24 Perioperative bradycardia and tachyarrhythmia

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Key findings

- Severe bradycardia (heart rate less than 30/minute) is uncommon, occurring in 1 in 450 (0.22%) of all anaesthesia cases in the NAP7 Activity Survey.
- Severe bradycardia during laparoscopy occurred more often but was also uncommon, occurring in 1 in 180 (0.55%) of laparoscopic cases in the NAP7 Activity Survey.
- A vagal bradycardia progressing to cardiac arrest is very rare and occurred in about 1 in 50,000 cases based on the NAP7 annual anaesthetic workload estimate of 2.71 million cases.
- A bradycardia progressing to cardiac arrest during insufflation for gynaecological laparoscopy and requiring chest compressions occurred in about 1 in 4,500 cases based on the NAP7 annual anaesthetic gynaecological laparoscopy workload estimate of 66,000 cases. All these patients survived.
- For all cardiac arrests associated with bradycardia, 74% survived to hospital discharge compared with 37% for all non-bradycardia associated cardiac arrests in NAP7.
- Tachyarrhythmias (new-onset atrial fibrillation (AF), rapid AF, ventricular tachycardia, VT, or supraventricular tachycardia, SVT) are uncommon during anaesthesia, occurring in 1 in 550 (0.19%) of all anaesthesia cases in the NAP7 Activity Survey.
- Tachyarrhythmia associated with the cardiac arrest is very rare and occurred in about 1 in 50,000 cases based on the NAP7 annual anaesthetic workload estimate of 2.71 million cases.

What we already know

Arrhythmias (bradycardia and tachyarrhythmia) occurring during anaesthesia are relatively common but usually not life threatening and rarely require specific treatment. In a study of 17,201 patients having general anaesthesia with volatile drugs, published in 1990, arrhythmia (atrial, nodal, ventricular) occurred in 10.9% of cases, bradycardia in 18.9%, and tachycardia in 40.9%, and they rarely caused patient harm (Forrest 1990). This study is old, and the anaesthetic techniques used (halothane, enflurane or isoflurane) did not include total intravenous anaesthesia with propofol or newer drugs (eg sevoflurane, remifentanil). It is likely that arrhythmias are now less common, particularly in the absence of halothane, which is associated with a high incidence of arrhythmias.

The Australian Incident Monitoring Study database identified 12 cases of cardiac arrest associated with insufflation for pneumoperitoneum, with bradycardia preceding 9 of these cases (Yong 2015). All patients required cardiopulmonary resuscitation and survived. The authors recommended early recognition of bradycardia, deflation of the pneumoperitoneum and atropine as the key interventions to prevent cardiac arrest. In an Israeli single-centre study of 9,915 patients having laparoscopic surgery between June 2008 and August 2013, 1,540 (15.5%) had intraoperative bradycardia (heart rate less than 50/minute) and 9.5% had a heart rate less than 45/minute (Dabush-Elisha 2019). Most were related to carbon dioxide (CO_2) insufflation or bolus opioid administration. There were no cardiac arrests or evidence of harm. There is currently little evidence or consensus on the use of routine prophylaxis with anticholinergic drugs to prevent bradycardia caused by CO_2 insufflation (Steer 2019).

Bradycardias are defined as a heart rate less than 60/minute and tachycardias a rate faster than 100/minute. In practice, only those arrhythmias that cause compromise (hypotension, myocardial ischaemia, heart failure) require urgent treatment (RCUK 2021). Arrhythmias usually occur from combinations of:

- primary cardiac disease (eg pre-existing ischaemic heart disease or AF, or a new acute problem such as an acute coronary syndrome)
- acute illness (eg hypovolaemia, hypoxaemia or metabolic – severe metabolic acidosis) or electrolyte disturbances (hypokalaemia, hypomagnesaemia)
- surgical (eg vagal) stimulation
- drugs including those given before (eg beta blocker) or during (eg vasopressors) anaesthesia

- procedures (eg guidewire insertion during central venous access).

When severe arrhythmias are left untreated, they can progress to cardiac arrest. For example:

- Untreated severe bradycardia or acquired complete heart block can progress to asystole.
- A very rapid SVT (eg > 250/minute) or very rapid AF may lead to profound hypotension or loss of cardiac output.
- VT can degenerate into ventricular fibrillation (VF), especially if the VT is very fast (eg > 200/minute). This is more likely in the presence of myocardial ischaemia or electrolyte abnormalities.

Arrhythmias are less well tolerated by patients with underlying structural heart disease or when left untreated. In patients with a healthy heart, a heart rate of less than 150/minute is usually well tolerated, whereas heart rates of 100–150/minute may cause haemodynamic compromise in patients with pre-existing heart disease. Current Resuscitation Council UK guidelines for periarrest arrhythmia recommend (Soar 2021):

- Treating arrhythmia when there is compromise or risk of compromise (shock, hypotension, heart failure, myocardial ischaemia, extremes of heart rate).
- Correction of reversible causes (eg stopping vagal stimuli causing profound bradycardia by removing traction of eye muscles, deflating a pneumoperitoneum).
- Optimising oxygenation, ventilation and circulating volume, and correcting electrolyte abnormalities (eg sinus tachycardia or fast AF in a patient with pre-existing AF, which may be in response to hypovolaemia) or there may be a broad complex tachycardia in the presence of hyperkalaemia.

Severe bradycardia will usually respond to correcting the underlying cause or anticholinergic drugs (atropine or glycopyrrolate). When these are unsuccessful, adrenaline in small bolus doses (eg 50 µg in adults) may be effective. In severe cases, isoprenaline, adrenaline infusions or pacing (transcutaneous or transvenous) may be required.

