



Cervical Nerves in Impingement Regions

lower cervical nerves scanned with
ultrasound

At Voorhorst/EchoProcedures
www.echoprocedures.nl

Foreword: lower Cervical Nerves in Impingement Regions

Ultrasound researchers and physiotherapists do not often examine the cervical region with ultrasound. However, if the cervical anatomy under the echo probe was still difficult to interpret a few years ago, the current generation of ultrasound equipment has changed this. The regional anatomy is extremely complex and sometimes confusing, but with regular scanning it is possible to develop your skills and make statements about the continuity of nerve roots and impingement problems such as those played by thoracic outlet syndrome, the quadrilateral axillary syndrome, N. suprascapularis compression and compression in the spinoglenoid notch.

It is a condition that we first gather knowledge about the nerves in the neck, the course of the brachial plexus around the shoulder and in the upper arm. In addition, the relationship between the plexus and the most important landmarks requires your special attention. These are the processus transversi of the vertebrae, the arteries and veins.

By immersing ourselves in the ultrasound of various regions such as the neck and the groin, we more or less go beyond the more frequently walked paths of shoulder and knee examination. My experience is that increasing knowledge of 'alternative regions' benefits ultrasound research in a general sense.

To gain knowledge about the cervical structures in combination with ultrasound, you must (again) consult the anatomy and study the scientific literature in this area. With this presentation, the preliminary work has already been done with which the lower cervical plexus has become more accessible for interested physiotherapist, ultrasound and health care professionals.

At Voorhorst

Prologue

We will focus on the 'normal' anatomy and its presentation with ultrasound equipment. Regular anatomy has many variants, that is a fact. No blood vessel pattern is the same on the left or right side; no nerve runs in the exact same spot. There are also more differences between individuals than agreements when we observe closely. This argues for laying nerve blocks always under ultrasound guidance, because the various nerve branches can be localized very accurately.

Although no constricted nerves are shown at this location, it is good to realize that impingement problems have many causes and are likely to be under-diagnosed because of the varied complaints presentations.

A nerve that is trapped - or has been seated - shows a fusiform thickening; sometimes the characteristic honeycomb pattern has disappeared or become blurred on your echo plate because of edema that has accumulated between the nerve fibers. The nerves can be compressed, but the accompanying arteries and veins can also be involved in clamping, with all its consequences.

Known causes of mechanical compression are: the scalene anticus syndrome, a neck rib, form variations of the clavicle and the first rib, bone fractures (clavicle, first rib, humerus) connective tissue strings, enlarged processus transversi of C7, ganglion cysts or a lung tumor (Pancoast tumor).

Besides the mechanical compression we know inflammation of the plexus brachialis by unknown cause as it is the case with neuralgic amyotrophy. The exact cause of this disorder is unknown but is thought to be a mistake of the immune system.

Disclaimer:

This presentation is intended for educational purposes. The compiler refers to persons or institutions if literal texts are used or if texts can be traced to certain individuals. In addition to the right to quote, the image quote right is used. Never are images from elsewhere intended as embellishments of the whole, but always as elements necessary for the presentation to maintain or increase its educational value. If, despite the above, someone feels essential shortcomings, please contact the compiler so that images or texts can be adapted or removed if necessary.

Nerves and vessels

n. ulnaris
n. radialis
n. medianus
n. musculocutaneus

n. suprascapularis
n. axillaris

subclavian artery
axillary artery
circumflex artery humeral head
subclavian vein
axillary vein

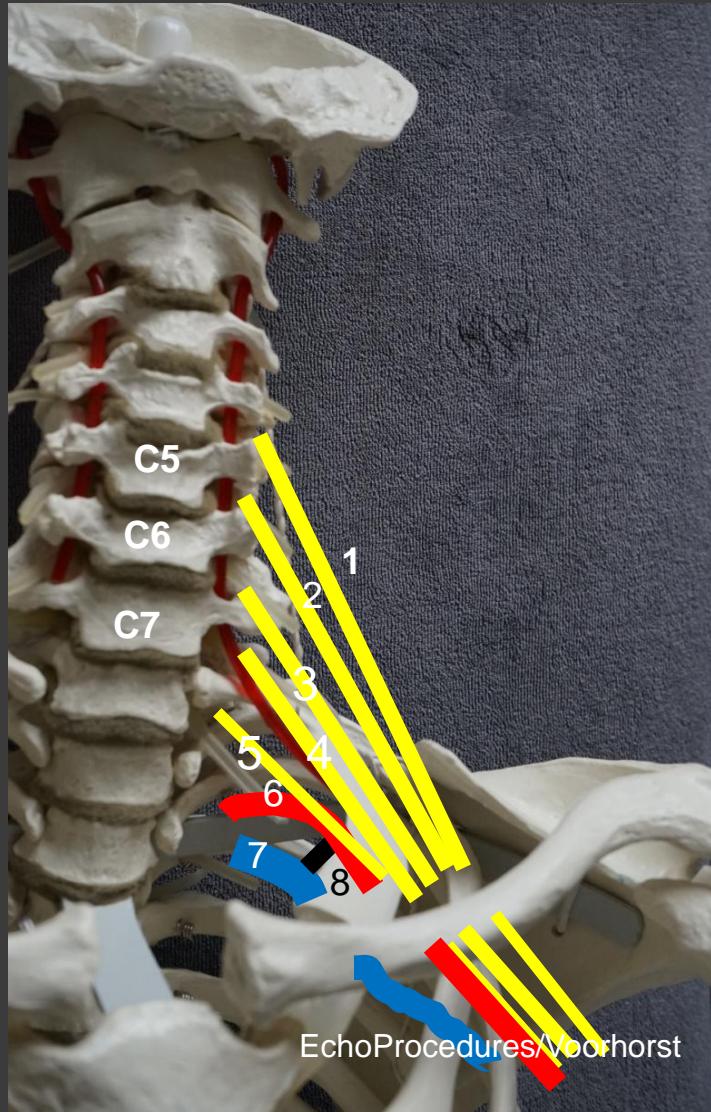
miscellaneous

medial ramus of dorsal root
n. phrenicus
n. vagus

Impingement symptoms

1. nerve(s): pain, numbness, tingling
2. artery(s): pain, aneurysma, ischemic infarct
3. vein(s): pain, stowing, aneurysma, embolism
4. combination: 1, 2 and 3

Schematic

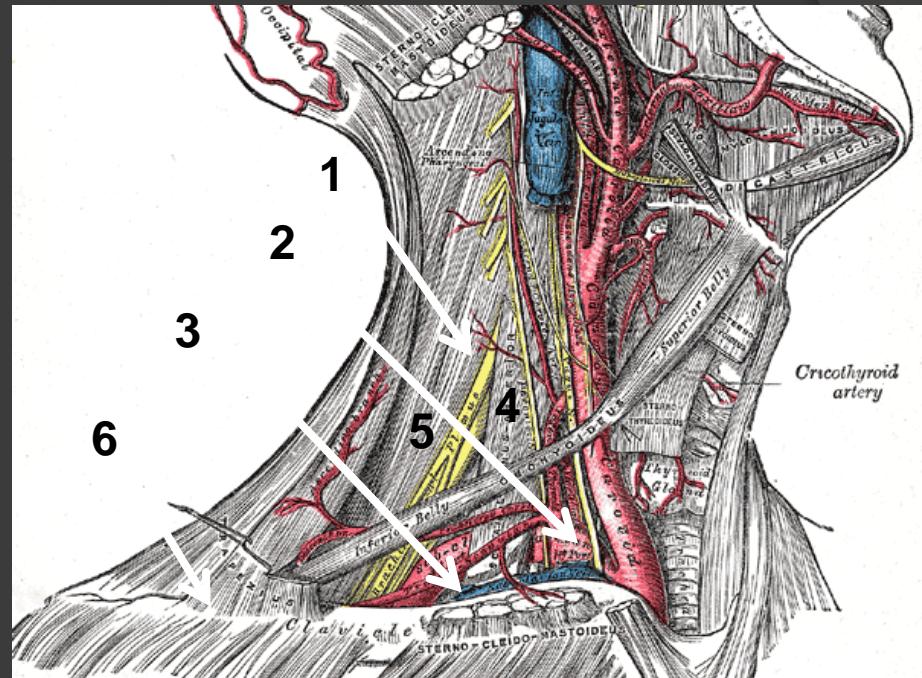
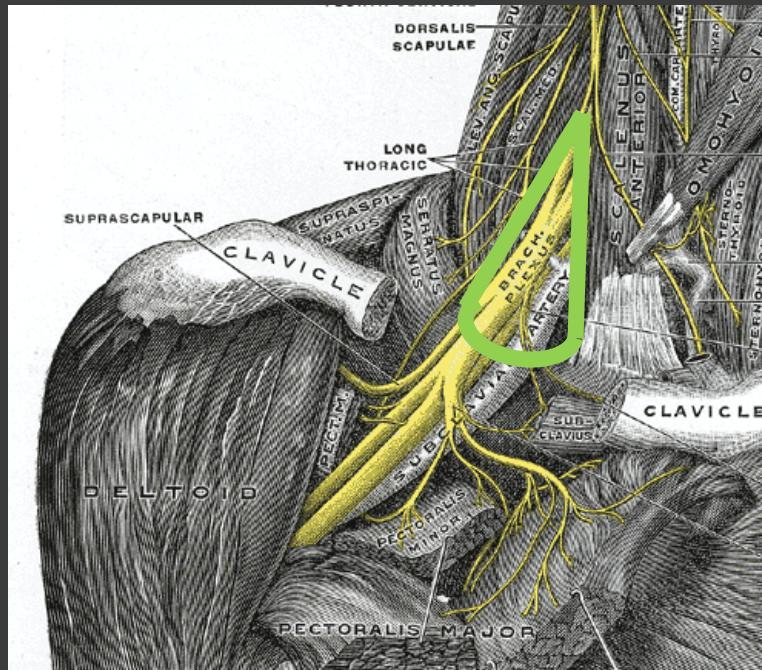


plexus brachialis (C5-C8-T1) and vessels

1. nerve root C5
2. nerve root C6
3. nerve root C7
4. nerve root C8
5. nerve root T1
6. subclavian artery
7. subclavian vein
8. footprint m. scalenus anterior

