EXPLORATION OF ARTERIAL CIRCULATION

By their anatomical disposal, upper and lower limb arteries are easily accessible for current functional explorations, the complex investigations being conducted in strict specialized units.

PULSE

The blood forced into aorta during systole not only moves the blood in the vessels forward but also sets up a pressure wave that travels along arteries. The pressure wave expands the arterial wall as it travels, and the expansion is palpable as the pulse.

Pulse is the manifestation of peripheral arterial mechanical activity of the heart, consisting of a periodic waveform expansive arterial wall, synchronous ventricular ejection perceived on palpation of the arteries hard bone underlying practically palpate arterial wall motion generated by a pressure wave generated by the heart in systole, called pulse wave; it is propagated along the arterial system at a rate that increases from the arteries of large calibre for small calibre arteries (such as the aorta is the pulse wave velocity of 3-5 m / sec, radial artery of 5-10 m / second.

Pulse wave velocity is much higher than the speed of blood flow and increases as vascular wall is thicker and more rigid (and hypertension increases with age) and smaller calibre blood vessels. Arterial pulse can be recorded graphically - arteriogram or sphygmogram. Normally there is an upward wave that has a slope (anacrotic), a rounded top and a downward slope (dicrotic), which is recorded in the proximal portion of a notch - notch dicrota - which causes a second peak wave dicrota. From the clinical point of view, can be determined by probing pulse of an artery in a plane bone, the probe is made with the thumb or fingers 2-4. Examination pulse is symmetrical. We follow the following elements: rate, rhythm, volume, character, vessel wall thickness.

1. **Rate**: count the pulse for 1 min / at least 30 sec
   
   Normal: 60 – 100 /min
   Tachycardia: >100 /min
   Bradycardia: <60 /min

   ![Pulse Pressure Diagram](image)

   - Sinus tachycardia: physiological: infants, children, emotion
     pathological: tachyarrhythmia
     drugs – atropine, nifedipine, nicotine, caffeine
   - Sinus bradycardia: physiological: athletes sleep
     pathological: severe hypoxia, hypothermia, myxoedema, obstructive jaundice
     drugs: beta blockers, verapamil, diltiazem

2. **Rhythm**: assessed by palpating radial artery; regular/ irregular

   Irregular in healthy: acceleration – inspiration; slowing down – expiration due to variation in vagal tone – children, young adult

3. **Volume** assessed by palpating carotid artery
High volume – elderly, anxiety, emotional excitability, high output states
Low volume (pulsus parvus) – shock, myocardial, valvular, pericardial dysfunction, hypovolemia

4. **Character** assessed by palpating carotid artery

Normal / Abnormal

5. **Vessel wall thickness** - assess the state of medium sized arteries which are palpable.

**METHOD:** palpate artery

**Comments**
- arterial pulse palpation is compared to both members; the arterial obstruction is diminished or absent distal pulse obstacle. The carotid pulse is the most accurate reflection of central aortic pulse.

![Arterial Palpation Diagram](image)

Peripheral pulses are graded on a scale of 0-4 by the following system.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>absent, without a pulse.</td>
</tr>
<tr>
<td>+1</td>
<td>diminished, barely palpable.</td>
</tr>
<tr>
<td>+2</td>
<td>average, slightly weak, but palpable.</td>
</tr>
<tr>
<td>+3</td>
<td>full and brisk, easily palpable.</td>
</tr>
<tr>
<td>+4</td>
<td>bounding pulse, sometimes visible.</td>
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**Radial pulse**: at wrist, lateral to flexor carpi radialis tendon, place your three middle fingers over the radial pulse
Radial pulse

Carotid pulse


**Carotid pulse**- palpates carotid pulse with the pt lying on a bed / couch; place tip of thumb b/w larynx and anterior border of sternocleidomastoid. Never compress both carotid arteries simultaneously. Use your left thumb for right carotid pulse and vice versa.

**Brachial pulse**: use your thumb (right thumb for right arm and vice versa) with your fingers cupped round the back of the elbow. Brachial pulse – felt in front of the elbow just medial to tendon of biceps.

**Femoral pulse**: is felt at groin just below inguinal ligament midway b/w ant.sup.iliac.spine and symphysis pubis.

**Popliteal pulse**: knee to be flexed 40 degrees, heel resting on bed; place fingers over lower part of popliteal fossa and fingers are moved sideways to feel pulsation of popliteal. A against post.aspect of tibial condyles.
Popliteal pulse


Posterior tibial pulse: felt just behind medial malleolus, midway b/w medial malleolus and tendon Achilles

Dorsalis Pedis Pulse: Felt just lateral to tendon of ext.hallucis longus

AUSCULTATION OF ARTERIES - is performed by placing the stethoscope on the trail of an artery superficial probe pulse points. Interpretation: normal => artery pressure do not occur because the flow is laminar murmurs pathologic => murmurs can be heard in case of stenosis, dilatation or abnormal communication

THE DOPPLER ULTRASOUND OF THE ARTERIES

There is the possibility to explore the arteries of the lower members, the upper members, the neck and the head but also the abdominal and digestive arteries. The exploration is always achieved bilaterally so that the physician can have means of comparison. For the exploration of the arteries of the lower members, the patient is lying down on his back, and the physician starts with the exploration of the blood flows at the level of the feet. The Doppler permits to measure the flows at the level of the artery situated behind the knee and the arteries of the fold of the groin. Then, an ultrasound probe is used in order to analyse the arteries and their flow.

Concerning the arteries of the upper members, the examination starts with the artery localized under the clavicle then goes down along the arm. The exam of the arteries of the neck is also called the Doppler ultrasound of the “supra aortic arteries”. It starts with the survey of the artery localized under the clavicle, the subclavian artery. Then the physician studies the artery going along the neck, the
carotid artery, which thereafter divides into the internal carotid artery and the external carotid artery. Some arteries of the brain can be perceived by the Doppler, the probe being positioned very close to the temple. In addition, it can be seen the walls of the arteries and their content. The Doppler permits to study the blood flows in the arteries.

The exam mainly look for the following elements:
- Presence of plates on the walls of the arteries;
- Measure of the flow in the different arteries;
- Research of a stricture of the diameter of the artery, associated to an acceleration of the blood flow with the Doppler;
- Analysis of the wall of the artery;
- Research of an obstacle, capable of corresponding to a clot for example.

A fundamental element is the research and the analysis with the Doppler of an obstacle on an artery. Indeed, the degree of obstruction of the artery is a very important element of discussion for the future treatment.

The main indications for the achievement of a Doppler ultrasound of the arteries are as follows:
- Research of a stricture;
- Research of an obstacle preventing the passage of blood;
- Analysis of the walls of the arteries;
- Implementation of a preoperative check-up before a by-pass for example;

Plethysmography - a method detects changes in the volume of an ends at each cardiac cycle or due to temporary interruption of venous return. Plethysmography is useful for assessing peripheral ischemia, in particular in small blood vessels. The most common is Digital Plethysmography carried out with a digital transducer is placed in the last phalanx. It will be appreciated pulse amplitude and waveform. Pathological arterial obstruction: primary wave amplitude decreased, absent wave dicrote; severe arterial obstruction: it does not register a pulse.