For regular tachyarrhythmias with cardiovascular compromise, the safest approach is to treat all broad-complex tachycardia as VT unless there is good evidence that it is supraventricular in origin. A tachyarrhythmia with life-threatening features should be treated with a synchronised DC cardioversion – this is more likely to be successful if the underlying cause is also corrected. If cardioversion fails, give amiodarone 300 mg intravenously over 10–20 minutes. Further cardioversion attempts and amiodarone may be needed; faster rates of amiodarone administration risk causing or exacerbating hypotension. When time permits, expert cardiology help may be required.

In a large observational study, a perioperative tachyarrhythmia was associated with an increased risk of a perioperative myocardial infarction or injury and an increased risk of major adverse cardiac events including acute myocardial infarction, heart failure, life-threatening arrhythmia and death during one year of follow-up (Puelacher 2023).

What we found

Activity Survey

The number of arrhythmias reported to the Activity Survey is shown in Table 24.1. In addition:

- The specialties for the 54 severe bradycardia (< 30/minute) cases (0.22%) of 24,172 cases in the NAP7 Activity Survey were:
  - gynaecology: 10 of 1,962 cases (0.5%)
  - orthopaedic trauma: 7 of 2,109 cases (0.3%)
  - general surgery: 6 of 2,242 cases (0.3%)
  - urology: 5 of 2,037 cases (0.2%)
  - ear, nose and throat: 4 of 1,356 cases (0.3%)
  - orthopaedic elective: 4 of 2,496 (0.2%)
  - cardiac electrophysiology: 3 of 135 cases (2.2%)

Table 24.1 Arrhythmia events reported to the Activity Survey

Event	Patients		
	All (*n*=24,172), *n* (%)	Non-obstetric (*n*=20,996), *n* (%)	Non-obstetric, and non-cardiac* (*n*=20,516), *n* (%)
Severe bradycardia (< 30/minute)	54 (0.22)	52 (0.25)	47 (0.23)
Fast atrial fibrillation	24 (0.1)	24 (0.11)	23 (0.11)
Supraventricular tachycardia	10 (0.04)	10 (0.05)	10 (0.05)
Ventricular tachycardia	8 (0.03)	8 (0.04)	5 (0.02)
Complete heart block	1 (<0.01)	1 (<0.01)	0 (0)
Other (not specified)	21 (0.09)	17 (0.08)	15 (0.07)
Overall	118 (0.49)	112 (0.53)	100 (0.49)

* Not having cardiac surgery or cardiac catheter laboratory procedures.

  - upper gastrointestinal surgery: 3 of 523 cases (0.6%)
  - cardiac interventional: 2 of 106 cases (1.9%)
  - neurosurgery: 2 of 424 cases (0.5%)
  - obstetric: 2 of 3,176 cases (0.06%)
  - ophthalmology: 1 of 1,046 cases (0.1%)
  - interventional radiology: 1 of 197 cases (0.5%)
  - dental: 1 of 745 cases (0.13%)
  - other unspecified: 3 of 509 cases (0.6%).
- There were 27 cases of new-onset atrial fibrillation. Of these, 19 (70%) were ASA 3–5, 12 (44%) were elective, 18 (66%) were planned for major or major complex surgery and 18 (66%) were over 65 years of age.
- Most (80%) arrhythmia occurred during general anaesthesia, 8% during sedation and 12% in awake patients.
- Of the 100 arrhythmias in 20,516 non-obstetric or non-cardiac cases:
  - 40 occurred in the 14,637 ASA 1 or 2 patients, a rate of 0.3%.
  - Only 6 (4 bradycardia, 2 not specified) occurred in children (0–18 years, 3,340 children), a rate of 0.2%.
  - 55 of 13,830 elective cases had an arrhythmia (28 bradycardia, 3 fast AF, 18 other, 5 SVT, 1 VT), a rate of 0.4%.
- Ten patients were treated with emergency DC cardioversion during their procedure. These were distributed across ages (6–15 years: 1; 26–35 years: 1; 46–55 years: 3; 66–75 years: 3; 76–85 years: 2) and priority of surgery (elective: 6; expedited: 1; urgent: 1; immediate: 2). Half of these occurred during cardiac (n = 4) or cardiology (n = 1) procedures.

Severe bradycardia during laparoscopic procedures reported to the Activity Survey

There were 14 cases of severe bradycardia (< 30/minute) during 2,532 laparoscopic surgery cases reported to the Activity Survey (0.55%). The data for these cases are summarised in Table 24.2. There was no difference between the groups on univariate statistical analysis using a two-sided Chi-squared test.

Table 24.2 Severe bradycardia during laparoscopic procedures reported to the Activity Survey

Procedure	Severe bradycardia, *n* (%)	Total cases (*n*)
All laparoscopic cases	14 (0.55)	2546
Gynaecology laparoscopy	3 (0.51)	593
Non-gynaecology female laparoscopy	3 (0.30)	1009
All female laparoscopy reports	6 (0.37)	1602
All male laparoscopy reports	8 (0.85)	943

During gynaecological surgery, 10 cases reported a severe bradycardia (< 30/minute) of 1,962 cases (0.5%). Three occurred in 593 laparoscopic gynaecology cases (0.51%) and seven occurred in 1,369 non-laparoscopic gynaecology surgery (0.51%).

