The Management of Atrial Flutter

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CONTENTS

Historical Perspectives
Incidence
A Review of Right Atrial Anatomy
Electrocardiographic Features
Mechanism of Atrial Flutter
Treatment of Atrial Flutter
Conclusion
References

HISTORICAL PERSPECTIVES

Atrial flutter was first described in 1911 by Jolly and Ritchie (1), who differentiated this arrhythmia from atrial fibrillation (AF) and reported the typical saw-tooth-shaped atrial waves in leads II and III. Early insight into atrial flutter was facilitated by Lewis, who defined the electrocardiographic findings and through a series of animal experiments concluded that the arrhythmia resulted from circus movement around one or both caval orifices (2–4).

After five decades of debate over the mechanism of atrial flutter between proponents of a single-focus theory and those favoring reentry (5), it is now clear that atrial flutter arises from a single macroreentry circuit confined to the right atrium. This theory has been supported by animal studies and confirmed over the last two decades in humans via electrophysiologic studies utilizing detailed multiple electrode pace mapping and entrainment mapping techniques (6–17). In typical atrial flutter, the anatomic barriers within the right atrium have mostly been defined (18–20). The circuit depends on an area of slow conduction within the inferior, medial right atrium between the inferior vena cava (IVC) and the tricuspid valve (16,21–24). This anatomic zone of slow conduction is the target of modern ablation techniques.

INCIDENCE

Atrial flutter is a relatively rare arrhythmia in comparison to AF. Both arrhythmias share a very similar clinical profile, and often coexist within the same individual.
Because of their similarities, they are often combined together in studies reporting incidence and treatment efficacy. Therefore, there is insufficient independent data on the incidence of atrial flutter and its response to pharmacologic therapy. In one retrospective analysis of ICD-9 (i.e., billing) codes for atrial flutter in 54,000 patients in the Marshfield Epidemiologic Study Area, there was an annual incidence rate of 0.9 per 1000 patients. The annual incidence rate was 7.3 per 1000 patients greater than 80 yr of age. It is estimated that there are approx 200,000 new cases of atrial flutter in the United States per year (25).

Atrial flutter is commonly associated with AF, and may often coexist in some patients, occasionally simultaneously, manifesting as “flutter-fibrillation.” Atrial flutter often complicates the postoperative management of patients who have undergone cardiac surgery. It has an association with chronic obstructive pulmonary disease (COPD), thyrotoxicosis, structural heart disease including mitral or tricuspid valve disease, atrial enlargement of any etiology, and surgical correction of congenital heart disease (26–29).

A REVIEW OF RIGHT ATRIAL ANATOMY

Because atrial flutter is usually confined to the right atrium, an appreciation of the anatomy of the endocardial surface of the right atrium is essential. The interior surface of the right atrium can be divided into three regions: a smooth-walled venous component derived from the embryonic sinus venosus; a trabeculated atrium proper; and the right atrial appendage (33).

The crista terminalis is a ridge on the internal surface of the right atrium which is located lateral to the superior vena cava (SVC) and IVC. It separates the venous component from the trabeculated atrium. The venous component of the right atrium receives the superior and inferior vena cavae posterior to the crista terminalis as well as the coronary sinus (CS).

Located anterior and medial to the orifice of the IVC is the Eustachian valve (EV). The EV, if present, is the remnant of an embryonic baffle that shunted blood from the IVC (oxygenated from the placenta) into the left atrium via the foramen ovale. The lateral portion of the EV continuous with the inferior portion of the crista terminalis. The Eustachian ridge continues inferiorly and anteriorly to the atrial septum between the orifice of the IVC and tricuspid annulus. The CS runs in the left atrioventricular groove, and its ostium is in the interior medial right atrium, posterior to the tricuspid annulus (33) (see Fig. 1).

The macroreentrant circuit of typical atrial flutter is dependent on an isthmus or zone of slow conduction, which lies between the IVC and the tricuspid annulus. The posterior barrier of the circuit is the crista terminalis, EV, and Eustachian ridge. The anterior barrier is the tricuspid annulus. In counterclockwise typical atrial flutter, the circuit moves through the isthmus of slow conduction, up the intra-atrial septum, over the superior vena cavae, down the lateral wall, and through the isthmus, thus completing the loop.

In clockwise typical atrial flutter, the circuit is bound by the same barriers and is also dependent on the isthmus of slow conduction. The direction of rotation is up the lateral wall, over the SVC, down the intra-atrial septum, through the isthmus, and up the lateral wall, thus continuing the loop. In both counterclockwise and clockwise