

Recommendations from the Association for European Paediatric Cardiology for training in diagnostic and interventional cardiac catheterisation

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CARDIAC CATHETERISATION IN PATIENTS WITH congenital cardiac disease includes both diagnostic studies and interventional treatment. Diagnoses include a wide range of congenital and acquired cardiac lesions. The patients range from neonates to adulthood. With the introduction of non-invasive diagnostic techniques such as echocardiography, computed tomography, and magnetic resonance imaging, the need for invasive diagnostic studies has decreased. At the same time, treatment by catheter intervention techniques has steadily increased. At present, diagnostic invasive studies are mostly limited to more complex cases. As opposed to echocardiography and MRI, cardiac catheterisation and catheter intervention are unique for their invasive nature and the fact that in many cases, treatment is part of the procedure.^{1,2} These trends have implications for doctors in training for cardiac catheterisation and catheter intervention.

This document summarises the requirements for training in diagnostic and interventional cardiac catheterisation, which should be provided at three levels, basic, intermediate, and advanced and should

include both knowledge and skills.³⁻⁵ It does not include recommendations for invasive electrophysiology.

Delivery of training

Training should not be undertaken in a random fashion, but should be focused according to the level of training to be achieved. Trainees should only be involved in procedures appropriate for their level of experience and training. In regular appraisal meetings, the trainee and the trainer should set goals, and evaluate whether these goals are being met within a realistic time frame.

Levels of training

Basic level

The basic level is required of *all* trainees to perform as a competent paediatric cardiologist. This training includes an understanding of the indications, complications, and limitations of diagnostic cardiac catheterisation and common catheter interventions (Table 1).

In addition to the knowledge and skills set out in Table 1, the trainee should perform at least

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Table 1.

Basic training level
<p>Knowledge</p> <ul style="list-style-type: none"> • Formal training in radiation protection • Radiological anatomy of the cardiovascular system • Indications and limitations of diagnostic cardiac catheterisation • Indications and limitations of common interventional techniques • Potential complications of cardiac catheterisation and their management <p>Skills</p> <ul style="list-style-type: none"> • Obtain informed consent, including an explanation of the benefits and potential risks of the procedure • Interpretation of haemodynamics and oximetry • Calculation of blood flow, shunts, and resistances • Interpretation of angiography • Use of catheter data to select cases for surgery • Communicate the results of catheter studies • Selection of patients for common interventional procedures • Independently perform pericardiocentesis and balloon atrial septostomy

10 balloon atrial septostomies and five pericardiocentesis procedures.

Intermediate level

Training to an intermediate level will enable a paediatric cardiologist to perform diagnostic cardiac catheterisation independently and a limited range of simpler interventional procedures such as balloon pulmonary and aortic valvoplasty, occlusion of patent arterial ducts, pulmonary artery, and coarctation/reoarctation angioplasty (Table 2). Many interventional procedures have a diagnostic component as well, and the trainees should obtain competence in using the diagnostic component of these procedures.

The trainee should perform 100 diagnostic cardiac catheterisation procedures of which 75 should be as a first operator. The trainee should also perform 100 interventional procedures of which 50 should be as a first operator, under supervision. These interventional procedures should include a variety of techniques such as occlusion of patent arterial duct, balloon dilation of pulmonary and aortic valve, pulmonary artery angioplasty, and coarctation/reoarctation angioplasty.

Advanced level

Training at the advanced level will enable a paediatric cardiologist to perform the majority of interventional procedures, including those that require a high level of skill. This level can only be obtained after completion of the normal paediatric

Table 2.

