

# Crisis management during anaesthesia: tachycardia

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**Background:** Tachycardia during anaesthesia is a common event. In most cases the cause is easily identified and the problem promptly resolved. However, in some the cause may be rare or obscure. Under such circumstances, attempting to initiate appropriate supportive therapy and to consider a large differential diagnosis in a comprehensive manner may lead to delays which can put a patient at risk.

**Objectives:** To examine the role of a previously described core algorithm "COVER ABCD-A SWIFT CHECK", supplemented by a specific sub-algorithm for tachycardia, in the management of tachycardia developing in association with anaesthesia.

**Methods:** The potential performance of this structured approach for each of the relevant incidents among the first 4000 reported to the Australian Incident Monitoring Study (AIMS) was compared with the actual management as reported by the anaesthetists involved.

**Results:** There were 145 causative events identified in 123 reports of tachycardia during anaesthesia which were extracted and studied from the first 4000 incidents reported to AIMS. Subgroups were identified based on blood pressure at the time of presentation. Of the 145 causes, tachycardia was associated with hypotension (33%), normotension (27%), hypertension (26%), and cardiac arrest (17%). For simplicity it is recommended that other cardiovascular sub-algorithms are followed when the blood pressure is also abnormal. This includes cardiac arrest and hypotension. In hypotensive states the tachycardia sub-algorithm should be followed until the cardiac rhythm is diagnosed. Sinus tachycardia and hypotension should be managed as hypotension. It was considered that, correctly applied, the core algorithm COVER would have diagnosed 35% of cases and led to resolution in 70% of these. It was estimated that completion of COVER followed by the sub-algorithm for tachycardia would have led to earlier recognition of the problem and/or better management in four cases when compared with actual management reported.

**Conclusion:** Tachycardia during anaesthesia is frequently associated with a simultaneous change in other monitored vital signs. The differential diagnosis is large. Addressing it in a comprehensive fashion requires a structured approach. A specific sub-algorithm treatment for tachycardia based on the associated blood pressure and on the prevailing heart rhythm in the case of hypotension offers a systematic guide which complements the benefits obtained by employing the core algorithm COVER ABCD.

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Tachycardia during the course of an anaesthetic is a common event. The clinical significance of tachycardia will in part be determined by the blood pressure and cardiac rhythm of the patient at the time. This may vary from a hypotensive to a hypertensive crisis. Tachycardia and hypertension have been shown to be independently associated with a poor outcome after prolonged procedures.<sup>1</sup> Hypotension may degenerate into a cardiac arrest or the patient may be pulseless from the outset.<sup>2</sup>

The scope of the problem is large when these situations are considered collectively. Problems are commonly resolved because the anaesthetist recognises patterns learnt from previous experiences. The potential exists, however, for the problem to lie outside the repertoire of the anaesthetist, particularly if they are inexperienced, the cause is rare, or the tachycardia is associated with an unusual phenomenon. Addressing the problem becomes increasingly difficult when there are simultaneous abnormalities in other systems. Attempting to initiate appropriate supportive therapy and consider a large differential diagnosis in a comprehensive manner may involve unacceptable delays in a crisis. It was therefore decided to examine the role of a structured approach to the problem of tachycardia associated with anaesthesia.

In 1993 a "core" crisis management algorithm represented by the mnemonic COVER ABCD-A SWIFT CHECK (the AB precedes COVER for the non-intubated patient) was

proposed as the basis for a systematic approach to any crisis during anaesthesia where it is not immediately obvious what should be done or where actions taken have failed to remedy the situation.<sup>3</sup> This was validated against the first 2000 incidents reported to the Australian Incident Monitoring Study (AIMS). AIMS is an ongoing study which involves the voluntary anonymous reporting of any unintended incident which reduced or could have reduced the safety margin for the patient.<sup>4</sup>

It was concluded that, if this core algorithm had been correctly applied, a functional diagnosis would have been reached within 40–60 seconds in 99% of applicable incidents, and the learned sequence of actions recommended by the COVER portion would have led to appropriate steps being taken to handle 60% of problems relevant to this portion of the algorithm.<sup>3</sup> However, this study also showed that the 40% of problems represented by the remainder of the algorithm ABCD-A SWIFT CHECK were not always promptly diagnosed or appropriately managed.<sup>3–5</sup> It was decided that it would be useful for these remaining problems to develop a set of sub-algorithms in an easy-to-use crisis management manual.<sup>6</sup> This study reports on the place of the COVER ABCD-A SWIFT CHECK algorithm in the diagnosis and initial management of tachycardia, provides an outline of a specific crisis management sub-algorithm for tachycardia during anaesthesia, and provides an indication of the potential value of using this structured approach.