Arrhythmia leading to chest compressions and or defibrillation in the Activity Survey

Twelve patients had an arrhythmia that was associated with chest compressions and/or defibrillation. Of the 54 cases of severe bradycardia (heart rate less than 30/minute) reported, 7 (13%) were associated with chest compressions:

- During anaesthesia for laparoscopic procedures in four patients who were treated successfully with treatment that included chest compressions.
- During induction of anaesthesia with airway and ventilation difficulties causing severe hypoxaemia in two patients. One of these patients was not successfully resuscitated.
- During a non-elective interventional cardiology procedure in a middle-aged patient under general anaesthesia secondary to cardiac ischaemia – the patient required more than five chest compressions and defibrillation for successful resuscitation.

Five patients with tachycardias had chest compressions and/or defibrillation:

- Three older patients with frailty had fast atrial fibrillation during non-elective surgery. Two survived the initial resuscitation attempt.
- A patient with a major haemorrhage requiring general anaesthesia was reported to have an SVT, progressing to VT and then VF. The patient had cardiopulmonary resuscitation, including defibrillation, but could not be resuscitated.
- A young patient was reported to have developed pulseless VT (pVT) during a cardiac electrophysiology procedure and required defibrillation. They survived the event.

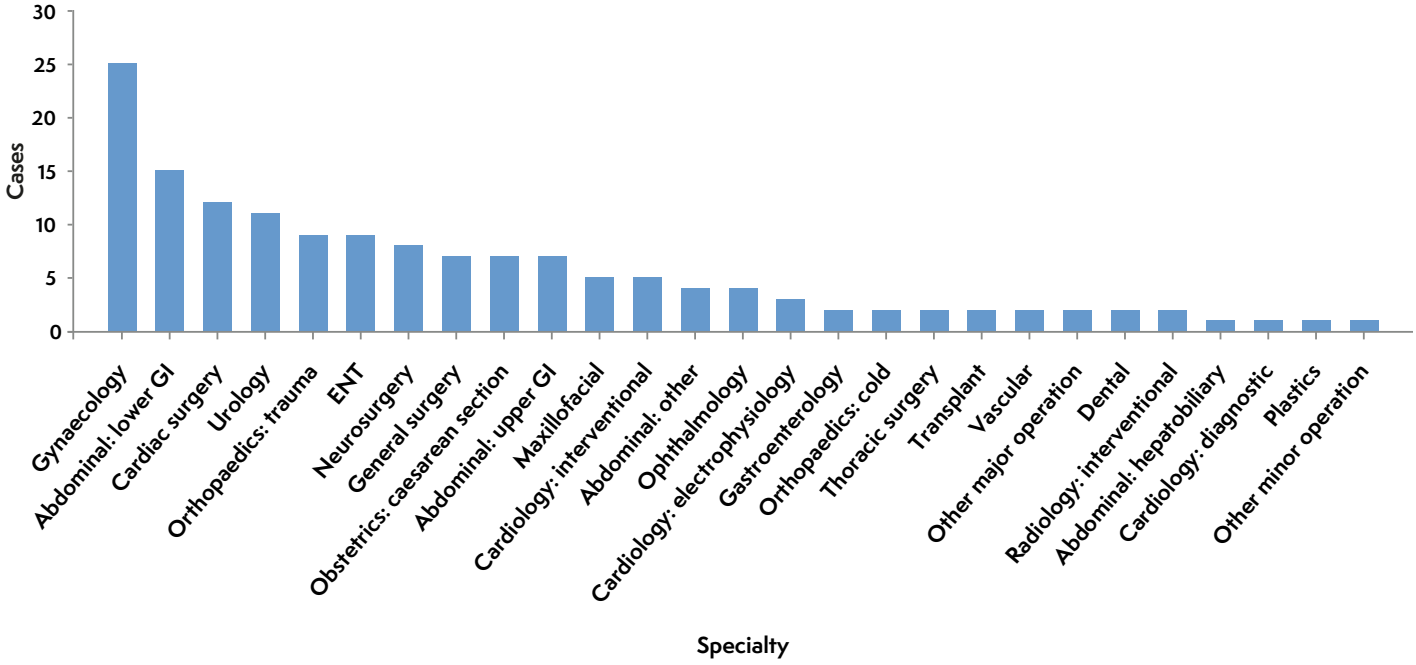
Perioperative cardiac arrest and arrhythmia case reports

Of 881 cardiac arrests reported to NAP7, 155 (17.6%) had a bradycardia before cardiac arrest and 54 (6.1%) had a tachycardia.

Perioperative cardiac arrest and bradycardia case reports

The demographic of patients with bradycardia-associated perioperative cardiac arrest was similar to the overall Activity Survey demographics for age, sex, body mass index, ethnicity, ASA score, frailty, the day of the week or time of day. Eighty-five percent of bradycardias associated with perioperative cardiac arrest occurred during general anaesthesia cases, similar to the rate for all 54 severe bradycardia cases reported in Activity Survey (80%). As 72% of Activity Survey cases were undertaken with general anaesthesia, this suggests a modest overrepresentation of general anaesthesia in bradycardic events.

Figure 24.1 Surgical specialties for case reports of bradycardia-associated perioperative cardiac arrest reported to NAP7 (n=155). ENT, ear nose and throat; GI, gastrointestinal.



Regarding specialties, the highest number of cases (*n* = 25) occurred during gynaecology procedures, accounting for 2.8% of all perioperative cardiac arrests associated with bradycardia. Gynaecology accounted for 16% of severe bradycardias and 8.2% of the overall workload in the Activity Survey. The surgical specialties of cardiac arrests associated with bradycardia are shown in Figure 24.1.

Compared with other causes of cardiac arrest, those having a bradycardia-associated cardiac arrest were more likely to be female (52% vs 41%), ASA 1 or 2 (40% vs 21.5%), have a modified Rankin Scale score of 0 (no symptoms or disability; 42% vs 23%), lower frailty scores (clinical frailty scale score ≤ 4 in 67% vs 51%). In addition, they were much more likely to be having minor surgery (19% vs 9.1%) and elective surgery (50% vs 23%).

