Royal College of Anaesthetists

Chapter 18

Guidelines for the Provision of Anaesthesia Services (GPAS)

Guidance on the Provision of Anaesthesia Services for Cardiac and Thoracic Procedures 2021

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Declarations of interest

All chapter development group (CDG) members, stakeholders and external peer reviewers were asked to declare any pecuniary or non-pecuniary conflict of interest, in line with the Guidelines for the Provision of Anaesthetic Services (GPAS) conflict of interest policy as described in the GPAS Chapter Development Process Document.

Declarations were made as follows:

- two authors were involved in producing five of the items of evidence
- one member of the chapter development group was involved in producing one of the items of evidence.

The nature of the involvement in all declarations made above was not determined as being a risk to the transparency or impartiality of the chapter development. Where a member was conflicted in relation to a particular piece of evidence, they were asked to declare this and then if necessary removed themselves from the discussion of that particular piece of evidence and any recommendation pertaining to it.

Medicolegal implications of GPAS guidelines

GPAS guidelines are not intended to be construed or to serve as a standard of clinical care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to guideline recommendations will not ensure successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available. It is advised, however, that significant departures from the national guideline or any local guidelines derived from it should be fully documented in the patient's case notes at the time the relevant decision is taken.

Promoting equality and addressing health inequalities

The Royal College of Anaesthetists is committed to promoting equality and addressing health inequalities. Throughout the development of these guidelines we have:

- given due regard to the need to eliminate discrimination, harassment and victimisation, to advance equality of opportunity, and to foster good relations between people who share a relevant protected characteristic (as cited under the Equality Act 2010) and those who do not share it, and
- given regard to the need to reduce inequalities between patients in access to, and outcomes from, healthcare services and to ensure services are provided in an integrated way where this might reduce health inequalities.

GPAS guidelines in context

The GPAS documents should be viewed as 'living documents'. The GPAS guidelines development, implementation and review should be seen not as a linear process, but as a cycle of interdependent activities. These in turn are part of a range of activities to translate evidence into practice, set standards and promote clinical excellence in patient care.

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Each of the GPAS chapters should be seen as independent but interlinked documents. Guidelines on the general provision of anaesthetic services are detailed in the GPAS chapter 2: Guidelines for the Provision of Anaesthesia Services for the Perioperative Care of Elective and Urgent Care Patients.

These guidelines apply to all patients who require anaesthesia or sedation and are under the care of an anaesthetist. For urgent or immediate emergency interventions, this guidance may need to be modified as described in GPAS chapter 5: guidelines for the provision of emergency anaesthesia.

The rest of the chapters of GPAS apply only to the population groups and settings outlined in the 'Scope' section of these chapters. They outline guidance that is additional, different or particularly important to those population groups and settings included in the 'Scope'. Unless otherwise stated within the chapter, the recommendations outlined in chapters 2–5 still apply.

Each chapter will undergo yearly review and will be continuously updated in the light of new evidence.

Guidelines alone will not result in better treatment and care for patients. Local and national implementation is crucial for changes in practice necessary for improvements in treatment and patient care.

Aims and objectives

The objective of this chapter is to promote current best practice for service provision in cardiac and thoracic anaesthesia services. The guidance is intended for use by anaesthetists with responsibilities for service delivery and healthcare managers.

This guideline does not comprehensively describe clinical best practice in cardiac and thoracic anaesthesia services but is primarily concerned with the requirements for the provision of a safe, effective, well-led service, which may be delivered by many different acceptable models. The guidance on provision of cardiac and thoracic anaesthesia services applies to all settings where this is undertaken, regardless of funding. All age groups are included within the guidance unless otherwise stated, reflecting the broad nature of these services.

A wide range of evidence has been rigorously reviewed during the production of this chapter, including recommendations from peer-reviewed publications and national guidance where available. However, both the authors and the CDG agreed that there is a paucity of Level 1 evidence relating to service provision in cardiac and thoracic anaesthesia services. In some cases, it has been necessary to include recommendations of good practice based on the clinical experience of the CDG. We hope that this document will act as a stimulus to future research.

The recommendations in this chapter will support the RCoA's Anaesthesia Clinical Services Accreditation (ACSA) process.

Scope

Target audience

All staff groups working in cardiac and thoracic anaesthesia, including (but not restricted to) consultant anaesthetists, staff grade, associate specialist and specialty (SAS) anaesthetists, anaesthetists in training, operating department practitioners and nurses.

Target population

All ages of patients undergoing cardiac and thoracic anaesthesia.

Healthcare setting

All settings within the hospital in which cardiac and thoracic anaesthesia are provided.

Clinical management

Key clinical issues that will be covered:

Key components needed to ensure provision of high quality anaesthetic services for cardiac and thoracic procedures.

Areas of provision considered:

- levels of provision of service, including (but not restricted to) staffing, equipment, support services and facilities
- areas of special requirement, such as paediatric patients, critically ill patients, pregnant patients, and cardiac catheter laboratories
- training and education
- research and audit
- organisation and administration
- patient information.

Exclusions

Provision of cardiac and thoracic anaesthesia services provided by a specialty other than anaesthesia.

Clinical guidelines specifying how healthcare professionals should care for patients.

This guideline relates only to critically ill patients undergoing procedures in the operating theatre. General provision of critical care is outside the scope of this document. Further information, including definitions of levels of critical care can be found in the Faculty of Intensive Care Medicine and Intensive Care Society publication, Guidelines for the Provision of Intensive Care Services.

Introduction

Cardiothoracic anaesthesia services are provided for patients undergoing cardiac and thoracic procedures. To reflect current practice, these guidelines have been more clearly divided to identify areas of differing requirement. Anaesthetists in cardiac surgical services are now more frequently required to provide anaesthesia for invasive cardiology procedures.

Cardiac surgery

Cardiac surgery may involve adult, paediatric and neonatal patients and includes many forms of open and closed heart surgery, both elective and emergency. Some complex procedures are increasingly performed in hybrid operating rooms, where operating theatres have enhanced radiological imaging facilities. Cardiac surgery may also include heart or heart and lung transplantation, and the implantation of ventricular assist devices to support patients with advanced heart failure.

