Chapter 4
Emergency Medical Services and Atrial Fibrillation

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Introduction

Emergency medical services (EMS) personnel frequently encounter patients with atrial fibrillation (AF). Atrial fibrillation is an irregularly irregular rhythm which is generated by multiple foci originating above the ventricles in the atria. Approximately 3–6 million residents of the United States have atrial fibrillation [1, 2], accounting for around 270,000 emergency department visits per year [3]. Many of these patients will be transported to the emergency department by emergency medical services (EMS). Therefore, it is prudent that prehospital providers be familiar with how to approach AF in the field.

Field Assessment

The prehospital provider has a limited number of diagnostic tools and therapeutic options to detect and care for the patient with atrial fibrillation. Luckily, teaching an EMS provider to detect AF is not difficult, as this is nearly always the cause of a

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cardiac rhythm that is *irregularly irregular*. As this term is almost pathognomonic for AF and is eminently teachable, this rhythm is easily learned by prehospital providers.

EMS Scope of Practice

It is important to define the scope of practice for prehospital providers. In the United States, several levels of EMS providers exist. These are largely determined by state laws and may be broadly divided into two groups, those that provide Basic Life Support (BLS) and those that provide Advanced Life Support (ALS). Within this dichotomy, many other levels may exist (intermediate, EMT-1, EMT-2, etc.). Differences between these levels depend upon the scope of practice at the national level as well as state, regional, and local protocols. Often those at the BLS level have few interventions to offer to the patient in AF. ALS providers will be able to utilize Advanced Cardiac Life Support (ACLS) protocols.

All providers, no matter their level, should have an understanding of atrial fibrillation and that atrial fibrillation is the most likely origin of a patient in an irregularly irregular heart rhythm on their physical assessment. A BLS provider should, at the very least, recognize this as an abnormal pulse rate and/or rhythm.

Chief Complaint

Patients with atrial fibrillation have a wide variety of primary complaints on evaluation. These can be wide ranging and include palpitations, an elevated heart rate, shortness of breath, chest pain, and weakness.

Physical Examination

Field providers are educated from an early point in their training to perform a careful, yet focused, physical examination. At all levels, this includes taking a pulse, including its inherent rhythm. This is one possible place providers may identify atrial fibrillation, with detection of an irregularly irregular rhythm. Most providers are also taught to evaluate signs of normal vs. altered perfusion including skin temperature, capillary refill, and mental status. Other common physical findings in atrial fibrillation include pale and diaphoretic skin, labored breathing, and jugular venous distention. Determining these findings will help the EMS providers in their evaluation of the patient with atrial fibrillation.

ECG

The 12-lead electrocardiogram (ECG) is the mainstay of diagnosis of atrial fibrillation and should be obtained on every patient. Atrial fibrillation is defined as an irregular R-R interval. Advanced Life Support providers were able to detect atrial fibrillation 71–86 % of the time on 3-lead interpretation examination [4, 5]. While a 3-lead, 4-lead, or 5-lead are often used to detect dynamic changes in the patient's condition, the formal 12-lead ECG is critical to evaluate for potential underlying causes of atrial fibrillation, including acute myocardial infarction.

The EMS Challenge

Interventions

Specific interventions for the patient in atrial fibrillation will vary by the level of the provider, the protocols in effect, and the clinical condition of the patient. Included in this section is a broad cross section of the available treatments. Emergency medical services physician leadership should be heavily involved in the development and refinement of local prehospital treatment protocols and guidelines. If prehospital intervention is warranted, it is focused on rate control in symptomatic patients and rhythm control in unstable patients. Rate control is first considered when AF is accompanied by rapid ventricular response (RVR) defined as a ventricular rate >100 bpm.

General treatment as indicated in the prehospital setting would include:

- Peripheral IV
- 12-lead ECG and continuous cardiac monitoring
- Rate control with either calcium channel-blocking or beta-blocking agent if indicated (not usually required if rate is <140 and hemodynamically stable)
- Cardioversion if patient is hemodynamically unstable (hypotension or signs of hypoperfusion)

Aspirin

Aspirin is commonly available. It is a cheap salicylate drug that is used as an analgesic, antipyretic, and anti-inflammatory agent and most importantly an antiplatelet agent. Aspirin has been shown to significantly decrease mortality in patients with acute myocardial infarction [6]. Some of these patients are in AF secondary to acute ischemia. They may present with chest pain or other possible cardiac complaints. EMS providers are often requested or required per local protocol to treat these patients with aspirin. Anticoagulation in AF will be discussed in more detail in Chap. 9.