The cardiac arrest characteristics of those having a bradycardia-associated cardiac arrest compared with those who did not include:

- an initial rhythm of asystole (44% vs 9.3%) or bradycardia (37% vs 9.8%) when chest compressions were started
- a lower need for defibrillation (3.9% vs 20.5%)
- a shorter duration of cardiac arrest (92% < 10 minutes vs 62%).

The panel judged the cause of cardiac arrest in the 25 cases of bradycardia-associated cardiac arrest occurring during gynaecological surgery as insufflation/pneumoperitoneum in 15 cases (60%), anaesthesia drugs in 7 cases (28%) and severe hypoxaemia, major haemorrhage and sick sinus syndrome for one case each. Most of these patients (21/25, 84%) were between 18 and 65 years, ASA 1 or 2 (21/25, 84%) and having elective surgery (18/25, 72%). All had a cardiac arrest of less than 10 minutes' duration and a sustained restoration of spontaneous circulation. All cases were alive at the time of reporting – 21 had been discharged and 4 were alive and still admitted.

Table 24.3 Outcomes for patients with bradycardia-associated perioperative cardiac arrest

Outcome	Bradycardia cardiac arrest (*n*=155), *n* (%)	Non-bradycardia cardiac arrest (*n*=726), *n* (%)
Initial cardiac arrest outcome:		
Died	6 (3.9)	203 (28)
ROSC > 20 minutes	147 (95)	518 (71)
Not known	2 (1.3)	5 (0.7)
Hospital outcome:		
Alive	114 (74)	270 (37)
Dead	13 (8.4)	335 (46)
Still admitted	28 (18)	121 (17)

ROSC, return of spontaneous circulation.

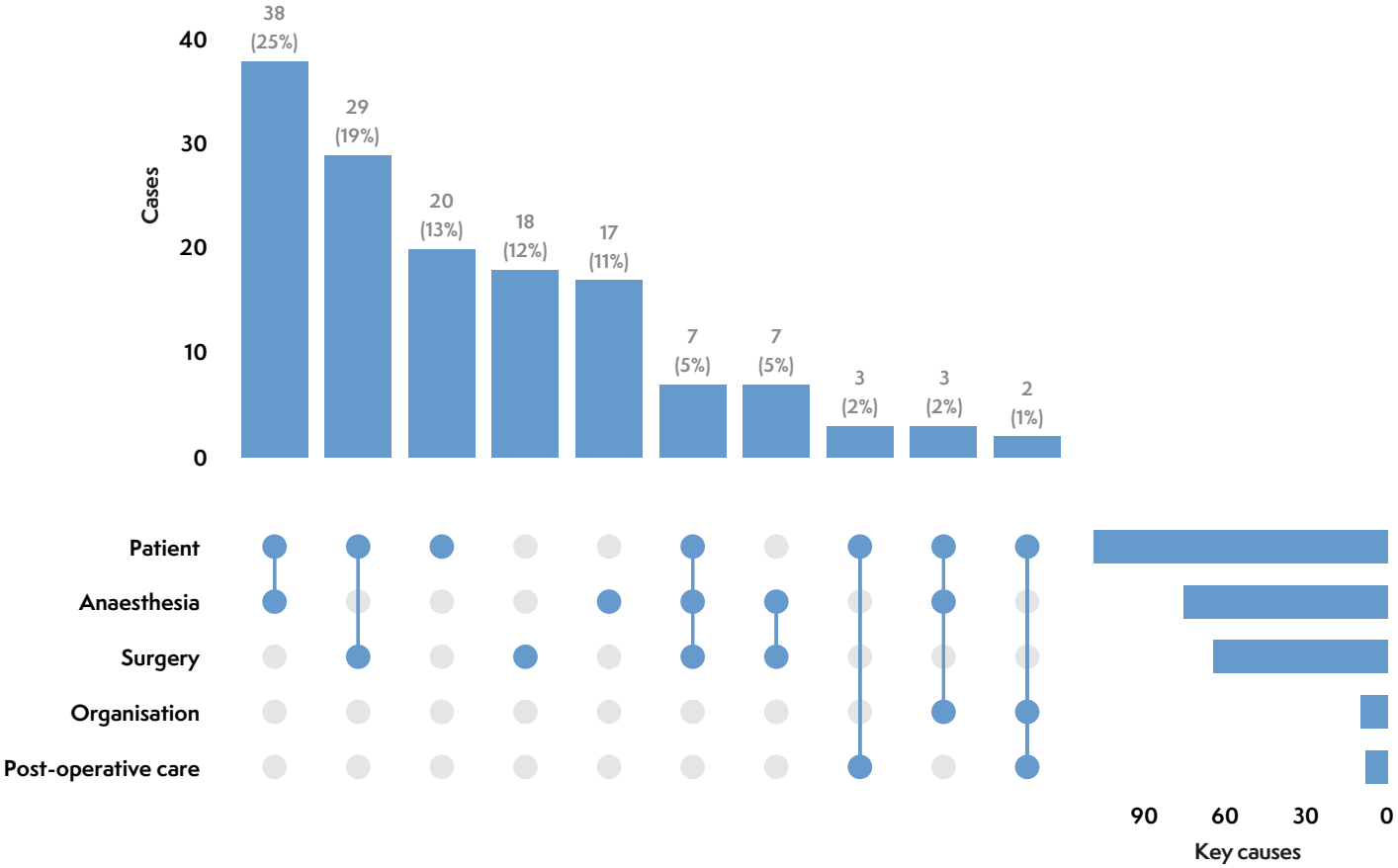
Patients having a bradycardia associated cardiac arrest had much better outcomes than those who did not (Table 24.3). The NAP7 panel assessments of the care provided to the cases of bradycardia-associated cardiac arrest (*n* = 153) are shown in Table 24.4. These ratings are similar to non-bradycardia cardiac arrests.