There are a number of different unit models for delivery of cardiac surgery: large standalone tertiary centres with supraregional services, units in large multispecialty university centres and smaller units in a large general hospital setting. The degree of specialisation of the anaesthetists and their job plans are likely to reflect this setting.

Cardiac anaesthetists should be integrated into the multidisciplinary nature of each cardiac unit and take an active part in shaping services and analysing quality. Cardiac anaesthetists frequently have critical care cover in their job plans, which may assist integration of services. Patient mortality audit data is currently in the public domain for each unit and each surgeon and anaesthetist should have an understanding of how their own role contributes to patient outcomes.[1]

The nature of cardiac surgery demands that all patients should be cared for postoperatively in a unit that conforms to the standards of Level 2 or 3 critical care facilities. Patients may frequently have complications and require rapid escalation of the level of care. Anaesthesia and critical care services should work together to ensure that these services are flexible and responsive to the needs of the patients.

Cardiac anaesthesia provides an important area of training for trainee anaesthetists. It offers training in the perioperative care of patients with severe heart and lung disease that is essential for all anaesthetists, whatever their future area of practice.

Thoracic surgery

Thoracic surgery may include surgery on the lungs (including lung transplantation), pleura, thymus, oesophagus and other thoracic structures, as well as the chest wall. Less invasive video assisted surgery is now mainstream practice for most types of surgery, but particularly for those patients with effusions, pneumothoraces and tumours. Surgery for patients who have sustained trauma to the thorax is becoming more common and may be integrated into major trauma centres. Interventional large airway services are frequently provided alongside thoracic surgery. Tracheobronchial surgery for congenital abnormalities of the large airways in children is a supraregional service.

Anaesthesia for lung transplantation may sometimes require the use of cardiopulmonary bypass. There is an expanding use of extracorporeal membrane oxygenation for acute lung injury that may involve anaesthetists in defined centres.

Recommendations

The grade of evidence and the overall strength of each recommendation are tabulated in Appendix 1.

1 Staffing requirements

1.1 Availability of two consultant anaesthetists, or a consultant and senior trainee or SAS doctor should be considered for more complex procedures, such as thoracoabdominal aortic aneurysm repair.[2]

1.2 Continuity of care should be a priority in prolonged cases and when this is not possible, a formal documented process with some overlap should be in place for handover of clinical care from one anaesthetist to another.[3]

1.3 The complexity of some cases may necessitate anaesthetic involvement in multidisciplinary team meetings and this activity should be reflected in job plans.

1.4 Consultant anaesthetists in cardiac and thoracic units should be responsible for the provision of service, teaching, protocol development, management, research and quality improvement. Adequate time should be allocated in job plans for these activities.

Cardiac

1.5 Each unit should have a designated clinical lead (see glossary) anaesthetist who is responsible for cardiac anaesthesia services. This should be recognised in their job plan and they should be involved in multidisciplinary service planning and governance within the unit.

1.6 An appropriately trained consultant cardiac anaesthetist should be available at all times, through a formal on-call rota.[4]

1.7 Trained staff and appropriate facilities should be immediately available for emergency resternotomy and bypass. A suitably trained resident anaesthetist should be immediately available for emergencies.[5]

1.8 Appropriate local arrangements should be made for the care of postoperative surgical patients being managed outside the main cardiothoracic intensive care unit (ICU), for example postoperative recovery areas and wards.[6]

1.9 Perfusion services should be provided by suitably trained and accredited perfusion scientists[7] and comply with Department of Health guidelines.[8]

1.10 Interventional cardiology services increasingly require anaesthesia, critical care and nursing resources depending on procedural complexity and patient morbidity. General anaesthesia may be needed to facilitate complex interventions or required in an emergency for invasive cardiological procedures. Both eventualities require that appropriate anaesthetic staffing, skilled assistance, equipment and monitoring should be available.[2]

1.11 At centres where 24/7 primary percutaneous coronary interventions are performed, and in designated heart attack centres, which include out of hospital cardiac arrest patients, there should be provision for immediate availability of a resident anaesthetist, skilled assistance and appropriate equipment and facilities.

Thoracic

1.12 Each unit should have a designated clinical lead (see glossary) anaesthetist for thoracic anaesthetic services. This should be recognised in their job plan and they should be involved in multidisciplinary service planning and governance within the unit.

1.13 An appropriately trained consultant anaesthetist should be available at all times, through a formal thoracic or cardiothoracic anaesthetic on-call rota, particularly if lung transplantation is performed.

1.14 Wherever thoracic anaesthesia and surgery are performed there should be a resident anaesthetist available at all times.

2 Equipment, services and facilities

Equipment and monitoring

2.1 The same level of equipment should be available for cardiac and thoracic surgery as is available in general theatres as specified in chapter 3. Additional specialty specific monitoring is required and is detailed below.[9]

2.2 The standard of monitoring in the operating theatre should allow the conduct of safe anaesthesia for surgery as detailed by the Association of Anaesthetists standards of monitoring.[10]

2.3 During the transfer of the patient at the end of surgery to the postoperative care unit there should be access to electrocardiogram (ECG), invasive blood pressure monitoring, pulse oximetry, disconnection alarm for any mechanical ventilation system, fractional inspired oxygen concentration, and end-tidal carbon dioxide.[10]

2.4 Access to cardiac output monitoring should be available for high risk cardiac cases and its availability for thoracic cases should be considered.[11,12]

2.5 Physiological monitoring alarm settings should be appropriate for the specific procedure.[13]

2.6 A fluid warmer allowing the transfusion of warmed blood products and intravenous fluids should be available.[14]

2.7 Availability of a rapid infusion device should be considered for the management of major haemorrhage.[14]

2.8 A cell salvage service should be available for cases where massive blood loss is anticipated and for patients who decline blood products. Staff who operate this equipment should receive training and use it frequently to maintain their skills.

