

Regional anesthesia and obesity

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Current Opinion in Anaesthesiology 2009, 22:683–686

Purpose of review

Worldwide, the number of overweight and obese patients has increased dramatically. As a result, anesthesiologists routinely encounter obese patients daily in their clinical practice. The use of regional anesthesia is becoming increasingly popular for these patients. When appropriate, a regional anesthetic offers advantages and should be considered in the anesthetic management plan of obese patients. The following is a review of regional anesthesia in obesity, with special consideration of the unique challenges presented to the anesthesiologist by the obese patient.

Recent findings

Recent studies report difficulty in achieving peripheral and neuraxial blockade in obese patients. For example, there is an increased incidence of failed blocks in obese patients compared with similar, normal weight patients. Despite difficulties, regional anesthesia can be used successfully in obese patients, even in the ambulatory surgery setting.

Summary

Successful peripheral and neuraxial blockade in obese patients requires an anesthesiologist experienced in regional techniques, and one with the knowledge of the physiologic and pharmacologic differences that are unique to the obese patient.

Keywords

anesthesia, obesity, regional anesthesia

Curr Opin Anaesthesiol 22:683–686
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0952-7907

Introduction

The incidence of morbid obesity has tripled over the past three decades throughout the world [1,2]. The WHO estimates that as of 2005, 1.6 billion people were overweight (defined as BMI 25–30 kg/m²) and 400 million obese (BMI > 30 kg/m²). WHO projects that by 2015, 2.3 billion people will be overweight and 700 million will be obese. Today, in the United States, 65% of the adult population is overweight. Over the past 20 years, the incidence of obesity has doubled in the United States. Obesity and, particularly, morbid obesity (BMI > 40 kg/m²) are associated with an increased incidence of medical comorbidities, including type 2 diabetes, hypertension, obstructive sleep apnea, cardio-pulmonary disease, venous thromboembolism, and psychosocial disease. The rate of premature death in patients weighing 140–160% of their ideal body weight is double that of similar normal weight individuals [3].

The use of regional anesthetic techniques for obese patients is increasing in popularity. Regional anesthesia offers distinct advantages over general anesthesia for these patients. A regional anesthetic allows minimal airway manipulation, avoidance of anesthetic drugs with cardiopulmonary depression, and reduced postoperative nausea and vomiting (PONV), as well as

greater postoperative pain control. Regional anesthesia may also reduce perioperative and postoperative opioid requirements, which is of critical importance in a patient population prone to postoperative pulmonary complications. However, the limitations of regional anesthesia and the technical difficulties encountered with its use in obese patients must be carefully considered.

Influence of obesity on regional anesthesia

The anthropometric changes associated with obesity can make performance of peripheral nerve blockade technically difficult. In a prospective study [4*] examining 9342 regional blocks performed in an outpatient setting, BMI of more than 25 kg/m² was an independent risk factor for block failure. The rate of block failure increased incrementally with BMI. Of the failed blocks, paravertebral and continuous epidural, continuous supraclavicular, and superficial cervical plexus blocks had the highest failure rates. Failed blocks often required supplementation with general anesthesia.

In a retrospective review of 1565 supraclavicular blocks performed in nonobese individuals and 455 supraclavicular blocks performed in obese patients, Franco *et al.* [5] demonstrated a significantly lower success rate in the

obese patients, although the success rate was still relatively high (94.3 vs. 97.3%).

As with peripheral nerve blocks, establishing neuraxial blockade in the morbidly obese patient can also be challenging. In the obese patient, there may be difficulty in palpating bony landmarks or even identifying the midline, and the presence of fat pockets may result in false-positive loss of resistance during needle placement. Drug distribution may also be altered [6,7]. Hood and Dewan [7] described an initial success rate of only 42% for placing epidural catheters in obese patients compared with an initial 94% success rate in nonobese controls. Overall, the success rate was similar for both groups, but obese patients required more placement attempts to achieve success.

