Advances in cardiac magnetic resonance (CMR) techniques and image acquisition have made it an excellent tool in the assessment of atrial myopathy. Remodeling of the left atrium is the mainstay of atrial fibrillation (AF) development and its progression. CMR can detect phasic atrial volumes, atrial function, and atrial fibrosis using cine, and contrast-enhanced or non–contrast-enhanced images. These abilities make CMR a versatile and extraordinary tool in management of patients with AF including for risk stratification, ablation prognostication and planning, and assessment of stroke risk. We review the latest advancements in utility of CMR in management of patients with AF.

Atrial fibrillation (AF) is increasingly recognized as the cardiac electrophysiologic manifestation of a multifactorial systemic disease. Several risk factors for development of AF have been identified; many are modifiable. There is evidence to suggest that aggressive management of modifiable risk factors has potential to significantly reduce the burden of AF, before and after AF ablation. Specific risk factor management (RFM) clinics have been shown effective in conferring these benefits into tangible improvements in large cohorts of patients. This review discusses the evidence behind RFM as a key adjunctive management strategy alongside AF ablation and suggests a model for RFM in clinics.

High-density (HD) mapping presents opportunities to enhance delineation of atrial fibrillation (AF) substrate, improve efficiency of the mapping procedure without sacrificing safety, and afford new mechanistic insights regarding AF. Innovations in hardware, software algorithms, and development of novel multielectrode catheters have allowed HD mapping to be feasible and reliable. Patients to particularly benefit from this technology are those with paroxysmal AF in setting of preexisting atrial scar, persistent AF, and AF in the setting of complex congenital heart disease. The future will bring refinements in automated HD mapping including evolution of noncontact methodologies and artificial intelligence to supplant current techniques.
Advances in Atrial Fibrillation Ablation: Energy Sources Here to Stay 167
Gurukripa N. Kowlgi and Suraj Kapa

Energy sources used for catheter ablation of atrial fibrillation (AF) ablation have undergone an exceptional journey over the past 50 years. Traditional energy sources, such as radiofrequency and cryoablation, have been the mainstay of AF ablation. Novel investigations have led to inclusion of other techniques, such as laser, high-frequency ultrasound, and microwave energy, in the armamentarium of electrophysiologists. Despite these modalities, AF has remained one of the most challenging arrhythmias. Advances in the understanding of electroporation promise to overcome the shortcomings of conventional energy sources. A thorough understanding of the biophysics and practical implications of the existing energy sources is paramount.

Balloon-Based Ablation Technologies 175
Rahul Bhardwaj, Petr Neuzil, Vivek Y. Reddy, and Srinivas R. Dukkipati

Pulmonary vein isolation (PVI) is widely accepted as the mainstay of interventional treatment of atrial fibrillation. Ablation with radiofrequency (RF) point-by-point catheters is highly operator dependent and may fail because of ineffective lesions or gaps. Several balloon-based catheter ablation technologies have emerged as an alternative to effect PVI. Cryoballoon ablation is widely used, and current iterations of the technology show comparable acute and long-term efficacy to RF ablation. Techniques such as time to isolation have emerged to improve efficacy and safety. Laser balloon is a highly compliant variably sized balloon that has been validated as an effective strategy for PVI.

Recurrent Atrial Fibrillation After Radiofrequency Ablation: What to Expect 187
Tharian S. Cherian and David J. Callans

Recurrent atrial fibrillation after radiofrequency ablation is observed in up to 50% of patients within 3 months. Early and multiple recurrences predict late recurrences within 1 year, which occurs in 20% to 50% of patients. Although no consensus exists regarding patient selection and timing of redo ablation, we refer symptomatic patients with multiple recurrences and persistent atrial fibrillation for ablation. Resynchronization of reconnected pulmonary veins and ablation of nonpulmonary vein triggers is the primary ablation strategy. In addition to repeat ablation, we recommend weight loss, treatment of sleep-disordered breathing, and management of comorbid conditions for durable maintenance of sinus rhythm.