2.9 Ultrasound should be available for the placement of vascular catheters.[15]

Cardiac

2.10 Cardiac anaesthesia and surgery are carried out under intensive physiological patient monitoring. Equipment used routinely for monitoring during cardiac surgery should be available. This includes invasive pressure monitoring for both systemic arterial and central venous pressures.[10,15]

2.11 Transoesophageal echocardiography should be immediately available.[16,17]

2.12 Complex cases may require additional monitoring, such as pulmonary arterial pressure monitoring, measurement of cardiac output and cerebral near-infrared spectroscopy.[18]

2.13 Monitoring during cardiopulmonary bypass should conform to the standards recommended by the joint working group of the Society of Clinical Perfusion Scientists of Great Britain and Ireland, Association for Cardiothoracic Anaesthesia and Critical Care (ACTACC), and Society for Cardiothoracic Surgery in Great Britain and Ireland.[7,19]

2.14 An intraaortic counter pulsation balloon pump should be available.[20]

2.15 Equipment for temporary pacing should be available.

Thoracic

2.16 Fibreoptic bronchoscopy should be immediately available for all cases where lung isolation is used.[21]

2.17 A range of equipment to facilitate lung isolation should be available. This may include left and right double lumen tracheal tubes, bronchial blockers, dual lumen tracheostomy tubes,[22] and airway exchange catheters.[23]

2.18 Dedicated equipment for jet ventilation should be available for interventional airway procedures.[24]

Facilities

2.19 Designated thoracic, cardiac or cardiothoracic wards should be considered.

2.20 Cardiac and thoracic surgery should ideally be performed in dedicated operating rooms. It is unlikely that an operating room will be kept available at all times for emergencies. Local arrangements for urgent and emergency cases should be in place.

Cardiac

2.21 In some centres, selected cardiac surgical patients are managed in facilities other than designated ICUs following surgery. These are variously referred to as the high dependency unit (HDU), cardiac recovery or cardiac fast-track unit. These areas aim to minimise the period of mechanical ventilation. The equipment, monitoring and staffing requirements for such a facility are no less than the requirements of patients cared for in Level 3 ICU. Agreed clinical criteria for the appropriate case mix should be in place. Suitably experienced anaesthetic and surgical staff should be immediately available. Arrangements should be in place for escalation to a Level 3 ICU facility as required.[6]

2.22 Facilities should be available for the decontamination and safe storage of transoesophageal echocardiography probes in line with local and national recommendations.[25,26,27] There should also be a method to report, archive and retrieve all echocardiography studies performed in cardiac theatres. Major complications related to transoesophageal echocardiography should be monitored.[28]

2.23 Cardiac units should consider developing an enhanced recovery after surgery (ERAS) programme.[29,30]

Thoracic

2.24 After major thoracic surgery, patients should be transferred to an appropriately sized, equipped and staffed post-anaesthetic recovery area. Planned or emergency access to ICU or HDU should be available.[31]

2.25 Non-invasive ventilation facilities should be available in the immediate postoperative period, for example bilevel positive airway pressure (BiPAP), continuous positive airway pressure (CPAP) and high-flow nasal oxygen therapy (HFNO).[32]

2.26 Thoracic surgery units should develop an ERAS programme.[33,34,]

Support services

2.27 Where possible, point of care or near patient testing should be used for blood gas analysis, measurement of electrolytes and blood sugar, haemoglobin and coagulation. This might include platelet mapping, thromboelastography or thromboelastometry.[35]

2.28 Immediate access to expert haematology advice, haematology laboratory services and blood products should be available.

2.29 There should be immediate access to expert radiology advice, x-ray facilities and computerised axial tomography services for patients undergoing cardiac or thoracic surgery.

2.30 Access to measurements of respiratory function should be available for patients undergoing cardiac or thoracic surgery, including a facility for cardiopulmonary exercise testing.

2.31 Physiotherapy services should be available during the preoperative preparation and postoperative care of patients undergoing cardiac or thoracic surgery.

2.32 All anaesthetic equipment should be checked before use in accordance with the Association of Anaesthetists published guidelines. Anaesthetic machine checks should be recorded in a log and on the anaesthetic chart.[36]

2.33 Pain relief protocols should be clearly defined for thoracic and cardiac surgery patients.[37]

Cardiac

2.34 For cardiac patients, dedicated echocardiography equipment, including transoesophageal echo should be immediately available in the operating suite and postoperative care areas. Those who deliver intraoperative echocardiography services should be trained to the level of competence defined by specialist bodies.[38,39,40]

2.35 There should be access to a range of specialist cardiology services.[41]

2.36 24/7 access to cardiac electrophysiology services should be available.

3 Areas of special requirement

Children

3.1 Children undergoing cardiac and thoracic procedures have special requirements and the responsibility for paediatric anaesthetic care may be shared with paediatric anaesthetists.[42]

3.2 Paediatric cardiac surgical patients should be cared for in a unit designed and equipped to care for paediatric patients and staffed by appropriately trained nurses. Such a unit should meet the standards defined for paediatric critical care, including adequate arrangements for retrieval and transfer of patients.[43,44]

3.3 Anaesthetists should be aware of legislation and good practice guidance[45] relevant to children and according to the location in the UK.[46,47,48,49] These documents refer to the rights of the child, child protection processes and consent.

Adult congenital heart disease patients

This group comprises adult patients who have had cardiac disease diagnosed in childhood; those who present with a new primary diagnosis of congenital heart disease; and patients requiring heart surgery for the failures or complications arising from the prior interventional management of congenital cardiac lesions.[50]

3.4 Children currently transition to adult congenital heart disease services at the age of 16–18 years, although transition services are integrated into the care pathway from age 12 years. Anaesthetists should be aware of legislation and good practice guidance relevant to young and vulnerable adults.[45,51]

3.5 Specialist anaesthetists should be involved in the discussion of referrals and planning when this is conducted in the setting of a multidisciplinary team. This should be recognised in job plans.

Transplant patients

This includes patients undergoing heart or lung transplantation, and patients who have previously received a transplant who require further cardiothoracic surgery.

3.6 Consultants providing anaesthesia for heart or lung transplantation should have appropriate training and substantial experience of advanced cardiovascular monitoring and support.

3.7 Cardiothoracic anaesthetists working in non-transplant centres should be familiar with the principles of the anaesthetic management of patients who have previously undergone heart or lung transplantation.[52]

3.8 Patients undergoing lung transplantation may be under the age of 18 years. Anaesthetists must be aware of legislation and good practice guidance relevant to young and vulnerable adults.[45,51] Children undergoing transplantation should be cared for in a paediatric centre.

