Short title: Perioperative echocardiography BP

1. Purpose of review

The previous version of PG46 was published in 2014 and termed ‘cardiac ultrasound’. Since then, the scope of practice of cardiac ultrasound has expanded to include other areas of practice such as structural heart programs, assessment of acute clinical deterioration, pre and post operative assessment and use in some high-risk procedures such as liver transplantation. Furthermore, point of care cardiac ultrasound using the transthoracic approach has become increasingly common, with more formal training and certification has become an expected requirement for those undertaking comprehensive cardiac ultrasound procedures, better termed ‘echocardiography’. Hence it was considered that a review of PG46 was required.

2. Background and discussion

Ultrasound imaging of the heart is a means of providing enhanced diagnostic and monitoring information that is vital to the safe and appropriate conduct of surgery and anaesthesia in addition to patient assessment in other perioperative or procedural environments. It can be performed using a transoesophageal or transthoracic route.

With the growth in cardiac ultrasound by the transthoracic route as part of Point of Care Ultrasound (POCUS), it was considered by the PG46 Document Development Group (DDG) that it was important to distinguish comprehensive studies from cardiac POCUS because of the different training and reporting requirements and also the different contexts of use, Hence the term ‘echocardiography’ is used for the comprehensive studies considered by PG46, while ‘cardiac ultrasound’ and ‘cardiac POCUS’ would be used to for transthoracic cardiac ultrasound for point-of-care assessment. Cardiac POCUS was thus separated from PG46 and is described in *PG47 Perioperative diagnostic Point of Care Ultrasound (POCUS)*.

While transoesophageal echocardiography (TOE) is largely confined to use during operative or cardiac interventional procedures, transthoracic echocardiography (TTE) is useful in all phases of perioperative medicine.

PG46 guides echocardiography in perioperative practice for ANZCA Fellows and trainees. It may be considered by others qualified through ANZCA in perioperative medicine, although it is recognised that other colleges (eg RACP and its societies) have their own echocardiography training recommendations. It covers training in, practice of, and continuing professional development in echocardiography. It is not otherwise intended for the guidance of fellows and trainees of other colleges.

Echocardiography is used to describe the conduct of comprehensive TOE and TTE examinations by suitably trained practitioners. This also includes “Basic” TOE studies. The use of transthoracic cardiac ultrasound for point-of-care assessment is covered by *PG47 Perioperative diagnostic Point of Care Ultrasound (POCUS)* because such studies require less comprehensive training to undertake and are usually part of a focussed assessment to address a specific clinical situation undertaken in conjunction with other clinical information.

2.1 History of cardiac ultrasound in anaesthesia

The use of ultrasound in anaesthesia for both imaging and guiding procedures has increased rapidly in the past decades. This has been driven in part by technological improvements enabling deployment to the clinic and operating room, and improved image quality and modalities. The use of echocardiography in anaesthesia started in the 1990s with TOE in cardiac anaesthesia. This was formalised in 2004, when ANZCA published recommendations on the training and experience requirements for perioperative echocardiography. Since then, the use of cardiac ultrasound by anaesthetists has grown to include TOE use during non-cardiac surgery, and TTE imaging intra-operatively and perioperatively. The concept of ”Basic” TOE studies is in keeping with use outside the cardiac surgical environment, where less sophisticated modalities and analysis is used, usually to assess ventricular function and filling as well as basic valvular pathology. The advent of structural heart interventions, typically in cardiology laboratories, requires sophisticated assessments of specific aspects of the heart during a procedure. Such examinations are referred to as “Limited” TOE studies and require the level of skills and training as for comprehensive studies complemented by additional levels of relevant expertise.

Use by other critical care specialties (intensive care medicine and emergency medicine) has developed in a similar manner to that in anaesthesia, especially with cardiac POCUS.

3. Justification for PG46

Patient safety dictates that standards are required for all areas of practice of all medical practitioners and there is an increasing need for them to be documented. The inaugural document was promulgated in 2004 with subsequent review in 2013/14. The 2025 review considered whether there was a clear continued need for the guideline, whether there were sufficient grounds to support such a guideline, and if so, whether the current document needed revision to reflect changes in practice.

3.1 Practice of anaesthesia

ANZCA promulgates advice on clinical aspects of the practice of anaesthesia and perioperative medicine. Cardiac ultrasound is part of the scope of practice of anaesthetists, being practised initially by cardiac anaesthetists, and subsequently also by other anaesthetists and perioperative medicine practitioners involved in the assessment of patients with potentially significant cardiac disturbances. Core training for FANZCA includes familiarity with, but not the practice of, any form of cardiac ultrasound. For that reason, PG46 contains recommendations on the further training required for practice of echocardiography, along with recommendations for continuing professional development.

