RESEARCH LETTER

The Increasing Burden of Atrial Fibrillation Compared With Heart Failure and Myocardial Infarction: A 15-Year Study of All Hospitalizations in Australia

In recent years, reports have suggested that the incidence of atrial fibrillation (AF) is increasing.[1] Importantly, it has been recognized that hospitalizations account for the majority of the economic cost associated with AF.[2] Trends in hospitalizations for this common condition have shown 2- to 3-fold increases in both North America and Europe through the 1980s and 1990s.[3-5] Despite the limitations of representative data and modest-sized cohorts, these reports highlight a growing clinical and public health problem.

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It is not known whether these increasing trends have continued in recent years and whether they are occurring elsewhere outside North American and Europe. The present study thus examined nationwide trends in AF hospitalizations across the entirety of Australia over a 15-year period (a follow-up period of almost 300 million person-years). In addition, we sought to contrast them with that of 2 other common cardiovascular conditions, myocardial infarction (MI) and heart failure (HF).

Methods. Data were obtained from the National Hospital Morbidity Data set, a source maintained by the Australian Institute of Health and Welfare that includes inpatient information at every hospital in Australia. We identified hospitalizations with a principal diagnosis of AF, MI, and HF from 1993 through 2007. Atrial fibrillation was defined for patients with *International Classification of Diseases, Ninth Revision, Clinical Modification* code 4273, and *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (*ICD-10-AM*) code I48. Myocardial infarction was defined for patients with *ICD-9-CM* code 410 and *ICD-10-AM* code I21. Heart failure was defined for patients with *ICD-9-CM* code 428 and *ICD-10-AM* code I50. Australian Bureau of Statistics population estimates were used to calculate hospitalization prevalence. Statistical analyses were performed using SAS version 9.2 software (SAS Institute Inc).

Results. We identified a total of 473 501 AF hospitalizations, 208 305 MI hospitalizations, and 622 082 HF hospitalizations (**Figure**). There was an increase in the number of hospitalizations for AF of 203% (7.9% annually; rate ratio [RR], 1.079 [95% CI, 1.069-1.088];

