Royal College of Anaesthetists

Chapter 18

Guidelines for the Provision of Anaesthesia Services (GPAS)

Guidance on the Provision of Anaesthesia Services for Cardiac Procedures 2024

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Guidelines for the Provision of Anaesthesia Services for Cardiac Procedures 2024

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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.

The nature of the involvement in all declarations made 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, remove 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 based on 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 (RCoA) 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 defined in the Equality Act 2010) and those who do not share it

- 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.

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 following chapters:

- Chapter 1: Guidelines for the Provision of Anaesthesia Services: The Good Department
- 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 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 1–5 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 anaesthesia services. The guidance is intended for use by anaesthetists with responsibilities for service delivery and healthcare managers.

This guideline does not describe clinical best practice in cardiac anaesthesia services comprehensively 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 anaesthesia services applies to all settings where such services are 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 Chapter Development Group (CDG) agreed that there is a paucity of level 1 evidence relating to service provision in cardiac 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.

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

Target population

Patients of all ages undergoing cardiac anaesthesia.

Healthcare setting

All settings within the hospital in which cardiac anaesthesia is provided.

Clinical management

Key clinical issues that will be covered:

- Key components needed to ensure provision of high-quality anaesthetic services for cardiac 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 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

Cardiac anaesthesia services are provided for patients undergoing cardiac 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 in the catheter laboratory. Intraoperative

transoesophageal echocardiography is a specialist skill that cardiac anaesthetists are trained in and use to guide diagnostic and therapeutic decision making in surgery.

Cardiac surgery may involve adult, paediatric and neonatal patients and includes many forms of open, closed and minimally invasive 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 acute and advanced heart failure, and extracorporeal membrane oxygenation (ECMO) services, both venovenous and venoarterial, and mobile retrieval ECMO services.

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 should 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 and morbidity audit data is in the public domain for each unit. Each surgeon and anaesthetist should have an understanding of how their own role contributes to patient in-hospital mortality 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 disease that is essential for all anaesthetists, whatever their future area of practice.

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 procedures 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 procedures may necessitate anaesthetic involvement in multidisciplinary team meetings and this activity should be reflected in job plans.

1.4 Consultant or autonomously practising anaesthetists in cardiac 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.

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 or autonomously practising cardiac anaesthetist should be wholly and exclusively available at all times, through a formal on-call rota.[4] The out of hours duties of the on-call consultant or autonomously practising cardiac theatre anaesthetist should cover only cardiac emergencies, as they can arise and escalate very rapidly, particularly in tertiary referral units. On-call cardiac intensive care consultants or autonomously practising anaesthetists should be trained in and provide support and cover for critical care emergencies such as out of hours diagnostic transoesophageal echocardiography.

1.7 Trained anaesthetic assistance, theatre staff and appropriate facilities should be immediately available for emergency resternotomy and cardiopulmonary bypass. A suitably trained resident anaesthetist should be immediately available for theatre emergencies and to assist the on-call consultant or autonomously practising cardiac anaesthetist in theatre out of hours.[5]

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

1.9 Perfusion services should be provided by suitably trained and accredited clinical perfusion scientists[7] and should comply with Department of Health guidelines.[8] A suitable number of trained perfusionists should be always available according to the recommendations for standards of monitoring during cardiopulmonary bypass.[7]

1.10 Interventional cardiology services increasingly require anaesthesia, critical care, perfusion, operating department practitioners and nursing resources, depending on procedural complexity and patient morbidity. General anaesthesia is frequently 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 that 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.

2 Equipment, services and facilities

Equipment and monitoring

2.1 The same level of equipment should be available for cardiac 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.[10,11]

2.4 Access to cardiac output monitoring should be available for high-risk cardiac patients perioperatively.[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 and should be used.[14]

2.7 A rapid infusion device should be available for the management of major haemorrhage.[14]

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

2.9 A dedicated ultrasound machine should be present in each cardiac theatre for the placement of vascular catheters.[15]

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, central venous and pulmonary artery pressures.[10,15]

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

2.12 Patients with complex conditions may require additional monitoring, such as pulmonary arterial pressure monitoring and measurement of cardiac output. [10] Facilities for on-bypass haemofiltration should be available, which may include cytokine haemadsorption filters in patients with higher inflammatory burden.

2.13 Noninvasive cerebral monitoring should include depth of anaesthesia monitors and cerebral near-infrared spectroscopy.[10]

2.14 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, ACTACC, the Society for Cardiothoracic Surgery in Great Britain and Ireland, and the European Guidelines on Cardiopulmonary Bypass in Adult Cardiac Surgery.[7,18]

2.15 An intraaortic counter pulsation balloon pump should be available.[19]

2.16 ECMO services may be available for post cardiotomy following failure to wean from cardiopulmonary bypass or as a planned transition.