Anaesthesia care alone or in combination with patient factors was judged by the NAP7 panel to have been the cause of cardiac arrest in 55 cases, whereas surgery alone or in combination with patient factors was judged to have caused cardiac arrest in 47 cases (Figure 24.2).

Table 24.4 NAP7 panel assessment of the care provided to the cases of bradycardia-associated cardiac arrest

Period of care	Good, *n* (%)	Good and poor, *n* (%)	Poor, *n* (%)	Unclear, *n* (%)
Pre-cardiac arrest	81 (53)	32 (21)	11 (7.1)	30 (19)
During cardiac arrest	124 (81)	18 (12)	1 (0.7)	10 (6.5)
Post-cardiac arrest	128 (84)	9 (5.9)	3 (2.0)	13 (8.5)
Overall	85 (56)	46 (30)	1 (0.7)	21 (14)

Figure 24.2 Panel-agreed factor for cause of cardiac arrest in patients with bradycardia. Top 10 combinations shown.



The NAP7 panel-agreed list of causes of bradycardia-associated perioperative cardiac arrest when there was high or moderate confidence (n = 109) in the cause of the cardiac arrest were:

- vagal stimulus: 52 cases, including 25 laparoscopic cases, 1 during squint surgery
- complete heart block: 16
- severe hypoxaemia: 9 including 2 following drug error
- anaesthesia induction: 6, including 1 due to remifentanil dosing, 2 due to propofol and remifentanil dosing
- spinal anaesthesia: 5
- major haemorrhage: 4
- cardiac ischaemia: 2
- intracranial haemorrhage: 2
- suxamethonium: 2
- pacemaker problem: 2
- hyperkalaemia: 2
- stroke, sepsis, complex congenital heart disease, cardiology interventional procedure, epidural, post cardioversion, bone cement implantation syndrome: 1 each.

The panel had low certainty in the cause of the bradycardia in 46 (27%) of cases. Many of these were attributed to cardiac ischaemia.

Panel lessons from case reports of bradycardia associated perioperative cardiac arrest

The treatment of vagal stimuli induced bradycardia is to stop the stimulus, give an anticholinergic drug and start chest compressions early if there is severe hypotension or progression to asystole. The precise trigger to start chest compressions is uncertain; this is discussed in Chapter 25 ALS for perioperative cardiac arrest. If bradycardia progresses to cardiac arrest, adrenaline (50–100 µg in adults) should be given in small doses in addition to starting chest compressions.

A young healthy patient undergoing a daycase elective gynaecological laparoscopy with general anaesthesia developed severe bradycardia (20–30/minute) during carbon dioxide insufflation. This heart rate improved by releasing the gas from the abdomen, 600 µg of glycopyrrolate and 30 seconds of chest compressions. The patient's heart rate returned to normal and surgery was completed. She made a good recovery and was discharged the same day. The panel discussed that this case met the NAP7 inclusion criteria because of the use of chest compressions, although this was likely a very low flow state rather than a cardiac arrest. The panel's view was that chest compressions may be beneficial in supporting the circulation and hastening the response to drug treatment.

Anaesthetic induction drugs can cause severe bradycardia in fit and healthy patients with slow resting heart rates, patients taking beta-blocker drugs and older frail patients.

A fit and healthy patient with a resting heart rate of 50/minute developed severe bradycardia and loss of consciousness after a target-controlled infusion (TCI) of remifentanil was started with a plasma target of more than 5 ng/ml. This effect occurred before TCI propofol was started. The bradycardia was rapidly recognised and treated by stopping the remifentanil, intravenous glycopyrrolate and chest compressions. After treating the bradycardia, the patient regained consciousness and underwent anaesthesia and surgery successfully.

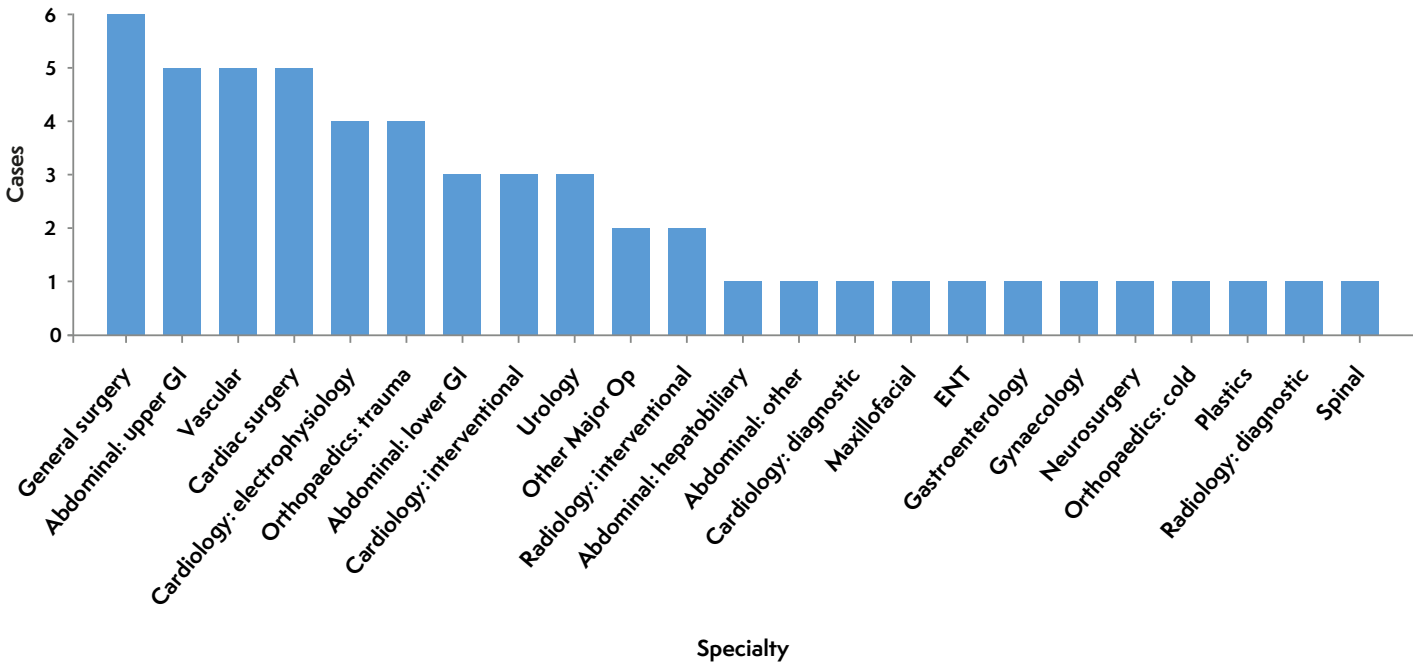
Perioperative cardiac arrest and tachyarrhythmia case reports