Anatomie

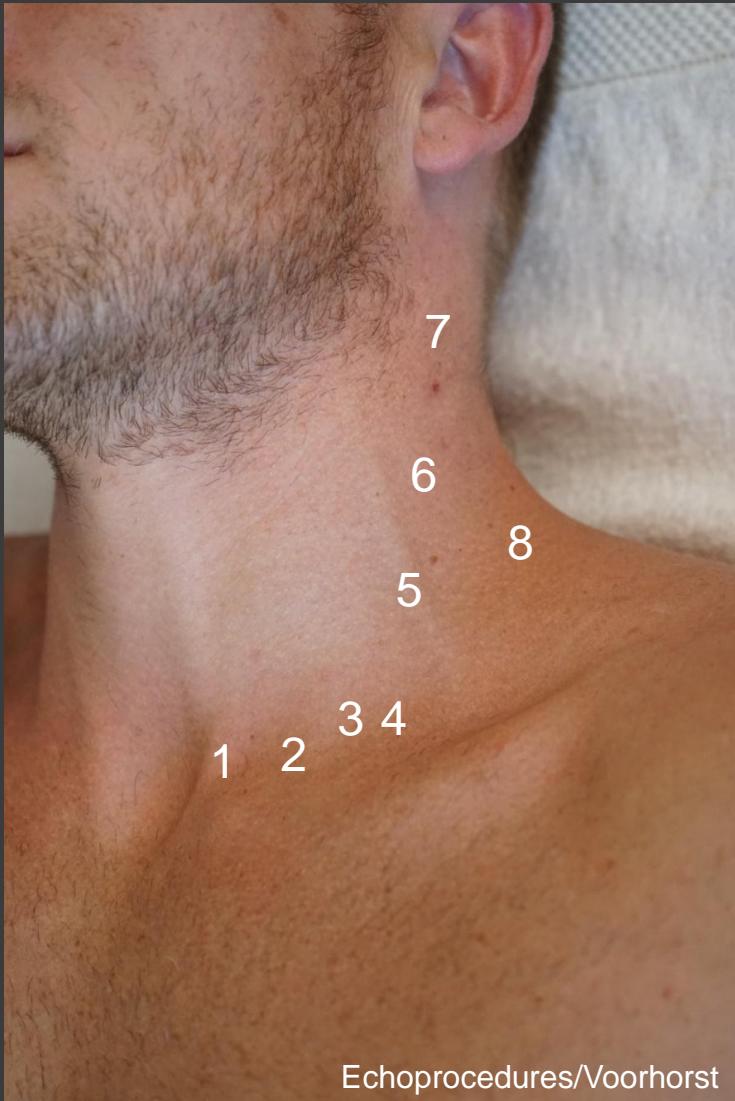
interscalene triangel: m. scalenus anterior + m. scalenus medius + first rib



left and right: Anatomy of the Human Body 1918; Henry Gray (1825–1861). (green, arrows and numbers: EchoProcedures)

1. plexus brachialis
2. subclavian artery
3. subclavian vein
4. m. scalenus anterior
5. m. scalenus medius
6. clavica

In vivo

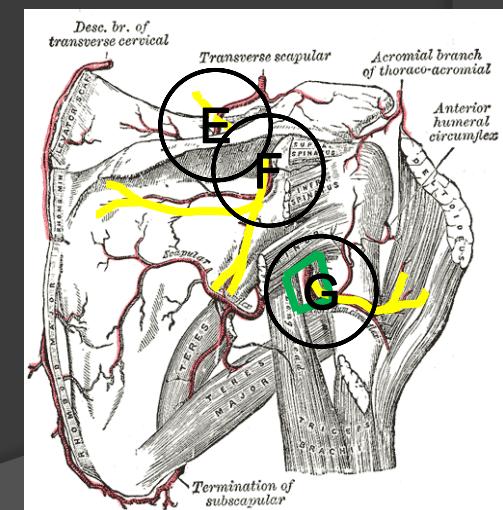
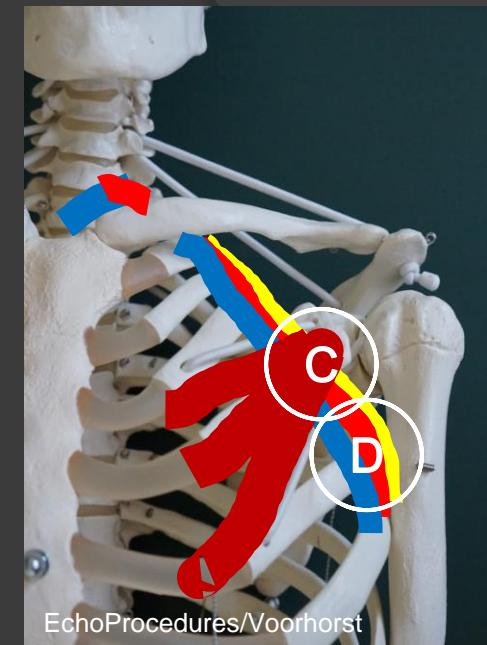
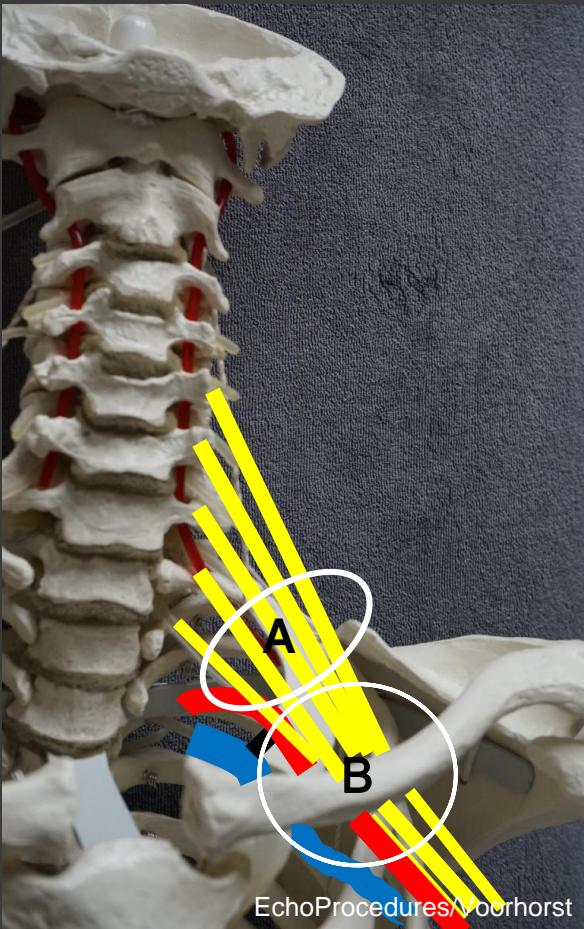


plexus brachialis cervical region

1. m. sternocleidomastoideus (sternal part)
2. m. sternocleidomastodeus (clavicular part)
3. m. scalenus anterior
4. m. scalenus medius
5. v. jugularis externa
6. m. levator scapulae
7. m. splenius capitis
8. m. trapezius

