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REVIEW

Lifestyle management to prevent and treat atrial fibrillation

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ABSTRACT

Introduction: Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia with a one in four lifetime risk in adults over the age of forty. Traditionally, AF management has focused on the three pillars of rate control, rhythm control and appropriate anticoagulation to reduce stroke risk. More recently, the importance of cardiovascular risk factor management in AF has emerged as a fourth and essential pillar with improved patient outcomes.
Areas covered: Here, we aim to summarize the current available evidence for the association between various modifiable risk factors and AF, and to identify optimal treatment targets to improve outcomes.
Expert Commentary: Care for AF patients utilizing an integrated approach and aggressive lifestyle management may reduce the enormous burden of this arrhythmia.

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KEYWORDS
Atrial fibrillation; risk factor; lifestyle modification; integrated care; multidisciplinary care

1. Introduction

The incidence and prevalence of atrial fibrillation (AF) are progressively rising with resultant increases in health-care burden globally [1]. Much of the health-care burden of AF is related to an exponential rise in hospitalizations that have surpassed heart failure admissions [2]. Importantly, this 'rising tide' of AF is accompanied by an almost 2-fold increase in AF-related mortality over the last two decades [1,3]. This is despite advances in catheter ablation strategies for combating AF over that time period, yielding promising long-term results with AF symptom control and declining complication rates [4,5]. Therefore, there is an urgent need for a new approach to care delivery in AF to enhance outcomes in this burgeoning population. Whilst numerous non-modifiable risk factors exist for the development of AF including rheumatic heart disease, ageing, and genetics, recently there has been a greater awareness on the role of modifiable cardiovascular risk factors.

Indeed, modifiable risk factors such as hypertension, overweight and obesity, smoking, and diabetes mellitus contribute significantly to the AF burden [6]. More recently, novel risk factors including obstructive sleep apnea (OSA), aortic stiffness, and metabolic syndrome have also been associated with AF [7–10]. Further, the presence of increasing numbers of concomitant risk factors such as hypertension, diabetes mellitus, and cardiomyopathy in the same individual has been associated with a higher risk of developing AF as well as a more persistent form of the arrhythmia [10,11]. Whilst data overwhelmingly support an association between numerous modifiable cardiovascular risk factors and AF, there is little evidence to support treatment of them to prevent onset of the condition, although intuitively this is likely to be the case. Additionally, inadequately treated underlying primary risk factors for AF may also be responsible for the attrition in success rates of catheter ablation whereby recent work has highlighted continual evolvement of an abnormal substrate even after previous successful ablation procedure [12]. Unfortunately, despite the known associations between numerous cardiovascular risk factors and AF, optimal targets to improve outcomes in this population have yet to be identified and current guidelines make little reference to this emerging aspect of AF management [13,14].

More recently, targeting the substrate for AF with cardiovascular risk factor management has gained significant momentum with studies in overweight AF subjects demonstrating improvement in AF burden and severity, together with reverse cardiac remodeling and improved outcomes post catheter ablation [15,16]. The Aggressive Risk Factor Reduction Study for Atrial Fibrillation and Implications for the Outcome of Ablation (ARREST-AF) cohort study demonstrated that a physician–led, goal-directed lifestyle management program (Figure 1) improved cardiovascular risk factor status as well as reduced AF frequency, duration, and symptom severity to result in greater arrhythmia-free survival following catheter ablation in patients who had a body mass index (BMI) at study baseline of greater than 27 kg/m^2 [16]. Here, we aim to detail the different components of this lifestyle management program in terms of the rationale for treatment and proposed treatment targets in those with established AF (Figure 1 and Box 1).

2. Hypertension

Due to its high prevalence, hypertension contributes to more AF than any other risk factor with rates of reported

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Box 1. Cardiovascular risk factor management in AF

- Target systolic BP < 120–130 mmHg
  - Renin angiotensin aldosterone system inhibitors as first-line pharmacotherapy, if required
- In those who are overweight or obese, aim for 10% weight loss or BMI < 27 kg/m^2; avoid weight fluctuation
- Tailored physical activity of moderate intensity, 3–5 times per week, up to 200 min per week
- Appropriate screening for OSA, particularly in high-risk patients (those with hypertension and obesity)
  - Treat with CPAP, if required
- Target HbA1c ≤ 7.0%
  - Use metformin, if required
- Target LDL < 2.6 mmol/L; Triglycerides < 2.6 mmol/L
  - Use statin ± fibrates, if required
- Complete smoking cessation
- Complete alcohol abstinence or limit to 3 standard drinks per week