Obese patients require less local anesthetic in their epidural and subarachnoid spaces in order to achieve the same level of block when compared with nonobese controls. After 3 ml of 0.5% bupivacaine was injected into the subarachnoid space at the L3–4 interspace, Taivainen *et al.* [6] demonstrated a higher cephalad spread in obese vs. nonobese individuals. Similarly, Hodgkinson and Husain [8] demonstrated a higher cephalad spread of 20 ml 0.75% bupivacaine injected into the L3–4 epidural in obese vs. nonobese individuals. Although the apparent lower spinal anesthetic dose requirement may be explained by the fact that obese patients have smaller cerebrospinal fluid volumes than do nonobese individuals [9], the reason for the lower epidural anesthetic dose requirement is less clear.

Ultrasound-guided techniques have been promoted to aid epidural catheter placement [10–13]. Even with the use of ultrasound, there have been reports of accidental dural puncture during attempted epidural placement in morbidly obese patients [14]. Improved success rates using ultrasound-guided regional anesthesia in the obese population have also been reported for peripheral nerve blocks [15,16]. However, sufficient proficiency with ultrasound is needed before consistent success can be achieved. Once achieved, the experienced anesthesiologist finds ultrasound-guided regional anesthesia useful for localizing peripheral nerves when performing a peripheral nerve block. Routine use of ultrasound is likely to improve the success rate of peripheral nerve blockade for all patients including obese ones and reduce the rate of complications compared with regional anesthesia attempted using peripheral nerve stimulation.

However, the use of ultrasound for performing neuraxial blockade remains controversial. Ultrasound for neuraxial blockade is not routinely used at our facility. Although there have been anecdotal reports of success using ultrasound for neuraxial blockade, we have found that

familiarity with spinal anatomy, pharmacology of local anesthetic techniques, and experience in performing neuraxial blocks are sufficient to perform a successful neuraxial block in morbidly obese patients.

However, increased difficulty of performing neuraxial blocks in obese patients must be taken into consideration. Longer spinal and epidural needles may be necessary, and landmarks may be concealed by excess body tissue.

Regional anesthesia and pulmonary function

Obesity is associated with perioperative hypoxia [17] and an increased risk of postoperative pulmonary complications, including pneumonia [18] and respiratory failure [19]. Opioid analgesia can be dangerous in some obese patients, especially those with obstructive sleep apnea or obesity hypoventilation syndromes. Even with patient-controlled opioid analgesia, respiratory depression has been reported in obese patients [20]. The increased risk of hypoxia, the very high association of obstructive sleep apnea with obesity, and the increased incidence of adverse respiratory events following surgery have led some bariatric anesthesiologists to recommend the use of short-acting opioids and the sparing use of long-acting opioids in the obese population [2,21].

Epidural anesthesia in obese patients undergoing thoracic and upper abdominal surgery decreases opioid requirements and reduces postoperative pulmonary complications [22,23]. When combined with a general anesthetic, epidural anesthesia may result in earlier time to tracheal extubation than with a balanced anesthetic alone [24].

Regional anesthesia and ambulatory surgery

Obese surgical patients are at an increased risk for difficult airways, cardiopulmonary dysfunction, acid aspiration, and even death [2]. These concerns have forced some to consider morbid obesity a contraindication for ambulatory surgery [25]. Recently, the appropriateness of ambulatory surgery in the obese population has been re-examined [26,27]. These reports supported the feasibility of ambulatory anesthesia in the obese population, so long as specific guidelines are considered. Guidelines include the need for careful selection of patients appropriate for day surgery, the presence of skilled surgeons and anesthesiologists, prophylaxis against deep venous thrombosis and PONV, and adequate postoperative pain control. For patients with extreme obesity, regardless of these guidelines, a low threshold for postoperative hospital admission must be adhered to. Bryson *et al.* [28] studied 2799 obese patients and 14569 normal weight individuals undergoing outpatient surgery. Adverse respiratory events occurred four times more frequently in obese patients vs. normal weight individuals, although

these events did not increase the overall rate of unanticipated hospital admissions.

