

Ultrasonographic visualizing of peripheral nerves

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History of peripheral nerve

In 1978, La Grange et al.* first reported the use of Doppler blood flow detector in the blockade of Brachial Plexus.
This is the first publication of sonographic control of regional anesthesia.

In 1994, Kapral et al.* first published work on the use of direct sonographic visualization in regional anesthesia (supraclavicular block Brachial Plexus) with an assessment of the spread of anesthetic

This was rare publications on sonography of peripheral nervous system

*La Grange P, Foster PA, Pretorius LK. Application of the Doppler ultrasound bloodflow detector in supraclavicular brachial plexus block. Br J Anaesth 1978; 50:965–7.

**Kapral S, Krafft P, Eibenberger K, et al. Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus. Anesth Analg 1994; 78: 507–13.

***Fornage BD. Peripheral nerves of the extremity: imaging with ultrasound. Radiology 1988; 167: 179–82

Graif M, Seton A, Nerubai J, Horoszowski H, Itzchak Y. Sciatic nerve: sonographic evaluation and anatomic-pathologic considerations. Radiology 1991; 181: 405–8

Minimum requirements for ultrasound equipment to monitor anesthesia

- High-resolution ultrasound (HRUS) - visualizing nerves requires the use of high frequency US
- Effective Doppler (color and energy) - provided by CPU power.
- Simple and intuitive controls.
- Using techniques to optimize image - Tissue Harmonics, feature multifocus etc.
- Desirable presets for sonography of muscle tissue, nerves, puncture of nerves.
- Easy image storage and retrieval.
- Easier to use portable ultrasound machines

Techniques of nerve visualization

- Location of nerve on the principles of anatomy relative to position of surrounding structures (syntopy)
- Transducer movement - nerve searching
- System scanning along the nerve in the transverse and longitudinal scan
- Setting the best visualization of nerve

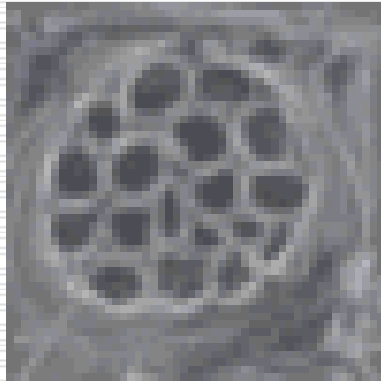
NB! Anatomical landmarks are secondary after visual verification of nerve!

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- Nerves optimally are visualized in the transverse (perpendicular - out of plane) scan.

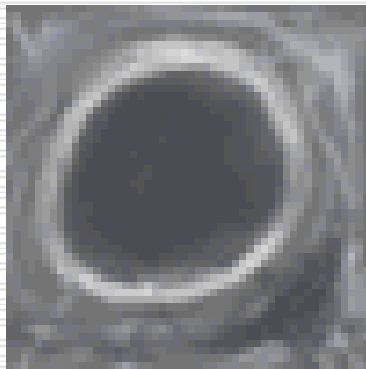
In the longitudinal scan (in plane) nerves detect hypo- and hyperechoic parallel tubular signals

- Silvestri E, Martinoli C, Derchi LE et al. Echotexture of peripheral nerves: correlation between US and histologic findings and criteria to differentiate tendons. *Radiology* 1995;197:291-6.