<b>TACHYCARDIA</b>	
<p><b>EMERGENCY MANAGEMENT</b>            Complete COVER ABCD–A SWIFT CHECK            Do not hesitate to treat as Cardiac Arrest → page 38* (1)**            If hypertensive → page 34* (2)            If hypotensive (3)                Confirm change in blood pressure is real (4)                Recheck that vaporiser(s) are off                Crystalloid 10ml/kg bolus and repeat if necessary.</p> <p><b>DIAGNOSE RHYTHM</b>            If sinus tachycardia → page 32* (5)            If not sinus tachycardia choose treatment based on severity of hypotension (6)            If severe, use synchronised cardioversion                Start at 100J, if unsuccessful, 200J                Consider antiarrhythmic drugs (see below)            If mild, use appropriate antiarrhythmic drugs                VT: Lignocaine 1 mg/kg IV (or amiodarone 5 mg/kg) (7)                AF: Digoxin 0.05 mg/kg IV (or amiodarone 5 mg/kg) (8)                SVT: Adenosine 6–12 mg IV (or titrated beta blocker: atenolol 1 mg boluses) (9)</p> <p><b>REVIEW AND TREAT PROBABLE CAUSES</b>  <b>Hypovolaemia (10)</b>            Consider: Blood loss, dehydration, diuresis, sepsis            Ensure: Adequate IV access, fluid replacement, cross match and check haematocrit.  <b>Drugs (11)</b>            Consider: Induction and inhalation agents, atropine, local anaesthetic toxicity, adrenaline, cocaine, vasopressors.  <b>Airway: (12)</b>            Hypoventilation → page 20*            Hypoxia → page 26*  <b>Anaphylaxis (13)</b> → page 48*  <b>Reflex Stimulation (14)</b>            Consider: Laryngoscopy, CVC insertion, surgical manipulation.            Ensure: Adequate anaesthesia.  <b>Cardiopulmonary Problems (15)</b>            Consider: Tension pneumothorax, haemothorax, tamponade, embolism (gas, amniotic or thrombus), sepsis, myocardial irritability (from drugs, ischaemia, electrolytes, trauma), pulmonary oedema.            Ensure: Review of appropriate pages in manual.</p> <p><b>The sub-algorithm forms a facing page of the Crisis Management Manual<sup>14</sup>.</b>            * Page references refer to the <i>Crisis Management Manual</i><sup>14</sup>.            ** Numbers in brackets refer to Notes in the right hand panel.</p>	<p><b>FURTHER CARE</b>            Monitor for myocardial ischaemia            Consider further drug therapy</p> <p><b>NOTES:</b>            It was judged that correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 3% of 123 relevant incidents reported to AIMS.</p> <ol style="list-style-type: none"> <li>(1) 17% presented as cardiac arrest.</li> <li>(2) There was associated hypertension in 26% of cases.</li> <li>(3) There was associated hypotension in 33% of cases.</li> <li>(4) Use sphygmomanometer and auscultate the blood pressure. When using an arterial line check the zero and calibration.</li> <li>(5) With sinus tachycardia, treatment is that of the primary cause. In the vast majority of cases this alone will result in resolution. If it is persistent and associated with hypotension, refer to hypotension (page 32)*.</li> <li>(6) Non sinus tachycardia was present in 46% of cases including ventricular tachycardia in 13%, paroxysmal supraventricular tachycardia in 9%, atrial fibrillation in 8% and atrial flutter in 1%.</li> <li>(7) Ventricular tachycardia.                100–200/min slightly irregular, broad complexes                IV lignocaine 1 mg/kg (or amiodarone 5 mg/kg)                Also, see pulseless VT (page 11)*.</li> <li>(8) Atrial fibrillation/flutter.                100–200/min, irregular narrow complexes, no P waves                (flutter: P waves 250–300/min, ventricular rate 100 or 150),                IV digoxin 0.01 mg/kg (or amiodarone 5 mg/kg).</li> <li>(9) Paroxysmal supraventricular tachycardia 150–250/min, regular narrow complexes, obscured P waves, IV adenosine 6–12 mg (or atenolol 1 mg IV boluses).</li> <li>(10) Hypovolaemia was associated with 3% of cases, however it is the commonest cause of tachycardia and hypotension. It is so common it is not usually regarded as an incident.</li> <li>(11) Drugs were associated in 33% of cases. The most commonly implicated were induction and volatile agents, atropine, local anaesthetic toxicity, adrenaline, cocaine and vasopressors.</li> <li>(12) Airway problems were often one of multiple contributing factors but were specifically reported in 4% of cases: hypoventilation/hypoxia occurred in the setting of difficult intubation and circuit problems, and caused secondary light anaesthesia in some instances.</li> <li>(13) Allergy/anaphylaxis was a factor in 11% of cases.</li> <li>(14) Autonomic reflex stimulation was reported in 9% of cases.</li> <li>(15) Cardiopulmonary problems as causes were reported in 8% of cases.</li> </ol> <p><b>These notes comprise a reverse side of a page of the Crisis Management Manual<sup>14</sup>.</b>            * Page references refer to the <i>Crisis Management Manual</i><sup>14</sup>.</p>

