Isobaric Spinal Anesthesia: A Suitable Approach for a Morbidly Obese Patient

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Morbid obesity is a relatively common and vastly increasing condition that can have a profound impact on morbidity and mortality during the administration and maintenance of general and regional anesthesia. Physiological derangements, difficult airway management, and biological augmentation in pharmacokinetics are some of the clinical challenges involved with this particular patient population. This case report discusses the advantages of regional versus general anesthesia in the morbidly obese patient population, in conjunction with an analysis of the various types of spinal anesthetics. This will be followed by a focused discussion related to the management of a morbidly obese patient undergoing a nonelective orthopedic procedure.

Keywords: Isobaric spinal anesthesia, morbid obesity.

The artistry of spinal anesthesia has progressed tremendously since the 1800s and presently continues to evolve. As anesthesia providers are faced with multiple challenges in providing a safe anesthetic for a growing morbidly obese populace, spinal anesthesia has increased in popularity. Spinal anesthesia offers distinct advantages over general anesthesia for this particular patient population. Minimal airway manipulation, forbearance of anesthetic drugs with cardiopulmonary depression, decreased postoperative nausea and vomiting, superior postoperative pain control, and reduced intraoperative and postoperative narcotic requirements responsible for causing postoperative pulmonary complications continue to uphold spinal blockade as a preferred anesthetic for systemically compromised individuals.1

Spinal is generally suitable for surgical procedures involving the lower abdominal area, perineum, and lower extremities.2 Local anesthetic solution injected into the intrathecal space impedes conduction of impulses along all nerves it comes in contact with including motor, sensory, and autonomic. In determining whether to use this type of neuraxial anesthesia, a couple of vital factors influencing the distribution of a spinal anesthetic must be examined (ie, baricity of the local anesthetic and patient position during and postsubarachnoid injection). These, in congruence with the clinical circumstance, and in combination with an individually tailored anesthetic goal, may govern whether a spinal anesthetic is appropriate.

Based on the principle of the uptake of spinal anesthetics being greatest at the area of highest concentration in the cerebrospinal fluid, and decreased caudal and cephalad respectively, the amalgamation of baricity of the local anesthetic solution and patient position determine allocation of the spinal blockade.3 By selecting a local anesthetic of appropriate density relative to the position of the patient, the dispersion of anesthesia can be controlled. Baricity possesses an important role in predicting the movement of a local anesthetic solution in the subarachnoid space and is equal to the density of the local anesthetic divided by the density of the cerebrospinal fluid at 37°C. Also, rooted in the basic law of gravity, physical arrangement will influence dissemination of the local anesthetic as well.4

A delicate patient population with various comorbidities may not have the physiologic capability or tolerance for remaining stable in a particular position for an extended period of time. This could present difficulties with using a spinal anesthetic in an otherwise appropriate patient and procedure. Fortunately, in instances when intrathecal block is deemed the safest anesthetic option, the positioning challenges could potentially be overcome by the use of an isobaric spinal solution. The baricity of an isobaric solution is equal to 1.0 and patient posture does not affect the expansion of the local anesthetic. Injection can be administered in any position, and following injection, the patient may remain in the original stance for the duration of the surgery. Unlike with hypobaric or hyperbaric local anesthetics, gravity does not play a role in the spread of isobaric solutions.4 Thus, an isobaric spinal blockade may indeed prove to be an advantageous approach for a patient with low biological endurance with regard to remaining fixed in a specific position throughout the course of surgery. The case report that follows examines a clinical circumstance wherein the use of an isobaric spinal anesthesia in a morbidly obese patient proved to have quite favorable intraoperative and postoperative outcomes.

Case Summary
A 57-year-old, 320-lb (145.4 kg), 63-in (160.02 cm) woman presented to the operating room for repair of a right ankle fracture by an open reduction internal fixation. At the outset, the anesthesia provider encountered the patient in the preoperative holding area and a thor-
ough preoperative anesthesia assessment was conducted. The patient was identified as a nursing home resident. The anesthesia assessment uncovered a health history of morbid obesity with a body mass index >35 and several comorbidities including hypertension, chronic heart failure, and moderate to severe obstructive pulmonary disorder resulting in a necessity for delivery of continuous 6 L of oxygen via nasal cannula. The patient was also struggling with emphysema, gastroesophageal reflux disease, noninsulin dependent diabetes, gout, migraines, polycythemia secondary to smoking (108 packs per year), osteoarthritis, and depression. The patient was taking prednisone, hydralazine, amlopidine besylate, insulin glargine, ipratropium bromide, albuterol, pantoprazole, insulin aspart, alprazolam, Robitussin, promethazine, morphine, furosemide, bupropion, methylprednisolone, losartan, and aspirin daily.