BP: Blood pressure; BMI: body mass index; OSA: obstructive sleep apnea; CPAP: continuous positive airway pressure; LDL: low-density lipoprotein.

hypertension in AF studies ranging from 49% to 90% [18]. Hypertension has consistently demonstrated an association with incident AF, whereby the increased risk was to the order between 1.4 and greater than 2-fold [19,20]. Furthermore, systolic blood pressure (BP) may be a better predictor of AF risk than diastolic BP and importantly, systolic BP at 'prehypertensive' levels of 130–139 mmHg was also significantly associated with AF [21]. Indeed, even at the pre-hypertensive stage, measures of aortic stiffness have demonstrated a reduced likelihood of freedom from AF post catheter ablation, although optimal ways of detecting and treating this condition are yet to be determined [9]. The substrate for AF due to hypertension is thought to involve both electrical and structural remodeling with experimental studies showing 'progressive' changes with the duration of hypertension and involvement of atrial dilatation, inflammation, increased interstitial fibrosis, and conduction disturbances [22–24]. Fortunately, this abnormal hypertensive substrate has been shown to be reversible [25,26]. However, clinical data have shown conflicting results regarding the efficacy of different classes of BP-lowering therapies in preventing AF recurrences, with one meta-analysis demonstrating that renin–angiotensin–aldosterone blockers were superior to calcium-channel blockers and beta blockers in reducing the risk of AF recurrence [27]. It remains unclear whether the differences are attributable to the achieved systolic BP levels or the class of antihypertensive agents used.

Despite the strong association between AF and hypertension, an optimal BP target has yet to be determined in the AF population. Previous studies have demonstrated that in the AF population a systolic BP of greater than 160 mmHg has been associated with a 1.9-fold increase in all-cause mortality risk [28] and a BP of greater than 140/90 mmHg with a heightened risk of stroke or systemic embolism [29]. Furthermore, recent primary prevention data have demonstrated that in a high-risk population (systolic BP above 130 mmHg and one additional cardiovascular risk factor but not diabetes), intense treatment of systolic BP to a target of 120 mmHg was associated with a significant reduction in all-cause mortality, fatal, and nonfatal cardiovascular events [30]. This has been further affirmed by a large systematic review and meta-analysis demonstrating that each 10 mmHg reduction in systolic BP was associated with significant reduction in major cardiovascular disease events, coronary heart disease, stroke, heart failure, and a 13% reduction in all-cause mortality [31]. Specifically, this impact was

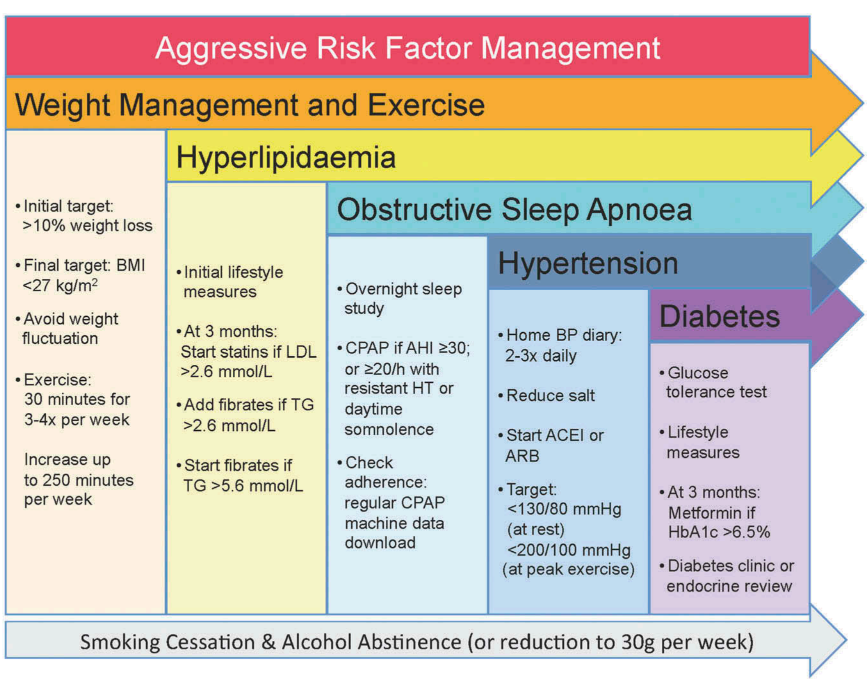

Figure 1. Aggressive risk factor management strategies from the ARREST-AF cohort study. Used with permission from Lau et al. [17]. (LDL – low density lipoprotein; TG – triglycerides; AHI – apnea-hypopnea index; ACEI – angiotensin converting enzyme inhibitor; ARB – angiotensin receptor blocker).

also observed in those at lower baseline BP of <130 mmHg indicating that there may be benefit in treating AF patients with prehypertension [31]. In the ARREST-AF cohort study, treating BP to a target of <130/80 mmHg and <200/100 mmHg at peak exercise levels and use of angiotensin converting enzyme inhibitors or angiotensin receptor blockers as a component of overall cardiovascular risk factor management was associated with enhanced patient outcomes including greater arrhythmia-free survival post catheter ablation, decreased AF burden, and symptom severity (Figure 1).

