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ORIGINAL

Ultrasound description of Pecs II (modified Pecs I): A novel approach to breast surgery

R. Blanco^{a,*}, M. Fajardo^b, T. Parras Maldonado^c

^a Department of Anaesthesiology and Pain Therapy, Hospital Abente y Lago, Complejo Hospitalario Universitario A Coruna, Spain

^b Department of Anaesthesiology and Pain Therapy, Hospital del Tajo, Madrid, Spain

^c Department of Anaesthesiology and Pain Therapy, Hospital Universitario Ciudad de Jaen, Jaen, Spain

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block;
Anatomy: axilla

Abstract

Objective: The Pecs block (pectoral nerves block) is an easy and reliable superficial block inspired by the infraclavicular block approach and the transversus abdominis plane blocks. Once the pectoralis muscles are located under the clavicle the space between the two muscles is dissected to reach the lateral pectoral and the medial pectoral nerves. The main indications are breast expanders and subpectoral prosthesis where the distension of these muscles is extremely painful.

Material and methods: A second version of the Pecs block is described, called "modified Pecs block" or Pecs block type II. This novel approach aims to block at least the pectoral nerves, the intercostobrachial, intercostals III-IV-V-VI and the long thoracic nerve. These nerves need to be blocked to provide complete analgesia during breast surgery, and it is an alternative or a rescue block if paravertebral blocks and thoracic epidurals failed. This block has been used in our unit in the past year for the Pecs I indications described, and in addition for, tumorectomies, wide excisions, and axillary clearances.

Results and conclusions: The ultrasound sequence to perform this block is shown, together with simple X-ray dye images and gadolinium MRI images to understand the spread and pathways that can explain the benefit of this novel approach.

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* Corresponding author.

E-mail address: rafablanca@mac.com (R. Blanco).

PALABRAS CLAVE

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del abdomen;
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Bloqueo de los
nervios pectorales;
Anatomía: axila

Descripción de la ecografía de los pectorales II (pectorales I modificados): un nuevo enfoque de la cirugía mamaria

Resumen

Objetivo: El bloqueo Pecs es un bloqueo regional superficial sencillo que se inspira en el abordaje del bloqueo infraclavicular y en el bloqueo TAP (plano del transversus abdominis). Una vez identificados los músculos pectorales distales a la clavícula disecamos el plano fascial entre ambos para alcanzar los nervios pectorales lateral (LPM) y medial (MPN). La indicación principal del bloqueo Pecs es para expansores subpectorales y en prótesis submarias donde la distensión muscular produce un dolor extremo.

Material y método: En este artículo describimos una segunda modificación del bloqueo Pecs. Lo llamamos bloqueo Pecs modificado o bloqueo Pecs II. Es un abordaje original que pretende alcanzar los nervios pectorales, nervios intercostobraquial, intercostales III-IV-V-VI y el torácico largo. Estos nervios son esenciales a la hora de proporcionar analgesia completa en la cirugía oncológica de mama y se posiciona como una alternativa o un bloqueo de rescate de los bloqueos paravertebrales y epidurales torácicas. En el último año hemos estado usándolo en nuestro centro en tumorectomías, ampliaciones de bordes y para vaciamientos axilares además de las indicaciones del Pecs I.

Resultados y conclusiones: Mostraremos la secuencia ecográfica para poder realizar este bloqueo junto con imágenes con contraste radiográfico y resonancia magnética con gadolinium para poder entender los beneficios de este bloqueo.

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Introduction

The neural supply of the anatomical structures involved in breast surgery is not well understood when it comes to providing analgesia for perioperative pain relief. Thoracic epidural¹ and paravertebral²⁻⁴ blocks became the gold standard techniques to achieve this goal, but not every anesthesiologist is comfortable performing these procedures. As an alternative for these techniques we designed a novel series of blocks: Pecs I and Pecs II.

The Pecs block type I⁵⁻⁷ is a recently described, easy and reliable superficial block that targets the lateral and median pectoral nerves at an interfascial plane between the pectoralis major (Pmm) and minor (Pmm) muscles. It can be used for different breast operations, but we mainly use it for the insertion of breast expanders and subpectoral prostheses. Other potential indications are traumatic chest injuries, iatrogenic pectoral muscle dissections, pacemakers, Port-a-caths and chest drains.

In this paper we describe a second version of the Pecs block type I. We call it "modified Pecs's block" or Pecs block type II. This novel approach aims to block the axilla that is vital for axillary clearances and the intercostal nerves, necessary for wide excisions, tumorectomy, sentinel node exeresis and several types of mastectomies.

