Victorian Consultative Council on Anaesthetic Mortality and Morbidity

## Victorian Consultative Council on Anaesthetic Mortality and Morbidity Triennial report 2015–2017



#### DISCLAIMER

This report is aimed at health professionals and is intended to provide a summary of clinical and system issues and related learning points identified from cases referred to the VCCAMM during 2015–2017. The content of the report is not intended to be a substitute for a clinician's judgement (taking into consideration the particular circumstances of their patients), nor is it intended to replace information contained within consensus guidelines.

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### Foreword

Since 1976, the Victorian Consultative Council on Anaesthetic Mortality and Morbidity (VCCAMM or 'the council') has received and reviewed voluntary reports about possible anaesthesia-related mortality and morbidity occurring in Victoria. The purpose has always been to identify opportunities to continue to improve the quality and safety of anaesthetic care, and the council is immensely appreciative to Victorian anaesthetists for their ongoing contribution of cases.

The VCCAMM was originally established by the Minister for Health under the *Health Act 1958* to enquire into the circumstances of deaths and illnesses occurring during or as a result of anaesthesia, with the 'sole object of making recommendations which would lead to their prevention' (Letter accompanying the first report, 1983). The council now operates under the *Public Health and Wellbeing Act 2008*.

For more than 40 years, Victorian anaesthetists have generously provided information about possible anaesthesia-related mortality and morbidity to help improve overall safety and quality of anaesthetic care in Victoria. Since 1985, the council has contributed to national reporting through the Australian and New Zealand College of Anaesthetists (ANZCA). The inclusion of morbidity reporting has always been an important and unique focus in the Victorian model. This has become increasingly relevant as anaesthesiarelated mortality becomes less common.

From 2015 to 2017, over 3 million individual episodes of anaesthesia care were recorded in Victoria<sup>1</sup>. Anaesthesia in Victoria continues to be very safe, but there are always opportunities to learn how clinical care can continue to be improved. Identifying and addressing the influence of human factors is one such opportunity.

The council's findings for cases reported during the 2015–2017 triennium are shared in this report. Referrals in the 2015–2017 triennium reflected the growth of non-operating-room anaesthesia and included an increasing number of referrals around broader perioperative issues, particularly in older patients with complex medical problems. The council welcomed this trend because it highlights the changing context in which anaesthesia is now delivered and the multifactorial nature of perioperative outcomes.

<sup>1</sup> This information is derived from the Department of Health and Human Services' Victorian Admitted Episodes Dataset (VAED). This dataset records a standard set of variables for inpatient and day-only admissions from all public and private hospitals, including demographic characteristics, diagnoses, procedures and patient status at discharge.

In this spirit, this will be the last triennial report from the VCCAMM, which will complete its current term on 30 June 2019. From July 2019, Safer Care Victoria will establish the Victorian Perioperative Consultative Council to take perioperative outcome reviews forward with a new direction and focus that is more consistent with Victoria's evolving health context.

I hope the key findings and recommendations in this final report from the VCCAMM highlight the range of important skills anaesthetists bring to a multidisciplinary and shared decision-making approach to perioperative care and reflect the rationale for a new approach to perioperative outcome review.

Thank you to all who have contributed for more than 40 years to an important safety and quality initiative: those who have generously referred cases, past and present council and subcommittee members, and the dedicated staff of the Consultative Councils Unit. The council is also thankful for the much-valued collaborations with the ANZCA Mortality Subcommittee, the Victorian Audit of Surgical Mortality, the Coroner's Office and with our colleagues on the Victorian Surgical Consultative Council and the Consultative Council of Obstetrics and Paediatric Mortality and Morbidity.

#### Dr Andrea Kattula Chair

Victorian Consultative Council on Anaesthetic Mortality and Morbidity

### Acknowledgements

This report was made possible through the generous assistance of many individuals and organisations.

Foremost, the council thanks those who have referred cases to help inform our understanding of anaesthesia-related mortality and morbidity in Victoria. The council would also like to express its gratitude to the Victorian Audit of Surgical Mortality, the State Coroner's Office and the Victorian Institute of Forensic Medicine for their ongoing assistance and support, as well as our colleagues on the ANZCA Mortality Subcommittee, the Victorian Surgical Consultative Council and the Consultative Council of Obstetrics and Paediatric Mortality and Morbidity. These close working relationships have been highly valued.

We are deeply appreciative to the council and case review subcommittee members for their contributions over the triennium, both in terms of their comprehensive case deliberations and kind assistance in preparing this report. Their knowledge, experience and multidisciplinary expertise has been invaluable. We would also like to acknowledge the members who retired during the 2015–2017 triennium, many of whom generously contributed their time and expertise to the VCCAMM over a great number of years.

We would also like to acknowledge the dedicated work of Associate Professor Larry McNicol AM, who chaired the council from 2004 to 2017 with tireless effort and commitment to improving the safety of anaesthetic care in Victoria and was involved with reviewing cases included in this report.

The chair is also extremely grateful to the staff of the Consultative Council Unit (CCU) for their valued secretariat support, advice and guidance. In particular, the chair would like to express great appreciation to Sarah Kenny, the CCU Team Leader, who has worked closely with the chair since 2017 in both the day-to-day running of the VCCAMM and in preparing this report.

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### **Executive summary**

This report provides quantitative and qualitative analysis from the Council's review of 238 cases submitted to the Victorian Consultative Council on Anaesthetic Mortality and Morbidity (VCCAMM) during the period 2015–17. This included 110 cases classified as anaesthesia-related mortality and morbidity. The report emphasises three key overarching themes:

- the importance of human factors and organisational safety
- the growth of non-operating-room anaesthesia
- the value of multidisciplinary shared decision making in perioperative care

#### **KEY MESSAGES**

The key messages to emerge from VCCAMM deliberations were:

- Perioperative outcomes are becoming increasingly complex.
- A more complete understanding of patterns of risk is needed.
- The context in which anaesthesia is delivered is changing.
- A 'human factors' approach remains vital in preventing adverse events.
- Perioperative multidisciplinary shared decision making is becoming increasingly relevant.
- Perioperative management of patients with obstructive sleep apnoea needs a more consistent approach.
- Supporting communication with patients from culturally and linguistically diverse (CALD) backgrounds requires practical point-of-care tools.

These key messages have led to the following recommendations by VCCAMM.

#### RECOMMENDATIONS

### Recommendation 1: Strengthening perioperative outcome review

Council recommends a more multidisciplinary and shared learning approach to perioperative outcome reviews to enable more strategic system recommendations, with a stronger focus on human factors, organisational safety and consideration of patient-centred outcomes.

### Recommendation 2: Supporting targeted perioperative outcome review

Council recommends considering targeted reviews of selected perioperative events and outcomes over defined time periods to facilitate a more complete understanding of incidence and contributing factors for priority areas of concern. This will enable more strategic recommendations at the state level.

## Recommendation 3: Improving our understanding of perioperative anaphylaxis

Council recommends consideration be given to either extending mandatory anaphylaxis reporting in Victoria to include perioperative anaphylaxis or conducting a targeted audit of perioperative anaphylaxis.

### Recommendation 4: Monitoring outcomes in a changing anaesthesia context

Council recommends that monitoring and assessing anaesthesia-related outcomes in the broader and rapidly growing context of non-operating-room anaesthesia and procedural sedation is an integral part of an evolving governance approach to a changing anaesthesia context.

### Recommendation 5: Driving a 'human factors' approach in perioperative care

Council recommends that Safer Care Victoria supports greater education, training and implementation of 'human factors' principles in the Victorian health sector, particularly in relation to multidisciplinary perioperative care.

## Recommendation 6: Facilitating perioperative multidisciplinary shared decision making

Council recommends that Safer Care Victoria explores with Victorian hospitals how systems and processes can be implemented to better support perioperative, multidisciplinary and informed shared decision making for surgical patients with complex medical problems, particularly the elderly.

## Recommendation 7: Guiding consistent perioperative care for obstructive sleep apnoea

Council recommends developing a statewide set of principles to guide and support a more consistent approach to the perioperative care of patients with diagnosed or suspected obstructive sleep apnoea to reduce the risk of postoperative complications.

## Recommendation 8: Supporting patients from culturally and linguistically diverse (CALD) backgrounds

Council recommends that Safer Care Victoria explores existing and new opportunities with health services to develop practical point of care tools to facilitate greater communication between patients from culturally and linguistically diverse (CALD) backgrounds and their healthcare providers across the perioperative period.

### **About this report**

#### **PURPOSE**

This report provides an analysis of anaesthesia-related mortality and morbidity from cases referred to the Victorian Consultative Council on Anaesthetic Mortality and Morbidity (VCCAMM or 'the council') during 2015–2017. The analysis is derived from council deliberations undertaken after collating the submitted written report and any additional information required to add value to the findings.

Centralised collation and analysis help identify common factors and opportunities to improve anaesthetic and perioperative care for what are often infrequent but significant events.

The primary purpose of the report is to inform Victorian anaesthetists and healthcare providers about clinical and system issues emerging from these referred cases. As the first VCCAMM report (1977–1982) noted, the council aims to provide:

'in one place, a summary of serious morbidity for the information of all practitioners.'

Voluntary reporting means that many cases have most likely been referred by anaesthetists because of their recognised value in sharing learnings with other colleagues. The 'Clinical themes' section of the report has been prepared with this in mind. Key messages summarise salient points from the aggregated cases, while practice points reflect more specific learning outcomes derived from the cases and often raised by a referring anaesthetist. Neither is meant to replace individual clinical judgement or advice in consensus guidelines. We hope this section may be of particular interest and value to trainees.

The classification of mortality and morbidity events as anaesthesia-related remains a subjective judgement based on council consensus opinion. A description of the definitions, classification system, event categories and preventability scoring is provided in the appendix.

#### DEVELOPMENTS IN THE 2015–2017 TRIENNIUM

The 2015–2017 triennium saw a number of changes in the VCCAMM structure and processes including:

- appointment of a new council and establishment of the Case Review Subcommittee
- enhanced multidisciplinary representation, including much-valued consumer representation on both the council and Case Review Subcommittee – this has greatly broadened the council's focus regarding opportunities for improving anaesthetic and perioperative care
- collaboration with the Victorian Audit of Surgical Mortality in 2016, increasing the council's ability to identify possible anaesthesia-related mortality
- introduction of an online reporting form, facilitating more timely and complete referral submissions.

In 2018, the council also participated in a Safer Care Victoria review of the VCCAMM and the Victorian Surgical Consultative Council. This was a significant and welcomed opportunity to review past achievements, revisit objectives in a changing healthcare context and consider opportunities to strengthen perioperative outcome review in Victoria. The Victorian Perioperative Consultative Council Report, arising from this review is available at: https://www.bettersafercare. vic.gov.au/reports-and-publications/the-victorianperioperative-consultative-council-report

#### PERIOPERATIVE OUTCOMES ARE BECOMING INCREASINGLY COMPLEX

This triennium, referrals to VCCAMM notably included events occurring/unfolding across the perioperative period as well as intraoperative events related specifically to anaesthesia.

It is now well understood that perioperative outcomes are multifactorial in nature, influenced by patient factors (including age, comorbidities and functional status), the quality and effectiveness of multidisciplinary perioperative care, organisational factors and other causes of variation (Minto & Biccard, 2014).

This multifactorial influence was apparent in many of the cases reported to the VCCAMM this triennium and highlights the importance of considering anaesthesia-related mortality and morbidity within a broader context of perioperative outcomes.

### Recommendation 1: Strengthening perioperative outcome review

Council recommends a more multidisciplinary and shared learning approach to perioperative outcome reviews to enable more strategic system recommendations, with a stronger focus on human factors, organisational safety and consideration of patient-centred outcomes.

Greater knowledge about the organisational context in which reported events occur and the outcomes of organisational-level adverse event reviews would strengthen such an approach.

#### A MORE COMPLETE UNDERSTANDING OF PATTERNS OF RISK IS NEEDED

Dependence on voluntary reporting limits the council's ability to identify important patterns of risk and strategic opportunities for improvement at the state level.

## Recommendation 2: Supporting targeted perioperative outcome review

Council recommends considering targeted reviews of selected perioperative events and outcomes over defined time periods to facilitate a more complete understanding of incidence and contributing factors for priority areas of concern. This will enable more strategic recommendations at the state level. Perioperative anaphylaxis is an important example where incomplete information about the incidence, predisposing factors, triggering factors and clinical care outcomes limits the council's ability to make specific recommendations about this significant cause of anaesthesia-related mortality and morbidity.

#### Recommendation 3: Improving our understanding of perioperative anaphylaxis

Council recommends consideration be given to either extending mandatory anaphylaxis reporting in Victoria to include perioperative anaphylaxis or conducting a targeted audit of perioperative anaphylaxis.

This would improve understanding of the incidence, predisposing factors, triggering agents and clinical care outcomes for this adverse event, which continues to be a significant cause of anaesthesia-related mortality and morbidity, including in otherwise healthy individuals.

An enhanced understanding will help identify ongoing research opportunities and specific areas where clinical practice change may reduce risk and/or improve outcomes.

#### THE CONTEXT IN WHICH ANAESTHESIA IS DELIVERED IS CHANGING

Anaesthesia (including general anaesthesia, major regional blocks, intravenous sedation and local anaesthesia with potential to cause systemic toxicity) is increasingly being provided in non-traditional locations for a growing range of non-surgical disciplines and procedures, and by a range of providers (not always anaesthetists). This broader context is not reliably covered in the current council's voluntary reporting processes.

This changing context and growth of nonoperating-room anaesthesia inherently brings with it:

- new multidisciplinary teams
- new environments and facilities
- new workflows
- new clinical scenarios.

Risk assessment considerations around providing procedural sedation and anaesthesia in nonoperating-room locations are essential, including assessment of facilities, staffing, training, equipment, workflows and emergency response needs. This includes the recovery period. Council notes recent developments in this space including:

- the Health Services (Private Hospitals and Day Procedure Centres) Amendment Regulations 2018 ('the 2018 regulations'), which came into effect on 1 July 2018
- an initiative led by the Australian and New Zealand College of Anaesthetists (ANZCA) with stakeholders (medical, nursing and dental practitioner groups and colleges) to develop a set of safe procedural sedation competencies for training programs (ANZCA, 2019).

#### Recommendation 4: Monitoring outcomes in a changing anaesthesia context

Council fully supports steps to improve the safety of procedural sedation and anaesthesia that encompass non-traditional procedure locations and providers both within and outside of hospital environments and that consider facilities, staffing, training, equipment, workflows and emergency response needs.

Council recommends that monitoring and assessing anaesthesia-related outcomes in the broader and rapidly growing context of non-operating-room anaesthesia and procedural sedation is an integral part of an evolving governance approach to a changing anaesthesia context.

#### A 'HUMAN FACTORS' APPROACH IS VITAL IN PREVENTING ADVERSE EVENTS

Human factors (interactions between people, procedures, equipment, workflows and the work environment) contributed to many anaesthesiarelated events considered as having a greater degree of preventability.

These events highlighted the importance of training in crisis management, use of cognitive aids such as checklists and algorithms at the point of care, and design of workflows, work environments and equipment in reducing the risk of preventable anaesthesia-related mortality and morbidity. Specific areas of concern included the impact of disruptions and distractions during high-risk tasks, the timing and structure of clinical handovers, production pressure and communication between multidisciplinary team members during crisis management.

Council notes and supports the significant and ongoing work by ANZCA in developing a broad range of education and training materials, as well as point-of-care tools and resources, that address human factors in delivering anaesthetic and perioperative care.

#### Recommendation 5: Driving a 'human factors' approach in perioperative care

Council recommends that Safer Care Victoria supports greater education, training and implementation of 'human factors' principles in the Victorian health sector, particularly in relation to multidisciplinary perioperative care.

