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The involvement of nurses in clinical echocardiography

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ABSTRACT

Echocardiography is a basic examination in cardiology used to assess the anatomy and function of the heart. An echocardiography nurse is a health care specialist who is able to use echocardiographic equipment to obtain images of the heart. Standards for echocardiography personnel vary widely between countries. In the Czech Republic, there is no training program for nurses to carry out echocardiograms and the work is done almost exclusively by physicians. In many other countries, including the United Kingdom and the USA, specialist nurses carry out and report echocardiograms independently. In this article, we compare requirements for echocardiography nurses in different countries.

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Introduction

Echocardiography is a standard examination in cardiology used to assess the anatomy and function of the heart. Personnel requirements for this procedure vary considerably between countries, and the role of the nurse in clinical echocardiography is evolving [1, 2, 3].

In this paper, we describe requirements for echocardiography nurses in the Czech Republic and compare them to standards in other countries – education, professional qua-

lification, certification, carry out TTE, report examination and physician's review (Table 1).

Basics of echocardiography

An echocardiogram is an examination that uses high frequency waves (ultrasound) to produce images of the heart. An echocardiogram is carried out for a variety of reasons, although it is mostly used to assess the anatomy and function of the heart and its valves [4, 5]. Pulses of ultrasound are sent from the echocardiographic probe toward the heart, and the reflected waves (echoes) that bounce back from

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Table 1 – Requirements and standards for echocardiography nurses in different countries

Country	Czech Republic	Belgium	United Kingdom	USA
Education	Medical doctor	Bachelor	Bachelor	Bachelor
Professional qualification	Not available	None	Accredited program	Accredited program
Certification	Not available	Certification exam (not compulsory)	Certification exam	Certification exam
Carry out TTE	Not available	Independent	Independent	Independent
Report examination	Not available	Usually independent	Independent	Independent
Physician's review	Not available	Necessary	Not necessary	Not necessary

TTE – transthoracic echocardiography

the heart and other structures are detected by a receiver (built into the same probe) and displayed as a picture on a monitor.

There are various forms of echocardiography. Transthoracic echocardiography (TTE) uses a probe that is placed on the chest; a lubricating jelly is used to ensure good contact with the skin (Fig. 1).

Doppler echocardiography uses the same probe, but additionally, can also measure the direction and speed of blood flow within the heart. Transesophageal echocardiography (TEE) is an alternative method in which the probe is passed into the patient's esophagus [5, 6, 7, 8] (Fig. 2).

Common indications for TEE are to rule out endocarditis, cardiac clots (prior to cardioversion), and assess the degree and cause of valvular regurgitation. Stress echocardiography uses a treadmill, or medications such as dobutamine, during the echocardiography procedure, to make

the heart beat faster and stronger. This is done to assess heart muscle function under increased workloads and at increased heart rates. Advanced technologies, such as three-dimensional speckle tracking and contrast echocardiography are also available, but are mostly used for research purposes in highly specialized departments [9, 10, 11]. Intracardiac echo (ICE) uses a probe that is inserted inside the heart via the femoral vein. The technique is invaluable for interventional electrophysiology procedures such as transseptal punctures [12, 13]. An ICE probe is inserted into the heart by the physician, but a trained nurse is able to find basic projections to navigate catheters during catheter ablation (Fig. 3).

Personnel and technical equipment in the echocardiography laboratory

The echocardiography laboratory is a facility with the primary purpose of accepting referrals for echocardiographic examination [14, 15]. The goal is to provide a full scope of echocardiography services and engage appropriately trained personnel to carry out and interpret adult and/or pediatric examinations. All laboratories should establish protocols for the acquisition, reporting, and recording of echocardiographic examinations. These protocols should be reviewed and accepted by all staff involved. A fully equipped and perfectly functioning echocardiographic machine is essential if optimal examinations are to be produced. In addition, an examining bed, chairs for the personnel, blood

**Fig. 1 – Transthoracic echocardiography****Fig. 2 – Transesophageal echocardiography**



Fig. 3 – Intracardiac echocardiography in České Budějovice Hospital

pressure monitoring, oxygen, and pulse oxymetry, as well as intravenous and resuscitation equipment must also be available [16].