To perform the Pecs II block or "modified Pecs's block" we use two needle approaches instead of one. The first puncture is a Pecs I block with 10 ml of local anesthetic injected between the pectoralis muscles, and the second puncture gives 20 ml of local anesthetic between the Pmm and the serratus muscle. This will break through the 'axillary door' and will reach the long thoracic nerve and reliably at least two intercostal nerves. We designed this block because, although during breast expander and subpectoral prosthesis insertions the Pmm is mainly affected, there is still significant pain

reported over the serratus muscle area. The Pecs II aims to block this region, together with the lateral branches of the intercostal nerves that exit at the level of the mid-axillary line to innervate the mammary gland and the skin from T2 to T6.

To understand the theory and practice of the Pecs blocks we must first make a detailed review of the anatomy involved in this region. The pectoral nerves are major nerves arising from the brachial plexus innervating the pectoral muscles. The lateral pectoral nerve most commonly arises from C5, C6 and C7, and the median pectoral nerve from C8 and T1. The lateral pectoral nerve is the bigger of the two and runs between the major and minor pectoral muscles in a fascial plane in close proximity to the pectoral branch of the thoracoacromial artery and innervates the Pmm.

The medial pectoral nerve runs under the Pmm. It crosses the muscle to reach the lower third of the Pmm in the pectoral region after piercing the two layers of the clavicular fascia. Various groups agree that the medial pectoral nerve crosses Pmm in 62% of the patients, while in the remainder it is located on its lateral border.⁸

A second set of nerves involved are the anterior divisions of the thoracic intercostal nerves from T2 to T6. They lie at the back between the pleura and the posterior intercostal membrane and run in a plane between the intercostal muscles as far as the sternum. The intercostal nerves give off lateral and anterior branches. Lateral branches: the nerves pierce the intercostalis externi and the serratus anterior muscles at the mid-axillary line to give off anterior and posterior terminal branches. The lateral cutaneous branch of the second intercostal nerve does not divide in anterior and posterior branches and it is called the intercostobrachialis nerve. Anterior branches: the nerves cross in front of the internal mammary artery, pierce the intercostalis interni

muscle, the intercostal membranes and PmM to supply the breast in its medial aspect.

Finally a third group of nerves needs to be taken into account: these are the long thoracic and the thoracodorsal nerve. The long thoracic nerve or serratus anterior nerve arises from C5 to C7 entering the axilla behind the rest of the brachial plexus and resting on the serratus anterior muscle. It supplies this muscle, and when it is damaged by axillary clearances or radical mastectomies produces a winging scapula, especially when the arm is lifted forward. During surgery the serratus muscle is dissected together with the pectoralis muscles to make the pocket needed for breast expanders.

The thoracodorsal nerve is a branch of the posterior cord made up of the three posterior divisions of the trunks of the brachial plexus. It follows the thoracodorsal artery and innervates the latissimus dorsi in the posterior wall of the axilla. It lies very deep, and it is important during latissimus dorsi flaps for breast reconstructions.

To complete the knowledge of the axillary and breast region we need to mention two other structures involved in these blocks: the clavipectoral fascia and Gerdy's ligament. The fascia on the superficial surface of Pmm is the clavipectoral fascia and the hard fascia on the lateral border is Gerdy's ligament or suspensory ligament of the axilla, which is a connective tissue that maintains the concave shape of the axilla. We can see the anatomical relationship of the structures involved in Figure 1.

The Pecs II block is a simple alternative to the conventional paravertebral and neuroaxial blocks for breast surgery. The block produces excellent analgesia and can be used to provide a balanced anesthesia and as a rescue block in cases where the analgesia provided by the paravertebral or epidural was patchy or ineffective. In our opinion, the easily identifiable landmarks make this block a good novel regional anesthetic technique.

Material and methods

Description of the block sequence

It is our practice to perform Pecs I for operations where expanders are inserted during breast reconstruction. We

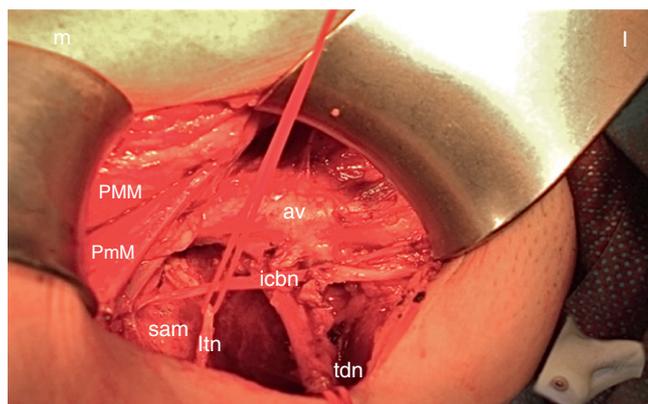


Figure 1 Dissection of the axilla. Pectoralis major muscle (PMM), pectoralis minor (PmM), axillary vein (AV), intercosto-brachial nerve T2 (ICBN), serratus anterior muscle (SAM), long thoracic nerve (LTN) and thoracodorsal nerve (TDN).