An important part of this process is seeking clinician input about the contexts in which perioperative adverse events and nearmisses occur. An improved understanding of the factors that influence decision making and performance will inform effective 'human factor' solution design.

#### PERIOPERATIVE MULTIDISCIPLINARY SHARED DECISION MAKING IS BECOMING INCREASINGLY RELEVANT

Patients with complex medical problems presenting for elective or emergency surgery is increasingly common, presenting significant challenges for patients and their families, as well as clinicians. This was strongly reflected in cases classified as category 3 (medical/surgical and anaesthesia factors identified) and category 5 (inevitable deaths).

Multidisciplinary preoperative assessment by senior clinicians can help inform discussions with patients (and their families or carers) about perioperative risks, treatment options and patient goals of care, helping optimise individual care plans and outcomes and avoiding futile interventions.

Decision making is more difficult in the intraoperative and early postoperative period when such conversations have not occurred or been clearly documented, and a patient's condition rapidly deteriorates.

#### Recommendation 6: Facilitating perioperative multidisciplinary shared decision making

Council recommends that Safer Care Victoria explores with Victorian hospitals how systems and processes can be implemented to better support perioperative, multidisciplinary and informed shared decision making for surgical patients with complex medical problems, particularly the elderly. Key aspects include:

- senior-level, multidisciplinary preoperative assessments and discussions that explore patient wishes and goals of care
- support for patients (and their families or carers) to effectively participate in these discussions
- ensuring goals of care discussions are appropriately documented, updated and communicated to clinicians involved in the patient's care
- monitoring the efficacy of these discussions in meeting goals of care and reducing futile interventions
- creating training programs that support junior medical staff in developing relevant skills.

#### THE PERIOPERATIVE MANAGEMENT OF OBSTRUCTIVE SLEEP APNOEA NEEDS A MORE CONSISTENT APPROACH

Obstructive sleep apnoea (OSA) is associated with a higher risk of postoperative respiratory complications. OSA and the emerging issues of undiagnosed OSA and central hypoventilation syndromes are becoming increasingly relevant to perioperative care in the context of a rising prevalence of severe obesity.

#### Recommendation 7: Guiding consistent perioperative care for obstructive sleep apnoea

Council recommends developing a statewide set of principles to guide and support a more consistent approach to the perioperative care of patients with diagnosed or suspected obstructive sleep apnoea to reduce the risk of postoperative complications. Principles are needed around:

- elective versus emergency surgical contexts
- location of postoperative care including monitoring and staffing considerations
- actions to take when a patient's own CPAP machine is not available for use postoperatively.

#### SUPPORTING COMMUNICATION WITH PATIENTS FROM CULTURALLY AND LINGUISTICALLY DIVERSE (CALD) BACKGROUNDS REQUIRES PRACTICAL POINT-OF-CARE TOOLS

Language barriers impede effective communication of relevant clinical information (including symptoms, history and changes in condition) and limit opportunities for patients to participate in safety initiatives such as preoperative checking procedures.

This is particularly relevant in the context of busy day of surgery admission (DOSA) areas, rapid turnover surgical lists and postoperative wards when interpreters may not always be present.

Timely and effective communication with patients and their families or carers is one of our most important lines of defence in preventing adverse events and optimising clinical outcomes. Risks when patients cannot effectively communicate with their healthcare providers include loss of relevant information, incorrect assumptions, missed opportunities to recognise errors and delays in diagnosis or intervention.

#### Recommendation 8: Supporting communication with patients from culturally and linguistically diverse (CALD) backgrounds

Council recommends that Safer Care Victoria explores existing and new opportunities with health services to develop practical pointof-care tools that help facilitate greater communication between patients from culturally and linguistically diverse (CALD) backgrounds and their healthcare providers across the perioperative period. This is particularly important in relation to facilitating participation in preoperative checking procedures and supporting postoperative communication of patient concerns.

### Referred events in the 2015–2017 triennium

#### **IS THIS REPORT A COMPLETE PICTURE?**

Accuracy of data regarding the number of anaesthesia-related deaths is dependent on the council's ability to obtain information on all potential anaesthesia-related deaths in Victoria. Under existing arrangements, cases directly referred to the council have been voluntarily reported.

The council has greatly appreciated continued efforts by individual anaesthetists, anaesthetic departments, the Coroner's Office and, more recently, the Victorian Audit of Surgical Mortality to inform VCCAMM of potential and/or significant cases of anaesthesia-related mortality and morbidity. Notifications from the Victorian Audit of Surgical Mortality, which began in 2016, have importantly improved the council's ability to identify anaesthesia-related events that may have unfolded or first become apparent in the postoperative period.

However, anaesthesia is a broad concept that includes general anaesthesia, major regional blocks, intravenous sedation and local anaesthesia. As such, anaesthesia is not always administered in an operating theatre or by an anaesthetist. Anaesthesia is increasingly being provided in non-traditional locations for a growing range of non-surgical disciplines and procedures, and by a range of providers. The council currently has limited ability to capture anaesthesiarelated mortality and morbidity occurring in this expanding, broader context.

#### HOW MANY CASES WERE REFERRED IN THE 2015–2017 TRIENNIUM?

During the triennium, 239 events were referred to the council. One referral involved distinct mortality and morbidity events and was included as two separate events. The review and classification of one event is not yet complete, pending availability of further information. This case has not been included in the findings of this report.

In total, 238 events were reviewed and classified as 181 mortality events and 57 morbidity events.

Of the 238 events classified by the council, 110 were classified as anaesthesia-related mortality or morbidity.

### **Council classifications**

### WHERE DID THE REFERRALS COME FROM?

Fourteen per cent of referrals came from the private sector and 86 per cent from the public sector. This is not unexpected, as high-risk cases may be more likely to be undertaken in public hospitals. Nineteen per cent of cases referred from the public health sector were from regional or rural health services, and it is encouraging that reports are reflecting a range of hospital types and locations.

58% of all cases were direct reports from anaesthetists (approximately 46% of the 181 mortality events and 98% of the 57 morbidity events).

Fifty-four per cent of the 181 mortality referrals were generated by the Victorian Audit of Surgical Mortality. Thirty-five (32 per cent) of these were ultimately classified by the council as anaesthesiarelated mortality events. This new referral source highlighted the value of being able to consider

#### Table 1: Category assigned by the council

events occurring in the postoperative period to which anaesthetic factors may have had some contribution.

#### HOW WERE REFERRED CASES CLASSIFIED?

Cases were reviewed and assigned a category, primary event type and sub-type. Category 1–3 cases were further assigned sub-categories based on identified contributing factors and given a preventability rating. Keywords were also assigned to help theme common factors.

Details of these classifications are provided in Appendices 1–2.

#### **Assigned categories**

The council categorised 181 mortality events and 57 morbidity events as anaesthesia-related, nonanaesthesia-related or unassessable as per the 10 classification categories summarised in Table 1.

Category assigned by the council*	Morbidity	Mortality	Total		
Anaesthesia-related mortality/morbidity: 110 cases					
1: Reasonably certain due to anaesthetic factors	35	12	47		
2: Some doubt whether entirely due to anaesthetic factors	2	2	4		
3: Attributed to medical/surgical and anaesthetic factors	15	44	59		
Non-anaesthesia-related mortality/morbidity: 127 cases					
4: Attributed to surgical factors	4	35	39		
5: Inevitable death or morbidity (with or without surgery)	0	82	82		
6: Fortuitous (cause unrelated to surgery or anaesthesia)	0	6	6		
Unassessable mortality/morbidity: one case					
7: Could not be assessed despite considerable data	0	0	0		
8: Could not be assessed due to inadequate data	0	0	0		
9: Critical incident, with no morbidity or mortality	1	0	1		
10: Morbidity with satisfactory anaesthesia and surgical techniques	0	0	0		
Total	57	181	238		

\* A full description of categories is provided in Appendix 2.

#### **Mortality classifications**

Of the 181 mortality events, 58 (32 per cent) were considered anaesthesia-related (categories 1–3). Twelve of these events were deemed category 1 (reasonably certain due to anaesthetic factors).

Of the 181 mortality events, 123 (68.3 per cent) were considered non-anaesthesia-related (categories 4–10).

#### **Morbidity classifications**

Of the 57 morbidity events, 52 (91.2 per cent) were classified as anaesthesia-related. This is not unexpected in a voluntary reporting system where morbidity reports are predominantly submitted by anaesthetists.

#### **Demographics of classified cases**

For the events classified as anaesthesia-related (categories 1–3), male and female patients were fairly equally represented.

For the events classified as anaesthesia-related (categories 1–3), 81 per cent (47/58) of the anaesthesia-related mortality events occurred in patients aged over 60 years, with just over half (51.7 per cent; 30/58) occurring in patients aged over 80 years (Figure 1). The morbidity events were more evenly spread across age groups.

For the non-anaesthesia-related and unassessable events (categories 4–10), 87.8 per cent (108/123) of the mortality events occurred in patients aged over 60 years (Figure 2).

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Patient age	Morbidity	Mortality	Total
0–30	10	0	10
31–40	8	1	9
41–50	6	5	11
51–60	7	5	12
61–70	8	6	14
71–80	9	11	20
81–90	4	20	24
> 90	0	10	10
Total	52	58	110

### Figure 1: Age distribution of anaesthesia-related events (categories 1–3)

#### Figure 2: Age distribution of non-anaesthesiarelated events (categories 4–10)

Patient age	Morbidity	Mortality	Total
0–30	0	1	1
31–40	1	3	4
41–50	0	8	8
51–60	1	3	4
61–70	1	22	23
71–80	0	27	27
81–90	2	45	47
> 90	0	14	14
Total	5	123	128





# Category 1–3 cases: Anaesthesia-related mortality and morbidity

The 110 cases classified as anaesthesia-related mortality or morbidity events are the main focus of this report.

- 47 (42.7 per cent) cases were deemed category 1 (reasonably certain the event was due to anaesthesia factors) (12 mortality and 35 morbidity).
- Four (3.6 per cent) cases were deemed category 2 (some doubt whether the event was entirely due to anaesthesia factors) (two mortality and two morbidity).
- 59 (53.6 per cent) cases were deemed category 3 (medical/surgical and anaesthesia factors were thought to be involved) (44 mortality and 15 morbidity).

#### PRIMARY EVENT TYPE CLASSIFICATIONS FOR CATEGORY 1–3 CASES

Table 2 shows the primary event type in order of frequency for the events classified as anaesthesiarelated (categories 1–3). More detail regarding their clinical nature is provided in the 'Clinical themes' section. It is important to note that each event can only be assigned to one (primary) event category and event sub-type. Cases classified under one event type may have also involved other clinical issues that are not reflected in the event classification. This overlap is explored further in the 'Clinical themes' section.

The most commonly reported anaesthesia-related events were cardiovascular events. These events were predominantly classified as category 3 events (attributed to medical/surgical and anaesthetic factors).

The 12 category 1 mortality events involved:

- six intraoperative anaphylaxis events
- four aspiration events
- one airway event with suspected oesophageal intubation
- one neurological event with hypoxic ischaemic brain injury.

Eight of these 12 category 1 mortality events were considered by the council to have not been preventable.

Event type	Number of cases	Morbidity	Mortality	Cat 1	Cat 2	Cat 3
Cardiovascular	42	10	32	5	1	36
Drug-related	21	15	6	15	0	6
Respiratory	13	4	9	5	2	6
Neurological	13	6	7	6	0	7
Airway	9	7	2	8	1	0
Procedure-related	8	8	0	7	0	1
Metabolic	1	1	0	1	0	0
Miscellaneous	3	1	2	0	0	3
Total	110	52	58	47	4	59

#### Table 2: Event type for category 1–3 cases

#### ASSIGNED EVENT SUB-TYPES FOR CATEGORY 1–3 CASES

#### Cardiovascular events included: (n = 42)

 cardiac arrests (24), significant hypotension (six), myocardial ischaemia (three), myocardial infarction (two), haemorrhage (two), arrhythmia (one), embolism (one), cardiac failure (one), cardiorenal multiorgan failure (one) and postoperative hypotension (one).

#### Drug-related events included: (n = 21)

 anaphylaxis (17), drug-related adverse effects (two), atypical pseudocholinesterase (one) and an unintended medication overdose (one).

#### Respiratory events included: (*n* = 13)

 aspiration (five), pneumothorax (two), hypoventilation (one intraoperative, one postoperative), hypoxia (one), pulmonary oedema (one), unplanned postoperative ventilation (one) and type 2 respiratory failure (one).

#### Neurological events included: (n = 13)

 stroke (six), awareness under general anaesthesia (GA) (three), inadequate neuromuscular blockade reversal (one), nerve injury (one), hypoxic ischaemic brain injury (one) and 'other' (one).

#### Airway events included: (*n* = 9)

 failed intubations (three, including a suspected oesophageal intubation), endotracheal tube (ETT) dislodgement/displacement (two), a suspected oesophageal intubation (one), airway obstruction (one), a retained throat pack causing respiratory distress after extubation (one) and a vocal cord problem following GA with an ETT (one).

#### Procedure-related events included: (n = 8)

 wrong-side nerve blocks (three), procedural errors (two, including a retained throat pack), vascular injury (one), pneumothorax (one) and an epidural catheter break (one).

#### Metabolic events included: (*n* = 1)

malignant hyperthermia (one).

#### Miscellaneous events included: (n = 3)

 communication error (one), deterioration and death in the early postoperative period (one) and progressive hypotension and hypoxia after return to the ward (one).

#### **CONTRIBUTING FACTORS IDENTIFIED**

Table 3 shows the underlying factors identified by the Council for events classified as anaesthesia related.

#### Table 3: Contributing factors identified in category 1–3 cases

Identified factors	Morbidity cases	Mortality cases	Total*
A. Preoperative factors	1	3	4
Ai Assessment	1	2	3
Aii Management	0	1	1
B. Anaesthesia technique	22	6	28
Bi Choice or application	12	1	13
Bii Airway maintenance (including pulmonary aspiration)	7	5	12
Biii Ventilation	3	0	3
Biv Circulatory support	0	0	0
C. Anaesthesia drugs	25	8	33
Ci Selection	0	0	0
Cii Dosage	7	1	8
Ciii Adverse drug reaction	17	7	24
Civ Inadequate reversal	1	0	1
Cv Incomplete recovery	0	0	0
D. Anaesthesia management	4	5	9
Di Crisis management	2	3	5
Dii Inadequate monitoring	1	2	3
Diii Equipment failure	1	0	1
Div Inadequate resuscitation	0	0	0
Dv Hypothermia	0	0	0
E. Postoperative	6	2	8
Ei Management	3	0	3
Eii Supervision	2	0	2
Eiii Inadequate resuscitation	1	2	3
F. Organisational	12	4	16
Fi Inadequate supervision, experience or assistance	3	1	4
Fii Poor organisation of the service	2	0	2
Fiii Failure of interdisciplinary planning	7	3	10
Total for sub-categories A to F	70	28	98
G. No correctable factor identified	14	30	44
H. Medical condition of the patient	14	49	63

\* The total count is greater than the number of cases reviewed as more than one underlying factor may be identified for each event.

#### No correctable factor identified

In 44 (40 per cent) of the 110 events classified as anaesthesia-related mortality or morbidity, no correctable factor could be identified by the council (sub-category G). These events predominantly involved mortality cases (30 of the 44 events).

In 31 (70.5 per cent) of these 44 cases, the medical condition of the patient (sub-category H) was also identified as a significant factor.

This finding is a reminder that, despite enormous advances in safety, anaesthesia and surgery are still associated with some risk, particularly in patients with complex medical problems.

#### Medical condition of the patient

In 63 (57.3 per cent) of the 110 events classified as anaesthesia-related mortality or morbidity, the medical condition of the patient was identified as a significant contributing factor (sub-category H) (Table 3).

