

ORIGINAL ARTICLE

Expert consensus statement ‘Neonatologist-performed Echocardiography (NoPE)’—training and accreditation in UK

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Abstract Targeted echocardiographic assessments of haemodynamic status are increasingly utilised in many settings. Application in the neonatal intensive care units (NICU) is increasingly demanded but challenging given

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the risk of underlying structural lesions. This statement follows discussions in UK led by the Neonatologists with an Interest in Cardiology and Haemodynamics (NICHe) group in collaboration with the British Congenital Cardiac Association (BCCA) and the Paediatricians with Expertise in Cardiology Special Interest Group (PECSIG). Clear consensus was agreed on multiple aspects of best practice for neonatologist-performed echocardiogram (NoPE)—rigorous attention to infection control and cardiorespiratory/thermal stability, early referral to paediatric cardiology with suspicion of structural disease, reporting on standardised templates, reliable image storage, regular skills maintenance, collaboration with a designated paediatric cardiologist, and regular scan audit/review. It was agreed that NoPE assessments should confidently exclude structural lesions at first scan. Practitioners would be expected to screen and establish gross normality of structure at first scan and obtain confirmation from paediatric cardiologist if required, and subsequently, functional echocardiography can be performed for haemodynamic assessment to guide management of newborn babies. To achieve training, NICHe group suggested that mandatory placements could be undertaken during core registrar training or neonatal subspecialty grid training with a paediatric cardiology placement for 6 months and a neonatology placement for a minimum of 6 months. In the future, we hope to define a precise curriculum for assessments. Technological advances may provide solutions—improvements in telemedicine may have neonatologists assessing haemodynamic status with paediatric cardiologists excluding structural lesions and neonatal echocardiography simulators could increase exposure to multiple pathologies and allow limitless practice in image acquisition.

Conclusion: We propose developing training places in specialist paediatric cardiology centres and neonatal units to facilitate training and suggest all UK practitioners performing neonatologist-performed echocardiogram adopt this current best practice statement.

What is Known:

- Neonatologist-performed echocardiogram (NoPE) also known as targeted neonatal echocardiography (TNE) or functional ECHO is increasingly recognised and utilised in care of sick newborn and premature babies.
- There are differences in training for echocardiography across continents and formal accreditation processes are lacking.

What is New:

- This is the first document of consensus best practice statement for training of neonatologists in neonatologist-performed echocardiogram (NoPE), jointly drafted by Neonatologists with interest in cardiology & haemodynamics (NICHe), paediatric cardiology and paediatricians with expertise in cardiology interest groups in UK.
- Key elements of a code of practice for neonatologist-performed echocardiogram are suggested.

Keywords Echocardiography · Training · Neonatologist · Heart disease · Haemodynamics · Ultrasound

Abbreviations

ASE	American Society of Echocardiography
BAPM	British Association of Perinatal Medicine
BCCA	British Congenital Cardiac Association
BCS	British Cardiovascular Society
CCPU	Certificate in Clinician-Performed Ultrasound
EAE	European Association of Echocardiography
NICHe	Neonatologists with Interest in Cardiology and Haemodynamics
NICU	Neonatal intensive care unit
NoPE	Neonatologist-performed echocardiogram
PDA	Patent ductus arteriosus
PEC	Paediatricians with Expertise in Cardiology
PECSIG	Paediatricians with Expertise in Cardiology Special Interest Group
PPHN	Persistent pulmonary hypertension of the newborn
RCPCH	Royal College of Paiatrics and Child Health
TNE	Targeted neonatal echocardiography

Background

Intensive care clinicians in multiple specialties are utilising ultrasound techniques to improve patient monitoring and management [1–4]. This is particularly the case for cardiovascular assessment in the neonatal intensive care unit (NICU) setting where non-invasive imaging techniques such as echocardiography are particularly attractive due to their portability

and bedside feasibility in haodynamic assessment, diagnosing congenital heart conditions and monitoring patient clinical progress. Multiple personal practice statements have highlighted potential utility of echocardiography on the NICU [5–12], and these views are increasingly supported by clinical data demonstrating scope for improvement in practice [5, 13–16]. The use of bedside echocardiography in NICU has been shown to improve outcome [8]. There is growing interest in utilising bedside echo for decision making such as assessing cardiac output and myocardial function while managing poor perfusion states in sick and premature newborn babies [11]. The concerns among neonatologists and paediatric cardiologists about clinicians using bedside echocardiography without appropriate training and accreditation include delayed or inappropriate treatment leading to patient harm. Thus, bedside echocardiography is an attractive tool, but it requires standardisation of techniques to foster confidence and minimise harm that can only be achieved through structured training and accreditation.

