Sonoanatomy Of The Brachial Plexus With Single Broad Band-High Frequency (L17-5 Mhz) Linear Transducer

A Thallaj

Citation

Abstract
Background: Sonographic mapping of the brachial plexus has been reported and may have clear clinical applications. The aim of this study is to evaluate the quality of images of the brachial plexus with single high frequency broad band (L17-5MHZ) ultrasound transducer for different regions.

Methods: 25 patients (5 femal, 20 male) age range (35-70yr), underwent sonographic examination for assessment of the brachial plexus and its spatial relationship with other adjacent structures.

Results: Excellent quality of images was obtained in all patients except for infraclavicular region (19 images were rated as excellent and 6 were rated as good).

Conclusion: Using single (L17-5 MHZ) ultrasound transducer can reliably illustrate the brachial plexus and the adjacent structures of interest for different scanning depth.

BACKGROUND AND PURPOSE
Mapping of the brachial plexus with broad band high-frequency linear transducers such as (5-10 MHz), (10-13MHZ) and (8-14MHz) has been reported (1, 2, 3). The purpose of this study is to demonstrate that mapping of the brachial plexus with a wider band range; higher frequency (L17-5MHz) ultrasound transducer may give more clear images to superficial and deep adjacent structures. Also, we are aiming to evaluate the efficiency of a single transducer for different imaging depth.

METHODS
In this prospective observational study, conducted on 25 adult patients (5 female) age range 35-70yr, scheduled for upper limb and carotid artery sonographic assessment in the vascular laboratory. Consent was obtained for the brachial plexus ultrasonography.

Sonographic images were obtained with “Philips IU22” ultrasound system using (L17-5 MHz, USA) linear transducer (Fig1).
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Figure 1
Figure 1: Philips (IU22, USA) ultrasound system.

The examinations were performed while patients lying supine and the head turned 45 degrees to the contralateral side. Photographs were taken to identify the probe position at each different site.

Started from the interscalene region, the probe positioned in an axial oblique plane (Fig2-A).

Figure 2
Figure 2a: Axial oblique plane

In the supraclavicular fossa, the probe was placed in a coronal oblique plane (Fig2-B).

Figure 3
Figure 2b: Coronal oblique plane

The infraclavicular region was imaged in a parasagittal plane (Fig2-C), and the axillary region was scanned in a transversal view (Fig2-D).

Figure 4
Figure 2c: Coronal transverse view.
**RESULTS**

**INTERSCALENE REGION**

Excellent images were obtained in all patients, the brachial plexus was illustrated as hypoechoic nodules surrounded by hyperechoic rims between the anterior and middle scalene muscles and the posterior margin of the sternocleidomastoid muscle. Adjacent and deeper structures of interest (carotid artery, internal jugular vein, vertebral artery) all were imaged clearly (Fig 3).

**SUPRACLAVICULAR FOSSA**

Excellent images were obtained in all patients. The brachial plexus, appeared as a cluster of hypoechoic nodules lateral to the subclavian artery, deeper structures (lung, first rib) were illustrated clearly (Fig 4, 5).

**INFRACLAVICULAR REGION**

The quality of images were rated as excellent in (19 patients) and good in(6 patient), the brachial plexus cords were visualized deep to the pectoralis minor around the axillary artery(Fig 6), no image was rated as poor.
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**Figure 9**
Figure 6: Transverse sonogram in the infraclavicular region showing the brachial plexus nodules (N).

AXA = axillary artery; AXV = axillary vein; PM = pectoralis major muscle; Pm = pectoralis minor muscle

**THE AXILLARY LEVEL**

Excellent images were obtained in all patients (Fig 7). The terminal branches of brachial plexus appeared as hypoechoic nodules around the axillary artery.

**Figure 10**
Figure 7: Transverse sonogram in the axillary region showing the terminal branches of the brachial plexus as hypoechoic nodules (N), AA = axillary artery; AV = axillary vein (one or two can be seen).

The musculocutaneous nerve was also illustrated as a round to oval hypoechoic nodule between the two heads of the coracobrachialis muscle (Fig 8).

**DISCUSSION**

In 1978, la Grang (4) reported the use of Doppler ultrasound blood flow detector to facilitate supraclavicular brachial plexus block, although he was unable to visualize the brachial plexus because of the limited ultrasound technology at that time.

In 1994, Kapral described the use of ultrasound to directly visualize the brachial plexus (5). In 1998, Sheppard recommended linear transducers of 7.5 MHZ or higher for imaging the brachial plexus (6). During the last few years ultrasound technology has evolved dramatically. This lead to better understanding of sonoanatomy (7, 8, 9).

Visualizing the roots, cords and nerves of the brachial plexus requires high frequency transducers. However, the higher the frequency the smaller the penetration depth.

New development in ultrasound technology has allowed a broader band and higher frequencies to be achieved by a single transducer, and may eliminate the need to change the transducer for different imaging depth.

In 2003, Perlas used (L12-5 MHZ) probe to map the brachial plexus, he could visualize the brachial plexus in only 27% of patients in the infraclavicular region (10).

In our study, we used more advanced ultrasound system with broader band and higher frequency (L17-5MHZ) transducer with 100% success rate in visualizing the brachial plexus.
and its spatial relationship to surrounding structures in all patients and for different scanning depth. This has clear implications not only to identify the target structure, but also to visualize the structures to be avoided during the procedure.

This study also has demonstrated that single broad band transducer can reliably cover different imaging depth with at least good quality of images.

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References

Author Information

Ahmad Thallaj, M.D., CABA
Consultant, Anesthesia & Intensive Care, King Khalid University Hospital