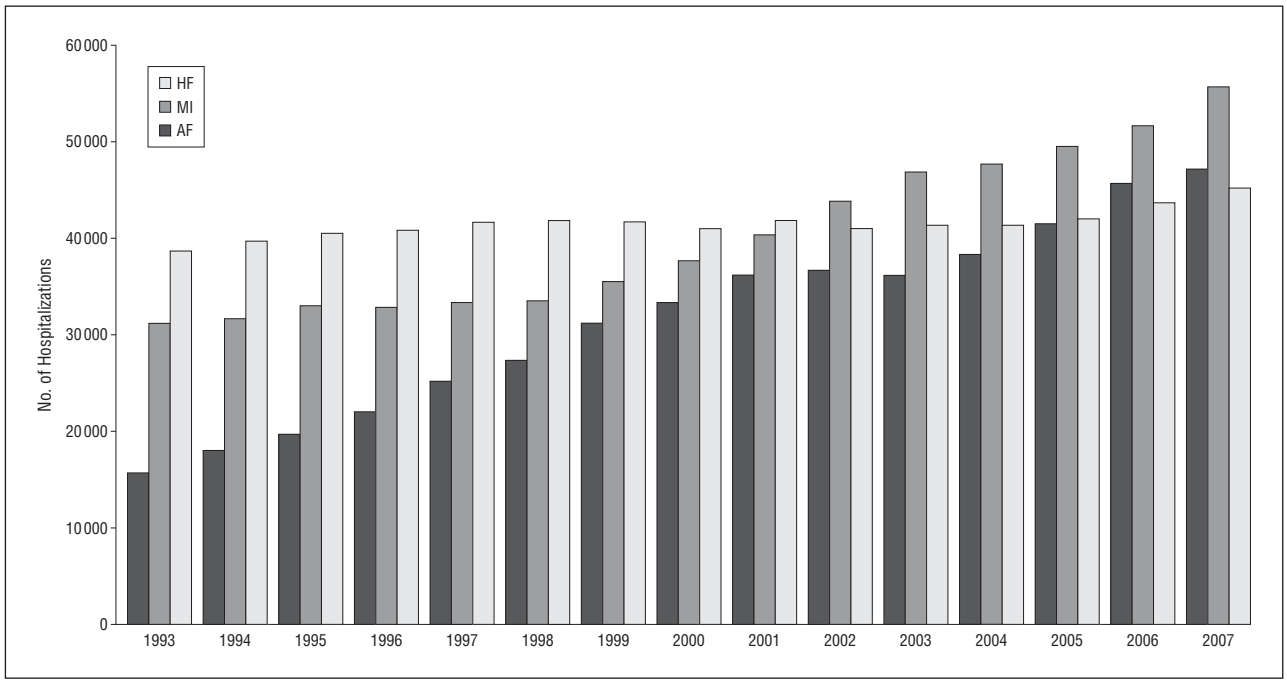

Figure. Number of hospitalizations for atrial fibrillation (AF), myocardial infarction (MI), and heart failure (HF), from 1993 through 2007, inclusive.

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$P<.001$). In contrast, the number of hospitalizations for MI and HF only demonstrated increases of 79% and 17%, or 4.5% (RR, 1.045 [95% CI, 1.040-1.050]; $P<.001$) and 0.7% (RR, 1.007 [95% CI, 1.004-1.009]; $P<.001$) annually, respectively ($P<.001$ for both compared with AF).

The prevalence of AF hospitalizations increased by 155% (6.5% annually; RR, 1.065 [95% CI, 1.056-1.075]; $P<.001$). The prevalence of MI hospitalizations only increased by 50% (3.2% annually; RR, 1.032 [95% CI, 1.027-1.037]; $P<.001$), and the prevalence of HF hospitalizations decreased by 2% (3.0% annually; RR, 0.970 [95% CI, 0.968-0.973]; $P<.001$). Though the prevalence of hospitalizations for HF showed a noticeable decline in both sexes and all age groups ($P<.001$ for all), the prevalence of hospitalizations for AF and MI increased in both sexes and all age groups ($P<.001$ for both).

While the mean length of stay for AF, MI, and HF hospitalizations fell (4.0 to 3.1 days, 8.2 to 5.4 days, and 10.4 to 7.8 days, respectively), there was a 125% increase in the total bed-days used for AF hospitalizations (5.9% annually; RR, 1.059 [95% CI, 1.055-1.063]; $P<.001$); in contrast, there was only an 18% increase (1.7% annually; RR, 1.017 [95% CI, 1.010-1.024]; $P<.001$), and a 15% decrease (1.1% annually; RR, 0.989 [95% CI, 0.985-0.993]; $P<.001$) in bed-days for MI and HF, respectively.

Comment. Over a 15-year period from 1993 through 2007 in Australia, we showed that the number of hospitalizations for AF nationwide had increased significantly compared with MI and HF. These differences were even more pronounced when the prevalence of these hospitalizations were examined. Furthermore, despite similar decreases in length of stay for all 3 conditions, there was a striking increase in the number of bed-days used for AF.

Our nationwide findings confirm previous reports using representative data that the epidemic of AF is continuing exponentially.[3-5] It also highlights that the number of resultant hospitalizations has shown no sign of abating in recent years. Furthermore, comparing AF trends with that of 2 other common cardiovascular conditions puts the clinical and public health importance of these trends in context. While previous reports suggested that HF once accounted for twice as many hospitalizations,[4] AF hospitalizations have since surpassed that for HF and are approaching that for MI.

A number of reasons are likely to be contributing to the rise in AF hospitalizations. The aging population is certainly in part responsible for these AF trends, though our data show that the age-specific prevalence is also increasing. Improving medical care has also resulted in individuals having a more prolonged exposure to traditional and newer risk factors for AF, such as obesity and obstructive sleep apnea.[6-9]

In conclusion, to our knowledge, this is the first report on nationwide trend in hospitalizations for AF outside North American and Europe. The public health burden of AF is enormous and is continuing to increase at a rate greater than that of other common cardiovascular conditions. These findings have important implications for health care planning and the need for better primary prevention and treatment of AF.

