

Arterial Catheter

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An **arterial catheter** is used as an entry into a patient's arterial network, most frequently into the **radial artery** or the **femoral artery** and in some cases into the **dorsalis pedis artery**.

Indications

An arterial catheter is indicated in cases when a continuous invasive blood pressure measurement is necessary **in patients with blood pressure instability**, mostly when vasoactive substance – administration is necessary. In such cases, the invasive blood pressure measurement enables to detect an immediate reaction to rapid blood pressure changes and to evaluate the influence of the administered drugs. An arterial catheter also allows to estimate the arterial volume and consequently also the cardiac output. An arterial catheter is also indicated in **complicated surgical interventions** when cardiovascular complications are suspected. Further indications include surgical interventions with controlled hypotension, cardiac surgery and an intrasurgical application of large artery clamps. Another category of indications for an arterial catheter encompasses cases when access into an arterial network is necessary **due to the need of repeated arterial blood draws** for blood tests (e.g., blood gases). An arterial catheter is also used in cases of sustained polytraumas, burn injuries or in cases when **a non-invasive blood pressure measurement cannot be performed**. An entry into an arterial network is also used in **intervention radiology and cardiology**.

Contraindications

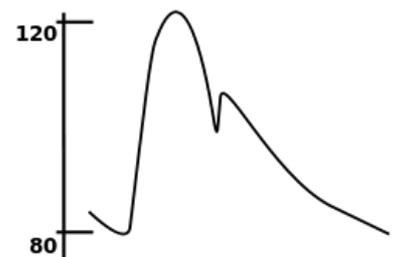
Contraindications include infections in the insertion site, an injury of an artery or an extremity proximally to the insertion site, a tumor in an extremity or a decrease in lymphatic drainage of an extremity (e.g., after mastectomy with an axillary lymphadenopathy), arterial insufficiency of an extremity, or arterial closure.

Principle of Arterial Pressure Measurement

Arterial pressure is directly projected onto the column of fluid inside the catheter. If blood pressure monitoring is not inhibited by performing a blood draw, solution application or other procedures, the blood pressure is converted by a pressure transducer into an electric signal, which is amplified and transferred onto the screen of the monitor.

Evaluation of the invasive blood pressure curve

The course of a blood pressure curve differs according to the monitored artery. In the proximal artery, there is visible a smaller difference between systolic and diastolic pressure, and the shape and location of the dicrotic notch (closure or the aortic valve) changes. Paradoxically, the more distal the measured pressure, the higher it is (although physiologically, blood flow proceeds from a site with a higher pressure to a site with a lower pressure) due to an increase in arterial resistance, and the component of gravitation, i.e., lower extremities have higher blood pressure due to the influence of gravitation. In blood pressure assessment, **location of the blood pressure sensor** needs to be taken into consideration, i.e., if located below heart, false high blood pressure values might be measured and vice versa.



The shape of an arterial pressure curve

Topography and Arterial Entries

- **Radial artery** – is palpated on the radial side of a wrist between the radius and the flexor carpi radialis muscle. In order to facilitate palpation and subsequent puncture, positioning of an extremity into dorsal flexion is advisable.
- **Brachial artery** – is palpated in the elbow pit (cubital fossa) medially from the tendon biceps brachii on an extended upper extremity.
- **Axillary artery** – in the space below coracobrachialis muscle in an abducted extremity in external rotation and 90° elbow flexion.
- **Femoral artery** – is palpated in the groin under the inguinal ligament approximately in the medial part of the thigh.
- **Dorsalis pedis artery** – the dorsal side of the foot arch between the first and the second metatarsus.

In order to facilitate catheter placement, ultrasound guidance may be used.

Technically, the Swan-Ganz catheter, may also serve as arterial entry. It is inserted via the venous system through right-hand heart chambers into the pulmonary artery. However, its application is described in the article itself and its indications differ from the indications of a systemic arterial catheter.

In these topographic sites, arterial blood may be drawn by a single puncture with a needle without a catheter, mainly for blood gases tests.

Equipment for Artery Puncture

In order to perform puncture, tools for sterile puncture of an artery are necessary (antiseptic solution, sterile face masks, sterile gloves, local anaesthetic and a syringe with a needle to administer the anaesthetic), pressure set to connect the artery to the sphygmomanometer (an intravenous infusion and a blood pressure cuff) and a puncture set with various components depending on the technique used:

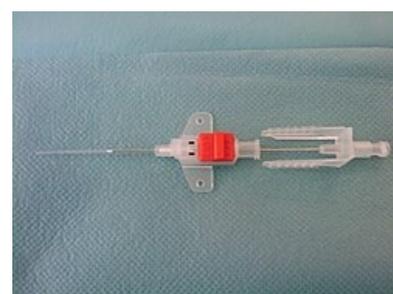
- for the **Seldinger technique** (introducer needle, guidewire, a catheter),
- for *over the needle technique*, a special puncture needle similar to a cannula for securing a peripheral vein,
- for intervention techniques, a special hub, which enables the introduction of catheterizing tools into the lumen of the artery while the actual puncture is generally performed by means of the Seldinger technique.



Arterial Catheter for the Seldinger technique

The Procedure of Catheter Placement

An aseptic technique involves disinfection, a sterile dressing, face masks, sterile gloves. It is important to administer a sufficient dose of local anaesthetic (Lidocaine 1%, Mepivacaine), checking the correct puncture location (in pulse waveform, blood flows out of the catheter) and a careful documentation (date and time of catheter insertion, puncture site, application of local anaesthetic).



Arterial catheter for „over the needle“ technique

Step-by-step Procedure

- Indications for the procedure,
- instructions given to a patient,
- positioning of a patient,
- artery palpation and identification of leading anatomical structures,
- preparation of the operation theatre (disinfection and application of sterile face masks),,
- local anaesthetic,
- the puncture of the artery,
 - in Seldinger method – insertion of a catheter via the guidewire through previously dilated puncture channel and a subsequent removal of the guidewire,
- connection to an intravenous infusion set,
- careful fixation of the inserted catheter with sutures or a sterile band,
- connection to a sensor and a monitor for arterial blood pressure measurement **⚠ The sensor has to be placed next to the left heart chamber!** ,
- after calibration, blood pressure is measured.

In case of any further manipulation with the whole system, sterile conditions of the procedure should be maintained.

Removal of the Catheter

A catheter is removed:

- In case it is not further indicated.
- In case of complications such as an infection or a insecure position of a catheter (e.g., in case of ejection of the catheter or in case of its incorrect fixation).

The Procedure of Catheter Removal

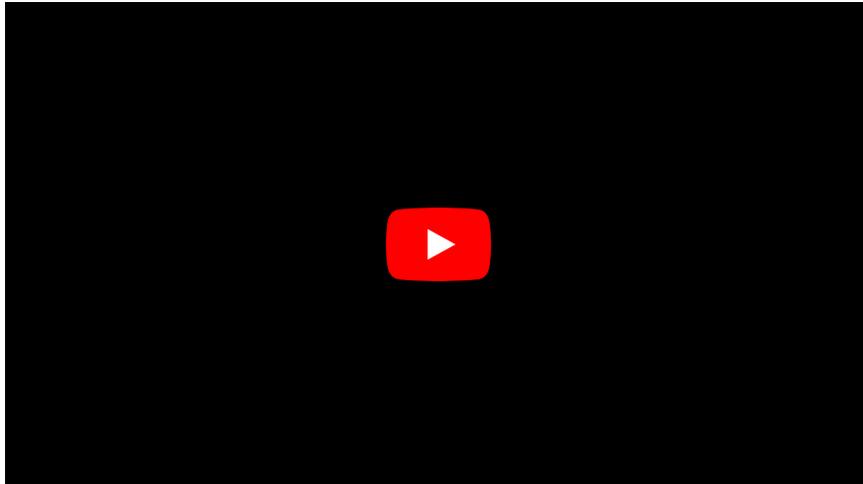
- Removal of a fixation of the catheter,
- disinfection of the puncture location,
- removal of the catheter,
- a sterile dressing,
- application of pressure on the wound,
- documentation (time of catheter removal, appearance of the puncture site, complications).

Complications

Possible complications of an insertion of an arterial catheter include artery perforation with subsequent bleeding and a hematoma, infection, thrombosis and embolisation, swelling, rupture or clogging of the needle, incorrect catheter fixation with a change of its position and possible arterial bleeding.

Video

The video below illustrates puncture of the radial artery by applying the Seldinger technique. (In the section of the video demonstrating puncture, a simulator is used, therefore the "blood" is light and flows very slowly in comparison with a real-life situation).



References

External references

Template:KameraCatheter Insertion (<https://www.youtube.com/watch?v=F1s08XoKdYY&feature=PlayList&p=B1BB55102ED85F76&index=1>) - YouTube tutorial (english)

Related articles

- Blood pressure
- Blood pressure monitoring
- Arterial cannulation

Sources and bibliography

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- KARIM VFN Zajištění intravenózního, intraarteriálního, tracheálního a intraoseálního vstupu (<http://www.karim-vfn.cz/userfiles/image/download-arip/zajisteni-intravenozniho-intraarterialniho-trachealniho-a-intraosealniho.pdf>)
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