RESEARCH ARTICLES

SURFACE LANDMARKS OF THE SUPRACLAVICULAR PART OF THE BRACHIAL PLEXUS: CADAVERIC AND RADIOLOGIC STUDY

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SUMMARY :

Purpose: *Brachial plexus block offers an alternative to general anesthesia for a variety of procedures involving the upper limb, including surgery and reduction of fractures and joint dislocations. All the techniques for supraclavicular plexus block described before were point descriptions depending on the assigned surface structures. In a different aspect taking the continuity between neck and arm into account, we decided to describe a certain line under which the brachial plexus lies in the supraclavicular region.* ***Methods:*** *Landmarks were described after an anatomic study on several formalin fixed cadavers. The first line was between the mastoid process and sternal insertion of the sternocleidomastoid (SCM) muscle. The second line was perpendicular to the first line, drawn from the laryngeal prominence. The third line was between the crossing point of the first and second lines and midclavicular point. The latter line was considered as the supraclavicular part of brachial plexus (SBP). This line was further assessed on four formalin fixed cadavers. Indian ink was injected blindly at three different points on this line underneath which the brachial plexus was presumed to lie. Surface landmarks were also evaluated by ultrasonography in 30 volunteers (15 male, 15 female) after the aforementioned lines were drawn bilaterally. SBP was easily found on ultrasonographic study on this line.* ***Results:*** *Dissections were performed carefully and colored structures were determined. Indian ink was found at different depths on this line due to the fact that there was blind injection and the neurovascular sheath was stained. The level of the trunks of the brachial plexus was 15.8 ± 2.3 mm depth on the left and 16.3 ± 3.2 mm on the right in the ultrasonographic study. The results of early clinical observations with insulated needles (Stimplex, Braunâ) seem to be satisfactory.* ***Conclusion:*** *We hope this line may facilitate approximation of the brachial plexus at the supraclavicular region even in conditions where ultrasonography is not available.*

Key Words: *Brachial Plexus Block, Landmark, Anatomy, Ultrasonography.*

INTRODUCTION

Brachial plexus block offers an alternative to general anaesthesia for a variety of procedures involving the upper limb, including the surgery and the reduction of fractures and joint dislocations (1).

Brachial plexus block can be performed by supraclavicular, infraclavicular, axillary or interscalene approaches (2,3). The supraclavicular approach for a brachial plexus block is preferred as it produces a more extensive area of blockade than the axillary approach for

the same dose of drug (4). Although the supraclavicular approach is an easy technique, there is a risk of pneumothorax, arterial puncture and hematoma formation (3, 5, 6). Therefore any method which may decrease the problems of the supraclavicular approach warrants attention.

All the techniques for supraclavicular plexus block that have been described are point descriptions based upon the structures assigned from the body surface. Taking continuity between neck and arm into account, we decided to describe a line under which brachial plexus lies in the supraclavicular region. This line is described easily and is not dependent on the patient's physical status. Interscalene and supraclavicular plexus blocks can be performed on this line by separate needle insertions, the complications will be minimized and a successful brachial plexus block can be performed.

MATERIALS AND METHODS

Anatomic Study: This study was performed on four embalmed cadavers used for student demonstrations at Gazi University Faculty of Medicine's Department of Anatomy. Landmarks were described after anatomic study of several embalmed cadavers. The first line was between the mastoid process and sternal insertion of the sternocleidomastoid muscle (SCM). The second line was perpendicular to the first line, drawn from the laryngeal prominence. The third line was between the crossing point of the first and second lines and the midclavicular point. The latter line was considered as the supraclavicular part of the brachial plexus (SBP) (Fig. 1). This line was further assessed on four embalmed cadavers. Indian ink was injected blindly at three different points unilaterally on this line underneath which brachial plexus was presumed to lie. The points of injection were as follows; I) a point on the middle of the posterior aspect of SCM, II) a point approximately 1 cm above the middle of the clavicle, III) a point between the first two points. Meanwhile the neck was hyperextended and the face was turned to the opposite side. Dissections were performed carefully with routine dissection methods (7) and colored structures were determined. Indian ink was found at different depths on this line because of blind injection and the neurovascular sheath was stained.