**Figure 1** Tachycardia.

## METHODS

Of the first 4000 incidents reported to AIMS, those which made reference to tachycardia or tachydysrhythmia were extracted and analysed with respect to the following criteria: surgical group, anaesthetic technique, patient's ASA status, phase of anaesthesia at the time of presentation, presenting features (cardiac rhythm, blood pressure, oxygen saturation and other associated vital signs), the presumed precipitating cause, management, and outcome. The COVER ABCD–A SWIFT CHECK algorithm, described elsewhere in this series of articles,<sup>6</sup> was applied to each report to determine the stages at which the problem might have been diagnosed and to confirm that activating the COVER portion would have led to appropriate initial steps being taken. As tachycardia is not adequately dealt with by this algorithm, a specific sub-algorithm for tachycardia was developed (fig 1) and its

putative effectiveness was tested against the reports. How this was done is described elsewhere in this series of articles.<sup>6</sup> The potential value of this structured approach—that is, the application of COVER ABCD–A SWIFT CHECK to the diagnosis and initial management of the problem followed by the application of the tachycardia sub-algorithm—was assessed in the light of the AIMS reports by comparing its potential effectiveness for each incident with that of the actual management, as recorded in each report. It was also of interest to evaluate if delays in diagnosis and overall outcome could be improved with the application of the sub-algorithm.

## RESULTS

There were 123 reports which contained the word “tachycardia” or “tachydysrhythmia”. These occurred across a range of surgical groups (table 1).

**Table 1** Surgical groups reported in cases of tachycardia

Surgery	No of cases
Orthopaedics	27
General surgery	23
Otorhinological surgery	12
Cardiothoracic surgery	11
Plastic surgery	9
Neurosurgery	7
Vascular surgery	6
Obstetrics	5
Urology	4
Ophthalmology	3
Dental surgery	3
Gynaecology	2
Cardioversion	1
Diagnostic procedure	1
Endoscopy	1
Gynaecology	1
Not specified	7
Total	123

The patients' ASA grades were available in 117 cases (table 2).

Tachycardia was reported during all phases of anaesthesia but occurred most commonly at induction and in the maintenance period (table 3).

### Aetiology and diagnosis

The contributing causes for all reported cases of tachycardia and for the subgroups are presented in table 4. A total of 145 causative events were identified within the 123 reports. In this series, drugs are the dominating associated cause of tachycardia. The haemodynamic status of the patient at the time that tachycardia was detected included cardiac arrest (17%), hypotension (33%), normotension (27%), and hypertension (26%).

Cardiac arrest was reported in 24 events (17%). The prevailing rhythm was sinus pulseless electrical activity (PEA), formerly known as electromechanical dissociation (four cases), pulseless ventricular tachycardia (VT; n = 9), and ventricular fibrillation (VF; n = 5). In one case a bizarre undiagnosable rhythm was present initially which degenerated into VT and VF and then asystole. One episode of VT could not be clearly distinguished from supraventricular tachycardia (SVT) on the monitor. In four cases VT degenerated into VF.

Most specified ASA grades were represented in the cardiac arrest group: ASA IV (n = 4), ASA III (n = 6), ASA II (n = 2), ASA I (n = 8), not stated (n = 4). Cardiac arrests occurring in ASA I patients were caused by anaphylaxis (n = 3, PEA), hypoxaemia (n = 1, VT-VF), and hypovolaemia (n = 1, VF). Two ASA I patients experienced sudden VT in association with intravenous induction agents and another during handling of the myocardium during thoracic surgery. None of these patients died.

