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Advantages and Challenges of Peripheral Nerve Blocks in Obese Patients: A Narrative Review

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ABSTRACT

Over the past decade, obesity has increased significantly. Due to this, anaesthesiologists routinely encounter a significant problem in performing peripheral nerve blocks in these patients in clinical settings. The difficulty in identifying the bony structure and the anatomical landmarks, an increase in depth of nerve structures and difficulty in patient positioning makes this technique a bit complicated to apply in patients who are obese. Moreover using regional anaesthesia in these patients, for establishing neuraxial blockade can also be challenging. On the other hand, this technique also provides several advantages over general or spinal anesthesia in obese or morbidly obese patients. In peripheral anesthesia, airway manipulation can be avoided. Moreover, the systemic effects of different anesthetic agents can be avoided. Regional anesthesia also decreases postoperative nausea, and vomiting, and excessive consumption of opioid and therefore results in a reduced stay in the post-anesthesia care unit. In addition, they also are reported to have reduced hospital stay. An array of literature is available that has reported using a various upper limb, lower limb and truncal nerve blocks in obese patients. However, there exist lacunae that can compare all these studies and provide a comprehensive review. Thus, this review aimed to discuss the different peripheral nerve blockade techniques used in obese patients previously, and the advantages of using peripheral nerve block in these patients.

Keywords: Obesity, Regional Anaesthesia, Peripheral Nerve Blocks, USG, Local Anesthetics.

INTRODUCTION

In general, obesity is can be defined as accumulation of abnormal or excessive fat accumulation resulting in a significant health risk. According to The World Health Organisation (WHO) the calculated BMI is the standard method of calculating the obesity. By definition, a BMI ranging from 25 and 29.9 indicates that excess weight for an individual. Obesity is termed for a person with a BMI of 30 or over. The basic reason behind overweight and obesity is the imbalance of the energy between gained calories and used calories.[1,2]

Other than the body fat the waist-to-hip ratio size (WHR), and waist-to-height ratio (WtHR), also play a role in identification of how healthy a person's weight and body shape should be.[3,4]

Complications of obesity

Obesity or overweight can expose a person to the risk of multiple morbid health conditions. These health condition include hypertension, dyslipidemia, cardiovascular disease, type 2 diabetes, cerebrovascular disease, metabolic syndrome, stroke, pulmonary abnormalities, gastrointestinal abnormalities, reproductive disease, etc. Obesity can increase the risk of musculoskeletal disorders especially osteoarthritis. Besides, some cancers including ovarian, kidney, endometrial, breast, liver, prostate, gallbladder, and colon can be influenced by obesity. Finally, it creates numerous psychosocial issues and hinders access to care.[5]

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Challenges of nerve block in obese patients

Overall, anthropometric parameters in obese and super-obese patients hinder the performance of peripheral nerve block techniques. Difficulties in positioning, the disappearance of landmarks and increased depth of nerve structures contribute to an increased failure rate in applying peripheral anesthesia in obese patients. Studies have shown that a BMI of more than 25 kg/m2 act as an independent risk factor. The rate of failure increases linearly with an increase in BMI. The nerve blocks that show the highest rates of failure are continuous epidural and paravertebral block, superficial cervical plexus blocks, and continuous supraclavicular blocks. In the case of peripheral nerve blocks in morbidly obese patients, establishing neuraxial blockade can also be challenging. There are other difficulties also in the nerve block of the obese patient including presence

of lot of fat pockets, loss of bony landmarks, and difficulty in identifying the midline. These may result in false-positive loss of resistance during needle placement. In an obese individual, the drug distribution may also be altered. Studies have shown that successful placement of epidural catheter requires more attempts in obese patients than in non-obese individuals.[6]

Looking at pulmonary complications, perioperative hypoxia is most commonly associated with obesity. The risk of postoperative pulmonary complications including the respiratory failure is also more common in obese patients. In overweight patients presence of obstructive sleep apnea is a commonly found complication and increased opioid analgesia can be detrimental in these cases. In addition, surgical patients who are obese are at an increased risk for cardiopulmonary dysfunction, airways complications, and even death.[6]

Advantages of peripheral nerve block in obese patients

Regional anesthesia and the incorporation of peripheral nerve blocks allow for localized, targeted anesthesia for both surgical anesthesia and post-operative pain control. By focusing on a specific location, systemic and generalized adverse effects can be avoided. To perform a peripheral nerve block, the provider must have the appropriate equipment (peripheral nerve needles, nerve stimulator, local anesthetics) and a targeted nerve structure. Surgical duration should be taken into account when choosing a local anesthetic for a true surgical block. Literature has shown that one of the most important factors is the mass or total dosage of the local anesthetic. Multiple adjuncts are used in combination with local anesthetics to increase duration, decrease the time of onset, and increase the quality and density of the block.[7]

Several perturbations both in the form of physiological and anatomic may occur in association with obesity. Especially in the gastrointestinal, cardiovascular, and neurological systems. These complications also pose a great threat for anaesthesiology procedures. Moreover, presence of some other co morbid conditions also limits the systemic effect of the anaesthesia. In peripheral anesthesia these complications can be avoided. Besides, this procedure provides a better pain control. 6 Regional anesthesia also decreases incidents of PONV, opioid consumption, and therefore results in reduced hospital stay.

