

# Postoperative Atrial Fibrillation

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## KEYWORDS

- Atrial fibrillation • Arrhythmia
- Postoperative • Antiarrhythmic • Surgery

The incidence of atrial fibrillation (AF) in the general population is estimated as 0.4% in patients younger than 70 years, and 2% to 4% in older patients.<sup>1</sup> The incidence of AF is higher in patients with cardiovascular disease. The Cardiovascular Health Study demonstrated that the prevalence of AF was 9.1%, 4.6%, and 1.6% in patients with clinical, subclinical and no cardiovascular disease, respectively.<sup>2</sup> Atrial arrhythmias occur frequently after major cardiothoracic surgery and result in increased morbidity and length of hospital stay.<sup>3–6</sup> The prevalence of atrial arrhythmias after cardiac surgery has been reported to vary between 10% and 65%,<sup>4,7–27</sup> depending on type and technique of surgery, patient characteristics, method of arrhythmia surveillance, and definition of arrhythmia. Postoperative AF may occur in up to 40% of patients undergoing coronary artery bypass surgery,<sup>28–31</sup> 35% to 40% after valvular surgery,<sup>13,28,32</sup> 60% after combined coronary artery bypass graft (CABG) and valve surgery, and 11% to 24% after cardiac transplantation.<sup>13,33</sup> In a large, multicenter, international cohort study, the majority of the initial episodes of AF occurred within the first few (2–5) days after CABG surgery (**Fig. 1**).<sup>29</sup>

## PATHOGENESIS

The electrophysiologic mechanisms of AF after cardiac surgery are not yet well understood. However, preexisting atrial substrate, such as atrial fibrosis or dilatation may predispose to atrial fibrillation.<sup>34</sup> Perioperative factors, such as atrial injury or ischemia, inflammation, increase in adrenergic tone, catecholamines, atrial stretch from volume overload, or electrolyte disturbances, may trigger

postoperative AF in patients who are susceptible to AF through dispersion of atrial refractoriness,<sup>35,36</sup> nonuniform atrial conduction,<sup>37</sup> or increased premature atrial complexes.<sup>38</sup>

Expression of proinflammatory cytokines and activation of oxidases with an increase in oxidative stress have also been implicated in the genesis of postoperative AF.<sup>39–46</sup> Oxidative stress may decrease atrial effective refractory period and may also promote progressive fibrosis.<sup>47</sup> Consistent with these mechanisms, steroids and statins have been shown to attenuate profibrillatory effects of oxidative stress.<sup>48,49</sup>

## CLINICAL IMPLICATIONS

Postoperative AF is associated with increased incidence of postoperative complications and longer length of hospital stay.<sup>7,8,13,29,30</sup> Patients with postoperative AF are more likely to develop hypotension, pulmonary edema,<sup>19</sup> and cerebrovascular accident.<sup>7,8,13,50,51</sup> The incidence of stroke is significantly higher in patients who developed AF after cardiac surgery (3.3% versus 1.4%).<sup>13</sup> The incidence of a composite outcome, including encephalopathy, decline in Mini-Mental State Examination score, increase in National Institutes of Health Stroke Scale score, renal dysfunction, renal failure, pneumonia, mediastinitis or deep sternal wound infection, sepsis, harvest site infection, vascular catheter infection, and genitourinary infection is also higher in patients with postoperative AF (22.6% versus 15.4%).<sup>29</sup> The cost of care on patients who developed postoperative AF was increased by approximately \$10,000 per patient.<sup>30</sup>

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A version of this article originally appeared in *Medical Clinics of North America*, volume 92, issue 1. Division of Cardiovascular Medicine, Cardiovascular Center, University of Michigan, Room 2556, 1500 East Medical Center Drive, Ann Arbor, MI 48109-5853, USA

