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Review article

Use of ultrasound guidance in vascular cannulation and effusion punctures at the cardiology department

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ABSTRACT

The use of ultrasound in cardiology for the guidance of vessel cannulations and effusion punctures is getting more and more frequent every day. Ultrasound in this setting provides the operator with many advantages and after a certain learning curve, one is then able to cannulate vessels, that are small or normally inaccessible with the standard anatomical landmarks approach. Since many randomized studies confirmed the benefits of using ultrasound in these procedures, it has become a standard of care for many physicians and hospitals.

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Introduction

Cardiology has become a highly invasive discipline in the last few decades. This trend brought with itself a large spectrum of diagnostic and therapeutic procedures. Punctures of different vessels and effusions are an integral part of these tasks and carry with them a risk of serious complications.

In the effort to lower the rate of these setbacks, ultrasound (US) is being used more and more often during invasive cardiology procedures. Many different studies have been published, showing in agreement that using US to guide punctures of vessels and effusions lowers the risk of complications.

The aim of this paper is to review the aforementioned issues. Firstly, we will describe the technique of venous cannulation – the area that has received the most attention as far as randomized studies are concerned. The next part of the article will focus on the arterial cannulation. Finally, the puncture of effusions will be considered – an integral part of every cardiologist-intensivist' job.

Venous system cannulation

Learning the technique of precise and safe “large” vein cannulation is a necessity for a physician undergoing training for acute or interventional cardiology. The spectrum of application is broad – from establishing access for central line or dialysis cannula, to complex procedures in electrophysiology and emergent tasks such as ECMO cannulation. Many of these procedures are performed in patients who are old, not optimally hydrated, hemodynamically unstable or anticoagulated. The risk of (possibly fatal) complications rises due to these facts. The most common of these is the arterial puncture, which complicates up to 15% of central vein cannulations. The group of less frequent ones includes pneumothorax, hemothorax, hematoma, bleeding, AV fistula, etc. Papers recently published unambiguously confirmed, that ultrasound-guided cannulations are safer, faster, more successful and more comfortable for the patient.

The following text will focus primarily on “classic” large vein cannulations – internal jugular, subclavian/axillary and femoral. Nevertheless, it is also possible to cannulate peripheral venous system using ultrasound guidance. The basic approach is always the same. Ultrasound gel is applied on a suitable ultrasound probe (high-frequency linear is optimal) which is then placed in a sterile plastic cover. Having

a sterile ultrasound gel for the operating field is advantageous, it is not completely necessary however – keeping the skin moist using normal saline or disinfectant is sufficient. Then, after draping the patient, a physician holds the US probe in one hand (usually non-dominant) and the needle in the other, puncturing the skin and then the vessel with continuous US guidance (Picture 1). It is usually easy for an experienced operator to distinguish between vein and artery just by using plain 2D imaging. When there is uncertainty, the vein can be compressed down with the probe while artery cannot. One can also use color or pulsed-wave Doppler in this matter. The vessel can be visualized either in longitudinal or transverse plane. Both of these approaches have their pros and cons. Using the transverse plane, one can appreciate very well the position of both vein and artery and also their relationship to the surrounding structures (pleura, rib cage, etc.). The whole



Picture 1 – Setting for ultrasound real-time guided puncture of femoral vein.

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