Of 881 (6.1%) cardiac arrest case reports, 54 had a tachyarrhythmia (including AF or VT) associated with the cardiac arrest. The demographic of patients with tachyarrhythmia-associated perioperative cardiac arrest was similar to the overall Activity Survey and case reports. Regarding specialties, the highest number of cases (n = 6) occurred during general surgery (Figure 24.3).

A preceding tachyarrhythmia was far more likely to cause a shockable cardiac arrest than for other arrest reports without a preceding tachyarrhythmia:

- 52% of cases (28/54) had pVT as the initial cardiac arrest rhythm, compared with 2.5% (21/827) of the other cardiac arrest cases.
- 15% (8/54) had VF as the initial cardiac arrest rhythm, compared with 6% (49/827) of other cardiac arrests.
- 57% were defibrillated (31/54), compared with 15% (123/827) of other arrests.

Figure 24.3 Surgical specialties for case reports of tachyarrhythmia-associated perioperative cardiac arrest reported to NAP7 (n=54). ENT, ear nose and throat; GI, gastrointestinal.



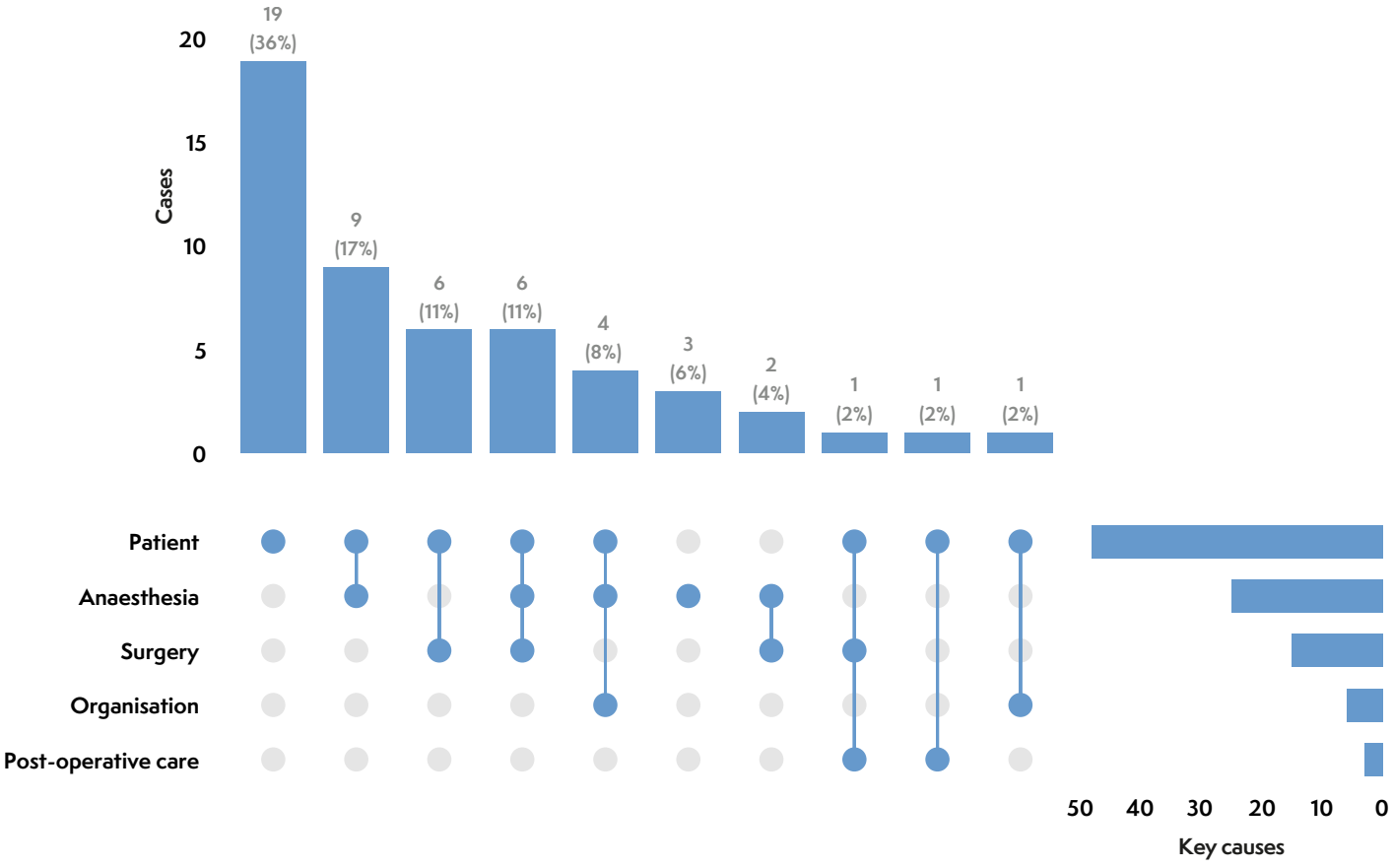
The cardiac arrest outcomes were similar for the tachyarrhythmia-associated cardiac arrests and the non-tachyarrhythmia-associated cardiac arrests (Table 24.5). Patient factors alone or combined with other factors were the most common underlying cause of cardiac arrest (Figure 24.4). In most cases (35/54, 65%), the primary cause of the tachyarrhythmia-associated cardiac arrest was uncertain or attributed to underlying primary heart problems. For the remaining cases, the panel agreed cause was:

