



Diagnostic and Therapeutic Value of Echocardiography in Critically Ill Patients

Essay

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Abstract

Background: Echocardiography is one of the best diagnostic tools that the intensivist has, because it can be performed at the bedside, avoiding patients' displacements, and can provide transcendental information on real time for making vital decisions in a noninvasive or semi-invasive form, such as fluid therapy continuity, early vasoactive or inotropic treatment.

Echocardiography is not only a routine diagnostic tool in critically ill patient but also has an important role in assessment of patient with unstable cardiovascular diseases, which is known as emergency echocardiography. In this situation there are 3 scopes of emergency echocardiography: diagnostic, symptom or sign-based and resuscitative.

We also have to distinguish between emergency echo, which is a comprehensive study, from Focused cardiovascular ultrasound or examination performed with pocket size imaging devices.

Aims: The aim of this essay is to discuss the importance of usage of echocardiography in critically ill patients and in emergency settings either as a diagnostic or a therapeutic tool.

Conclusion: Echocardiography has become the primary imaging tool for bedside diagnosis and monitoring of patients in acute cardiovascular conditions. It is non-invasive, provides rapid and accurate assessment of cardiac morphology and haemodynamics under stressful situations and is very useful in assisting therapeutic procedures.

Keywords: Echocardiography, Diagnostic, Therapeutic, Critically Ill Patients



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List of Abbreviations

AAA	Acute Aortic Aneurysm
ACSs	Acute Coronary syndrome
AI	Acoustic impedance
ARDS	Acute respiratory Distress syndrome
AR	Aortic regurge
AS	Aortic stenosis
ASD	Atrial septal defect
AMI	Acute myocardial infarction
AoVTI	Aortic velocity time integral
BAV	Ballon aortic valvuloplasty
CFD	Colour flow doppler
CWD	Continuous wave doppler
DCM	Dilated cardiomyopathy
DT	Deceleration time
EDV	End diastolic volume
EF	Ejection fraction
ERO	Effective regurgitant orifice
ESV	End systolic volume
GLS	Global longitudinal strain
HF	Heart failure
HF_{nef}	Heart Failure with normal ejection fraction
ICM	Ischemic cardiomyopathy
HCM	Hypertrophic cardiomyopathy
ICD	Implantable cardioverter defibrillator
IDCM	Idiopathic cardiomyopathy
IMH	Intra mural hematoma
IVC	Inferior vena cava

List of Abbreviations

IVRT	Isovolumic relaxation period
LA	Left atrium
LAA	Left atrial appendage
LV	Left ventricle
LVIDD	Left ventricular internal diameter at end-diastole
LVOT	Left ventricular outflow tract
LVEDV	Left ventricular end diastolic volume
MR	Mitral regurge
MS	Mitral stenosis
PA	Pulmonary artery
PAsP	Pulmonary artery systolic pressure
PE	Pulmonary embolism
PEEP	Positive end expiratory pressure
PFO	Patent foramen ovale
PISA	Proximal isovelocity surface area
PLAX	Parasternal longitudinal axis
PMC	Percutaneous mitral commissurotomy
PRF	Pulse repetition frequency
PSAX	Parasternal short axis
PTX	pneumothorax
PV	Pulmonary vein
PVR	Pulmonary vascular resistance
PWD	Pulsed wave doppler
RV	Right ventricle
RAP	Right atrial pressure
RCM	Restrictive cardiomyopathy
RVIDD	Right ventricular internal diameter in diastole
SAM	Systolic anterior motion
STE	Speckel tracking echocardiography

List of Abbreviations

SV	Stroke volume
SVC	Superior vena cava
TAPSE	Tricuspid annular plane systolic excursion
TAVI	Transcatheter aortic valve implantation
TDE	Tissue Doppler echocardiography
TEE	Transesophageal echocardiography
TR	Tricuspid regurge
TTE	Transthoracic echocardiography
VSD	Ventricular septal defect
VTI	Velocity-time integral
2D	Two-dimensional

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Introduction

Echocardiography is one of the best diagnostic tools that the intensivist has, because it can be performed at the bedside, avoiding patients' displacements, and can provide transcendental information on real time for making vital decisions in a noninvasive or semi-invasive form, such as fluid therapy continuity, early vasoactive or inotropic treatment, realization of a pericardiocentesis in a cardiac tamponade, systemic fibrinolysis in severe pulmonary embolism, or the indication of cardiac surgery for the existence of mechanical complications in context of acute coronary syndrome. In spite of this, it continues to be an underused diagnostic method, even in the coronary units (**Romero-Bermejo *et al.*, 2011**).

Echocardiography is not only a routine diagnostic tool in critically ill patient but also has an important role in assessment of patient with unstable cardiovascular diseases, which is known as emergency echocardiography. In this situation there are 3 scopes of emergency echocardiography: diagnostic, symptom or sign- based and resuscitative (**Neskovic *et al.*, 2013**).

Emergency echocardiography is directly related to acute resuscitation such as detection of pericardial effusion and tamponade, regional left ventricular function, right ventricular size, checking central venous volume status and condition of great vessels, which may be crucial for acute decision-making (**Neskovic *et al.*, 2013**).

Transthoracic echocardiography is the main source of information in the emergency setting but when its results are non-diagnostic, transesophageal echocardiography should reasonably be the first choice (**Neskovic *et al.*, 2013**).

We also have to distinguish between emergency echo, which is a comprehensive study, from Focused cardiovascular ultrasound or examination performed with pocket size imaging devices (**Neskovic *et al.*, 2013**).

Aim of the Work

The aim of this essay is to discuss the importance of usage of echocardiography in critically ill patients and in emergency settings either as a diagnostic or a therapeutic tool.

Chapter 1

Physical Aspects, Types and Different Modes of Echocardiography

I. Physics of ultrasound:

Sound is an example of a longitudinal wave oscillating back and forth through a transmitting medium at a fixed velocity, resulting in zones of compression and rarefaction. Ultrasound includes that proportion of the sound spectrum above 20kHz. Echo machines use frequencies of 2–10MHz. The wavelength (λ) is inversely related to the frequency (f) by the sound velocity (c) so that $c = \lambda f$. Sound velocity in a given material is constant but varies in different materials. Ultrasound propagates poorly in air. c in blood is 1570 m/s, soft tissue 1540 m/s and air 330 m/s (Figure 1) (Otto, 2004).