3.9 Facilities should be available for the storage, administration and routine monitoring of immunosuppressive medication.

Pregnant patients

Patients requiring cardiac or thoracic surgery during pregnancy will typically be undergoing an urgent or emergency intervention. Indications include chest trauma, acute coronary ischaemia, aortic or coronary dissection, decompensated valvular disease and acute cardiomyopathy.

3.10 Cardiothoracic anaesthetists should be familiar with the normal physiological effects of pregnancy and the general principles of obstetric anaesthesia.

3.11 Where cardiothoracic surgery is scheduled to occur immediately after Caesarean section, there should be early involvement of obstetricians, specialist obstetric anaesthetists, neonatal paediatricians and midwifery services.

3.12 Equipment, services and facilities should be equivalent to those found in an obstetric unit.[53]

3.13 Whenever possible, escalation in care should ideally not lead to the separation of mother and baby.

3.14 A multidisciplinary team should agree and document plans for the peripartum management of patients with known congenital or acquired cardiac disease in advance. Staff and facilities should be available for monitored or operative delivery, and for managing acute decompensation.

Chronic thromboembolic pulmonary hypertension patients

3.15 A subgroup of patients with chronic thromboembolic pulmonary hypertension (CTEPH) will benefit from surgery and should be managed in designated national centres. Currently only one UK centre provides specialist surgical intervention for patients with CTEPH.

Extracorporeal membrane oxygenation

3.16 The use of extracorporeal membrane oxygenation (ECMO) for the management of adults with severe respiratory failure is currently confined to five UK cardiothoracic centres. Anaesthetists often institute ECMO and support retrieval of patients from non-specialist hospitals. Anaesthetists providing ECMO should be suitably trained.[54]

Cardiac catheter laboratories

Anaesthetists are requested to provide services for an increasing number of structural, electrophysiological and interventional cardiology procedures, including emergency procedures. The same conditions and requirements apply as for the radiology department outlined in chapter 7,[55] with some additional conditions:

3.17 Anaesthetists should be aware of the risks of exposure to ionizing radiation in cardiac catheterisation laboratories and ensure they use protective garments and screens and wear exposure monitoring devices if requested to do so.[56]

3.18 The use of dedicated anaesthetic monitoring equipment, in addition to any monitoring used by cardiologists, is recommended. A remote or slave anaesthetic monitor display should be available to cardiologists.

3.19 Cardiac patients are often at high risk of cardiac arrest. Sufficient space and facilities should be available for managing this eventuality.

3.20 Cardiovascular instability may, on occasion, necessitate the use of extracorporeal support. Catheter laboratories should have sufficient space, medical gas outlets, electrical sockets, network sockets, and other essential facilities to meet this demand.

3.21 Where revision of rhythm management devices is considered to pose a high risk of requiring emergency surgical intervention, cardiopulmonary bypass equipment and a plan for surgery should be available at the start of the procedure.

Preassessment

3.22 In recent years there has been a trend towards assessment of elective patients in preadmission clinics, typically one to two weeks before surgery. This allows routine paperwork and investigations to be completed before admission, permits 'same day' admission and reduces the likelihood of delays or cancellation.[57] Anaesthetists should be part of the preadmission clinical pathway, including implementing interventions to promote enhanced recovery, this activity should be reflected in job plans. [9,58,59,60]

4 Training and education

4.1 Cardiac and thoracic anaesthesia is a 'key unit of training' for intermediate level training in anaesthesia.[61] Trainee anaesthetists should be of appropriate seniority to be able to benefit from this area of training.

4.2 All trainees should be appropriately clinically supervised at all times.[62]

4.3 Trainees should have an appropriate balance between thoracic, cardiac and ICU training based on their individual requirements.[63]

4.4 Trainees planning to embark in a career in cardiac anaesthesia should be encouraged to undertake training and accreditation in transoesophageal echocardiography.[39]

4.5 Consultant anaesthetists intending to undertake anaesthesia for cardiac or thoracic surgery should have received training to a higher level in cardiac and/or thoracic anaesthesia, for a minimum of one year in recognised training centres, as part of general training.[61] Those providing critical care for cardiac surgical patients should have received training to the minimum level as defined by the Faculty of Intensive Care Medicine special skills year in cardiothoracic intensive care.[6]

4.6 Consultant anaesthetists intending to follow a career in paediatric cardiothoracic anaesthesia should have higher training in general paediatric anaesthesia of at least one year followed by a specialist training period of an appropriate duration in the subspeciality.

4.7 All staff should have access to adequate time, funding and facilities to undertake and update training that is relevant to their clinical practice, including annual mandatory training such as basic life support.

4.8 Fellowship posts should be identified to allow additional training for those who wish to follow a career in cardiac or thoracic anaesthesia to help ensure there are adequate numbers of skilled anaesthetists in the specialty. These should be suitable for trainees who wish to take time out of training programmes, or for those who are post certificate of completion of training (CCT). Such posts should provide similar or enhanced levels of teaching, training and access to study leave as for regular training posts.

4.9 Departments should consider providing all newly appointed consultants, particularly those with limited experience, with a mentor to facilitate their development in cardiac or thoracic anaesthesia.

5 Organisation and administration

5.1 Anaesthetic involvement in the leadership of cardiothoracic units should be considered.

5.2 There should be a forum for discussion of matters relevant to both surgeons and anaesthetists, for example protocol development and critical incidents.

5.3 Clinical protocols should be developed from national guidelines and reviewed on a regular basis.

5.4 Anaesthetists should be part of the multidisciplinary team engaged in development and implementation of enhanced recovery programmes in cardiac and thoracic surgery.[59,60,64]

5.5 Hospitals should have systems in place to facilitate multidisciplinary meetings for both cardiac and thoracic services.

5.6 All handovers should contain representatives for the multidisciplinary teams from both theatre and the receiving area and should be documented and structured to ensure continuity of care.[65]

5.7 The theatre team should all engage in the use of the World Health Organization (WHO) surgical safety process,[66] commencing with a team brief, and concluding the list with a team debrief. The debrief should highlight things done well and also identify areas requiring improvement. Teams should consider including the declaration of emergency call procedures specific to the location as part of the team brief.