Regional anesthesia for obese patients in the ambulatory settings does offer several theoretical advantages over general anesthesia. These advantages include reduction in the need for airway intervention, fewer drugs with less cardiopulmonary depression, decreased need for opioid and other sedatives, and decreased PONV [29–31].

The use of regional anesthesia has reduced postanesthesia care unit (PACU) [29,31] and overall hospital length of stay [29,30]. In a recent retrospective study [32], 9038 regional nerve blocks were performed in 6920 patients undergoing outpatient surgery. In this series, 31.3% were obese. Obese patients had similar pain scores (at rest), opioid requirements, incidence of PONV, PACU length of stay, and rate of unplanned hospital admission when compared with normal weight individuals. However, the rate of block failure and acute block complications were statistically greater in obese patients compared with nonobese individuals.

Although regional anesthesia is a viable option for the obese patient undergoing outpatient surgery, the difficulty in performing these blocks must also be considered. Furthermore, the type of anesthetic performed should never supersede a thorough history of the patients' comorbidities and physical examination when determining appropriateness for outpatient surgery.

Special considerations: regional anesthesia for postbariatric procedures

The incidence of bariatric surgery has increased in tandem with the increases in the obese and morbidly obese population. The number of bariatric procedures performed between 1995 and 2005 increased from 20 000 to 170 000 per annum. Of these, the Roux-en-Y gastric bypass (RYGP) and gastric banding procedures are currently the most popular.

A malabsorptive procedure such as RYGB is associated with postoperative nutritional deficiencies that can present unique problems to the anesthesiologist performing regional anesthesia. Vitamin K deficiency occurs in 50–68% patients following RYGB, even in those taking daily vitamins [33]. There have been case reports describing the adverse effects of vitamin K deficiency on coagulation after gastric surgery [34]. The anesthesiologist considering a neuraxial block in a patient who has had RYGB surgery in the past should be concerned about potential vitamin K deficiency.

In addition, water-soluble vitamin deficiencies may also be present, most notably vitamins B₁₂ and folate. B₁₂

deficiency is present in an estimated 6–70% of postbariatric surgery patients [35]. Manifestations of B₁₂ deficiency include peripheral neuropathy and subacute combined degeneration with white matter lesions in the posterior column and pyramidal tract that can manifest as demyelination and can progress to axonal degeneration and neuronal death [36]. This may lead to weakness, loss of motor function, and proprioception. The risk/benefit of a neuraxial block should be considered in the context of whether the patient has a peripheral neuropathy.

In addition to nutritional deficiencies and malabsorption, rapid weight loss may also lead to peripheral neuropathy in postbariatric surgical patients. A recent study [37] found that significant weight loss is correlated to a higher risk of peroneal nerve injury after bariatric surgery. Mechanical injury to peripheral nerves may occur during positioning as a decreased fat pad after weight loss may leave nerves more susceptible to compression [35,38].

Therefore, careful consideration should be taken before performing regional anesthesia in a patient following bariatric surgery. A thorough history and physical examination directed at any potential nutritional deficiencies or neurologic dysfunction are mandatory before a block is performed. A high index of suspicion for coagulopathy must be present, and a coagulation profile should be obtained.

Conclusion

Regional anesthesia is becoming increasingly popular for obese and morbidly obese patients. The potential benefits of regional anesthesia in obese patients are substantial and have increased the interest in these techniques for obese patients undergoing ambulatory surgery. Nevertheless, difficulties of performing regional techniques must be considered. Despite the fact that a successful regional anesthetic allows minimal manipulation of the airway, it does not free the patient from the potential for airway compromise. Ultrasonography should be used for guidance of peripheral nerve blockade; however, its use for neuraxial blockade remains controversial. We conclude that obesity is not a contraindication for the use of regional anesthesia when performed by an experienced anesthesiologist familiar with morbidly obese surgical patients.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 697).

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