Impingement regions

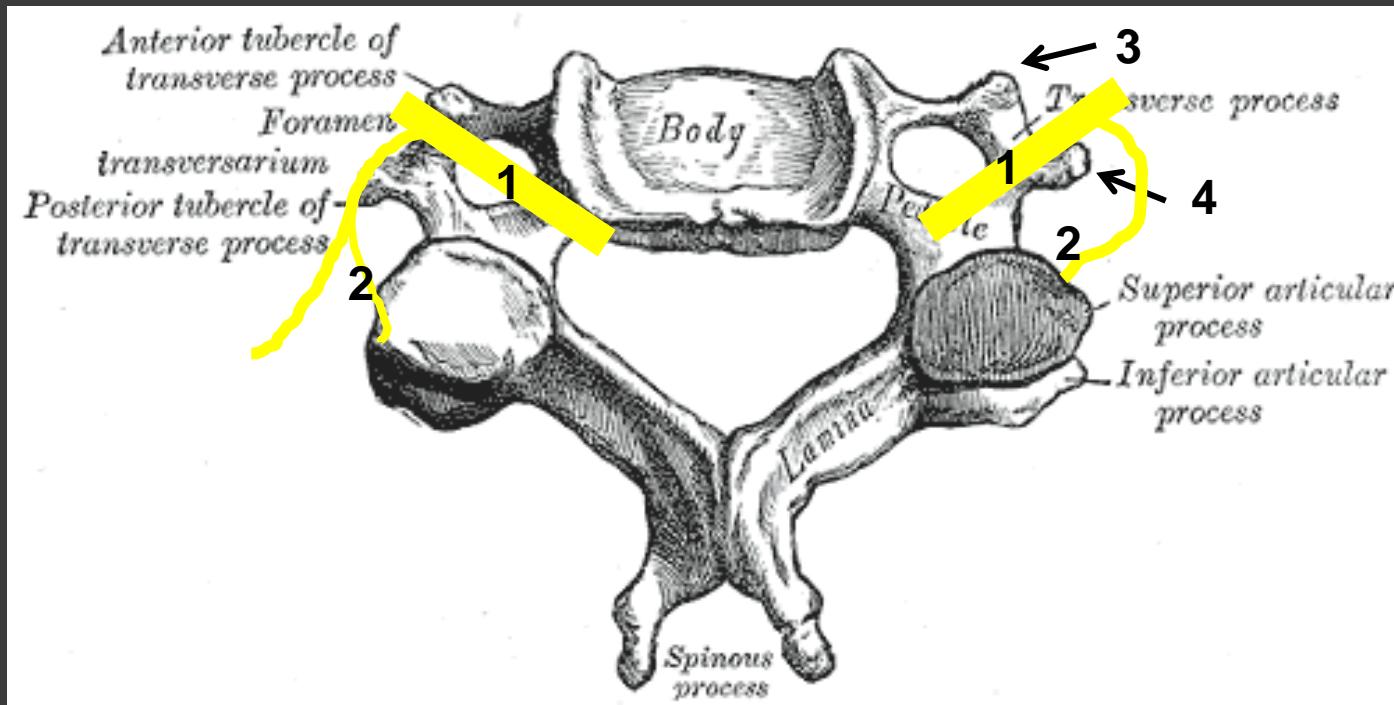
- A scalene triangel
- B supraclavicular
subclavicular
infrascapular
- C pectoralis minor
- D upper arm
- E suprascapular notch
- F spinoglenoid notch
- G quadrilateral space



Anatomy of the Human Body 1918;
Henry Gray (1825–1861).

Bony landmarks

for ultrasound identification: nerve root situated between anterior and posterior tuberculum of transvers process



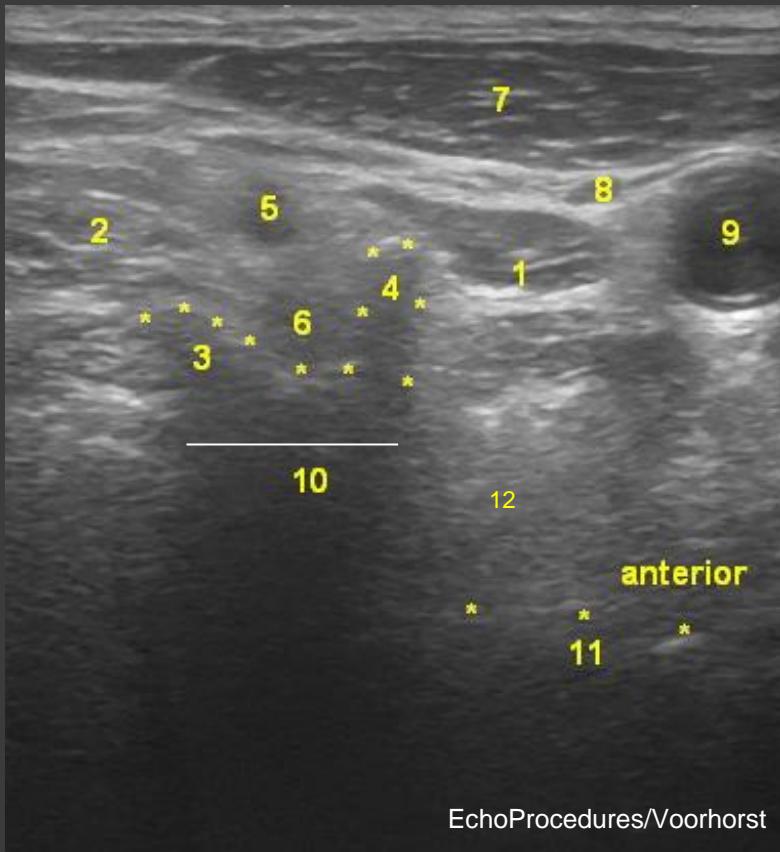
Anatomy of the Human Body 1918; Henry Gray (1825–1861).
(Yellow: EchoProcedures)

1. nerve root
2. medial ramus
3. anterior tuberculum
4. posterior tuberculum

A

Ultrasound landmarks

brachial nerve root identification in the paravertebral area



1. m. scalenus anterior
2. m. scalenus medius
3. tuberculum processus posterior
4. tuberculum processus posterior
5. nerve root C5
6. nerve root C6
7. m. sternocleidomastoideus
8. jugular vein
9. common carotic artery
10. processus transversus
11. pedicle
12. m. longus colli



probe

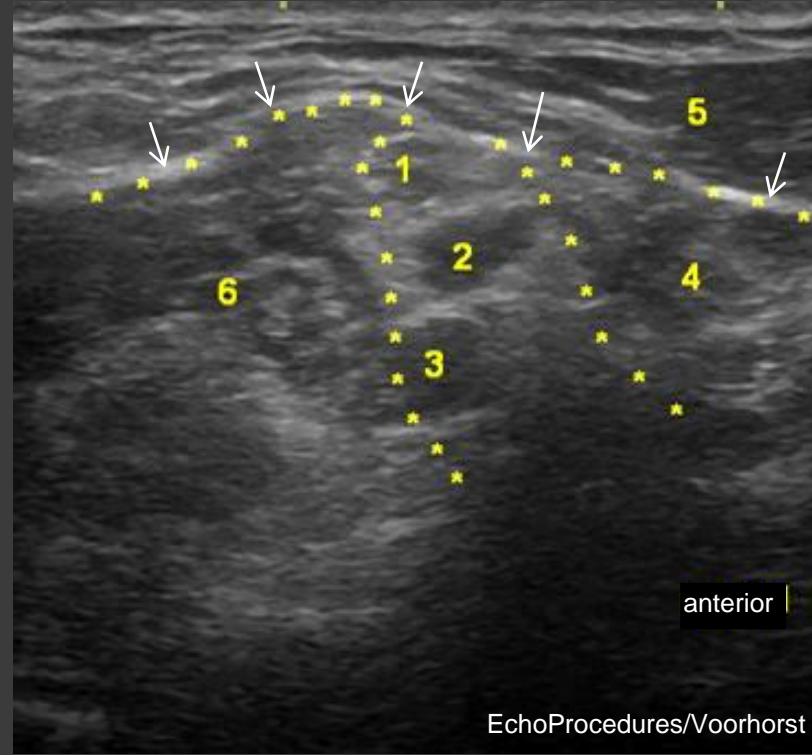
A

Ultrasound landmarks

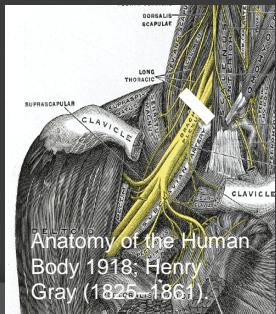
paravertebral plexus brachialis level C7



EchoProcedures/Voorhorst



EchoProcedures/Voorhorst



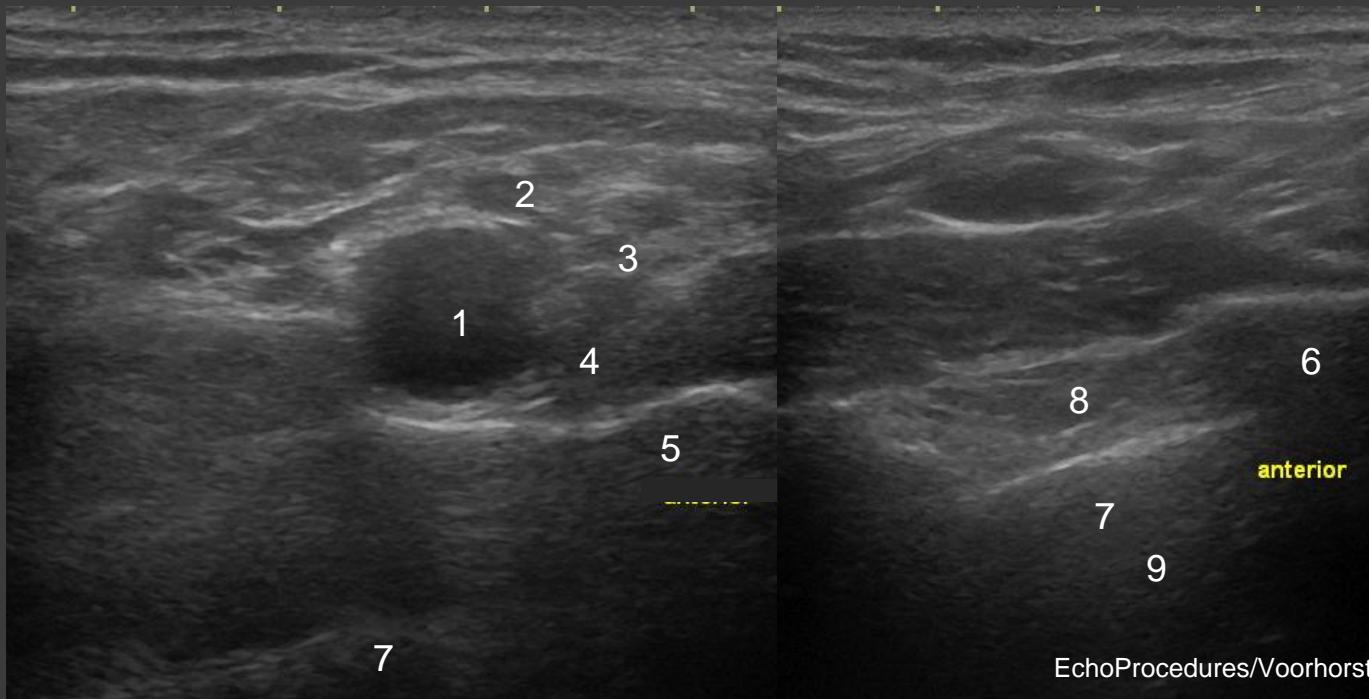
Probe

1. nerve root C5 / superior trunk
 2. nerve root C6 / middle trunk
 3. nerve root C7 / inferior trunk
 4. m. scalenus anterior
 5. m. sternocleidomastoideus
 6. m. scalenus medius
- prevertebral fascia