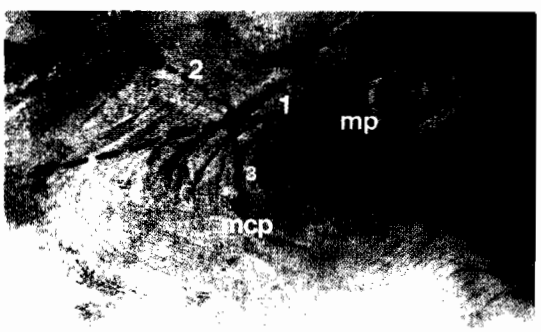

Fig. 1 : Surface landmarks of SBP.
Lp: laryngeal prominence
mp: mastoid process
mcp: midclavicular point
si: sternal insertion

Radiologic Study: Surface landmarks were also evaluated by ultrasonography in volunteers after the aforementioned lines were drawn. Institutional approval for human research was obtained and informed consents were taken. 15 male and 15 female volunteers constituted the study groups. Surface landmarks were drawn bilaterally and an ultrasonography probe (Hitachi® EUB 405, Israel, 7.5 mHz lineer probe) was applied on both sides by turning the head slightly contralaterally. The route of the probe was followed towards the arcus aorta and its branches to find the subclavian artery (8). The brachial plexus was found by applying the probe perpendicular to the skin and minimally turning it to both sides. Axial and longitudinal views were taken nearly at the same level and dimensions between the skin and the upper rim of subclavian artery (S-SA) were measured.

Mann-Whitney U and student's t test for paired samples were used for statistical analyses. Data was expressed as Mean ± Standard Error of the Mean (SEM). $p < 0.05$ was considered as statistically significant.

RESULTS

In this study, the structures colored by the Indian ink injected through the aforementioned points on the line which was considered as the SBP were examined. Considering the middle of the three points as a reference point, it was recognized that the Indian ink reached the desired structures in all cadavers (Fig.2). The phrenic nerve and underlying anterior scalene muscle were stained. The brachial plexus was stained in

the supraclavicular region along its whole length. The coloration of the brachial plexus along its whole length was due to the axillary sheath through which the plexus lies. There was no dye incorporation into the carotid sheath and the structures lying through it. This was important, especially for the vagus nerve.

Demographic data obtained from volunteers were shown in Table1. A statistically significant difference was found for age, weight and height when male and female subjects were analysed ($p<0.05$). Diameters of skin-subclavian artery (S-SA) on both sides and axial and longitudinal views are summarized in Table 2. Ultrasonographic images of axial and longitudinal views can be followed on Fig. 3. The curve of the subclavian artery and fan-like distribution through the cervical vertebrae of the brachial plexus were shown as relatively hypoechoic images on longitudinal view.

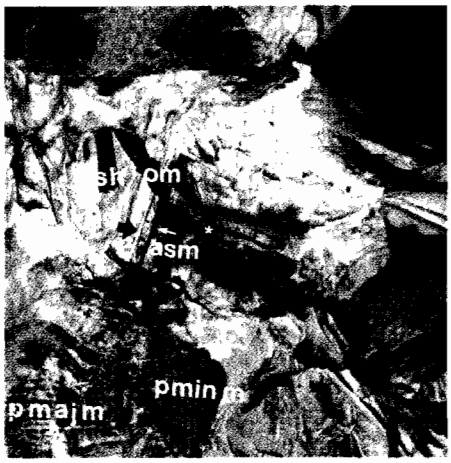

Fig. 2 : General view of supraclavicular region.
sh: Sternohyoid muscle
om: omohyoid muscle
c: clavicle
asm: anterior scalene muscle
p maj m: pectoralis major muscle
p min m: pectoralis minor muscle
*: brachial plexus
: phrenic nerve
: vagus nerve

Table 1: Demographic changes of study groups (Mean±SEM). *: p 0.05.

	Group I (n:15) (Males)	**Group II** (n:15) (Females)
Age (year)	29.53±1.72	21.40±0.65*
Weight (Kg)	74.53±3.31	52.93±1.28*
Height (cm)	174.66±2.01	162.66±1.38*

Table 2: The S-SA measurements (mm) of longitudinal and axial ultrasonographic view of brachial plexus (Mean±SEM). *: p 0.05.

