Regional anesthesia and obesity

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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

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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/m^2) and 400 million obese (BMI > 30 kg/m^2). 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/m^2) 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/m^2 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% bupivicaine 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% bupivicaine 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 14 569 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 B_{12} and folate. B_{12} deficiency is present in an estimated 6–70% of postbariatric surgery patients [35]. Manifestations of B_{12} 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).

1 Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999–2000. JAMA 2002; 288:1723–1727.

2 Adams JP, Murphy PG. Obesity in anaesthesia and intensive care. Br J Anaesth 2000; 85:91–108.

3 Garrison RJ, Castelli WP. Weight and thirty-year mortality of men in the Framingham Study. Ann Intern Med 1985; 103:1006–1009.

4 • Cotter JT, Nielsen KC, Guller U, *et al.* Increased body mass index and ASA physical status IV are risk factors for block failure in ambulatory surgery: an analysis of 9,342 blocks. Can J Anaesth 2004; 51:810–816.
A large prospective study identifying patient characteristics associated with block failure.

5 Franco CD, Gloss FJ, Voronov G, *et al.* Supraclavicular block in the obese population: an analysis of 2020 blocks. Anesth Analg 2006; 102:1252–1254.

6 Taivainen T, Tuominen M, Rosenberg PH. Influence of obesity on the spread of spinal analgesia after injection of plain 0.5% bupivacaine at the L3-4 or L4-5 interspace. Br J Anaesth 1990; 64:542–546.

7 Hood DD, Dewan DM. Anesthetic and obstetric outcome in morbidly obese parturients. Anesthesiology 1993; 79:1210–1218.

8 Hodgkinson R, Husain FJ. Obesity and the cephalad spread of analgesia following epidural administration of bupivacaine for Cesarean section. Anesth Analg 1980; 59:89–92.

9 Hogan QH, Prost R, Kulier A, *et al.* Magnetic resonance imaging of cerebrospinal fluid volume and the influence of body habitus and abdominal pressure. Anesthesiology 1996; 84:1341–1349.

10 Grau T, Bartusseck E, Conradi R, *et al.* Ultrasound imaging improves learning curves in obstetric epidural anesthesia: a preliminary study. Can J Anaesth 2003; 50:1047–1050.

11 Grau T, Leipold RW, Conradi R, *et al.* Efficacy of ultrasound imaging in obstetric epidural anesthesia. J Clin Anesth 2002; 14:169–175.

12 Grau T, Leipold RW, Conradi R, Martin E. Ultrasound control for presumed difficult epidural puncture. Acta Anaesthesiol Scand 2001; 45:766–771.

13 Wallace DH, Currie JM, Gilstrap LC, Santos R. Indirect sonographic guidance for epidural anesthesia in obese pregnant patients. Reg Anesth 1992; 17:233–236.

14 Whitty RJ, Maxwell CV, Carvalho JC. Complications of neuraxial anesthesia in an extreme morbidly obese patient for Cesarean section. Int J Obstet Anesth 2007; 16:139–144.

15 Chantzi C, Saranteas T, Zogogiannis J, *et al.* Ultrasound examination of the sciatic nerve at the anterior thigh in obese patients. Acta Anaesthesiol Scand 2007; 51:132.

16 Schwemmer U, Papenfuss T, Greim C, *et al.* Ultrasound-guided interscalene brachial plexus anaesthesia: differences in success between patients of normal and excessive weight. Ultraschall Med 2006; 27:245–250.

17 Vaughan RW, Wise L. Intraoperative arterial oxygenation in obese patients. Ann Surg 1976; 184:35–42.

18 Flancbaum L, Choban PS. Surgical implications of obesity. Annu Rev Med 1998; 49:215–234.

19 Livingston EH, Huerta S, Arthur D, *et al.* Male gender is a predictor of morbidity and age a predictor of mortality for patients undergoing gastric bypass surgery. Ann Surg 2002; 236:576–582.

20 VanDercar DH, Martinez AP, De Lisser EA. Sleep apnea syndromes: a potential contraindication for patient-controlled analgesia. Anesthesiology 1991; 74:623–624.

21 Shenkman Z, Shir Y, Brodsky JB. Perioperative management of the obese patient. Br J Anaesth 1993; 70:349–359.

22 Buckley FP, Robinson NB, Simonowitz DA, Dellinger EP. Anaesthesia in the morbidly obese: a comparison of anaesthetic and analgesic regimens for upper abdominal surgery. Anaesthesia 1983; 38:840–851.

23 Fox GS, Whalley DG, Bevan DR. Anaesthesia for the morbidly obese: experience with 110 patients. Br J Anaesth 1981; 53:811–816.

24 Gelman S, Laws HL, Potzick J, *et al.* Thoracic epidural vs balanced anesthesia in morbid obesity: an intraoperative and postoperative hemodynamic study. Anesth Analg 1980; 59:902–908.

25 Davies KE, Houghton K, Montgomery JE. Obesity and day-case surgery. Anaesthesia 2001; 56:1112–1115.

26 Servin F. Ambulatory anesthesia for the obese patient. Curr Opin Anaesthesiol 2006; 19:597–599.

27 Raeder J. Bariatric procedures as day/short stay surgery: is it possible and reasonable? Curr Opin Anaesthesiol 2007; 20:508–512.

28 Bryson GL, Chung F, Finegan BA, *et al.* Patient selection in ambulatory anesthesia: an evidence-based review – part I. Can J Anaesth 2004; 51: 768–781.

29 Coveney E, Weltz CR, Greengrass R, *et al.* Use of paravertebral block anesthesia in the surgical management of breast cancer: experience in 156 cases. Ann Surg 1998; 227:496–501.

30 Lynch EP, Welch KJ, Carabuena JM, Eberlein TJ. Thoracic epidural anesthesia improves outcome after breast surgery. Ann Surg 1995; 222:663–669.

31 D'Alessio JG, Rosenblum M, Shea KP, Freitas DG. A retrospective comparison of interscalene block and general anesthesia for ambulatory surgery shoulder arthroscopy. Reg Anesth 1995; 20:62–68.

32 Nielsen KC, Guller U, Steele SM, *et al.* Influence of obesity on surgical regional anesthesia in the ambulatory setting: an analysis of 9,038 blocks. Anesthesiology 2005; 102:181–187.

33 McMahon MM, Sarr MG, Clark MM, *et al.* Clinical management after bariatric surgery: value of a multidisciplinary approach. Mayo Clin Proc 2006; 81: S34–S45.

34 Van Mieghem T, Van Schoubroeck D, Depiere M, *et al.* Fetal cerebral hemorrhage caused by vitamin K deficiency after complicated bariatric surgery. Obstet Gynecol 2008; 112:434–436.

35 Thaisetthawatkul P. Neuromuscular complications of bariatric surgery. Phys Med Rehabil Clin N Am 2008; 19:111–124; vii.

36 Kumar N. Nutritional neuropathies. Neurol Clin 2007; 25:209–255.

37 Weyns FJ, Beckers F, Vanormelingen L, *et al.* Foot drop as a complication of weight loss after bariatric surgery: is it preventable? Obes Surg 2007; 17:1209–1212.

38 Elias WJ, Pouratian N, Oskouian RJ, *et al.* Peroneal neuropathy following successful bariatric surgery: case report and review of the literature. J Neurosurg 2006; 105:631–635.