Typical appearance of a nerve trunk and plexus



- Nerve – “fascicular pattern” – high echogenicity (light) with dark spots



- Trunk - tubular hypoechoic (dark) structure

The effect of anisotropy - the loss of structure in the study of angle

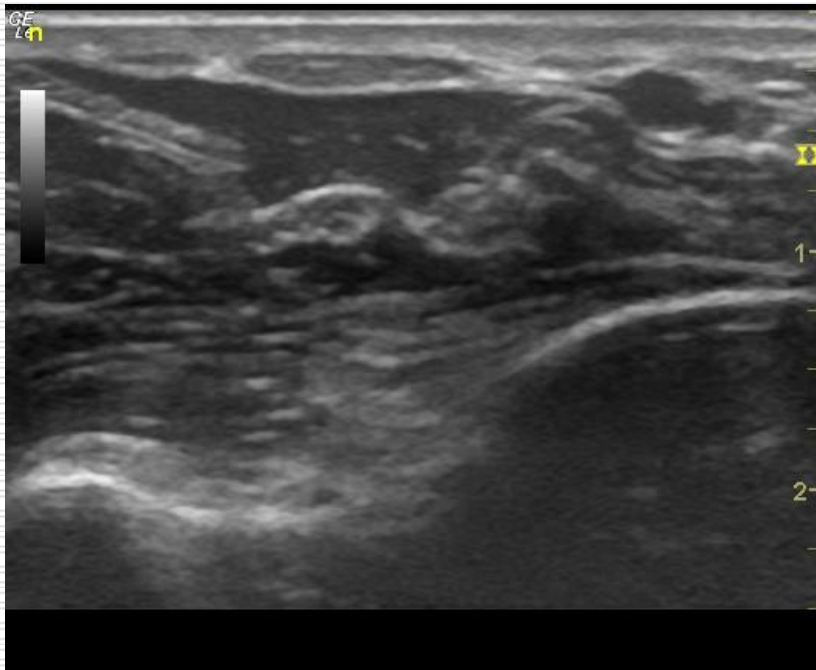


Figure 1.

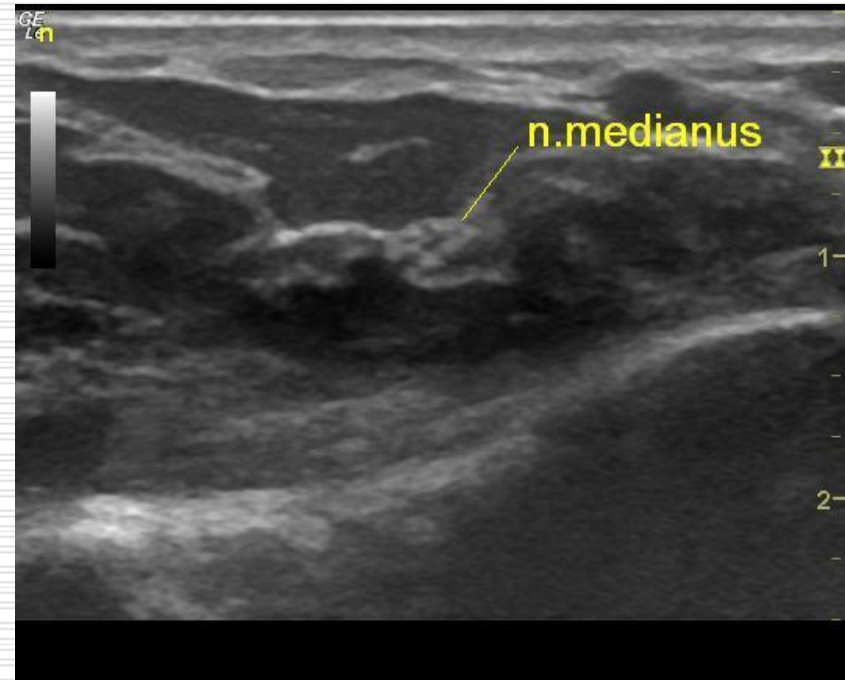


Figure 2.

- Visualize angle - the effect of anisotropy on the left (Figure 2). Effect more pronounced in the tendon.

Choice of Probe

- Depth of most nerves ranges from 3 to 7 cm - available installation of focus distance in the high-frequency probes
- We consider the optimal frequency around 8-10 MHz
- However, we do not exclude the possibility of using convex probes, especially multifrequency.