Personnel staffing standards and requirements vary widely between countries. In some countries, such as the USA, a very structured model for personnel involved in echocardiographic examination has been put in place. In other places, such as the Czech Republic, echocardiography examinations are done exclusively by physicians, and no standards involving personnel who are not physicians are available. According to recent guidelines [3] there should at least be a designated medical director, who is a licensed physician, responsible for supervision of the staff and for the delegation of responsibilities. Additional duties include setting local guidelines, performing clinical studies, training doctors and sonographers, auditing, and clinical meetings.

Where nationally permitted, specialty echocardiography personnel independently carry out and report the results of echocardiographic studies, while support personnel are present for patient scheduling, record keeping and maintenance of laboratory equipment.

Concept of an echocardiography nurse

An echocardiography nurse is a medical care specialist who is proficient in the use of echocardiographic equipment to obtain images of the heart and blood vessels [17]. They are sometimes known as cardiac sonographers (in the USA), echo technicians, or cardiographers (UK and Belgium, respectively) or in many other cases echocardiography nurses (even though they do not necessarily need to have a nursing background).

As a profession, echocardiography requires good judgment and the ability to provide competent medical services to patients. The role of echocardiography technicians, their education, training and responsibilities vary substantially between hospitals and countries. In general, their role is to check the indication for echocardiographic examination, carry out a standard echocardiography examination, and record and report the results [18].

Echocardiography nurses in the Czech Republic

The role of an echocardiographic nurse in the Czech Republic is solely that of a doctor's assistant. Within echocardiography services, the role of the nurses is to schedule patients for the procedure, confirm patient identification, and position them on the examining bed. The nurse may take part in the initial assessment, including taking note of the patient's cardiac history, allergies, and the patient's current medication regimen, but these tasks mostly remain the responsibility of the doctor. During TEE, the nurse may also be asked to establish intravenous access, administer conscious sedation, prepare esophageal intubation supplies, disinfect the transducer, confirm the availability of emergency airway equipment, and assist the physician by positioning the patient in order to minimize risk of aspiration.

As far as we know, there are no training programs for cardiac sonographers and there are no hospitals in the Czech Republic where echocardiographic examinations are performed by personnel that are not physicians. All of our attempts to establish a nurse-performed echocardiographic service in Czech hospitals have been turned down by the relevant department heads. Standards for allied health professionals such as radiographers and anesthetic nurses are listed in the Czech Licensing Law (96/2004) [19, 20, 21]. However, a possible role for echocardiographic technicians is not mentioned in the law.

A physician, wishing to become a licensed cardiologist and independently perform echocardiograms, must first carry out and interpret at least 300 echocardiograms (although, not always under supervision) in a hospital certified for postgraduate training. The Czech Medical Chamber issues specialized licenses for performing TEE, congenital heart disease echocardiography, fetal echocardiography and peri-procedural echocardiography in children with congenital heart disease.

The Cardiovascular Imaging Association of the European Society of Cardiology (EACVI) provides individual certification and laboratory accreditation in echocardiography in an effort to uniformly raise the quality standards across Europe. Echocardiography technicians can apply for certification, but there is not a single non-physician professional certified from the Czech Republic (www.escardio.org).

Echocardiography nurses in Belgium

Echocardiography examinations are traditionally performed by doctors in small hospitals and private practices, and by echocardiography nurses in university and large non-university hospitals. A person seeking a job as an echocardiographic nurse must obtain a bachelor's degree in nursing or in biomedicine. Traditionally, echo technicians have received on-the-job training lasting 12 months, which includes being tutored and supervised by experienced echo technicians and the clinical director responsible for echo services. There is no formal cardiac ultrasound training and no certification examination required for echocardiographic nurses, but there are regular in-house examinations. Presently, increasing numbers of sonographers are taking the EACVI exams to achieve accreditations recognized by the European Society of Cardiology. Most sonographers

carry out echo studies independently and one sonographer is usually on-call to cover 24-h echo services. A clinical director should legally oversee all images, ideally at the time of the examination, but this is not always the case.