B

Ultrasound landmarks

supraclavicular artery and brachial plexus in close relation with ribs and pleura



1. supraclavicular artery
2. upper part cervical trunk
3. middle part cervical trunk
4. lower part cervical trunk
5. first rib
6. second rib
7. pleura
8. intercostal muscles
9. lung



probe

Arterial compression

'The incidence of arterial compression in patients diagnosed with neurogenic thoracic outlet syndrome is not accurately known. In a consecutive series of 148 patients diagnosed with neurogenic thoracic outlet syndrome, a standard objective method of Doppler ultrasound examination was implemented, with standard manoeuvres for the arm involved. [...]. It was found that 75 patients (51%) had definite arterial occlusion. The potential for even venous compression was examined in this type of patient, and 11 patients (8%) were found to have vascular compression of the subclavian vein when performing the manoeuvres'*

*The vascular component in neurogenic-arterial thoracic outlet syndrome J Ernesto Molina, MD PhD and Jonathan D'Cunha, MD PhD

Schematic

plexus brachialis on chest and upper arm



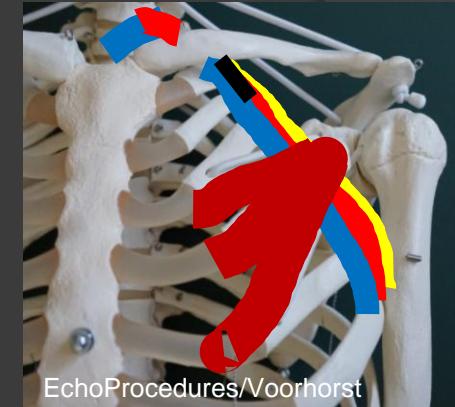
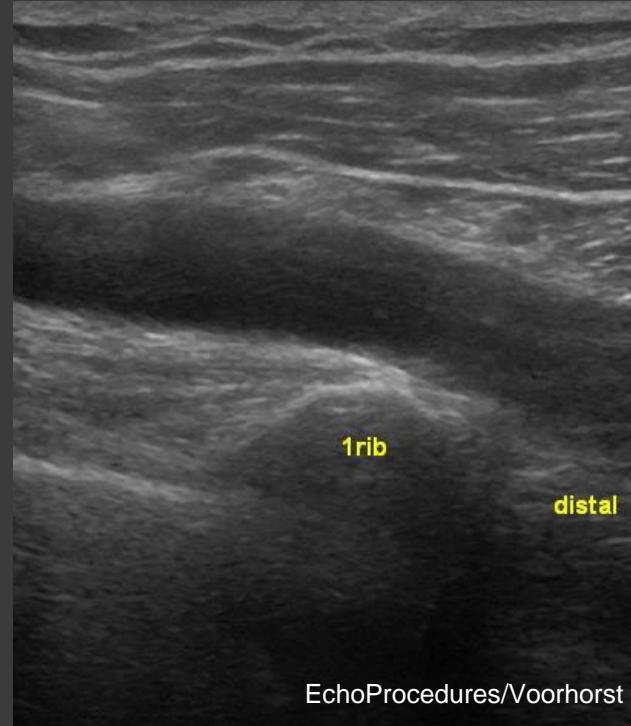
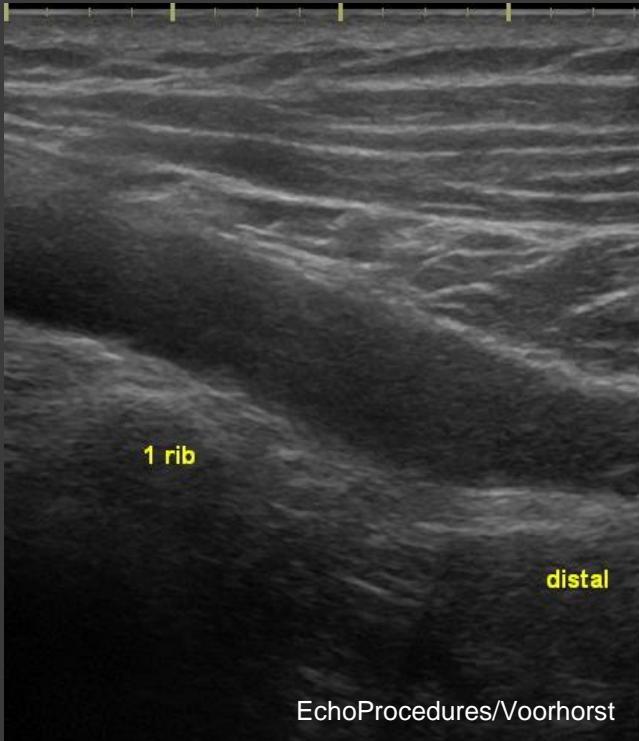
1. plexus brachialis
2. subclavian artery
3. subclavian vein
4. m. pectoralis minor
5. axillary vein
6. axillary artery

EchoProcedures/Voorhorst

B

Ultrasound landmarks

normal axillary artery just distal the clavicular head: neutral and elevated humerus



A

neutral position humerus

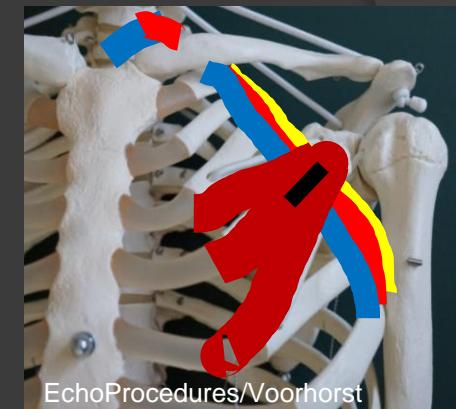
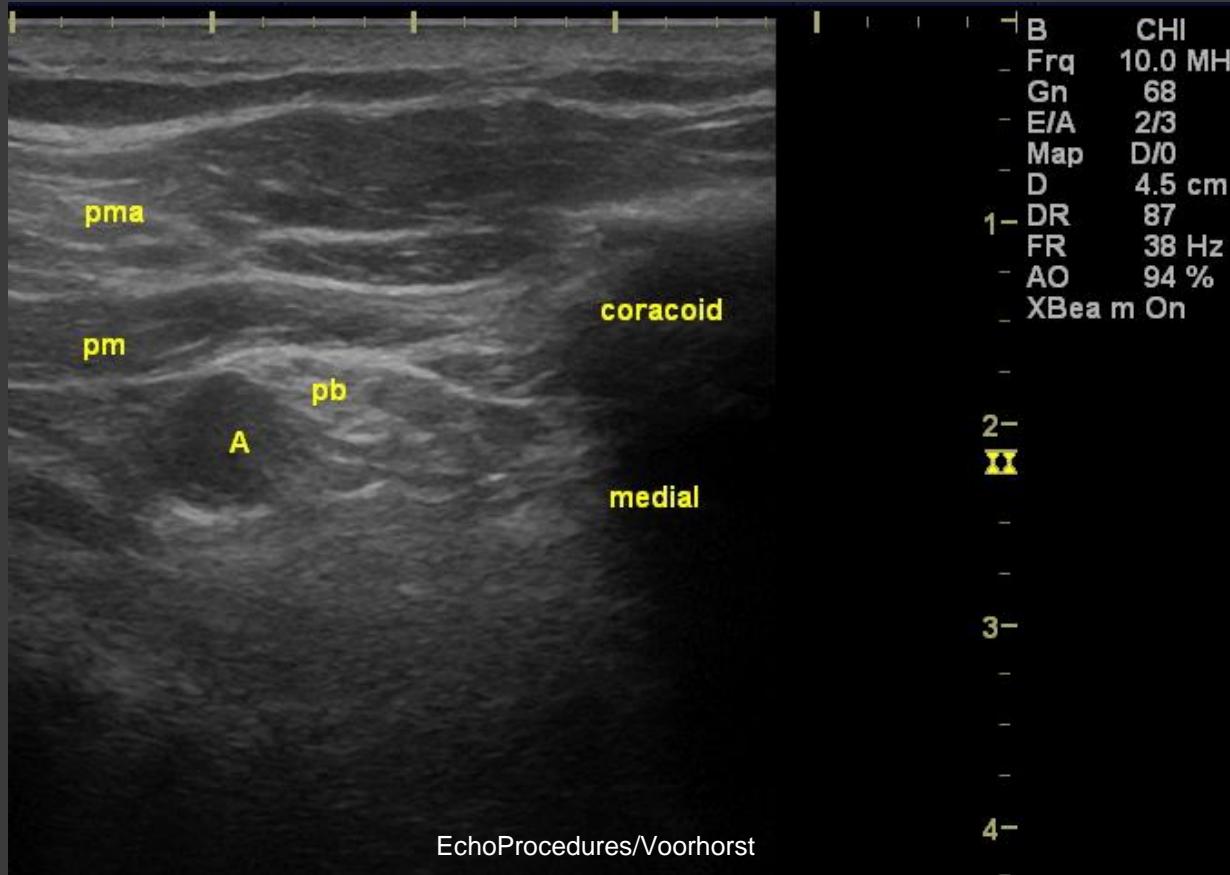
B

