Training in Targeted Neonatal Echocardiography (TNE) for Swiss Neonatologists

Introduction

"Targeted neonatal echocardiography (TNE) is proposed to describe the bedside use of echocardiography to longitudinally assess myocardial function, systemic and pulmonary blood flow, intracardiac and extracardiac shunts, organ blood flow and tissue perfusion. The primary goals of TNE are to provide non-invasive information on the underlying cardiovascular pathophysiology causing haemodynamic instability and the response to treatment in an individual patient over time. In summary, the core or basic TNE level includes the ability to perform comprehensive transthoracic echocardiography in neonates and the ability to distinguish normal from abnormal." (Mertens et al, J Am Soc Echocardiogr 2011)

Training guidelines

The neonatologist interested in TNE core level will perform training under supervision of a paediatric cardiologist and a neonatologist with advanced TNE knowledge. The conditions required are listed as follow:

- The training starts with a certified **theoretical course** (2 days) on the topic of echocardiography including a basic understanding of the physical principles of ultrasound and clinical ultrasound equipment (a list of accepted national and international courses will be provided).
- At least two months **practical training in a paediatric cardiology** unit of a Swiss perinatal centre level 3 (can be divided in two periods of one month each). During that time, the neonatologist will concentrate on echocardiography mainly on structural normal hearts and work under supervision of a paediatric cardiologist. The standard imaging components of TNE is listed below.
- Thereafter the logbook can be completed with **practical training** on patients of the own **neonatology unit** with a main focus on neonatal aspects (e.g. haemodynamic assessment) under supervision of a neonatologist fulfilling the advanced TNE level requirements or of a paediatric cardiologist.

  The training is recommended to be completed within 12 months, can be extended to a maximum of 24 months.
- Logbook requirements (modified training guidelines of the ACC/AHA/ASE):
  - Number of **performed** echocardiograms: 150

    At least 75 in neonates, of which at least 50 must show pathologic findings (e.g. structural heart defect, PDA).

- Number of supervised **reviewed** echocardiograms: 150

  At least 75 must show pathologic findings.

  Studies are selected from the digital hospital data base and are interpreted by the trainee under supervision (approx. 15 minutes per echo study). At least half of the performed and reviewed echos should be done at the paediatric cardiology unit.

- The trainee keeps records of his studies in a **logbook** (XL table) including: initials or patient ID, patient's date of birth, date of the echo, and the echocardiographic diagnosis. A logbook summary including the number of studies, the training period, and the signature of both trainee and paediatric cardiologist trainer (by the end of the training period) is required.
- A **practical oral test** will take place by the end of the training period including one life case and 3 – 5 review cases (to be described in detail in a separate document). The assessment will be limited to a maximum of 90 minutes and will take place at the paediatric cardiology or neonatal unit of one Swiss perinatal centre. The trainee must be able to obtain all standard imaging views and must be able to perform standard TNE that will allow the identification of structural heart disease. The assessment will be conducted by a paediatric cardiologist and a second examiner (advanced level TNE neonatologist or paediatric cardiologist), both not involved in the training of the candidate. The trainee will be given a certificate by the primarily responsible paediatric cardiologist (see below). An examination fee of CHF 300. - will be paid by the trainee to cover the expenses of the examiners (CHF 100. - each; the remaining CHF 100. - being required to cover administration costs, and being administered by the TNE steering committee.). A maximal number of two failed tests per examinee are accepted.
- Each trainee has a **primarily responsible paediatric cardiologist** for the training. This person can delegate part of the supervision to other colleagues, but has the responsibility to perform the final assessment and to sign the logbook and the certificate.
- During the first **three years after certification**, a minimal number of 50 performed echocardiograms per year are required to maintain the certificate core level. At the end of the 3 years, the logbook must be signed by the supervising paediatric cardiologist.
- Neonatologists with a certification in core level TNE can reach **advanced TNE level** as follows: (1) Regular TNE training in neonatal echocardiography in a perinatal centre level 3 during at least 5 years with a total number of at least 100 documented TNE examinations per year. (2) Regular participations to interdisciplinary discussions with paediatric cardiologists (i.e. presentations of cases with echo, discussion of echo findings). (3) Participation as a teacher to a core level theoretical course. All conditions (1) to (3) have to be fulfilled, signed by the supervising neonatologist and paediatric

cardiologist and reported to the steering group to issue the certificate. The function and position of an advanced level TNE neonatologist only exists in the team of a perinatal centre level 3.