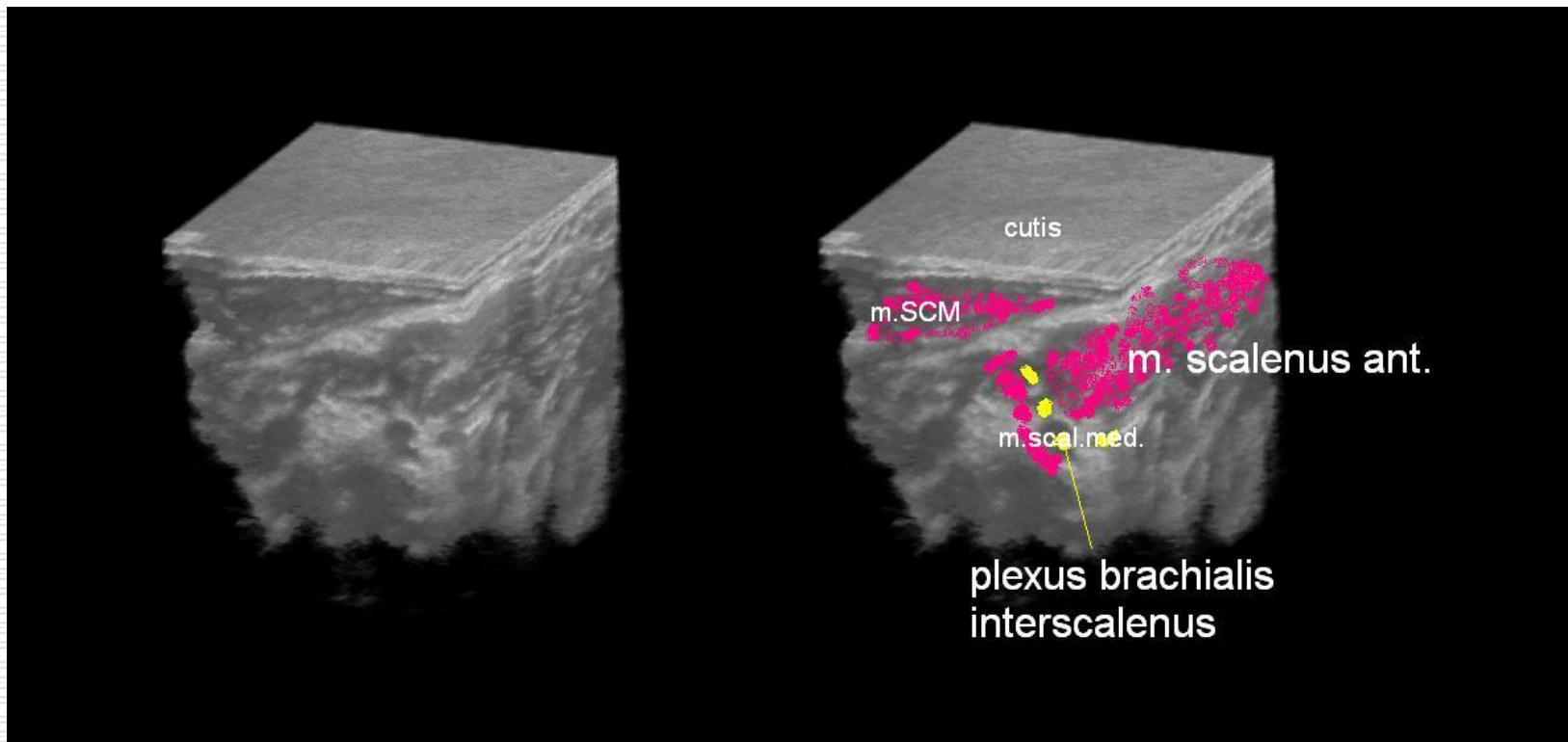
Marhofer P, Greher M, Kapral S: Ultrasound guidance in regional anaesthesia. Br J Anaesth 2005; 94:7-17