The patient reported a general feeling of malaise and exertion with any movement at all. All of her medications were administered to her either the evening before surgery, or the morning of, by the nursing home registered nurse. The patient was experiencing shortness of breath upon admission and claimed that her activity level had greatly declined over the course of the previous few months. Surgical history included a tonsillectomy and adenoidectomy as a child, an appendectomy, and a bilateral tubal ligation, with no reported anesthetic complications. The patient’s preoperative laboratory reports, which included a complete blood count, coagulation studies, arterial blood gases, basic metabolic panel and urinalysis, included the following: hemoglobin, 12.5 g/dL; PaO₂, 67 mm Hg; PaCO₂, 48 mm Hg; SaO₂, 86%; a blood urea nitrogen level (BUN) of 43 mg/dL; and a BUN/creatinine ratio of 30.7. All other laboratory results were within normal limits.

A chest radiograph taken 1 day before surgery showed a mildly enlarged cardiac silhouette but was otherwise unremarkable. An echocardiogram from 2 weeks before surgery revealed grade 1 diastolic dysfunction with an ejection fraction of 45% to 50%. Mild to moderate right and left ventricular hypertrophy and a small pericardial effusion were also noted. An electrocardiogram, also from 1 day before surgery, showed a normal sinus rhythm with no signs of injury or ischemia. Preoperative vital signs were as follows: heart rate, 95/min; blood pressure, 149/72 mm Hg; respiratory rate, 16/min; and SaO₂, 89% on 6 L of oxygen via nasal cannula and temperature of 37.1°C. Physical examination by the anesthesia provider the morning of surgery was within normal limits for neurological status. Heart rate and rhythm were regular, and heart sounds were free of murmurs, rubs or gallops. The patient’s lungs were clear to auscultation bilaterally. The patient’s airway was evaluated as a class 3 airway using the Mallampati classification system. Her thyromental and sternomental distances, range of motion, and prognath assessments deviated slightly from normal limits and predicted that the patient would be a moderately difficult intubation. The anesthesia provider assigned the patient an ASA physical status 4. The anesthetic plan for this patient’s ankle surgery included a spinal blockade with light sedation to combat the patient’s anxiety as requested by the surgeon. In addition, all accessible advanced airway equipment and essential medications in the event of a required conversion to general endotracheal anesthesia were prepared and available. The anesthesia provider planned to use a para-median approach, indicated in patients who cannot adequately flex as a consequence of pain or whose ligaments are ossified, as opposed to the more traditional midline approach. After discussing the anesthetic plan with the patient and clarifying the risks, benefits and complications of the subarachnoid block, the patient agreed to the plan and the anesthesia provider proceeded accordingly.

In the preoperative holding area, the patient was pretreated with 10 mg of metoclopramide and 2 g of cefazolin. A 500-mL normal saline fluid bolus was also given via a peripheral intravenous catheter. The patient was transported to the operating room and assisted when she was moved to the operating table. The patient was then connected to full standard monitors (blood pressure, pulse oximetry, heart, and respiratory rates), placed on 10 L of oxygen via a simple face mask and was lightly sedated with midazolam (1 mg) and fentanyl (25 µg). Preemptively, 2 additional 16-gauge peripheral intravenous catheters were initiated, and a normal saline drip was started at a rate of approximately 750 mL/h. The patient was in the upright sitting position supported by a registered nurse at the foot of the operating table. Anatomic landmarks for the desired level of the block were identified. An attempt to palpate the superior iliac crests was made and level L4 was identified. The spine was palpated to ensure spine position with relation to the plane of the floor. A sterile field was established by betadine application with 3 sponges. The solution was applied starting from the injection site moving outward in a circular fashion. A fenestrated drape was applied, and using sterile gauze, the betadine was wiped from the injection site to avoid initiation into the subarachnoid space. A skin wheal was then raised with 3 mL of 1% lidocaine using a 25-gauge needle to the chosen space. An 18-gauge introducer was inserted 1 cm lateral to the spinous process and directed toward the middle of the interspace, angled slightly cephalad through the epidermis, dermis, subcutaneous tissue, supraspinous ligament, interspinous ligament, finally stopping in the ligamentum flavum. A 25-gauge Whitacre needle was inserted into the introducer, passing through the epidural space, dura, and arachnoid, to the subarachnoid space, finally stopping when the presence of cerebrospinal fluid was determined. No parasthesias or blood return was noted. Two
mL of 0.5% bupivacaine in water was injected smoothly and slowly at a speed of less than 0.5 mL/s. Additional aspiration of cerebrospinal fluid at the midpoint and end of injection was carried out to confirm continued subarachnoid administration. When the local anesthetic injection was complete, the introducer and spinal needle were removed as 1 unit from the patient’s back.

The patient was then assisted in leaning back against the steep reverse Trendelenburg operating table with the support of 6 pillows. Sensory loss was assessed by testing temperature sensation using an alcohol swab and also with light blunt needle pricks moving from the nipple line down. The spinal block was deemed to be at a T10 level and at a surgical anesthesia level in approximately 13 minutes. After injection of the spinal anesthetic, the cardiovascular and respiratory status of the patient were assessed and there were no indications of falling blood pressure (pallor, sweating, complaining of nausea) noted. An additional 1 mg of midazolam and 50 µg of fentanyl were given before the procedure began. The patient experienced no dyspnea throughout the procedure and continued to be hemodynamically stable. Total surgical time was 1 hour and 45 minutes, and the patient was stable and comfortable for the remainder of the procedure, requiring no supplementary opioid or benzodiazepine administration.