Taken together, management of hypertension is an essential strategy to both prevent and treat AF. Optimal targets in the AF population remain unknown, but a systolic BP above 140 mmHg is associated with unfavorable outcomes and treatment through lifestyle measures and pharmacotherapy targeting the renin angiotensin system is likely to lead to improved outcomes. In light of recent primary prevention data, this target could be further lowered and may be closer to a systolic BP of 120–130 mmHg. Further prospective studies in the AF population are required to confirm if this target is associated with enhanced rhythm control outcomes.

3. Obesity

Numerous studies have demonstrated a strong and consistent association between obesity and AF [20,32–35]. A recent meta-analysis of cohort studies estimated that every 5-unit increase in BMI conferred a 29% increase in incident AF risk [36]. Additionally, every 5-unit increase in BMI was significantly associated with a 10% increase in postoperative AF and 13% increase in post-ablation AF, respectively [36]. In obese subjects, increased left atrial pressure and volume as well as shortening of the effective refractory period have been found to be potential contributing factors to the substrate for AF [37]. Furthermore, in a sheep model, obesity was associated with progressive atrial remodeling consisting of conduction slowing, increased conduction heterogeneity, pro-fibrotic mediators, and interstitial fibrosis to result in greater AF vulnerability and more sustained AF episodes [38]. More recently, obesity has been shown to be associated with a unique atrial substrate with epicardial fat infiltration into the posterior left atrium myocardium [39]. Indeed, epicardial adipose tissue has been shown to be metabolically active and may facilitate increased atrial inflammation and fibrosis [40]. These findings may underlie the numerous imaging series linking epicardial or pericardial fat with the presence, severity, and outcomes of AF [41,42].

Obesity is a central component of the metabolic syndrome. In the Atherosclerosis Risk in Communities study, each component of the metabolic syndrome (hypertension, elevated waist circumference, low high-density lipoprotein (HDL), impaired fasting glucose, and elevated triglycerides) was associated with an increased risk of AF. Importantly, the presence of each additional cardiovascular risk factor in a patient with metabolic syndrome further compounded their risk of developing AF [10]. Obesity is closely associated with OSA, which is also a known risk factor for AF. It is noteworthy that despite this, both obesity and OSA are independently associated with incident AF, as shown in the Olmsted County cohort study [43].

The abnormal cardiac remodeling due to obesity has been demonstrated to be reversible following weight reduction with beneficial effects on cardiac metabolism, fibrosis, and function [44]. The contributing factors to these benefits are likely to include improved metabolic status with better BP levels, glycemic control, and lipid profile as well as improved comorbid conditions of OSA and cardiomyopathy. The mechanisms responsible for reverse remodeling may include improved adipokine profile, inflammatory milieu, microvascular fibrosis, cardiac autonomics, and reduced oxidative stress [45]. Specific to the atria, one randomized control trial, examining the use of a targeted weight loss intervention in a physician-led clinic with short-term follow-up, has shown improvement in AF burden and severity as well as echocardiographic parameters including interventricular septal thickness and left atrial area [15]. Favorable outcomes have also been demonstrated in longer term follow-up with the Long-Term Effect of Goal Directed Weight Management in an Atrial Fibrillation Cohort study demonstrating the importance of sustained weight loss over 5-year follow-up with those who maintained a weight loss of greater than 10% having a 6-fold increase in the likelihood of arrhythmia-free survival compared to those with smaller degrees of weight loss (<10%) [46]. Similarly, in the ARREST-AF cohort study, weight loss of >10% with a final target BMI of under 27 kg/m^2 was associated with enhanced long-term success of catheter ablation [16]. The mechanisms specific to atrial reverse remodeling with weight reduction has been demonstrated in an ovine model showing reduced total body fat, atrial dilatation, fibrosis, and pro-fibrotic mediators together with improved atrial conduction properties to result in reduced AF inducibility [47]. Taken together, weight management is an essential component of AF management and targeted effort should be directed at attainment and maintenance of normal body weight to reduce symptom burden and improve outcomes.

