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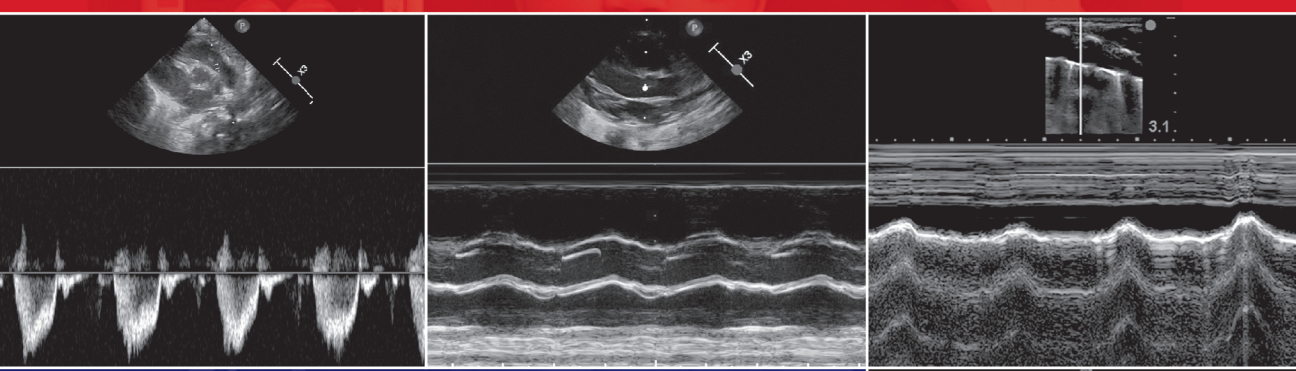
Handbook of

Applied Neonatal Point of Care Ultrasonography and Hemodynamics



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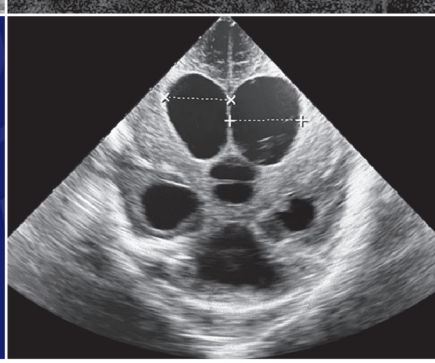

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CHAPTER 13

Ethics, Training, and Patient Safety While Performing POCUS in Neonates

Mohit Sahni, Manoj Modi, Venkataseshan Sundaram

KEY POINTS

- Ethics—consent process, indications for point-of-care ultrasound (POCUS), role of deferred consent, recording and storing data, data safety and data ethics, data sharing, identity of patient protection.
- Suggested sample form for indications, findings documentation, parental consent.
- Patient safety—regulating frequency, infection-prevention measures, thermoregulation, pain and discomfort, effect on development, hidden harms of overdoing—overdiagnosis and overtreatment.
- Training and curriculum—who can perform POCUS, minimum requirements and experience for performing POCUS, reporting and recording findings of POCUS in an ICU form the backbone of POCUS.
- Archiving the studies, retrieving them, and remote archiving are often ignored but important steps from ethics and legalities point of view.
- Curriculum and regulations: NMC requirements for DM, DNB; NNF and IAP fellowship requirements, current PCPNDT Act and regulations.

13.1. INTRODUCTION

As a clinician using point-of-care ultrasound (POCUS) for bedside management, it is important to stick to the principles of "do no harm". This includes patient safety, asepsis, and minimal handling. Equally important is the process of explaining to the parents about the procedure, seeking their consent, reporting procedures, certification and training, and PCPNDT act and legally binding regulations. It is important that the learner is aware of all the nitty-gritties before applying his/her skills in bedside sonography.

13.2. ETHICAL ASPECTS OF POCUS

There are certain basic etiquettes of doing any ultrasound examination in a neonate. Adhere to these principles at all costs:

- Hand hygiene and aseptic no-touch technique: After hand hygiene, disinfect the probe with alcohol rub (including the wire, as it may encounter the infant's surroundings). For a list of disinfectants compatible with the probe, refer to the user manual.
- Use a probe cover, sterile gloves, and single-use gel whenever doing a sterile procedure.
- Prewarm the ultrasound gel to avoid hypothermia—this can be done by ultrasound gel warmers or by taking a small amount of gel in a sterile gauze and warming it under dry heat from the radiant warmer. Do not use moist heat (steam or hot water) as it can increase the risk of infection.
- While using multiuse ultrasound gels, make sure that the nozzle or tip of the gel box is wiped with alcohol before use. Do not use the opened multiuse gel container for more than 28 days.
- Use pain-control measures to minimize pain and stress—use multimodal/

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sensorial saturation pain management strategies (combination of positioning, tucking, oral sucrose, etc.).

