



Case Report

A case report of arthroscopic surgery under extended spinal anesthesia for 402 minutes, assisted by monitored anesthesia care



Jihyoung Park, M.D., Clinical assistant professor^a, Seung Woo Song, M.D., Anesthesiologist^{a,b,*}, Dong Wook Kim, Resident^c, Kwang Ho Lee, M.D., Ph.D., Professor^a

^a Department of Anesthesiology and Pain Medicine, Wonju College of Medicine, Yonsei University, Wonju, South Korea

^b Department of Anesthesiology and Pain Medicine, Yangju Armed Forces Hospital, Yangju, South Korea

^c Department of Anesthesiology and Pain Medicine, Wonju Severance Christian Hospital, Wonju, South Korea

ARTICLE INFO

Keywords:

Bupivacaine
Anesthesia adjuvants
Epinephrine
Spinal anesthesia
Arthroscopy
Case report

ABSTRACT

Introduction: Surgical spinal anesthesia is usually maintained for approximately 3 h with bupivacaine, but it is difficult to accurately predict the duration of surgery for each case. When an operation continues for an extended duration, regression of spinal anesthesia often leads to general anesthesia. Here we present a case of extended spinal anesthesia assisted by monitored anesthesia care.

Case presentation: A 32-year-old male who suffered from persistent pain of the right knee was diagnosed with rupture of the right anterior cruciate ligament. Arthroscopic surgery of the right knee was conducted with spinal anesthesia. A local anesthetic mixture of 0.5% hyperbaric bupivacaine 12 mg with 50 µg of epinephrine was used. The surgery took longer than expected with a total anesthesia time of 402 minutes. In the final 30 minutes of surgery, spinal anesthesia regressed and the procedure was completed under monitored anesthesia care (MAC).

Clinical discussion: When spinal anesthesia is on regression during the final stage of surgery, the application of MAC safely secures additional operation time. By adopting MAC, the patient avoided general anesthesia and had minimal physiological distress and a rapid recovery. Another benefit of MAC is the reduced consumption of resources. Further, by avoiding endotracheal intubation and mechanical ventilation, the risk of transmission of infectious agents is minimized.

Conclusion: In situations where spinal anesthesia is regressing close to the end of a surgical procedure, the application of MAC has potential benefits over general anesthesia. These benefits are particularly relevant during the current COVID-19 pandemic.

1. Introduction

Spinal anesthesia, which is produced by an injection of local anesthetic into the cerebrospinal fluid (CSF), is a widely used anesthetic technique for arthroscopic knee surgery. The duration of surgical spinal anesthesia with bupivacaine is usually limited to approximately 130–230 minutes [1].

This article presents an arthroscopic knee surgery case that lasted 402 minutes and was performed under spinal anesthesia for the duration of the procedure, without converting to general anesthesia. After six hours of surgery, spinal anesthesia was on regression and monitored anesthesia care (MAC) was provided while the operation was completed.

Despite the unexpectedly long duration of surgery, an anesthesia machine was not utilized except for auxiliary oxygen supply. This case report has been reported in line with the SCARE Criteria [2].

2. Case presentation

A 32-year-old male patient (height, 175 cm; weight, 68 kg) visited the orthopedic outpatient department of a secondary military hospital for persistent pain of the right knee. Initial MRI evaluation showed the patient was diagnosed with a rupture of the right anterior cruciate ligament (ACL), a medial meniscus tear, and a Baker's cyst. The patient had no significant medical and surgical history other than a suspected

* Corresponding author. Department of Anesthesiology and Pain Medicine, Yangju Armed Forces Hospital, 1133, Hwahap-ro, Eunhyeon-myeon, Yangju-si, Gyeonggi-do, South Korea.

E-mail address: yonfong@yonsei.ac.kr (S.W. Song).

<https://doi.org/10.1016/j.amsu.2021.102358>

Received 8 March 2021; Received in revised form 21 April 2021; Accepted 25 April 2021

Available online 29 April 2021

2049-0801/© 2021 The Authors. Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

personality disorder, and no known relevant family medical history. He was a non-smoker and a social alcohol drinker. Preoperative laboratory results showed no remarkable findings and there was no medication administered. The surgical plan was for ACL reconstruction and meniscal repair. Because the orthopedic surgeon estimated the operative time as 150 minutes, the initial anesthetic plan was for spinal anesthesia.