4. OSA

OSA has emerged as a novel risk factor in the pathogenesis of AF with its presence associated with greater than 2-fold increase in risk and its severity a strong predictor of AF [43,48]. OSA is highly prevalent amongst those with AF with some estimating that it is present in approximately 40–50% of patients or higher [7,49]. Furthermore, OSA in AF is associated with poorer outcomes with greater risk of antiarrhythmic drug failures, AF recurrence post cardioversion or catheter ablation and greater than 3-fold increase in ischemic stroke [50–53]. The atrial remodeling as a result of OSA has been shown to include both electrical and structural abnormalities such as atrial enlargement, conduction abnormalities, voltage reduction, and electrogram fractionation [54]. In addition, a multitude of acute and chronic mechanisms are known to contribute to increased AF in OSA including acute respiratory obstruction, sympatho-vagal imbalance, intrathoracic pressure changes, oxidative stress, endothelial dysfunction, inflammation, gap junction dysregulation, and atrial fibrosis [7,55].

Treatment of OSA with continuous positive airway pressure (CPAP) therapy has been shown to result in better outcomes post catheter ablation with similar risk of AF recurrence in OSA patients using CPAP to those without OSA, which is significantly lower than those not using CPAP [56]. Therefore, it is vital that effective screening for OSA be undertaken in all patients with AF with special emphasis in those who are obese and hypertensive and those with no other obvious risk factors for AF. Unfortunately, the screening questionnaires for OSA may not always be accurate and clinicians must have a low index of suspicion to further investigate with formal polysomnography test. For example, one study has found that the typical OSA symptom, such as daytime somnolence, was not as prevalent in the AF population with poor correlation to the presence and severity of OSA [57]. As part of an overall cardiovascular risk factor management program, treatment with CPAP if the apnea–hypopnea index is ≥30 or ≥20 with resistant hypertension or daytime somnolence has been associated with a reduction in AF burden (Figure 1) [16]. Furthermore, ensuring patient adherence with regular machine downloads is also an essential component of managing this risk factor.

5. Physical inactivity and cardiorespiratory fitness

Higher cardiorespiratory fitness is associated with a reduction in all-cause mortality and cardiovascular events [58]. Further, a graded inverse relationship has been demonstrated with every additional metabolic equivalent (METs) achieved during exercise stress testing associated with a 7% lower risk of incident AF [59]. However, there may be an upper limit threshold with other studies demonstrating a U-shaped relationship with AF risk, whereby moderate-intensity exercise was associated with reduced AF risk but not high-intensity exercise [60]. Possible mechanisms associated with a reduction in AF risk with regular exercise may include blood pressure reduction, reduced inflammation, improved insulin sensitivity, autonomic tone, and cardiac function [61].

Previous studies have shown benefits with exercise training in the chronic AF population including improvements in health-related quality of life and a lower resting pulse rate [62,63]. It has been demonstrated that the addition of physical activity has additive benefits beyond weight loss in reducing AF burden. The CARDIO-FIT study, which examined the impact of cardiorespiratory fitness on AF burden in overweight and obese patients, demonstrated that a greater than 2-METs gain in cardiorespiratory fitness was associated with reduced AF burden compared to a gain of less than 2-METs over long-term follow-up [64]. Importantly, the benefits seen with improved cardiorespiratory fitness were independent of weight loss. This intervention was delivered as part of a dedicated physician-led lifestyle modification program in patients with AF who were overweight or obese at baseline (BMI > 27 kg/m^2). More recent work by Malmo and coworkers in a randomized study also demonstrated beneficial effects in reduced AF burden, improved left atrial function, peak oxygen consumption, quality of life, and lipid levels with short-term aerobic interval training in non-permanent AF patients referred for catheter ablation therapy [65].

Therefore, exercise prescription, through a tailored and individualized plan, is strongly encouraged for enhancing both AF and general health outcomes. In the absence of robust data on exercise modalities or intensity for AF patients, practitioners should encourage aerobic and/or resistance exercise training tailored to the individual patient per level of enjoyment to maximize adherence rather than being overly rigid or specific. Broadly, this should target regular exercise of 3–5 days per week, aiming for 85–95% of maximum age-specific heart rate and total duration up to approximately 200 min per week (Figure 2) [61].

