Peripheral Nerve Stimulator guided serratus anterior plane block: A novel approach to the chest wall block

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Abstract

Introduction: In the recent years, chest wall blocks have gained popularity amongst the anesthesiologists across the globe. Blanco et al. initially described the ultrasound (US) guided chest wall blocks that used local anesthetic (LA) deposition under pectoralis major (PEC I), then under the pectoralis minor (PEC II) but later modified these PEC blocks to cover larger areas of the chest wall by depositing LA more proximally under and/or above the serratus anterior (SA) muscle (SA plane block).

Technique of block: Please refer the Article

Discussion: The long thoracic nerve or SA nerve arises from the brachial plexus (C5-C7) to enter the axilla behind the rest of the brachial plexus and rest on the SA muscle at the midaxillary level. The limitation of this superficial and easy to approach analgesia technique is the availability of US machines. In this article, we describe a novel approach to the SA plane block with the use of a peripheral nerve stimulator (PNS).

Keywords: Chest wall blocks, pectoral blocks, serratus anterior plane, serratus anterior plane block, ultrasound, peripheral nerve stimulator, ultrasound-guided, peripheral nerve stimulator guided.

Introduction
In the recent years, chest wall blocks have gained popularity amongst the anesthesiologists across the globe. These blocks are superficial and provide an easier approach to the thoracic wall for perioperative analgesia needed for thoracic surgeries. In 2011, Blanco et al. first described the “PECS” block as a novel analgesia technique for breast surgery [1,2]. The very next year, in 2012, he published the ultrasound (US) techniques for PEC I and PEC II blocks [3]. In 2013, he described a further modification to his PEC blocks, the serratus anterior plane (SAP) block, which covered a wider area and provided superior analgesia. He described blocking the anterior chest wall by depositing local anesthetic (LA) above and/or below the SA muscle under US guidance and named this technique asSAP block [4]. Various publications have described the analgesic efficacy of the SAP block for post-thoracotomy, breast surgery, multiple rib fracture, and other chest wall procedures [5,6]. This novel, superficial and easy to approach analgesia technique is limited by the availability of US machines, especially in the developing world. In this article, we describe a novel approach using a peripheral nerve stimulator (PNS), which will expand the usage of this block.

Anatomy relevant to the SAP block
The SAP contains the chest wall nerves and includes the lateral branches of the thoracic intercostal nerves and the long thoracic nerve. The thoracic intercostal nerves arising from T2 to T6, and lying between the SA and the external intercostal muscles. These intercostal nerves give lateral and anterior branches. The lateral branches of the intercostal nerves pierce the SA muscle at the midaxillary level to lie on it and provide the anterior and posterior terminal branches. The lateral cutaneous branch of the second intercostal nerve does not divide into anterior and posterior branches and contribute to the intercostobrachial nerve. The anterior branches cross in front of the internal mammary artery, pierce the intercostales interni muscle, the intercostal membranes and pectoralis major muscle to supply the breast in its medial aspect [7,8]. The long thoracic nerve or SA nerve arises from the brachial plexus (C5-C7) to enter the axilla behind the rest of the brachial plexus and rest on the SA muscle at the midaxillary level (Fig. 1) [8,9].

Description of the technique
The SAP block done by PNS technique needs the patient to be in the lateral position with block side up and with the arm in front of the chest or insuline position with the ipsilateral arm abducted. The midaxillary line is identified and marked. The 5th rib is traced to this line and the intersection point marked. This point is the needle insertion point (Fig. 2 and 3).

