before and after the positioning procedure were not different, apart from NRS scores.

Discussion

In our study, performed in the geriatric population with more frequent hip fractures and with the aim of resolving pain that may occur during spinal anesthesia, fascia iliaca compartment block administered accompanied by USG or with the anatomic landmark method was compared in terms of efficacy and administration durations. In order to obtain more accurate data for the NRS scores of patients, each patient had the SMMT applied preoperatively. Commonly used internationally, the validity and reliability of the SMMT for diagnosis of mild dementia in Turkish society was investigated by Güngen et al. and the threshold value of 23 on the SMMT was shown to have 91% sensitivity and 95% specificity for diagnosis of mild dementia in Turkish elderly people (7).

Based on the World Health Organization definition, the geriatric period is stated to be 65 years and older. With the increase in technological opportunities and easier access to these opportunities, the mean life expectancy around the world has lengthened and the anesthesia administration requirements for the geriatric population have increased. It was observed that patients aged over 65 years will undergo surgical interventions at least 1 time during the remainder of their lives (8). Surgeries like trauma-linked hip fracture repair, hip prosthesis and knee prosthesis, especially, are frequently performed in geriatric patients. The reduction of physiological adaptation capacities in geriatric patients taken for surgery and presence of comorbid systemic diseases increase the complication risks that may occur during and after the operation. Attempts are made

to reduce the mortality and morbidity rates in geriatric patients and complications that may develop with regional anesthesia (9).

Neuroaxial anesthesia includes epidural and spinal blocks. Spinal anesthesia administration forces a cessation in afferent conduction of painful stimuli and removes the efferent stimuli responsible for skeletal muscle tone inducing operation conditions. Thus, with sensory block, both somatic and visceral painful stimuli are blocked (10). There is a reduction in thromboembolic complications with the low surgical stress response, which causes a reduction in mortality and morbidity in high-risk patients especially (11). Neuroaxial anesthesia is chosen for geriatric patients due to superior aspects like reduced risk of postoperative thromboembolism, prevention of immune suppression linked to surgery, preservation of the postoperative nitrogen balance, reduced blood loss and lower incidence of postoperative confusion (12).

Kaufmann et al. (13) stated that neuroaxial anesthesia administration for patients assessed as high risk with planned hip surgery may reduce the probability of being transferred to postoperative intensive care (24%). Mark et al. (14) compared the hospitalization durations of hip fracture patients with general and regional anesthesia and found the number of days of admission was fewer in the group with regional anesthesia. A study by Chow et al. (15) stated that postoperative delirium development rates were lower for patients undergoing surgery with regional anesthesia compared to those with general anesthesia. The lower observation of delirium in patients with regional anesthesia administration also affects mortality and reduces the rate of postoperative cognitive dysfunction. Only 9 of the patients included in our study (9%) had postoperative intensive care monitoring, mainly due to comorbid diseases. Additionally, due to the effective analgesia provided by FICB in patients with advanced age undergoing hip fracture surgeries, the delirium tableau which frequently accompanies postoperative pain and could delay treatment was not encountered.

Based on these studies, we choose regional anesthesia administration for surgical treatment of hip fractures, especially in the high ASA group, due to reasons like lower mortality-morbidity. Among our reasons for specifically choosing FICB to resolve pain that may be caused by positioning during spinal anesthesia administration, administered accompanied by ultrasonography or with the anatomic landmark method (by feeling the double pop), are that it does not require much experience and the area is distant from neurovascular structures.

FICB was first described by Dalens et al. (16) in 1989 in a study comparing FICB with Winnie's '3 in 1 block'. Just as it may be accepted as the anterior approach to lumbar plexus block, it is thought to be an easier alternative to femoral nerve or lumbar plexus block. The mechanism of this block is blockage of the femoral, lateral femoral cutaneous and obturator nerves under the fascia iliaca. Sufficient amounts of local anesthetic administered under the fascia iliaca induces block in the compartment under the fascia, even if it spreads somewhat distant from the nerves (17). With statistical data in our study, the reason for analgesia induced with the anatomic landmark method without observing the nerves being equal to analgesia induced using USG is ensured by this spread and may be considered an advantage. The three nerves found within the compartment ensure sensory innervation of the anterior, medial and distal sides of the thigh, the medial side of the leg and the femur, along with motor innervation of adductor muscles in the thigh and the extensor muscles in the leg (18). As a result, local anesthetic medication administered into this region ensures sufficient blockage for all mechanical and positional pain paths that can be affected during spinal anesthesia administration.

Though FICB was described very recently, there is a broad field of use because it is a block that can be applied easily and in a short duration, with low cost and without requiring serious experience (19). During our study, once again the advantages like easy administration and lack of requirement for serious experience lead to consideration that its use may be beneficial, not just in operating rooms, but for patients with hip fractures linked to trauma or falls in the emergency service or for pain management before hip fracture surgeries.