This is important because in these cases the mortality or morbidity outcome was not deemed inevitable (category 5) or fortuitous (category 6). These cases highlight the potential opportunities offered by a multidisciplinary approach to managing and optimising the medical condition of patients across the perioperative period.

#### Table 4: Contributing factors identified in category 1–3 cases in order of frequency

	Number of cases		
Factor identified	or definitely preventable**)	Morbidity	Mortality
Ciii Adverse drug reaction	24 (1)	17	7
Bi Anaesthesia technique – choice or application	13 (12)	12	1
Bii Airway maintenance (including pulmonary aspiration)	12 (8)	7	5
Fiii Failure of interdisciplinary planning	10 (8)	7	3
Cii Anaesthesia drugs – dosage	8 (6)	7	1
Di Anaesthesia crisis management	5 (3)	2	3
Fi Organisational – inadequate supervision, experience or assistance	e 4	3	1
Ai Preoperative assessment	3	1	2
Biii Anaesthesia technique – ventilation	3 (2)	3	0
Dii Inadequate monitoring	3 (1)	1	2
Ei Postoperative management	3	3	0
Eiii Postoperative – inadequate resuscitation	3	1	2
Eii Postoperative – supervision	2	2	0
Fii Poor organisation of the service	2	2	0
Aii Preoperative management	1	0	1
Civ Anaesthesia drugs – inadequate reversal	1 (1)	1	0
Diii Anaesthesia management – equipment failure	1	1	0
Total*	98	70	28

\* The total count is greater than the number of cases reviewed as more than one underlying factor may be identified for each event.

\*\* For definitions of preventability see Appendix 2.

These issues and related learning points are explored further in the 'Clinical themes' section.

#### ASSESSMENT OF PREVENTABILITY FOR CATEGORY 1–3 CASES

Since 2015, the council has assigned a preventability rating to cases classified as category 1, 2 or 3:

- Fifty-five (50 per cent) of the 110 category 1–3 cases were considered not preventable (37 mortality and 18 morbidity).
- Twenty-six (23.6 per cent) of the 110 category 1–3 cases were considered definitely or probably preventable; 24 of these were morbidity events.

Of the category 1 events:

- 10 were considered definitely preventable
- 10 were considered probably preventable
- eight were considered possibly preventable
- 19 were considered not preventable.

While this is derived from a subjective consensus opinion, it helps identify potentially addressable factors.

In the subset of events considered at least probably preventable, the most frequently

#### Table 5: ASA category assigned by the council

identified contributing factors related to choice or application of anaesthesia technique (n = 12), airway maintenance (n = 8), failure of interdisciplinary planning (n = 8), dosage of anaesthesia drugs (n = 6), crisis management (n = 3), ventilation (n = 2), inadequate reversal of anaesthesia drugs (n = 1), inadequate monitoring (n = 1) and adverse drug reaction (n = 1).

The most frequent types of events considered at least probably preventable were airway events, procedure-related events, awareness under GA and cardiac arrests. Associated factors are explored in the Reducing the Risk section.

#### **GENERAL RISK FACTORS**

Level of risk was assigned using the American Society of Anaesthesiologists (ASA) 'physical status' rating (ASA House of Delegates/Executive Committee, 2014). The ASA classifications in this report are intended to provide an 'at a glance' overview of the council's assessment of the general preoperative health status of cases referred during 2015–2017 (Table 5).

ASA rating	Morbidity	Mortality	Total	Brief description*
1	11	2	13	A normal healthy patient
2	19	7	26	A patient with mild systemic disease
3	20	19	39	A patient with severe systemic disease
4	2	29	31	A patient with severe systemic disease that is a constant threat to life
5	0	1	1	A moribund patient who is not expected to survive without the operation
Total	52	58	110	

\* A full description of The American Society of Anaesthesiologists' ASA Physical Status Classification System is available online <a href="https://www.asahq">https://www.asahq</a>. org/standards-and-guidelines/asa-physical-status-classification-system>.

The ASA physical status is a subjective classification originally developed in 1941 (updated in 1961 and 2014) to help collate outcomes from anaesthesia (Mayhew, Mendonca, & Murthy, 2019). The rating has been shown to be associated with postoperative morbidity and mortality outcomes. While it remains a subjective classification, reintroducing case vignettes in 2014 (ASA House of Delegates/Executive Committee, 2014) was demonstrated to have improved objectivity and inter-observer variability (Hurwitz, et al., 2017). Interestingly an assessment of functional status was included in the original tool, and with increasing concerns about frailty, it has been raised whether this should be reintroduced (Mayhew, Mendonca, & Murthy, 2019).

Most anaesthesia-related mortality events occurred in patients classified as ASA 4 (50 per cent; 29/58) or ASA 3 (32.8 per cent; 19/58). Most anaesthesia-related morbidity events occurred in patients classified as ASA 3 (38.5 per cent; 20/52) or ASA 2 (36.5 per cent, 19/52).

#### **URGENCY OF PROCEDURE**

For consistency in approach, procedures were classified as emergency (non-elective) or elective by considering the definition of emergency surgery used by the Australian Institute of Health and Welfare (AIHW).

'Emergency surgery is surgery to treat trauma or acute illness subsequent to an emergency presentation. The patient may require immediate surgery or present for surgery at a later time following this unplanned presentation. This includes where the patient leaves hospital and returns for a subsequent admission. Emergency surgery includes unplanned surgery for admitted patients and unplanned surgery for patients already awaiting an elective surgery procedure (for example, in cases of acute deterioration of an existing condition).'

(AIHW METeOR)

This classification of urgency of procedure is intended to give an overview of the proportion of cases where procedural intervention under anaesthesia was required for an acute condition. This distinction is important because elective procedures offer greater opportunity for preoperative assessment, discussion, planning and optimising management of comorbidities and intercurrent illness.

Classification was most difficult in procedures on scheduled surgical lists and described as 'semi-elective'.

Using this approach, 54 (49 per cent) of the referred cases involved emergency (non-elective) procedures.

#### **GRADE OF ANAESTHETIST**

In most category 1–3 cases (77.3 per cent, 85/110), the grade of anaesthetist was reported to be a specialist anaesthetist. In 12.7 per cent (14/110 cases) the grade of anaesthetist was reported to be a trainee (Table 6).

Council was encouraged to see reports submitted by trainees as well as by specialist anaesthetists. This has helped identify issues that may arise more commonly with trainees such as shift handover concerns.

#### LOCATION FOR ANAESTHESIA-RELATED MORTALITY AND MORBIDITY

Anaesthesia-related morbidity events occurred mostly in the operating room (82.7 per cent; 43/52), while events in anaesthesia-related mortality cases occurred across a broader range of perioperative care locations (Table 7).

Of the anaesthesia-related deaths (categories 1–3), in 31 per cent (18/58) the location of death was in an operating theatre during induction of anaesthesia or during surgery (Table 8).

#### Table 6: Grade of anaesthetist reported for category 1–3 cases

Grade of anaesthetist	Morbidity	Mortality	Total
GP/anaesthetist	1	0	1
Specialist (FANZCA)	41	44	85
Trainee	10	4	14
Unknown	0	10	10
Total	52	58	110

FANZCA = a fellowship with ANZCA

#### Table 7: Location of event recorded for category 1-3 cases

Location of event	Morbidity	Mortality	Total
Operative room during induction	26	7	33
Operative room during surgery	17	17	34
Post-anaesthetic care unit	6	7	13
High dependency unit/intensive care unit/critical care unit	1	10	11
Postoperative ward	2	11	13
Other	0	6	6
Endoscopy suite	0	1	0
Emergency department	0	1	0
During positioning	0	1	0
Day procedure ward	0	1	0
Cath lab	0	1	0
Unclear – postoperative period	0	1	0
Total	52	58	110

### Table 8: Location of death recorded for category 1–3 mortality cases

Location of death	
Operative room during induction	4
Operative room during surgery	14
Post-anaesthetic care unit	3
High dependency unit/intensive care unit/critical care unit	20
Postoperative ward	11
Other	6
Emergency department	2
Day procedure ward	1
Cath lab	2
Unclear – postoperative period	1
Total	58

#### **TYPE OF ANAESTHESIA ADMINISTERED**

Of the events classified as anaesthesia-related, 73.6 per cent (81/110) occurred in patients administered GA. Of the mortality events, 10.3 per cent (6/58) occurred in patients administered intravenous sedation and four of the mortality events occurred in patients who received combined general and regional anaesthesia (Table 9).

#### Table 9: Type of anaesthesia administered for category 1–3 cases

Type of anaesthetic	Morbidity	Mortality	Total
General	41	40	81
Intravenous sedation	1	6	7
Regional and sedation	4	4	8
General and regional	3	4	7
Regional	3	4	7
Total	52	58	110

#### **TYPE OF PROCEDURE**

Table 10 shows procedure types for category 1–3 cases.

#### Table 10: Procedure type category 1–3 cases

Procedure type	Morbidity	Mortality	Total
Orthopaedic	5	25	30
Abdominal	14	6	20
Endoscopy	2	6	8
Urological	3	5	8
Cardiothoracic	4	2	6
General (non-abdominal)	4	2	6
Gynaecological	4	1	5
Ophthalmological	4	1	5
ENT & head/neck	3	1	4
Vascular	1	3	4
Obstetrics	2	0	2
Electroconvulsive therapy	1	0	1
Maxillofacial	1	0	1
Neurosurgery	1	0	1
Resuscitation	0	1	1
Other	3	5	8
Total	52	58	110

For anaesthesia-related mortality events, the most common procedure type was orthopaedic (n = 25) followed by abdominal (n = 6) and endoscopic procedures (n = 6).

For anaesthesia-related morbidity events, the most common procedure type was abdominal (n = 14).

### Category 4–10 cases: Non-anaesthesiarelated mortality and morbidity

128 of the cases referred to the VCCAMM as possibly anaesthesia-related events were classified as non-anaesthesia-related mortality (123 cases) and morbidity (five cases):

- 82 (64.1 per cent) were considered inevitable deaths (category 5)
- 39 (30.5 per cent) were considered surgical mortality (35 cases) and morbidity (four cases) (category 4)
- six (0.05 per cent) were considered fortuitous deaths (category 6)
- one was deemed a critical event with no associated morbidity or mortality (category 9).

The category 5 deaths are particularly important because the council considered these patients would most likely have died irrespective of anaesthesia or surgical procedures. This is an area where greater support for multidisciplinary preoperative discussions and shared decision making may have particular benefit, particularly in elderly patients with complex comorbidities and severe intercurrent illness.

The group of category 6 deaths, while small, is a reminder that unexpected and unpredictable clinical events occasionally occur in the perioperative period that are unrelated to the indication for surgery and not under the control of the anaesthetist or surgeon.

Table 11 shows the primary event type in order of frequency for the events classified as category 4–10.

#### **Event type** Number of cases **Category 4 Category 5 Categories 6–10** Cardiovascular 49 22 27 0 Miscellaneous 38 8 27 3 (category 6) 2 Respiratory 18 15 1 (category 6) 5 Neurological 18 11 2 (category 6) Airway 2 0 1 1(category 9) Procedure-related 1 1 0 0 Drug-related 1 1 0 0 Metabolic 1 0 1 0 Total 128 39 82 7

#### Table 11: Event type for category 4–10

Cardiovascular events (49) formed the largest sub-group of category 4–10 events. Of these 49 events, 27 (55.1 per cent) were considered inevitable (category 5). Category 4–10 cardiovascular events included:

- 16 cardiac arrests (nine considered inevitable (category 5))
- nine haemorrhage events (six considered inevitable (category 5))
- five embolic events (three involved suspected embolic events during repair of fractured hips)
- two myocardial infarction events (both considered inevitable (category 5))
- two myocardial ischaemia events.

Of the 38 miscellaneous events, 27 (71 per cent) were considered inevitable (category 5). Underlying conditions in these category 5 cases included malignancy (eight cases), bowel infarction/ischaemia (four cases), multiorgan failure (six cases) and sepsis (two cases).

Of the 18 neurological events, 15 were classified as stroke (10 were considered inevitable (category 5)).

### **Reducing the risk**

This section summarises the council's findings by looking at the overarching themes and the clinical themes raised by the cases referred in the 2015–2017 triennium. Mortality and morbidity events are reviewed together to keep the report event rather than outcomes-focused, with an emphasis on 'what could we do differently next time'. An overview of the event types and subtypes for category 1–3 and 4–10 events is provided in Table 12 at the end of the section.

Key messages and practice points are included with all levels of anaesthesia providers in mind. They highlight learning points raised by the reported cases and do not replace information contained within consensus guidelines.

#### **OVERARCHING THEMES**

Three topics are explored that cross event types and reflect broader opportunities to reduce anaesthesia-related mortality and morbidity and deliver safer perioperative care:

- 'human factors' and organisational safety
- growth of non-operating-room anaesthesia
- multidisciplinary shared decision making in perioperative care.

#### **CLINICAL THEMES**

Cases were assigned to one primary event type and sub-type but may have raised learning points that crossed more than one clinical theme. Nine clinical themes are explored including:

- airway and respiratory events
  - focus on aspiration
- cardiovascular events
  - focus on perioperative cardiac arrests and myocardial ischaemia
- metabolic events
- drug-related events
  - focus on anaphylaxis
- neurological events
  - focus on awareness during general anaesthesia
- procedural complications
  - focus on wrong-side nerve blocks
  - focus on retained throat packs
- comorbidities
  - focus on obesity and obstructive sleep apnoea OSA
- preoperative assessment and management
  - focus on DOSA checks
- clinical deterioration in the early postoperative period
  - focus on events in the post-anaesthesia care unit (PACU) and soon after return to the ward

### **Three overarching themes**

#### 1. THE IMPORTANCE OF HUMAN FACTORS AND ORGANISATIONAL SAFETY

Human factors examines the interactions between people, tasks, equipment and their work environment in order to design systems that enhance performance and are resilient to adverse events (Russ, et al., 2013). It greatly depends on understanding the context in which tasks are performed. In health care, the focus of human factors often centres around 'team working, communication, situational awareness and human error' (Jones, et al., 2018, p. 12) rather than specific technical skills.

#### This triennium (2015–2017)

This triennium, interactions between people, procedures, equipment, workflows and the work environment were identified as significant contributing factors in many of the anaesthesiarelated events considered as having a significant degree of preventability. These factors were often identified with the benefit of hindsight and raised by clinicians as potential areas for system improvement to prevent similar events in the future and/or to mitigate the level of harm and/or improve post-event outcomes.

Associated events occurred across a range of elective and emergency situations, including:

- crisis management
- difficult intubations
- awareness under GA
- retained throat packs
- wrong-side nerve blocks
- drug administration
- handover of anaesthetic care
- transitions of care
- coordination and organisation of perioperative care.

Contributing factors in many of these events often related to team functioning within complex, busy environments, which is an important reminder that anaesthetists do not work alone but as part of a multidisciplinary team (Weller & Merry, 2013).

Identified issues included:

- insufficient clarity about roles and responsibilities in crisis management
- assumptions about the meaning of critical communications without verification/ confirmation
- the impact of distractions during high-risk tasks – for example, after induction and intubation
- missing information in clinical handovers
- dosage calculation error with an unfamiliar medication
- impact of production pressures on checking processes, assessments and decision making
- team members working in isolation such as:
  - no formal check with the anaesthetic team before surgical incision
  - relevant team members not informed of perioperative complications
- equipment design alarms not set and alarms disabled to avoid noise during anaesthesia induction and not re-enabled
- visual reminders not functioning as intended (e.g. removal before needed)
- impact of pattern modes.

These factors come back to the core concepts of teamwork, communication, situational awareness and human error. They underscore the importance of:

 training in crisis management, effective teamwork and communication, with an emphasis on non-technical skills as well as technical skills

- developing skills in situational awareness for example, minimising distractions during high-risk tasks
- using cognitive aids at the point of care to reduce reliance on memory and decrease the impact of unavoidable distractions in a complex and unpredictable environment
- actively designing work environments, workflows and equipment to reduce the risk of human error.