Choice of Probe



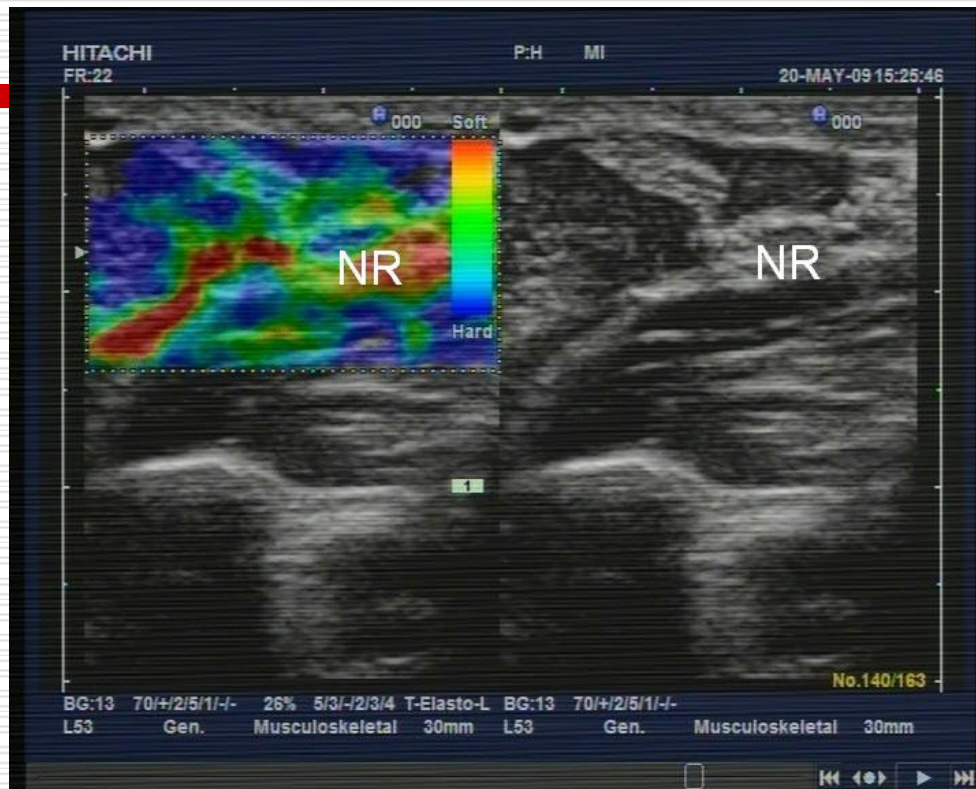
Sciatic nerve in lower part of thigh –
linear probe (left), convex (right)