- Limit the examination time to minimum, to avoid hypothermia. This is especially important in infants who are nursed in incubators, as keeping the potholes open for a longer duration may reduce ambient air temperature. It is better to switch to air mode in such cases. For infants in open care warmer, setting a higher set temperature (37–37.5°C) in servo mode or changing to manual mode with a higher heater output can be considered. Make sure to expose only the part to be examined. For cranial ultrasound, try to perform the examination with the bonnets in situ (just uncover the area over the AF so that head is not exposed, which may exacerbate heat loss). Wipe the neonate's scalp/body part off the ultrasound gel with a sterile gauze after examination
- Always ensure that we are sure about what we want to assess from POCUS and have a protocol for the same (clinical indications should be clear before performing the scan—to look for IVH/PVL, screen for PDA, screen for pulmonary hypertension, etc.). New learners should perform scans only if parents understand and consent that the trainee/student is doing for the purpose of learning.
- Infants who are hemodynamically unstable or labile (shock, pulmonary hypertension, infants in incubators, extremely premature infants) should get the examination done by a trained neonatologist, so that examination is quick and to the point. Beginners can learn basic skills from their mentors in otherwise stable infants.
- Any elective imaging should be done only when the baby is awake and not when the baby is asleep (clustering of care).
- Informed consent is an important aspect of any procedure. Before performing an ultrasound, talk to the parents why it is being done, details about how pain management will be done to avoid any discomfort to the baby, and how the findings of the scan will help in further management/understanding the baby's illness or problems. As for any other emergency procedure, if an ultrasound is performed in an emergency to help the baby's management, there is no need to take consent, if the physician acts in the best interest of the baby. Obtain written consent for all ultrasound -guided procedures and verbal consent for elective noninvasive scans, as may be the case (this applies to both educational training and exams done for patient care).

13.3. PRECAUTIONS RELATED TO PATIENT SAFETY

While performing ultrasound or echocardiography, the neonatal team shall have clear objectives of the sonographic assessment. The unit shall have documented guidelines regarding credentials required for performing ultrasound, scope of sonographic assessment, and diagnostic or therapeutic implications from the information derived. Verbal consent shall be taken from the parents/caregivers, for noninvasive elective scans. Invasive scans and ultrasound-guided procedures will require a written informed consent. The same principles are applicable for consent with respect to educational training for students. In emergencies, consent may be deferred, if the clinician feels that he is acting in the best interest of the baby and waiting for consent will delay

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appropriate care. Due care shall be taken to avoid inadvertent harm to the baby during the procedure. A fundamental approach to the safe use of diagnostic ultrasound is to use the lowest output power and the shortest scan time consistent with acquiring the required diagnostic information. For routine sonographic assessment through intact skin, a transducer probe shall be cleaned thoroughly using chlorhexidine or alcohol-based disinfectant along with meticulous hand hygiene practices. For ultrasound-guided invasive procedures such as central line placement, etc., the probe shall be disinfected by immersing it for 10–30 minutes into glutaraldehyde, chlorhexidine, or hydrogen peroxide solution (refer the user manual for a list of compatible disinfectants) as per unit guidelines. It is important to immerse the probe only until the desired depth (check the probe immersion levels in the user manual). It is advisable to use sterile probe cover or sheath for ultrasound-guided procedures. Probe covers are made of inert, nontoxic, and sterile polyethylene material and are latex free. They are available for all types of probes and a pack of 30 costs around Rs. 300/-. They are also available in different sizes.

13.4. CURRICULUM AND TRAINING REQUIREMENTS OF POCUS

Utility of 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. There is limited availability of trained personnel conducting supervised training, and there are strict legislations related to ultrasound use in India.

The terms "functional echocardiography", "clinical performed ultrasonography", "neonatologist-performed echocardiography", and "point-of-care echocardiography" have been interchangeably used in the literature—all uniformly pointing toward ultrasonographic imaging of the heart for its functions.