5.8 Hospitals should review their local standards to ensure that they are harmonised with the relevant national safety standards, e.g. National Safety Standards for Invasive Procedures in England (NatSSIPs) or the Scottish Patient Safety Programme in Scotland.[67,68] Organisational leaders are ultimately responsible for implementing local safety standards as necessary.

5.9 There should be sufficient numbers of clinical programmed activities in clinicians' job plans to provide cover for all elective cardiac and thoracic operating lists and to provide adequate emergency cover.[69]

5.10 Perfusion services should be included in a clinical directorate or equivalent, under the managerial control of a consultant, who may be a consultant anaesthetist.

6 Financial considerations

Part of the methodology used in this chapter in making recommendations is a consideration of the financial impact for each of the recommendations. Very few of the literature sources from which these recommendations have been drawn have included financial analysis.

The vast majority of the recommendations are not new recommendations, but they are a synthesis of already existing recommendations. The current compliance rates with many of the

recommendations are unknown, and so it is not possible to calculate the financial impact of the recommendations in this chapter being widely accepted into future practice. It is impossible to make an overall assessment of the financial impact of these recommendations with the currently available information.

6.1 Service developments outside the operating theatre, e.g. interventional cardiology, often place unintended demands on anaesthetists. The business plans for such services should include provision for anaesthetic services.

7 Research, audit and quality improvement

7.1 Most research in cardiac and thoracic anaesthesia will be undertaken in specialist cardiothoracic units and should be given high priority.

7.2 Regular clinical audit of the work of cardiac and thoracic anaesthesia services is essential. This might also include submission of data to national audits, such as the ACTACC national audit project which includes both cardiac and thoracic anaesthesia topics. Information technology (IT) support should be available for such activities.[1,70]

7.3 Centres should consider contributing to multidisciplinary national benchmarking audits such as the National Cardiac Benchmarking Collaborative (NCBC).[71]

7.4 All cardiac and thoracic units should have regular morbidity and mortality meetings. These should have a list of patients to discuss in advance, an attendance register, and minutes with learning points. Consultant anaesthetists should attend these meetings and where possible inclusion in job plans should be considered. Trainees should be encouraged to attend during their attachments.

7.5 Robust procedures should be in place to report and investigate adverse incidents involving equipment, staff or patients. The published outcomes of these investigations should be disseminated to all relevant anaesthetists and others.

8 Implementation support

The Anaesthesia Clinical Services Accreditation (ACSA) scheme, run by the RCoA, aims to provide support for departments of anaesthesia to implement the recommendations contained in the GPAS chapters. The scheme provides a set of standards, and asks departments of anaesthesia to benchmark themselves against these using a self-assessment form available on the RCoA website. Every standard in ACSA is based on recommendation(s) contained in GPAS. The ACSA standards are reviewed annually and republished approximately four months after GPAS review and republication to ensure that they reflect current GPAS recommendations. ACSA standards include links to the relevant GPAS recommendations so that departments can refer to them while working through their gap analyses.

Departments of anaesthesia can subscribe to the ACSA process on payment of an appropriate fee. Once subscribed, they are provided with a 'College guide' (a member of the RCoA working group that oversees the process), or an experienced reviewer to assist them with identifying actions required to meet the standards. Departments must demonstrate adherence to all 'priority one' standards listed in the standards document to receive accreditation from the RCoA. This is confirmed during a visit to the department by a group of four ACSA reviewers (two clinical reviewers, a lay reviewer and an administrator), who submit a report back to the ACSA committee.

The ACSA committee has committed to building a 'good practice library', which will be used to collect and share documentation such as policies and checklists, as well as case studies of how

departments have overcome barriers to implementation of the standards, or have implemented the standards in innovative ways.

One of the outcomes of the ACSA process is to test the standards (and by doing so to test the GPAS recommendations) to ensure that they can be implemented by departments of anaesthesia and to consider any difficulties that may result from implementation. The ACSA committee has committed to measuring and reporting feedback of this type from departments engaging in the scheme back to the CDGs updating the guidance via the GPAS technical team.

9 Patient information

In order to give valid informed consent, patients need to understand the nature and purpose of the procedure. Full guidance, including on providing information to vulnerable patients, can be found in chapter 2.[9] Specific considerations for cardiac and thoracic surgery are outlined below:

9.1 Booklets providing information for patients about their stay in hospital should be available for all patients. This will include the patient information booklets published by the British Heart Foundation on cardiac disease, prevention, treatment and lifestyle modification, and those by the British Thoracic Society on lung disease and the Roy Castle Lung Cancer Foundation for information about lung cancer and its surgical treatment. Sources of information about the anaesthetic should also be available.[9,72,73,74,75,76]

9.2 Information about cardiac rehabilitation generally, and information regarding the availability of such courses locally, should also be available.

9.3 Information on specific individual risks of invasive monitoring, e.g. risk of injury due to arterial and central venous lines, should be available to patients.

9.4 All cardiothoracic units should provide patient information about preoperative smoking cessation, including how to access local services to support patients wishing to quit before their operation.

Areas for future development

Cardiac

There is an increasing use of mechanical circulatory support in cardiac anaesthesia, cardiac critical care and cardiology services within the NHS. As experience and the evidence base of this grows, more marginal indications for mechanical support will emerge. Post-cardiotomy support following transplantation and pulmonary endarterectomy is established, while venoarterial ECMO (VA-ECMO) following cardiac surgery generally has poor outcomes.[77] Where services require percutaneous support, e.g. ECMO in cardiology, business cases should include provision of senior anaesthetic and critical care support.

Risk of stroke increases with patient age and surgical complexity. Access to acute stoke services is, most often, only required following embolic stroke. Under these circumstances patients should have access to the same rehabilitation facilities as other stroke patients.

There is an expansion of minimally invasive and percutaneous procedures, e.g. balloon pulmonary angioplasty in patients with chronic thromboembolic pulmonary hypertension deemed unsuitable for surgery. Evidence of symptomatic and prognostic benefit is awaited.

