Among all cardiovascular complications, atrial fibrillation (AF) remains common, having an incidence that is consistently reported to range between 27 and 40%, with little change over the past two decades. As well, it is clear that AF is associated with an increased incidence of congestive heart failure (CHF), renal insufficiency, and stroke, prolonging hospitalization\(^1\)\(^2\) and increasing rehospitalization after discharge.

**Incidence of Atrial Fibrillation**

The incidence of new-onset postoperative atrial fibrillation is approximately 30%, being remarkably similar across multiple countries and continents.\(^3\) AF is most commonly detected by continuous monitoring followed by 12-lead ECG and physical examination. Forty-three percent of patients experience more than one episode of atrial fibrillation. AF is most common on postoperative day 2 while recurrence was most common on postoperative day 3 with over 60% of initial recurrence occurring within two days of first onset; however, few experience more than two episodes.

**Risk Factors**

Advanced age, history of atrial fibrillation or chronic obstructive pulmonary disease (COPD), valve surgery, and withdrawal of beta-blockers or ACE-inhibitors prior to the onset of atrial fibrillation are significant predictors of new-onset atrial fibrillation. Conversely, treating patients with beta-blockers preoperatively and postoperatively or just postoperatively is associated with a reduced incidence of atrial fibrillation. Similarly, treatment with ACE inhibitors preoperatively and postoperatively as well as postoperative potassium supplementation and non-steroidal anti-inflammatory drug administration is associated with a reduced incidence of AF. More recently, assessments of genomic factors suggest that 2 single nucleotide polymorphism (rs2200733 and rs10033464) in proximity to a gene associated with the development of pulmonary myocardium may be significant risk factors.\(^4\)\(^6\)

**Resource Utilization**

Patients with AF experience longer ICU and hospital stays, with a median difference in postsurgical hospitalization of two days. Once discharged from the ICU, patients with atrial fibrillation are also more likely to return to the ICU. Thirty five percent of patients with AF are discharged to an extended care facility. Patients with more than one episode of AF experience longer ICU and hospital stays than those with a single episode.

**Sequelae of Atrial Fibrillation**

AF is associated with a greater incidence of postoperative complications including neurological injury, renal dysfunction, and infection, with this incidence being greater in patients with multiple episodes of atrial fibrillation than in patients with a single episode. In-hospital mortality in patients with AF is double that of patients without AF (4.7% vs. 2.1%). Long-term mortality is also greater in patients with AF, largely because of increased embolic events.\(^7\)
Assessing Stroke Risk

Non-surgical patients with atrial fibrillation are at increased risk of stroke but the stroke rate is heterogeneous in subpopulations with rates ranging from 2-10%. Because the relative risk reduction of stroke from warfarin and aspirin therapy are substantially different (62% vs. 22%), an accurate estimation of stroke risk is needed to guide therapy. In 2001, Gage and colleagues combined the Atrial Fibrillation Investigators (AFI) classification system with the Stroke Prevention in Atrial Fibrillation (SPAF) III scheme to create the CHADS\textsuperscript{2} index. The CHADS\textsuperscript{2} index was formed by assigning 1 point each for the presence of congestive heart failure (recent exacerbation), hypertension, age ≥ 75 years, and diabetes mellitus and 2 points for history of stroke or transient ischemic attack (TIA). The CHADS\textsuperscript{2} index was an accurate predictor of stroke in a national registry with a c-index of 0.82 (Figure 1). A score ≥ 2 was considered high risk, meriting treatment with anticoagulants.

Over the next decade additional risk factors were identified leading to the development of the CHA\textsubscript{2}DS\textsubscript{2}-VASc scoring system for not just stroke but for any thromboembolic event (TE). An additional motivation for revising the CHADS\textsuperscript{2} version was that it generated a large intermediate risk group (> 60%) for whom it was difficult to define anticoagulation therapy. The CHA\textsubscript{2}DS\textsubscript{2}-VASc scoring system and the associated point value are as follows: Congestive heart failure or LV dysfunction (1 pt); Hypertension (1 pt); Age ≥ 75 (2 pts); Diabetes mellitus (1 pt); Stroke, TIA, or TE (2 pts); Vascular disease (prior myocardial infarction, peripheral artery disease, or aortic plaque) (1 pt); Age 65-74 (1 pt); Sex category (female gender) (1pt). Although, the c-statistic was only 0.61 indicating modest predictive value, the CHA\textsubscript{2}DS\textsubscript{2}-VASc scoring system was better at identifying truly low-risk patients where high-risk is defined by a score ≥ 2.

Comparisons of the CHADS\textsuperscript{2} vs. CHA\textsubscript{2}DS\textsubscript{2}-VASc scoring systems abound. In one study of 73,538 patients with non-valvular atrial fibrillation, CHA2DS2-VASc performed better than CHADS\textsuperscript{2} in defining patients at high risk, and those considered to be low risk by CHA2DS2-VASc were truly at low risk for thromboembolism\textsuperscript{10}. When the same patients were divided into low, intermediate, and high risk groups, the c-statistic for thromboembolic events at 10 years’ follow-up was 0.81 for CHADS\textsuperscript{2} and 0.89 for CHA2DS2-VASc. With regards to perioperative stroke, only one recent study\textsuperscript{11} compared the CHADS\textsuperscript{2} and CHA\textsubscript{2}DS\textsubscript{2}-VASc scores against the stroke risk indices developed by the Northern New England Cardiovascular Disease Study Group (NNECDSG)\textsuperscript{12} and Multicenter Study of Perioperative Ischemia (McSPI) Research Group.\textsuperscript{13} In 2910 patients undergoing isolated coronary artery bypass grafting, areas under the curve were 0.71 for CHADS\textsuperscript{2}, 0.72 for CHA2DS2VASc, 0.69 for Northern New England Cardiovascular Disease Study Group, and 0.73 for McSPI risk indices. Sensitivity was best for the McSPI Risk Index at 78.7% but specificity was best for the NNECDSG at 62.4%. The NNECDSG and CHA2DS2VASc scores were better at discriminating patients with particularly low or high risk of stroke but all were limited by classifying a high proportion of patients as having intermediate stroke risk.

Treatment of Postoperative Thromboembolic Stroke

Treatment of postoperative stroke has been largely limited to continuing anticoagulation, supportive care, and rehabilitation. Several techniques available to the nonsurgical stroke patients should be considered although none of them have been formally investigated. These include the use of therapeutic hypothermia, intra-arterial tissue plasminogen activator (t-PA), and embolus extraction.
Figure 1: Risk of stroke stratified by CHADS$_2$ score.$^8$
References:


