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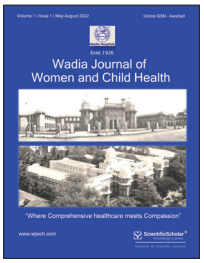

Narrative Review

Overview of point-of-care ultrasound and functional echocardiography training programs in India

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ABSTRACT

Utility of point-of-care ultrasound (POCUS) and functional echocardiography (fECHO) is increasing in neonatal intensive care units (NICUs) across India. However, there is a lack of structured training, guidelines for its use, competency requirements, and limited availability of trained personnel conducting supervised training. POCUS can potentially improve patient care and outcomes, reduce unnecessary testing and procedures, and enhance the efficiency of care delivery. In this review article, we will explore the current use of POCUS/fECHO in NICUs in India, its benefits and limitations, and the challenges associated with its implementation. We also describe briefly about a formal structured training for POCUS at a large tertiary pediatric hospital in Western India.

Keywords: Point-of-care ultrasound, Functional echocardiography, Neonatal intensive care units, Training, India

INTRODUCTION

Point-of-care ultrasound (POCUS) and functional echocardiography (fECHO) are increasingly being used in neonatal intensive care units (NICUs) and pediatric intensive care unit across the world, including in India.[1,2] As per a recent survey of clinicians, there is a lack of structured training and guidelines for its use across India. Moreover, there is a limited availability of trained personnel conducting supervised training and strict legislation related to ultrasound (US) use which are major barriers to its implementation.[3] There was a recommendation for accredited training programs and standardized guidelines which need to be established for the safer use of POCUS/fECHO in India. POCUS can potentially improve patient care and outcomes, reduce unnecessary testing and procedures, and enhance the efficiency of care delivery. In this review article, we will explore the current use of POCUS/fECHO in NICUs in India, its benefits and limitations, and the challenges associated with its implementation.

BENEFITS OF POCUS IN NICUS

The use of POCUS in NICUs in India has several benefits. First, it provides real-time imaging, which can be used to guide clinical decision-making and reduce the need for additional diagnostic tests. Second, POCUS is non-invasive and does not expose the neonate to ionizing radiation,

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which is a concern with traditional imaging modalities such as X-rays and CT scans. Third, POCUS can be used at the bedside, reducing the need to transport critically ill neonates and improving care delivery efficiency.

With the increasing interest in POCUS, a need for formal training of neonatologists and pediatric intensivists has arisen. Internationally, Certificate of clinicians performed Ultrasound (CCPU)[4] by Australian society of ultrasound medicine (ASUM) was one of the early structured training programs followed by targeted neonatal echocardiography[5] training in Canada. Surveys in UK and Europe evaluated and confirmed the need for neonatologist performed echocardiography (NPE) training.[6] Formal guidelines were laid down and consensus statements were published by various groups such as NPE/NoPE for structured training in UK and Europe and a more unified approach to performing hemodynamic assessment of newborns.[7,8] In India, national bodies like national neonatology forum and Indian academy of pediatrics are promoting regular POCUS workshops in annual conferences and many institutes are now conducting individual workshops/courses at a local level or in collaboration with international groups. There are a few programs in India developed by leaders in the field for online training for POCUS, some of which offer limited hands-on training. Thus overall training opportunities are increasing but there is a lack of unified structure for training, guidelines for its use, competency requirements, and national certification for training which will cover legal requirements.

NEONATAL fECHO

fECHO training is a specialized training program designed to teach healthcare professionals how to perform and interpret fECHO exams. fECHO is a non-invasive technique that uses US imaging to evaluate the function of the heart and its blood flow. It is commonly used in critical care settings to assess the hemodynamic status of patients, particularly those with shock, cardiac arrest, or other critical illnesses. The training program for fECHO typically includes both theoretical and practical components. The theoretical component covers the principles of US physics, cardiac anatomy and physiology, hemodynamic monitoring, and interpretation of fECHO findings. The practical component involves hands-on training on how to acquire and interpret fECHO images, as well as how to integrate fECHO findings into clinical decision-making.

Following are the general steps one could take to get formally trained for fECHO:

Education

The first step is to obtain a strong foundation of theoretical knowledge on the principles and applications of echocardiography. This could be through formal education in a cardiac US program or self-study using textbooks, online resources, and other educational materials.

Observation

Observing experienced operators performing echocardiograms can be beneficial in developing an understanding of scanning techniques and positioning.

Hands-on training

Hands-on training is critical to developing proficiency in echocardiography scanning. This can be obtained through a structured training program or through on-the-job training under the supervision of a qualified sonographer.

Practice

Consistent practice is a key to developing echocardiography scanning skills. This can include practicing on volunteer patients or utilizing simulation models to improve technique and image quality.

Continuing education

Continuing education is important to keep up-to-date with advances in technology and techniques. Attending conferences, workshops, and online courses can further develop skills and stay current with best practices.

Feedback and reflection

Receiving feedback from peers and supervisors and reflecting on one's own performance is important for identifying areas for improvement and continuing to refine scanning skills. Overall, developing echocardiography scanning skills requires dedication, persistence, and a commitment to ongoing learning and improvement.

Training for fECHO requires close collaboration with pediatric cardiology services during training and beyond. This results in better concordance of echocardiographic findings between neonatologists and cardiologists.[9] Centers having fetal echocardiography, echo lab, interventional cardiology, cardiac intensive care, arrhythmia clinic, and operative cardiology services under one roof have the potential to provide excellent in-house training opportunity.

