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Postoperative arrhythmias in general surgical patients

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ABSTRACT

INTRODUCTION New-onset arrhythmias are a common problem in cardiothoracic surgery. They are also common following major non-cardiac surgery. This review examines the available literature to establish the incidence and significance of new-onset arrhythmias following major non-cardiothoracic surgery.

MATERIALS AND METHODS A literature search was performed using the Medline and Pubmed databases using the terms 'post-operative arrhythmia', 'peri-operative arrhythmia', 'atrial fibrillation/flutter', 'supraventricular arrhythmia/tachycardia', 'cardiac complications' and 'non-cardiothoracic surgery'. Articles were cross-referenced for additional relevant publications and reviewed for data regarding new-onset arrhythmias following major non-cardiothoracic surgery.

RESULTS There was considerable heterogeneity in the literature regarding cardiac monitoring, types of arrhythmias considered and potential associations investigated, thus hindering interpretation. The available data suggest that new-onset arrhythmias affect about 7% of patients following major non-cardiothoracic surgery. These arrhythmias are often associated with other underlying complications.

KEYWORDS

Postoperative complications – Arrhythmia

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Postoperative dysrhythmias are a common complication of cardiothoracic surgery, affecting 10–40% of patients.[1–5] There is a considerable body of literature regarding the subject in cardiothoracic patients but little work in non-cardiothoracic surgical cohorts. The reported incidence following major non-cardiothoracic surgery ranges from 4–20%, depending on the type of surgery performed, the degree of cardiac monitoring undertaken and the type of arrhythmia studied.[4–8] The majority of patients included in these series were undergoing major abdominal or vascular surgery. Non-vascular abdominal surgery has been identified as an independent risk factor for postoperative supraventricular arrhythmias (SVAs).[8] In view of this, gastrointestinal surgeons may expect to encounter post-operative arrhythmias on a regular basis. This review summarises the current data regarding incidence and clinical significance of postoperative arrhythmias in non-cardiothoracic surgical patients. Potential treatment strategies are outlined.

Materials and Methods

The Medline and Pubmed databases were searched using combinations of the search terms 'postoperative arrhythmia', 'peri-operative arrhythmia', 'atrial fibrillation/flutter', 'supraventricular arrhythmia/tachycardia', 'cardiac complications' and 'non-cardiothoracic surgery'. Relevant articles published between 1966 and 2005 were obtained. The reference lists of each article were searched to identify further relevant publications. To date, there are no randomised controlled trials involving arrhythmias complicating non-cardiothoracic surgery. Case reports and articles dealing solely with arrhythmias in cardiac or thoracic surgical patients were excluded.

Results

Incidence

There are few published data regarding the incidence of new-onset arrhythmias after non-cardiac surgery. The

available series are heterogeneous with respect to patient groups studied, the degree of cardiac monitoring performed and the types of arrhythmias included in the data. The reported incidence ranges from 0.37%[9] to 20%.[4,5] Christians *et al.*[9] reported that atrial fibrillation (AF) affected only 0.37% in a cohort of over 13,000 patients. However, the series was retrospective and included patients undergoing orthopaedic and ophthalmic procedures as well as relatively minor procedures such as hernia repair and appendicectomy.[9] Ophthalmic patients have a risk of AF of about 0.01%[10] while the reported incidence of SVA in orthopaedic patients is about 4%.[11] The inclusion of patients at very low risk of arrhythmias is likely to have reduced the overall observed incidence considerably.

Series restricted to patients having major surgery report higher rates of arrhythmias. Goldman[7] reported a 4% incidence of postoperative SVA in patients over the age of 40 years while Polanczyk *et al.*[8] reported an rate of 7.6% in patients over 50 years. With over 5000 patents between them, these series represent the largest prospective cohorts in the current literature. The studies were restricted to patients with an expected length of stay of 2 days or more, eliminating the confounding effect of large numbers of patients undergoing minor procedures. However, there are a number of limitations to both studies. Neither used continuous or daily cardiac monitoring, instead using a combination of electrocardiograms as clinically indicated and routinely on day 5 in Goldman's series and days 1, 3 and 5 in that of Polanczyk and colleagues. Some arrhythmias were probably missed, particularly in Goldman's cohort. Both series included thoracic surgical patients while the group of Polanczyk and co-workers also included patients with a previous history of SVAs or digoxin use. The inclusion of these high-risk patients may have inflated the apparent incidence.