The Onze Lieve Vrouw Hospital in Aalst, Belgium has a busy echocardiography laboratory that performs more than 20,000 transthoracic and 2000 transesophageal echocardiograms each year. The staff includes nine echocardiography technicians, five physicians in training (not always present in the laboratory), two research fellows, and a director responsible for the echocardiography program. Training of sonographers is on-the-job, although there is a trend toward passing the relevant exams and achieving EACVI accreditation.

Echocardiography nurses in the United Kingdom

Echo technicians in the UK need to become Cardiac Physiologists first by completing an accredited bachelor degree under the NHS Practitioner Training Programme. The above-mentioned degree program is offered by several universities across the UK. The programs include work-based training in the NHS over a three-year period.

Trainee Cardiac Physiologists are mostly given on-the-job training. The training starts with electrocardiograms, 24-h Holter monitoring, stress tests, tilt-table tests, and then progresses to more specialized skills, such as pacemaker/ICD checks and echocardiography. An echocardiographer routinely performs diagnostic transthoracic echocardiography and interprets the results in adherence to national guidelines. Transesophageal and other more complex echocardiograms are mostly done by a Consultant Cardiologist or by a physician from the Cardiology department.

Specialization in echocardiography is organized by the British Society of Echocardiography (BSE). Every member of the BSE, including echo technicians, has to undertake the accreditation process that consists of a written as well as practical assessment. There is an agreement with the EACVI for reciprocity between the BSE and EACVI accreditation.

Echocardiography nurses in the USA

Anyone wishing to become a sonographer in the USA has to complete a cardiac sonography program that is accredited by the Commission on Accreditation of Allied Health Education Programs. To enter the program, the applicant must have a minimum of a two-year degree from a clinically related school in allied health. The program lasts 14 months, is full time, and provides clinical training, including hands-on practice and an academic curriculum in echocardiographic principles, technology, physics and instrumentation. By attending the accredited program and upon graduation from the program, sonographers are eligible to apply to take the national certification examinations offered by the American Registry of Diagnostic Medical Sonographers or Cardiovascular Credentialing International. By successfully completing the certification exams, they are awarded a credential of “registered” in that field, and most employers hire only registered sonographers.

Quality is assured by an established quality assurance program, including regular reviews of study acquisition and interpretation, usually by regular internal review of a fixed number of random studies over a set time interval. Processes that allow for constructive feedback involve staff meetings, external reviews and validation against other diagnostic modalities. The sonographers are legally responsible for the quality of their work and are usually insured against possible lawsuits.

The České Budějovice Hospital experience

There is an established Echocardiography department at České Budějovice Hospital, where all scans are carried out, recorded, and reported by one of the staff cardiologists. However, implementation of nurses in the process of acquiring echo images was not successful. On the other hand, we were able to train our electrophysiology nurses to perform ICE examinations during ablations for atrial fibrillation (Fig. 3). In the electrophysiology department, the ICE is used to navigate a needle for a transseptal puncture and to closely monitor the exact position of the ablation catheter. Nurses have been trained to find basic structures such as the cavotricuspid isthmus, interatrial septum, pulmonary veins, and the mitral isthmus.

After the doctor in charge of the procedure introduces the echo probe in the heart via the femoral vein, a specialist nurse takes over, monitors the position of the probe and assists the physician, within the limits of their training. Using this approach, we have been able to free up the physician who was previously needed to manage the ICE during the ablation procedure.

Conclusion

Unlike the USA and some countries in Western Europe, echocardiography has traditionally been performed exclusively by physicians in the Czech Republic. It reflects the physician-led care model in the Czech Republic and the relatively low competencies of nurses. It is difficult to believe that what works in many other countries cannot also work in the Czech Republic, but it may need a substantial change in mindset. It is likely that with the increasing number of university-educated nurses, coupled with the number of physicians leaving the Czech Republic soon after graduation, we will undoubtedly see, by necessity, some departments turning to trained nurses to perform echocardiograms in the near future.

Conflict of interest

The authors have no conflict of interest to disclose.

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