Transitional circulatory changes after birth pose major challenges in the neonatal setting that distinguish it from ‘point of care’ ultrasound in other specialties. Congenital heart defects are known to be well tolerated antenatally because of foetal shunts but present clinically only after birth during the process of adaptation to postnatal circulatory physiology (closure of the arterial duct, falling pulmonary vascular resistance and increasing systemic vascular resistance). Thus, it cannot be assumed that the newborn presenting with haodynamic instability has a structurally normal heart. The challenge is therefore to ensure that the use of echocardiographic techniques to assess cardiac performance can be maximised, whilst at the same time ensuring that those who undertake such scans have the relevant training and experience to recognise deviations from normality in terms of cardiac structure.

Although the use of echocardiography on the NICU is well recognised, and increasingly advocated, there is currently no accepted pathway for training in this field in the UK nor are there consistent systems of clinical governance. This area of practice has come under increased scrutiny following initiatives such as the safe and sustainable cardiac services review, which highlighted the need for high standards throughout cardiac networks.

Current training recommendations

In 2011, the American Society of Echocardiography (ASE) and European Association of Echocardiography (EAE) published practice guidelines and recommendations for training in ‘targeted neonatal echocardiography’ [17]. This consensus statement was jointly written by cardiologists and neonatologists from North America and Europe, including one of the authors of this manuscript (JMS).

The statement initially sets out the background and indications for targeted neonatal echocardiography (TNE), also referred to as ‘functional echocardiography’ and ‘point of care echocardiography’. The pathophysiology of the transitional circulation and potential indications for TNE are discussed. A key principle of the ASE/EAE statement, and a view which we support, is that an initial echocardiogram should always be a comprehensive study to exclude structural abnormality even when structural congenital heart disease is not strongly suspected. This initial echocardiogram should establish structural normality or identify the presence of structural heart defects. While the precise delineation of complex congenital heart defects remains primarily the domain of paediatric cardiologists, it would be appropriate to expect the person undertaking TNE to be able to determine if the cardiac defect is critical or not, whether it requires intervention to maintain ductal patency or urgent attention by the paediatric cardiologist. Suspicion of a structural heart lesion or inability to establish normality should initiate prompt discussions with paediatric cardiologists.

The TNE statement also provides details of technical and safety requirements, an approach to image acquisition and the core components of an echocardiographic examination. The document lays out guidance for an approach to assessment of patent ductus arteriosus (PDA), persistent pulmonary hypertension of the newborn (PPHN), hypotension and other common neonatal presentations.

Additionally, the statement refers to the current training models for neonatal echocardiography and lays out a proposed joint model for training across North America and Europe. The key components of the ASE/EAE model are for basic/core training suggesting clinicians:

- Spend 4–6 months in a dedicated paediatric cardiology training post
- Perform 150 echocardiograms (of which 80 % should be abnormal)
- Interpret a further 150 echocardiograms (of which 80 % should be abnormal)
- Undergo a formal evaluation of image acquisition by an echocardiography lab director

The core level training is proposed to allow practitioners to learn to acquire images and to have a supervised period of training that is consistent with the type of initial training in transthoracic echocardiography that other groups such as paediatric cardiology trainees would receive in their initial years. Advanced-level training requires independent acquisition and reporting of echocardiograms with a further 4–6 months training in a dedicated unit with echocardiography training under supervision (ideally in a NICU environment). This requires performing 150 echocardiograms and interpreting a further 150 echocardiograms. Throughout this process, it is

recommended that training be coordinated by an echocardiography lab director who would directly observe a proportion of the performed scans, and a record of all scans performed should be maintained. This programme is identical to the process used for paediatric cardiology trainees in their initial years in the UK.

Following basic and advanced training, the report suggests maintenance of echocardiography skills by performing >100 scans/year, regularly participating in courses/conferences and adhering to rigorous standards of image acquisition, storage and reporting.