Ultrasound imaging techniques



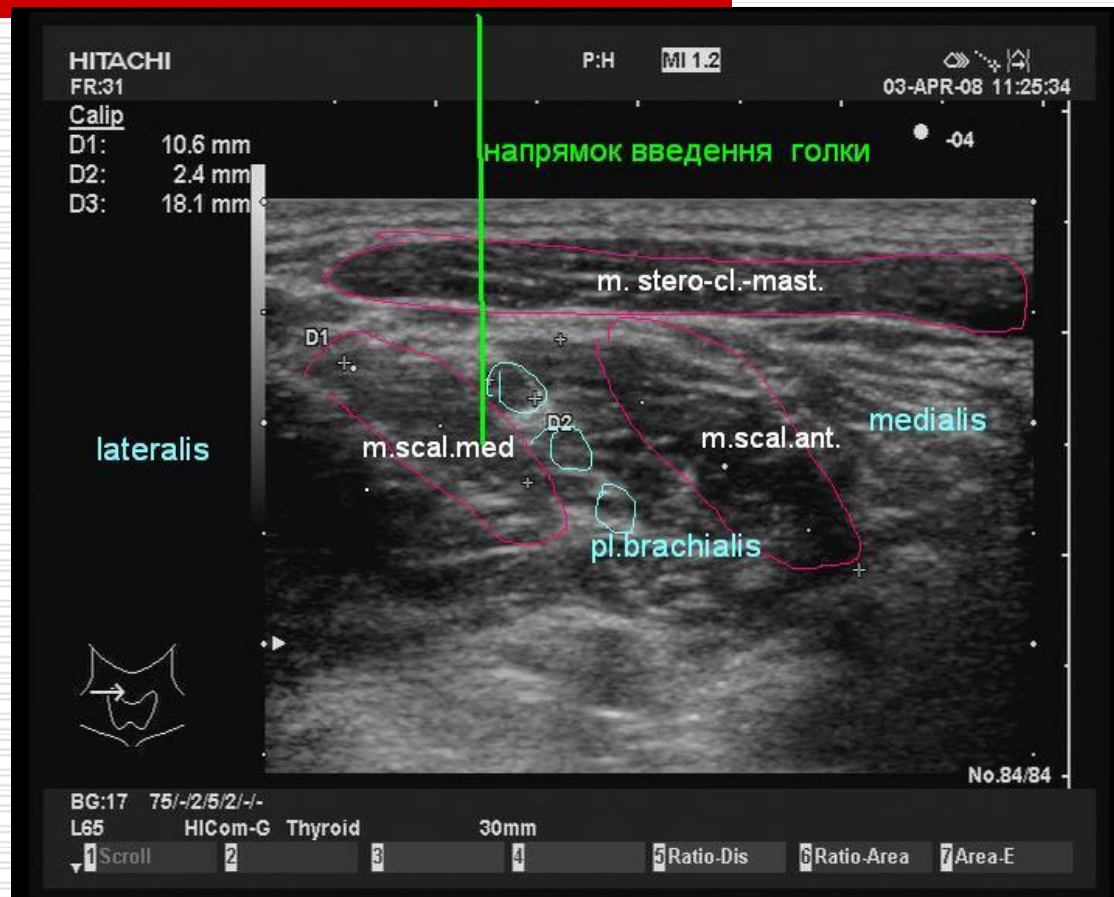
- Three-dimensional reconstruction of the brachial plexus

Sonoelastography

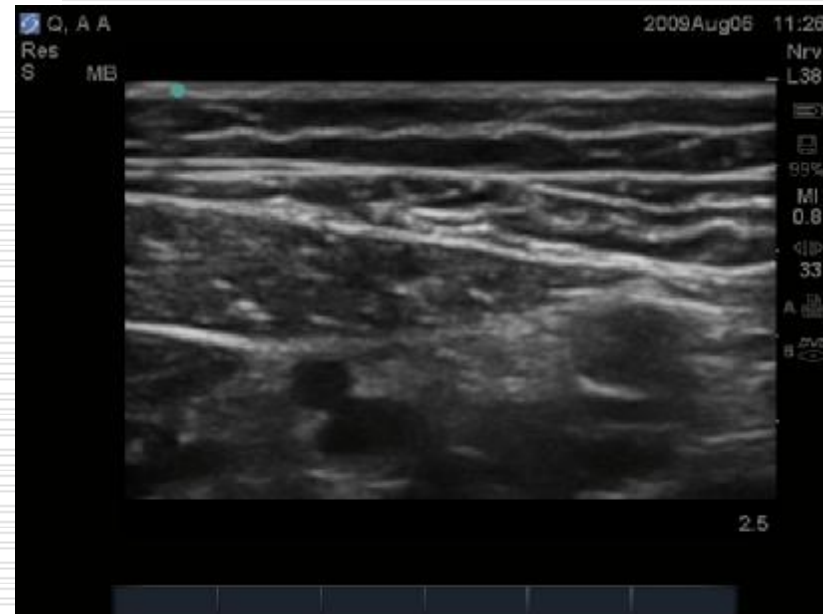
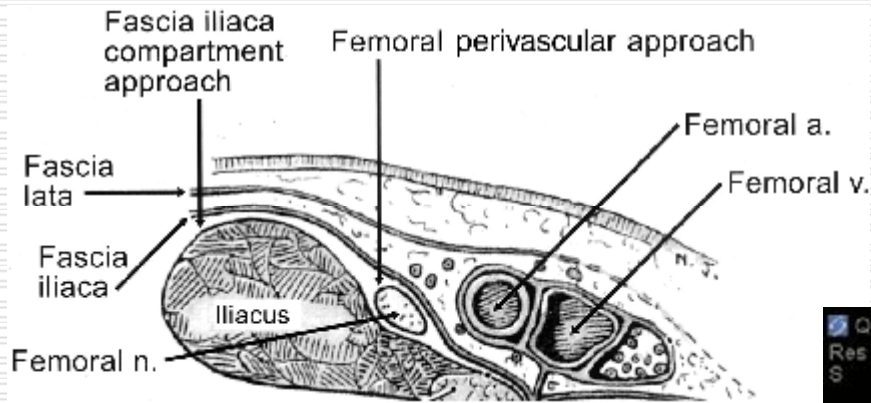