Three series restricted to non-cardiothoracic patients in critical care units report an incidence of about 10%.[4,6,12] All three used continuous cardiac monitoring which is likely to have increased the arrhythmia detection rate. On the other hand, some arrhythmias may have gone un-noticed as none of the patients were followed-up after discharge to a general ward. As a result, the overall in-hospital incidence of arrhythmias in these cohorts remains unknown.

A small prospective series of consecutive patients undergoing elective open large bowel resection found that 21% developed a postoperative arrhythmia.[5] The 51 patients in this study underwent daily ECGs throughout their postoperative hospital stay. Continuous cardiac monitoring was only performed when the patients were in a critical care unit. Once again, some arrhythmias may have been missed.

With respect to major vascular surgery, postoperative atrial fibrillation affects 10–20% of patients, although both of these cohorts included operations of the proximal, *i.e.* thoracic aorta.[13,14] Thoracic aortic surgery involves disruption of the aortic fat pad, leading to a reduction in cardiac vagal tone which may predispose these patients to postoperative arrhythmias.[14] Both series were retrospective. Continuous cardiac monitoring was used. However, the only arrhythmia considered was atrial fibrillation. Other supraventricular arrhythmias were not recorded. Another study of 8 major vascular patients found that almost all had brief periods of supraventricular or ventricular ectopy on postoperative Holter monitoring, though there were no major sustained rhythm disturbances.[15]

Table 1 Rates of arrhythmias in prospective cohort series

	Series (first author) T							Totals
	Polanczyk[8]	Goldman[7]	Brathwaite[6]	Batra[4]	Valentine[13]	Bender[12]	Walsh[5]	
Total patients	4181	916	462	226	211	206	51	6253
Atrial fibrillation	171	17	31	20	21	9	7	276 (4.41%)
Atrial flutter	51	5	0	0	–	3	0	59 (0.94%)
Paroxysmal atrial tachycardia	14	4	0	1	–	0	0	19 (0.3%)
Multifocal atrial tachycardia	10	3	1	7	–	0	0	21 (0.4%)
Paroxysmal supraventricular tachycardia	156	6	15	0	–	16	4	197 (3%)
Ventricular ectopics	–	–	–	18	–	–	1	19 (0.3%)
Ventricular tachycardia	–	–	–	7	–	–	1	8 (0.13%)
Ventricular fibrillation	–	–	–	1	–	–	0	1 (0.02%)
Any dysrhythmia	317	35	47	29	21	28	13	490 (7.84%)

Types of arrhythmias

The majority of arrhythmias are supraventricular in origin (Table 1). Atrial fibrillation (AF) is the single most common arrhythmia encountered, affecting just over 4% of patients following major non-cardiothoracic surgery. About 3% of patients develop paroxysmal supraventricular tachycardia while small numbers develop other atrial arrhythmias such as paroxysmal or multifocal atrial tachycardias. The pooled data suggest that ventricular arrhythmias are rare. However, only the two small series from the UK[4,5] provided data regarding ventricular arrhythmias, so the pooled results may be misleading in this area. Restricting the analysis to these two series only suggests that ventricular arrhythmias affect about 10%, although most of these are simple ectopics. Malignant ventricular arrhythmias (fibrillation or tachycardia) occurred in 3% of the patients in these two series.[4,5]

Clinical significance of arrhythmias

Arrhythmias following cardiothoracic surgery are thought to result from direct mechanical irritation of the pericardium or myocardium. Obviously, such a mechanism cannot account for the observed incidence in major non-cardiothoracic surgery. Surgery and anaesthesia produce a stress response characterised by increased sympathetic and hormonal activity[16,17] which may predispose the patient to arrhythmias. However, activation of inflammatory pathways may account for some of the arrhythmias. Recent data suggest that atrial fibrillation may be triggered and maintained by an inflammatory mechanism.[18] The use of cardiopulmonary bypass is associated with a systemic inflammatory response and activation of the complement cascade that may result in arrhythmias.[19] Similar inflammatory responses are observed after major non-cardiothoracic surgery.[20,21] Arrhythmias occur most often in the first 4 days after surgery[5,8], co-inciding with the period of maximal inflammatory response.[19]

The magnitude of the inflammatory response to any type of surgery is proportional to the magnitude of the surgery.[22] The inflammatory response may be exacerbated by the development of complications such as sepsis. Given this, it is unsurprising that most authors have found significant associations between postoperative arrhythmias and other complications. In fact, Goldman[7] observed that the development of new-onset SVA appeared dependent on the presence of concurrent postoperative complications with very few patients developing idiopathic arrhythmias.