The patient was transported to the postanesthesia care unit where she was pain-free and comfortable. When the anesthesia provider reappeared for a postoperative visit approximately 2 hours later, the patient delighted at her comfort level and had not received any narcotics to combat pain. She was to be transferred to the orthopedic floor for an overnight observation and discharged to the nursing home the following day.

Discussion
Spinal anesthesia, compared with general anesthesia, offers many benefits for morbidly obese patients. In the existence of an elevated risk for intraoperative pulmonary and hemodynamic compromise, such as in the case of grossly overweight patients, neuraxial anesthesia may provide unparalleled stability. Although the reduction in perioperative lung volumes is increasingly augmented with an elevating body mass index, it has been discovered that in obese individuals, the reestablishment of lung volumes is more rapid in patients receiving spinal anesthesia rather than general anesthesia. Also, early postoperative ambulation and mobilization may aid in expediting the return of preoperative lung function that may have been impaired by spinal anesthesia.3-7

In contrast to general anesthesia, for the individual with chronic obstructive pulmonary disorder, the conservation of spontaneous respirations signifies a lesser cephalad displacement of the diaphragm and a decreased possibility of atelectasis.2 Subsequently, closing capacity and functional residual capacity may be minimally affected, and a patient that may otherwise be unable to maintain adequate gas exchange, would be successful in doing so.4 In addition, subarachnoid blockade has the capability of providing excellent postoperative pain relief while omitting any potential for respiratory depression. In patients with moderate to advanced lung disease who are unable to lie supine for the period of surgery, refraining from the aggressive stimulation of direct laryngoscopy and the possibility of a bronchospasm on extubation that accompany general anesthesia are considerable advantages.

With regard to the matter of the use of isobaric versus hyperbaric or hypobaric spinal anesthetic solutions, a study conducted by Solakovic3 revealed baricity to be a variable influencing the behavior of blood pressure and pulse. Hemodynamic fluctuations and decline of blood pressure and heart rate were more pronounced in individuals who received hyperbaric compared to isobaric anesthesia. Hence, an isobaric spinal is not only beneficial in a situation when limitations in patient positioning are present but also in circumstances when physiological stability needs to be optimized.

Although spinal blockade is an invaluable anesthetic method in an anesthesia provider’s armamentarium, the research has identified some disadvantages aligned with its use. Anthropometric alterations correlated with morbid obesity can diminish the successful placement of a spinal anesthetic. In a study discussed by Ingrande et al,1 body mass index of more than 25 kg/m² was identified as an independent risk factor for block failure. Also, it has been noted that in obese individuals a higher cephalad spread may be achieved, perhaps due to smaller cerebrospinal fluid volumes associated with obesity, potentially predisposing these particular patients to hemodynamic and respiratory depression. Thus, despite a successful spinal blockade minimizing airway manipulation, complete elimination of airway compromise is not definitive.7

Conclusion
Neuraxial blockade is a safe and effective method of providing adequate anesthesia and superior postoperative analgesia to patients with respiratory deficiencies undergoing lower extremity procedures. Anesthesia providers must cautiously evaluate each patient to determine the appropriateness of and securely administer the spinal anesthetic. Although there does not seem to be neither an entirely correct nor false method to anesthetize compromised patients, expanding the boundaries of intrathecal anesthesia by incorporating an isobaric local anesthetic as part of the spinal blockade may provide distinguished advantages over general anesthesia in this particular patient population.
REFERENCES

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Corrections
Typographical Errors
There were 2 typographical errors in the August 2012 article by Pauline Maietta, CRNA, MS, titled “Accidental Carotid Artery Catheterization During Attempted Central Venous Catheter Placement: A Case Report.” Both errors occurred on page 252, left column, second paragraph.

1. At the end of line 8, “SpO2” should be “SpO2.” The corrected sentence is “Vital signs just prior to catheter placement were: heart rate, 98/min; blood pressure, 83/52 mm Hg, SpO2, 100%.”
2. In line 12, “PaCO2” should be “PaO2.” The corrected sentence is “A pulsatile arterial waveform was noted, and arterial placement confirmed via PaO2 of 429 mm Hg.”

AANA Journal Course Examination #31
An error occurred in the August 2012 Examination Answers. On page 307, the correct answer for question number 8 is answer number 4, not number 1. The correct answer is highlighted below.

8. All of the following are predictors of difficult intubation EXCEPT:
   1. Mallampati score ≥ 3
   2. large body mass index
   3. decreased thyromental distance
   4. neck circumference > 35 cm

The online version of the August issue reflects these corrections.