	Group I (n:15) (Males)	**Group II** (n:15) (Females)
Right (Longitudinal)	16.01±0.80	14.44±0.64*
Right (Axial)	16.00±0.68	14.16±0.65*
Left (Longitudinal)	16.38±0.64	13.74±0.43*
Left (Axial)	16.23±0.68	14.48±0.42*

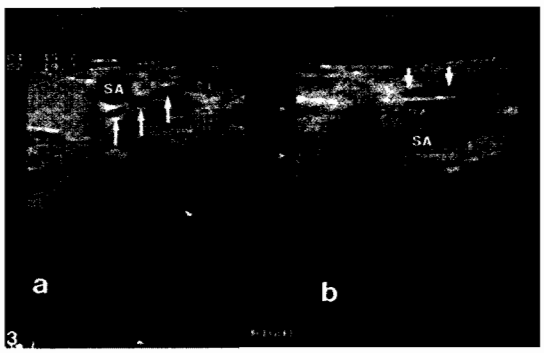

Fig. 3 : Sonographic appearances of the trunks of the brachial plexus (arrows). SA: Subclavian artery.
a. Axial view
b. Sagittal view

DISCUSSION

Brachial plexus block can be performed by the axillary, infraclavicular, interscalene and supraclavicular routes. The success of these techniques may be enhanced by a peripheric nerve stimulator or ultrasonography (3, 9). Supraclavicular brachial plexus blocks performed without Doppler control have been associated with pneumothorax in approximately 5% of the patients (4). For this reason Brown et al (1993) and Pham-Dang et al (1997) performed the techniques for the supraclavicular blockade, which they described, on the embalmed cadavers for the first time. Then dissections were conducted to verify the safety of the new approaches (5, 10). In our study we injected Indian ink blindly through the aforementioned points. Then we examined the colored structures during dissection.

In textbooks, the landmark for the supraclavicular approach is the middle point of the clavicle midway between the acromial end and the sternal end of the clavicle. The point of needle entry is on the lateral border of the anterior scalene muscle at the midpoint of the clavicle (3).

In this study, the described landmarks for supraclavicular approach were three points on the line between the middle point of the clavicle and the crossing point of the first two aforementioned lines. The first point was on the midpoint of the posterior aspect of SCM, the second was approximately 1 cm above the midpoint of the clavicle, the third point was between the midpoint of the first two points. When the Indian ink was injected through the third point, it was observed that all the three trunks of the brachial plexus was colored successfully.

The perineural sheath surrounding the plexus merely gives the local anaesthetic preferential direction and provides a space for diffusion of the drug, although it is not a uniform space (9, 11). During dissection in our study, we found that the Indian ink reached the perineural sheath, colored the trunks of the brachial plexus and spread towards the axilla.

Under ultrasonographic evaluation, in the lower cervical region (C6) by axial view, the brachial plexus is visualized as three hypoechoic nodules between the anterior and the middle scalene muscles which are determined as trunks of the brachial plexus. Trunks and divisions were cephaled from the subclavian artery. This appearance is vital for catheterization (8). In this study we have evaluated the trunks as three hypoechoic nodules over the subclavian artery (Fig. 3). This is important not only for the determination of anatomy but for the blockade of the plexus. It is important to know the distance between the skin and the brachial plexus for the supraclavicular approach. In this study, the brachial plexus was found at 1.6 cm depth in males and at 1.4 cm depth in females on an average using an ultrasonography probe perpendicular to the skin. We could not find any literature data regarding this depth.

Several techniques have been described other than classical approaches (5, 6, 10, 12). All these techniques describe a point for approximation based on surface landmarks, rather than a line which we described in our study. We hope this line may facilitate approximation to the brachial plexus in the supraclavicular region even in conditions where ultrasonography is not available.

Based on both anatomic and radiologic studies, our findings supported the fact that our surface landmarks are valuable. The advantages of our study can be stated as follows: it is simple, not dependent on structure variations and not related to deeper structures that may be difficult to find in obese patients. All approximations can be made on this line for blocking. The brachial plexus in the supraclavicular region and complications, such as pneumothorax, can be minimized.

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