Acute management of atrial fibrillation with rapid ventricular response

Atrial fibrillation with rapid ventricular response is a common tachyarrhythmia that prompts emergency hospital admission and also frequently arises during general medical admissions. The incidence of atrial fibrillation ranges between 0.21 and 0.41 per 1000 person/years and is projected to rise in the future (Ball et al, 2013; Zoni-Berisso et al, 2014). Despite significant progress in the management of atrial fibrillation, it remains a major cause of heart failure, cardiovascular morbidity and sudden death across the globe. Of particular note, the risk and severity of thromboembolic events is greatly increased causing significant morbidity and mortality.

This article provides an evidence-based practical guide for junior doctors on the management of atrial fibrillation with rapid ventricular response in the acute medical setting.

Establishing a diagnosis

It is important to recognize atrial fibrillation early. Common presenting symptoms of atrial fibrillation with rapid ventricular response include palpitations, dyspnoea, chest pain and dizziness (Rienstra et al, 2012).

Patients presenting with these symptoms should have 3-lead monitoring in an appropriate resuscitation area or acute medical unit. Combined with clinical examination this may be sufficient for detection of an irregular rhythm. Atrial fibrillation can then be confirmed by performing a 12-lead electrocardiogram but may be difficult to distinguish from other supraventricular tachycardias (*Table 1*). Distinguishing features include the irregularly irregular variation in the RR interval and the absence of discernible p waves. These can be subtle at a higher heart rate and may be unmasked by vasovagal manoeuvres or administration of intravenous adenosine as per the Resuscitation Council (UK) adult tachycardia algorithm (Rescuscitation Council (UK), 2015). The electrocardiogram can provide additional important information such as signs of conduction defects, ischaemic changes and structural heart disease.

Table 1. Differential diagnoses of atrial fibrillation: the supraventricular tachycardias

Regular tachycardia	Sinus tachycardia
	Sinus nodal re-entrant tachycardia
	Atrial tachycardia
	Atrioventricular nodal re-entrant tachycardia
	Atrioventricular re-entrant tachycardia
Irregular tachycardia	Atrial fibrillation
	Atrial flutter with variable block
	Sinus rhythm with frequent ectopic beats
	Multifocal atrial tachycardia

Goals of initial management

Once a diagnosis of atrial fibrillation with rapid ventricular response has been established, there are several priorities for initial management: assessing and addressing haemodynamic instability if present, identifying and treating any underlying cause, achieving rate control and establishing anticoagulation if applicable (*Figure 1*).

Assess and address haemodynamic instability

Following a diagnosis of atrial fibrillation with rapid ventricular response, haemodynamic status should be assessed. Features consistent with haemodynamic compromise include hypotension, heart failure, myocardial ischaemia and loss of consciousness. Where correctable factors are identified, such as hypovolaemia or hypoxia, these should be addressed immediately. If still compromised, urgent synchronised direct current electrical cardioversion under general anaesthesia or sedation is indicated (Resuscitation Council (UK), 2015). Continuous monitoring of blood pressure and oximetry during the procedure is recommended (Furniss and Sneyd, 2015) and intravenous atropine or temporary transcutaneous pacing should be available to mitigate post-cardioversion bradycardia.

In the absence of adverse features or for individuals who have been in atrial fibrillation for more than 48 hours, electrical cardioversion should be avoided until oral anticoagulation therapy has been established for at least 3 weeks (Camm et al, 2010), given the risk of thromboembolic stroke following cardioversion in non-anticoagulated patients (Stellbrink et al, 2004; Hansen et al, 2015). At least 4 weeks of therapeutic anticoagulation is recommended after successful cardioversion to normal sinus rhythm. Should electrical cardioversion be unsuccessful, expert help should be sought and pharmacological agents such as amiodarone may be considered.

Identify and treat the underlying cause

Upon diagnosing atrial fibrillation with rapid ventricular response in the acute setting, emphasis should be placed on identifying and treating the underlying cause where possible (*Table 2*). Common causes of atrial fibrillation with rapid ventricular response include recent heavy alcohol intake, acute coronary ischaemia, valvular heart disease, electrolyte imbalance, hyperthyroidism and infection (Iqbal et al, 2005). Correction of an underlying cause has the potential to

