All intensivists need echocardiography skills in the 21st century

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ABSTRACT

The value of echocardiography to the intensivist has been well recognised in the past two decades. Regular reviews of the subject can be found in all major journals. Most intensivists surveyed feel that echocardiography is the way of the future. Yet, despite the undisputed advantages of echocardiography, uptake of the technique into the intensive care unit has been slow. Reasons for this are multiple, and include conservatism among senior clinicians and limited availability of equipment. Above all, the lack of a consistent and widely available education program has limited the opportunities for intensive care trainees to learn echocardiography. There is a need for a "three-tier" program, where all intensivists learn the basic skills to perform a focused examination on a patient whose condition is unstable, while those with a special interest develop more comprehensive skills or go on to lead a critical care echocardiography program.

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The first reported use of ultrasound to assess cardiac function was over 50 years ago,[1] and by the 1970s and 1980s increasingly sophisticated ultrasound techniques were well established in cardiology. The application of echocardiography has been slower in critical care medicine. Traditionally, cardiologists or sonographers would visit the intensive care unit on request, undertake a "snapshot" study, often without any knowledge of the patient's underlying clinical condition or the changing pathophysiology arising from a dynamic disease process and active treatment. These studies were invariably reported as "technically difficult", and the information conveyed to the intensivist was often not particularly helpful.

In the past decade, the importance of dynamic critical care echocardiography has been recognised, performed by or under the guidance of an intensivist who understands the patient's pathophysiology. A number of comprehensive reviews have been published in each of the major intensive care journals.[2-4] Echocardiography has proven invaluable in a number of unique "intensive care" clinical problems, including the evaluation of haemodynamics in severe sepsis[5] and the haemodynamic consequences of mechanical ventilation, and in the titration of therapy during difficult weaning of ventilatory support.[6] When formally asked as part of a questionnaire on knowledge and understanding of the pulmonary artery (PA) catheter, 62% of Australian intensivists either agreed or strongly agreed with the statement, "For the future, do you think the use of echocardiography by intensive care specialists should supersede the use of PA catheters?"[7]

Defining the indications

The Australian and New Zealand Intensive Care Society (ANZICS) Committee on Echocardiography in Intensive Care first met in 2006. The Committee has proposed indications for echocardiography in intensive care, which have been circulated as a draft for discussion (Table 1). A number of the proposed indications are unique intensive care problems, and it seems obvious that an "intensivist–echocardiographer" is the best qualified person to undertake this evaluation.

Why do intensivists not welcome echo into their armamentarium?

There is a variety of reasons why echocardiography has not been aggressively adopted in intensive care. One is conservatism, particularly by senior clinicians who are comfortable with what they have always done and support the maxim "you can't teach an old dog new tricks". A second is cost, or perceived cost. The reality is that a high quality ultrasonograph with cardiac Doppler, an appropriate software package and appropriate probes for intensive care use can be purchased for under $100 000, which puts it in the same price range as a good quality intensive care ventilator or continuous renal replacement machine. And the third, and most important impediment, is the lack of accessible training and education.

Intensivist training in echocardiography

Unlike Europe, and especially France, where there is a strong national program to train all intensivists in echocardiography (Professor Michel Slama, Hôpital Sud Amiens, France, personal communication; see also *page 247*), Australia and New Zealand have no systematic program. Most intensivists with an interest in echocardiography organise time for themselves on an ad-hoc basis in echocardiography laboratories and cardiac operating theatres. A few specific training positions

Table 1. Draft indications for echocardiography in the critically ill patient*

Indications for transthoracic echocardiography

- Haemodynamically unstable patient
  - ➢ Assessment of ventricular contractility
  - ➢ Identification of major valvular abnormalities
  - ➢ Assessment of preload
  - ➢ Assessment of left ventricular diastolic function
  - ➢ Initial assessment for large intracardiac shunts
- Unexplained respiratory failure
- Left ventricular failure
- Right heart failure/pulmonary hypertension
- Suspected valvular disease
- Sepsis of unknown origin — initial assessment for features of endocarditis
- Clinical features suggesting presence of pericardial effusion and tamponade
- Suspected thoracic aortic pathology
- Onset of new heart murmur