120 ° elevation + abduction humerus

C

Ultrasound landmarks

axillary artery and plexus brachialis under pectoralis minor



probe

pma: pectoralis major
pm: pectoralis minor
A: axillary artery

C

Ultrasound landmarks

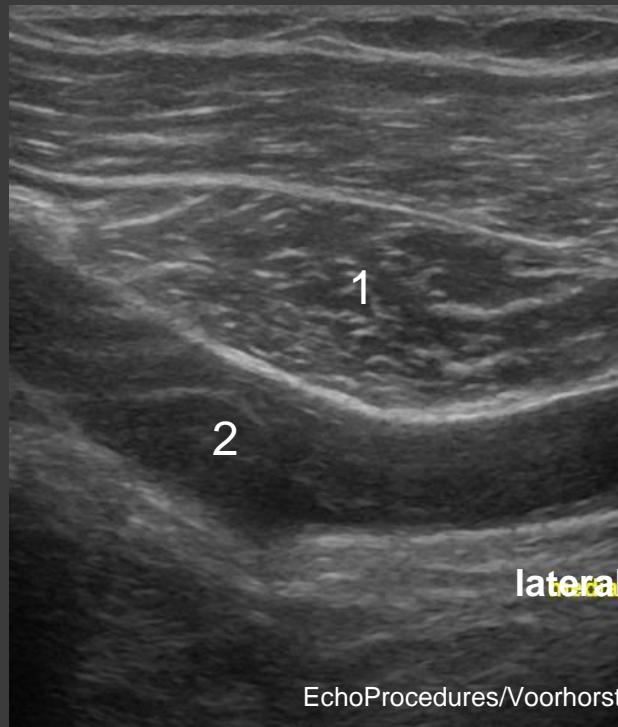
axillary artery under pectoralis minor,
neutral humerus position



A

1. pectoralis minor
2. axillary artery

axillary artery under pectoralis minor,
humerus 120° elevated



B

no compression at this level



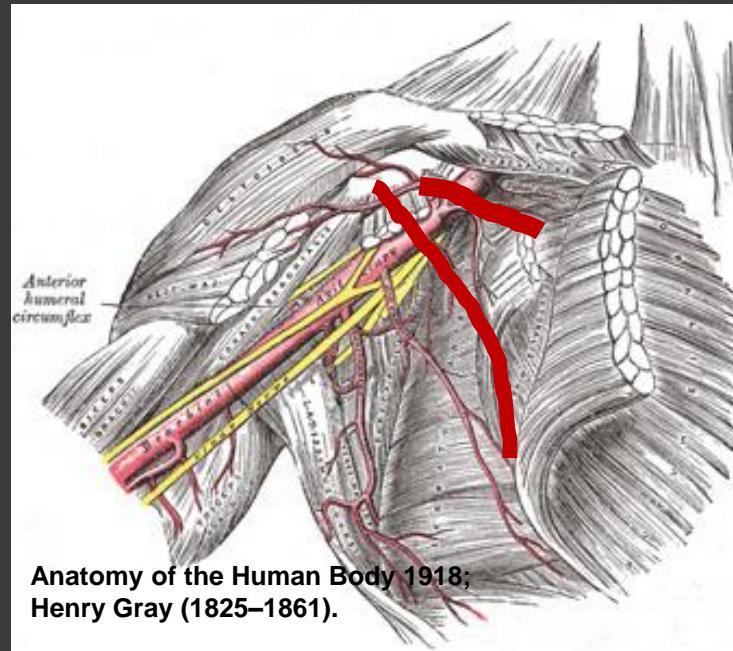
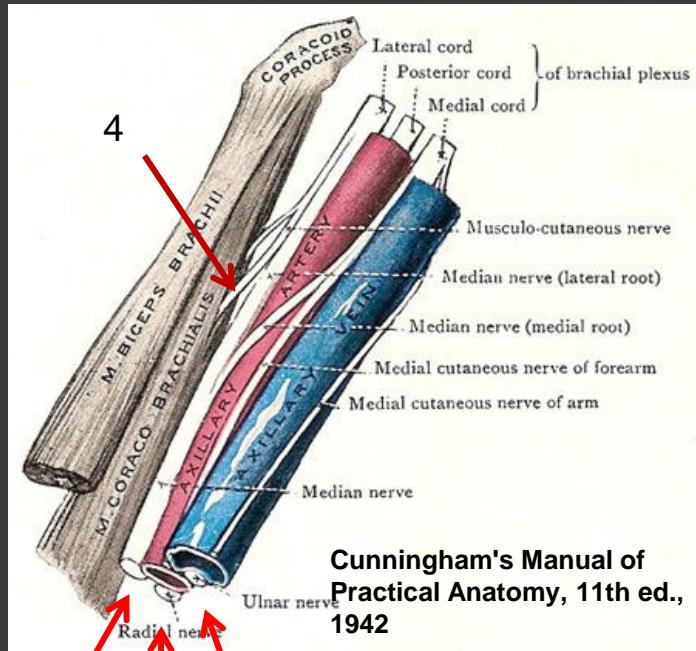
A: Shoulder in
neutral position

B: Shoulder 120 °
elevated

Anatomie

axillary nerves and vessels

axillary nerves and axillary artery
situated just under the m. pectoralis minor

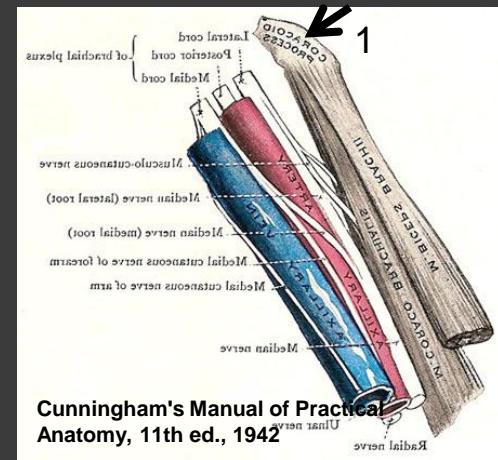
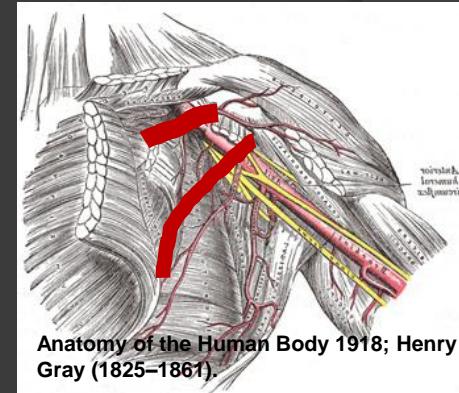


1. n. medialis
2. n. radialis (running at the posterior side of the upper arm)*
3. n. ulnaris
4. n. musculocutaneus

m. pectoralis minor

In vivo

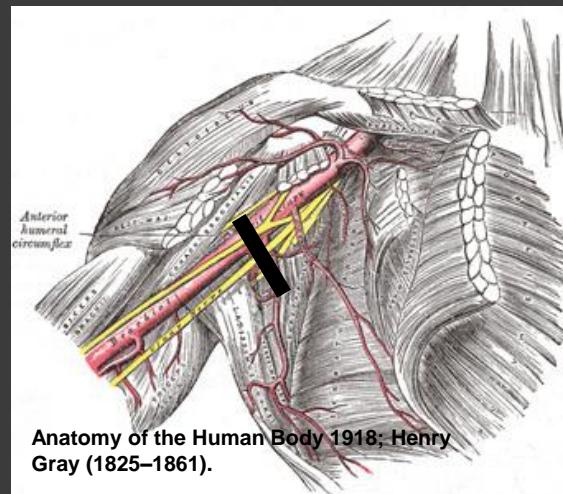
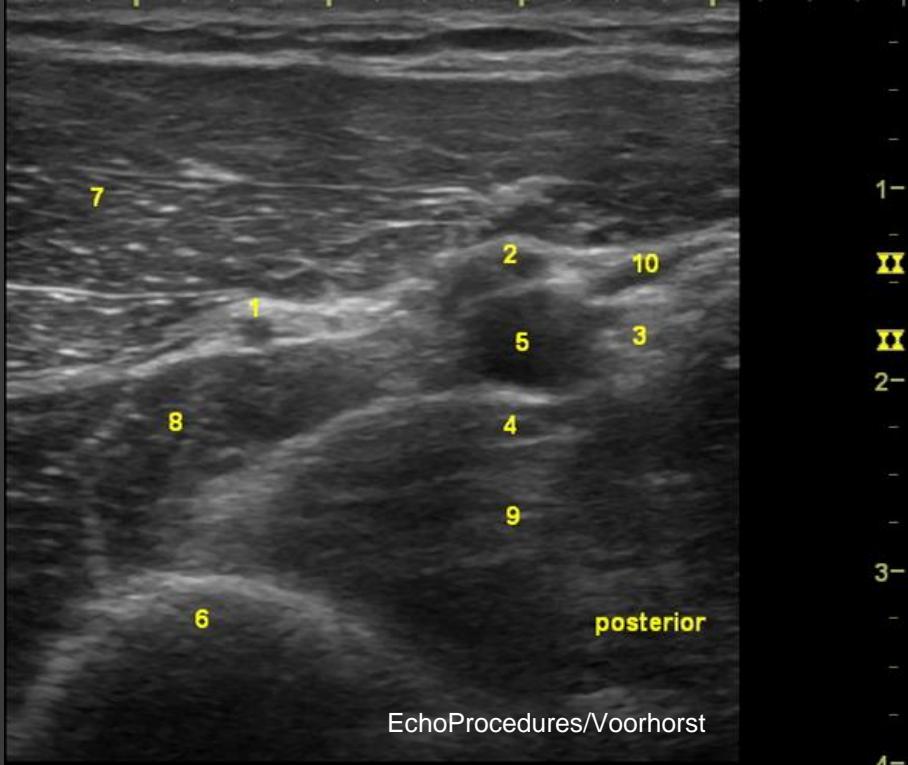
plexus brachialis on chest and upper arm region