**Table 2** ASA rating

ASA	No of cases
I	32
I <sub>p</sub> *	4
II	35
III	37
IV	9
V	0
Not specified	6

\*p refers to children <14 years.

**Table 3** Phase of anaesthesia at time of detection of tachycardia

Phase of anaesthesia	No of cases
Pre-induction	11
Induction	34
Maintenance	49
Emergence	7
Recovery	10
Postoperative	5
Not specified	7

There appears to be a higher incidence of allergy and cardiopulmonary events as causes among the reported cases of tachycardia (table 4). In 10 of the reports the patient was initially hypotensive and subsequently deteriorated to cardiac arrest. A pulseless state was reported from the outset to the remainder. No differences in aetiology were evident from an inspection of the reports. This supports the use of the cardiac arrest algorithm in every case of cardiac arrest, irrespective of how it presents.

Hypotension occurred in association with tachycardia in 48 cases (33%, table 4). Again there is a higher representation of allergy and cardiopulmonary events, but this is not the case for hypovolaemia as might be expected. The causes were also compared between sinus and non-sinus tachycardia. All cases of allergy were associated with sinus tachycardia. No other patterns were apparent; however, the number of cases was small. As a general observation, the profile of causes for hypotension and tachycardia occurring together is significantly different from either hypotension or tachycardia overall to warrant its own subgrouping.

Hypertension was reported in 37 cases (26%). The majority of cases involved sinus tachycardia. The remaining seven cases were associated with non-sinus tachyarrhythmias: VT (n = 1), SVT (n = 2), atrial fibrillation (n = 1), bigeminy (n = 2), and ventricular ectopy (n = 1). There was no apparent difference in causes with respect to rhythm.

There are notable differences in the causes in this group compared with hypotension. Light anaesthesia was the attributed cause in six cases. This included frank awareness and perceived pain. Two of these involved the inadvertent administration of muscle relaxant and one involved an empty vaporiser. Three cases were associated with hypercarbia secondary to rebreathing resulting from malfunction of the expiratory unidirectional valve or soda lime exhaustion. Drugs were implicated in 11 cases and again the profile of drugs differs considerably from hypotension (table 5). Four of these were associated with syringe or ampoule errors, three of which involved adrenaline.

Tachycardia occurred without a change in blood pressure in 39 cases (27%). The causes described in this category represented those already observed in hypotension and hypertension (tables 4 and 5).

An apparent abnormality of gas exchange as evidenced by desaturation on pulse oximetry, inadequate ventilation, obstruction, or dyspnoea was described in 30 reports (24%). Evaluation of these cases showed that desaturation may represent an artefact on pulse oximetry secondary to diminished peripheral perfusion,<sup>7</sup> but this could not be distinguished at the time of detection of tachycardia from those cases in which real abnormalities of gas exchange existed.

### Outcomes

The outcome of patients experiencing tachycardia during anaesthesia was studied. Poor outcomes are given in table 6.

**Table 4** Causes of tachycardia expressed as percentage of total causes

Causes	Tachycardia (n = 145)	Tachy-CA (n = 24)	Tachy-Hypo (n = 48)	Tachy-Normo (n = 39)	Tachy-Hyper (n = 37)
Allergy	11	17	21	5	0
Airway	4	4	4	3	6
Hypovolaemia	3	13	4	0	0
Regional anaesthesia	1	0	4	0	3
Drugs	33	25	19	48	37
Cardiopulmonary events	8	13	11	3	6
Autonomic reflexes	9	13	4	12	9
Sepsis	1	0	0	5	0
Surgical factors	6	8	6	3	6
Pre-existing condition	1	4	0	0	0
Central nervous system	1	0	0	0	3
Metabolic	2	4	0	3	3
Monitoring	1	0	4	0	0
Other	2	0	6	0	0
Light anaesthesia	4	0	0	0	18
Hypercapnia	4	0	0	8	9
Not determined	8	0	17	10	0
Total (%)*	99	101	100	100	100

Tachy-CA, tachycardia in association with cardiac arrest; Tachy-Hypo, tachycardia in association with hypotension; Tachy-Normo, tachycardia in association with normotension; Tachy-Hyper, tachycardia in association with hypertension.

Examples of causes:

Cardiopulmonary events: Tachy-CA, pressure on pericardium (n = 2), myocardial infarct (n = 1); Tachy-Hypo, left ventricular failure (n = 1), tension pneumothorax (n = 2), haemothorax (n = 1), gas embolism (n = 1); Tachy-Normo, myocardial infarct (n = 1); Tachy-Hyper, pulmonary oedema (n = 1), fat embolism (n = 1).