choose Pecs II for the same operation when axillary clearances are required or for the rest of glandular operations involving intercostal innervations. Informed consent for the block was requested, together with consent for general anesthesia or deep sedation. An IV access is also inserted for monitoring. The infraclavicular and axillary regions were cleaned with chlorhexidine. The orientation of the probe and the ultrasound sequence are vital in ensuring proper spread of local anesthetic. There are many approaches, but we describe an in-plane technique from proximal and medial, to distal and lateral in an oblique manner at dermatome level T2-T3 which ensures that the clavicle is away from the area of interest during the block. The skin point of puncture is infiltrated with 2% lidocaine and once the structures are identified with ultrasound we proceed to inject 10ml of levobupivacaine 0.25% between the pectoral muscles and 20ml under Pmm above the serratus muscle as described previously. The onset time of analgesia is three minutes on average, and analgesia lasts for 8 hours. The block is performed with the patient fully awake, followed with a general anesthetic, except if the block is used as a rescue block in the postoperative period. Based on our experience of more than one hundred cases, so far, we recommend the use of catheters in breast expanders with an infusion of 0.125% levobupivacaine set at 5 ml/hour. The catheter must be inserted in the interfascial plane between both pectoral muscles, leaving 10 cm in the space to avoid migration.

Description of the ultrasound sequence

The Pecs II block aims to reach the lateral border of the Pmm at the level between ribs r2, r3 and r4. This will cover dermatomes T2, T3 and T4. The probe is positioned under the lateral third of the clavicle (Fig. 2). After locating the subclavian muscle, the axillary artery and the axillary vein we move the probe distally towards the axilla, until the Pmm is identified. We start counting the ribs (Fig. 3), from r1 under the axillary artery and maintaining the Pmm as a reference, we move distally and laterally until the lateral border of Pmm is reached. Over r3 we can see the continuation of Gerdy's ligament and underneath, another muscle covering r2, r3, r4, that is the serratus anterior muscle, this point being the entrance into the axilla. In the Figures we can observe the distribution between the pectoralis muscles (Fig. 4) and the spread under the Pmm, as well as above the serratus anterior muscle (Fig. 5).

In the gadolinium enhanced MRI images we can see the distribution of contrast entering into the axilla and reaching the long thoracic nerve (Fig. 6). We can also see that the spread of contrast goes all the way down until T8.

Results and discussion

The analgesia for breast reconstructive surgery can involve different degrees of nerve blocks, so we have described different types of modifications to suit the type of surgery depending on the affected tissues and nerves (Pecs I and Pecs II or modified Pecs). During breast expanders and prosthesis insertions the PmM is mainly involved. For tumorectomies, mastectomies and sentinel node dissection, the intercostal

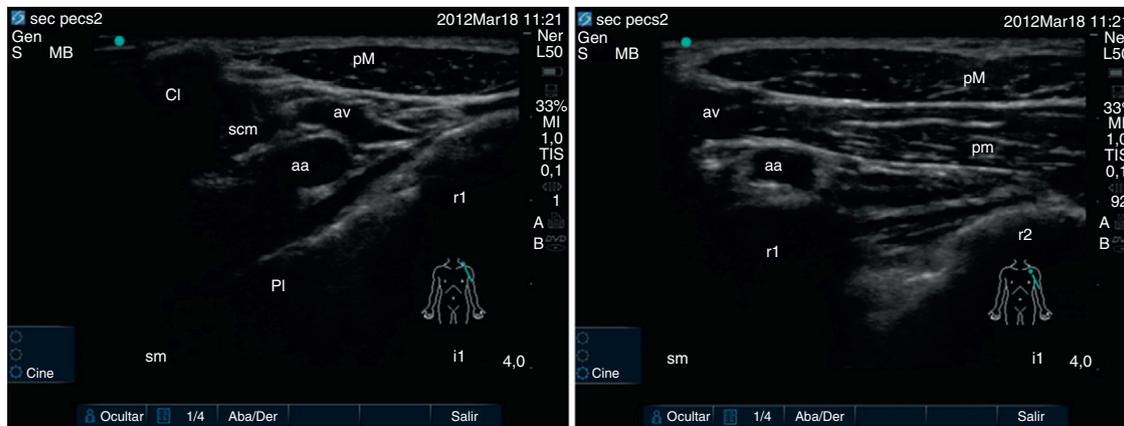


Figure 2 Ultrasound of the sequence of a Pecs block II at the level of the clavicle (left) and the axilla (right). We can identify clavicle (Cl), subclavius muscle (SCM), axillary artery (AA), axillary vein (AV), pleura (Pl), rib 1 and r2 (r1, r2), the pectoralis major muscle (PMM) and pectoralis minor (PmM).