3.2 Benefits and indications

The use of cardiac ultrasound by anaesthetists provides benefits for their patients. Comprehensive echocardiography studies provide a detailed diagnostic assessment of the heart and surrounding structures. Such studies are now considered standard of care in cardiac surgery [1] and structural heart interventions [2] and are of value in the preoperative assessment of patients with suspected pathology. Guidelines for TTE have also been published. [3]

Basic TOE studies provide an assessment of haemodynamic state and of any cardiac pathology that might affect haemodynamic state which may be of vital importance in anaesthesia and critical care beyond procedures on the heart. This includes assessment of acute cardiorespiratory deterioration, pre and post operative assessment, and use in some non-cardiac procedures associated with haemodynamic instability such as liver transplantation. [4, 5] In critical care, the most common indications for TOE are hemodynamic instability, trauma, cardiac arrest, respiratory failure, and procedural guidance.[6] While traditional clinical examination and

monitoring continues to be the mainstay, there is increasing recognition that more advanced techniques help resolve dilemmas where different conditions have similar clinical appearances but require very different responses or where accurate assessment and diagnosis has significant management implications. Cardiac ultrasound, whether point-of-care or basic TOE studies, or more comprehensive echocardiography is an imaging modality that can give vital information not readily discernible by other means. Guidelines have been developed describing the appropriate indications and conduct of cardiac ultrasound in noncardiac surgery. [7, 8]

Development of appropriate standards for the practice of cardiac ultrasound by anaesthetists minimises the risks to patients from incorrectly performed or interpreted studies.

3.3 Risks to patient safety

As there are risks to patient safety associated with either the technique, or reporting and subsequent use of findings, these guidelines have been developed to assist practitioners performing these procedures. The risks inherent in the technique are mainly those of transoesophageal echocardiography (TOE). [1, 9, 10] Those risks include but are not confined to: damage to the teeth, pharynx and oesophagus including mucosal injury, oesophageal tears or rupture or thermal injury. For these reasons it is important that those practising echocardiography are appropriately skilled, so that the risk of harm is minimised and appropriate responses are taken should injury occur. Although obtaining all standard views should be the aim of a comprehensive study, some views may be unobtainable in some patients and, for TOE, excessive probe manipulation to obtain a complete comprehensive study in circumstances where this is demonstrably unlikely also risks trauma and a more limited study can be undertaken on a case-by-case basis.

The risks inherent in reporting and its subsequent use are those of misinterpretation with subsequent incorrect changes in anaesthetic or surgical management. Echocardiography trainees should check with their supervisor (or another experienced practitioner) before altering or advising on clinical management based on their cardiac ultrasound findings, unless in an emergency.

Avoidance of distraction must be considered. In some situations where TOE is undertaken by the patient's anaesthetist on anaesthetised patients during procedures, an assistant may be required to ensure appropriate monitoring and observation of the patient is being performed. This is to ensure timely detection and intervention for any change in the patient's clinical status. In this context, the assistant may be another anaesthetist or anaesthesia trainee or, noting that the anaesthetist is immediately available, a suitably qualified assistant to the anaesthetist as described in *PS08 Assistant to the Anaesthetist*.

3.4 Standards for cardiac ultrasound

The relevant standards are related to those of other specialties within Australia and New Zealand, and those of anaesthesia bodies internationally, and cover the training, continuing professional development of practitioners and the performance of cardiac ultrasound, including its documentation.

Within Australia and New Zealand, the Australasian College for Emergency Medicine has produced standards and the College of Intensive Care Medicine of Australia and New Zealand have produced recommendations for their own Fellows undertaking cardiac (and other) ultrasound studies, usually transthoracic cardiac POCUS and often in a situation of clinical deterioration. The Royal Australasian College of Physicians (RACP) has produced standards for the practice of cardiac ultrasound for cardiology trainees and Fellows. Each of these standards/recommendations has been developed specifically for the practice of that specialty.

International standards for anaesthetists have been developed by the American Society of Echocardiography/Society of Cardiovascular Anesthesiologists, [3, 11-13], the Association of Cardiothoracic Anaesthetists/British Society of Echocardiography,[14] and the European Association of Cardiovascular Imaging/European Association of Cardiothoracic Anaesthesiologists,[15, 16] and these standards have been considered when developing ANZCA recommendations. Achieving consistency with other anaesthesia organisations was one of the aims of the document.

