NonInvasive CO Measurement

Overview of mostly used methods
Impedance Cardiography (ICG)

Method:
- Injection of an alternating current to the patient
- Calculation of cardiac output based on analysis of impedance change during heart cycle

Pro:
- Easy to use
- Operator independent
- Continuous measurement (monitoring)
- Beat-to-beat analysis

Contra:
- Limitations in case of severe aortic valve regurgitation and cardiac arrhythmia

Products: Niccomo (medis), NICOM (Cheetah), ICON (Osypka), PhysioFlow
Continuous Arterial Blood Pressure

Method:
- Continuous measurement of arterial pulse curve in the finger
- Calculation of cardiac output based on pulse contour analysis and transfer function

Pro:
- Easy to use
- Operator independent
- Continuous measurement (monitoring)
- Beat-to-beat analysis
- Continuous arterial blood pressure

Contra:
- Weak accuracy if pulse curve is not calibrated by invasive method
- Venous occlusion of the finger (uncomfortable)
- No information about thoracic fluid

Products: Portapres (FMS)
Inert Gas Rebreathing

Method:
- Rebreathing of gas mixture
- Calculation of cardiac output based on measurement of soluble (N\textsubscript{2}O) and insoluble (SF\textsubscript{6}) gas concentrations

Pro:
- Accurate

Contra:
- Single measurement (no beat-to-beat analysis)
- Patient assistance is needed
- Not applicable for intensive care and during anaesthesia

Products: INNOCOR (Innovision)
Transthoracic Ultrasound

Method:
• Measurement of aortic flow by transthoracic Doppler placed on the chest
• Calculation of cardiac output based on the flow profile and cross section area in the aorta

Pro:
• Fast application

Contra:
• Single measurement (no beat-to-beat analysis)
• Limited accuracy caused by assumption of aortic cross sectional area
• User depended

Products: USCOM
Partial Gas Rebreathing

Method:
- Measurement of CO$_2$ concentrations during normal breathing and rebreathing
- Calculation of cardiac output based on modified Fick equation

Pro:
- No consumables needed

Contra:
- Single measurement (no beat-to-beat analysis)
- Only applicable in ventilated patients

Products: NICO (Respironics)