Upper limb blocks

The indications for upper limb blocks are for surgical anesthesia as well as post-operative pain management for surgeries involving either the upper arm or forearm. Each upper extremity block has its indications based on the location of the surgery. Studies have shown that in obese patients the upper extremity blocks are usually not advisable because of the complications associated with the technique. In a study by Nielsen et al, it was reported that in patients with a body mass index > 30kg/m2 the associated complications of peripheral nerve block are more.8 Another study reported that ultrasound imaging time is more in obese patients compared with normal patients.

1. **Interscalene block**

   These blocks are typically indicated for shoulder surgery. In a retrospective review it was reported that increased BMI is associated with significantly increased time required for nerve bock placement, intraoperative administration of fentanyl and opioid. These patients were scheduled for shoulder arthroscopy surgery and interscalene nerve blocks was performed by using a US-based imaging modalities. 9 Continous interscalene catheters are more prone for catheter migration and related complications like, intravascular migration are much more in obese patients.

2. **Supraclavicular block**

   The supraclavicular block is a peripheral nerve block that covers the entire arm. The infraclavicular and the axillary nerve blocks are indicated for surgeries involving the elbow and below the elbow, respectively. 9 In a review study conducted by Franco et al, it was reported that with an increase in the body mass index the success rate associated with supraclavicular block decreases. Moreover, this study also pointed out that in obese patients using the peripheral nerve block also becomes difficult. However, they have reported no acute complications in obese patients. Thus they have concluded that supraclavicular block can be successfully administered to obese patients without any further complication.[10]

Lower Limb Block

A complete block of the foot can be achieved with five injections at the ankle. The deep peroneal nerve is blocked at the anterior ankle between the extensor hallucis longus and extensor digitorum longus. The superficial peroneal nerve is blocked anterior to the lateral malleolus. The position between the lateral malleolus and the Achilles tendon is used for the blockade of the sural nerve.[11]

1. **The lumbosacral block**

   The lumbosacral plexus (L1 to S4 nerve roots) innervates the lower extremity. The lumbosacral plexus divides into four nerves i.e. obturator, femoral, lateral femoral cutaneous, and sciatic, which entirely innervate the lower extremity. The femoral nerve can be blocked deep to the fascia iliaca just caudad and medial to the anterior superior iliac spine or at the femoral crease. The fascia iliaca is a continuous band of fascia in this region, so local

anesthetic injected under this fascia reliably produces a block of the femoral and lateral femoral cutaneous nerves. The obturator nerve is less reliably blocked the more caudad the block is performed. The saphenous nerve can be blocked at the mid-shaft femur or with a field block at the tibial plateau. Saphenous nerve blocks the sensation while sparing motor function for ideal physical therapy and rehabilitation.[11] Performing lumbar plexus block in obese individuals are very difficult because of poor landmarks, deep seated location which can be overcome by using both nerve stimulator and USG.

1. **Sciatic block**

The nerve sensation in the gluteal region can be blocked by using sciatic nerve blockade procedure. The gluteal region is the place situated between the greater trochanter and ischial tuberosity. It is situated just deep to the gluteus muscles and superficial to the quadratus femoris. The sciatic nerve can also be blocked as it travels through the thigh adductors. Finally, the sciatic nerve can be blocked approximately 6 cm above the popliteal fossa. After this point the nerve is divided into the tibial and common peroneal nerves.[11] Studies have shown that this nerve block can be achieved even in obese patients. The anatomical landmarks for this nerve are easily identifiable and hence are a suggested route in obese patients for peripheral nerve block. Many of the studies have also pointed out that despite using the ultrasound guidance; this nerve blockade procedure remains the less applied technique in obese patients.

Abdallah et al (2013) the performance time of infragluteal and subgluteal space techniques were compared in overweight patients undergoing sciatic nerve block. This study reported that in patients with a higher BMI (more than 25 kg/m) subgluteal technique can be performed 50% faster compared with the infragluteal space technique without any complications.[12]

2. **Paravertebral blocks (PVBs)**

PVBs have shown to have higher postoperative analgesic effects. In addition, this technique also results in decreased hospital stay, less consumption of opioids and lower number of associated side effects.[13] In a observational study conducted on a pool of patients scheduled for major breast surgery under general anaesthesia were received a single T4 paravertebral block to evaluate the effect of the block on the post operative pain score. The study results pointed out that a single injection can decrease the pain score significantly up to 6 hours.[14] Naja et al (2011) have applied the paravertebral nerve block in an obese woman with a BMI more than 30 kg/m2 who were scheduled for breast cancer surgery. They had used a nerve stimulator guided technique for applying the block. This study reported that even in obese women this technique can be used for performing breast cancer surgery.[15]

Pectoral nerve blocks (PECS) are used as a local anaesthetic between the thoracic wall muscles. Among these groups of blocks PECS 1 is a superficial block. This block targets the lateral and medial pectoral muscles and usually is used in superficial clinical procedures.[16] On the other hand, PECS II is used in blockade of nerve sensation between the pectoralis minor and serratus anterior muscles. In addition to the long thoracic and thoracodorsal nerves, PECS II also affect the sensation of third to sixth intercostal nerves.[17] In a recent study by Poonam Pi et al (2019) have stressed that this blockade procedure can also be used in super obese patients for implantation of ICD successfully.[18] In obese female patients , it is difficult to trace the landmarks for PEC I & PEC II blocks and can be overcome by proper positioning and assistance.