Intermediate training level
<p>Knowledge</p> <ul style="list-style-type: none"> • A working knowledge of equipment used in the catheterisation laboratory, including pressure transducers, physiological recorders, blood gas analysers, image intensifiers, and digital image acquisition systems • Knowledge of materials used in the equipment and techniques to carry out common interventions in congenital cardiac disease for diagnostic cardiac catheterisation and a limited range of interventions • An understanding of medico-legal and ethical issues related to interventions <p>Skills</p> <ul style="list-style-type: none"> • Obtain informed consent, including an explanation of the benefits and potential risks of the procedure • Prepare a detailed plan of how catheterisation is to be performed and how important information is to be obtained • Plan what equipment is necessary • Plan and supervise management before and after catheterisation • Acquire vascular access in all ages • Manage anticoagulation during the procedure • Choose appropriate catheters • Manipulate catheters successfully and safely • Acquire appropriate pressure and oximetry data in a logical sequence • Perform angiography, including selection of image intensifier angles, magnification, coning, contrast volume, rate of delivery, catheter type, size, and position • React quickly and appropriately to adverse changes in rhythm or haemodynamics • Manage intraprocedural complications such as tamponade (pericardiocentesis), haemothorax (chest drain insertion), and arrhythmias (drug treatment, cardioversion, and temporary pacing) • Manage post-procedure vascular complications, including thrombolytic treatment • Participate in audit of activity in the catheterisation laboratory • Perform diagnostic cardiac catheterisation independently • Perform a limited range of interventions as first operator under supervision (occlusion of patent arterial duct, balloon dilation of pulmonary and aortic valves, pulmonary artery angioplasty, and reoarctation angioplasty) • Teach other staff such as nurses, technicians, and junior medical staff in the catheter laboratory

cardiology training and basic and intermediate-level competencies should have been achieved. To achieve this, it is anticipated that continuous and intense exposure to a wide variety of interventions will be needed for several years (Table 3). The trainee should be able to perform independently procedures listed in Table 3, such as occlusion of the arterial duct, coarctation/reoarctation angioplasty, stenting of aortic coarctation and pulmonary arteries, a variety of embolisation procedures, and retrieval of devices or foreign bodies. More complex procedures

Table 3.

Advanced training level
<p>Knowledge</p> <ul style="list-style-type: none"> • A wide knowledge of literature and studies relevant to catheterisation and intervention, including recent innovations • A thorough understanding of the materials and specialised equipment required for interventional procedures in congenital cardiac disease • Technical details of all interventional procedures used in congenital cardiac disease • Technical problems associated with specific interventions and their solutions • The range of approaches available to solve interventional problems • How to use a wide range of imaging modalities to support interventional work, for example, TOE guidance, intracardiac echocardiography, magnetic resonance imaging, three-dimensional imaging <p>Skills</p> <ul style="list-style-type: none"> • Select intervention cases on the basis of comparing risk and outcome against surgical alternatives • Select the best interventional solution to the patient's problem • Form a detailed plan of the interventional approach, including strategies and equipment to deal with difficulties • Demonstrate a high level of procedural judgment • Carry out long-term follow-up of patients after interventional procedures • Undertake research activity related to cardiac catheterisation and intervention • Teach cardiac catheterisation • Perform the following interventions independently: occlusion of patent arterial duct, balloon dilation of pulmonary and aortic valves, pulmonary artery angioplasty, and coarctation/recoarctation angioplasty • Perform the following interventions as first operator under supervision: device occlusion of atrial septal defect, device occlusion of patent arterial duct, primary coarctation angioplasty, coarctation stenting, pulmonary artery stenting, stent redilation, embolisation of collateral vessels, and retrieval of foreign bodies • Collaborate with experts in performing complex interventions such as: trans-septal puncture, blade septostomy, stenting of the atrial septum, radiofrequency perforation of pulmonary atresia, ductal stenting, stenting of venous pathways after Senning and Mustard operations, transcatheter VSD closure, occlusion of coronary artery fistula, and myocardial biopsy • Teach other staff such as nurses, technicians, and junior medical staff in the catheter laboratory

listed in Table 3 will need to be performed in collaboration with an expert.

No specific numbers are required, but trainees need to be certified as competent by their trainers

on the basis of ongoing performance of complex procedures.

Assessment of training

A logbook should be maintained by the trainee to document all diagnostic and interventional procedures undertaken by the trainee. In addition, attendance at catheter conferences and teaching sessions should be documented. The trainer(s) should perform regular standardised direct observation of procedural skills during a procedure and evaluate and provide feedback to the trainee.

It should be understood that merely achieving the minimum numbers of procedures is not adequate. This should be combined with assessments by the trainer, who should certify the trainee as being competent for the appropriate level of training.

Institutional requirements for diagnostic and interventional cardiac catheterisation

The training institute should be equipped with an up-to-date cardiac catheterisation laboratory for infants and children.⁶⁻⁷

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