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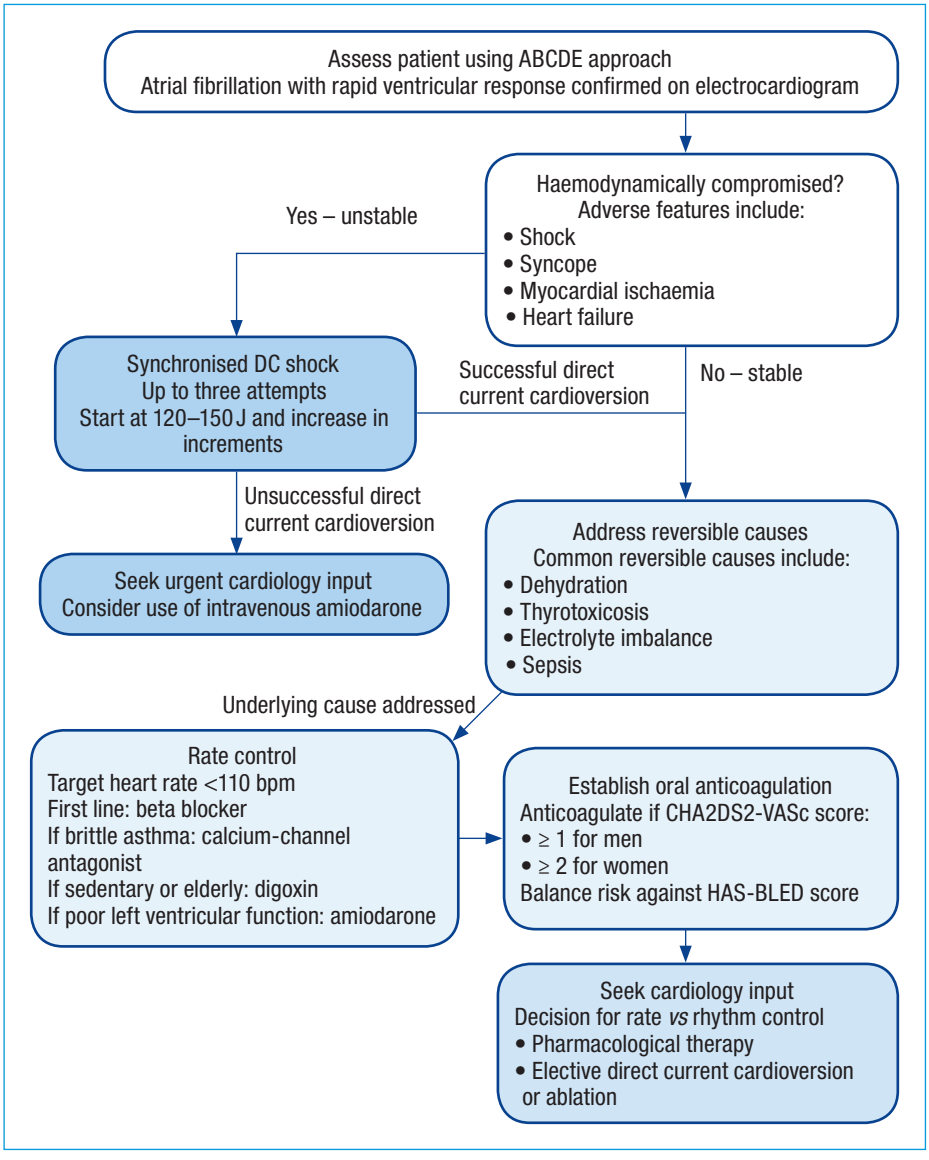

Figure 1. Algorithm for managing atrial fibrillation with rapid ventricular response.

Table 2. Causes of atrial fibrillation

Chronic causes	Cardiomyopathy
	Chronic kidney disease
	Chronic obstructive pulmonary disease
	Congenital heart disease
	Heart failure
	Hypertension
	Ischaemic heart disease
	Obesity
	Obstructive sleep apnoea
	Old age
	Valvular heart disease
Acutely reversible causes	Heavy episodic alcohol intake >8 units/sitting
	Hypothermia
	Low potassium, magnesium or calcium
	Pneumonia
	Pulmonary embolism
	Thyrotoxicosis or hypothyroidism

spontaneously revert atrial fibrillation into sinus rhythm or may allow rate control (National Institute for Health and Care Excellence, 2014). If rate control is pursued without addressing reversible causes, medications could cause further clinical deterioration. For example, the use of beta blockers in the context of sepsis can cause worsening organ hypoperfusion by blocking the physiological tachycardic response.

A number of important investigations should be considered at an early stage to assess for reversible causes (Ramrakha and Hill, 2012). As well as the electrocardiogram, key blood tests include full blood count and C-reactive protein level to suggest an infective precipitant, thyroid function test to assess for thyrotoxicosis, and urea and electrolytes to identify electrolyte imbalance. Troponin should be considered if there is strong suspicion of concomitant acute coronary syndrome. Mild troponin elevation can be observed in atrial fibrillation with rapid ventricular response, which is often attributable to the tachycardia. A chest radiograph should be performed to assess for cardiomegaly, pulmonary oedema, respiratory tract infection or valve calcification.