2.17 Equipment for temporary pacing, including external pacing pads and emergency defibrillation, must be available.

Facilities

2.18 A designated cardiac step-down unit and cardiac ward should be considered.

2.19 Cardiac surgery should 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 patients should be in place.

2.20 In some centres, selected cardiac surgical patients are monitored following surgery in facilities other than designated ICUs. These are variously referred to as the high dependency unit, cardiac recovery or cardiac fast-track unit. These areas aim to minimise the period of mechanical ventilation and improve outcomes. The equipment, monitoring and staffing requirements for such a facility are no less than the requirements of patients cared for in a 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]

2.21 Facilities should be available for the decontamination and safe storage of transoesophageal echocardiography probes in line with local and national recommendations.[20,21,22] 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.[23]

2.22 Cardiac units should consider the implementation of an enhanced recovery after surgery programme.[24,25]

Support services

2.23 Where possible, point of care or near-patient testing should be used for blood gas analysis, measurement of electrolytes and blood sugar, haemoglobin, lactate and coagulation. This testing should include platelet function, thromboelastography or rotational thromboelastometry and early acute kidney injury urinary markers.[26] The need for direct oral anticoagulant analysis at point of care should be carefully considered. [27]

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

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

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

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

2.28 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.[28]

2.29 Pain relief protocols should be clearly defined for cardiac surgery patients.

2.30 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.[29,30]

2.31 There should be access to a range of specialist cardiology services such as imaging cardiology.[31]

2.32 24/7 access to cardiac electrophysiology services should be available.

3 Areas of special requirement

Children

3.1 Children with congenital heart disease undergoing cardiac procedures have special requirements and care should be provided by appropriately trained paediatric cardiac anaesthetists.[32,33]

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. There should be facilities and staffing to support parents/carers accompanying children in the an aesthetic environment. Such a unit should meet the standards defined for paediatric critical care, including adequate arrangements for retrieval and transfer of patients.[33,34]

3.3 Anaesthetists should be aware of legislation and good practice guidance[35] relevant to children and according to the location in the UK.[36,37,38,39] These documents refer to the rights of the child, child protection processes and consent. Local arrangements for training should be implemented.

Adult congenital heart disease

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.[40]

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 12 years of age. Anaesthetists should be aware of legislation and good practice guidance relevant to young and vulnerable adults.[35,41]

3.5 Specialist anaesthetists should be involved in the discussion of referrals and planning when conducted in the setting of a multidisciplinary team. This involvement should be recognised in job plans. Anaesthesia for complex adult congenital heart procedures should be undertaken by suitably trained adult congenital anaesthetists. Appropriate support from ACHD cardiologists and other cardiologists with suitable expertise in ACHD is necessary.[33]

Transplants

This group includes patients undergoing heart transplantation and patients who have previously received a transplant who require further cardiac surgery.

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

3.7 Cardiac anaesthetists working in non-transplant centres should be familiar with the principles of the anaesthetic management for patients who have previously undergone heart or lung transplantation.[42]

3.8 Patients undergoing heart or 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.[35,41] 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.

Pregnancy

Patients requiring cardiac 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 Cardiac anaesthetists should be familiar with the normal physiological effects of pregnancy and the general principles of obstetric anaesthesia.[43]

3.11 Where cardiac 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.[44]

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 in advance for the peripartum management for patients with known congenital or acquired cardiac disease. Staff and facilities should be available for monitored or operative delivery and for managing acute decompensation.

Chronic thromboembolic pulmonary hypertension

3.15 A subgroup of patients with chronic thromboembolic pulmonary hypertension (CTEPH) will benefit from surgery and thise condition 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 ECMO for adult patients with severe respiratory failure is commissioned by the NHS in a small number of specialist centres. The use of ECMO for adult patients with cardiovascular collapse is currently commissioned by the NHS mainly in cardiothoracic transplant centres as a bridge to transplant. An increasing number of non-transplant cardiothoracic and heart attack centres are providing non-commissioned ECMO and other extracorporeal life support services. ECMO should only be provided by staff who are trained and are working within approved clinical governance arrangements.