13.5. PROPOSED TRAINING STRUCTURE

13.5.1. Broad objective for training:

The objective is to empower the neonatal care clinician with basic skills in performing echocardiography at point-of-care in the neonatal intensive care unit.

13.5.2. Who should undergo training?

- All neonatal intensivists who cater to sick neonates irrespective of age and gender
- Essential qualification for completing both basic and advanced components of the training program—DM in Neonatology or DRNB in Neonatology or 2 years of a certified fellowship program
- For basic training program—in case the candidate has a minimum of 12 months of specialist training in neonatal care that involved neonatal intensive care after their completion of pediatric training, he/she may be considered for the basic training component of the program. However, these 12 months of training should have been training in a level 3 or more accredited unit with facilities for mechanical ventilation including high-frequency ventilation,

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surfactant replacement therapy, blood gas monitoring, invasive BP monitoring, multi-channel vital signs monitoring facility, and inhaled nitric oxide administration facility.
- The candidate should have continuous access to ultrasound machines of appropriate quality to allow accurate and repeatable scanning ability. Continuous access is defined when the ultrasound machine can be mobilized to the point-of-care within a few minutes of time and should preferably be located in-house and within the same building. The machine should have cardiac package software and transducers of 5–12 MHz frequency for neonatal cardiac ultrasound and one more transducer for cranial and abdominal vasculature ultrasound

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 ultrasound 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:* This 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 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:* This is important to keep up to date with advances in technology and techniques. Attending conferences, workshops, and online courses can help 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 are 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. Centers having fetal echocardiography, echo laboratory, interventional cardiology, cardiac intensive care, arrhythmia, and operative cardiology services under one roof allow for the excellent in-house training opportunity.

13.5.3 Course structure

Table 1 provides an overview of the proposed course structure.

Functional ECHO or POCUS courses can be conducted as:
- Basic course
- Advance course.

Table 2 summarizes the various components to be covered and develop competency in cognitive and practical skill by the participant. **Table 3** provides a glimpse of

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TABLE 1: Basic course structure in modules.

Modules	*Core areas to be covered*
Mod 1	Basic sciences (embryology, anatomy, physiology and applied physiology of heart and other major organs such as brain, gut, kidneys, and adrenals) and their applications in clinical medicine
Mod 2	Clinical sciences in relation to hemodynamics
Mod 3	Skills related to hemodynamics
Mod 4	Supportive care, hemodynamic monitoring (basic and advanced), and pharmacological adjuncts

TABLE 2: Cognitive and practical skills for basic and advanced training levels.

Competency	*Cognitive*	*Practical skills*
Basic training	• Understanding of the physics of ultrasound and its practical applications • Understanding of the indications and limitations of an USG examination • Understanding of cardiovascular, brain, and lung anatomy and its relationship with ultrasound/echo images • Understanding of the principles of pulsed and color • Doppler and the application of the principles in clinical practice • Understanding of the physiology of the fetal and neonatal transitional circulation • Understanding the methods for assessing ventricular function and the factors influencing systolic and diastolic function • Understanding of the methods for assessing pulmonary artery pressure and the normal adaptations • Understanding the clinical significance of a hemodynamically significant PDA (hsPDA) and its natural course	• Special precautions for scanning neonates, such as temperature stability, infection prevention, minimal touch approach, and limiting scan times • Knowledge of machine operation and knobology, including optimal selection of probes and techniques for image optimization for neonatal scanning • Be able to obtain the standard pediatric views (subxiphoid, parasternal, apical, and suprasternal) and know how interpret the images • To be able to obtain cranial USG views (sagittal, coronal, mastoid, and temporal) • Use of pulsed-wave Doppler, continuous-wave Doppler, and color Doppler to demonstrate blood flow velocities; knowledge of normal velocity patterns • Knowledge of the use M-mode and 2D echocardiography to measure wall thickness and chamber dimensions and calculation of FS and EF • Know how to perform and interpret images used for the different techniques to assess ventricular systolic and diastolic function • To know how to use POCUS in the context of shock, PDA, pulmonary hypertension (echo), identify normal and abnormal lung profiles, pathologies in cranial ultrasound (IVH, PVL, asphyxia, hydrocephalus) • Focus on image optimization during acquisition • Know how to properly store images • Ability to communicate the result of an examination and produce a written report