Pharmacologic Rate Control

Calcium Channel Blockers

Diltiazem is the most commonly utilized calcium channel blocker for managing narrow complex atrial fibrillation with rapid ventricular response. Diltiazem has been found to lower heart rate in patients with atrial fibrillation with a ventricular response rate over 150 beats per minute when compared with non-pharmacologic treatment. In one study by Wang et al., 81 % of patients were found to have a therapeutic response to diltiazem compared with 17 % in the control group [7]. A second study had similar findings with diltiazem having prehospital efficacy of 73 %, and only 0.7 % (2/278) of patients who received diltiazem had an episode of hypotension [8]. Therefore, diltiazem is considered to be a safe and effective intervention for patients with narrow complex AF with RVR in the prehospital environment.

Verapamil has been used for AF with RVR with success in both the emergency department and the prehospital environment. Little has been published, however, about the prehospital use of verapamil. However, based on pharmacologic similarities, emergency department use, as well as EMS use, it would also be presumed to be an effective treatment choice.

Beta Blockers

No placebo-controlled studies of beta blockade for the treatment of atrial fibrillation with rapid ventricular response in the prehospital environment are available. Metoprolol is the most commonly utilized beta blocker for atrial fibrillation in the hospital setting [9]. Head-to-head trials in the emergency department, however, have been performed.

Calcium Channel Blocker Versus Beta Blocker

While no prehospital studies have been performed, there are several emergency department studies examining calcium channel blockers and beta blockers head to head. Demircan et al. randomized 40 patients to weight-based doses of either diltiazem or metoprolol for atrial fibrillation with heart rate greater than 120 beats per minute. They found diltiazem to have better and earlier heart rate control with a similar side effect profile [10]. Fromm et al. randomized 54 patients to a similar regimen; in 30 min, 95 % of the diltiazem group and 46 % of the metoprolol group had reached target heart rates with no difference in rates of hypotension or bradycardia [11]. While these studies are emergency department based, the pharmacology likely is similar in the prehospital environment. These two randomized clinical

trials are the only high-quality evidence available to base recommendations on calcium channel blockade, specifically diltiazem, over beta blockade as a strategy to treat atrial fibrillation with rapid ventricular response.

It is unadvisable to utilize both beta-blocking and calcium channel-blocking agents simultaneously. Blocking both beta receptors and calcium channels can lead to negative chronotropic, inotropic, and dromotropic effects [12]. The combination, when administered to healthy volunteers, significantly lowered heart rate, compared to either alone. However, the combined drug administration also significantly increased adverse effects, most notably fatigue and first-degree heart block [12].

Adenosine

Some EMS systems allow for prehospital treatment of supraventricular tachycardia (SVT) with adenosine. Adenosine blocks conduction through the AV node. Care must be taken to instruct ALS providers about the risks of this strategy, namely, that if SVT is incorrectly diagnosed, significant adverse outcomes can result. Haynes reported two cases of atrial fibrillation that became fatal when adenosine was used to treat presumed SVT [13]. Gupta et al. described four emergency department patients that went into a ventricular tachycardia after administration of adenosine for presumed SVT that was later found to be atrial fibrillation [14]. These cases likely represent atrial fibrillation in the presence of accessory conduction pathways, also known as Wolff–Parkinson–White (WPW) syndrome. Patients with WPW syndrome will frequently decompensate when adenosine is administered as their accessory conduction pathway takes over and their ventricular rate elevates into the 200s with increasing hemodynamic instability. For this reason, adenosine is generally avoided in cases of atrial fibrillation or irregularly irregular tachycardic patient.

Electrical Rate Control

Cardioversion/Defibrillation

Patients that are in atrial fibrillation and are hemodynamically unstable may require cardioversion. Electrical cardioversion for atrial fibrillation was first described in the 1960s [15]. Atrial fibrillation in a hemodynamically unstable patient should be treated with synchronized cardioversion, where possible, using a biphasic waveform. In a double-blind randomized trial of elective cardioversion, a biphasic waveform was found to be superior to a monophasic waveform [16]. Sedation for cardioversion is outside the scope of this chapter but will be discussed in detail in Chap. 11 of this book. Generally, sedation for cardioversion is recommended whenever possible, for patient comfort. Indications for defibrillation or non-synchronized cardioversion are discussed in Chap. 10.

Conclusions

Atrial fibrillation is a disorder commonly encountered in the prehospital environment. EMS providers play a vital role in extending the patient's care from the emergency department into the prehospital arena. This can be done despite the relatively limited resources in the prehospital setting. Management should be focused on stabilization with rate control using calcium channel blockers or beta blocker therapy with cardioversion reserved for only hemodynamically unstable patients. Through earlier access to advanced therapies, patients may have improved outcomes.

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