#### **Broader context**

The number of events the VCCAMM reviewed this triennium is small and based on voluntary reporting. However, similar issues have been identified in other analyses and audits of anaesthesia-related mortality and morbidity (Cook, Woodall, & Frerk, 2011b; Pandit, et al., 2014) and highlighted in reviews of human factors in anaesthesia-related settings (Jones, et al., 2018).

Many of these issues are recurring themes highlighting the ongoing challenge of effectively implementing human factor solutions (Sevdalis, Hull, & Birnbach, 2012; Chandran & DeSousa, 2014; Stiegler & Tung, 2014).

Simple and practical initiatives can and have been developed such as the ABCDE anaesthesia component checklist in the NAP 5 report (Pandit, et al., 2014). This checklist has been advocated for use before surgery starts and after any time the patient is moved to help reduce the risk of adverse events through a sequence of checks relating to airway, breathing, circulation, drugs and effective teamwork (Pandit, et al., 2014).

#### **Overall key message**

Identifying and addressing human factors is vital to ongoing improvements in safety in anaesthesia and perioperative care. Factors relating to interactions between people, procedures, equipment and the work environment are often best known to those involved in an adverse event. They have thought in detail about the context in which an event occurred, have detailed knowledge as to what they were aware of and not aware of at the time of the event, and about what influenced their decision making. This information is vital to improving our understanding of how our usual systems of care contribute to potentially preventable causes of anaesthesia-related mortality and morbidity and how these systems of care can be improved.

#### An opportunity moving forward

Support for strengthening education, training and implementing human factor principles in the Victorian health sector is vital, particularly in relation to multidisciplinary perioperative care.

Seeking clinician input about the contexts in which perioperative adverse events and near-misses occur is an important part of this process to better understand factors that influence decision making and help inform effective and targeted human factor solution design.

#### **References and resources**

Chandran & DeSousa, 2014 Cook et al., 2011b Cornelissen & Pitsopoulos, 2019 Dekker, 2014 Jones et al., 2018 Pandit et al., 2014 Russ, et al., 2013 Sevdalis et al., 2012 Stiegler & Tung, 2014 VIFM Clinical Communique, March 2019 Weller & Merry, 2013

#### 2. THE GROWTH OF NON-OPERATING-ROOM ANAESTHESIA

Anaesthesia (including GA, major regional blocks, intravenous sedation and local anaesthesia with potential to cause systemic toxicity) is increasingly being provided in non-traditional locations for a growing range of non-surgical disciplines and procedures, and by a range of providers (not always anaesthetists). This broader context is not reliably covered by the current council's voluntary reporting processes.

This rapidly changing context and growth of non-operating-room anaesthesia inherently brings with it new:

- multidisciplinary teams
- environments and facilities
- workflows
- clinical scenarios.

Risk assessment considerations around providing procedural sedation and anaesthesia in nonoperating-room locations are essential, including assessment of facilities, staffing, training, equipment, workflows and emergency response needs. This includes the recovery period.

Council notes recent developments in this space, including:

The Health Services (Private Hospitals and Day Procedure Centres) Amendment Regulations 2018, which came into effect on 1 July 2018 and requires that 'anaesthesia (general anaesthesia, major regional blocks, intravenous sedation and local anaesthesia with potential to cause systemic toxicity) may only be provided in a registered hospital or day procedure centre. Dental practices must use the services of a registered mobile anaesthetic or dental sedation service if they are providing anaesthesia or intravenous sedation.'  An important ANZCA-led initiative to design and develop with stakeholders (medical, nursing and dental practitioner groups and colleges) a set of safe procedural sedation competencies that are designed to be used by all sedation practitioners and incorporated into relevant training programs (Australian and New Zealand College of Anaesthetsists, 2019).

#### **Broader context**

Rapid growth of non-operating-room anaesthesia is also gaining attention in other countries, particularly in relation to the need for greater information at a central level about the number and nature of non-operating-room anaesthesia cases (Nagrebetsky, Gabriel, Dutton, & Urman, 2017).

The dynamic nature of this changing context has raised concerns about the development of individual rather than standardised approaches to clinical care and the need to more accurately measure outcomes (Nagrebetsky, Gabriel, Dutton, & Urman, 2017).

#### An opportunity moving forward

Monitoring and assessing anaesthesia-related outcomes in the broader and rapidly growing context of non-operating-room anaesthesia and procedural sedation is an integral part of an evolving governance approach to a changing context.

#### References

Australian and New Zealand College of Anaesthetsists, 2019

Health Services (Private Hospitals and Day Procedure Centres) Amendment Regulations 2018

Nagrebetsky et al., 2017

#### 3. THE VALUE OF MULTIDISCIPLINARY SHARED DECISION MAKING IN PERIOPERATIVE CARE

#### This triennium (2015–2017)

Patients with complex medical problems presenting for elective or emergency surgery have become an increasingly common scenario, presenting significant challenges for patients and their families, as well as clinicians. This was strongly reflected this triennium in cases classified as category 3 (medical/surgical and anaesthesia factors identified) and category 5 (inevitable deaths).

Multidisciplinary preoperative assessment by senior clinicians can help inform discussions with patients (and their families or carers) about perioperative risks, treatment options and patient goals of care, helping optimise individual care plans and outcomes, and avoiding futile interventions.

Decision making is more difficult in the intraoperative and early postoperative period when such conversations have not occurred or been clearly documented and a patient's condition rapidly deteriorates.

#### **Broader context**

The concept of multidisciplinary shared decision making in health care has been gaining support (Barry & Edgman-Levitan, 2012; Austin, Mohotige, Sudore, Smith, & Hanson, 2015). 'Health decisions often have no single 'best choice' and require choosing from multiple options, each with potential benefits, harms, trade offs and uncertainties. For patients (and carers) to understand and have the opportunity to be actively involved in sharing decisions, clinicians need to provide relevant and clear information about the options, and the potential benefits and harms of each. This information should reflect the best available evidence and also take into account the patient's personal opinions, preferences, values and priorities.'

Ref: https://contenttest.learningseat.com/ safetyandquality/part1/shell.html

This is becoming increasingly relevant to perioperative care as chronic illnesses increase in the population (Australian Bureau of Statistics, 2018) and older patients present for elective and emergency surgery with complex comorbidities.

#### Key messages

- Good communication between teams and with patients, their families or carers is vital to effective coordination of perioperative care.
- Patients with complex comorbidities benefit from experienced multidisciplinary perioperative care planning.
- Multidisciplinary discussion facilitates informed risk-benefit assessments regarding treatment options, timing of surgery, preoperative planning and optimisation and coordination of postoperative care.

#### The clinical themes explored

#### **Opportunities moving forward**

There is a need to explore with Victorian hospitals how systems and processes can be implemented to better support perioperative, multidisciplinary and informed shared decision making for surgical patients with complex medical problems, particularly the elderly. Key aspects include:

- senior level, multidisciplinary preoperative assessments and discussions that explore patients' wishes and goals of care
- support for patients (and their families or carers) to effectively participate in these discussions
- ensuring goals of care discussions are appropriately documented, updated and communicated to clinicians involved in the patient's care
- monitoring the efficacy of these discussions in meeting goals of care and reducing futile interventions
- creating training programs that support junior medical staff in developing relevant skills.

#### **References and resources**

Austin et al., 2015

Barry & Edgman-Levitan, 2012

Thomas et al., 2014

Australian Commission on Safety and Quality in Health Care, 2015

ACSQHC – https://www.safetyandquality.gov.au/ our-work/partnering-consumers/shared-decisionmaking
## **Airway and respiratory events**

#### BACKGROUND

Expertise in airway management is a cornerstone of anaesthetic practice. With improvements in anaesthesia safety, major airway management complications are now rare (Cook, Woodall, & Frerk, 2011b). However, when they do occur, such events are potentially life threatening and require rapid assessment and intervention.

#### **THIS TRIENNIUM (2015–2017)**

#### **Airway events**

Airway events formed the largest group of events deemed definitely or probably preventable this triennium.

The council classified nine cases primarily as anaesthesia-related airway events (categories 1–3), including two mortality events and seven morbidity events.

Most airway events were unexpected and occurred in the context of emergency procedures (six cases), including when providing emergency airway assistance. All occurred in adults. Two patients required an emergency surgical airway.

Airway-related issues included (noting some events included more than one issue):

- two suspected oesophageal intubations in the context of cardiac arrest, with return of spontaneous circulation after reintubation
- two intraoperative ETT dislodgements requiring emergency reintubation, one in the context of a known difficult airway and one in a prone patient
- two episodes of suspected laryngospasm requiring intubation (one during a procedure under sedation, the other post-extubation)

- endobronchial intubation following a difficult intubation
- a retained throat pack presenting as respiratory distress after extubation
- a vocal cord problem after uneventful GA with an ETT.

Airway-related issues also occurred in cases not primarily classified as airway events, including:

- difficult intubation while managing suspected anaphylaxis
- ETT dislodgement after intubation for a cardiac arrest at the end of a procedure.

These events underscore the important roles of training, planning, preparation (including assessment of required skills, experience, expertise) and team communication during anticipated difficult airway management. But they also emphasise the importance of being prepared for an unexpected airway emergency when anaesthesia is administered, even when sedation is planned.

Suspected oesophageal intubations and intraoperative ETT dislodgements highlight the importance of end-tidal carbon dioxide (ET CO<sub>2</sub>) monitoring and interpretation, and the value of systematic approaches to assessing problems with oxygenation and ventilation.

Several cases were also reviewed this triennium where challenging airway management proceeded without adverse event, with specific actions identified that contributed to a good outcome. Learning points from these cases are included in this section's key messages and practice points.

#### **Respiratory events**

The council classified 13 cases primarily as anaesthesia-related respiratory events (categories 1–3), including nine mortality events and four morbidity events. Nine of the events occurred in the context of emergency procedures. Aspiration events are explored in more detail in the next subsection.

Respiratory events included:

- five intraoperative aspiration events (four mortality cases and one morbidity case)
- two cases of early postoperative respiratory failure (one requiring reintubation) where the possibility of aspiration was suspected but not confirmed – one after spinal anaesthesia block and one after GA
- difficult ventilation in a morbidly obese patient undergoing a laparoscopic procedure with improvement after pneumoperitoneum release
- two cases involving pneumothorax:
  - one presenting as hypotension and desaturation progressing to cardiac arrest in an obese patient during GA for a surgical procedure with a known associated risk of pneumothorax
  - the other presenting as deterioration with hypotension (but no respiratory symptoms) in the PACU in an elderly patient with emphysema after GA
- one case of hypoxia due to sputum plugging, requiring reintubation in the PACU
- apnoea in an obese patient after GA requiring admission to and intensive care unit (ICU) and non-invasive ventilation for suspected central hypoventilation syndrome
- one case of acute pulmonary oedema requiring immediate postoperative reintubation.

#### KEY MESSAGES FROM AIRWAY AND RESPIRATORY EVENTS

- Planning and preparation are critical in airway management. This includes having strategies for managing unexpected difficult airways, evolving airway obstruction, transitioning to a 'can't intubate, can't oxygenate' (CICO) emergency and front of neck rescue.
- Absence or loss of ET CO<sub>2</sub> in an intubated patient should always prompt an immediate reassessment of ETT position to exclude malposition, dislodgement or obstruction, including in the context of concurrent cardiac arrest.
- A systematic approach to assessing intraoperative oxygenation and ventilation problems can help identify an unsuspected cause quickly.

#### PRACTICE POINTS HIGHLIGHTED BY AIRWAY AND RESPIRATORY EVENTS

## Assess the airway of all patients presenting for anaesthesia

- Planned local or regional anaesthesia or sedation does not preclude potential need for airway management.
- A reported history of difficult airway management requires due consideration.
- When preoperative airway examination is difficult, consider risk factors for a difficult airway and review past anaesthetic records when possible.

<sup>32</sup> Safer Care Victoria Victorian Consultative Council on Anaesthetic Mortality and Morbidity

## When difficult airway management is anticipated

- Consider anaesthetic options and the skills, experience and expertise needed. This is particularly important in the out-of-hours context.
- Assess the availability and timeframes for specialist assistance to arrive when developing contingency plans.
- Managing obstructed airways and shared airways (such as removing an inhaled foreign body) are particularly challenging and require skill and careful planning with the surgical team.

#### When failed intubation occurs

 An important principle is not to persist with an intervention that is not working to resolve the situation. Using a difficult airway algorithm or cognitive aid can help ensure steady progression through a range of potential solutions.

## Monitoring and interpreting end-tidal carbon dioxide

 Absence/loss of ET CO<sub>2</sub> trace in an intubated patient should always raise concern regarding possible ETT malposition, dislodgement or obstruction and prompt immediate assessment of ETT position.

This is particularly important in the context of concurrent cardiac arrest when absence/loss of  $ET CO_2$  should not be assumed to be due to loss of cardiac output.

This point was also raised in the 2011 UK National Audit of Airway Management complications (Cook, Woodall, & Frerk, 2011b; Cook & MacDougall-Davis, 2012).

## When carbon dioxide is used for insufflation during upper gastrointestinal endoscopy

If endotracheal intubation is required in this context, the presence of gastric carbon dioxide needs to be taken into consideration when interpreting an  $\text{ETCO}_2$  trace to assess ETT position.

#### Securing airway devices and re-assessing ventilation after a change in patient position

- Securing an ETT requires extra attention when the patient will be in a non-supine position for surgery and/or the ETT will be covered by surgical drapes, or in the surgical field.
- After a change in patient position, reassess the airway devices and adequacy of ventilation to allow issues to be identified and addressed before surgery begins.

## Assessing desaturation and/or ventilatory difficulties in an intubated patient

- Desaturation and/or ventilatory difficulties can occur unexpectedly in any intubated patient. A systematic approach to assessing the problem is important in facilitating timely identification of an unsuspected cause.
- In the context of a difficult airway management where specialised equipment was required to secure the airway, ongoing availability of that equipment should be ensured until anaesthetic care is complete.

#### **REFERENCES AND RESOURCES**

Australian and New Zealand College of Anaesthetists, 2017 Cook et al., 2011b Cook & MacDougall-Davis, 2012 Chui, J., & Craen, R. (2016) Honardar et al., 2017 Royal College of Anaesthetists (UK) National Audit Projects <https://www.rcoa.ac.uk/research/ national-audit-projects>

### **Focus on aspiration**

#### BACKGROUND

Despite improved understanding of risk factors and preventative strategies, aspiration remains an important cause of anaesthesia-related mortality. In the United Kingdom, the 4th National Audit Project of The Royal College of Anaesthetists and the Difficult Airway Society identified aspiration as the 'single commonest cause of death' in anaesthesia-related airway events (Cook, Woodall, & Frerk, 2011a).

#### **THIS TRIENNIUM (2015–2017)**

The council classified five cases as anaesthesiarelated aspiration events this triennium (four mortalities and one morbidity). All patients had significant systemic disease. Other risk factors (Kluger & Short, 1999; Robinson & Davidson, 2014) included oesophageal and upper gastrointestinal pathology, recent trauma and opioids. Four cases involved non-elective procedures.

- Two events occurred during procedures under intravenous (IV) sedation in fasted patients.
- Three events occurred during induction of GA, in one case during a modified rapid sequence induction, and in another case during rapid sequence induction in a patient being managed as a high risk for aspiration.
- Significant hypoxia and respiratory symptoms/ signs were usually, but not always, immediately apparent. One patient deteriorated in the PACU, another developed hypoxia overnight.

## KEY MESSAGES FROM ASPIRATION EVENTS

- Assessment of aspiration risk is important in all patients receiving anaesthesia.
- Regurgitation and aspiration can still occur despite careful assessment and management. Clinicians providing GA and procedural sedation need to be alert to the possibility of regurgitation and aspiration and be able to promptly manage such an event in terms of skills, equipment and staffing. This is particularly important in non-operating-room locations.