Sonoelastography of radial nerve - nerve shows the less elasticity than surrounding tissue (colored blue)

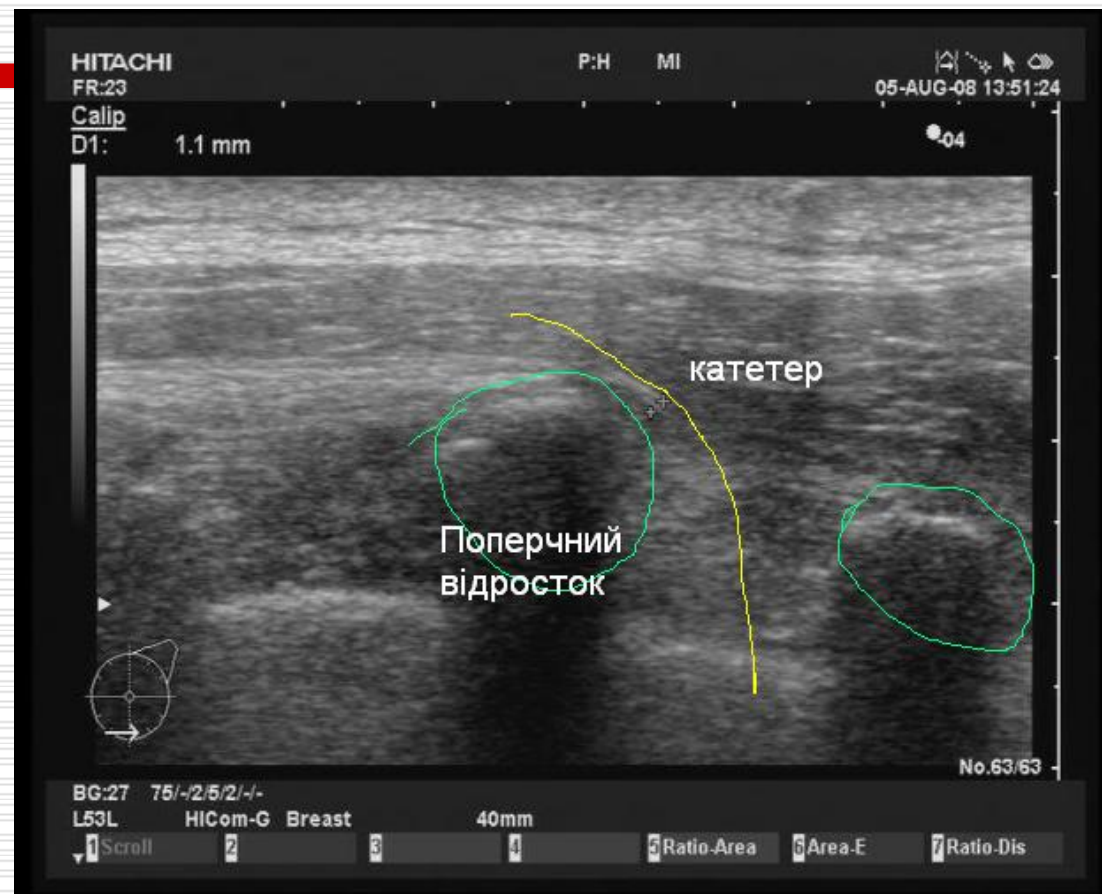