Recurrent Atrial Fibrillation After Cryoballoon Ablation: What to Expect! 199
Arash Aryana, Gian-Battista Chierchia, and Carlo de Asmundis

Atrial fibrillation (AF) recurrence following cryoballoon ablation may occur as a consequence of pulmonary vein (PV) reconnection, which can be treated effectively by performing repeat PV isolation. Alternatively, AF recurrence can manifest in absence of bilateral antral PV isolation. In such circumstances, one may pursue catheter ablation of AF triggers, if present, or proceed with empiric posterior left atrial wall ablation. Although traditionally, focal radiofrequency ablation has been used for this, cryoballoon ablation, itself, may also be used for ablation/isolation of certain structures such as the superior vena cava, the left atrial appendage and even the posterior left atrial wall.
Recurrent Atrial Fibrillation with Isolated Pulmonary Veins: What to Do

Carola Gianni, Alisara Anannab, Domenico G. Della Rocca, Anu Salwan, Bryan MacDonald, Angel Quintero Mayedo, Sanghamitra Mohanty, Chintan Trivedi, Luigi Di Biase, and Andrea Natale

When patients have symptomatic recurrent atrial tachyarrhythmias after 2 months following pulmonary vein antral isolation, a repeat ablation should be considered. Patients might present with isolated pulmonary veins posterior wall. In these patients, posterior wall isolation is extended, and non-pulmonary vein triggers are actively sought and ablated. Moreover, in those with non-paroxysmal atrial fibrillation or a known higher prevalence of non-pulmonary vein triggers, empirical isolation of the superior vena cava, coronary sinus, and/or left atrial appendage might be performed. In this review, we will focus on ablation of non-pulmonary vein triggers, summarizing our current approach for their mapping and ablation.

Beyond Pulmonary Vein Isolation in Nonparoxysmal Atrial Fibrillation: Posterior Wall, Vein of Marshall, Coronary Sinus, Superior Vena Cava, and Left Atrial Appendage

David F. Briceño, Kavisha Patel, Jorge Romero, Isabella Alviz, Nicola Tarantino, Domenico G. Della Rocca, Veronica Natale, Xiao-Dong Zhang, and Luigi Di Biase

The optimal ablation strategy for non-paroxysmal atrial fibrillation remains controversial. Non-PV triggers have been shown to have a major arrhythmogenic role in these patients. Common sources of non-PV triggers are: posterior wall, left atrial appendage, superior vena cava, coronary sinus, vein of Marshall, interatrial septum, crista terminalis/Eustachian ridge, and mitral and tricuspid valve annuli. These sites are targeted empirically in selected cases or if significant ectopy is noted (with or without a drug challenge), to improve outcomes in patients with non-paroxysmal atrial fibrillation. This article focuses on summarizing the current evidence and the approach to mapping and ablation of these frequent non-PV trigger sites.

Fluoroless Atrial Fibrillation Catheter Ablation: Technique and Clinical Outcomes

Jorge Romero, Kavisha Patel, David Briceno, Isabella Alviz, Nicola Tarantino, Domenico G. Della Rocca, Veronica Natale, Xiao-Dong Zhang, and Luigi Di Biase

Fluoroscopy continues to be considered an indispensable part of atrial fibrillation (AF) ablation worldwide. Deleterious effects of radiation exposure to patients, physicians, and catheter laboratory personnel are gaining increased consideration. Safety and efficacy of a fluoroless approach for AF ablation is comparable with outcomes achieved with fluoroscopy use. This article focuses on AF ablation with zero fluoroscopy use as well as current evidence on efficacy and safety of this technique. In contrast, minimal fluoroscopy is an alternative. Relying on intracardiac echocardiography for transseptal access and electroanatomic mapping for catheter manipulation can help implement this approach on a wider scale.

Current Status of Esophageal Protection

Rahul Bhardwaj, Jacob S. Koruth, and Vivek Y. Reddy

Catheter ablation of atrial fibrillation necessitates ablation on the posterior left atrium. The anterior esophagus touches the posterior left atrium, although its course is highly variable. The proximity of the left atrium to the esophagus confers risk of injury with radiofrequency and cryoablation owing to the heat transfer that occurs with thermal ablation. Early detection of esophageal temperature changes with probes may decrease the extent of damage to the esophagus, but evidence is
mixed. Avoiding ablation on the esophagus with esophageal deviation and modifying ablation approaches may decrease the risk of injury.

Discontinuing Anticoagulation After Catheter Ablation of Atrial Fibrillation

Naga Venkata K. Pothineni and David S. Frankel

Atrial fibrillation is a leading cause of ischemic stroke. Stroke risk can be reduced with oral anticoagulation. Current guidelines recommend that decisions regarding anticoagulation after catheter ablation be based solely on preprocedural risk, as defined by established risk scores. Whether the absolute risk of stroke is sufficiently reduced by successful catheter ablation such that the benefit in terms of further reduction in strokes with continued anticoagulation is outweighed by increased bleeds, remains to be determined. Here, we review the observational data pertaining to anticoagulation discontinuation after atrial fibrillation ablation and describe the authors’ practice in this regard.