Prior to surgery, the patient was laid in the right lateral decubitus position. The anesthetic procedure was conducted by a sole board-certified anesthesiologist. The injection area was anesthetized with 2 mL of 2% lidocaine through a 1.5-inch long 25-gauge needle. The anesthetic solution was a mixture of 2.4 mL (12 mg) of 0.5% hyperbaric bupivacaine with 0.05 mL (50 µg) of 0.1% epinephrine. Lumbar puncture was performed via a midline approach with a 25-gauge Whitacre needle at the L3-4 intervertebral space. After observing free flow of CSF in all directions, the anesthetic solution was injected with the needle orifice oriented to the right side of the patient.

No immediate adverse events such as hypotension, bradycardia, or nausea occurred. Five minutes after intrathecal injection, the cephalad level of dispersion of anesthesia was T10. The patient was positioned for surgery with both knees flexed, and the left leg abducted. Compressive pressure was applied to the right thigh with a tourniquet at a 300 mmHg for 154 minutes. The patient was sedated with 5 mg of midazolam (Fig. 1) and oxygen was supplied at 5 L/min. An orthopedic surgeon with two years of surgical experience after board certification conducted the operation.

After 190 minutes, the patient wanted to be sedated again. The surgeon required additional time to complete the operation. Accurate evaluation of the level of spinal block level under the umbilicus was limited because of the surgical drapes and instruments. Regression of spinal anesthesia was anticipated at this time point, but the patient reported no pain at all in the right leg. After the anesthesiologist discussed all anesthetic options with the patient and the surgeon, the patient was sedated with 4 mg of midazolam and became calm and stable again. The anesthesiologist closely observed the patient's respiration and checked for regression of the block.

After 120 minutes, while the surgeon was commencing surgical wound closure, the patient complained of mild pain in the surgical area. Considering that the surgery was nearly complete, MAC was adopted as an additional anesthetic modality because the anesthesiologist wanted to avoid unnecessary general anesthetic. While carefully monitoring the airway, 2 mg of midazolam and 50 µg of fentanyl were administered. A supraglottic airway device and neuromuscular blocking agent for general anesthesia were prepared in case general anesthesia was necessary. Oxygen continuously supplied at 5 L/min.

After 5 min, the patient's blood pressure dropped from 106/61

mmHg to 88/42 mmHg. Normal saline (100 mL) was loaded, and the blood pressure increased to 104/54 mmHg after another 5 min. Oxygen saturation remained above 95%. The patient's airway was carefully observed, and intubation was not required. Thirty minutes after MAC was adopted, the operation was completed. The total anesthesia time was 402 minutes. The total infused volume of intravenous fluid was 1100 mL.

The patient did not experience nausea or vomiting in the operating room or in the post-anesthetic recovery unit (PACU). The patient reported mild pain in the right thigh where the tourniquet was applied. The patient was returned to the general ward after close observation for 20 minutes in the PACU.

In the ward, catheter urination of 700 mL was done according to the decision of the surgeon 8 h after the spinal anesthesia. The patient was able to void independently 350 mL of urine 2 h later then, which demonstrated no post-operative urinary retention. The patient reported a tingling sensation on the sole of his right foot on POD #1, which had almost resolved by the night of POD #2. The patient only reported mild pain (Numeric rating scale ≤ 3/10) after the surgery and had Calvien-Dindo Classification Grade I postoperative complications.

Two and five months after surgery, the patient visited the orthopedic outpatient clinic for follow-up appointments with no significant complications. The patient was admitted for removal of hardware devices nine months after the initial surgery. During the preoperative anesthesiology visit, the patient's experience of anesthesia during the initial surgery was discussed. The patient reported that the overall anesthetic experience was satisfactory and that at the time of surgery, he had perceived the procedure to have lasted about 3 h. The patient was discharged after undergoing hardware removal surgery under uneventful spinal anesthesia, without complication.

3. Clinical discussion

The duration of spinal anesthesia cannot be accurately predicted in each individual [3]. Dose is the most commonly mentioned and important factor which effects the duration of anesthesia, assuming that the same local anesthetic agent is injected [1]. However, even with the same dose of bupivacaine injected at the same site, the duration of anesthesia may vary significantly between patients. In one study conducted in patients who were injected with 15 mg of bupivacaine in the L3-4 intervertebral space, time to regression to L1 differed between patients by up to 2 h (150–270 minutes) [4]. Exceptionally prolonged block can occur in patients with spinal hematoma, cauda equina syndrome, or spinal cord injury [5,6]. These were ruled out in the case reported here because there were no clinical signs such as severe back