Brachial Plexus interscalene



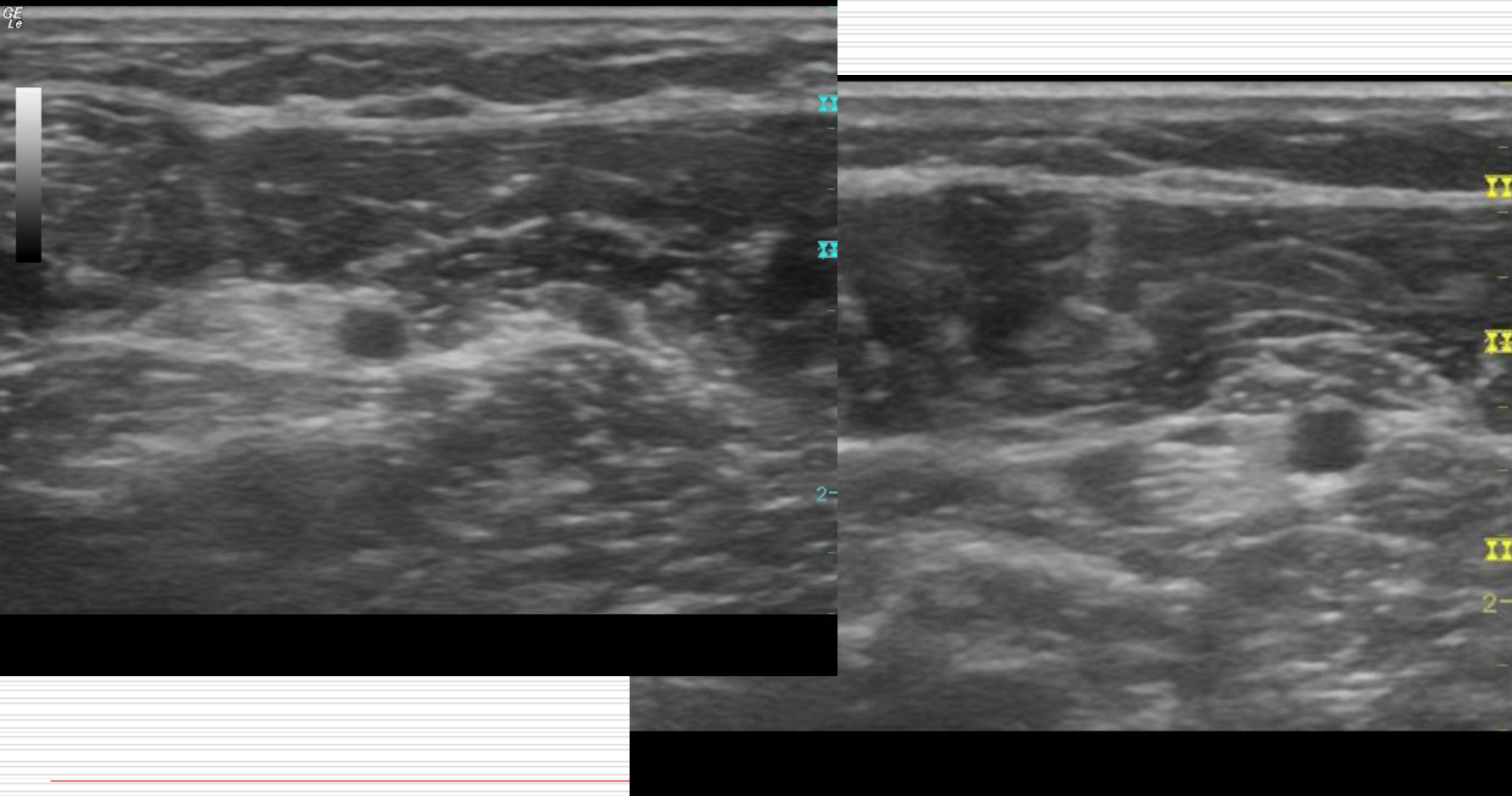
Femoral nerve



Continuous paravertebral block (longitudinal paravertebral scan)