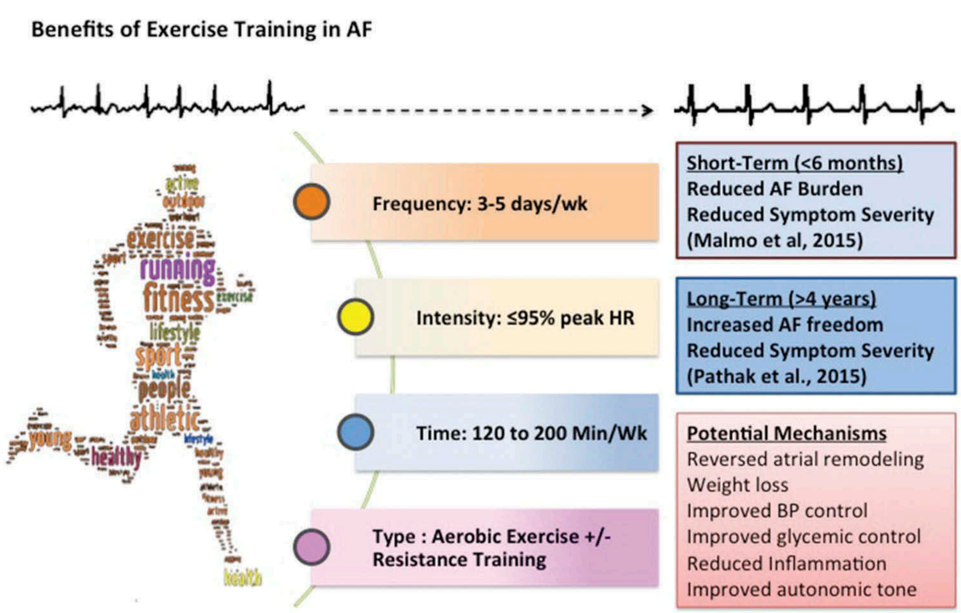

Figure 2. Exercise training and AF. Current concepts with suggested recommendations. Used with permission from Elliott et al. [61]. (BP – blood pressure; HR – heart rate).

6. Diabetes mellitus

Diabetes mellitus (DM) is significantly associated with incident AF with an approximate one-third increase in relative risk as demonstrated in various studies [19,20,66]. Furthermore, a case control study has demonstrated that both durations of DM and glycemic control were significantly associated with AF, with each additional year of DM conferring a 3% increase in the risk of AF and an almost doubling of AF risk in those with HbA1c above 9% [67]. Further, the presence of AF in a diabetic individual portends worsened clinical outcomes with some studies demonstrating at least a 1.6-1.7-fold increase in all-cause mortality, cardiovascular death, and heart failure [68,69]. There are several possible underlying mechanisms linking DM and AF, including autonomic remodeling, oxidative stress, structural abnormalities with atrial fibrosis and conduction slowing [70–72]. The combination of DM and AF appears to be a particularly dangerous one and this population deserves special attention. Despite the intuitive importance of good diabetic control to improve cardiovascular outcomes, conflicting evidence exists regarding intensive glucose control (HbA1c < 6.0%), with one study not finding any difference to those with HbA1c between 7.0 and 7.9% and another showing increased stroke risk in those with HbA1c above 6.9% [68,73]. Perhaps, the risk of ischemic stroke in a diabetic individual with AF has a greater correlation with the duration of diabetes than glycemic control, with those who have had the condition for greater than 3 years demonstrating a significantly greater risk [74].

Lifestyle strategies to improve outcomes in this population remain largely elusive at this stage, and further studies are required to ascertain appropriate treatments and targets. Due to a current paucity of outcome data on those with DM and AF, target recommendations in this population are largely drawn from the primary prevention field. Recent guidelines suggest that those with diabetes should be treated to a HbA1c of ≤7.0% to reduce the incidence of microvascular complications [75], and this is in keeping with one study suggesting an increase in risk of stroke in individuals with AF and diabetes above this level [73]. Treatment with metformin if HbA1c is >6.5% after a 3-month period of intense lifestyle management may further enhance patient outcomes as part of an overall cardiovascular risk factor management strategy (Figure 1) [16].

7. Dyslipidemia

Conflicting data exist in the association between dyslipidemia and the development of AF. Interestingly, in contrast to the association between an elevated low-density lipoprotein (LDL) and ischemic heart disease risk, many epidemiological studies have found an inverse correlation between LDL and AF [76–79], although another study did not find any association between LDL and AF risk [80]. Despite these somewhat discrepant data, the potential cardiovascular sequelae of an untreated elevated LDL in the context of overall cardiovascular risk clearly need to be taken into account. Data concerning the association between HDL and AF are also variable with some studies demonstrating a reduction in AF risk with higher HDL [79–81] and another showing no association [78].