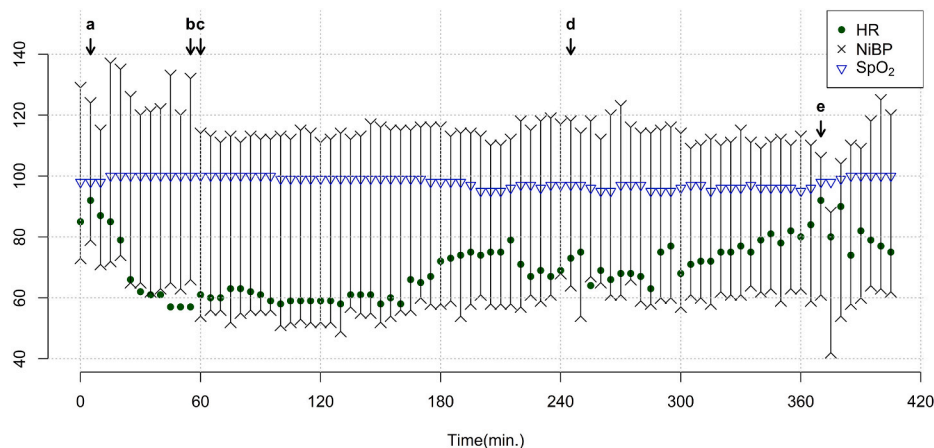


Fig. 1. Vital signs and major events in the case of a 32-year-old male patient undergoing arthroscopic surgery of the right knee under spinal anesthesia for 402 minutes. a. spinal anesthesia; b. Administration of the first 5 mg of midazolam; c. Skin incision; d. Administration of additional 4 mg of midazolam; e. Application of monitored anesthesia care. HR, heart rate; NiBP, non-invasive blood pressure; SpO₂, peripheral oxygen saturation.

pain, unilateral neurological deficit, or urinary retention.

Other than dosage and choice of local anesthetic, the presence of an additive drug is a predominant controllable factor that affects the duration of spinal anesthesia. Epinephrine, dexamethasone, and opioids are commonly used because they are familiar to anesthesiologists and relatively safe. A recent meta-analysis reported that epinephrine prolongs anesthesia time without causing bradycardia, pruritus, or post-operative nausea and vomiting [7]. In the case reported here, epinephrine was used as an additive, resulting in the unusually prolonged spinal anesthesia. It should be noted that when epinephrine is added to an anesthetic solution, it is recommended to observe level of dispersion approximately 3 min because intrathecal epinephrine increases the time to reach the highest sensory block [7].

Despite the application of methods to prolong spinal anesthesia time, there are some cases where the patient begins to feel pain before the surgery is finished. If an anesthesiologist is confident that the surgery will be finished soon, MAC is a good supplement for spinal anesthesia on regression. There are some reports of the application of MAC with various regional anesthesia [8–10], but this case is the first report of the combined use of MAC and regressing spinal anesthesia. The advantages of MAC include invoking less physiological disturbance, more rapid recovery, and shorter hospitalization compared with general anesthesia [11].

Among the many choices, benzodiazepines and opioids are mainstays of sedation and MAC [12]. For ease of titration, an intravenous bolus of a short-acting opioid such as fentanyl is particularly useful for MAC. However, the combined use of midazolam and opioid can increase the risk of respiratory depression and severe hypotension [13].

MAC has the potential to provide additional benefits during the COVID-19 pandemic. Some anesthetic agents, such as vasopressors and neuromuscular blockers, are currently in short of supply for some countries [14]. If general anesthesia is not required, these agents and other resources including anesthetic circuits, and facial masks can be spared. In addition, transmission of asymptomatic or undiagnosed respiratory infection through the anesthetic machine can be avoided if the machine is not used. Contaminations by enterococci or other pathogens via contact with the reservoir can be also reduced if general anesthesia is not required, avoiding touching the inhalant vaporizer and the adjustable pressure limiting valve. This is significant because the anesthesia machine is difficult to routinely disinfect, sterilize, and clean [15]. Limitation is that these benefits would not be applicable if general anesthesia is required after MAC had been adopted.

4. Conclusion

It is difficult to accurately estimate the duration of spinal anesthesia for each patient. Its duration can be significantly extended with additives. When spinal anesthesia is on regression during the last stage of surgery, additional operative time can be secured safely without general anesthesia, through the application of MAC. This approach can reduce the need for general anesthesia, which has associated clinical benefits as well as sparing resources and reducing the risk of spreading infectious pathogens.

Ethical approval

This study was approved by the Institutional Review Board of the Armed Forces Medical Command, the Republic of Korea.
IRB Approval Number: AFMC-20073-IRB-20-073.

Sources of funding

The authors received no specific funding for this work.