Cardiac catheter laboratories

Anaesthetists are requested to provide services for an increasing number of structural, electrophysiological and interventional cardiology procedures such as transcatheter aortic valve implantation, including emergency procedures. The same conditions and requirements apply as for the radiology department outlined in Chapter 7,[45] with some additional conditions:

3.17 Anaesthetists should be aware of the risks of exposure to ionising radiation in cardiac catheterisation laboratories and should ensure that they use protective garments and screens and wear exposure monitoring devices if requested to do so.[46]

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. Transoesophageal echocardiography should be immediately available.

3.20 Cardiovascular instability may, on occasion, necessitate the use of extracorporeal support, including cardiopulmonary bypass. 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. [47]

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.[48] [49,50,51] Anaesthetists should be part of the preadmission clinical pathway, including implementing interventions to promote enhanced recovery and preselection of patients suitable for enhanced recovery. This activity should be reflected in job plans.[9]

4 Training and education

4.1 Cardiac anaesthesia is a 'key unit of training' for stage 2 training in anaesthesia.[42]Trainee anaesthetists should be of appropriate seniority to be able to benefit from this area of training.

4.2 All anaesthetists in training should be appropriately clinically supervised at all times.[52]

4.3 Trainees should have an appropriate balance between cardiac and ICU training based on their individual requirements.

4.4 Trainees planning to embark in a career in cardiac anaesthesia should undertake training and accreditation in transoesophageal echocardiography.[30]

4.5 Consultant or autonomously practising anaesthetists intending to undertake anaesthesia for cardiac surgery should have received training to a higher level in cardiac anaesthesia for a minimum of one year in recognised training centres. [43] Those providing critical care for cardiothoracic surgical patients should have received training as described by the Faculty of Intensive Care Medicine (see *Cardiothoracic Critical Care, Guidelines for the Provision of Intensive Care Services*).[6] This should include training in transoesophageal echocardiography.

4.6 Consultant or autonomously practising 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 subspecialty.

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 anaesthesia(Including adult congenital heart disease and paediatric cardiac anaesthesia) to ensure that 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. 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 or autonomously practising anaesthetists, particularly those with limited experience, with a mentor to facilitate their development in cardiac anaesthesia.

5 Organisation and administration

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

5.2 There should be a joint 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 and international guidelines and reviewed and implemented on a regular basis. This may include, for example, guidance for coagulation management, venous thromboembolism treatment, and treatment for anaemia and patient blood management.

5.4 Anaesthetists should be part of the multidisciplinary team engaged in development and implementation of enhanced recovery programmes in cardiac surgery.[50,51]

5.5 Hospitals should have systems in place to facilitate multidisciplinary meetings for discussion of high-risk and complex cardiac procedures to allow for adequate advance planning of service provision.

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.[53]

5.7 The theatre team should all engage in the use of the World Health Organization surgical safety checklist,[54] commencing with a team brief and concluding the list with a team debrief. The debrief should highlight things done well and should 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. Deficiencies highlighted at the end of the team brief should be addressed in a timely and appropriate manner.

5.8 Hospitals should review their local standards to ensure that they are harmonised with the relevant national safety standards, such as the National Safety Standards for Invasive Procedures in England or the Scottish Patient Safety Programme.[55,56] 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 operating lists and to provide adequate emergency cover. Compensatory rest periods for out of hours on-call work should be appropriately included in rotas and job planning. This may affect the subsequent day's scheduled theatre activity and staffing provisions should be made for this.

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, 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 anaesthesia will be undertaken in specialist cardiac units and should be given high priority with appropriate time and infrastructure support.

7.2 Regular clinical audit of the work of cardiac anaesthesia services is essential. This should also include submission of data to national audits, such as the ACTACC national audit project. Information technology support should be available for such activities.[1,57]

7.3 Centres should consider contributing to multidisciplinary national benchmarking audits such as the National Institute for Cardiovascular Outcomes Research, Getting It Right First Time, and the National Cardiac Benchmarking Collaborative.[58]

7.4 All cardiac units should have regular multidisciplinary morbidity and mortality meetings. These should have a list of patients to discuss in advance, an attendance register, and minutes with learning points. Consultant or autonomously practising 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, provides a set of standards based on the recommendations contained in the GPAS chapters. As part of the scheme, departments of anaesthesia self-assess against the standards and undertake quality improvement projects to close the gap. Support is provided by the RCoA in the form of the good practice library, which shares documents and ideas from other departments on how to meet the standards. Further advice can be obtained from the ACSA team and department's assigned College guide.

The ACSA standards are regularly reviewed on at least a three yearly basis to ensure that they reflect current GPAS recommendations and good practice. This feedback process works both ways and the ACSA scheme regularly provides CDGs with comments on the GPAS recommendations, based on departments' experience of implementing the recommendations.