Nevertheless, the role of Hydroxy-Methyl Glutaryl Coenzyme A (HMG-CoA) reductase inhibitors in AF appears to show greater promise in those with established AF than in preventing incident AF. A recent meta-analysis of the use of statins in both primary and secondary prevention of AF demonstrated a combined reduction in risk, with subgroup analysis showing this risk reduction to be greater in those with established AF [82]. Similarly, the effectiveness of statins in the secondary prevention of AF was confirmed in another meta-analysis, with no impact seen for primary prevention, although a significant and homogenous effect of statins on the prevention of post cardiac surgery AF was evident [83]. The beneficial role of statins is in keeping with their antiarrhythmic effects shown in experimental studies with favorable alteration to the action potential and suppression of triggered activity arising from the pulmonary veins [84]; attenuated atrial electrical remodeling due to atrial tachycardia induced shortening of the effective refractory period and downregulation of L-type calcium channel [85]; as well as attenuated atrial structural remodeling due to congestive heart failure induced conduction abnormalities and fibrosis to result in reduced AF propensity [86]. Further prospective HMG-CoA inhibitors trials with incorporation of AF-related endpoints are needed to improve our understanding of their mechanistic role in the prevention and treatment of AF [87].

Taken together, despite the lack of evidence for the association between dyslipidemia and incident AF risk, there appears to be a role for HMG-CoA reductase inhibition use in the secondary prevention of AF. In the absence of specific data in this area, treatment of LDL according to overall cardiovascular risk would appear to be a reasonable strategy. Primary prevention guidelines suggest the use of high-intensity statin therapy in adults over the age of 21 with an LDL ≥ 190 mg/dL (4.9 mmol/L) and consideration of absolute cardiovascular risk estimates in those with an LDL of 70–189 mg/dL (1.8–4.9 mmol/L) [88]. Exceptions to this include those with diabetes, where moderate-intensity statin use is recommended in those aged 40–75 years or high-intensity statin therapy if the estimated absolute cardiovascular disease risk is ≥7.5% [88]. Use of statin therapy in those with established AF to treat LDL > 2.6 mmol/L and additional fibrates if triglycerides >2.6 mmol/L has been shown to improve patient outcomes in the context of an overall cardiovascular risk factor management strategy (Figure 1) [16].

8. Alcohol

Most prospective studies have described an association between higher levels of alcohol intake and incident AF. Data from the Framingham cohort demonstrated an association between levels of alcohol intake of >3 standard drinks per day and AF [89]. In a higher risk population (those over the age of 55 with either cardiovascular disease or diabetes), a significant increase in AF risk was seen at a lower level of alcohol intake (1–14 standard drinks per week in women and 1–21 standard drinks per week in men) [90]. Other studies have described gender differences with a heightened AF risk for men at a consistent level of 4–5 standard drinks per day, with no association for women at any level of alcohol intake

[91–93], whilst an elevated risk in former drinkers has also been described [94]. Two previous meta-analyses have described a significant 8% increase in relative risk of incident AF with each standard drink per day compared to nondrinkers [95,96]. Therefore, it appears that a 'safe' level of alcohol intake cannot be assumed and there may be gender differences in the safety threshold. The mechanisms by which alcohol intake impacts on AF risk remain unclear although the pro-arrhythmic effects of alcohol may include shortening of the atrial refractory period, alteration in atrial current densities, increased sympathetic activity, and decreased vagal tone modulation [97–99]. In addition, alcohol may also play a part in modification of the substrate for AF as a mediator for other known cardiovascular risk factors including hypertension and obesity.

The role of alcohol in the prognosis of AF patients is less clear and requires further investigation. In keeping with data concerning risk of incident AF, gender differences have been described in prognosis with one study describing an increase in mortality in men consuming greater than 27 standard drinks per week but no association in women [100]. However, this was not seen in another study at any level of alcohol intake except in former drinkers [94]. Further, the risk of thromboembolism was significant for women consuming greater than 20 standard drinks of alcohol per week but not in men [100], whilst other studies have described a reduction in thromboembolic risk with regular alcohol use [101,102]. Recent data also suggest that alcohol consumption is associated with an unfavorable outcome post catheter ablation and that this may in part be due to atrial remodeling with greater amount of low-voltage zones seen in those with higher daily alcohol consumption [103]. In the absence of clear guidelines recommendations on a safe level of alcohol intake in AF patients and the possibility of a small but significant AF risk even with one standard drink per day, abstinence from alcohol consumption is therefore advisable. As seen in the ARREST-AF cohort study, abstinence or alcohol intake of not more than 30 g per week (approximately 2.5–3 standard drinks) has been associated with improved patient outcomes as part of an aggressive cardiovascular risk factor management program (Figure 1) [16].