ARRHYTHMIAS AND SEPSIS

A number of authors have observed an association between sepsis and arrhythmias. Kirkpatrick *et al.*[21] reported three patients in whom an arrhythmia was the initial presenting feature of an anastomotic leak. Goldman[7] noted that major infection was present in 31% and was felt to be the major precipitant in 26% of SVA patients. Polanczyk *et al.*[8] also noted a strong association with septic complications. Arrhythmia patients had a relative risk (RR) of bacterial pneumonia of 7.4 (95% confidence interval [CI] 5.5–9.9). They also had an increased risk of bacteraemia (RR 6.2; 95% CI 4.0–9.7).[8] Several other series also found that 20–30% of arrhythmia patients had underlying sepsis,[4,5,12,13] most often in the lower respiratory tract.[4,5,13]

ARRHYTHMIAS AND OTHER CARDIAC COMPLICATIONS

Arrhythmias may also herald other cardiac complications. However, the data suggest that underlying cardiac morbidity such as myocardial infarction is less common than underlying sepsis in these patients. Polanczyk *et al.*[8] reported an increased incidence of myocardial infarction in SVA patients. The relative risk was 4.2 (95% CI 2.7–6.6). This is considerably less than the relative risks for either bacterial pneumonia or bacteraemia. Myocardial ischaemia in the absence of infarction (RR 3.3; 95% CI 2.6–4.2) and congestive cardiac failure (RR 3.9; 95% CI 2.9–5.3) also occurred less often than sepsis.[8] In Goldman's series,[7] myocardial infarction (MI) was thought to be the primary precipitant of SVA in 4 patients while pneumonia triggered arrhythmias in another 4. An antecedent MI accounted for only 3 of 22 episodes of atrial fibrillation following aortic surgery[13] while sepsis accounted for 4 episodes in this cohort. However, pulmonary oedema was the initiating insult in 8 of 22. Similarly, pulmonary oedema was found to be more frequent in patients developing new arrhythmias following elective open colorectal resection,[5] although this series lacks sufficient power (n = 51) to rule out an association with sepsis.

ARRHYTHMIAS AND BIOCHEMICAL DISTURBANCES

Few postoperative arrhythmias are a direct consequence of electrolyte derangement alone. Goldman[7] identified a metabolic derangement as the main precipitant in only one patient. The derangement in question was a marked metabolic acidosis. In this series, hypokalaemia may have been a contributory factor but not the main precipitant in 5 patients.[7] Unfortunately, Polanczyk *et al.*[8] did not provide electrolyte data in their otherwise exhaustive analysis. Batra *et al.*[4] noted that about one-third of patients with new arrhythmias had abnormal magnesium, sodium or potassium levels. Patients with new arrhythmias following colorectal surgery also have lower sodium and potassium levels.[5] From the limited information available, it appears that metabolic derangements are relatively common in arrhythmia patients but are usually a contributory cause rather than the sole precipitant of the arrhythmia.

OTHER COMPLICATIONS

Other complications reported to co-exist in arrhythmia patients include peritonitis,[7,12] anaemia,[7] cardiac tamponade,[7]

hypoxia,[7] wound infection,[8] urinary tract infection,[8] cerebrovascular accident,[8] pulmonary emboli,[6,8,13] and gastrointestinal bleeding.[8]

EFFECT ON OUTCOME

New onset arrhythmias may affect postoperative stay and mortality. Polanczyk *et al.*[8] found that new-onset SVA was associated with an increased length of stay, even when other confounding variables were accounted for. Arrhythmia patients may be more likely to require admission to a critical care unit, although this is probably due to other concomitant complications.[5] Although Polanczyk *et al.*[8] did not report mortality, several other authors report a mortality of 20–50% in patients with new-arrhythmias.[6,7,12] Of note, the arrhythmia itself is rarely the cause of death. Instead, most patients died from another underlying complication thought to have triggered the arrhythmia.[6,7,12]

CLINICAL COURSE OF ARRHYTHMIAS

The majority of new-onset arrhythmias in non-cardiothoracic surgical patients are self-limiting. Over 80% of patients with new-onset arrhythmias revert to sinus rhythm prior to discharge.[4–7,13] In 20–30% of cases, no therapeutic intervention is required for the arrhythmia.[4,7] Haemodynamic compromise is uncommon and few patients require urgent cardioversion.[4,7] There are no data regarding the effect of new-onset SVA on long-term prognosis following non-cardiothoracic surgery.