Further information about the ACSA scheme can be found here: https://www.rcoa.ac.uk/safety-standards-quality/anaesthesia-clinical-services-accreditation

9 Patient information

The Royal College of Anaesthetists has developed a range of Trusted Information Creator Kitemark-accredited patient information resources that can be accessed from the RCoA website. Our main leaflets are now translated into more than 20 languages, including Welsh.

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 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 modifications. Sources of information about the anaesthetic should also be available such as those from the RCoA.[9,59,60]

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 (.g. risk of injury due to arterial and central venous lines, blood product transfusion and transoesophageal echocardiography) 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

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 following cardiac surgery generally has less favourable outcomes.[61] Where services require percutaneous support (e.g. ECMO in cardiology), business cases should include provision of senior anaesthetic and critical care support. Mobile retrieval for ECMO provision is increasingly in use. The use of algorithm and artificial intelligence-based clinical decision support systems in theatre and intensive care to guide therapy will increase.

There is an expansion of minimally invasive and percutaneous procedures (e.g. balloon pulmonary angioplasty in patients with CTEPH deemed unsuitable for surgery) and mitral valve clipping and percutaneous closure of ischaemic complications of myocardial infarction. Evidence of symptomatic and prognostic benefit is awaited. Transcatheter mitral and tricuspid valvular procedures will become more commonplace.

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.[34]

Abbreviations

ACSA	Anaesthesia Clinical Services Accreditation
ACTACC	Association for Cardiothoracic Anaesthesia and Critical Care
CDG	Chapter Development Group
CTEPH	Chronic thromboembolic pulmonary hypertension
ECMO	Extracorporeal membrane oxygenation
GPAS	Guidelines for the Provision of Anaesthetic Services
NHS	National Health Service
RCoA	Royal College of Anaesthetists
VATS	Video-assisted thoracic surgery

Glossary

Clinical lead – Specialty and associate specialist doctors undertaking lead roles should be autonomously practising 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 continuing professional development activities. Individuals should be fully supported by their clinical director and should 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	Moderate
1.2	B	Moderate
1.3	GPP	Moderate
1.4	GPP	Strong
1.5	GPP	Strong
1.6	B	Moderate
1.7	B	Strong
1.8	B	Moderate
1.9	B	Strong
1.10	B	Moderate
1.11	GPP	GPP
2.1	B	Strong
2.2	B	Strong
2.3	B	Strong
2.4	B	Moderate
2.5	B	Moderate
2.6	B	Moderate
2.7	B	Moderate
2.8	GPP	Moderate
2.9	B	Moderate
2.10	B	Moderate
2.11	B	Strong
2.12	B	Moderate

2.13	GPP	Moderate
2.14	C	Strong
2.15	C	Moderate
2.16	GPP	Moderate
2.17	GPP	Moderate
2.18	GPP	Moderate
2.19	GPP	Strong
2.20	GPP	Moderate
2.21	C	Moderate
2.22	C	Strong
2.23	C	Moderate
2.24	GPP	Moderate
2.25	GPP	Moderate
2.26	GPP	Moderate
2.27	GPP	Moderate
2.28	C	Strong
2.29	GPP	Moderate
2.3	C	Strong
2.31	C	Moderate
2.32	GPP	Moderate
3.1	C	Strong
3.2	C	Strong
3.3	C	Strong
3.4	C	Strong
3.5	C	Strong
3.6	GPP	Strong
3.7	GPP	Strong

3.8	C	Strong
3.9	GPP	Strong
3.10	C	Moderate
3.11	GPP	Moderate
3.12	C	Moderate
3.13	GPP	Moderate
3.14	GPP	Moderate
3.15	GPP	Moderate
3.16	GPP	Moderate
3.17	C	Moderate
3.18	GPP	Moderate
3.19	GPP	Moderate
3.20	GPP	Moderate
3.21	GPP	Moderate
3.22	C	Moderate
4.1	GPP	Moderate
4.2	C	Strong
4.3	GPP	Strong
4.4	C	Strong
4.5	C	Strong
4.6	C	Strong
4.7	GPP	Strong
4.8	GPP	Strong
4.9	GPP	Strong
5.1	GPP	Moderate
5.2	GPP	Moderate
5.3	GPP	Moderate

5.4	C	Strong
5.5	GPP	Strong
5.6	C	Strong
5.7	C	Strong
5.8	C	Strong
5.9	C	Strong
6.1	GPP	Strong
7.1	GPP	Strong
7.2	C	Strong
7.3	GPP	Moderate
7.4	GPP	Strong
7.5	GPP	Strong
9.1	C	Strong
9.2	GPP	Strong
9.3	GPP	Strong
9.4	GPP	Strong

About these guidelines

Methodology

The process by which this chapter has been developed has been documented within the GPAS Chapter Development Process Document, which is available on request.