1. coracoid process
 2. brachial vein
 3. brachial plexus and artery
 4. m. pectoralis minor

Ultrasound landmarks

plexus and vessels in upper arm (position 1)

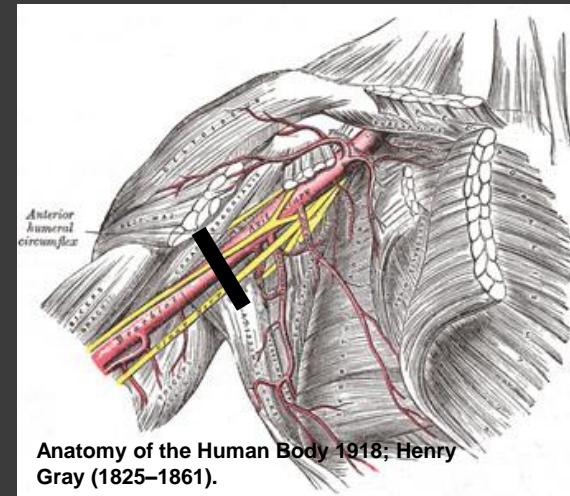


probe position1

1. n. musculacutaneus
2. n. medianus
3. n. ulnaris
4. n. radialis
5. axillary artery
6. humerus
7. m. biceps
8. m. coracobrachialis
9. m. triceps
10. axillary vein

Ultrasound landmarks

plexus and vessels in upper arm (position 2)

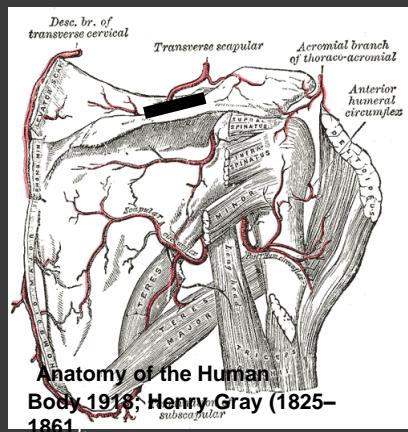
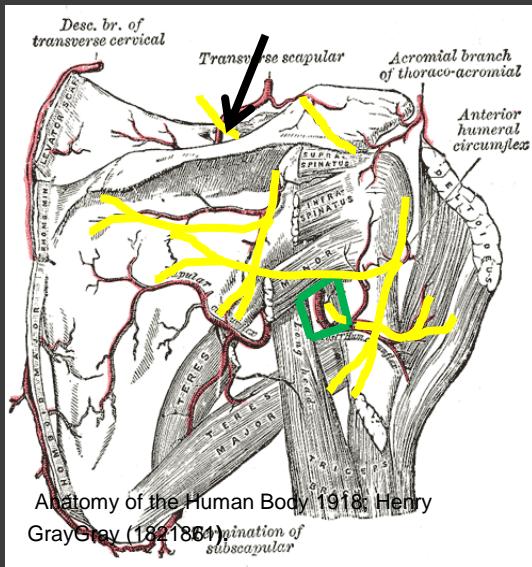


probe placement position 2

1. n. musculocutaneus
2. m. biceps
3. m. coracobrachialis
4. humerus
5. axillary artery
6. axillary vein

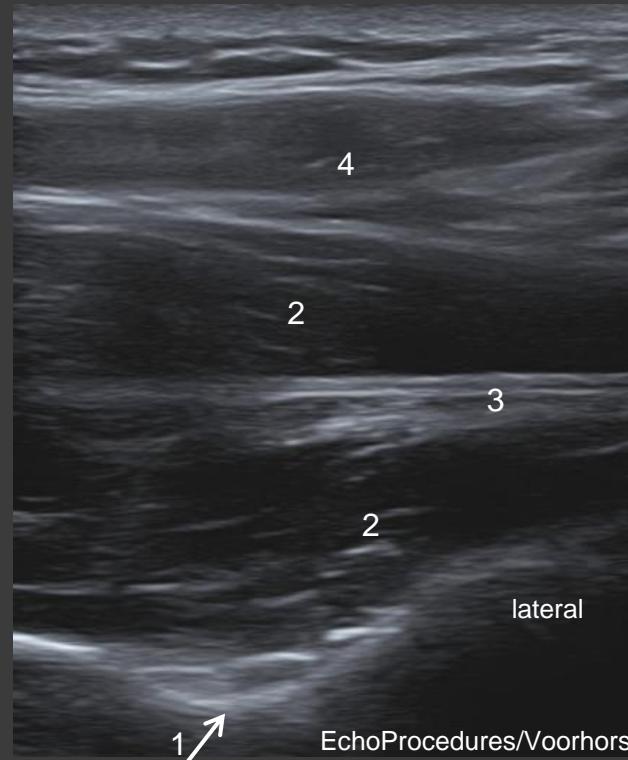
E

Ultrasound landmarks



probe

Inside the suprascapular notch: n. suprascapularis (C5). Motor innervation: m. supraspinatus + m. infraspinatus. Sensory innervation: AC-joint + glenohumeral joint

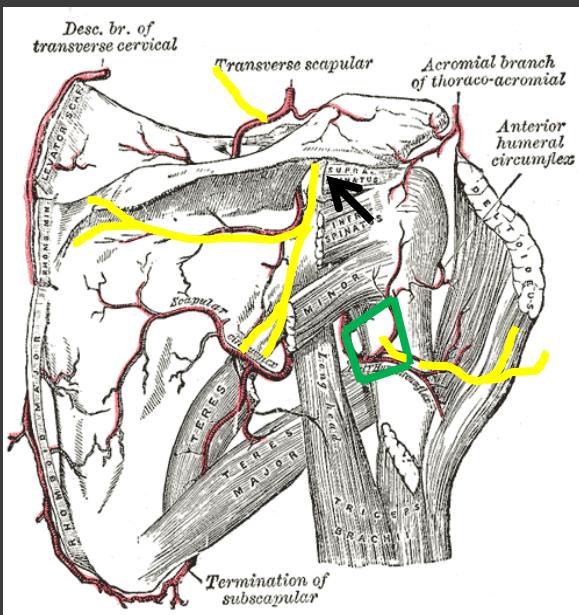


1. supraclavicular notch*
2. supraspinatus
3. tendon supraspinatus
4. trapezius

* scan both statically and dynamically
 - during passive humeral abduction
 - to neutralize compression of the SSP

Ultrasound landmarks

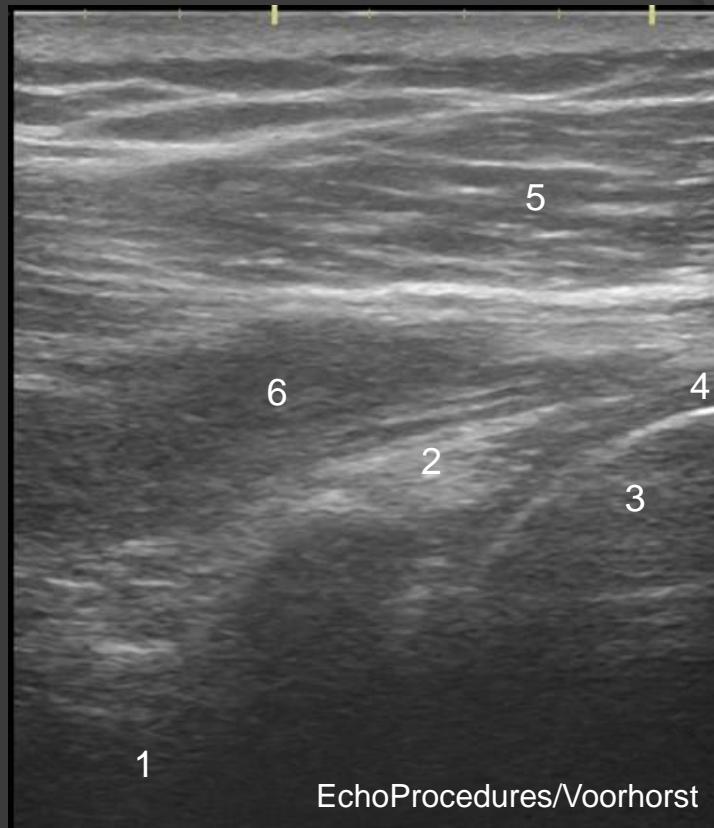
spinoglenoid notch



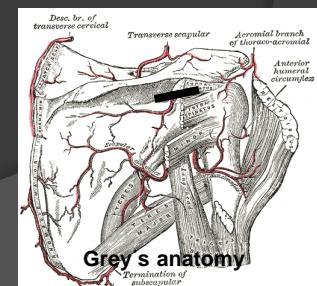
Anatomy of the Human Body 1918; Henry Gray (1825–1861).