#### PRACTICE POINT HIGHLIGHTED BY ASPIRATION EVENTS

 An extended period of close observation and monitoring is worthwhile after possible/ suspected intraoperative aspiration, as hypoxia and respiratory symptoms can take time to develop.

#### **REFERENCES AND RESOURCES**

Cook et al., 2011a Kluger & Short, 1999 Kluger et al, 2005 Marik, 2001 Robinson & Davidson, 2014 Warner et al., 1993

## **Cardiovascular events**

#### BACKGROUND

Major perioperative cardiac events are thought to complicate between 1.4–3.9 per cent of surgical procedures (Patel & Eagle, 2015). Therefore, it is not surprising that the largest group of reported cases to the VCCAMM this triennium involved cardiovascular events (42 classified as anaesthesia-related events (categories 1–3) and 49 classified as non-anaesthesia-related (categories 4–10).

#### **THIS TRIENNIUM (2015–2017)**

The council classified 42 cases as anaesthesiarelated (categories 1–3) cardiovascular events (33 mortality events, nine morbidity events).

These included:

- 24 cardiac arrests (18 mortalities, six morbidities)
- six significant hypotension events (four mortalities, two morbidities) and another mortality associated with postoperative hypotension and hypoxia
- three myocardial ischaemia events
- two myocardial infarctions
- two haemorrhage events with intraoperative cardiac arrest in elderly patients with significant cardiovascular comorbidities
- one intraoperative arrythmia in a child (brief asystolic cardiac arrest during inhalational induction of GA)
- one embolism event
- one case of cardiac failure and one case of cardiorenal multiorgan failure.

A number of other cases also involved perioperative cardiac arrest or myocardial infarction/ischaemia but were assigned a different primary event type and/or sub-type. These broader groups are described in more detail in the focus sections below.

The five mortalities associated with significant hypotension all occurred in patients aged over 80 with complex comorbidities who had undergone fractured hip repairs (three under GA, two under spinal anaesthesia block). One died intraoperatively, and two required transfer to a high-dependency unit (HDU) or an ICU following significant hypotension in PACU and died within 24 hours. One was palliated after review in the PACU and another deteriorated overnight on the ward and was palliated. These events highlight the importance of preoperative discussions and documentation regarding goals of care in elderly patients with complex comorbidities undergoing emergent orthopaedic surgery.

#### FOCUS ON PERIOPERATIVE CARDIAC ARRESTS AND MYOCARDIAL ISCHAEMIA

#### **Perioperative cardiac arrests**

Thirty-six cases classified as anaesthetic-related morbidity (nine cases) or mortality (27 cases) involved a perioperative cardiac arrest. Depending on the availability of information about the precipitating cause, these cases were classified by a range of primary event types:

- 28 arrests occurred intraoperatively five in the PACU and three postoperatively on a ward.
- 21 of these perioperative arrests occurred in association with elective (18) or 'semi-elective' (three) surgical procedures; 15 occurred in association with emergency surgical procedures.

- 33 of the patients were aged 50 years or older. Most patients had significant comorbidities.
- 13 patients were obese, six had known OSA,
  13 had known ischaemic heart disease. An intraosseous line was successfully inserted in one case where intravenous access was difficult due to obesity.
- Associated events included confirmed or suspected anaphylaxis (seven cases), deep volatile agent (three cases), cementing during fractured hip repair (three cases) intraoperative haemorrhage (two cases) and suspected embolic events (two cases).
- In several patients the arrest was thought to be related to significant underlying cardiovascular or pulmonary disease, in particular ischaemic heart disease. In some cases the underlying cause was unknown. One patient was diagnosed with severe OSA during post-event investigations. In another case, air embolism was suspected after pressurised infusion of IV fluids.
- Type of anaesthesia included GA (26 cases), combined spinal and GA (three cases), spinal anaesthesia (two cases), local anaesthesia and sedation (two cases), sedation (two cases), regional block and sedation (one case).
- Most of these events were considered by the council to be not preventable (20 cases) or only possibly preventable (12 cases).

## Perioperative myocardial infarction or ischaemia

Eight cases classified as anaesthesia-related mortality involved confirmed or suspected perioperative myocardial infarction or ischaemia (although this may not have been the primary event classification). All were categorised as category 3. All eight patients were aged over 70 years; six had known ischaemic heart disease (including a history of recent STEMI and severe heart failure in one patient undergoing an emergency procedure). Three were undergoing elective procedures. Seven cases were performed under GA, and one occurred at the end of a procedure under a local anaesthetic block and sedation.

Deterioration occurred:

- during the procedure in three cases (presenting as cardiac arrest, ST depression after induction and haemodynamic deterioration postcementing during hip fracture repair)
- at the end of the procedure in two cases (presenting as cardiac arrest)
- in the PACU in two cases (presenting as cardiac arrest)
- during the first postoperative night in one case (presenting as acute pulmonary oedema with hypoxia).

In three cases, the intraoperative course was noted to have been uneventful.

Two patients died during attempted emergency coronary revascularisation.

Referred events highlighted the importance of preoperative consultation with the patient's cardiologist regarding the perioperative management of antiplatelet therapy (APT) / dual antiplatelet therapy (DAPT) in patients with coronary stents undergoing non-cardiac surgery (NCS) to determine an appropriate plan. 'Cardiac risk in noncardiac surgeries is best tackled by a perioperative team approach. Close collaboration and shared decisionmaking among the patient, primary caregiver, cardiologist, surgeon, and anaesthesiologist is key to ensuring proper implementation of current evidence-based guidelines.'

(Patel & Eagle, 2015, p. 2146)

#### **BROADER CONTEXT**

#### **Perioperative cardiac arrest**

Estimates of risk of perioperative cardiac arrest vary depending on geographical location and methodology. Recently in the United States, the overall risk of cardiac arrest intraoperatively and in the PACU was estimated at 5.6 per 10,000 patients, with a mortality rate of 58.4 per cent, based on data reported to the National Anaesthesia Clinical Outcomes Registry (from 2010 to 2013), with the rate highest in ASA 3–4 patients and increasing with age (Nunally, O'Connor, Kordylewski, Westlake, & Dutton, 2015).

### The risk of air embolism with pressurised infusion of IV fluids

The risk of air embolism with pressurised infusion of IV fluids was a topic in a 2017 Therapeutic Goods Administration (TGA) Medical Devices Safety Update (Therapeutic Goods Administration, 2017). The TGA safety update addressed re-spiking of IV solution bags and pressurised infusion of IV fluids. It highlighted that 'intravenous solution bags are designed for single use only and there are no circumstances where they should be reconnected (re-spiked) after first use' (p.1). The TGA Medical Devices Safety Update is available from the TGA website <https://www.tga. gov.au/sites/default/files/medical-devices-safetyupdate-volume-5-number-4-july-2017.pdf>.

### Cemented hemiarthroplasty and adverse cardiovascular events

A consensus guideline by the Association of Anaesthetists of Great Britain and Ireland (2015) noted that approximately 20 per cent of hip fracture operations involving a cemented prosthesis are complicated by an adverse cardiovascular event. In addition to specific technical aspects of care, strategies suggested in this guideline to reduce risks associated with cemented hemiarthroplasties emphasised the importance of team awareness of potential adverse events, identification of patients at higher risk for 'cardiorespiratory compromise' (p. 624), being prepared, clear team roles and responsibilities, vigilance and monitoring during and after cementing, and effective team communication.

## Perioperative myocardial infarction or ischaemia

Perioperative myocardial infarction after NCS is associated with a high mortality rate, even with percutaneous coronary intervention (PCI) (Parashar, et al., 2016). In an observational study by Parashar et al. (2016), mortality within 30 days of PCI after perioperative myocardial infarction was predicted by 'bleeding event, peak troponin T level and peripheral vascular disease', while long-term mortality was predicted by 'older age, vascular surgery, bleeding event, and renal dysfunction' (p. 337).

#### Perioperative management of APT/DAPT

Previous coronary stent implantation (both baremetal and drug-eluting stents) within a year of NCS has been found to be an independent risk factor for major adverse cardiac and cerebrovascular events and bleeding (Mahmoud, et al., 2016).

A 2017 review of APT/DAPT for post-PCI patients undergoing NCS (Banerjee, et al., 2017) noted 'the need to carefully consider the risk of ischemic complications, consequences of delayed surgery, and perioperative bleeding in post-PCI patients on DAPT undergoing NCS, and to individualize treatment decisions' (p.1868) noting the importance of 'an astute clinician, a highly individualized and collaborative approach to patient care, and team-based decision making' (p.1869). This review noted the complexity of these decisions around APT and the difficulty in developing consensus recommendations.

## KEY MESSAGES FROM CARDIOVASCULAR EVENTS

- Perioperative cardiac arrests are uncommon but do occur, particularly in older patients with significant underlying comorbidities. In such patients, it is important to ensure that preoperative discussions regarding goals of care and limitations of treatment are appropriately documented, updated and communicated to clinicians involved in the patient's care.
- The cause of a perioperative cardiac arrest can be difficult to ascertain at the time of the event, particularly in patients with multiple comorbidities undergoing major surgery. This emphasises the importance of resuscitation training and protocols, using crisis checklists and continually considering the differential diagnosis, looking for potentially reversible causes.

- Critical events sometimes occur at the end of a previously uneventful procedure, highlighting the need for ongoing monitoring vigilance at the end of a surgical procedure when theatre staff are busy and distractions are common.
- A multidisciplinary perioperative team-based approach to managing cardiac risk in NCS is of value, particularly in patients with coronary stents in situ on APT.
- Perioperative myocardial infarction or ischaemia may not present with classic symptoms or signs (for example, due to the effects of anaesthetic drugs/analgesics). It may present as haemodynamic instability or as respiratory distress/hypoxia during the perioperative period.

#### PRACTICE POINTS HIGHLIGHTED BY CARDIOVASCULAR EVENTS

## Reducing the risk of cardiovascular events

- Consider intra-arterial blood pressure monitoring in elderly patients with significant cardiovascular disease undergoing major surgery to assist with early detection of haemodynamic compromise.
- Rapid deepening of volatile anaesthesia can be associated with adverse cardiovascular effects including arrhythmia and hypotension.
- Anticipation, preoperative planning and use of massive transfusion protocols enhance effective management of major intraoperative haemorrhage.
- Intravenous solution bags should not be re-spiked after first use.

#### Cardiac arrest and crisis management

- In situations where there is concurrent absence/loss of ET CO<sub>2</sub> signal and cardiac arrest in an intubated patient, the possibility of ETT malposition/dislodgement/obstruction should always be considered and the ETT position checked.
- Cardiac arrest in obese patients can be complicated by difficulties with vascular access. Intraosseous access is another possible option to remember in the context of resuscitation if there are no contraindications and staff are available who are familiar with the technique (Anson, 2014).

#### **REFERENCES AND RESOURCES**

Air embolism – TGA Medical Safety Update <https://www.tga.gov.au/sites/default/files/medicaldevices-safety-update-volume-5-number-4july-2017.pdf> Anson, 2014 Association of Anaesthetists of Great Britain and Ireland, 2015 Banerjee et al., 2017 Mahmoud et al., 2016

Nunally et al., 2015

Parashar et al., 2016

Patel & Eagle, 2015

## **Metabolic events**

#### **THIS TRIENNIUM (2015–2017)**

One event was classified by the council as an anaesthesia-related (categories 1–3) metabolic event. This was a morbidity event involving malignant hyperthermia presenting in a PACU context with early recognition and rapid-effective crisis management.

This case highlighted the importance of early suspicion and the value of a readily accessible malignant hyperthermia resource kit.

#### **REFERENCES AND RESOURCES**

Malignant Hyperthermia Australia and New Zealand website <http://malignanthyperthermia. org.au/>

## **Drug-related events**

#### **THIS TRIENNIUM (2015–2017)**

The council classified 21 events as category 1–3 drug-related events. One case was classified as a category 4 drug-related morbidity (anaphylaxis to patent blue V dye). Only 1 event was considered likely to be preventable.

- Seventeen of the category 1–3 events involved confirmed or suspected intraoperative anaphylaxis and were considered not preventable at the time of the event. Fatal outcomes occurred in some patients despite early recognition and appropriate resuscitation efforts. These events are explored in more detail in the focus section on anaphylaxis.
- Reactions to patent blue V dye injection were confirmed in one morbidity event (category 4) and suspected in two other morbidity events. These are discussed further in the focus section on anaphylaxis.
- One case of tachyarrhythmia and hypertension, with subsequent acute pulmonary oedema, followed lingual injection of bupivacaine with adrenaline.
- One case of awareness occurred due to residual paralysis in the context of undiagnosed atypical pseudocholinesterase.
- One unintended drug overdose resulted in over sedation and cancellation of an elective procedure. Both a human drug calculation error and an unspecified drug pump calculation error were reported. This event highlighted the risk of error when anaesthetic staff are using unfamiliar medications and/or dosing regimens (for example, mcg/kg/hr, not mcg/kg/min).

#### **BROADER PERSPECTIVE**

#### Medication errors in anaesthesia

Medication errors in operating theatres remain a significant problem with the potential to

cause serious harm, despite many of them being considered preventable. In a prospective observational study published in 2016 (Nanji, Patel, Shaikh, Seger, & Bates, 2016), it was found that 5.3 per cent of medication administrations in an operating room context were affected by a medication error and/or adverse drug event, with 79.3 per cent of these considered preventable and 64.7 per cent of errors considered serious. The most common errors were labelling errors (24.2 per cent), wrong dose errors (22.9 per cent) and omitted medications / failure to act (17.6 per cent).

A 2017 review of the literature around medication errors and medication safety in operating rooms (Wahr, et al., 2017) noted the few 'rigorous' studies in this field but derived a set of strategies from the literature supported by expert opinions that may reduce the risk of medication errors during surgery. In this review, recommended strategies around drug information included use of cognitive aids, checklists, protocols and infusion rate charts. The use of smart pumps with drug libraries, guardrails and alerts was one of the recommended strategies for infusions.

#### **PRACTICE POINTS**

Protocols with clear and detailed drug preparation and administration instructions (including tables with calculated maintenance infusion doses and infusion rates for a range of patient body weights) may be helpful reference points for staff working with unfamiliar medications and/ or dosing regimens (if technology-based aids are not available).

#### **REFERENCES AND RESOURCES**

Nanji et al., 2016 Wahr et al., 2017

## **Focus on anaphylaxis**

#### BACKGROUND

Anaphylaxis remains an important cause of anaesthesia-related morbidity and mortality. Its ability to unpredictably affect the lives of otherwise healthy patients undergoing elective surgical procedures underpins the importance of continuing efforts to:

- gain a better understanding of predisposing factors
- provide education and training around recognition and management
- promote the use of cognitive aids to support evidence-based, effective crisis management
- ensure post-event follow-up to identify triggering agents and provide patient education, information and support.

#### **THIS TRIENNIUM (2015–2017)**

Eighteen cases were classified as anaphylaxis events. Sixteen cases (six mortality, 11 morbidity events) were classified as anaesthesia-related (category 1–3) anaphylaxis events. One case was classified as a category 4 morbidity (confirmed anaphylaxis to patent blue V dye). Another postoperative death involved likely intraoperative anaphylaxis on the basis of post-mortem testing.

- Eleven cases occurred during elective procedures and seven during emergency procedures.
- Cases were spread across the ASA score categories 1–3 (with one patient ASA 4). Ages ranged from 17 to 74 years.
- All reported cases had features of at least moderate grade anaphylaxis (Kolawole, Marshall, Crilly, Kerridges, & Roessler, 2017; Rose, Green, Crilly, & Kolawole, 2016). Only one patient was identified as having a previous history of anaphylaxis. All other cases were deemed not preventable at the time of the event.