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 perioperative 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 Neuroanaesthetic services 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 June 2022.

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 Neuroanaesthetic care, under the responsibility of an anaesthetic clinical director, including (but not restricted to) consultant anaesthetists, autonomously practising anaesthetists, anaesthetists in training, nurses, operating department practitioners, surgeons, pharmacists, general practitioners, radiologists and radiographers.

Exclusion criteria

The literature review used the following exclusion criteria:

- provision of neuroanaesthesia provided by a speciality other than anaesthesia.

Data extraction and analysis

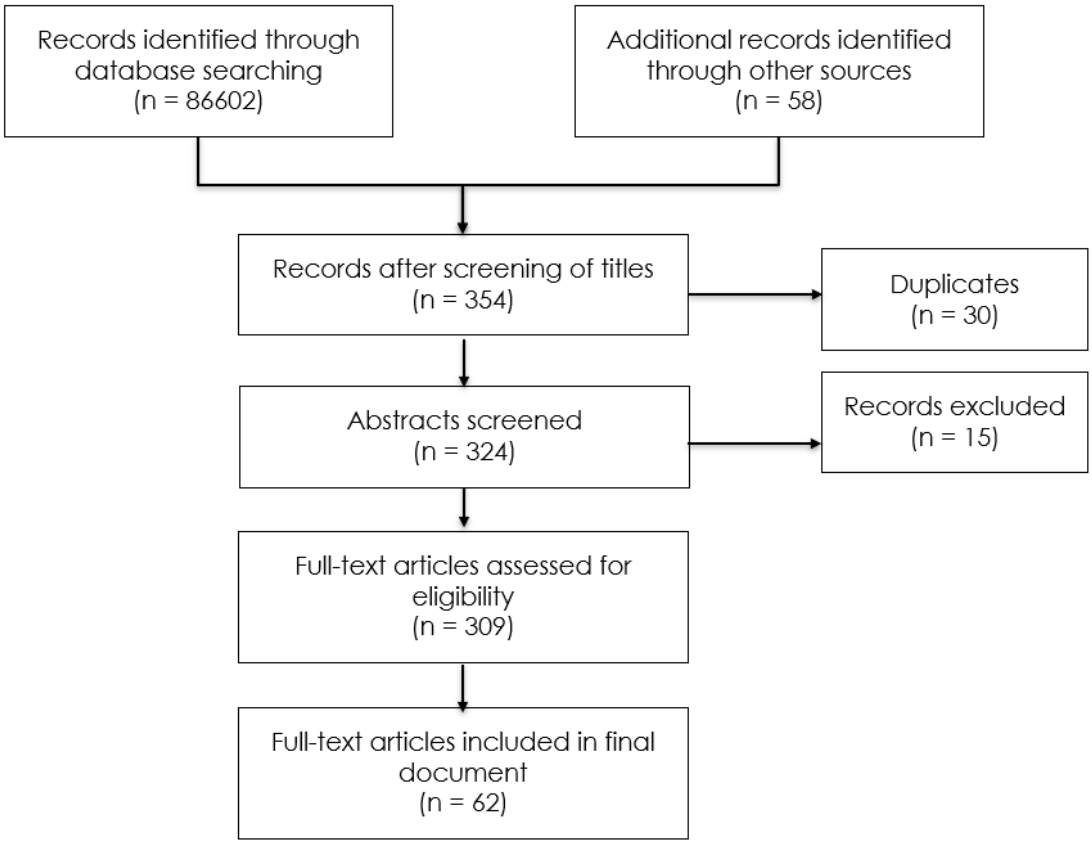
Data were extracted by the authors using a proforma. The study characteristics data included:

- 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 a 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 perioperative care anaesthesia services 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.

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 (available on request) 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, Clinical Quality and Research Board (CQRB) or through the Clinical Leaders in Anaesthesia Network. 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 CQRB and PatientsVoices@RCoA. Comments from all groups were considered and incorporated into a consultation draft.

The consultation draft of this chapter was circulated for public consultation from TBC. 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 wholly 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 2 programmed activities (PA) backfill funding. All funding decisions by the College are made by the chief executive officer, 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 (available on request). 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 and from clinical directors, and which also has PatientsVoices@RCoA 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 PatientsVoices@RCoA, 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 republication in January 2025.

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 2028.

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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