Service provision for cardiac surgery in children and adults with congenital heart disease is currently under review, with a proposed model of care and draft designation standards.[43]

Thoracic

Robot assisted thoracic surgery (RATS) is currently undertaken in a small number of UK centres and may provide better surgical outcomes due to improved surgical dexterity and stereoscopic high definition operating conditions. There is currently a paucity of literature supporting improved clinical outcomes or cost effectiveness of RATS and the technique presents unique challenges for anaesthesia.[78]

Video assisted thoracic surgery (VATS) with regional anaesthesia or spontaneously breathing general anaesthesia is described in the literature and currently being performed by a small number of units in the UK. There are theoretical advantages of avoiding general anaesthesia, lung isolation and positive pressure ventilation[79] and many procedures can be performed without these interventions by a suitably trained team with good patient selection. Evidence of the putative benefits of using these strategies is emerging.[80,81,82]

Abbreviations

ACSA	Anaesthesia Clinical Services Accreditation
ACTACC	Association for Cardiothoracic Anaesthesia and Critical Care
BiPAP	Bilevel positive airway pressure
CDG	Chapter Development Group
CPAP	Continuous positive airway pressure
CQC	Care Quality Commission
CTEPH	Chronic thromboembolic pulmonary hypertension
ECMO	Extracorporeal membrane oxygenation
GMC	General Medical Council
GPAS	Guidelines for the Provision of Anaesthetic Services
GPICS	Guidelines for the Provision of Intensive Care Services
HFNO	High-flow nasal oxygen therapy
HDU	High dependency unit
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
PSC	Professional Standards Committee
QMSG	Quality Management of Service Group
RATS	Robot-assisted thoracic surgery
RCoA	Royal College of Anaesthetists
RCTs	Randomised controlled trials
SAS	Specialty and associate specialist
VATS	Video-assisted thoracic surgery

Glossary

Clinical lead – SAS doctors undertaking lead roles should be autonomously practicing doctors who have competence, experience and communication skills in the specialist area equivalent to consultant colleagues. They should usually have experience in teaching and education relevant to the role and they should participate in Quality Improvement and CPD activities. Individuals should be fully supported by their Clinical Director and be provided with adequate time and resources to allow them to effectively undertake the lead role

Immediately – Unless otherwise defined, 'immediately' means within five minutes.

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Appendix 1: Recommendations Grading

The grading system is outlined in the methodology section of this chapter. The grades for each of the recommendations in this chapter are detailed in the table below:

Recommendation Number	Level of Evidence	Strength of Recommendation
1.1	C	Weak
1.2	B	Strong
1.3	GPP	Strong
1.4	GPP	Strong
1.5	GPP	Strong
1.6	C	Strong
1.7	B	Strong
1.8	C	Strong
1.9	C	Strong
1.10	C	Strong
1.11	GPP	Strong
1.12	GPP	Strong
1.13	GPP	Strong
1.14	GPP	Strong
2.1	C	Strong
2.2	C	Strong
2.3	GPP	Strong
2.4	B	Strong
2.5	B	Strong
2.6	C	Strong
2.7	C	Weak
2.8	GPP	Strong
2.9	C	Strong
2.10	C	Strong
2.11	B	Strong
2.12	B	Strong
2.13	C	Strong

Recommendation Number	Level of Evidence	Strength of Recommendation
2.14	B	Strong
2.15	GPP	Strong
2.16	GPP	Strong
2.17	B	Strong
2.18	GPP	Strong
2.19	GPP	Weak
2.20	GPP	Aspirational
2.21	C	Strong
2.22	B	Strong
2.23	C	Moderate
2.24	B	Strong
2.25	B	Strong
2.26	C	Strong
2.27	C	Strong
2.28	GPP	Strong
2.29	GPP	Strong
2.30	GPP	Strong
2.31	GPP	Strong
2.32	C	Strong
2.33	B	Strong
2.34	C	Strong
2.35	C	Strong
2.36	GPP	Strong
3.1	C	Strong
3.2	C	Strong
3.3	M	Mandatory
3.4	M	Mandatory
3.5	GPP	Strong
3.6	GPP	Strong
3.7	C	Weak
3.8	M	Mandatory
3.9	GPP	Strong
3.10	GPP	Strong
3.11	GPP	Strong
3.12	C	Strong
3.13	GPP	Strong
3.14	GPP	Strong

Recommendation Number	Level of Evidence	Strength of Recommendation
3.15	GPP	Strong
3.16	C	Strong
3.17	C	Strong
3.18	GPP	Weak
3.19	GPP	Strong
3.20	GPP	Strong
3.21	GPP	Strong
3.22	B	Strong
4.1	C	Strong
4.2	C	Strong
4.3	C	Strong
4.4	C	Strong
4.5	C	Strong
4.6	GPP	Strong
4.7	GPP	Strong
4.8	GPP	Strong
4.9	GPP	Strong
5.1	GPP	Weak
5.2	GPP	Strong
5.3	GPP	Strong
5.4	B	Strong
5.5	GPP	Strong
5.6	B	Strong
5.7	C	Strong
5.8	C	Strong
5.9	C	Strong
5.10	GPP	Strong
6.1	GPP	Strong
7.1	GPP	Strong
7.2	B	Strong
7.3	C	Strong
7.4	GPP	Strong
7.5	GPP	Strong
9.1	C	Strong
9.2	GPP	Strong
9.3	GPP	Strong
9.4	GPP	Strong

Chapter 18
Guidelines for the Provision of Anaesthesia Services for Cardiac and Thoracic Procedures 2021

Chapter 18
Guidelines for the Provision of Anaesthesia Services for Cardiac and Thoracic Procedures 2021

About these guidelines

Methodology

The process by which this chapter has been developed has been documented within the GPAS Chapter Development Process Document.

The evidence included in this chapter is based on a systematic search of the literature. Abstracts were independently screened by two investigators and reviewed against inclusion and exclusion criteria. Data were extracted by one investigator in accordance with predefined criteria. The review objective was to determine the key components needed to ensure provision of high-quality cardiac and thoracic anaesthesia services for patients who have undergone surgery and/or interventions which involve anaesthesia.

Search strategy

Searches were performed on Embase (1980 to 2015), Ovid MEDLINE (1946 to present), CINAHL and Cochrane Library, for the literature search strategy, outcomes, databases, criteria for inclusion and exclusion of evidence (for the full cardiac and thoracic anaesthesia chapter search protocol please contact the RCoA). A hand search of the literature was also conducted by the authors using the reference lists of relevant original articles and review articles.