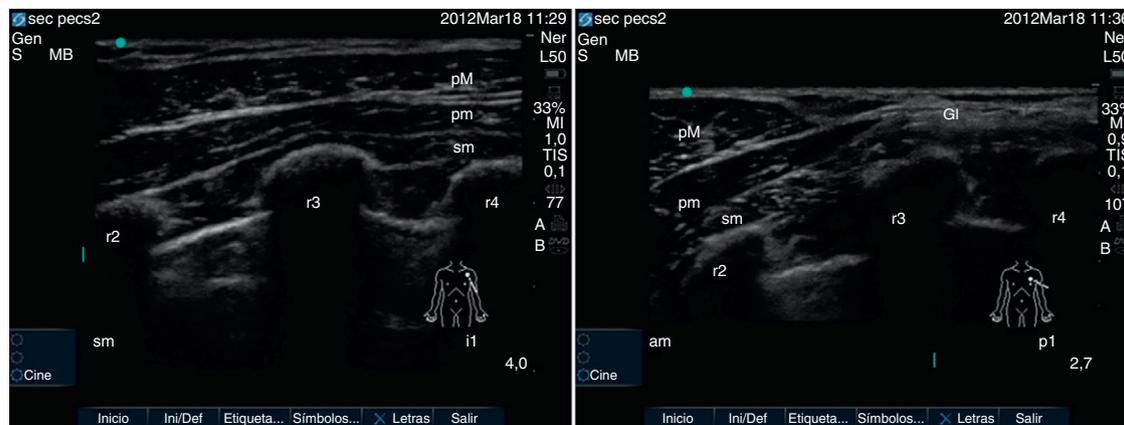


Figure 3 Sonogram of the probe counting the ribs (left) and at the lateral border of pectoralis minor muscle (right). We can identify pectoralis major muscle (PMM), pectoralis minor (PmM), serratus muscle (SM), rib 2 (r2), rib 3 (r3), rib 4 (r4) and Gerdy's ligament (GL).

nerves are the main nervous structures that we need to block. And, finally, for complex reconstructions the thoracodorsal nerve is also involved.

Until now paravertebral blocks and thoracic epidurals seemed to be the most effective pain treatment for these types of surgery. However, we questioned the effectiveness

based on our understanding that the brachial plexus nerves are the main component of this painful surgery and we described for the first time the use of pectoral nerve blocks with this indication. After our first description was published, another author showed similar results without using ultrasound.⁹ The Pecs blocks (types I and II) are peripheral

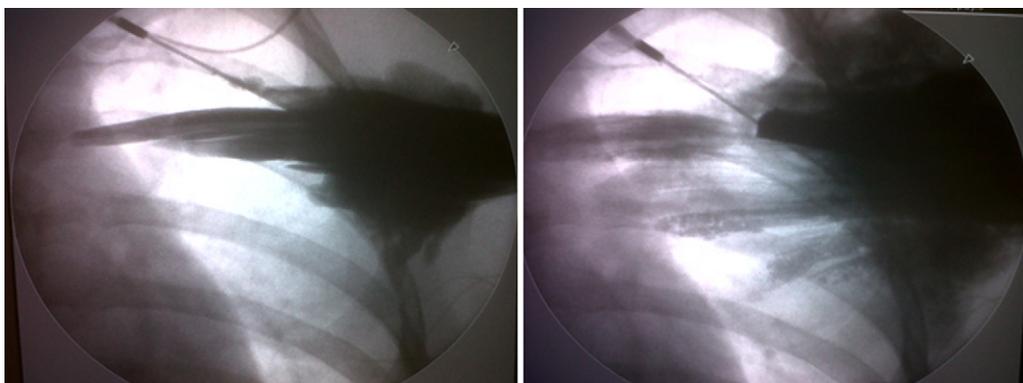


Figure 4 Contrast distribution of a Pecs II block between pectoralis muscles.