Contd…

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Competency	Cognitive	Practical skills
Advance training	• Understanding of cardiovascular pathology and the identification of abnormal cardiovascular anatomy on echocardiographic images • Understanding of cardiovascular physiology and the effect of different lesions on hemodynamics	• Be able to rule out structural CHD • Be able to obtain images in patients with more difficult windows and in more unstable patients • Use of more advanced Doppler applications and tissue Doppler techniques; interpretation of abnormal findings • Use of speckle tracking echocardiography • Know how to interpret measurements used in the assessment ventricular systolic and diastolic function and the influence of loading conditions • Know how to assess the hemodynamic importance of pericardial fluid • Know how to image central lines and identification of endocarditis • Ability to communicate the result of an examination and produce a detailed written report • Participate in echocardiography laboratory quality management programs with review of results and diagnostic errors

TABLE 3: Comparison of various necessary components in the established training programs in Australia known as CCPU and Canada TnECHO and courses in India.

	India	Australia	Canada
Course name	NNF-SONIC	CCPU	TnECHO
Duration	6 months	1–3 years	6 months to 1 year
PCPNDT registration	Must	Nil	Nil
Number of images	200	100	150
Modules covered	Cardiac, cranial, lung, vascular, and miscellaneous	Cardiac	Cardiac
Pediatric cardiologist involvement	Preferred; not mandatory	Preferred	Preferred
Nature of training	Hybrid (virtual classes, online mentoring and image reviews, site visits)	Physical + online	Physical
Mentors	Multiple	Single	Single
Number of supervisors	1	1	1
Presence for training	Online + onsite (vary with courses)	Online + onsite	Onsite
Maintain certification	Yes; mandatory	25 credits per module of 5 years	NIL
Maintain logbook	Yes; mandatory	Must	Must
Exit exam	Yes; mandatory; virtual	NA	NA
Certification	Certified for participation and training for bedside POCUS for diagnosis and management; not for reporting	Certified for bedside echocardiography	Certified for bedside echocardiography

Note: None of the courses offered in India have formal accreditation from the government of India or the National Medical Council (NMC).

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POCUS courses in other high-income countries and in India.



PRACTICE POINTS

- POCUS training for neonatal trainees in India is not governed by any regulatory authority; hence, it is important to have predefined objectives in the curriculum of neonatology.
- It is of utmost importance to know the safety aspects involved, with respect to patient safety and ethics.



CAUTION POINT

- Clinicians using POCUS to make informed decisions on patient care can document their findings as "bedside USG findings" and how it concurs with the clinical picture. They should refrain from signing reports based on the bedside USG findings.

SUGGESTED READING

1. Chao SK, Liu YT, Kropf CW, Huang RD, Theyyunni N, Taylor LA, et al. Consensus-based ethical best practices for performing educational point-of-care ultrasonography in the emergency department. AEM Educ Train. 2024;8(2):e10963.
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Handbook of Applied Neonatal Point of Care Ultrasonography and Hemodynamics

About NNF-SONIC

This handbook is written by the NNF-SONIC team. SONIC stands for "Sonography for Optimization of Neonatal Intensive Care", a mnemonic created to reflect the principles of point-of-care ultrasonography (POCUS) in the care of sick and small neonates. The SONIC team is a well-balanced group of both young and experienced neonatologists, equipped with the skills to perform POCUS and the expertise to teach its rational application. Each chapter has been meticulously crafted to provide practical knowledge, drawn from the team's collective decades of experience in POCUS. They have honed their skills not by simply observing others but by practicing themselves, learning from their mistakes, and developing their unique approaches. This individuality and simplicity are evident throughout the chapters they have written. At times, the discussion may veer toward practical tips rather than scientific theory. However, remember that experience and wisdom—often absent in standard textbooks—are the unique offerings of this handbook.

Salient Features

- Carefully designed chapters to take the reader from basics to advanced skill learning to give a wholesome understanding of POCUS in neonates
- Chapters written with a mix of science, evidence, and experience—rarely found in contemporary books of similar context
- Innumerable images and pictures to support the information provided in the text to make the learning process more visual
- Each chapter contains key points for practice and caution—useful for a novice as well as an expert neonatologist
- Clearly drafted protocols for performing POCUS as fast as possible in a sick child for assessment of shock, patent ductus arteriosus, and pulmonary artery hypertension.

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