- sepsis: 7 cases
- drug errors: 3 cases (including a large dose of adrenaline to treat bradycardia, an accidental high dose of potassium causing VT, and a magnesium bolus dose to treat SVT followed by cardiac arrest)
- major haemorrhage: 3 cases
- electrolyte disturbance: 2 cases (1 case of hypokalaemia and 1 of hyperkalaemia)
- tension pneumothorax: 2 cases
- electrochemotherapy to chest: 1 case associated with VT progressing to pVT
- pulmonary embolism: 1 case.

Table 24.5 Outcomes for the tachyarrhythmia-associated cardiac arrests

Outcome	Tachyarrhythmia cardiac arrest (*n*=54), *n* (%)	Non-tachyarrhythmia cardiac arrest (*n*=827), *n* (%)
Initial cardiac arrest:		
Died	9 (17)	200 (24)
ROSC > 20 minutes	45 (83)	620 (75)
Not known	0 (0)	7 (0.8)
Hospital:		
Alive	32 (60)	477 (58)
Dead	10 (18)	187 (23)
Still admitted	12 (22)	163 (20)

Figure 24.4 Panel-agreed factors for cause of cardiac arrest in patients with tachyarrhythmia. Top 10 combinations shown.



The panel rated care as good overall in half of all the cases; the panel ratings were similar to all non-tachyarrhythmia-associated cardiac arrests (Table 24.6).

The panel identified preoperative care factors as key lessons, including:

- issues regarding the management of arrhythmias and choice and dosing of drugs or electrical therapies (pacing, cardioversion) in 8 patients (15%)
- decision making regarding whether surgery was appropriate in high-risk patients (7 cases (13%).

Table 24.6 Panel rating of care for tachyarrhythmia-associated cardiac arrest

Period of care	Good, *n* (%)	Good and poor, *n* (%)	Poor, *n* (%)	Unclear, *n* (%)
Pre-cardiac arrest	28 (52)	15 (28)	3 (5.6)	8 (15)
During cardiac arrest	39 (72)	5 (9.3)	1 (1.9)	9 (17)
Post-cardiac arrest	40 (74)	3 (5.6)	0 (0)	11 (20)
Overall	27 (50)	16 (30)	2 (3.7)	9 (17)

A middle-aged patient with obesity had severe intrabdominal sepsis requiring an emergency laparotomy under general anaesthesia. During surgery, the patient required a noradrenaline infusion, was severely acidotic and developed an SVT with severe cardiovascular compromise. This was treated with amiodarone and progressed to a VF cardiac arrest. The cardiac arrest was treated successfully and the patient was admitted to the intensive care unit. The patient was still alive in the hospital at the time of reporting. The panel noted the difficulty in managing a tachyarrhythmia in these circumstances, given that sepsis and metabolic causes were the main precipitants of the arrhythmia. The panel opinion was that a synchronised DC cardioversion and correcting precipitating factors may have been the preferred first option to treat the arrhythmia in this scenario.

An older patient (> 85 years) with severe frailty and comorbidity presented with a ruptured abdominal aortic aneurysm. The patient was confused and had profound hypotension (systolic blood pressure < 50 mmHg). The patient developed VT between the induction of general anaesthesia and starting surgery. The patient had a pVT cardiac arrest and died despite resuscitative efforts, including defibrillation shocks, adrenaline and amiodarone. The panel considered whether starting surgery was appropriate in this patient's circumstances.

An older patient was listed for emergency surgery for abdominal sepsis – the patient's heart rhythm was fast AF with a normal blood pressure. The patient was given intravenous labetalol to treat the fast AF. Shortly after the labetalol (and before induction of anaesthesia), the patient had a pulseless electrical activity cardiac arrest. Resuscitation was not successful and the patient died. The panel's opinion was that optimising the patient's general condition (fluids, electrolytes) and only if needed, using a short acting beta-blocker (eg, esmolol) would have been more appropriate than labetalol (an alpha and beta -blocker) for managing fast AF in these circumstances.

A seemingly healthy patient on the day of surgery developed VT during an elective procedure that progressed to cardiac arrest; the patient was successfully resuscitated. The patient had a nurse-led telephone preoperative assessment and no 12-lead electrocardiogram (ECG). The patient had a complex medical history that was not communicated and, in the panel's view, it should have led to a more detailed face-to-face preoperative assessment, including a 12-lead ECG.