FICB was shown to be more effective to resolve positioning pain than opioids in studies by Yun et al. (20) and Diakomi et al. (21) using different doses of ropivacaine. As mentioned in our study, due to the possible

side effects of opioids and FICB being more effective in resolving positioning pain, giving priority to FICB especially in the geriatric patient group comes to the fore as a smarter approach.

Kumar et al. (22) used FICB for pain occurring linked to position during hip fracture surgeries and found that 86% of patients had good or better results on their assessment of patient satisfaction. Similarly in our study, high levels of patient and surgeon satisfaction were observed for FICB administration completed with both the anatomic landmark approach and using USG. The median values for NRS scores in both groups were 2 and positioning pain before spinal anesthesia was significantly resolved.

The region for FICB administration has large volume and success of anesthesia is linked to the spread of local anesthetic on the connective tissue planes. As a result, high-volume LA injection is required to ensure block (23). As the volume of LA increases, the chance of blocking the obturator nerve increases. Dolan et al. (24) compared the landmark approach with the ultrasound-guided block technique in a study and observed that the incidence of sensory loss medial of the thigh and motor block of femoral and obturator was increased for fascia iliaca block with ultrasound guidance. In light of information obtained in studies, in our study sufficient analgesia was provided with 20 mL bupivacaine as local anesthetic. As obturator nerve blockage was not required, sensory blockage of the obturator nerve was not checked.

A meta-analysis reported that regional anesthesia administration administered with ultrasound guidance had higher success rates to a clinically significant degree compared to the landmark technique, and that analgesia could be obtained with more rapid onset, long-duration block and lower vascular puncture risk (25). Further, defenders of the ultrasound guidance technique state that USG use reduces the risk of intraneural injections that may cause permanent nerve injury by serious rates (26). In our study, the NRS scores of two patients with the landmark technique were observed to be high (7 and 8); however, there was no difference for analgesia between the groups in statistical terms. No findings leading to consideration of any vascular or neuronal injection were identified.

As a result of data obtained in our study, FICB administered using USG (USG group) or with anatomic landmarks (LAND group) had close values for analgesic efficacy and both methods can be easily administered. However, the use of a device and duration to ensure sterile conditions for the device form disadvantages for FICB using USG.

Conclusion

FICB with both USG and the landmark method provide sufficient and similar analgesic levels for the positioning stage of spinal anesthesia. Blockage with USG appears to have disadvantages of both requiring a device and have longer duration for administration. However, though the procedure region is sufficiently distant from neurovascular structures not to require ultrasound imaging, the imaging of all structures with ultrasound will ensure administration of more reliable blockage. In conditions where there is an ultrasound device and time is not limited, the procedure should be performed with USG guidance.

In conditions where there is no ultrasound device, FICB with the anatomic landmark method provides sufficient analgesic effect. This block appears to be reliable and easy to administer to resolve positioning pain in all hip fracture patients with spinal anesthesia indications.

References

1. Mark D. Neuman, MD, MSc; Paul R. Rosenbaum, PhD; Justin M. Ludwig, MA; Jose R. Zubizarreta, PhD; Jeffrey H. Silber,MD, PhD. Anesthesia Technique, Mortality, and Length of Stay After Hip Fracture Surgery JAMA.2014;311(24):2508-2517. DOİ:10,1001/jama.2014,6499.
2. Tuzun S, Eskiyurt N, Akarirmak U, et al. Incidence of hip fracture and prevalence of osteoporosis in Turkey: the FRACTURK study. Osteoporosis international: a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA. 2012;23:949-55.
3. Koç M, Saçan Ö, Gamlı M, Taşpınar V, Postacı A, Fikir E, Dikmen B. Kalça Protezi Ameliyatlarında Uygulanan Anestezi Yöntemlerinin Retrospektif Olarak Değerlendirilmesi. Turk J Anaesth Reanim