A transthoracic echocardiogram may be requested, ideally when adequately rate controlled, to establish left ventricular function and identify valvular lesions or pericardial effusion. After receiving cardiology specialty input, a transoesophageal echocardiogram may be considered immediately before direct current cardioversion, to exclude intracardiac thrombus, if this procedure is to be performed as an inpatient. Left atrial size is an important predictor of likely future maintenance of sinus rhythm.

Achieving rate control

The ventricular rate during atrial fibrillation is determined by the intrinsic conduction characteristics of the atrioventricular node, sympathetic and parasympathetic activity. The aim of rate control is to reduce symptoms, improve haemodynamics, prevent heart failure and reduce the risk of adverse cardiovascular outcomes (Van Gelder et al, 2016). A number of drugs are widely used to reduce ventricular rate during atrial fibrillation: beta blockers, non-dihydropyridine calcium-channel antagonists, cardiac glycosides and amiodarone. The choice of rate-controlling drugs, alone or in combination, depends upon symptoms, comorbidities and potential side effects.

Beta blockers

Beta blockers act by blocking sympathetic activity in the atrioventricular node to slow ventricular rate. They are often used as the first-line rate-controlling agent based on the

TOP TIPS

- Establishing an early diagnosis is key. Obtain a 12-lead electrocardiogram for any patient who presents with palpitations, dyspnoea, chest pain and dizziness.
- Call for expert help at an early stage, particularly in those who appear haemodynamically compromised.
- Be aware of the broad range of reversible causes of atrial fibrillation and order investigations accordingly.
- Have a low threshold for starting oral anticoagulation once a patient has been stabilized.

potential for symptomatic improvement, relative safety and good tolerability profile across all ages (Kirchhof et al, 2016). Acute side effects include bronchoconstriction and hypotension. Use of cardioselective beta blockers is not contraindicated in patients with asthma or chronic obstructive pulmonary disease (Lipworth et al, 2016; Morales et al, 2017), but they are relatively contraindicated in patients with brittle asthma. Oral bisoprolol 2.5–5 mg or intravenous metoprolol 2.5–5 mg for faster onset of action is recommended as an appropriate starting point.

Calcium-channel blockers

Non-dihydropyridine calcium-channel antagonists, such as verapamil and diltiazem, slow atrioventricular node conduction by blocking calcium channels, thereby increasing the refractory period of the atrioventricular node. They should be avoided in patients who have accessory pathways (e.g. Wolff–Parkinson–White syndrome), cardiogenic shock or a history of heart failure. Overall, verapamil and diltiazem are considered effective second-line rate-controlling agents for those who cannot tolerate beta blockers. An intravenous bolus of verapamil 5–10 mg is suggested. For oral preparations, verapamil 40 mg or diltiazem 60 mg are recommended.

Cardiac glycosides

Cardiac glycosides such as digoxin have been used for almost 100 years to regulate heart rate in atrial fibrillation. The mechanism of action is threefold:

1. They have a positive inotropic effect
2. They slow activity at the sinoatrial node and prolong conduction at the atrioventricular node, thereby decreasing heart rate
3. They have a tonic parasympathetic effect.

Digoxin is contraindicated in those who have accessory pathways (e.g. Wolff–Parkinson–White syndrome) or evidence of ventricular arrhythmias. Digoxin is cleared by the kidney, has a narrow therapeutic window and interacts with many other drugs (including verapamil and certain antibiotics). It is more suitable for the elderly, or those who have sedentary lifestyles since it is less effective during exercise or in conditions with high sympathetic drive (National Institute for Health and Care Excellence, 2014). Use of digoxin may provide additional benefit to patients with concomitant heart failure with reduced ejection fraction (Ambrosy et al, 2016). An initial intravenous bolus of 0.75–1.5 mg in divided doses over 24 hours is recommended before conversion to an oral maintenance regimen.

Amiodarone

Amiodarone can be useful for rate control if atrial fibrillation with rapid ventricular response remains refractory to initial treatment. It has a wide range of adverse extracardiac effects which renders it a reserve agent in those whose heart rate cannot be controlled with combination therapy (beta blocker, verapamil or diltiazem combined with digoxin). Amiodarone is particularly useful for those with poor left ventricular function. However, caution should be exercised when using the intravenous formulation, the constituents of which may precipitate a drop in blood pressure (Cushing et al, 2010).

Choice of regimen

The choice of initial rate controlling regimen, whether as monotherapy or in combination, should be made on an individual basis and after consideration of patient characteristics. All therapies have the potential for adverse side effects and patients should initially be treated with a low dose that is uptitrated to achieve symptomatic improvement. For more information regarding medication subtypes, routes of administration and dosing, trainees are encouraged to read the article by Van Gelder et al (2016).