Surgical factors: Tachy-CA, central venous cannula wire (n = 2); Tachy-Hypo, central venous cannula wire (n = 2), hip cement or reaming (n = 1); Tachy-Normo, pneumoperitoneum (n = 1); Tachy-Hyper, hip cement (n = 1).

Central nervous system: Tachy-Hyper, ruptured cerebral aneurysm (n = 1).

Metabolic: Tachy-Normo: iatrogenic hyperthermia (n = 1); Tachy-Hyper: malignant hyperthermia (n = 1).

Light anaesthesia: Tachy-Hyper, pain (n = 1), light anaesthesia (n = 1), awareness (n = 3).

Hypercapnia: Tachy-Normo, hypoventilation (n = 1), malfunction circle or soda lime (n = 1), inhaled CO<sub>2</sub> (n = 1); Tachy-Hyper, hypoventilation (n = 2), malfunction circle or soda lime (n = 2).

\*Variation from 100% reflects rounding of percentages.

Thirty nine cases were considered to have had a poor outcome because they were not resolved by the completion of the normal recovery period. Three cases resulted in death on the table or in the postoperative period. This contrasts with previous reviews of death resulting from cardiac arrest under anaesthesia which described a 50% mortality rate.<sup>8</sup> Factors contributing to a poor outcome were considered in terms of ASA rating, rhythm, cause and management.

A poor outcome was more likely to occur if tachycardia was associated with a pulseless state. All deaths occurred in this

group. It appeared otherwise independent of blood pressure. Similarly, no strong relationship could be found with ASA rating (table 7). There were no cases in which it was felt that outcome could have been improved.

#### Verification of the sub-algorithm

When COVER ABCD–A SWIFT CHECK was applied to each report it was considered that the problem would have been detected in all cases either at the C1 stage of COVER or at C of ABCD; 40 cases (33%) from the database would have been

**Table 5** Drug related causes of tachycardia expressed as the number of cases in which the drug contributed to tachycardia within various presentation groups

Drugs	Tachy-CA	Tachy-Hypo	Tachy-Normo	Tachy-Hyper
IV anaesthetic agents	3	1	1	0
Benzodiazepines	0	1	0	0
Inhalational agents	0	0	2	1
Vaporiser	0	0	0	1
Suxamethonium*	2	0	2	1
Local anaesthetic†	0	0	0	2
Protamine	0	0	0	1
Vasopressors‡	0	0	2	1
Adrenaline/cocaine	0	1	6	0
Inotropes	0	1	1	2
Salbutamol	0	1	0	0
Clonidine withdrawal	0	0	0	1
Sudafed	0	0	1	0
Atropine	1	2	1	0
Miscellaneous¶	0	1	0	0
Syringe or ampoule errors§	0	1	3	4

Tachy-CA, tachycardia in association with cardiac arrest; Tachy-Hypo, tachycardia in association with hypotension; Tachy-Normo, tachycardia in association with normotension; Tachy-Hyper, tachycardia in association with hypertension.

\*Suxamethonium induced hyperkalaemia (n = 2).

†Adrenaline containing solutions (n = 2).

‡Metaraminol, ephedrine, phenylephrine ophthalmic solution.

¶Vancomycin.

§Sodium nitroprusside (n = 1), atropine (n = 2), adrenaline (n = 2), atracurium (n = 1), metaraminol (n = 1), thrombostat (n = 1).

**Table 6** Poor outcome associated with tachycardia

Outcome	No of cases
Death on table	1
Death postoperatively	2
ICU admission and recovery	19
HDU admission	1
Coronary care admission	4
Cardiac event*	3
Neurological event†	2
Delayed recovery	3
Other (abandoned procedure)	1
Other (awareness)	2
Other (coagulopathy, surgery deferred)	1

\*Myocardial infarction (n = 1), pulmonary oedema (n = 1), dysrhythmia (n = 1).

†Ruptured intracranial aneurysm.

diagnosed and, of these, 28 (70%) also resolved by application of the core algorithm COVER. The majority of these dealt with vaporiser incidents V2 (n = 1), circuit problems V1 (n = 7), possible artefacts from monitors R1 (n = 3), equipment malfunction or errors with non-anaesthetic drugs R2 (n = 25). The remaining cases required either completion of the sub-algorithm for tachycardia or pursuit of the sub-algorithms for the specific aetiological incidents dealt with under ABCD–A SWIFT CHECK. It was considered that carrying out the recommendations shown in fig 1 (the sub-algorithm) would have constituted appropriate management in all cases.