9. Smoking

Data concerning the association between smoking and incident AF are unclear with some epidemiological studies finding no association [19,33,77,104] and others demonstrating an increase in risk ranging from 32% to more than double in current smokers and 32–49% in former smokers [105–107]. Possible mechanisms involved in the contribution of smoking to AF risk include increased inflammation, atrial fibrosis, and oxidative stress [108,109]. Cigarette smoking is also known to contribute to atherogenesis, endothelial dysfunction, and promote a heightened prothrombotic state with enhanced platelet activation and raised fibrinogen levels [109], all of which are unfavorable in AF. Smoking is strongly correlated with thromboembolic risk in patients with established AF with one study citing a greater than 2-fold increase in risk in smokers [102] and another describing a stronger association for a combination of thromboembolic risk and death in women than men [110]. Therefore, targeted intense counseling and possible pharmacotherapy for complete smoking cessation in those with established AF should be recommended, although it remains unclear if smoking cessation will contribute to a reduction in the risk of AF development. However, in the context of overall cardiovascular and general health, this should clearly be recommended to all and has been associated with improved AF outcomes as part of a cardiovascular risk factor management program (Figure 1) [16].

10. Integrated care in AF

As with many other chronic cardiovascular conditions, the complex and multifaceted components associated with good patient outcomes call for a systematic approach to the management of the AF patient. Care delivery programs such as cardiac rehabilitation have demonstrated benefits in other chronic cardiovascular conditions with structured secondary prevention programs, demonstrating significant reductions in cardiovascular mortality, re-hospitalizations, and improvements in health-related quality of life [111]. Likewise, heart failure programs have also proven to be beneficial, with particular emphasis on the use of case management interventions to reduce heart failure readmissions and all-cause mortality [112]. Whilst there are little data in the AF population, it is highly likely that cardiovascular risk factor management is poorly undertaken, as studies have already demonstrated deficiencies in other high-risk cardiac populations [113,114].

Integrated care has been proposed as a model of care delivery that aims to provide continuity and cohesiveness of care and often incorporates elements including case management and multidisciplinary care [115]. This approach has been shown to be beneficial across numerous chronic disease processes including heart failure, diabetes, chronic obstructive pulmonary disease, and asthma with benefits including reduced hospital admissions and presentations, quality of life improvements, and increased adherence to guideline recommended care [116]. Specific to AF care, previous observational studies of specialized AF clinics have demonstrated improvements in various domains including reduction in AF-related emergency department and hospital admissions and significant improvement in the Atrial Fibrillation Effect on Quality of Life scores [117–119]. More recently, the use of the integrated care approach in a nurse-led, physician-supervised AF clinic demonstrated a 41% reduction in the composite end point of all-cause mortality, cardiovascular hospitalizations, and AF-related emergency department visits in patients presenting with new onset AF [120].

More robust data in the form of randomized studies are also available in two studies. The first single-center study in The Netherlands utilized an integrated care approach in the outpatient setting, involving a specialist cardiac nurse with software decision support and cardiologist supervision. Compared to standard cardiologist only outpatient care, this intervention resulted in a significant 35% reduction in the primary end point of cardiovascular hospitalizations and cardiovascular death as well as greater adherence to guidelines recommended care [121]. Additionally, this approach

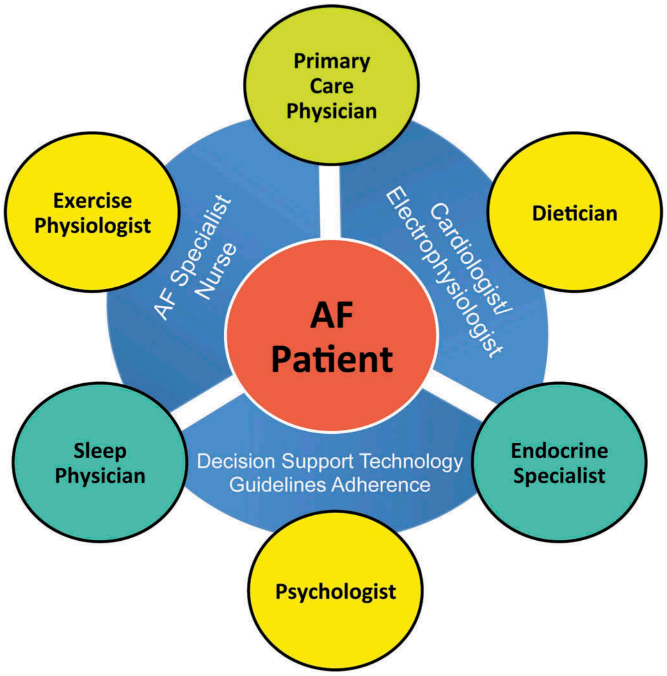

Figure 3. Integrated care for AF. Proposed key elements of a multidisciplinary approach. Reproduced with permission from Lau et al. [17]. by permission of Oxford University Press.