The format of the ASE/EAEs proposed training structure has met with some resistance, particularly in Australasia, where neonatologists have already developed and implemented a training and accreditation pathway for point of care neonatal ultrasound that does not demand a dedicated paediatric cardiology placement [18] (see <http://www.asum.com.au/newsite/Education.php?p=CCPU-Neonatal>). This Neonatal Certificate in Clinician-Performed Ultrasound (Neonatal CCPU) requires completion of an accredited physics course, attendance on an introductory course in neonatal ultrasound, followed by completion of 50 cardiac and 50 cranial ultrasound scans (all signed off by an accredited supervisor) to achieve a basic level of competence. To obtain ‘advanced’ CCPU requires further attendance at a 2-day advanced neonatal ultrasound course and completion of a further 25 cardiac, 25 cranial and 10 abdominal ultrasound scans. A specialist CCPU certification board then reviews recommendations for CCPU and refers to the Australasian Society for Ultrasound in Medicine. Recertification occurs every 4 years. An important distinction is that the Australasian process does not view exclusion of congenital heart disease as part of the remit of such a process which may at least in part explain the differences of opinion which emerge [18].

Current UK situation and logistic considerations

In the UK, there are currently approximately 350 neonatal consultants working in around 54 tertiary neonatal units nationally [19], many of whom have some prior experience/interest in neonatal echocardiography. These numbers do not include clinicians working in level 2 and level 1 units, where acute care is provided to a large number of newborns each year in the district general hospital setting prior to transfer for level 3 input or discharge home.

In a recent survey of lead neonatologists or neonatal consultants with an interest in cardiology at each level 3 neonatal unit in the UK, 70 % of clinicians stated that they regularly valued echocardiography as part of the assessment process. However, less than half (48 %) had undertaken a formal attachment (>6 months) in paediatric cardiology, only 48 % maintained a logbook of echocardiograms performed, 39 %

used a standardised reporting system and only 33 % performed in excess of 100 echocardiograms each year; 78 % indicated an interest in achieving formal accreditation in neonatal echocardiography (Gupta 2012, unpublished data).

Currently, prospective neonatal consultants in the UK are trained via the national grid trainee system, with around 70 trainees at any one time, an intake of 25–35 per year. In 2013, 23 of 41 (56 %) neonatal services offering subspecialty training in neonatal medicine offered training in echocardiography; a further 14 (34 %) offered some experience or exposure in neonatal cardiology [16]. However, this training is currently being performed without any set national curriculum, and it is unclear what echocardiography training and cardiology exposure is provided.

In paediatric cardiology, there are 36 training posts for paediatric cardiology training, with a 5-year curriculum tailored to doctors who wish to pursue a career in paediatric cardiology. The Centre for Workforce Intelligence has recommended that all these posts are required to train the current demand for consultant paediatric cardiologists until 2020 [20]. Tertiary paediatric cardiology centre placements are in demand to support the training pathway for Paediatricians with Expertise in Cardiology (PEC) a specialty which has now been recognised and implemented by the Royal College of Paediatrics and Child Health and the British Congenital Cardiac Association [21].

One of the challenges, which we foresee, is how neonatal specialist can gain a structured training in echocardiography to provide the levels of skills and competence recommended by recent guidelines. This training would certainly require on-going support from paediatric cardiology colleagues, to harness the potential benefits of TNE while minimising the risks of missed diagnosis and unnecessary intervention.

The formation of the Neonatologists with an Interest in Cardiology and Haemodynamics (NICHe) group in 2011 provides one potential forum for this process. We aim to learn from the Australasian experience and build in multiple components of the ASE/EAE recommendations to design a bespoke training and quality-assurance programme for the UK that is achievable with the resources available. The key elements of this proposed structure are discussed below.

For the majority of neonatologists, we would consider that practice should be primarily related to assessment of haemodynamics. Given the likelihood of infants with significant haemodynamic instability having a concomitant underlying structural cardiac abnormality, an initial premise is that any neonatologist carrying out a functional assessment should be competent to obtain a standard sequence of anatomical views to ascertain

normality of cardiac connections to exclude acute life-threatening cardiac lesions.