Discussion

The Activity Survey showed that about 0.5% of all patients having anaesthesia care have an arrhythmia that requires treatment. This would equate to an estimated 13,200 arrhythmia cases per year in the UK during anaesthesia (see Chapter 11 Activity Survey, for the calculation of annual cases). Of the 881 NAP7 case reports of perioperative cardiac arrest over one year, arrhythmia was associated with 209 (24%) cases.

Bradycardia

Severe bradycardia (heart rate < 30/minute) were uncommon at 1 in 450 (0.22%) of cases in the Activity Survey. The incidence of severe bradycardia during laparoscopic surgery was about 1 in 180 (0.55%) cases in the Activity Survey. The absolute number of events was small (14 cases of bradycardia associated with laparoscopy) and there was no clear signal of an increased risk of bradycardia associated with any particular type of laparoscopic surgery (Table 24.2). For gynaecological surgery, the incidence of bradycardia was similar for those having laparoscopic (0.51%) and non-laparoscopic surgery (0.51%). Other aspects of gynaecology surgery, such as cervical dilation, also cause bradycardia.

Most cases (47/54, 87%) of severe bradycardia reported to the Activity Survey did not appear to have caused any harm to the patient. We did not ask about specific treatments but they probably resolved with simple measures (stopping any surgical stimulus or using an anticholinergic drug). Seven

cases were associated with chest compressions. Five cases of primary bradycardia (four during laparoscopy, one during a cardiac catheter procedure) that had chest compressions were successfully resuscitated. In contrast, one of the two cases of secondary bradycardia caused by severe hypoxaemia could not be resuscitated. Not all of these cases met the criteria for NAP7, as they had fewer than five chest compressions.

The Activity Survey data suggest that severe primary bradycardia rarely leads to harm. In contrast, outcomes may be less good when bradycardia is secondary to another process (eg severe hypoxaemia).

Bradycardia was associated with perioperative cardiac arrest in 155 (17.6%) of the 881 NAP7 cardiac arrests arrest reports. A vagal bradycardia was the cause of cardiac arrest in about one third of cases (n = 52), complete heart block in 10% (n = 16) and uncertain in 30% (n = 46). A vagal bradycardia progressing to cardiac arrest occurred in about 1 in 50,000 cases based on the NAP7 annual anaesthetic workload estimate of 2.71 million cases.

Bradycardia-associated cardiac arrest was reported as occurring during gynaecological surgery in 25 cases and during insufflation/pneumoperitoneum in 15 of these cases (60%); all 25 cases survived. Our Activity Survey enables us to estimate that there are about 66,000 gynaecological laparoscopy cases per year in the UK, and we had 15 cases of cardiac arrest reported over a one-year period judged to have been caused by insufflation/pneumoperitoneum. We can therefore estimate that there is a need for more than five chest compressions in about 1 in 4,500 cases of gynaecological laparoscopy – the majority of these patients are fit and healthy and having elective surgery.

Most of the uncertain cases were attributed to undetected heart disease or cardiac ischaemia. In the remaining 26% (41 cases), bradycardia was secondary to another process, the most common being severe hypoxaemia. In these secondary cardiac arrest cases, severe bradycardia is part of the cardiac arrest process, and treatment and outcomes depend on reversing the underlying cause.

The ability to rapidly recognise and treat primary bradycardia by stopping/removing the stimulus, giving intravenous atropine or glycopyrrolate, and when there is a low flow/cardiac arrest state starting chest compressions and, if necessary small doses of adrenaline (see Chapter 25 ALS for perioperative cardiac arrest) should result in good outcomes. This is borne out by the outcomes of the bradycardia-associated cardiac arrest reports – 74% survived to hospital discharge compared with 37% for non-bradycardia-associated cardiac arrests (Table 24.3). Six bradycardia cardiac cases were judged by the panel to have been caused by induction drug dosing and this issue is discussed further in Chapter 26 Drug choice and dosing.

Tachyarrhythmia

The number of tachyarrhythmia cases reported in the Activity Survey was small, so it is difficult to make any firm conclusions (Table 24.1). There were 27 cases of new AF, 10 cases of SVT and 8 cases of VT, and 10 patients had a synchronised DC cardioversion. Tachyarrhythmia occurred in about 1 in 550 (0.19%) of all anaesthesia cases in the NAP7 Activity Survey. There was one death reported in this group.

There were 54 cases of tachyarrhythmia associated cardiac arrest reported over a one-year period. Tachyarrhythmia associated with cardiac arrest is therefore very rare and occurs in about 1 in 50,000 cases based on the NAP7 annual anaesthetic workload estimate of 2.71 million cases. The NAP7 case reports show that two thirds of the 54 cases of tachyarrhythmia-associated cardiac arrest cases had a shockable rhythm cardiac arrest and overall survival to hospital discharge was similar to those patients who had a non-tachyarrhythmia associated cardiac arrest (60% vs 58%; Table 24.5). Two thirds of the cases were thought to have been caused by primary heart disease and one third were secondary to other causes (eg sepsis). The panel mentioned issues regarding the treatment of the tachyarrhythmia in 8 (15%) cardiac arrest cases. Current guidelines (Soar 2021) recommend addressing reversible causes in haemodynamically compromised patients and using a synchronised cardioversion first strategy. The NAP7 panel recognised that treating secondary tachyarrhythmia can be challenging in terms of managing the underlying cause and choosing between drug treatments or electrical cardioversion.

Recommendations

Individual

- Anaesthetists should be familiar with the emergency treatment of bradycardia and tachyarrhythmia, including correcting the underlying cause (eg, hypovolaemia, electrolyte disturbance) and the specific treatments.

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