The training program is usually tailored to the specific needs of the health-care professionals who will be using fECHO in their practice, such as critical care physicians, anesthesiologists, and cardiologists. Some training programs may also offer certification or credentialing for individuals who successfully complete the program.

fECHO also provides a point of care hemodynamic assessment and monitoring in the NICU. It is now regarded as a useful adjunct to clinical examination and monitoring tools in the critically ill infant. The anatomical, physiological, and hemodynamic information from fECHO can be useful for specific targeted interventions and evaluating responses to treatment.[10]

POCUS/fEcho can be useful in the management of the following neonatal conditions/scenarios:

1. Extreme preterm infants (<30 weeks gestation)[11] – fECHO in the first 72 h of life can be considered to assess the infants cardiac function, transitional circulation and serial assessment of hemodynamically significant patent ductus arteriosus[12,13]
2. An fECHO at 36 weeks post-menstrual age can be done to assess the presence of pulmonary hypertension in babies with chronic lung disease (Bronchopulmonary dysplasia)[14,15]
3. In cases of suspected persistent pulmonary hypertension of newborn (PPHN),[19-21] fECHO should ideally be done before or within 12 h of commencing any pulmonary vasodilator therapies such as inhaled Nitric Oxide
4. Babies with congenital diaphragmatic hernia (CDH)[22,23] are a special cohort where fECHO is an essential tool for the early assessment of cardiac function and pulmonary hypertension associated with CDH and deciding timing of surgery
5. Babies with cardiac dysfunction, hypotension and/or impaired organ perfusion/shock[16-18] – any baby with signs of impaired organ perfusion and/or suspicion of cardiac dysfunction, should ideally have an fECHO assessment before or soon after commencing treatment
6. Hypoxic ischemic encephalopathy (HIE)[24-26] - Babies diagnosed with HIE should ideally have an fECHO performed within the first 24 h of life to assess cardiac function and PPHN, then again during hypothermia and also within 24–48 h of completing therapeutic hypothermia
7. Ultrasonography has been increasingly used for placing central lines in adult and paediatric population and now in the NICUs.[27] Also for confirming line placement[27-29], a limited ECHO can be performed to confirm Umbilical venous catheter (UVC), Umbilical Arterial Catheter (UAC), long line placement and also for extracorporeal membrane oxygenation (ECMO) – cannula position
8. Apart from the above functional information, an echocardiography can also help rule out major congenital heart defects and help differentiate a particular clinical condition from a heart defect, for example, a bedside echocardiography can help detect a cyanotic congenital heart defect that is mimicking PPHN.

OTHER ORGAN ULTRASOUND

Beyond the heart, POCUS extends to:

1. Acute head US to exclude cerebral/intraventricular hemorrhage and ischemic injury to brain
2. Abdominal and thoracic US to diagnose perforation, abnormal fluid, and early changes of necrotizing enterocolitis (NEC)
3. Bladder Ultrasound to confirm urine before supra-pubic aspiration
4. Screening of the entry points of the inferior vena cava and superior vena cava into the heart can exclude an intra-cardiac line tip position. US allows real time localization of UVC tip position during insertion.[30]
5. Confirmation of ECMO cannula
6. There is an evolving use of lung US to diagnose a range of pulmonary conditions for early diagnosis and decision for surfactant administration for respiratory distress syndrome[31] and transient tachypnea of newborn.[32] Moreover, Lung US is also useful for bedside diagnosis of pneumothorax, pleural effusions, pneumonia/consolidation, and changes in chronic lung disease (Bronchopulmonary dysplasia)
7. Newer techniques like US-guided endotracheal tube placement and assessing thickness of optic nerve are also practiced more in the NICUs.

CHALLENGES IN IMPLEMENTING POCUS IN INDIA

The implementation of POCUS in NICUs in India is not without challenges. First, there is a shortage of trained personnel who can perform POCUS. Second, there is a lack of standardized protocols and guidelines for the use of POCUS in NICUs. Third, there is a need for adequate infrastructure, such as appropriate equipment and facilities, to support the use of POCUS.

At Bai Jerbai Wadia Hospital for Children, we have designed and developed a structured program for formal training and certification of fECHO and POCUS. The program has a set curriculum offering a series of online and classroom lectures, observed and supervised hands-on ECHOs in the NICU, and Echo Lab-Pediatric cardiology outpatient department.

Trainees need to gain an understanding of the skills required to obtain echo images using standard views in the newborn, segmental sequential scanning, and also identifying normal anatomy (pattern recognition). Bedside discussion on interpretations of images and translation of information to clinical decision-making is an important part of program. To experience a variety of clinical scenarios and to achieve the learning objectives within the curriculum, trainees will be expected to perform a minimum of 100–150 fECHOs/POCUSs and maintain a logbook.

Limitations of POCUS in NICUs

Despite its many benefits, POCUS has some limitations in NICUs in India. First, it requires specialized training and expertise, which may not be available in all NICUs. Second, POCUS has limited accuracy in some cases, such as in the diagnosis of NEC, which is a common condition in neonates. Third, POCUS is operator-dependent, which can lead to variability in results.

CONCLUSION

POCUS and fECHO are an emerging technology that has the potential to improve patient care and outcomes in NICUs in India. Its use is increasing, particularly in tertiary care hospitals, but there are still challenges that need to be addressed. The development of standardized protocols and guidelines, increased availability of trained personnel, and adequate infrastructure are necessary for the effective implementation of training of POCUS in NICUs in India.

Declaration of patient consent

Patient consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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