The optimal target heart rate in patients with atrial fibrillation remains unclear. The results from the RACE (Rate Control Efficacy in Permanent Atrial Fibrillation) II study found no difference in a composite of clinical events between strict rate control (<80 bpm) and lenient rate control (<110 bpm) (Van Gelder et al, 2010). The European Society of Cardiology guidelines (Kirchhof et al, 2016) have subsequently adopted a more lenient initial rate control approach. This is particularly relevant for patients who are septic or highly scoring on the National Early Warning Score chart, where strict rate control may be associated with adverse outcomes. It is worth noting that even with adequate rate control, patients may still be severely symptomatic, requiring additional management. Therefore, in the acute medical setting, it is sensible to aim for a target heart rate that is also guided by patient symptoms.

Evaluating anticoagulation considerations

Once a patient with atrial fibrillation has been stabilized, initiation of stroke prevention therapy should be a priority. Oral anticoagulation therapy can prevent the majority of ischaemic strokes in patients with atrial fibrillation and has a proven prognostic benefit (Ruff et al, 2014). The considerable risk of stroke without oral anticoagulation often exceeds the bleeding risk from oral anticoagulation therapy, even in those who are elderly, have cognitive dysfunction, frequently fall or are frail (Donzé et al, 2012).

The introduction of the CHA2DS2-VASc score (*Table 3*) and subsequent incorporation into European Society of Cardiology (Kirchhof et al, 2016) and National Institute for Health and Care Excellence (2014) guidelines has made it easier to identify those who should be on oral anticoagulation. This can be balanced against the risk of bleeding, which can be assessed using the HAS-BLED score (*Table 4*). The European Society of Cardiology (Kirchhof et al, 2016) and National Institute for Health and Care Excellence (2014) guidelines state that the HAS-BLED scoring system should not be used to rule out oral anticoagulation, but rather to identify and address modifiable bleeding risk factors.

Long-term goals

Once approaching discharge, a decision should be made about whether to pursue a rate or rhythm control strategy for symptomatic control in the long term. Thereafter, various approaches can be taken to attempt conversion to and maintenance of sinus rhythm, such as elective outpatient direct current cardioversion or catheter ablation. These considerations are beyond the scope of this article, which focuses on stabilizing those in atrial fibrillation with rapid ventricular response in the acute medical setting. Trainees are encouraged to review

Table 3. The CHA2DS2-VASc scoring system

Risk factors	Score
Congestive heart failure	1
Hypertension	1
Age >75 years	2
Age 65–74 years	1
Diabetes mellitus	1
Previous stroke, transient ischaemic attack or thrombo-embolism	2
Vascular disease	1
Sex female	1

Anticoagulation should be initiated for those with a CHA2DS2-VASc of 1 or more for men, and 2 or more for women (National Institute for Health and Care Excellence, 2014).

Table 4. The HAS-BLED scoring system

Risk factors	Score
Hypertension (>160 mmHg systolic)	1
Abnormal liver function	1
Abnormal renal function	1
Stroke	1
Bleeding history or disposition	1
Labile international normalised ratio	1
Elderly (age >65 years)	1
Drugs (non-steroidal anti-inflammatory drugs or antiplatelets)	1

A HAS-BLED score of 3 or more indicates a high risk of bleeding

KEY POINTS

- Atrial fibrillation with rapid ventricular response is a common tachyarrhythmia with substantial cardiovascular morbidity and mortality.
- Common presenting symptoms include palpitations, dyspnoea, chest pain and dizziness. It is important to remember that up to a third of patients with atrial fibrillation may remain asymptomatic.
- Early management should focus on addressing haemodynamic instability, treating reversible causes, achieving rate control and establishing anticoagulation.
- Beta blockers, calcium-channel antagonists, digoxin and amiodarone are commonly used to reduce ventricular rate in atrial fibrillation.
- A more lenient approach to rate control is acceptable in the acute setting and can be guided by symptoms.
- Once a patient has been stabilized, there is significant prognostic benefit to starting oral anticoagulation therapy.
- A decision should be made regarding long-term rate or rhythm control strategy depending on a patient's characteristics, symptoms and comorbidities.

the National Institute for Health and Care Excellence (2014) and European Society of Cardiology guidelines (Kirchhof et al, 2016) for further information regarding ongoing management.

Conclusions

Atrial fibrillation with rapid ventricular response is a common tachyarrhythmia that carries substantial cardiovascular morbidity and is often difficult to manage in the acute medical setting. Early diagnosis is important to facilitate effective management. Initial goals of management include haemodynamically stabilizing the patient, treating any reversible causes, achieving rate control and establishing anticoagulation. Once these issues have been addressed, a long-term rate or rhythm control strategy can be implemented, depending on a patient's characteristics, symptoms and comorbidities. **BJHM**

Conflict of interest: none.

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