was also found to be highly cost-effective [122,123]. The second multicenter randomized study examined the impact of a predominantly home-based intervention on improving outcomes for patients who had been admitted to hospital primarily due to AF. The standard versus atrial fibrillation-specific management strategy (SAFETY) study involved the use of specialist care delivered and coordinated by a cardiac nurse [124]. The intervention was diverse and included a home visit, clinical assessment, home environment assessment, Holter monitor, liaison with other health-care providers, referral to urgent care if required, adjustment or prescription of medications, and on-call telephone support for all intervention participants with other potential components including delivery of an education package if deemed necessary and referral to community-based care (exercise programs, pharmacists, social workers). Although this intervention did not significantly impact on the combined end point of all-cause mortality and all-cause unplanned hospital readmission, it was associated with more days alive and out of hospital relative to standard care. Significant differences exist in the two randomized trials that have been undertaken to date and further studies are urgently needed to delineate the optimal integrated care approach to provide more robust data to improve care delivery for the burgeoning AF population. Proposed key elements of an integrated care approach are outlined in Figure 3.

11. Conclusions

Modifiable cardiovascular risk factors are important contributors to the abnormal AF substrate leading to increased arrhythmia burden and persistence. Aggressive risk factor management should be an essential component of AF care with emerging evidence of its role in improved symptom burden and arrhythmia-free survival. Given the significant health-care and economic burden associated with AF, an overhaul of care delivery is urgently needed with incorporation of dedicated AF clinic using an integrated care approach to improve guidelines adherence, patient outcomes, and cost-effectiveness. More research is needed to delineate evidence-based targets for the various modifiable risk factors in the AF population. Future management guidelines should feature the important fourth pillar of lifestyle management for AF in addition to the long established pillars of rate control, rhythm control, and stroke prevention.

12. Expert commentary

Management of the AF patient is undergoing considerable change. Over the last decades, this evolved largely around the issues of rate and rhythm control with particular focus on catheter ablation approaches as well as stroke prevention. However, the tides have recently changed with the role of cardiovascular risk factor management asserting itself as an integral component. At present, many questions remain unanswered in cardiovascular risk factor management in the individual with AF. Unlike ischemic heart disease, appropriate targets for cardiovascular risk factors for optimal patient outcomes do not exist for the AF population. Prospective well-designed studies are required to help understand the appropriate targets. Furthermore, we need to improve care delivery for this debilitating chronic cardiac condition. Structured care programs have shown improvements in patient outcomes in other chronic cardiovascular conditions including the acute coronary syndromes and heart failure. Similar care for AF patients utilizing an integrated approach with greater involvement of allied health professionals and aggressive lifestyle management has the potential to reduce the enormous burden of this arrhythmia both in the individual and the health-care system.

13. Five-year view

Recognition of AF as a chronic cardiovascular condition and a deeper understanding of successful components of care delivery will revolutionize the way in which this population is managed. The next 5 years should focus on the ascertainment of appropriate cardiovascular risk factor targets in the AF population, as well as developing cost-effective and reproducible methods of care delivery. The role of multidisciplinary, integrated care is likely to be a key component to achieving this and global collaboration to undertake multicenter randomized controlled trials to delineate the optimal approach is required. Improved understanding of the novel mechanisms underlying AF such as epicardial fat and aortic stiffness may add to greater success in the future. Cardiovascular risk factor management will become an important component of guideline recommended care for every AF patient.

Key issues

- AF is a condition associated with significant morbidity and mortality and poses a large personal and health-care burden worldwide.
- Traditionally, the focus of AF care has been on rate and rhythm control and stroke prevention.
- Recent studies have highlighted the importance of cardiovascular risk factor management in the AF patient.
- The major risk factors demanding aggressive management include hypertension, obesity, OSA, physical inactivity, dyslipidemia, diabetes, alcohol, and smoking.
- AF is a chronic cardiovascular condition and integrated, multidisciplinary management has shown promise as an effective method-of-care delivery through reduced health-care burden and improved patient outcomes.

Declaration of interest

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

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