PRE-OPERATIVE RISK FACTORS

Several authors have identified pre-operative risk factors for postoperative arrhythmias. Age,[5,7,8,11,13] male gender,[8] congestive cardiac failure,[7,8] valvular heart disease,[8] asthma,[8] history of SVA,[8] premature atrial complexes on the pre-operative electrocardiogram,[8,11] left anterior hemiblock,[11] ASA Class III or IV,[8] hypertension[5] and low pre-operative serum potassium levels[5] are all associated with an increased risk of postoperative arrhythmias.

Management

The literature contains few data pertaining to management of postoperative arrhythmias in non-cardiothoracic patients. The management of arrhythmias in the postoperative period will involve initially recognising a problem, diagnosing an arrhythmia and assessing its physiological effect on the patient. Treatment of the arrhythmia will be based on either electrical or pharmacological cardioversion. It must be emphasised that a thorough search for other underlying complications, especially sepsis, is mandatory in non-cardiothoracic surgical patients with new-onset arrhythmias. Rate or rhythm control alone is not sufficient.

It is important to recognise when a patient is very unwell. An arrhythmia may occur suddenly as a result of a cardiac event or may be a sign that a patient has become progressively unwell and is about to progress to cardiac arrest. The ALS protocol has algorithms for the treatment of bradycardia (heart rate < 40 bpm) and tachycardia (heart rate > 150 bpm). If the patient does not have a pulse, the arrest protocol should be followed.[24] The arrhythmias in this situation are divided into two groups – shockable rhythms (VT/VF) and non-shockable rhythms (asystole and PEA). The important difference in management is the need for attempted defibrillation in VT/VF.

The effects of arrhythmias in non-cardiac surgical patients are usually less dramatic. It may manifest as mild pulmonary oedema with low oxygen saturations or a low cardiac output with low blood pressure and a low urine output. Confusion is also a possibility due to a decrease in brain perfusion. These patients need care with fluid balance as well as rate/rhythm control. It is important to consider co-morbidities. Factors such as ischaemic heart disease, structural heart defects, hypertension and indeed older patient age are all associated with failure to restore sinus rhythm and difficulty with rate control.

Precipitating factors and electrolyte abnormalities should be corrected. Cardioversion may be necessary if the patient is compromised by their SVA (chest pain, hypotension, ischaemia on ECG or altered consciousness level). This should be performed in a controlled, monitored environment by a medical registrar and with the presence of an anaesthetist for sedation and airway control. In uncompromised patients, pharmacological agents may be used to achieve rate control.

The choice of pharmacological strategies depends on the patient's normal well-being, the drugs they normally take and their current physiological state. Digoxin can be used to slow the ventricular rate but there is no evidence that it is useful for converting AF to sinus rhythm[25] or maintaining it once it is established. It is important that patients already on digoxin are given a lower intravenous loading dose. Amiodarone can also be used to slow the ventricular rate. It does not restore sinus rhythm but will help to sustain it once regained. It must be given via a central line. Flecanide is the most effective drug at converting a patient to sinus rhythm but it must be used very carefully, especially if the patient has an element of left ventricular dysfunction or there are ventricular arrhythmias present. β-Blockers such as esmolol and propanalol are also drugs that should be used with caution. They are effective at controlling ventricular rate but may precipitate heart failure in patients with an impaired myocardium.[26]

Atrial fibrillation (AF) is the commonest sustained cardiac arrhythmia.[27] The UK National Institute for Health and Clinical Excellence has recently published specific guidance on the management of AF, including postoperative AF.[28] Patients who develop AF following non-cardiac surgery should be treated using the guidelines for treatment of

acute-onset AF. Electrical cardioversion should be attempted in any patient with life-threatening haemodynamic instability, regardless of the duration of their AF. In uncompromised patients with new-onset AF, electrical cardioversion is the preferred initial treatment choice. However, when a delay in organising electrical cardioversion is anticipated, amiodarone should be used. Flecainide is an alternative in patients with Wolff-Parkinson-White syndrome. A rate-control strategy is recommended for patients with known permanent AF who develop haemodynamic instability due to inadequate ventricular rate control. Pharmacological options in this situation include β-blockade or calcium antagonists. Amiodarone may be used if these prove ineffective.[28] Anti-thrombotic prophylaxis must be initiated in all patients with new-onset AF.

Conclusions

New-onset arrhythmias, most frequently atrial fibrillation, are common following major non-cardiothoracic surgery. They usually occur concomitantly with another underlying complication. There is a high associated mortality. Management should be directed towards treatment of the underlying cause and rate-control under expert medical guidance while treating the underlying cause.

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