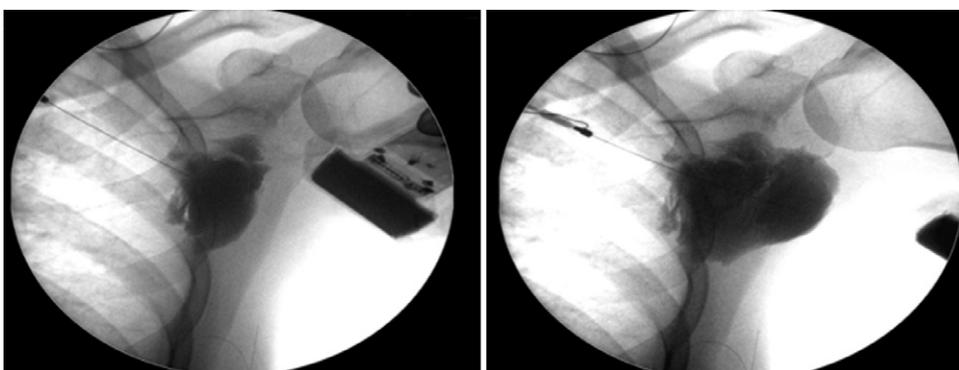


Figure 5 Contrast distribution of a Pecs II block entering the axillary port.

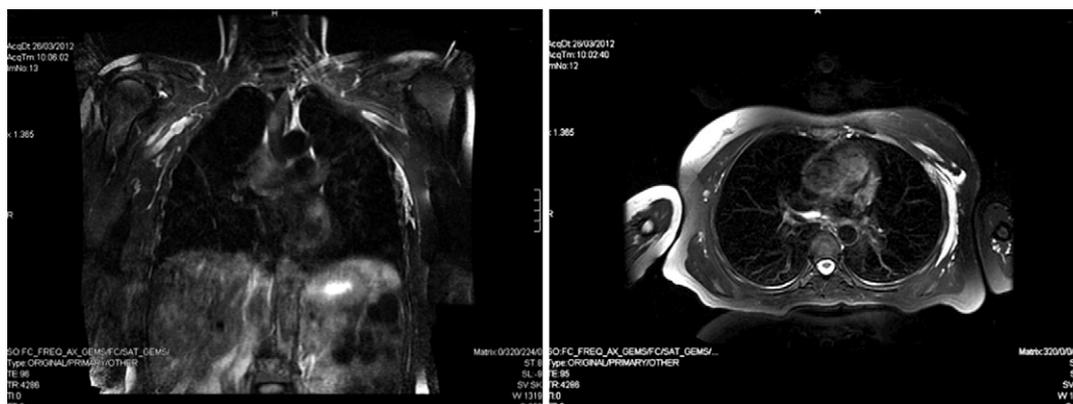


Figure 6 MRI transverse image (left) and coronal (right) with gadolinium of a Pecs II block.

approaches based on a good anatomical knowledge, and on the use of ultrasound. They combine both motor and sensory nerve blocks that compare with wound infiltration techniques that only aim for sensory nerves. It is important to emphasize the Pecs advantages. There is no sympathetic block that is associated to paravertebral and epidural blockades, opiates are not usually necessary, there could be less tumor recurrences, and it is a simple and fast acting block.

We believe that the injection in the fascial plane between the pectoralis muscles is not enough to reach the anterior branches of the intercostal nerves, and that they will not be reliably blocked, this being one of the main reasons for designing the Pecs II block. We routinely check dermatome distribution with lack of sensitivity to ice, and we obtain consistent anesthesia of the dermatomes from T2 to T4 with variable spread to T6. This is confirmed by the MRI study. With regards to the parasternal branches of the intercostal nerves it is advised to infiltrate between Pmm and serratus muscle, but on the medial side, close to the nipple. This is a type of reinforcement that can be considered a block on its own for operations where the incision is located in this area.

The limitation of this study is that we only performed MRI on one patient. The images are very conclusive as the contrast is taken up by the axilla and reaches as far posterior as the thoracodorsal nerve area, passing above the serratus muscle and, therefore, the long thoracic nerve, and are coincident with the clinical usefulness. Although the Pecs

II block is not as easy to perform as the Pecs I block, it can achieve better results and anesthetizes the whole breast and axilla.

Formal prospective randomized studies are needed to compare Pecs block to paravertebral and epidural blocks. Intravascular injection into the pectoral branch of the acromiothoracic artery is a possibility that should be considered. The puncture of the axillary fascia has also been described, probably due to a very high approach in the axilla. Both possible complications should be easily avoided with proper ultrasound training, and looking for the right pattern of spread of local anesthetic.

Breast surgery is associated with severe postoperative pain, and, on the other hand, axillary clearances are also often part of the surgery. We needed to find a single block that can cover all pain sources, and we propose the Pecs II block.

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