A small group of neonatologists who have an interest in cardiology and haemodynamics may wish to practice at a more advanced level, for example, taking referrals on the basis of concerns of structural congenital disease, performing echocardiograms in the non-emergent situation for newborns with cardiac murmurs or following up infants with known structural defects. This may become necessary because tertiary neonatal care and paediatric practice are often geographically separate, providing a further impetus for neonatologists themselves to acquire the skill of performing structural screening and functional echocardiographic assessment of sick newborn babies at the point of care and around the clock. Additionally, the potential application of national pulse oximetry screening for all newborns will likely increase the demand for echocardiography prior to hospital discharge. For practice in these settings, the skills necessary overlap considerably with the PEC group, for whom guidelines on training and governance are already in place. In our view, the agreed PEC skills and practices standards should apply to neonatologists who aim to practice at this more advanced level. With respect to echocardiography, attainment of European certification in echocardiography of congenital heart disease is recommended for this subgroup of NoPE practitioners who want to function as PECs.

An optimal training structure for neonatologist

For neonatologists utilising echocardiography for emergent haemodynamic assessments, we would recommend:

A. Neonatology trainees: training and quality assurance

Key elements of proposed training are shown in Table 1. Training can optimally be provided during neonatal grid training or core registrar training. A total of 12-month posting during registrar training years would be required, which includes placement in a specialist paediatric cardiology centre for 6 months and in a tertiary neonatal unit for at least 6 months under supervision of neonatologist with expertise in echocardiography and haemodynamic assessments.

During this period of training, trainees should attend an echocardiography course and learn about basics of cardiac physiology and neonatal echocardiography. Neonatologist supervisors should meet all of the criteria set out in Table 2 but also have particular clinical or research expertise in haemodynamics/imaging and maintain close links with paediatric cardiologists. Training could also potentially be acquired during a research placement

Table 1 Key elements of optimal training in neonatologist performed echocardiogram for neonatal trainees

- At least 12-month placement consisting of 6 months in a specialist paediatric cardiology centre and 6 months or more in a tertiary neonatal unit under supervision of neonatologist or paediatric cardiologist
- Ideally 20 % of time dedicated to learning echocardiographic techniques during placement
- Nominated paediatric cardiologist/neonatologist supervisor, with experience in neonatal echocardiography
- Attendance at an introductory echocardiography course
- Performance of >100 echocardiograms in newborns or infants of which at least 50 should show structural or functional pathology
- Attendance at >10 cardiology out-patient clinics with a consultant paediatric cardiologist or accredited Neonatologist
- Reflection on >10 neonatal cases where haemodynamic assessment using ‘functional’ echocardiography facilitated or changed clinical management
- Completion of >10 directly observed procedural skills (DOPS) assessments of infants with significant structural congenital heart disease or functional pathology
- Maintenance of a logbook of all scans performed and the principle diagnoses
- Reporting of all scans on a standardised template

involving neonatal echocardiography. Extensive experience of scanning infants with normal hearts and identifying abnormal structure of heart (though not necessarily defining the precise beyond ‘structural congenital heart disease’) is essential. Therefore, we recommend that during training, a total of 100 scans are recorded of which at least 50 scans must show structural or functional pathology. Patent foramen ovale would not constitute pathology; however, PDA in preterm infants, all other structural lesions and functional concerns such as PPHN, hypovolaemia and impaired contractility would all be considered pathologies. A paediatric cardiologist, paediatrician with expertise in cardiology (PEC), experienced

Table 2 Key elements of standardisation of practice and quality assurance for neonatal consultants

- Each neonatal consultant undertaking neonatologist-performed echocardiogram to have a designated link paediatric cardiologist
- Demonstrate prior attendance at an echocardiography course
- Carry out >50 echocardiograms/year in newborns
- Detailed review of >10 cases/year with a paediatric cardiologist or reflect on functional haemodynamic assessment leading to clinical decision
- Attendance at >5 cardiology out-patient clinics/year with a consultant paediatric cardiologist or at case conference meetings or haemodynamic club meetings
- Maintenance of a logbook of minimum number of scans required for quality assurance with the principle diagnoses
- Reporting of all scans on a standardised template

neonatologist or cardiac sonographer should supervise scans.

Training could also be augmented by use of simulators in neonatal echocardiography that are increasingly used for teaching on echocardiography courses. This could help in developing skills in acquiring standard echocardiographic views and recognising common congenital heart conditions. By the end of training placements, we would recommend that all trainees have undergone a formal evaluation of image acquisition in at least ten cases supervised by a paediatric cardiologist or neonatologist accredited for NoPE training. This evaluation should also include a review of a logbook, workplace-based assessments and audit or research activity as well as commitment to the guidelines for safe practice as laid out below.

This optimal training structure is a long-term goal as at present there are insufficient resources available to provide this programme to large numbers of neonatal trainees in the UK.