While all the above standards are relevant, it was considered appropriate to develop a guideline specifically for Fellows and trainees of ANZCA for use within the practice of anaesthesia and perioperative medicine in Australia and New Zealand.

4. Other issues considered

4.1 Terminology

The use of 'echocardiography' to distinguish comprehensive examinations, or those undertaken in a 'limited' context by those trained at least to the level of comprehensive studies, from cardiac POCUS (point of care ultrasound) has been discussed above.

The term 'echocardiography trainee' has been used throughout to avoid confusion with 'trainee' in other contexts (eg anaesthesia trainee).

The terms 'study' and 'examination' are considered equivalent and used interchangeably throughout the document.

4.2 Comprehensive studies

Only a few terms have been used to define a full and comprehensive examination. These are the examinations typically performed when a patient is referred to a cardiologist for a TOE or TTE. While such an examination is usually requested for a specific purpose, it looks at the heart through multiple windows, in multiple views and uses multiple echocardiographic modalities (that is, two-dimensional pulse wave Doppler and continuous wave Doppler, with M mode and/or three-dimensional added as required).

Although obtaining all recommended standard views is the desired goal of a comprehensive study, it is recognised that this may not be achieved in every case due to factors including individual patient characteristics, anatomic variations, pathologic features, or time constraints. [12]

Any comprehensive study and report should attempt to answer the clinical question being asked. However, it is also expected to include any and all other significant findings unrelated to the original referral, and to be a "stand-alone" study documented in a formal report.

Echocardiography studies done before and after an interventional procedure should include the minimum views to ensure that post-intervention review is complete, and possible complications are identified (eg aortic dissection following cardiac surgery or pericardial collections following structural heart procedures). In cardiac surgery a comprehensive study should be performed initially provided clinical circumstances permit. When undertaking a limited study, or in emergency situations, it is recognised that a comprehensive study may not be appropriate.

4.3 Approaches to cardiac ultrasound – inclusion of TTE but not Transthoracic Cardiac POCUS

The 2004 iteration of PG46 covered comprehensive TOE studies. In the 2013/14 review, inclusion of TOE and TTE (comprehensive and goal-directed) was discussed. For this 2025 revision it was agreed that the concept of 'goal-directed' TOE (eg the use of TOE during acute

clinical deterioration) be re-framed and considered a limited study and require at least the competencies outlined for Basic TOE. As noted above, point of care transthoracic cardiac ultrasound is now covered by *PG47 Perioperative diagnostic POCUS*.

Separate documents for anaesthetist TOE and TTE have been considered, but it was concluded that the similarities between TOE and TTE are far greater than the differences. Both are cardiac ultrasound, with the same principles covering all ultrasound studies, the same cardiac pathologies being examined, and the same knowledge base. The main differences between TOE and TTE are probe position and resultant differences in image acquisition techniques related to probe position, and the risk of tissue trauma and requirement for sedation or anaesthesia for TOE.

The decision on whether to use TOE or TTE to aid decision making during acute clinical deterioration during a procedure needs to be based on available resources and appropriate expertise, access to the patient, and risk of the procedure. A formal recommendation can therefore not be made for the type of cardiac ultrasound in such circumstances, however TTE or Transthoracic cardiac POCUS may well answer the clinical question and be the sole modality needed if continuous monitoring is not required.

4.4 Documentation and audit

Comprehensive study findings must be a part of a patient's record. Images reflecting the comprehensive nature of the study need to be saved, and a full report written and included in the patient's notes. Limited studies should also be recorded as a part of a patient's record. However, it is recognised that time or other constraints may preclude keeping a record and it may be more appropriate to incorporate the study findings in the anaesthetic or other patient record along with, but not separate from, all the other clinical information being recorded.

For those reasons, recommendations for digital storage and reporting of studies have been made[17] and PG46 includes minimum standards for reporting cardiac ultrasound studies.

Echocardiography studies need to be available for audit and review, therefore images and associated reports need to be accessible from image archives rather than through individual patient records. The image archive should be able to be searched by patient, date, sonographer and the reporting physician, if a separate person. Regular audit sessions, as well as sharing interesting cases, are considered essential whether held within a given hospital, region or other grouping.