- Six cases were attributed to suxamethonium (including the case of likely anaphylaxis), two to atracurium, one to cephazolin and one to patent blue V dye on the basis of post-event testing. Based on event timing, cephazolin and blue dye were suspected causes in two other cases. Information was not available at the time of this report regarding a triggering agent for the remaining eight cases, but, of note, all eight patients had received GA that included administering a neuromuscular blocking agent.
- Mast cell tryptase levels were elevated in 14 of the 17 cases.
- Of the six reported deaths attributed to anaphylaxis, all were over the age of 50 and the reaction was associated with progression to cardiac arrest in the operating theatre. Obesity was a known comorbidity in four of these patients. Three patients died in the operating theatre.
- Referrals this triennium have highlighted that persistence may be required to encourage patients to attend follow-up for further investigation of the reaction.

#### **BROADER PERSPECTIVE**

The 6th National Audit Project (NAP 6) report on perioperative anaphylaxis, published by the Royal College of Anaesthetists in 2018 (Royal College of Anaesthetists, 2018) provides a comprehensive review of 266 reports of grades 3–5 anaphylaxis collected over one year from all NHS hospitals in the UK. Access this report online <https://www. nationalauditprojects.org.uk/NAP6Report#pt>.

#### Reactions to patent blue V dye

Patent blue V is commonly used for sentinel node biopsy. A 2011 survey of the experience of Australian and New Zealand breast surgeons reported the incidence of anaphylactic reactions to patent blue V dye as 0.15 per cent (Wong & Spillane, 2014). In the recently released NAP 6 report on perioperative anaphylaxis from the United Kingdom, nine cases of confirmed anaphylaxis to patent blue V dye were identified, equating to 14.6 per 100,000 administrations in the UK, revealing this as the fourth most common cause of perioperative anaphylaxis in the audit (Harper, et al., 2018). There was often a delay between injection and onset of symptoms or signs, which has also been reported in other studies (Hunting, et al., 2009).

The NAP 6 report also reported that when patent blue V was assumed to be the cause of anaphylaxis; this was sometimes a reason for failing to refer patients for formal testing (Royal College of Anaesthetists, 2018). A low rate of formal allergy testing was also found in the survey by Wong and Spillane (2011).

#### KEY MESSAGES FROM ANAPHYLAXIS EVENTS

- Effective anaphylaxis treatment depends on early recognition and prompt crisis management with adrenaline administration in recommended doses, aggressive fluid administration and escalation of treatment when response is not sufficient.
- Other important aspects of effective anaphylaxis management include prompt declaration of an emergency, use of anaphylaxis crisis management cards to guide and progress care, careful decision making around whether or not to continue with surgery, cautious postoperative monitoring and ensuring thorough post-event follow-up to identify triggering agents.

 However, even with prompt recognition and appropriate care, some cases of perioperative anaphylaxis continue to be fatal. This highlights the importance of continuing to further enhance our understanding of the incidence, predisposing factors, triggering agents and clinical care outcomes for perioperative anaphylaxis. An enhanced understanding will help identify ongoing research opportunities and specific areas where further clinical practice changes may reduce risk and/or improve outcomes.

#### PRACTICE POINTS HIGHLIGHTED BY ANAPHYLAXIS EVENTS

## Presenting features of anaphylaxis vary widely

- Multiple clinical features may occur concurrently (for example, dermatological, cardiovascular, respiratory) or a single clinical feature (such as hypotension, tachycardia or bronchospasm) may dominate.
- Severe hypotension during anaesthesia, particularly when it is unexplained and/ or unresponsive to intervention, should raise concern regarding the possibility of anaphylaxis as a differential diagnosis.

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#### **Management of anaphylaxis**

- Early and adequate adrenaline administration and fluid resuscitation in recommended doses (as per the ANZCA and ANZAAG guidelines (Australian and New Zealand College of Anaesthetists and Australian and New Zealand Anaesthetic Allergy Group, 2016)) are critical in treating suspected perioperative anaphylaxis.
- Anaphylaxis crisis management cards are important cognitive aids to support and guide timely, comprehensive treatment and facilitate effective team-based care.

## Decision making around continuing surgery after intraoperative anaphylaxis

- Deciding whether to continue with surgery in the context of suspected anaphylaxis is a complex decision (Sadleir, Clarke, Bozic, & Platt, 2018), requiring careful risk-benefit discussion that considers the nature of the surgery, the severity of the anaphylactic reaction and the patient's underlying condition.
- In non-elective situations, another anaesthetic may be required before allergy testing has been undertaken. Seeking advice from an anaesthetic allergy testing centre can be helpful in this situation.

#### **POST-EVENT LOCATION OF CARE**

Airway oedema after anaphylaxis can last beyond 24 hours. This is an important reason for arranging HDU/ICU monitoring following perioperative anaphylaxis.

#### **POST-DISCHARGE FOLLOW-UP**

All patients discharged after experiencing perioperative anaphylaxis should be referred to an anaesthetic allergy testing centre for further investigation. The importance of followup should be discussed with the patient and persistent efforts made to encourage attendance. Assumptions regarding the likely triggering agent should not preclude referral.

#### **REFERENCES AND RESOURCES**

ANZCA and ANZAAG *Perioperative anaphylaxis management guidelines 2016* <a href="http://www.anzca.edu.au/resources/endorsed-guidelines">http://www.anzca.edu.au/resources/endorsed-guidelines</a>

Harper et al., 2018 Hunting et al. Kolawole et al., 2017 Rose et al., 2016 Royal College of Anaesthetists, 2018 Sadleir et al., 2018 The Australian and New Zealand Anaesthetic

Allergy Group <a href="http://www.anzaag.com/">http://www.anzaag.com/</a>

Wong & Spillane, 2014

## **Neurological events**

#### **THIS TRIENNIUM (2015–2017)**

Thirteen events were classified as anaesthesiarelated neurological events, including:

- three cases of intraoperative awareness these are discussed in the next subsection
- one case of inadequate neuromuscular blockade reversal, after a briefer than expected surgical procedure, with reintubation required in the PACU
- one case of temporary left tongue weakness and numbness after GA with an ETT in the beach chair position
- one case of non-specific progressive deterioration in the PACU with drowsiness and hypertension followed by unresponsiveness and hypotension in an elderly patient following a fractured hip repair (the patient died within seven hours of surgery)
- one case of hypoxic brain injury followed difficult intubation and ventilation and cardiac arrest
- six cases of perioperative stroke, which are described further below.

#### **PERIOPERATIVE STROKE**

Six cases classified as anaesthesia-related (categories 1–3) morbidity and mortality involved a diagnosis of perioperative stroke in the early postoperative period (five mortalities, one morbidity). Four of these cases involved elective surgical procedures and two involved emergency surgical procedures. Four patients had known underlying hypertension as a comorbidity. In four patients, the diagnosis of stroke became apparent after the patient was slow to awaken in PACU, with three patients requiring reintubation. No specific intraoperative issues were identified in any of the six cases.

#### **BROADER PERSPECTIVE**

#### **Perioperative stroke**

A review of published literature around perioperative stroke (Vlisides & Mashour, 2016) noted the range of pathophysiologic mechanisms (thrombosis, embolism, anaemia-associated tissue hypoxia, cerebral hypoperfusion, haemorrhage) and significant associated morbidity and mortality. Perioperative ischaemic stroke is more common than haemorrhagic stroke. Risk factors were noted to include 'advanced age, a history of cerebrovascular disease, ischaemic heart disease, congestive cardiac failure, atrial fibrillation and renal disease' (p. 193). This review identified that the highest risk was in patients undergoing cardiac and major vascular surgery but noted that the incidence of covert (clinically silent) stroke may be underestimated. The review also noted that while most perioperative strokes become apparent more than 24 hours after surgery, an estimated 5-15 per cent occur intraoperatively or become apparent in the immediate postoperative (PACU) period.

#### PRACTICE POINTS HIGHLIGHTED BY NEUROLOGICAL EVENTS

- Surgery in the 'beach chair' position requires careful anaesthetic and surgical management. This was a Quality and Safety topic in the ANZCA Bulletin in December 2013 (link in resources below).
- When a neuromuscular blocking agent has been administered and a surgical procedure is unexpectedly brief, it is important to consider the potential duration of action of the neuromuscular blocking agent used when determining the timing of extubation.
- Neurological assessment is important in patients who are slow to awaken in the PACU to facilitate timely diagnosis and escalation of care for acute neurological problems such as stroke.

#### **REFERENCES AND RESOURCES**

ANZCA Bulletin <a href="http://www.anzca.edu.au/documents/the-beach-chair-position">http://www.anzca.edu.au/documents/the-beach-chair-position</a>

Vlisides & Mashour, 2016

# Focus on awareness during general anaesthesia

#### **THIS TRIENNIUM (2015–2017)**

Four cases of awareness during GA were reported this triennium (three were classified as neurological events, one as a drug-related event). Three cases occurred during elective procedures and one during an emergency procedure. One patient had a previous history of intraoperative awareness. Circumstances included:

- delay in administering volatile anaesthetic agent after induction of GA, in the context of:
  - inactivated volatile agent alarms (to prevent alarming during induction)
  - disrupted workflows, including distractions/ interruptions
- lightening of volatile anaesthesia to avoid hypotension
- suspected high threshold for anaesthetic agents in a patient receiving total intravenous anaesthesia
- residual neuromuscular blockade in a patient subsequently found to have atypical pseudocholinesterase.

#### **BROADER CONTEXT**

The 5th National Audit Project (NAP 5) of the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland on accidental awareness during GA (Pandit, et al., 2014) reported an incidence of approximately 1:19,000 anaesthetics, with most cases occurring during induction and emergence from anaesthesia. Risk factors identified in that audit included being female, younger adults, obesity, a past history of awareness, anaesthesia by trainees, after-hours and emergency surgery, obstetric/cardiac/thoracic procedures and the use of neuromuscular blocking agent drugs.

#### KEY MESSAGES FROM AWARENESS EVENTS

The risk of awareness under anaesthesia remains a complication of great concern to both patients and anaesthetists. While a cause is not always apparent, important preventable causes include inadequate anaesthetic drug administration after induction of anaesthesia and residual neuromuscular blockade at the time of emergence.

#### PRACTICE POINTS HIGHLIGHTED BY AWARENESS EVENTS

- Consider awareness in the differential diagnosis of unexplained tachycardia and hypertension during GA, particularly in patients who have received a neuromuscular blocking agent.
- The period immediately following induction of anaesthesia/intubation is a time of particular risk for inadequate anaesthetic depth due to the number of concurrent tasks demanding attention:
  - Non-urgent interruptions should be avoided during this period.
  - The use of a post-induction anaesthesia checklist before surgery begins and after any patient move (such as the ABCDE anaesthesia checklist advocated in the NAP 5 report (Pandit, et al., 2014)) may help reduce the risk of adverse events through a sequence of checks relating to airway, breathing, circulation, drugs and effective teamwork (Pandit, et al., 2014).
- After relaxant GA, use a nerve stimulator to assess return of neuromuscular function before allowing the patient to emerge from anaesthesia.

#### **REFERENCES AND RESOURCES**

Pandit et al., 2014

## **Procedural complications**

#### **THIS TRIENNIUM (2015–2017)**

Eight events were classified as anaesthesiarelated (categories 1–3) procedural complications. These included:

- three morbidity events associated with inserting intravascular lines and neural blockade catheters – all three cases were classified as category 1 events, but no better anaesthetic technique could be suggested (sub-category G)
- one vascular injury following ultrasound-guided arterial line placement, requiring surgical repair
- one pneumothorax following interpleural catheter insertion – the patient had no respiratory symptoms but a chest x-ray was performed in the PACU due to developing tachycardia and hypertension; the patient required an urgent intercostal catheter (chest tube) insertion
- one report of a broken epidural catheter with a retained tip
- four wrong-sided nerve blocks in the context of elective procedures and rapid turnover lists
- one retained throat pack found in the PACU.

Wrong-side nerve blocks and retained throat packs are explored as separate focus topics.

#### **BROADER CONTEXT**

Arterial line complications are uncommon, with the rate estimated at 3.4 per 10,000 (Nuttall, et al., 2016), but the risk factors are not well understood.

The incidence of pneumothorax with interpleural catheter insertion has been estimated at approximately 2 per cent, although it is acknowledged that this may be an underestimate and a high degree of vigilance should be maintained (Dravid & Paul, 2007). A broken epidural catheter with fragment retention is a rare but known event and can go undetected (Pinciroli & Fumagalli, 2015).

## KEY MESSAGES FROM PROCEDURAL COMPLICATIONS

Intravascular line and neural blockade catheter complications may have occurred even when no problems were apparent at the time of insertion. Early recognition of such complications depends on having a low threshold for considering the possibility of a procedural complication when clinical symptoms and/or signs develop.

#### PRACTICE POINTS HIGHLIGHTED BY PROCEDURAL COMPLICATIONS

Factors contributing to good outcomes after procedural complications included early consideration of the possibility and prompt escalation of care with timely advice from relevant specialties regarding immediate management and subsequent follow-up.

#### **REFERENCES AND RESOURCES**

Dravid & Paul 2007 Nuttall et al., 2016 Pinciroli & Fumagalli 2015

### Focus on wrong-side nerve blocks

#### **THIS TRIENNIUM**

Four cases involving wrong-side nerve blocks were reported this triennium. No adverse clinical outcomes resulted, but the surgical procedures had to be re-scheduled. Identified contributory factors included:

- Ianguage barriers
- anaesthesia timeout not being performed immediately before inserting the nerve block needle, allowing time for intervening events to occur, including changes in staff and distractions
- reported time pressures and disrupted workflows
- lack of visibility of the surgical site marking
- impact of pattern modes (previous patients having the opposite side operated on).

Use of minimal sedation (presence of awake patients) did not prevent the errors.

#### **BROADER CONTEXT**

Findings from the four cases reported this triennium align with findings from a 2011 UK Health Service Local Area Anaesthetist Survey (Simmons & Brits, 2011) in which 40 per cent of 40 wrong-site blocks occurred in awake patients highlighting the fallibility of assuming an awake patient will alert the proceduralist to a potential wrong site error. Factors identified in this UK survey included distractions, changes to usual anaesthetic technique, time pressures, language barriers, surgical site marking not being visible and not using checking procedures.

#### KEY MESSAGES FROM WRONG-SIDE NERVE BLOCKS

These cases highlight the value of the 'Stop Before You Block' concept developed in 2010 at Nottingham Hospital in the UK. Local tools and educational resources have been developed for the Australian context and are available on the ANZCA website <a href="http://www.anzca.edu.au/documents/stop-blocking-flyer-a4-p1.pdf">http://www.anzca.edu.au/ documents/stop-blocking-flyer-a4-p1.pdf</a>.

The concept involves a 'stop before you block' procedure being performed by the anaesthetist, with their assistant, 'needle in hand immediately prior to needle insertion for the block'. Key elements include:

- confirming the side by viewing a written consent form
- asking the patient the side of the procedure (if awake and oriented)
- visualising the anaesthetic site mark.

#### PRACTICE POINTS HIGHLIGHTED BY WRONG-SIDE NERVE BLOCKS

- Block site and side verification needs to occur immediately prior to needle insertion for the block to prevent error due to subsequent interruptions (including staffing changes) and distractions.
- Surgical site marking needs to remain visible to staff at the time of the block.
- The 'anaesthetic team' needs to be present for anaesthetic timeout and the block.

#### **OPPORTUNITY FOR IMPROVEMENT**

## Supporting patients from culturally and linguistically diverse (CALD) backgrounds

Language barriers may limit the ability of patients from culturally and linguistically diverse (CALD) backgrounds to effectively participate in safety initiatives such as 'Stop Before You Block'. Practical point-of-care tools are needed that enable patients from culturally and linguistically diverse (CALD) backgrounds to participate in such initiatives.