nerve and artery are situated
inside the spinoglenoid notch

*scan both statically and dynamically -
during passive humeral exoration - to
neutralize compression of the ISP



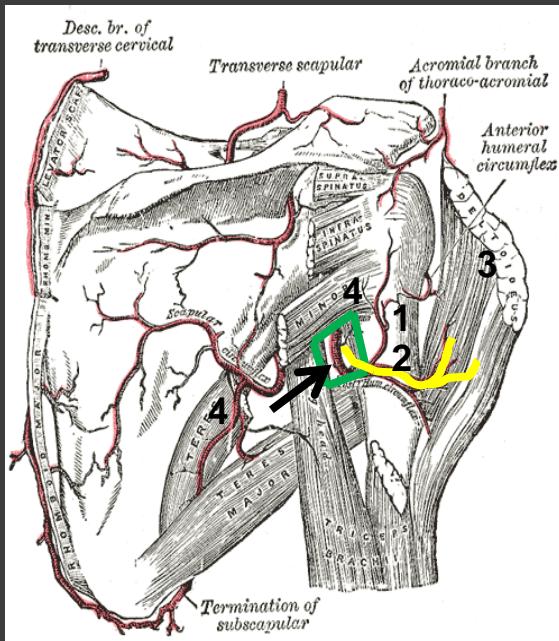
1. spinoglenoid notch*
2. labrum glenoidale
3. humerus
4. articular cartilage
5. m. deltoideus
6. infraspinatus



— probe

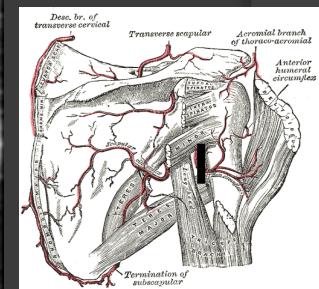
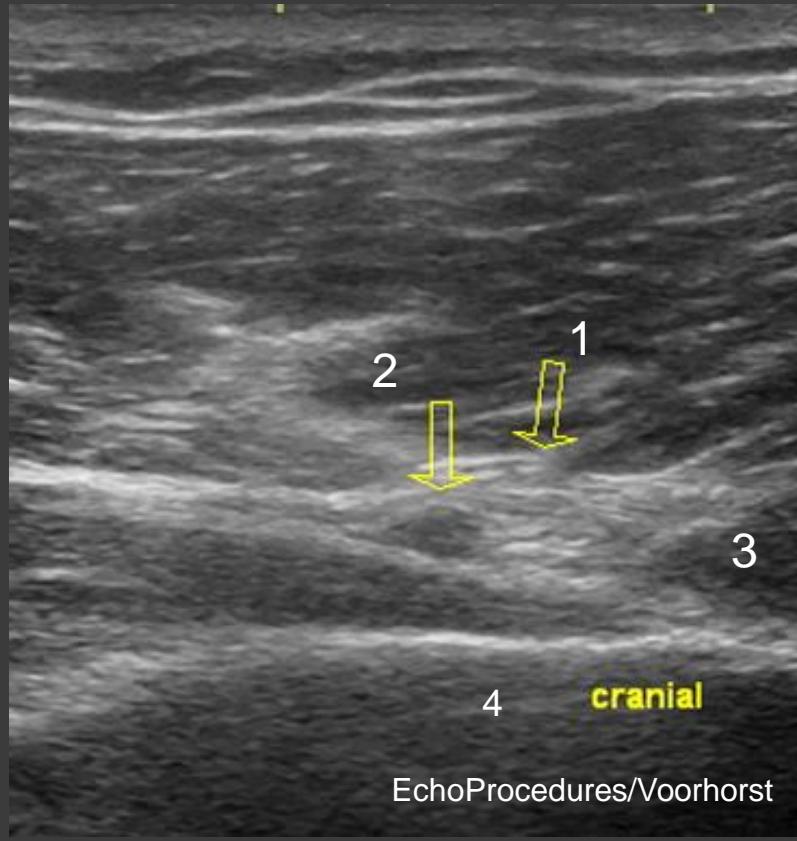
Ultrasound landmarks

Motor innervation n. axillaris (C5, C6) m. teres minor + m. deltoideus.
Sensory innervation: skin above deltoid muscle.



Anatomy of the Human Body 1918; Henry Gray (1825–1861). (yellow and green: EchoProcedures)

1. circumflex axillary artery
 2. axillary nerve
 3. m. deltoideus
 4. m. teres minor
- green: quadrilateral space



Anatomy of the human body; Henry Gray

probe

1. axillary nerve
2. circumflex axillary artery
3. m. teres minor
4. humerus

Miscellaneous

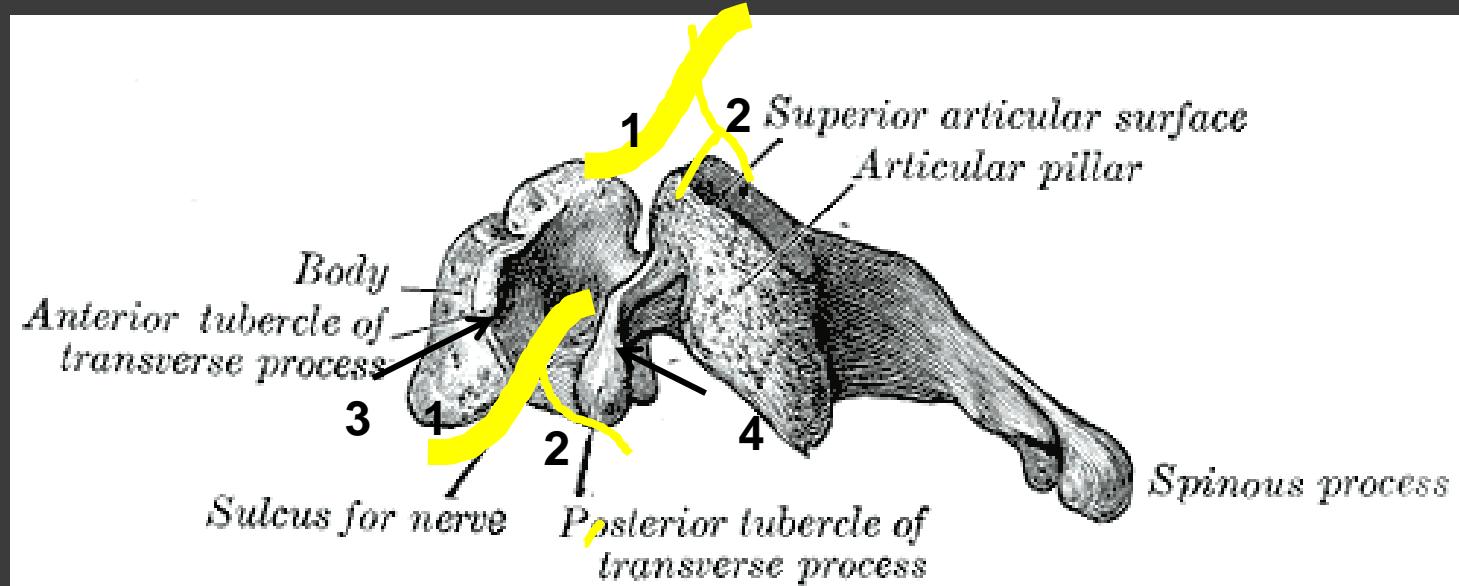
medial ramus of dorsal root

n. phrenicus

n. vagus

Bony landmarks

articular pillar for ultrasound identification medial ramus

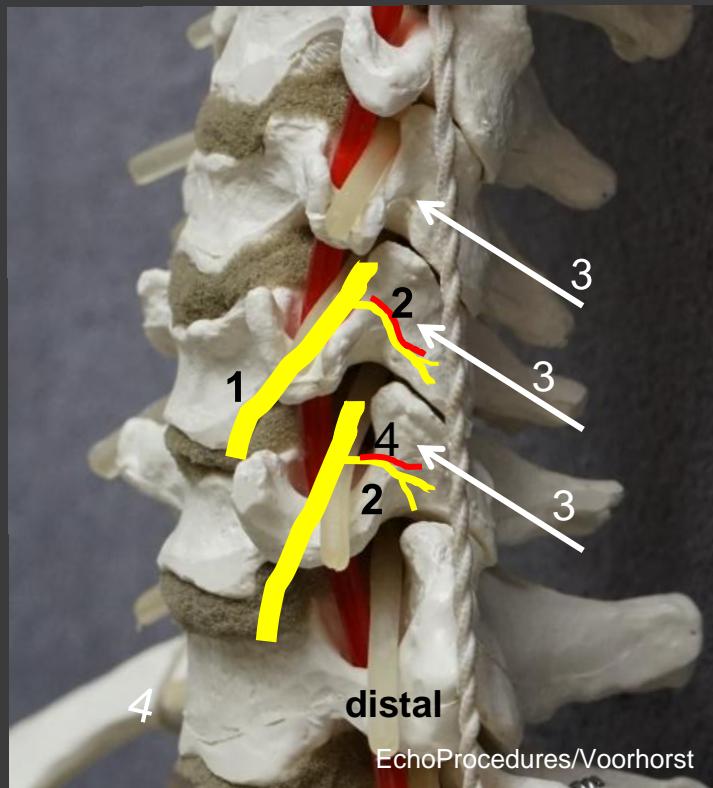


Anatomy of the Human Body 1918; Henry Gray (1825–1861).
(Yellow: EchoProcedures)