The ability to access and, if necessary forward, digital images allows for an anaesthetist with a minimum level of training to acquire, report and/or act on findings and then have them reviewed either contemporaneously or at a later date as appropriate while still in training and not meeting the full requirements of PG46. As an additional support, all anaesthetists even after meeting the minimum training and practice requirements of echocardiography, should have access to another practitioner with significant experience for support for both audit and assistance with more difficult cases.

4.5 Training

The guideline is for the guidance of echocardiography trainees (who may be Fellows or anaesthesia trainees) and credentialing bodies, rather than for certification to practise echocardiography. However, given the risks of incorrect techniques of TOE and incorrect interpretation of the studies, minimum standards for training were developed. While informed consent will always be required for medical treatment, it is especially important when education is the prime aim of any procedure.

Minimum standards for training include both knowledge and practical skills acquisition. Allowance has been made for the varied methods by which Fellows and trainees achieve these. As noted above, the minimum standards produced by other (international) anaesthesia bodies, along with the expert advice of the group of experts was used to develop the standards within PG46.

Sonographic anatomy for both basic and comprehensive studies should include coronary arteries and embryological remnants which are important to understand and differentiate from artifacts or pathology.

4.5.1 Volumes of practice

The numbers of studies required during training have been recommended after consideration of those required by other national and international bodies. [13, 15, 16, 18] Attainment of these numbers was considered realistic and reasonable by the DDG members. Careful consideration was given to the balance of directly supervised studies and other clinical studies, review of recorded studies and case reviews.

Simulation is gaining increasing recognition and popularity as a method of gaining skill in image acquisition, pathology interpretation and reporting, especially for TOE as it likely reduces to the exposure of patients to a learner if they train using simulation before on patients.[18] Simulator studies and pre-recorded cases must include several examples of abnormal left and right ventricular preload, contractility, afterload, valvular stenosis and regurgitation, pericardial effusion and massive pulmonary embolism.

4.5.2 Training courses

ANZCA does not endorse individual training courses in TOE or TTE. It is up to the echocardiography trainee and their supervisor to satisfy themselves that course organisers and sponsors (eg a society or university) have a curriculum which reflects the principles and points listed in PG46.

To assist those planning training, examples of echocardiography training and certification programs that provide either knowledge components or certification that are considered equivalent to meet some or all of the requirements listed in PG46, are listed in Appendix 1. The list of acceptable qualifications/accreditations is not exhaustive, and other qualifications/accreditations which are equivalent can be used to meet the knowledge requirement.

Likewise, programs with certification from recognised bodies are listed for comprehensive TOE and TTE. These programs have been considered by the DDG to provide evidence of equivalent training, however the principles of PG46 must otherwise be met, including safety and ongoing CPD.

4.5.3 Audit meetings

Audit meetings must present and discuss clinical cases, including images, and have commentary and discussion. They would be expected to run for approximately one hour. Minimum numbers of meetings have been stated for Basic TOE, and comprehensive TOE and TTE but more are highly desirable. Ongoing participation in these meetings is part of CPD maintenance.

4.6 Continuing professional development

Continuing professional development is an essential component of the practice of anaesthesia, and so recommendations on this are included. While cognisant of the principle underlying ANZCA Continuing Professional Development Program, namely that each practitioner should undertake continuing professional development appropriate to their practice, recommendations were made for those wanting further guidance. Note was taken of similar recommendations by other anaesthesia bodies.

Performance and/or review of at least 50 studies annually should include performing least 25 clinical studies. The remaining cases may be by case review or simulation.

These recommendations should support development of a high-quality service by ANZCA Fellows and trainees.

4.7 Recognition of prior learning

This was included, as those who have practised cardiac ultrasound from its entry into anaesthesia practice will have gained their experience and training prior to this version of PG46. The setting in which they acquired this training and experience was different from that of today, which is recognised in the statement in the document.

4.8 Potential restraint of trade

The document development recognised the need for all practitioners of cardiac ultrasound to meet appropriate standards as well as the need to ensure that those practitioners with appropriate skills were not excluded.

4.9 Conflicts of interest

All those who were involved in the document development at the various stages declared conflicts of interest, and any identified conflicts, which included involvement in courses teaching cardiac ultrasound, were managed and mitigated.

5. Literature search methods/methods of expert consensus development

The document development group met on two occasions, in 2023 and 2024, to develop consensus on the elements required for revision of PG46, which built on the work of earlier versions. References were sourced by members who drew on their own resources and also by conducting literature reviews in specific areas. Articles were then collected in a shared workspace (Microsoft SharePoint). Ongoing review of the document took place over 12 months using a collaborative workspace model of document development. Comments and feedback were resolved by group consensus.

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