The literature search was performed in October 2016.

The authors and researcher independently reviewed the abstracts and titles of the studies found in the initial search. After agreement on the primary selection of papers, full text versions were accessed and reviewed against the following predefined inclusion and exclusion criteria. The full text papers were also reviewed by the CDG for suitability. The final list of publications used can be found in the references.

Inclusion criteria

The literature review considered studies that included the following patient population with all of the inclusion criteria listed below:

- all patients undergoing elective or emergency anaesthesia
- all staff groups working within cardiothoracic anaesthesia, under the responsibility of an anaesthetic clinical director, including (but not restricted to) consultant anaesthetists, SAS anaesthetists, trainee anaesthetists, nurses, operating department practitioners, surgeons, pharmacists, general practitioners, radiologists and radiographers.

Exclusion criteria

The literature review used the following exclusion criteria:

- provision of cardiothoracic anaesthesia service provided by a speciality other than anaesthesia.

Data extraction and analysis

Data were extracted by the authors using a proforma. The study characteristics data included:

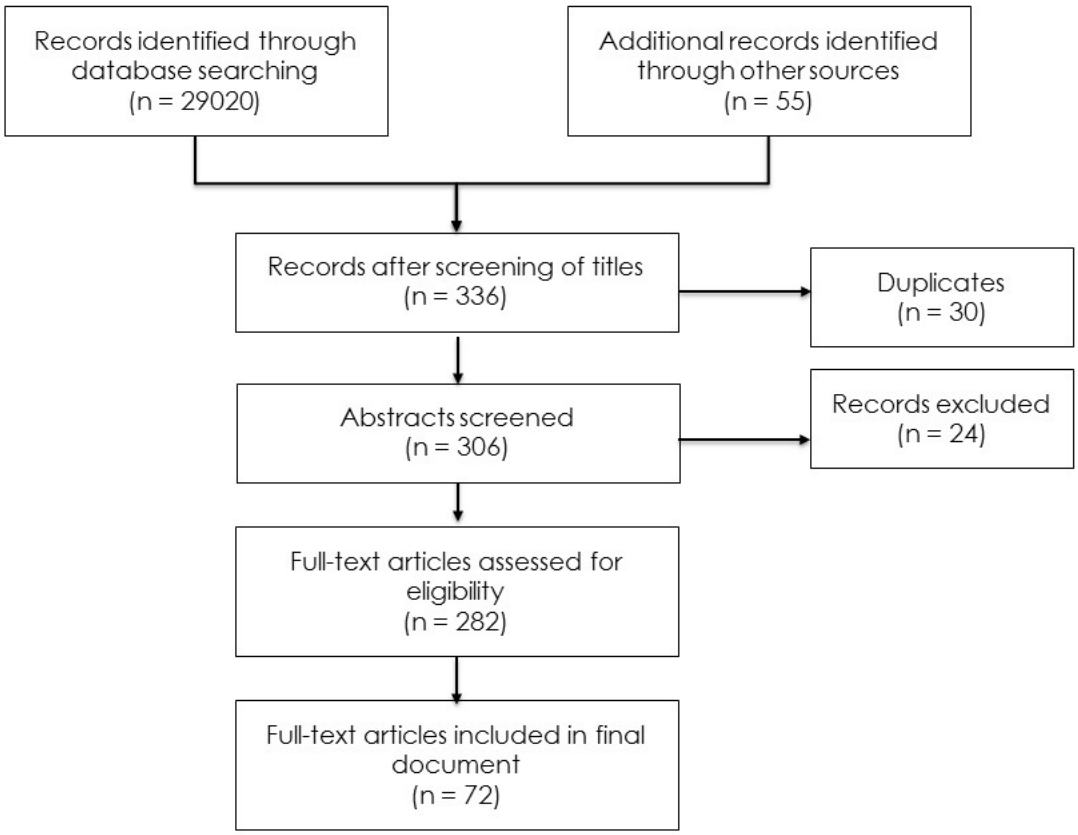
- the journal and country of publication
- the number of patients recruited into the study
- the study design
- patient characteristics

- outcome data
- the logic of the argument
- author's conclusions
- reviewer's comments.

The patient characteristics data extracted were; age, gender and type of surgery. The analysis considers studies that included any clinical outcome, including (but not restricted to) survival, length of stay, critical care or hospital, morbidity, adverse effects and complications.

The results of the literature review can be seen below:

Preferred Reporting Systems for Systematic Review and Meta-analysis (PRISMA) flow chart



The evidence that is included in this chapter has been graded according to grading system adapted from NICE and outlined below:

Level	Type of evidence	Grade	Evidence
Ia	Evidence obtained from a single large/multicentre randomised controlled trial, a meta-analysis of randomised controlled trials or a systematic review with a low risk of bias	**A**	At least one randomised controlled trial as part of a body of literature of overall good quality and consistency addressing the specific recommendation (evidence level I) without extrapolation
Ib	Evidence obtained from meta-analyses, systematic reviews of RCTs or RCTs with a high risk of bias	**B**	Well-conducted clinical studies but no high-quality randomised clinical trials on the topic of recommendation (evidence levels Ib, II or III); or extrapolated from level Ia evidence
IIa	Evidence obtained from at least one well-designed controlled study without randomisation		
IIb	Evidence obtained from at least one well-designed quasi-experimental study		
IIc	Evidence obtained from case control or cohort studies with a high risk of confounding bias		
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies		
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities	**C**	Expert committee reports or opinions and/or clinical experiences of respected authorities (evidence level IV) or extrapolated from level I or II evidence. This grading indicates that directly applicable clinical studies of good quality are absent or not readily available.
UG	Legislative or statutory requirements	**M**	This grading indicates that implementation of this recommendation is a statutory requirement, or is required by a regulatory body (e.g. CQC, GMC)
		GPP	Recommended good practice based on the clinical experience of the CDG.
Adapted from Eccles M, Mason J. How to develop cost-conscious guidelines. *Health Technology Assessment* 2001;5(16) and Mann T. Clinical guidelines: using clinical guidelines to improve patient care within the NHS. *Department of Health*, London 1996.			

