Role of ultrasound in pediatric anesthesia

An Essay

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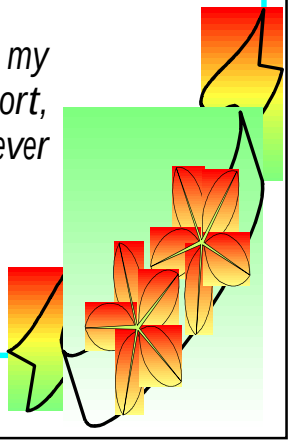

Abstract

The nature of ultrasound waves being reflected, refracted and scattered is the corner stone for the principle of action of ultrasound which makes it possible to visualize different tissues with various depth from the probe. Different techniques were proposed for peripheral nerve blocks which describe mainly the blocks for upper limb, lower limb and abdominal wall blocks which provide intra and post operative anaesthesia and analgesia in pediatrics which are becoming more easy and effective using the ultrasound units.

Key word: CVC- oesophageal- ECHO-US- LVISD

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valve, LV-left ventricle, AO- aorta.

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List of Abbreviations

ASD	Atrial septal defect
AV	Aortic valve
AV	Atrio-ventricular
CABG	Coronary artery bypass graft
CFD	Colour flow Doppler
CNS	Central nervous system
CPB	Cardiopulmonary bypass
CSF	Cerebrospinal fluid
CT	Computerized tomography
CVC	Central venous catheter
CVP	Central venous pressure
D	Dimensional
ECG	Electrocardiogram
IJV	Internal jugular vein
IVC	Inferior vena cava
IVS	Interventricular septum
LA	Left atrium
LA	Local anesthetics
LV	Left ventricle
LVIDD	Left ventricular internal diastolic dimension
LVISD	Left ventricular systolic dimension
MAC	Minimal alveolar concentration
MIDCAB	Minimally invasive direct coronary artery bypass

MR	Mitral regurgitation
MRI	Magnetic resonance imaging
MV	Mitral valve
OPCAB	Off pump coronary artery bypass
PA	Pulmonary artery
PAC	Pulmonary artery catheter
PICCs	Peripherally inserted central catheters
PNBs	Peripheral nerve blocks
PRF	Pulse repetition frequency
PTCA	Percutaneous transluminal coronary angioplasty
RA	Right atrium
RV	Right ventricle
SAS	Subaortic stenosis
SV	Stroke volume
SVC	Subclavian vein
SVC	Superior vena cava
SWMA	Segmental wall motion abnormalities
TEE	Transesophageal echocardiography
TGC	Time gain compensation
US	Ultrasound
VSD	Ventricular septal defect

Introduction

Pediatric anesthesia is a challenge for an anesthesiologist not only due to physiological differences that require wide medical knowledge but also due to anatomical differences that require fine skills to handle techniques needed for anesthesia as peripheral and central venous cannulation, arterial cannulation and peripheral and central Neuro-axial blocks. Being blind and depend on surface anatomy and individual skills, these techniques are difficult and may carry risk of failure or complications.[(1)]

Since its introduction in late 1990's.Ultrasonography has provided visibility for techniques needed in anesthesia increasing the success rate and decreasing the incidence of complications especially in the pediatric patients. Ultrasonography does not only facilitate vascular and peri-neural catheterization or central neuro-axial blocks but also provides a useful diagnostic tool through imaging of the heart in trans-esophageal echocardiography that provides data helping in guiding fluid therapy and diagnosing cardiovascular complications. Ultrasonography avoids the fatal complications in central venous cannulation such as hemothoracic, pneumothoracic and carotid hematoma and the increased success rate and reduced time required for cannulation.[(2)]

The major and minor complications associated with regional anesthesia in pediatric are well known to doctors and are well annotated. Complications can occur immediately or be delayed and they can be clinically insignificant or life threatening. Knowledge and attention to technique reduce likelihood for major complications. [(3)]

The use of ultrasound as an aid for accurate administration of local anesthetics is gaining in popularity for regional anesthesia over conventional landmark-based techniques and neurostimulation. [(4)]

Ultrasound imaging is rapidly emerging as one of the most promising tools as the size, depth and precise location of nerves in their surrounding environment can be determined, depending on correct interpretation. Viewing the moving needle once inserted at an appropriate angle and within the plane of the ultrasound probe, as well as the spread of local anesthetic provides valuable assistance to the anesthesiologist when performing regional anesthesia. [(5)]

The main advantages conferred by ultrasonographically guided techniques in children are the imaging of all anatomical structures and the possibility to directly ascertain the position of the tip of the cannula relative to the nerve. Consequently, inadvertent trauma of surrounding structures (e.g. cervical pleura during peri-clavicular brachial plexus blocks, peritoneum during abdominal wall blocks) or puncture of nerves or neuro-axial structures with subsequent damage can safely be avoided. Another advantage is the direct control of the distribution of local anesthetic. Therefore, a prediction of the success of a block is possible, and in cases of misdistribution of the local anesthetic, a correction of the needle position is possible. Additional advantages include the faster onset of sensory and motor blocks, longer duration of blocks, increased block qualities and painless blocks in lightly sedated or awake children as muscle twitches during nerve stimulation are avoided.[(4)]

Since the advent of small pediatric probes in the 1990s, Transoesophageal echocardiography (TEE) has become an important monitoring and diagnostic tool in the care of children undergoing surgery for congenital heart disease. According to the practice guidelines for perioperative TEE established by the Society of Cardiovascular Anesthesiologists and the American Society of

Anesthesiologists , there is strong evidence for the usefulness of TEE in surgery for congenital heart disease because it significantly improves the clinical outcome of these patients. Although it is now common practice for anesthesiologists to be primarily responsible for the interpretation of intraoperative TEE during adult cardiac surgery, their role in TEE during congenital cardiac surgery is still being debated . TEE performed during congenital heart surgery by appropriately trained anesthesiologists would result in changes in surgical and medical management in a significant number of cases irrespective of the pediatric population studied.[6]