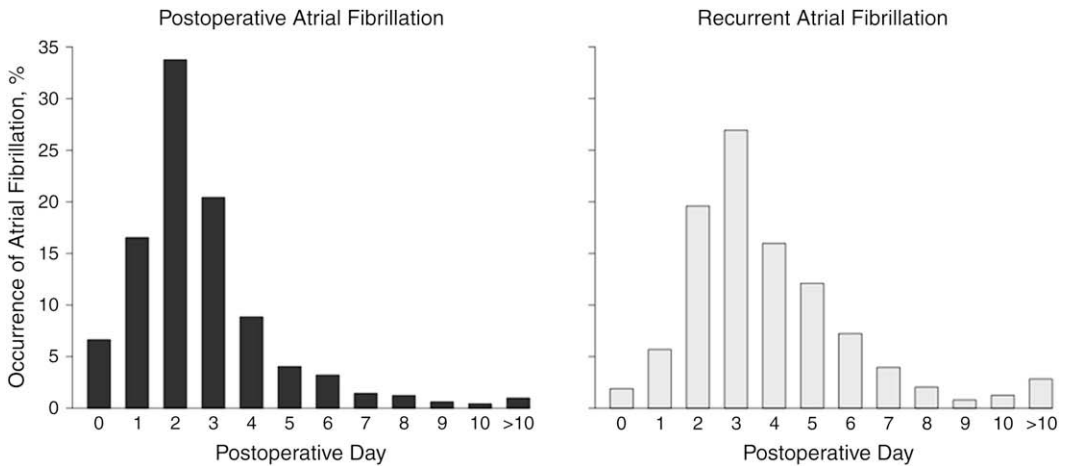
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Cardiol Clin 27 (2009) 69–78

doi:10.1016/j.ccl.2008.09.011

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The denominators are 1503 patients for postoperative atrial fibrillation and 640 for recurrent atrial fibrillation.

**Fig. 1.** Postoperative atrial fibrillation after CABG surgery was most common on postoperative day 2 (*left graph*) and recurrence was most common on postoperative day 3 (*right graph*). More than 60% of initial recurrence occurred within 2 days of first onset. (Reproduced from Mathew JP, Fontes ML, Tudor, IC, et al. A multicenter risk index for atrial fibrillation after cardiac surgery. *JAMA* 2004;291:1720; with permission.)

Postoperative AF is also associated with lower in-hospital and long-term survival. A retrospective cohort study found that patients who developed AF after CABG surgery had higher in-hospital mortality (odds ratio or OR 1.7,  $P = .0001$ ) and a decrease in survival at 4 to 5 years (74% versus 87%,  $P < .0001$ ).<sup>30</sup>

#### PREDICTORS OF ATRIAL FIBRILLATION AFTER CARDIAC SURGERY

Several clinical factors have been shown to be associated with an increased incidence of AF following cardiac surgery.<sup>28,29</sup> These include age, gender, hypertension, prior history of AF, obesity, chronic obstructive pulmonary disease (COPD), left atrial size, and left ventricular ejection fraction.<sup>52</sup>

Older age has been consistently shown in multiple studies as a predictor for postoperative AF. Every 10-year increase in age is associated with a 75% increase in the odds of developing AF and age greater than 70-years old alone is considered to be high risk.<sup>29</sup> The increase in postoperative AF in older age is likely related to degenerative changes in atrial myocardium, dilatation, and nonuniform anisotropic conduction.<sup>53</sup>

Men are more likely to develop AF after CABG surgery than women.<sup>7-9,21,27</sup> Previous history of AF also increases the risk of postoperative AF.<sup>4,11</sup> Hypertension is a predictor of AF in the general population as well as after cardiac surgery.<sup>7,8</sup> Higher body mass index has been shown to be an independent predictor for new-onset AF after cardiac surgery.<sup>52</sup> There is a strong correlation between body mass index and left atrial

enlargement.<sup>54-56</sup> Patients with COPD have been reported to have a 43% increase in the probability of developing postoperative AF,<sup>29</sup> likely because of an increase in P-wave dispersion and heterogeneity of conduction.<sup>57</sup>

#### PREVENTION

The incidence of AF after cardiac surgery is high, especially in patients with multiple risk factors described above. Although it is often transient, postoperative AF often is associated with increased morbidity and prolonged intensive care unit and hospital stay. Therefore, prophylactic therapy should be considered in all patients, particularly high risk, who are considered for cardiac surgery. Pharmacologic therapy and cardiac pacing have been evaluated in several trials.

#### Pharmacologic Prophylaxis

##### $\beta$ -adrenergic receptor antagonists

$\beta$ -adrenergic receptor antagonists alone or combined with other antiarrhythmic drugs, such as digitalis or calcium channel blockers, have been commonly used to prevent postoperative AF. Beta-blockers attenuate the effects of beta-adrenergic stimulation, which facilitates vulnerability to AF after cardiac surgery. The efficacy of beta-blockers in reducing the incidence of postoperative AF has been demonstrated in several trials. Therefore, beta-blockers should be administered perioperatively in patients without contraindications as the standard therapy to reduce the incidence of AF after CABG.<sup>58</sup>

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