Uses of Ultrasound in Intensive Care Unit

An essay

for partial fulfillment of master degree ***in intensive care***

Presented by

Nabil Hassan Ahmed Fouda
M.B.B. Ch
Ain Shams University

Supervised by

Prof. Dr. /Ahmed Abd Al-kader Sheesh
Professor of Anesthesia and Intensive Care
Faculty of Medicine
Ain Shams University

Dr. /Manal Mohamed Kamal Shams El-Dine
Assistant Professor of anesthesia and intensive care
Faculty of Medicine
Ain Shams University

Dr. /Waleed Abdalla Ibrahim
Lecturer of Anesthesia and Intensive Care
Faculty of Medicine
Ain Shams University

Faculty of Medicine
Ain Shams University
2012


بسم الله الرحمن الرحيم
قالوا سبحانك لا علم لنا إلا ما
علمتنا إنك أنت العليم الحكيم
صدق الله العظيم
سورة البقرة آية (٣٢)

First and foremost, thanks to ***Allah*** *for giving me the will and the patience to finish this work.*

In a few grateful words, I would like to express my deepest gratitude and appreciation to ***Prof. Dr. /Ahmed Abd Al-kader Sheesh*** *Professor of Anesthesia and Intensive Care, Faculty of Medicine-Ain Shams University, for his great concern and generous help. Without his generous help, this work would not have been accomplished in its present picture.*

I am sincerely grateful to ***Dr. /Manal Mohamed Kamal Shams El-Dine*** *Assistant Professor of anesthesia and intensive care, Faculty of medicine, Ain Shams University, for her kind help and constructive suggestions to achieve this work.*

I would also like to express my deep appreciation to ***Dr./Waleed Abdalla Ibrahim*** *Lecturer of Anesthesia and Intensive Care, Faculty of Medicine-Ain Shams University, for his great kindness, constant assistance and guidance.*

Lastly, there are no words to express my gratitude to my family who charged me with love and encouragement and to all patients and their families for their participation in this study.

Nabil Hassan Ahmed Fouda

Contents

List of Abbreviations

ACLS	:	Advanced cardiac life support
AHA	:	American heart association
AML	:	Anterior mitral leaflet
AR	:	Aortic regurgitation
BSA	:	Body surface area
CA	:	Carotid artery
CI	:	Cardiac index
COPD	:	Chronic obstructive pulmonary disease
CT	:	Computed tomography
CVC	:	Central venous cannulation
CXR	:	Chest X ray
2-D	:	Two-dimensional
DVT	:	Deep venous thrombosis
ECG	:	Electrocardiogram
ECHO	:	Echocardiography
EF	:	Ejection fraction.
FAST	:	Focused Assessment with Sonography for Trauma
FS	:	Fractional Shortening
ICU	:	Intensive Care Unit
IVC	:	Inferior vena cava

List of Abbreviations (Cont.)

IVS	:	Interventricular septum
LA	:	Left atrium
LV	:	Left ventricle
LVEF	:	Left ventricular ejection fraction
LVIDd	:	Left ventricular diastolic dimension
LVIDs	:	Left ventricular systolic dimension
LVOT	:	Left ventricular outflow tract
MRI		Magnetic resonance imaging
MV	:	Mitral valve
PDA	:	Patent ductus arteriosus
PE	:	Pulmonary embolism
PEA	:	Pulseless electrical activity
PML	:	Posterior mitral leaflet
PU	:	Pulmonary ultrasound
RA	:	Right atrium
RIJV	:	Right internal jugular vein
RV	:	Right ventricle
SVC	:	Superior vena cava
TTE	:	Transthoracic echocardiography
US	:	Ultrasound

List of Figures

List of Figures (Cont.)

List of Figures (Cont.)

List of Figures (Cont.)

Introduction

Management of critically ill patients requires imaging techniques, which are essential for optimizing diagnostic and therapeutic procedures.

Medical sonography (ultrasonography) is an ultrasound-based diagnostic medical imaging technique used to visualize muscles, tendons, and many internal organs, to capture their size, structure and any pathological lesions with real time tomographic images. Ultrasound has been used by radiologists and sonographers to image the human body for at least 50 years and has become one of the most widely used diagnostic tools in modern medicine. The technology is relatively inexpensive and portable, also as currently applied in the medical field, properly performed ultrasound poses no known risks to the patient. ***(Hangiandreou, 2003)***

Ultrasound is an extremely valuable diagnostic tool and with the appropriate knowledge, physicians might be able to improve its utilization compared with other techniques, such as magnetic resonance imaging (MRI) and computed tomography (CT). It consists of both cardiac (Echocardiography) and non-cardiac (lung, abdominal and vascular) ultrasound. ***(Liebeskind et al., 2002)***

General and cardiac ultrasound can be easily performed at the bedside by physicians working in the intensive care unit (ICU) and may provide accurate information with diagnostic and therapeutic relevance. It has become an attractive diagnostic tool in

a growing number of situations, including evaluation of cardiovascular status, acute abdominal disease such as peritoneal collections, hepatobiliary tract obstruction, acalculous acute cholecystitis, diagnosis of deep venous thrombosis and ventilator-associated sinusitis. Furthermore, ultrasound does not utilize ionizing radiation. ***(Lichtenstein et al., 1998)***

Recently, chest ultrasound has become an attractive new tool for assessing lung status in ventilated critically ill patients, as suggested by the increasing number of articles written about it by physicians practicing in chest, intensive care or emergency medicine. As a matter of fact, chest ultrasound can be used easily at the bedside to assess initial lung morphology in severely hypoxemic patients and can be easily repeated, allowing the effects of therapy to be monitored. ***(Lichtenstein et al., 2004)***

Aim of the Work

The aim of the work is to focus and highlight the uses of ultrasound in ICU which are essential for optimizing diagnostic and therapeutic procedures for critically ill patients.

Echocardiography in ICU

Introduction

The application of echocardiography in the critically ill has been well-recognized for several years, principally in patients following cardiac surgery. ***(Béïque et al., 2006)***

The use of this technique is presently expanding to include diagnosis and monitoring on the general intensive care unit (ICU). ***(Marik and Baram, 2007)***

Further, as echocardiography is an evolving technology with broadening applications throughout medical and surgical practice, and equipment is becoming cheaper, more portable and more widely available, it is inevitable and appropriate that medical practitioners other than cardiologists and echocardiographers should seek to develop skills in the performance of ICU echocardiography. ***(Perk, et al., 2007)***

The ACC/AHA 2003 guidelines provide recommendations for the use of echocardiography in various clinical settings They do not recommend the use of echocardiography for screening purposes, because of the cost and the very real possibility of generating false-positive results that could lead to further testing or inappropriate therapy. ***(Bonow et al., 2006)***

Imaging Modalities of Echocardiography

M-mode imaging (time-motion) mode

M-mode imaging records motion a single line of sight from the two-dimensional image selected by careful postioning of the on-screen cursor across a region of interest. Distance, or depth, is displayed along the vertical axis and time along the horizontal axis.

This is important in visualizing rapid motion, such as movement of valve leafleats and permits accurate timing of events as well as measurement of cardiac dimensions. ***(Edler and Hertz, 2004)***

Two-Dimensional Images

Whereas in M-mode imaging the heart is imaged along a single scan line, 2-D imaging a picture of the heart is built up from a series of scan lines side by side.

The 2-D image is produced either by rotating the scanning head rapidly through 80-90◦(single crystal) or by a phased array (multicrystal)scanning head. In the phased array system the ultrasound crystals are exicted in sequence or phase to produce a fan-shaped wave front. ***(Swantons et al., 2005)***