Strengths and limitations of body of evidence

Most of the published evidence on cardiac and thoracic anaesthesia is descriptive. There are publications describing aspects of this process based on expert opinion.

The limitations of the evidence are:

- the 'unmeasurables' (attitudes, behaviour, motivation, leadership, teamwork)
- few randomised controlled trials (RCTS); studies frequently use mixed populations of emergency and elective patients, or all emergency patients grouped together despite different underlying diagnoses
- papers often examine a single intervention within complex system or bundle
- papers are often examining small numbers and/or patients from a single centre
- poor use of outcome measures, frequently concentrating on easily measured short term outcomes which are not patient-centred
- generally, a paucity of long-term follow up
- there is no standard definition used of 'high risk'
- use of different risk-scoring systems
- decrease in outcome over time and geography when 'good papers' are used in quality Improvement programmes
- application of international studies in systems with either more or less resources than the UK into NHS practice
- older studies may no longer be applicable within the NHS
- very few studies included any analysis of financial implications
- evidence was mainly based on literature graded III and IV.

Methods used to arrive at recommendations

Recommendations were initially drafted based on the evidence by the authors for the chapter. These were discussed with the CDG, and comments were received both on the content and the practicality of the recommendations. The level of evidence that was the basis for each recommendation was graded according to a grading system, and the recommendation was then graded taking into account the strength of the evidence and the clinical importance using a recommendations criteria form (see GPAS Chapter Development Process Document).

Recommendations were worded using the following system of categorisation:

Strength	Type of evidence	Wording
Mandatory	The evidence supporting the recommendation includes at least one with an 'M' grading	Wording should reflect the mandatory nature of the recommendation i.e. 'must'
Strong	Confidence that for the vast majority of people, the action will do more good than harm (or more harm than good)	Wording should be clearly directive 'should' or 'should not'
Weak	The action will do more good than harm for most patients, but may include caveats on the quality or size of evidence base or patient preferences	Wording should include 'should be considered'
Aspirational	While there is some evidence that implementation of the recommendation could improve patient care, either the evidence or the improvement is not proven or substantial	Wording should include 'could'
Equipoise	There is no current evidence on this recommendation's effect on patient care	Wording should include 'there is no evidence of this recommendation's effect on patient care'

Consultation

The chapter has undergone several rounds of consultation. The multidisciplinary CDG formed the first part of the consultation process. The authors and GPAS Editorial board identified key stakeholder groups. Where stakeholders are represented by an association or other medical college, they were asked to nominate delegates to join the CDG. The GPAS Chapter Development Process Document explains the recruitment process for those CDG members who were not directly nominated. The CDG members were involved in drafting the recommendations, and were provided with an opportunity to comment on all subsequent drafts of the chapter.

The chapter underwent peer review. Peer reviewers were identified by the GPAS Editorial Board or Professional Standards Committee (PSC). Nominees were either anaesthetists of consultant grade or were nominated by a key stakeholder group. Nominees had not had any involvement in the development of GPAS to date and were asked to comment upon a late draft of the chapter.

Following peer review, the chapter was reviewed by the College's PSC and the College's Lay Committee. Comments from all groups were considered and incorporated into a consultation

draft.

The consultation draft of this chapter was circulated for public consultation from 15 January – 12 February 2018. As well as being made available on the College's website and promoted via Twitter and the President's newsletter to members, the draft was also circulated to all key stakeholder groups identified by the authors and the College. A list of organisations contacted by the College is available from the GPAS team at the College: GPAS@rcoa.ac.uk.

The editorial independence of GPAS

The development of GPAS is solely funded by the Royal College of Anaesthetists. However, only the GPAS technical team and the GPAS researcher are paid directly by the College for their work on GPAS, the GPAS Editors' employing organisation receives two programmed activities (PA) backfill funding. All funding decisions by the College are made by the CEO, in collaboration with the senior management team and College Council.

The authors of the chapters are all fellows of the Royal College of Anaesthetists. Members of College Council cannot act as chair of any CDG, as this individual has the deciding vote under the consensus method of decision making used in the chapters. Where College Council members have been involved in chapter development, this has been declared and recorded.

All persons involved in the development of GPAS are required to declare any pecuniary or non-pecuniary conflict of interest, in line with the GPAS conflict of interest policy as described in the GPAS Chapter Development Process Document. Any conflicts of interest are managed on a case-by-case basis to maintain the transparency and impartiality of the GPAS document. The conflicts, and the way they were managed, are outlined at the beginning of the chapter.

The role of the GPAS Editorial Board and CQRB

The overall development of the entire GPAS document is overseen by the CQRB of the Royal College of Anaesthetists, which includes representatives from all grades of anaesthetist, clinical directors and lay representation.

Responsibility for managing the scope of the document and providing clinical oversight to the project technical team is delegated by the CQRB to the GPAS Editorial Board, which includes individuals responsible for the various internal stakeholders (see above for membership). On the inclusion/exclusion of specific recommendations within each chapter, the Editorial Board can only provide advice to the authors. In the event of disagreement between the authors, the majority rules consensus method is used, with the GPAS Editor holding the deciding vote.

Both of these groups, along with the College's Lay Committee review each chapter and provide comment prior to public consultation and are responsible for signoff before final publication. In the event of disagreement, consensus is reached using the majority rules consensus method, with the chair of CQRB holding the deciding vote.

Updating these guidelines

This chapter will be updated for re-publication in January 2022.

Guidelines will be updated on an annual basis. The researcher will conduct the literature search again using the same search strategy to uncover any new evidence and members of the public will be able to submit new evidence to the GPAS project team. Where new evidence is uncovered, the lead author will decide whether the recommendations that were originally made are still valid in light of this new evidence.

If new evidence contradicts or strengthens existing recommendations, the authors decide whether or not to involve the remainder of the CDG in revising the recommendations accordingly.

If new evidence agrees with existing recommendations, then a reference may be added but no further action is required.

If there is no new evidence then no action is required.

This chapter is due to be fully reviewed for publication in January 2023.

Every five years guidance will be submitted to a full review involving reconvening the CDG (or appointment of a new, appropriately qualified CDG), and the process described in the methodology section of this chapter begins again.

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