Credit Author contribution

Jihyoung Park: conceptualization, investigation, supervision, writing-original draft, writing-review & editing.

Seung Woo Song: conceptualization, data curation, investigation, visualization, writing-original draft, writing-review & editing.

Dong Wook Kim: investigation, writing-original draft, writing-review & editing.

Kwang Ho Lee: investigation, supervision, Writing-review & editing.

Research registration

1. Name of the registry: not applicable
2. Unique Identifying number or registration ID: not applicable.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): not applicable.

Guarantor

Seung Woo Song

Department of Anesthesiology and Pain Medicine

Yangju Armed Forces Hospital

1133, Hwahap-ro, Eunhyeon-myeon, Yangju-si, Gyeonggi-do, Korea

Tel: +82-31-857-0963

Fax: +82-31-863-6465

E-mail: yonfong@yonsei.ac.kr

Consent

Written informed consent was obtained from the patient for the publication for the publication this case report. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors have declared that no competing interests exist.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2021.102358>.

References

- [1] R. Brull, A.J.R. Macfarlane, V.W.S. Chan, Spinal, epidural, and caudal anesthesia, in: Gropper (Ed.), *Miller's Anesthesia*, ninth ed., Elsevier, MA, 2020, pp. 1413–1449.
- [2] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, S. Group, The SCARE 2020 guideline: updating consensus surgical CAse REport (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230.
- [3] M.S. Abbas, O.A. Asker, Significantly prolonged spinal anesthesia with the addition of dexamethasone: a case report, *J. Clin. Anesth.* 27 (2015) 524–526.
- [4] H. Higuchi, J. Hirata, Y. Adachi, T. Kazama, Influence of lumbosacral cerebrospinal fluid density, velocity, and volume on extent and duration of plain bupivacaine spinal anesthesia, *Anesthesiology* 100 (2004) 106–114.
- [5] W. Merino-Urrutia, M. Villagrán-Schmidt, P. Ulloa-Vásquez, R. Carrasco-Moyano, A. Uribe, N. Stoicea, et al., Cauda equina syndrome following an uneventful spinal anesthesia in a patient undergoing drainage of the Bartholin abscess: a case report, *Medicine* 97 (2018), e0693-e.
- [6] V. Moen, N. Dahlgren, L. Irestedt, Severe neurological complications after central neuraxial blockades in Sweden 1990–1999, *Anesthesiology* 101 (2004) 950–959.
- [7] C. Tschopp, M.R. Tramer, A. Schneider, M. Zaarour, N. Elia, Benefit and harm of adding epinephrine to a local anesthetic for neuraxial and locoregional anesthesia: a meta-analysis of randomized controlled trials with trial sequential analyses, *Anesth. Analg.* 127 (2018) 228–239.

- [8] K.C. Lee, H. Shi, B.C. Lee, Ketofol for monitored anesthesia care in shoulder arthroscopy and labral repair: a case report, *J. Pain Res.* 9 (2016) 417–420.
- [9] J. Bing, M.S. McAuliffe, J.R. Lupton, Regional anesthesia with monitored anesthesia care for dermatologic laser surgery, *Dermatol. Clin.* 20 (2002) 123–134.
- [10] H.-S. Yoon, B.-W. Yu, Y.-M. Kim, J.-H. Lee, W.-U. Koh, H.-S. Yang, Serratus anterior plane block combined with monitored anesthesia care for surgery of lateral side of breast -a case report, *Korean J Anesthesiol* 72 (2019) 500–503.
- [11] B.S. Freeman, Monitored anesthesia care and sedation, in: *Anesthesiology Core Review, Part One: Basic Exam*, McGraw-Hill Education, 2014.
- [12] D.M. Laporte, C. Vallera, Sedation for hand surgery in adults, *J Hand Surg Am* 36 (2011) 1231–1233, quiz 4.
- [13] Y.Y. Jo, H.J. Kwak, Sedation strategies for procedures outside the operating room, *Yonsei Med. J.* 60 (2019) 491–499.
- [14] W.T. Siow, S.H. Tang, R.V. Agrawal, A.Y.H. Tan, K.C. See, Essential ICU drug shortages for COVID-19: what can frontline clinicians do? *Crit. Care* 24 (2020) 260.
- [15] C.J. Biddle, B. George-Gay, P. Prasanna, E.M. Hill, T.C. Davis, B. Verhulst, Assessing a novel method to reduce anesthesia machine contamination: a prospective, observational trial, *Can. J. Infect Dis. Med. Microbiol.* 2018 (2018) 1905360.