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INVITED COMMENTARY

Global Arrhythmia Burden: The Public Health Implications of the Rise in Atrial Fibrillation

Several recent studies have noted a rise in the prevalence and incidence of atrial fibrillation (AF). The population burden of AF is expected to double over the next 40 years and will likely affect between 6 to 12 million Americans by 2050.[1-3] In this issue of the *Archives*, Wong and colleagues[4] confirm that this phenomenon is not limited to the United States. Using administrative data, these investigators demonstrate that the number of hospitalizations for AF in Australia tripled over a 15-year period between 1993 and 2007. In comparison, the number of hospitalizations for myocardial infarction and heart failure increased only modestly during this time.

What accounts for this rise in AF? As Wong and colleagues[4] propose, an increasing population of older patients may explain part of this trend. Patients with coronary artery disease and congestive heart failure are surviving longer and contributing to the growing population at risk for AF. Increasing age is associated with other comorbidities, including valvular heart disease, diabetes mellitus, hypertension, and peripheral arterial disease, all of which are risk factors not only for the development of AF but also for AF-associated thromboembolic complications. Increasing use of ambulatory electrocardiography devices and implantable arrhythmia devices such as pacemakers, defibrillators, and cardiac resynchronization therapy devices have likely enhanced detection of asymptomatic and minimally symptomatic arrhythmias. These possibilities, however, likely explain only a part of the increase in AF hospitalizations.

A larger and older population with AF will increase the burden of morbidity and mortality associated with AF. Even with appropriate risk stratification and anticoagulation, the risk of thromboembolic stroke is increased in AF, especially among patients with risk factors.[5] Even brief, asymptomatic episodes of AF that are detected incidentally in patients with implantable arrhythmia devices are associated with ischemic strokes or peripheral emboli.[6] More ominously, incident AF is associated with an increased risk of all-cause mortality in health care professionals[7] and other cohorts.[8,9] These findings portend a potentially dramatic rise in hospitalizations, stroke, and AF-associated mortality by 2050 unless our therapeutic options evolve adequately to counter these challenges.

Unfortunately, no single therapeutic breakthrough alone is likely to mitigate the rising burden of AF. Although all AF is characterized by chaotic atrial electrical activity, the arrhythmia is a final common pathway of multiple heterogeneous conditions, including electrical triggers (especially in the pulmonary veins), underlying structural heart disease, long-standing hypertension, genetic disorders, cardiomyopathies, and, almost certainly, other conditions we do not yet understand. Currently, guideline-based treatment strategies for AF begin with assessment and appropriate reduction of stroke risk (with aspirin, warfarin, or other anticoagulants) followed by treatment of AF-associated symptoms beginning first with control of the ventricular response to AF. If a rate control strategy fails or is otherwise unacceptable to the patient, efforts to achieve and maintain normal sinus rhythm can include cardioversion, antiarrhythmic drugs, and/or ablation by either catheter-based or surgical approaches. Unfortunately, patients continue to be hospitalized with poor ventricular rate control despite the use of rate controlling drugs. Furthermore, even when control of the rhythm is desired, antiarrhythmic drugs have both incomplete efficacy and substantive toxicities. Although promising in some, catheter ablation in the best candidates has both nontrivial procedural risk and a likelihood of success for a first procedure on the order of 60% to 85%, even with concomitant antiarrhythmic drug therapy.[10] At a fundamental level, all of these treatments address a condition that has already afflicted the heart without addressing the upstream causes.

Clearly, both in the United States and abroad, the public health burden of AF is increasing. The good news is that anticoagulation with warfarin in appropriately risk-stratified patients has reduced (but not eliminated) stroke risk, and recent randomized trials suggest that simpler regimens with new anticoagulants are as efficacious as warfarin. Better insights into the mechanisms of AF have identified patients with structurally normal hearts and pulmonary venous atrial tachycardia triggers as particularly good candidates for AF ablation. Unfortunately, though, the burden of AF is increasing despite these and other advances.

We must do better—even greater support for scientific discovery may lead to better understanding of the mechanisms leading to AF and novel therapeutic approaches. Hopefully, new strategies with better profiles of safety and efficacy than those of our current therapeutic arsenal will mitigate the future symptoms and risks of adverse AF-associated outcomes. We are even more hopeful that other strategies may eventually emerge to prevent AF. Without such advances, the burden of AF will weigh heavily on our world in the coming decades.

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