However, we remain concerned about the vulnerabilities in the system as it stands in 2015, with many neonatologists performing echocardiography without having undertaken any formal training placement. Therefore we propose the components of best practice (Tables 1, 2 and 3) are adopted, and neonatal and paediatric cardiology training placements are made available to trainees during core and neonatal grid training that want to acquire this skill. A dedicated time for learning this skill is desirable and offered whenever possible.

Table 3 Key elements of a code of practice for neonatologist-performed echocardiogram

- Maintenance of rigorous infection control and cardiorespiratory/thermal stability at all times
- Initial echocardiograms in each child to include a basic structural assessment to rule out congenital heart defects
- Where there is a suspicion of structural disease, either clinically or by echocardiography, a paediatric cardiology opinion should be sought and appropriate treatment instigated
- Primary focus on ‘functional’ echocardiography to guide haemodynamic management in sick or premature newborn infant
- All scans should be reported using a standardised template and be specifically reported as having been carried out by a neonatologist rather than a cardiologist/sonographer
- Reliable storage of all images to facilitate future review
- All staff should continue to maintain a database of all scans performed and the principal diagnoses
- All staff should regularly seek continuing professional development to maintain awareness and skills in neonatal echocardiography and haemodynamics
- Regular audits and review of functional and structurally abnormal scans by peer group (neonatal consultant with experience in echocardiography or paediatric cardiologist)

B. Training and accreditation for neonatal consultants

We acknowledge that currently practicing clinicians will have a wide variety of skills and experience. We also acknowledge that busy professionals may not welcome further scrutiny of their practice. However, we would argue that an enhanced framework for practice could provide both governance and further training, allowing echocardiographic modalities to improve patient care in even larger numbers of newborns.

To achieve this, we propose that each neonatal service should have a designated lead for neonatal echocardiography who is responsible for governance of practice and who will have regular contact with their tertiary paediatric cardiac centre. A close working relationship between these two individuals will be necessary to ensure high standards of care throughout their network of linked hospitals. Echocardiography should be regarded as a subspecialisation and should only be undertaken by those who are either in agreed training roles or who meet standards for competence. Dedicated time for neonatal echocardiography training as a consultant may be hard to arrange, but we believe that standardisation of practice and a system of quality assurance should be a priority. Key elements of such a system are shown in Table 2. Performance of >50 echocardiograms/year may again prove challenging, but we would argue that the skill is a significant subspecialisation and that regular performance is necessary for maintenance of technique. Scans could be performed and images reviewed within the context of a paediatric cardiology clinic.

C. Guidelines for practice

We suggest that a ‘code of practice’ should be set up for neonatal consultants and trainees to follow. Key elements of this are shown in Table 3.

Accreditation

In the long term, ideally all neonatal consultants and trainees performing echocardiography should seek accreditation. Such accreditation should be in conjunction with other professional bodies, ideally the BCCA, BAPM, British Cardiovascular Society (BCS) or RCPCH. Accreditation could be reviewed every 3–5 years and be based on evidence of continuing professional development in the field, a minimum number of echocardiograms performed/year, review of the logbook of scans performed, and a potentially a formal evaluation of image acquisition in a number of cases by a paediatric cardiologist. However, negotiation and approval of such a system could be protracted, and we feel that an improvement in overall practice is the more urgent and achievable goal.

Summary

NoPE, also referred to as targeted neonatal echocardiography, functional neonatal echocardiography and point of care ultrasound is widely practiced in the UK, but by clinicians with varying degrees of training and experience. While the techniques have not yet been proven to improve clinical care they show significant promise. A formalised programme of training and quality assurance has considerable scope to standardise practice, reduce risk of misdiagnosis and improve patient care.

We recommend a training and quality-assurance system based on close liaison with paediatric cardiologists, PECs and neonatologists, attendance on training courses, supervised performance of scans, maintenance of scan logs and formal assessment of image acquisition ability.

Disclosures SG is founder and chair of the Neonatologists with Interest in Cardiology and Haemodynamics group (NICHe) and Conference director of Annual international Neonatal Cardiology and Haemodynamics conference (NeoCard), UK. AMG is a director of Neonatal Echo Skills, providing neonatal echocardiography training. YS is academic and educational convenor of PECSIG group, lead for training and accreditation at NICHe group and a course co-director at Yorkshire Paediatric Echocardiography Course. AG is chair of PECSIG group.

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