Truncal Block

Transversus abdominis plane (TAP) block is used in both in patient and ambulatory abdominal procedures regularly. This block is responsible for providing analgesic effects in both anterior abdominal walls as well as to the peritoneum.[19,20] Previously a landmark technique were used for performing this block. However, with the introduction of ultrasonography guided technique it had become more helpful in performing this block. Moreover, in obese patients this USG guided technique helps in visualization of the needle while it is used for blocking the nerve as well as for imaging the spread of local anesthetics.[21]

Among this group of abdominal blocks, the terminal branches of T9 to T11 intercostal nerves are blocked for providing the analgesia for umbilical region. Several studies have reported that these groups of blocks can be successfully used in abdominal surgeries such as in inguinal hernia repair, umbilical hernia repair and also in various laparoscopic surgeries. Some of the case studies also have reported using this procedure for rectus sheath blocks.[22]

In a prospective double-blind study by Hong et al (2019) rectus sheath block was successfully used in patients scheduled for a open gastrectomy surgery. In this study the authors reported that RSB is a good method when used in combination with ropivacaine.[23]

In another study by Nagata et al (2017) it was observed that even in obese patients rectus sheath block can be achieved by the transperitoneal approach. However, they have also pointed out that no large clinical trial is reported at present that can point out the role of RSB in obese patients.[24] The somatic pain control in the upper and lower abdomen can be obtained by applying the local

anaesthetics in the plane situated between the QL muscle and thoracolumbar fascia. This block provides increased analgesic effect compared with the TAP block.[25] The QL block can be further sub divided into QL1, QL2 or QL3 block based on the location of the deposition of the local anaesthetics and the approach of the injection.

Presently it was reported that in patient suffering from obesity, performance of this block is quite restricted. In obese patients the increased amount of subcutaneous fat and the depth of the transverse abdominis plane results in a great challenge for the anaesthesiologists to locate the plane. Moreover, with the help of the ultrasound guided techniques also it becomes difficult to trace the needle during the in-plane approach.[26]

The erector spinae plane (ESP) block helps in sensory blockade from T3 to T6 anterolateral thoracic area and T3 to T9 over posterior thorax. The main mechanism of blocking this pathway is achieved by blockade of the thoracic spinal nerves.[27] Currently, very few studies have conducted that have used this procedure for nerve blockade mechanism.

Use of ultrasound-guided peripheral mere block in obese patients

In patients who are overweight regional anesthesia provides a significant advantage over general anesthesia. However, in obese patients, the increased failure rate of peripheral regional anesthesia is observed due to difficulties in patient positioning, the disappearance of anatomical landmarks and an increase in the depth of nerve structures.[25]

Koh and LEE (2018) have pointed out that in obese patients for the attainment of posterior and lateral QL blocks a special low frequency curved probe can be used. This can be proved to be more helpful in detecting the nerve structures among these patients.[29] In another study by Kilicaslan et al (2014) has used ultrasound-guided peripheral nerve block technique in a superobese patient. In this study, multiple nerves including the femoral, common peroneal and tibial nerve were blocked. The patient had a BMI of 58 kg/m2. In this study, the authors were unable to locate the sciatic nerve and hence used the peroneal and tibial nerve block separately. In summary, the authors have stated that the US-guided in-plane technique can be successfully used in superobese patients without any reported complications.[28]

CONCLUSION

There are several reasons that regional anesthesia is gaining popularity in obese and morbidly obese patients. The substantial benefits as discussed earlier have made regional anesthesia a popular technique in obese patients undergoing daycare surgery. However, in spite of several advantages, the difficulties and challenges of implementing regional anesthesia in patients who are obese should be taken into consideration. Although successful peripheral regional anaesthesia allows less manipulation of the airway, it also poses a significant threat for compromise of the airway. It is to be taken into consideration that before choosing a particular the type of anesthetic technique a thorough check up should be done including the detailed blood investigation and evaluation of the history of the patients' comorbidities.

Recent advances in the use of ultrasound for guided peripheral nerve block have added to the efficiency of the procedure in obese patients. Greater success has been achieved in placing an epidural catheter guided by ultrasound. In spite of the assistance of ultrasound, dural puncture has been encountered during catheter placement. Therefore, the proficient anaesthesiologist who can locate peripheral nerve guided by ultrasound can only perform a successful nerve block. Although this approach is still controversial for neuraxial blockade an array of studies are using this approach successfully for day care surgeries.

In conclusion, studies have found that obesity is not a contraindication for performing regional anesthesia when performed by a well-trained, proficient anaesthesiologist who is familiar with the challenges of peripheral nerve block in morbidly obese patients.

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