

EDITORIAL

Baricity: an important issue for spinal anesthesia

Gokcen BASARANOGLU *

Department of Anesthesiology and Reanimation, Faculty of Medicine, Bezmialem Vakif University, Istanbul, Turkey

*Corresponding author: Gokcen Basaranoglu, Department of Anesthesiology and Reanimation, Faculty of Medicine, Bezmialem Vakif University, Vatan Caddesi, Fatih, 34093 Istanbul, Turkey. E-mail: gbasaranoglu@hotmail.com

Hip fractures occur 1.6 million times worldwide every year.¹ This patient population has specific problems. General anesthesia and spinal anesthesia represent the two common approaches for these groups of patients. Compared to general, spinal anesthesia is simple and easy; it provides pain control, reduces mortality and early cognitive dysfunction.^{2, 3} The major disadvantages of spinal anesthesia are risks of hypotension, higher level of blockade and cardiac arrest.

Intrathecal drug distribution is affected by a number of factors, including baricity, total dose, volume, concentration of the local anesthetic drug, injection site, conformation of spinal canal (presence of kyphosis, lordosis), position and cerebrospinal fluid (CSF) volume in the lumbosacral dural sac. Baricity is the ratio of density of the local anesthetic solution relative to the density of CSF at 37 °C. Isobaric solution is as the same density as the CSF. Hyperbaric solution is denser than CSF, whereas hypobaric solution is less dense than CSF. Thus, the choice of the drug baricity can be affected by patient position.

Isobaric solutions have minimal effects on distribution of anesthetic and cephalad spread of spinal anesthesia. It can be an advantage for orthopedic surgery. Hypobaric local anesthetics are suitable for hip surgery in the lateral

decubitus position, because of its selectively to distribute to the non-dependent (operative) side with no extra movement of the anesthetized patient. The other advantage of hypobaric solutions is a slight head down position keeps the level of blockade from rising and, at the same time, improves venous return and hemodynamic stability.⁴

Levobupivacaine is one of the less cardiotoxic and neurotoxic local anesthetic drugs and it can be used for orthopedic surgery patients. Its pharmacologic properties are similar to bupivacaine but electrolyte composition is different. Levobupivacaine has a higher sodium content, osmolality and H⁺ ion concentration compared with bupivacaine. When the concentration of levobupivacaine is increased, sodium ion concentration is held constant, but as the concentration of bupivacaine is increased, sodium concentration is reduced.⁵ In this issue of *Minerva Anestesiologica*, Vergari *et al.*⁶ assess a prospective randomized study comparing isobaric to hypobaric levobupivacaine for hip arthroplasty patients in lateral decubitus position. Using hypobaric levobupivacaine allows for a shorter onset time for sensory block and delayed regression of sensory and motor block in the non-dependent side without added complications. Isobaric and hypobaric bupivacaine were compared in the lateral decubitus position by Faust *et al.*⁷ Except for using levobupivacaine, results of

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that study were similar to those from the study by Faust *et al.*⁷

The mean density of CSF was affected by age, sex, pregnancy, CSF protein concentration and specific patient population subgroups. The mean CSF density was detected as 1.00067 ± 0.00018 g/mL for males, 1.00060 ± 0.00015 g/mL for postmenopausal females, 1.00047 ± 0.00008 g/mL for premenopausal and 1.00033 ± 0.00010 g/mL for pregnant woman.⁸ CSF densities vary among the population. Hyperbaric and hypobaric solutions must have densities three standard deviations above and below the mean CSF density, respectively, to predictably act in a hyperbaric or hypobaric manner.⁹ Plain bupivacaine without glucose is considered isobaric but some studies showed that it is hypobaric in manner.^{5, 8, 10} In the same way, 0.5% levobupivacaine has been described as hypobaric by some and isobaric by others.^{5, 8, 11, 12} It has been shown that even small differences in density may significantly affect the distribution of intrathecal anesthesia in a spinal canal model.¹³ Thus plain 0.5% bupivacaine and 0.5% levobupivacaine is unpredictable for a spinal anesthetic agent. Local anesthetics used with opioids markedly confuse this situation.

In light of this evidence, we should measure CSF densities of the patients. We can predict whether local anesthetic solutions are isobaric or hypobaric. If it is not possible to measure CSF density, it can be kept in mind that the concentration of local anesthetics, opioids and dextrose added in local anesthetics, electrolyte composition of local anesthetic, position of the patients, temperature, level and speed of injection,¹⁴ volume, viscosity and protein contents of CSF, sex and effects of patient subgroups will change intrathecal local anesthetic spread.

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