2014; 42: 133-9.
4. Liu P, Wu Y, Liang Z , Deng Y, Meng Q. Comparing the efficacy of pain managements after total hip arthroplasty: A network meta-analysis. J Cell Biochem. 2018;1-13.
5. Yanhui Ma, Jie Wu, Jixiu Xue, Fei Lan And Tianlong Wang Ultrasound-guided continuous fascia iliaca compartment block for preoperative pain control in very elderly patients with hip fracture: A randomized controlled trial Experimental and Therapeutic Medicine 16: 1944-1952, 2018.
6. Swenson JD, Davis JJ, Stream JO, Crim JR, Burks RT, Greis PE. Local anesthetic injection deep to the fascia iliaca at the level of the inguinal ligament: the pattern of distribution and effects on the obturator nerve. J Clin Anesth. 2015;27(8):652–657.
7. Güngen C, Ertan T, Eker E, ve ark. Standardize Mini Mental Test'in Türk Toplumunda Hafif Demans Tanısında Geçerlik ve Güvenilirliği. *Türk Psikiyatri Dergisi* 2002; 13:273-81.
8. Güneyli HC. Geriatrik hastalarda rejyonel anestezi, Turkiye Klinikleri J Anest Reanim. 2015;8:161-8.
9. Biboulet P, Jourdan A, Van Haevre V, Morau D, et al. Hemodynamic profile of targetcontrolled spinal anesthesia compared with 2 target-controlled general anesthesia techniques in elderly patients with cardiac comorbidities. Reg Anesth Pain Med. 2012;37(4):433-40.
10. Kelsaka E. Spinal Anestezi. Turkiye Klinikleri J Anest Reanim. 2015;8:41-52.
11. Butterworth JF, Mackey DC, Wasnick JD. Morgan & Mikhail Klinik Anesteziyoloji: McGraw-Hil; 2015. p. 937-70.
12. Schindler I. Regional anesthesia in the elderly: indications and contraindications. Acta Anaesthesiologica Scandinavica. 1997;111:209-11.
13. Kaufmann SC, Wu CL, Pronovost PJ, Jermyn RM, Fleisher LA. The association of intraoperative neuraxial anesthesia on anticipated admission to the intensivecare unit. J Clin Anesth. 2002;14(6):432-6.
14. Mark D. Neuman, MD, MSc; Paul R. Rosenbaum, PhD; Justin M. Ludwig, MA; Jose R. Zubizarreta, PhD; Jeffrey H. Silber,MD, PhD. JAMA.2014;311(24):2508-2517. DOİ:10.1001/jama.2014.6499.
15. Chow WB, Rosenthal RA, Merkow RP, Ko CY, Esnaola NF; American College of Surgeons National Surgical Quality Improvement Program; American Geriatrics Society. Optimal preoperative assessment of the geriatric surgical patient: a best practices guideline from the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatrics Society. J Am Coll Surg. 2012 Oct;215(4):453-66.
16. Dalens B, Vanneuville G, Tanguy A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. Anesth Analg. 1989;69(6):705–713.
17. Hadzıc A, A. Carrera, T.Clark, J.Gadseden, M.Karmakar, X. Sala-Blanch, C. Vandepıtte, D.Xu, Hadzıc Periferik Sinir Blokları ve Ultrason Eşliğinde Rejyonal Anestezi için Anatomi,2. Baskı, İstanbul. 2013; 217-227
18. McLain RF, Weinstein JN. Ortopedik cerrahi (Çeviri: Çimen A). Ağrı Tedavisi El Kitabı'nda (Çeviri editörü: Erdine S). Ankara: Güneş Kitabevi; 2006. s.435-51.
19. Christine Range, Christian Egeler. Fascia Iliaca Compartment Block: landmark and ultrasound approach. Anaesthesia tutorial of the week 193. 2010. www.totw.anaesthesiologists.org
20. Yun MJ, Kim YH, Han MK, Kim JH, Hwang JW, Do SH. Analgesia before a spinal block for femoral neck fracture: fascia iliaca compartment block. Acta Anaesthesiologica Scandinavica. 2009;53:1282-7.
21. Diakomi M, Papaioannou M, Mela A, Kouskouni E, Makris A. Preoperative fascia iliaca compartment block for positioning patients with hip fractures for central nervous blockade: a randomized trial. Regional Anesthesia and Pain Medicine. 2014;39:394-8.
22. Kumar D, Hooda S, Kiran S, Devi J. Analgesic Efficacy of Ultrasound Guided FICB in Patients with Hip Fracture. Journal of clinical and diagnostic research: JCDR. 2016;10:13-6.
23. Hadzıc A, A. Carrera, T.Clark, J.Gadseden, M.Karmakar, X. Sala-Blanch, C. Vandepıtte, D.Xu, Hadzıc Periferik Sinir Blokları ve Ultrason Eşliğinde Rejyonal Anestezi için Anatomi,2. Baskı, İstanbul. 2013; 405-410
24. Dolan J, Williams A, Murney E, Smith M, Kenny GN. Ultrasound guided fascia iliaca block: a comparison with the loss of resistance technique. Reg Anesth Pain Med. 2008;33(6):526–531.

25. Abrahams, M. S., Aziz, M. F., Fu, R. F., & Horn, J. L. (2009). Ultrasound guidance compared with electrical neurostimulation for peripheral nerve block: A systematic review and meta-analysis of randomized controlled trials. British Journal of Anaesthesia, 102, 408–417.
26. Auroy, Y., Benhamou, D., & Bargues, L. (2002). Major complications related to regional anaesthesia: The SOS Regional Anesthesia Hotline Service. Anesthesiology, 97, 1274–1280.

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