When the effectiveness of the structured approach represented by COVER ABCD–A SWIFT CHECK algorithm and the special sub-algorithm for tachycardia was compared with that of actual management as documented by each of the reports, it was considered that, if properly applied, the structured approach recommended would have led to quicker and or better resolution of the problem in four cases. There was a significant delay in diagnosis in three of these and inappropriate management in one.

## DISCUSSION

The specific sub-algorithm for tachycardia is shown in fig 1. The hallmarks of the sub-algorithm are early clarification of the haemodynamic status and context specific treatment.

Tachycardia is frequently associated with abnormalities of blood pressure and separate sub-algorithms have been developed for these. Following multiple sub-algorithms may generate unnecessary workload and delays. The data were

## Key messages

- From the first 4000 incidents reported to AIMS, 123 reports of tachycardia identifying 145 causes were extracted and studied.
- The predominant surgical groups implicated were orthopaedics, general surgery, ENT surgery, and cardiothoracic surgery.
- Most tachycardia was detected during the induction and maintenance phases of anaesthesia. At detection, 20% of patients were in cardiac arrest.
- There were no deaths among the cardiac arrest patients. All ASA grades were represented. Three such ASA I cases had pulseless electrical activity caused by anaphylaxis.
- The data in this series support the use of the cardiac arrest algorithm in every case of cardiac arrest, irrespective of how it presents.
- The causes of tachycardia associated with hypotension and those associated with hypertension were notably different (for example, the drug profiles involved).
- Light anaesthesia (including frank awareness) occurred in six of the tachycardia cases associated with hypertension.
- Poor outcomes were reported in 39 cases (32%), with predominance among the higher ASA grades.
- While 23% of the cases would have been fully resolved using the core algorithm, it was considered that the remaining 77% required either the specific tachycardia sub-algorithm or the application of other sub-algorithms in this series, as indicated by the aetiologies revealed by the core algorithm.

inspected for patterns which may provide guidance in this event and the following recommendations are made:

If the patient is:

- *Pulseless*: follow the sub-algorithm for cardiac arrest. A detailed discussion of the management of cardiac arrest is beyond the scope of this paper but can be found in other reviews<sup>2, 9</sup> and guidelines.<sup>10, 11</sup>
- *Hypertensive*: follow the sub-algorithm for hypertension. The differential diagnosis evident in the AIMS reports closely resembles that for hypertension described in other

**Table 7** Poor outcome related to ASA grade in tachycardia (number of cases)

Outcome	ASA grade				
	1	1p*	2	3	4
Death on table					1
Death postoperative	1			1	
ICU admission and recovery	4		8	2	5
HDU admission				1	
Coronary care admission	1		1	2	
Cardiac event			1	2	
Neurological event	1			1	
Delayed recovery			2	1	
Other (abandoned procedure)		1			
Other (awareness)	1				
Other (coagulopathy, surgery deferred)				1	
Other (awareness)			1		

\*p refers to children <14 years of age.

series<sup>12</sup> and elsewhere in this set of articles.<sup>13</sup> Management differs from other scenarios involving tachycardia in that immediate support of vital signs is not generally required, a diagnosis often being considered before any treatment is initiated.

- **Hypotensive:** the sub-algorithm for tachycardia should be followed until the cardiac rhythm is diagnosed. There will be some benefit in cross referencing to the hypotension sub-algorithm when hypotension co-exists with sinus tachycardia. Physiological models emphasise that sinus tachycardia is most likely to occur as a secondary response to hypotension. Immediate supportive and further definitive treatment will be similar to that described for hypotension. An exception to this is hypotension occurring as a result of tachycardia induced myocardial ischaemia. The sub-algorithm for hypotension incorporates this into its differential diagnosis.<sup>7</sup> Management of hypotensive patients with non-sinus tachydysrhythmias is specified in the tachycardia sub-algorithm.

## CONCLUSION

Tachycardia during anaesthesia is a common event which is frequently associated with a simultaneous change in status of other monitored vital signs. The differential diagnosis is large and addressing it in a comprehensive fashion must be preceded by supportive treatment. Tachycardia appears to be managed in an appropriate and timely manner in the majority of cases, but this is not without exception. Treatment pathways based on associated blood pressure and prevailing rhythm, in the case of hypotension, appear to offer a functional systematic guide which complements the already proven benefits obtained by employing the core algorithm COVER ABCD.

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