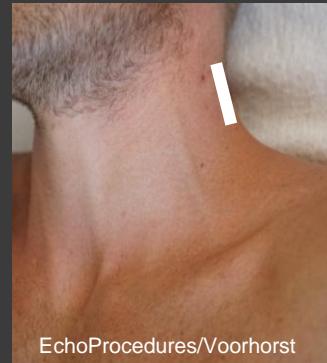
1. nerve root
2. medial ramus: innervating facet joints
3. anterior tuberculum
4. posterior tuberculum

Landmarks

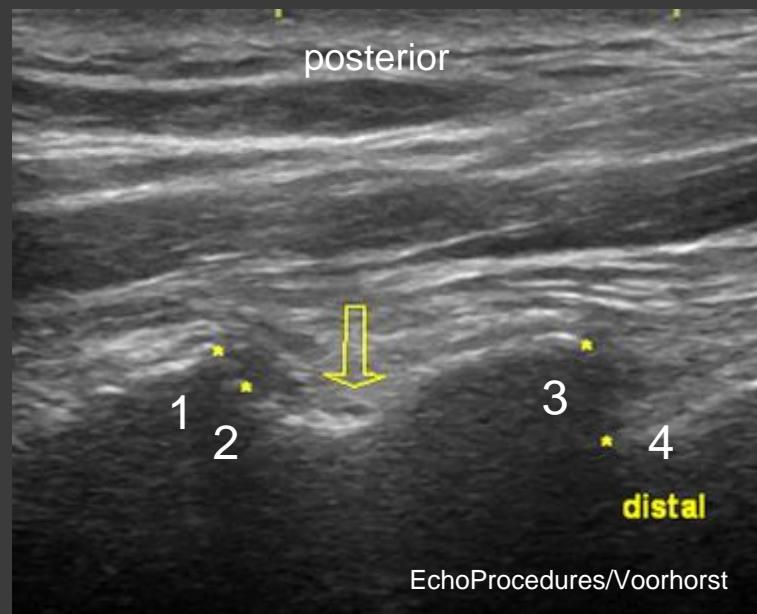
medial ramus innervating facet joints



- 1. nerve root
- 2. medial ramus
- 3. articular pilar(s)
- 4. artery



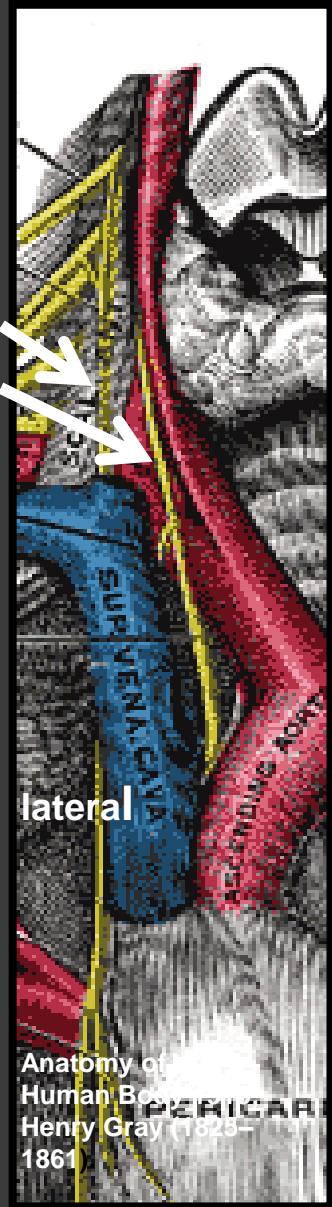
probe



longitudinal: articular pilar, under the open arrow the medial ramus and artery.

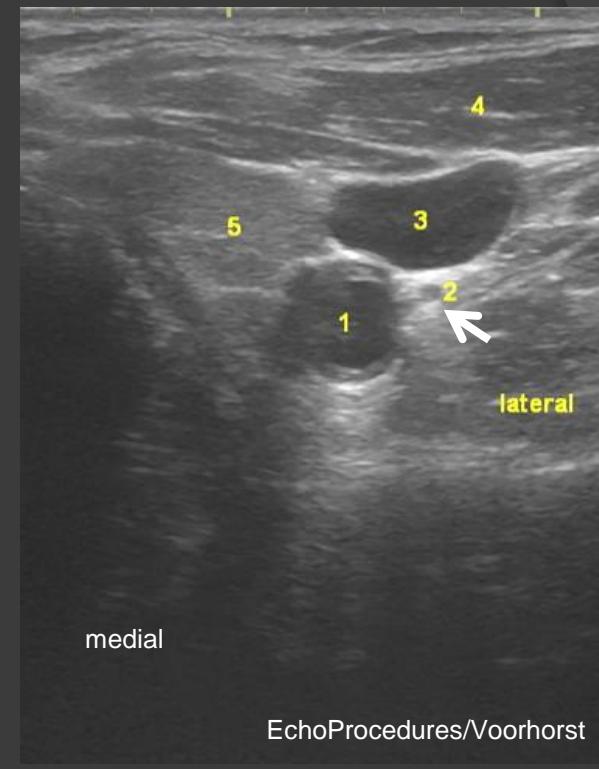
1, 3: inferior articular process
2, 4: superior articular process

Landmarks



n. phrenicus: C3,C4, C5

n. vagus: cranial nerve X



VJ: jugular vein

ACI: common carotid artery

1. carotic artery
2. n. vagus
3. jugular vein
4. m. sternocleidomastoideus
5. thyroid

1. n. phrenicus
2. n. vagus

Suggested Readings 1

* Martinoli, Brachial Plexus, normal anatomy and scanning technique; lecture: 27-06-2018, Amsterdam

* The cervical plexus: anatomy and ultrasound guided blocks

<http://www.apicareonline.com/the-cervical-plexus-anatomy-and-ultrasound-guided-blocks>

Risk of Encountering Dorsal Scapular and Long Thoracic Nerves during Ultrasound-guided Interscalene Brachial Plexus Block with Nerve Stimulator Korean J Pain 2016 July; Vol. 29, No. 3: 179-184 pISSN 2005-9159 eISSN 2093-0569

<http://dx.doi.org/10.3344/kjp.2016.29.3.179>

* Anatomy of the Human Body 1918; Henry Gray (1825–1861).

* High frequency ultrasound of the cervical spine and brachial plexus - essentials.

file:///C:/Users/Eigenaar/Downloads/ECR2014_C-1692.pdf

* Ultrasound-Guided Interscalene Brachial Plexus Block

<https://www.nysora.com/ultrasound-guided-interscalene-brachial-plexus-block>

Guided Intervention in Cervical Spine; J Korean Orthop Assoc. 2015 Apr;50(2):77-92. Korean. Published online April 30, 2015.

<https://doi.org/10.4055/jko.2015.50.2.77>

* Researchgate

<https://www.researchgate.net/figure/Normal-brachial-plexus-A-Transverse-ultrasound-image>

* Spinal accessory nerve

https://www.researchgate.net/figure/Spinal-accessory-nerve-A-Schematic-drawing-shows-the-pertinent-anatomy-of-the-spinal-fig14_47756593?sg=mRNj0a1gnwJGsZ7NsEzVPplcRzbew9_xspNYHqYvloDHTjAJEFtxqUCcuZ2U357BboOun7Mdux3U1iWPNB4A

Suggested Readings 2

Quadrilateral Space Syndrome: Diagnosis and Clinical Management

Patrick T. Hangge,^{1,2,*} Ilana Breen,^{2,3} Hassan Albadawi,² M. Grace Knuttilen,² Sailendra G. Naidu,² and Rahmi Oklu^{2,*}

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5920460/>

Dynamic ultrasonography of the shoulder

<https://www.e-ultrasonography.org/journal/view.php?number=206>

Sonographic evaluation of the axillary artery during simulated overhead throwing

positionStapleton, C, Herrington, LC and George, K positionStapleton, C, Herrington, LC and George, K

http://usir.salford.ac.uk/2306/1/stapleton_et_al_2008_PTiS.pdf:public

Ultrasonographic Diagnosis of Thoracic Outlet Syndrome Secondary to Brachial Plexus Piercing Variation

<file:///C:/Users/Eigenaar/Downloads/diagnostics-07-00040.pdf>

The vascular component in neurogenic-arterial thoracic outlet syndrome J Ernesto Molina, MD PhD¹ and Jonathan D'Cunha, MD PhD²

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2728415/>

Ultrasound-guided interventional procedures for cervical pain

<http://www.asociacionandaluzadeldolor.es/wp-content/uploads/2017/02/US-cervical.pdf>

Ultrasound-Guided Supraclavicular Brachial Plexus Block

<https://www.nysora.com/ultrasound-guided-supraclavicular-brachial-plexus-block-2>

Ultrasound-Guided Superficial Cervical Plexus Block

<https://www.nysora.com/ultrasound-guided-superficial-cervical-plexus-block>