- The process of TNE training and examination is observed by a **steering group** consisting of 2 neonatologists and 2 paediatric cardiologists, who are delegated/elected from the board of their respective society (Swiss society of neonatology and Swiss society of paediatric cardiology) for the duration of 4 years. One re-election is allowed.
- It is the responsibility of each centre to install a **common digital system** for the storage and analysis of all ("neonatal" and "cardiologic") echo studies and to install an ongoing, individually optimised, analysing / reviewing process for TNE studies between paediatric cardiologists and neonatologists.
- A core-level TNE neonatologist has the liberty to allow access to echo machines to **interested fellows**, provided that this is done under his strict supervision. Thus, each echo performed at the neonatal unit is under the responsibility of the accredited core TNE neonatologist.
- TNE training in foreign countries is theoratically possible, but each individual request needs to be addressed to the TNE steering committee **in advance**, in order to be reviewed and validated.

Indications for TNE (Mertens et al, J Am Soc Echocardiogr 2011)

1. Clinically suspected PDA, especially in VLBW neonates during the first 24 to 72 postnatal hours and beyond.
2. Assessment of infants with perinatal asphyxia
3. Abnormal cardiovascular adaptation presenting with hypotension, lactic acidosis, or oliguria during the first 24 postnatal hours and beyond in VLBW infants to diagnose low systemic blood flow state.
4. Suspected persistent pulmonary hypertension in neonates
5. Congenital diaphragmatic hernia

If structural congenital heart disease (CHD) or significant arrhythmia is clinically suspected in a neonate, the infant should be clinically assessed by a paediatric cardiologist, and echocardiography should be performed by a person trained in paediatric echocardiography and supervised by a paediatric cardiologist. In infants without any clinical suspicion for CHD, the first echocardiographic study must be a comprehensive examination assessing both structure and function. This initial study can be performed by a person with at least core training in TNE. The initial interpretation of this comprehensive study can be done by an advanced TNE-trained person, but it is recommended that the study should be reviewed within a reasonable time period by a paediatric cardiologist.

Standard imaging TNE: minimal requirements

1. Anatomy:
    a. Normal anatomical structure of the heart as it relates to the standard echocardiographic windows will be presented, including:
        i. Anatomy of the inflow tracts
        ii. Anatomy of the great vessels (outflow tracts)
        iii. Anatomy of the heart valves
        iv. Anatomy of the cardiac chambers
    b. Skills:
        i. 2D imaging of the neonatal heart using the LAX, SAX, high parasternal ductal/arch view, apical and subcostal echocardiographic windows
        ii. Use of M-mode to measure the LA:Ao ratio
        iii. Use of PW Doppler and Colour Doppler to demonstrate normal blood velocities across heart valves and through the outflow tracts.
2. LV systolic function:
    a. LV end-diastolic and end-systolic dimension (2D or M-mode)
    b. LV end-diastolic and end-systolic posterior wall thickness (2D or M-mode)
    c. LV end-diastolic and end-systolic septal wall thickness (2D or M-mode)
    d. LV shortening fraction (2D or M-mode)
    e. LV EF (2D Simpson)
3. LV diastolic function:
    a. MV E-wave peak velocity (PW Doppler)
    b. MV A-wave peak velocity (PW Doppler)
4. Assessment of pulmonary hypertension:
    a. TR peak velocity (CW Doppler)
    b. Pulmonary regurgitation, early diastolic velocity (PW/CW Doppler)
5. Assessment of PDA:
    a. Narrowest dimension of duct (2D)
    b. Shunt directionality (Colour/CW/PW Doppler)
    c. Peak and mean gradient of ductal flow (CW/PW Doppler)
6. Assessment of atrial-level shunt:
    a. Shunt directionality (Colour Doppler)
7. Assessment of pericardial effusion (if pericardial effusion suspected):
    a. Measurement of pericardial effusion in diastole (2D)

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