Indications for transoesophageal echocardiography

- Inadequate transthoracic echocardiography
- Requirement for detailed assessment of cardiac valves, interatrial and interventricular septum and great thoracic vessels (ie, suspected aortic dissection)
- Suspected endocarditis
- Suspected cardioembolic events or screening for intracardiac thrombi before cardioversion
- Suspected dysfunction of a prosthetic valve
- Assistance in interventional techniques and assessment of intracardiac devices
- Resuscitation

* Draft for discussion produced by the Australian and New Zealand Intensive Care Society (ANZICS) Committee on Echocardiography in Intensive Care (Professor A McLean, Nepean Hospital, NSW, personal communication).

exist, such as the Fellow in Critical Care Echocardiography position at Nepean Hospital, New South Wales. The distance education Postgraduate Diploma in Perioperative and Critical Care Echocardiography from the University of Melbourne has been growing in popularity among intensive care trainees. This provides a strong theoretical grounding, with a cardiac anaesthetic flavour, but no practical experience — it is possible to complete the entire diploma without ever picking up an ultrasound probe.

Focused echocardiographic examinations

While intensivists have generally been conservative, emergency physicians have been embracing ultrasound techniques with gusto. The first systematic program was FAST (Focused Abdominal Sonography in Trauma). This is a limited examination, deliberately designed to quickly answer a specific clinical question: is there free fluid in the abdomen? In no way does a FAST examination replace a comprehensive abdominal ultrasound examination, nor should it. There are now many FAST training programs worldwide, with appropriate systems of quality assurance and review.

The experience of FAST suggests a similar focused or goal-directed approach might be applicable in intensive care. This has been validated in the United States in "echo-naive" intensivists, using both transoesophageal[8] and transthoracic[9] echocardiography to predict haemodynamic status.

An analogous focused echocardiographic examination is applicable to all intensivists and emergency physicians, and a number of these have been developed worldwide. Nepean Hospital runs a program entitled RACE (Rapid Assessment by Cardiac Echo), which is being taught to emergency physicians and intensive care trainees. It is a focused examination designed to answer specific clinical questions using mainly two-dimensional echocardiography, and in no way claims to achieve the same as a comprehensive echo and Doppler examination by a properly trained sonographer. The first pilot courses were overwhelmed with demand.

Erik Sloth has developed a similar program in Denmark.[10] FATE (Focussed Assessed Transthoracic Echocardiography) is taught to intensive care trainees, and includes training in acquiring the basic measurements and interpreting these findings in a clinical context. The examination and algorithm can be printed on two sides of a pocket-sized laminated card. The FATE algorithm also includes bilateral ultrasound examination of the pleural space. Reliable diagnosis of pleural effusion can be important in critically ill patients, as this can impair respiratory function and cause cardiovascular instability. Other such programs, all with interesting acronyms, have also been developed, such as FEER (Focused Echocardiographic Examination in Resuscitation).[11]

Intensive care echocardiography in 2007

In 2007, an intensivist should expect and insist on the ready availability of echocardiography, 24 hours per day, 7 days per week. Aside from the rare institution with a particularly cooperative cardiology department, it is therefore incumbent on the ICU to provide this service itself.

For a patient whose condition becomes unstable at 03:00, it is reasonable to expect a focused echo examination to answer the following questions:

- Is the heart working?
- Is it really full or really empty?
- Is there an acute valve rupture with torrential regurgitation?
- Is there an acute cardiac rupture or ventricular septal defect?
- Is there a tamponade?

None of these are subtle findings, and they can be reliably assessed by most intensivists after a specific period of training. All such examinations must be recorded and reviewed subsequently by a more experienced echocardiographer.

There are thus three levels of echocardiography training for intensive care practice:

- Level 1— the focused clinical examination, 24 hours per day, to answer immediate clinical questions.
- Level 2 — the trained echocardiographer, with more advanced knowledge and skills, and ongoing maintenance of skills and quality assurance. Ideally there will be at least one of these in every ICU.
- Level 3 — the program director or researcher in critical care echocardiography.

Most intensive care trainees recognise and want this. The challenge for us now is to make it happen.

Summary

The benefits of critical care echocardiography are well understood, and specific intensive care indications are now being defined. Given that the difficulty and time required for comprehensive echocardiography training will limit it to a subgroup of clinicians, it is reasonable to expect a "focused" examination from all other intensivists, to answer clinical questions 24 hours per day. This has been largely implemented in parts of western Europe, especially France. The challenge is now on the Australasian intensive care community to make this happen here.

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