#### **REFERENCES AND RESOURCES**

#### ANZCA

ANZCA PS03 *Guidelines for the management of major regional analgesia* <a href="http://www.anzca.edu">http://www.anzca.edu</a>. au/resources/professional-documents>

'Stop before you block' resources:

- http://www.anzca.edu.au/fellows/safety-andquality/publications-and-resources
- http://www.anzca.edu.au/documents/stopblocking-flyer-a4-p1.pdf

#### **Royal College of Anaesthetists**

Safe Anaesthesia Liaison Group – Wrong Site Blocks During Surgery <a href="https://www.rcoa.ac.uk/system/files/CSQ-PS-10-wrong-site-block.pdf">https://www.rcoa.ac.uk/system/files/CSQ-PS-10-wrong-site-block.pdf</a>

Simmons & Brits, 2011

Wrong site block <https://www.rcoa.ac.uk/ standards-of-clinical-practice/wrong-site-block>

## **Focus on retained throat packs**

#### **THIS TRIENNIUM (2015–2017)**

Two cases involving retained throat packs were reported this triennium.

- In both cases the throat pack was identified after extubation. In one case the patient had no respiratory symptoms. Of note, the surgical count (which included the throat pack) had not detected the retained pack.
- In the other case the throat pack was identified after the patient developed respiratory distress following extubation. This occurred in the context of an emergency intubation and surgical procedure.

Risk factors for retained throat packs in a recently published systematic review included 'distractions, emergencies, changes of staff, need for additional airway packing and unexpected rapid recovery at extubation' (Athanassoglou, et al., 2018, p. 613).

#### KEY MESSAGES FROM CASES OF RETAINED THROAT PACKS

- Retained throat packs are a preventable cause of potential airway obstruction.
- Use of throat packs should be a carefully considered decision.
- Organisational protocols around throat pack use that include specified checking procedures can help reduce the risk of retained throat packs.

#### PRACTICE POINTS FROM CASES OF RETAINED THROAT PACKS

- The location of visual reminders regarding throat packs is important because they need to be able to act as visual cues until the throat pack has been removed. If visual reminders such as stickers are attached to surgical drapes, the cue may be lost before the throat pack has been removed when drapes are taken down at the end of the case.
- This issue of sticky label reminders potentially being removed with surgical drapes was also identified in a 2016 Patient Safety Update by the Safe Anaesthesia Liaison Group in the UK (The Royal College of Anaesthetists, 2016).

#### **REFERENCES AND RESOURCES**

Athanassoglou et al. 2018 The Royal College of Anaesthetists, 2016

## Comorbidities

#### **THIS TRIENNIUM (2015–2017)**

Comorbidities were common in cases referred this triennium as evident in the ASA classifications. This is not surprising given the increasing prevalence of chronic health conditions in the Australian population.

The 2017–18 National Health Survey by the Australian Bureau of Statistics (2018, p. 19) found:

'In 2017–18 just under half (47.3%) of Australians had one or more chronic conditions, an increase from 2007–08 when two-fifths (42.2%) of people had one or more chronic conditions.'

'The prevalence of chronic conditions increased with age, with four in five (80.0%) people aged 65 years and over having one or more chronic conditions.'

In the Australian Bureau of Statistics survey, some of these chronic conditions and their estimated prevalence included mental and behavioural conditions (20.1 per cent), asthma (11.2 per cent), heart, stroke and vascular disease (4.8 per cent), diabetes mellitus (type 2 – 4.1 per cent), chronic obstructive pulmonary disease (2.5 per cent), cancer (1.8 per cent) and kidney disease (1.0 per cent) (Australian Bureau of Statistics, 2018, p. 11).

#### Obesity

Obesity was present in 19 of the 110 cases classified as anaesthesia-related mortality or morbidity (categories 1–3) this triennium. This is not unexpected given the rising prevalence of obesity in Australian adults (Australian Institute of Health and Welfare, 2017) and the known association of obesity with chronic conditions that may lead to surgical intervention (including cardiovascular disease and some cancers). The 2017–18 National Health Survey by the Australian Bureau of Statistics (2018, p. 12) found that:

'In 2017–18, two thirds (67.0%) of Australian adults were overweight or obese (12.5 million people), an increase from 63.4% in 2014–15. This change was driven by the increase in the proportion of adults categorised as obese, which increased from 27.9% to 31.3%.'

The growing prevalence of severe obesity (body mass index of 35 kg/m<sup>2</sup>) is particularly relevant having almost doubled between 1995 and 2014–15 ('from 5% in 1995 to 9% in 2014–15') (Australian Institute of Health and Welfare, 2017, p. vi).

This rising prevalence is concerning due to the association of obesity with both technical difficulties in providing anaesthetic care and increased perioperative risk due to associated chronic conditions including hypertension, cardiovascular disease and type 2 diabetes with their long-term consequences.

Technical difficulties often relate to airway management, vascular access, drug dosing and positioning (Nightingale, et al., 2015). Examples of all these difficulties were noted in cases reported to the VCCAMM this triennium where obesity was a comorbidity.

#### **Obstructive sleep apnoea**

OSA was a noted preoperative comorbidity in nine of the 110 cases classified as anaesthesiarelated mortality or morbidity. In two patients, cardiac arrest occurred postoperatively in the ward. Another patient was admitted to HDU for non-invasive ventilatory support after developing respiratory failure in the immediate postoperative period. The council noted the variation around the perioperative care of patients with known OSA, particularly regarding elective versus emergency surgical contexts, the location of postoperative care and actions taken when a patient's own CPAP machine is not available for use in the hospital postoperatively.

The emerging issue of undiagnosed OSA and central hypoventilation syndromes is particularly relevant given the rising prevalence of severe obesity in Australian adults (Australian Institute of Health and Welfare, 2017). This triennium, central hypoventilation syndrome was suspected postoperatively in an obese patient who required unplanned admission to ICU for noninvasive ventilation after developing periods of hypoventilation and apnoea following a procedure under GA. In another case, a patient with severe obesity was diagnosed with severe OSA postoperatively after intraoperative cardiac arrest occurred during an elective procedure under combined spinal and GA.

The issue of undiagnosed obesity-related sleep-disordered breathing and associated perioperative risk has been gaining increasing attention (Nightingale, et al., 2015; Mutter, et al., 2014). OSA (diagnosed or undiagnosed) is associated with a higher incidence of postoperative respiratory complications, and undiagnosed OSA may be associated with a higher risk of postoperative cardiovascular complications (Mutter, et al., 2014). Practice guidelines for the perioperative management of patients with OSA have been developed by an American Society of Anesthesiologists taskforce (American Society of Anesthesiologists, 2014).

#### KEY MESSAGES FROM COMORBIDITY CASES

This rising prevalence of obesity and chronic health conditions in the Australian population has implications for both anaesthesiarelated mortality and morbidity, and broader perioperative outcomes. It is a strong imperative to continue working towards a more multidisciplinary approach to perioperative care to reduce risks and optimise outcomes.

#### **OPPORTUNITY FOR IMPROVEMENT**

Developing a statewide set of principles to guide and support a more consistent approach to the perioperative care of patients with diagnosed or suspected OSA or central hypoventilation syndromes would be beneficial.

Principles are needed around:

- elective versus emergency surgical contexts
- location of postoperative care monitoring and staffing considerations
- actions to take when a patient's own CPAP machine is not available for use postoperatively.

#### REFERENCES

American Society of Anaesthesiologists, 2014 Australian Bureau of Statistics, 2018 Australian Institute of Health and Welfare, 2017 Australian Institute of Health and Welfare, 2018 Mutter et al., 2014 Nightingale et al., 2015

# Pre-operative assessment and management

#### **THIS TRIENNIUM (2015–2017)**

Preoperative assessment and management factors identified as contributing to anaesthesiarelated morbidity and mortality related to patients with known cardiac problems undergoing NCS, DOSA checks, and airway assessment in difficult contexts.

For patients with significant cardiac comorbidities, cases highlighted the importance of:

- preoperative cardiology consultation regarding management of APT/DAPT for patients with coronary stents, and ensuring the patient has clear medication instructions
- considering the significance of new preoperative ECG changes
- ensuring documentation and handover of relevant clinical information – for example, pacemaker presence.

For DOSA patients, cases highlighted the importance of identifying any significant changes on arrival that may affect the plan for surgery or anaesthesia (for example, intercurrent illnesses, new diagnoses, changes in medications and instability of comorbidities) and ensuring such changes are communicated to the anaesthesia and surgical teams before the patient is transferred to theatre. Related cases noted a 'pressure' to proceed when such issues were flagged after the patient had been transferred to theatre.

For patients unable to assist with a normal airway examination, cases highlighted the importance of considering all available information, including previous anaesthetic records when possible.

#### KEY MESSAGES FROM PREOPERATIVE ASSESSMENT AND MANAGEMENT

## Patients with cardiac disease – consider preoperative review by their cardiologist

 Patients with significant cardiac comorbidities can benefit from preoperative consultation with their cardiologist regarding perioperative management of their underlying condition. This is particularly important for patients with coronary stents in situ.

## DOSA patients – triggering clinical review when something is 'not quite right'

- Coordinating effective preoperative assessment in the context of busy DOSA areas can be challenging when staff are concurrently preparing multiple patients for surgery.
- Production pressures can raise the risk that a significant change in a patient's condition, or new relevant information since the patient was last assessed may be missed. Examples include intercurrent illnesses, new diagnoses, changes in medications and instability of comorbidities. Formal checks for such changes are becoming increasingly important as more patients with increasingly significant comorbidities present as DOSA for elective procedures.
- Clinician review in the DOSA area is important when a significant change is identified, or when something is 'not quite right' on admission. Review in the DOSA area facilitates discussion regarding whether or not to proceed with surgery, in an environment with less pressure to proceed than the operating theatre. For patients who have arrived unwell, it also facilitates escalation of care (e.g. a MET call or specialty consultation).

#### PRACTICE POINTS ABOUT PREOPERATIVE ASSESSMENT AND MANAGEMENT

Many other referrals this triennium also conveyed important points regarding preoperative assessment and management. These learning points are included below.

## Contact the patient's usual treating doctor about complex comorbidities

- The patient's usual doctor(s) can facilitate perioperative management by providing:
  - a preoperative review to assess and optimise the patient's condition
  - an accurate understanding of the current status of comorbidities
  - planning around perioperative medication management
  - coordination of postoperative care and follow-up.

## Specialist referrals – ask specific questions

 Pre-operative referrals of a patient with complex comorbidities for non-anaesthetic specialist opinions can sometimes result in unexpected general advice regarding the type of anaesthesia that should or should not be given. This can be particularly difficult to navigate if the anaesthetist has a different opinion. Being specific about the question being asked in a referral may facilitate obtaining focused specialist advice.

## Ensure information relating to preoperative assessment is accessible to the perioperative team

 Changes in staffing or scheduling, postoperative deterioration and unplanned returns to theatre can all result in other clinicians needing to rapidly access information about the patient's preoperative status and underlying comorbidities, particularly if these conditions are usually managed externally.

## Patients need clear written instructions regarding usual medications before elective surgery

- This particularly matters for high-risk medications and in patients with complex comorbidities who take multiple medications, some of which are being ceased while others are continued.
- Confirming the patient understands the instructions is an important part of preoperative care, particularly for patients from culturally and linguistically diverse (CALD) backgrounds.
- A contact number is helpful in case the patient has questions about the instructions.

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# Clinical deterioration in the early postoperative period

#### **THIS TRIENNIUM (2015–2017)**

Eighteen cases classified as anaesthesiarelated morbidity and mortality involved clinical deterioration (without progression to cardiac arrest) in the early postoperative period (15 mortalities, three morbidities). Sixteen cases were categorised as category 3, and two were categorised as category 1. Only one case was considered to be probably preventable. Eleven of the 18 cases followed emergency surgical procedures.

Underlying comorbidities were identified as a factor in 16 cases (sub-category H), and no better anaesthetic technique (sub-category G) could be suggested in 13 cases. Most patients were aged over 70.

In 13 patients, deterioration occurred in the PACU, with most events related to hypoventilation and respiratory failure, or diagnosis of perioperative stroke after patients were slow to awaken following GA. Five patients were reintubated, and nine were transferred to ICU for ongoing care (one after a return to theatre).

Nine cases related to patients who had undergone a fractured hip repair, four of whom deteriorated in the PACU, and five deteriorated after returning to the ward. All were aged over 80. Deterioration on the ward included developing type 2 respiratory failure, progressive hypotension and hypoxia, and a decreased Glasgow Coma Score. One patient was intubated and transferred to ICU.

#### KEY MESSAGES FROM EARLY POSTOPERATIVE DETERIORATION

## Establishing and understanding patient wishes/goals of care preoperatively

- In elderly patients and/or patients with significant comorbidities, when the patient's condition deteriorates intraoperatively or in the early postoperative period, clinical decision making is more difficult when conversations about patient wishes/goals of care have not occurred or been clearly documented before anaesthesia and surgery begins.
- Theatre teams should be aware of any current documentation or directives regarding goals of care or limitations of treatment. This is particularly important in high-risk patients undergoing emergency procedures where the possibility of intraoperative cardiac arrest or deterioration in the early postoperative period is more likely.

#### **REFERENCES AND RESOURCES**

Thomas et al., 2014

## **Event types for all categories**

Table 12 shows the numbers of category 1–3 and 4–10 events by type and sub-types.

#### Table 12: Category 1–3 and 4–10 event types and sub-types

Event type	Cat 1–3 Morbidity	Cat 1–3 Mortality	Cat 4–10 Morbidity	Cat 4–10 Mortality	Total
Airway	7	2	1	1	11
Airway obstruction	1	0	0	1	2
Failed intubation	2	1	0	0	3
Other	4	1	1	0	6
Cardiovascular	10	32	2	47	91
Arrhythmia	1	0	0	1	2
Cardiac arrest	6	18	1	15	40
Embolism	1	0	0	5	6
Haemorrhage	0	2	0	9	11
Hypertension – significant	0	0	0	1	1
Hypotension – significant	2	4	0	1	7
Myocardial infarction	0	2	0	2	4
Myocardial ischaemia	0	3	1	1	5
Other	0	3	0	12	15
Drug-related	15	6	1	0	22
Anaphylaxis	11	6	1	0	18
Drug-related adverse effect	2	0	0	0	2
Overdose	1	0	0	0	1
Other	1	0	0	0	1
Metabolic	1	0	0	1	2
Malignant hyperthermia	1	0	0	0	1
Other		0	0	1	1
Miscellaneous	1	2	0	38	41
Other	1	2	0	38	41

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Event type	Cat 1–3 Morbidity	Cat 1–3 Mortality	Cat 4–10 Morbidity	Cat 4–10 Mortality	Total
Neurological	6	7	0	18	31
Awareness	3	0	0	0	3
Inadequate N/M reversal	1	0	0	0	1
Nerve/plexus Injury	1	0	0	0	1
Seizure	0	0	0	1	1
Stroke (including TIA)	1	5	0	15	21
Other	0	2	0	2	4
Procedure-related	8		1		9
Vascular injury	1	0	0	0	1
Other	7	0	1	0	8
Respiratory	4	9	0	18	31
Aspiration	1	4	0	1	6
Hypoventilation	1	0	0	0	1
Нурохіа	0	1	0	4	5
Pneumothorax	0	1	0	0	1
Pulmonary oedema	1	0	0	1	2
Unplanned postoperative ventilation	0	1	0	0	1
Other	1	2	0	12	15
Total	52	58	5	123	238

## Appendix 1: Council definitions of anaesthesia mortality and morbidity

#### ANAESTHESIA-RELATED MORTALITY

The council defines 'anaesthesia-related mortality' as one of the following:

- a death that occurs during an operation or procedure (or within 24 hours of its completion) performed with the assistance of sedative, analgesic, local or general anaesthetic drugs or any combination of these
- a death that may result (either partially or totally) from an incident during or after such an operation or procedure, even if more than 24 hours have elapsed since its completion.