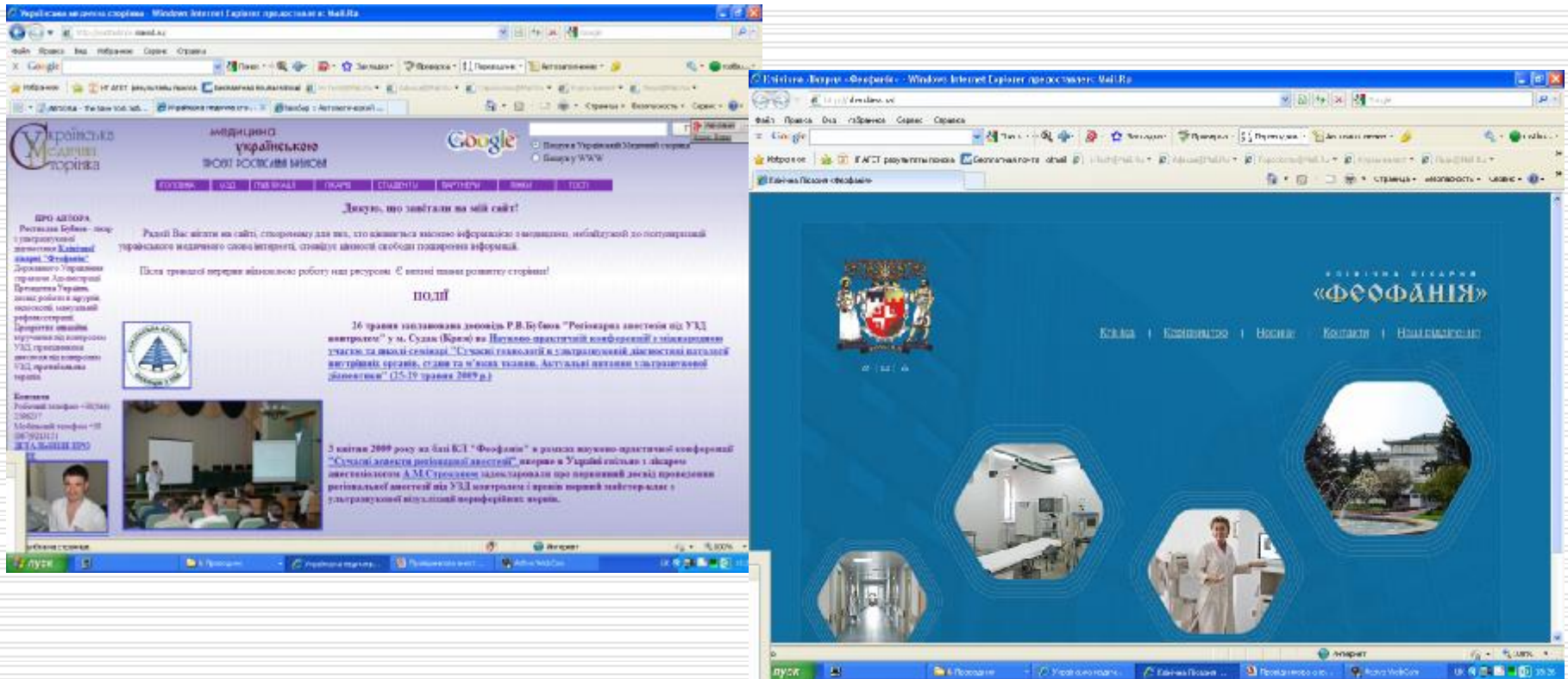
Ulnar nerve block



Conclusion

- Ultrasound imaging is the best method of verifying the optimal needle position and spread of anesthetic, ensuring the safety of the blockade.

Our web resources



- <http://rostbubnov.narod.ru/>
- <http://pheo.kiev.ua/>



Thank your for attention!