A 50 mm insulated nerve stimulator needle with a syringe filled with LA attached to the extension...
tubing is used for performing the block. Following preparing the area with antiseptic solution, sterile drapes are applied, and the area around the landmark is infiltrated with LA solution. The nerve stimulator is set to an initial current of 1mA of 0.1ms duration and 1Hz frequency. Once the LA has taken effect, the block needle is inserted at the above point and slowly advanced till the SA muscle contraction is noted, stimulation of long thoracic nerve that supplies the muscle. The needle is kept at this depth and current is reduced to 0.3mA. Persistence of contraction of SA at this level confirms the needle placement at target site, i.e. above the SA muscle plane. The authors observed that an injection superficial to the SA muscle spreads wider and lasts longer than an injection deep to it [3]. Varghese et al. have done anatomical studies to describe widespread of LA in SAP block using US guidance techniques as described by Blanco et al.[10]. The risk of LA toxicity remains low in this technique as lower volume of anesthetic, as compared to other fascial plane blocks, is required for a higher spread and the absorption is lower as the plane is avascular [11]. This can be considered an advantage over alternative technique such as intercostal nerve block. Dermatomal block after a single thoracic paravertebral injection is unpredictable and varies widely [12,13]. Wide dermatomal spread with paravertebral block and intercostal blocks need multiple injections, which are time-consuming, and associated with increased incidence of pneumothorax [14,15,16,17]. If the specialist is skilled with US and has a good understanding of the sonoanatomy of the lateral thoracic wall, serratus plane block is a superficial and easy to perform, with a high success rate and minimal incidence of complications. In situations where US machine is not available, it will not be possible for the block to be administered, and if the specialist is not skilled in the use of US, failure and/or pneumothorax could easily result [11]. SAP block has been studied by various researchers as a consistent and reliable block for hemithorax analgesia, particularly for breast surgeries [18], post-thoracotomy pain [6], multiple rib fractures, and other chest wall procedures [5]. The limitation of the novel technique being, availability of US machine. This limitation can be offset by the PNS guided technique as described above. It is comparatively reliable technique for the SAP block.

Discussion
In 2013, Blanco et al. first described a new block of the thoracic wall, the serratus plane block under US guidance. LA was deposited in the SA plane. The lateral cutaneous branches of the intercostal nerves, before dividing into anterior and posterior branches are blocked as they pass through this plane to supply sensation to most of the chest wall. The authors observed that an injection superficial to the SA muscle spreads wider and lasts longer than an injection deep to it [3]. Varghese et al. have done anatomical studies to describe widespread of LA in SAP block using US guidance techniques as described by Blanco et al.[10]. The risk of LA toxicity remains low in this technique as lower volume of anesthetic, as compared to other fascial plane blocks, is required for a higher spread and the absorption is lower as the plane is avascular [11]. This can be considered an advantage over alternative technique such as intercostal nerve block. Dermatomal block after a single thoracic paravertebral injection is unpredictable and varies widely [12,13]. Wide dermatomal spread with paravertebral block and intercostal blocks need multiple injections, which are time-consuming, and associated with increased incidence of pneumothorax [14,15,16,17]. If the specialist is skilled with US and has a good understanding of the sonoanatomy of the lateral thoracic wall, serratus plane block is a superficial and easy to perform, with a high success rate and minimal incidence of complications. In situations where US machine is not available, it will not be possible for the block to be administered, and if the specialist is not skilled in the use of US, failure and/or pneumothorax could easily result [11]. SAP block has been studied by various researchers as a consistent and reliable block for hemithorax analgesia, particularly for breast surgeries [18], post-thoracotomy pain [6], multiple rib fractures, and other chest wall procedures [5]. The limitation of the novel technique being, availability of US machine. This limitation can be offset by the PNS guided technique as described above. It is comparatively reliable technique for the SAP block.

Our experience
The authors have used this technique in more than 100 cases until now and documented the drug spread using US of the blocked area in patients after PNS guided injection of the drug and noticed good spread of the LA in the plane above SA muscle described as SA plane block as well as good post-operative pain relief (Fig.5a and b). Most of the patients were managed with simple oral analgesics in the post-operative period, and of the cases receiving this block, only 5 patients needed analgesia supplementation with opioids.

Limitations
SAP block is a relatively safe and superficial block that can be done by even those who are new to regional anesthesia, but concerns relating to deep puncture and pneumothorax remains. This area is a
relatively avascular and block needs to be done with caution to remain superficial, to avoid crossing ribs in any circumstances. Although experience in the number of cases done is limited; we have not encountered any complications yet. Larger studies need to be done to establish the safety of the technique compared to other modalities. We have observed the spread of LA under US; contrast study using fluoroscopy or even magnetic resonance imaging (MRI) would define the spread much better.

**Conclusion**

Serratus plane block is superficial and easy to perform, with a high success rate and minimal incidence of complications. As studied by various researchers, it is a consistent and reliable block for hemithorax analgesia particularly for breast surgeries, post-thoracotomy pains, multiple rib fractures, and other chest wall procedures. By describing a PNS guided technique; we conclude that we can overcome the limitation of having US machine and proficiency in US-guided blocks. The results of this novel PNS guided technique are comparable to US-guided approach to SAP block.

### References