In the event of an anaesthesia-related death, the following information should be forwarded to the VCCAMM within 28 days of the death:

- the anaesthesia record
- the preoperative assessment, including medical comorbidities, previous surgical history, current medications, investigations, airway or other anaesthesia issues
- the operation or procedure report
- a summary of postoperative events, including the intensive care unit or high-dependency unit if relevant
- any relevant postoperative investigations
- a copy of the eMedical deposition to the coroner if applicable
- other relevant data and/or documents including age, gender, ASA-P classification, elective or emergency status, location of the event leading to death, and the location of death.

#### **ANAESTHESIA-RELATED MORBIDITY**

The council defines 'anaesthesia-related morbidity' as any event related to an anaesthetic procedure that causes a life-threatening incident, temporary or permanent disability, or significant distress. Morbidity is categorised as 'major' or 'minor' according to its severity or outcome.

In the event of an anaesthesia-related morbidity, the following information should be forwarded to the VCCAMM within 28 days of the adverse event:

- the anaesthesia record
- the preoperative assessment, including medical comorbidities, previous surgical history, current medications, investigations, airway or other anaesthesia issues
- the operation or procedure report
- a summary of postoperative events, including the intensive care unit or high-dependency unit if relevant
- any relevant postoperative investigations
- details of the clinical outcome from the adverse event
- any other relevant data and/or documents, including age, gender, ASA-P classification, elective or emergency status, and the location of the event.

## Appendix 2: Classification tools and definitions

#### CATEGORIES OF MORTALITY AND MORBIDITY

#### Deaths or morbidity attributable to anaesthesia

Category	Description
Category 1	Where it is reasonably certain that death or morbidity was caused by the anaesthesia or other factors under the control of the anaesthetist.
Category 2	Where there is some doubt whether death or morbidity was entirely attributable to the anaesthesia or other factors under the control of the anaesthetist.
Category 3	Where death or morbidity was caused by both medical/surgical and anaesthesia factors.

#### Death or morbidity in which anaesthesia played no part

Category	Description
Category 4	Surgical death or morbidity where the administration of the anaesthesia was not contributory, and surgical or other factors are implicated.
Category 5	Inevitable death or morbidity that would have occurred irrespective of anaesthesia or surgical procedures.
Category 6	Fortuitous death or morbidity that could not reasonably be expected to have been foreseen by those looking after the patient and was not related to the indication for surgery and was not due to factors under the control of the anaesthetist or surgeon.

#### Unassessable death/morbidity

Category	Description
Category 7	Those that cannot be assessed despite considerable data but where the information is conflicting or key data is missing.
Category 8	Cases that cannot be assessed because of inadequate data.
Category 9	A critical incident where a problem is identified but no morbidity occurs.

## Causal or contributory factors in anaesthesia-related mortality and morbidity sub-categories

#### **A. Preoperative**

Causal or contributory factor		Description
(i)	Assessment	This may involve failure to take an adequate history or perform an adequate examination or to undertake appropriate investigation or consultation or make adequate assessment of the volume status of the patient in an emergency. Where this is also a surgical responsibility the case may be classified as category 3.
(ii)	Management	This may involve failure to administer appropriate therapy or resuscitation. Urgency and the responsibility of the surgeon may also modify this classification.

#### B. Anaesthesia technique

Causal or contributory factor		Description
(i)	Choice or application	There is inappropriate choice of technique in circumstances where it is contraindicated or by the incorrect application of a technique that was correctly chosen.
(ii)	Airway maintenance including pulmonary aspiration	There is inappropriate choice of artificial airway or failure to maintain or provide adequate protection of the airway or to recognise misplacement or occlusion of an artificial airway.
(iii)	Ventilation	Death or morbidity is caused by failure of ventilation of the lungs for any reason. This would include inadequate ventilator settings and failure to reinstitute proper respiratory support after deliberate hypoventilation (for example, bypass).
(iv)	Circulatory support	Failure to provide adequate support where there is haemodynamic instability, in particular in relation to techniques involving sympathetic blockade.

#### C. Anaesthesia drugs

Causal or contributory factor		Description
(i)	Selection	Administration of a wrong drug or one that is contraindicated or inappropriate. This would include 'syringe swap' errors.
(ii)	Dosage	This may be due to incorrect dosage, absolute or relative to the patient's size, age and condition and in practice is usually an overdose.
(iii)	Adverse drug reaction	This includes all fatal drug reactions, both acute such as anaphylaxis and the delayed effects of anaesthesia agents such as the volatile agent.
(iv)	Inadequate reversal	This would include relaxant, narcotic and tranquillising agents where reversal was indicated.
(v)	Incomplete recovery	For example, due to prolonged coma.

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#### D. Anaesthesia management

Caus	sal or contributory factor	Description
(i)	Crisis management	Inadequate management of unexpected occurrences during anaesthesia or in other situations that, if uncorrected, could lead to death or severe injury.
(ii)	Inadequate monitoring	Failure to observe minimum standards as enunciated in the ANZCA policy document or to undertake additional monitoring when indicated – for example, use of a pulmonary artery catheter in left ventricular failure.
(iii)	Equipment failure	Death or morbidity as a result of failure to check equipment or due to failure of an item of anaesthesia equipment.
(iv)	Inadequate resuscitation	Failure to provide adequate resuscitation in an emergency situation.
(v)	Hypothermia	Failure to maintain adequate body temperature within recognised limits.

#### E. Postoperative

Causal or contributory factor		Description
(i)	Management	Death or morbidity as a result of inappropriate intervention or omission of active intervention by the anaesthetist or a person under their direction (for example, a recovery or pain management nurse) in some matter related to the patient's anaesthesia, pain management or resuscitation.
(ii)	Supervision	Death or morbidity due to inadequate supervision or monitoring. The anaesthetist has ongoing responsibility, but the surgical role must also be assessed.
(iii)	Inadequate resuscitation	Death or morbidity due to inadequate management of hypovolaemia or hypoxaemia or where there has been a failure to perform proper cardiopulmonary resuscitation.

#### F. Organisational

Causal or contributory factor		Description
(i)	Inadequate supervision, inexperience or assistance	These factors apply whether the anaesthetist is a trainee, a non-specialist or a specialist undertaking an unfamiliar procedure. The criterion of adequacy of supervision of a trainee is based on the ANZCA policy document on supervision of trainees.
(ii)	Poor organisation of the service	Inappropriate delegation, poor rostering and fatigue contributing to a fatality.
(iii)	Failure of interdisciplinary planning	Poor communication in perioperative management and failure to anticipate the need for high-dependency care.

#### G. No correctable factor identifiable

Where the death or morbidity was due to anaesthesia factors but no better technique could be suggested.

#### H. Medical condition of the patient

Where it is considered that the medical condition was a significant factor in the anaesthesia-related death or morbidity.

#### **EVENT CATEGORIES**

- Airway
- Cardiovascular
- Drug-related
- Equipment-related
- Metabolic
- Miscellaneous
- Neurological
- Pain management
- Procedure-related
- Respiratory

#### **Category: Airway**

Abbreviated description of type	Full definition
Airway obstruction	Clinically significant partial or complete upper or lower airway obstruction
Airway soft tissue injury	Injury to non-dental structures
Dental injury	Any injury to the teeth or dental prosthesis
Endobronchial intubation	Unintended clinically significant endobronchial intubation
Failed intubation	Inability to correctly place the endotracheal or endobronchial tube at direct laryngoscopy requiring an alternative technique
Other	Free-text option – clinically significant event that is not otherwise specified

#### Category: Cardiovascular

Abbreviated description of type	Full definition
Anaemia	Hb < 70 g/L

#### Category: Equipment-related

Abbreviated description of type	Full definition
Arrhythmia	A clinically significant rate or rhythm disturbance requiring intervention
Cardiac arrest	Cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation
Embolism	Clinically significant suspected air, cement, fat or venous thromboembolism
Haemorrhage	Clinically significant bleeding from any site or source
Hypertension – significant	A 30 per cent or greater increase in systolic BP of at least five minutes' duration and requiring intervention
Hypotension – significant	A 30 per cent or greater decrease in systolic BP of at least five minutes' duration and requiring intervention
Hypovolaemia	Reduced circulating blood volume leading to significant hypotension
Myocardial ischaemia	Angina and/or characteristic ECG or echocardiographic changes
Myocardial infarction	Confirmed by a rise/fall of cardiac enzymes in the setting of myocardial ischaemia, new Q waves on the ECG, or autopsy findings
Other	Free-text option – clinically significant event that is not otherwise specified

#### Category: Drug-related

Abbreviated description of type	Full definition
Anaphylaxis	Clinically significant adverse drug reaction consistent with anaphylaxis
Drug error	Inadvertent or inappropriate administration of a drug that may or may not result in harm
Drug-related adverse effect	A clinically significant adverse drug reaction or side effect
Overdose	Clinically significant drug overdose
Other	Free-text option – clinically significant event that is not otherwise specified

#### **Category: Metabolic**

Abbreviated description of type	Full definition
Hyperglycaemia	Blood glucose > 10 mmol/L requiring intervention
Hypoglycaemia	Blood glucose < four mmol/L requiring intervention
Hypothermia	Unplanned temperature < 35°C on arrival in recovery room or equivalent
Malignant hyperthermia	Clinical evidence or suspicion of malignant hyperthermia
Other	Free-text option – clinically significant event that is not otherwise specified

#### **Category: Miscellaneous**

Abbreviated description of type	Full definition
Miscellaneous	Any significant adverse event not suitable for other listed categories
Other	Free-text option – clinically significant event that is not otherwise specified

#### **Category: Neurological**

Abbreviated description of type	Full definition
Awareness	Postoperative recall of intraoperative events
Delayed emergence	Unintended delay in recovery from anaesthesia
Inadequate neuromuscular block reversal	Clinically significant inadequate reversal of neuromuscular blockade
Nerve/plexus injury	New nerve injury confirmed by neurological examination or investigation
Seizure	Perioperative seizure
Spinal cord injury	New spinal cord injury confirmed by neurological examination or investigation
Stroke (including TIA)	New central nervous system deficit confirmed by investigation or neurological examination
Other	Free-text option – clinically significant event that is not otherwise specified
## **Category: Pain management**

Abbreviated description of type	Full definition
Excessive neuraxial block	Clinically significant and unintended extension of neuraxial analgesia in the postoperative period
Failed regional anaesthesia	Unplanned requirement to give supplemental analgesia for postoperative regional blockade
Inadequate postoperative analgesia	Inadequate postoperative analgesia regardless of chosen modality
Local anaesthetic toxicity	Inadvertent systemic local anaesthesia toxicity-related to a postoperative regional technique
Postoperative respiratory depression	Postoperative respiratory depression requiring intervention including naloxone or HDU/ICU care
Other	Free-text option – clinically significant event that is not otherwise specified

## Category: Procedure-related

Abbreviated description of type	Full definition
Excessive neuraxial block	Clinically significant and unintended extension of neuraxial anaesthesia or analgesia
Failed regional anaesthesia	Unplanned requirement to give supplemental analgesia or anaesthesia for surgery under local or regional blockade
Inadvertent dural puncture	Unintended dural puncture during epidural insertion
Local anaesthetic toxicity	Inadvertent systemic local anaesthesia toxicity related to regional or local technique
TOE gastro-oesophageal injury	Evidence of gastric or oesophageal injury relating to transoesophageal echocardiography
Vascular injury	Clinically significant vascular injury resulting from intravascular cannulation
Other	Free-text option – clinically significant event that is not otherwise specified

### **Category: Respiratory**

Abbreviated description of type	Full definition
Aspiration	Clinically significant pulmonary aspiration of gastrointestinal contents, blood or particulate matter with or without radiographic evidence
Bronchospasm	New or increased airflow obstruction, detected by wheeze and/or increased inspiratory pressures during mechanical ventilation
Hypoventilation	Clinically significant inadequate minute ventilation
Нурохіа	SpO2 < 90% for > five minutes or < 80% for > two minutes
Pneumothorax	Clinical or radiological evidence of gas in pleural space
Pulmonary oedema	Presence of pink frothy fluid in airway or radiological evidence
Respiratory arrest	Prolonged apnoea requiring urgent intervention
Unplanned postoperative ventilation	Invasive or non-invasive postoperative ventilation not planned prior to induction of anaesthesia
Other	Free-text option – clinically significant event that is not otherwise specified

## **EVENT OUTCOMES**

Abbreviated description of outcome	Full definition
Uneventful (critical incident)	No patient harm
Minor adverse event (minor morbidity)	Mild or transient injury to the patient
Major adverse event (major morbidity)	Severe life-threatening event, permanent disability or prolongation of hospital stay including unplanned ICU admission
Death (mortality)	Death

## **PREVENTABILITY SCORE**

Abbreviated description of preventability (score)	Full definition
Not preventable (0)	No reasonable evidence of preventability (likelihood < 10%)
Possibly preventable (1)	Modest evidence of preventability (likelihood 10–50%)
Probably preventable (2)	More than likely to have been preventable (likelihood 51–90%)
Definitely preventable (3)	Strong evidence of preventability (likelihood > 90%)

# AMERICAN SOCIETY OF ANAESTHESIOLOGISTS PHYSICAL STATUS CLASSIFICATION (ASA)

Classification	Description
ASA or P-1	A normal healthy patient
ASA or P-2	A patient with mild systemic disease
ASA or P-3	A patient with severe systemic disease
ASA or P-4	A patient with severe systemic disease that is a constant threat to life
ASA or P-5	A moribund patient who is not expected to survive without the operation
ASA or P-6	A brain dead patient whose organs are being removed for donor purposes
E	Patient requires an emergency procedure

For more information, visit the ASA website <www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system>.

# Appendix 3: Current council and subcommittee members

Given Name	Council membership
Dr Andrea Kattula	Chairperson council and subcommittee
Dr Andrew Jeffreys	Council and subcommittee
Ms Annette McPherson	Council and subcommittee
Dr Christopher Bain	Council and subcommittee
Dr Heinrich Bouwer	Council and subcommittee
Dr Maggie Wong	Council and subcommittee
Ms Paula Foran	Council and subcommittee
Dr Simon Tomlinson	Council and Deputy chair subcommittee
Ms Debra Sudano	Council
Dr Gaylene Heard	Subcommittee
Dr David Beilby	Subcommittee
A/Prof. Philip Ragg	Subcommittee
Dr Mariolyn Rajakulenthiran	Subcommittee

# **References and useful links**

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### **USEFUL LINKS**

ANZCA and ANZAAG Anaphylaxis management guidelines <a href="http://www.anzaag.com/Mgmt%20">http://www.anzaag.com/Mgmt%20</a> Resources.aspx>

Health Act 1958 < http://www5.austlii.edu.au/au/ legis/vic/repealed\_act/ha195869/>

Health Services (Private Hospitals and Day Procedure Centres) Amendment Regulations 2018 <https://www2.health.vic.gov.au/hospitals-andhealth-services/private-hospitals/legislationupdates>

Malignant Hyperthermia Australia and New Zealand website <a href="http://malignanthyperthermia">http://malignanthyperthermia</a>. org.au/>

Public Health and Wellbeing Act 2008 <http:// classic.austlii.edu.au/au/legis/vic/consol\_act/ phawa2008222/>

Royal College of Anaesthetists (UK) National Audit Projects <a href="https://www.rcoa.ac.uk/research/">https://www.rcoa.ac.uk/research/</a> national-audit-projects>

The Australian and New Zealand Anaesthetic Allergy Group <a href="http://www.anzaag.com/">http://www.anzaag.com/></a>

The Australian and New Zealand College of Anaesthetists professional documents <a href="http://www.anzca.edu.au/resources/professional-documents">http://www.anzca.edu.au/resources/professional-documents</a>



