Radiofrequency Catheter Ablation of Persistent Atrial Fibrillation Using a New Open Irrigated Tip Catheter

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ABSTRACT

Catheter ablation is considered a mainstay of therapy for patients with symptomatic, drug-refractory atrial fibrillation (AF). However, it remains a technically challenging procedure, and technological innovation is aimed at making AF ablation a more effective and safer practice. One of the main fields of ongoing research is the development of more effective and faster ablation catheters. The Cool Flex™ is a new open irrigated ablation catheter with a unique flexible electrode design that better adapts the ablation tip to the surrounding tissue. We report a case of persistent AF in a 73-year-old male patient treated by radiofrequency catheter ablation using this new irrigated tip catheter.

Key words: atrial fibrillation radiofrequency catheter ablation

Introduction

Radiofrequency catheter ablation (RFCA) has become an important treatment modality in numerous cardiac rhythm disorders. Continued development of catheters to improve efficacy and safety of RFCA has led to the use of a saline irrigated catheter to cool the electrode tip. Saline irrigation allows for greater power application to the tissue and creates deeper lesions. The use of an open irrigated catheter has become the standard ablation technique, particularly for the ablation of atrial fibrillation (AF). The Cool Flex™ ablation catheter is the first catheter with a fully irrigated, flexible tip electrode designed to conform to the cardiac anatomy, reduce operator transmitted force into the tissue, and improve cooling performance. This catheter has 4 open holes in the distal tip and multiple slits in the lateral side that allow preferential flow that directs the majority of the saline toward the tip–tissue interface when the catheter is flexed. We report our clinical experience with the new irrigation catheter in a case of persistent AF.
Case

A 73-year-old man was referred to our institution for RFCA of AF. He had been treated for symptomatic persistent AF for 3 years; however, antiarrhythmic drugs including flecainide, pilcainide, and amiodarone failed to control his symptoms. He had a history of essential hypertension and under went RFCA for isthmus-dependent atrial flutter 5 years ago. On admission, his physical examination was unremarkable and electrocardiography showed AF with a heart rate of 59 bpm. Transthoracic echocardiography showed left atrial (LA) enlargement with an anterior–posterior diameter of 51 mm and normal ejection fraction of 55%. Preoperative transesophageal echocardiography showed no evidence of intra–cardiac thrombus. According to our institution’s protocol for persistent AF, the ablation lesion set consisted of circumferential biaxial ablation with electrical pulmonary vein isolation and LA roof, posterior–inferior line, anterior line, and superior vena cave ablation (Figure 1A). Using the power-controlled mode fixed at 30–35 W, radiofrequency (RF) energy was delivered using the Cool Flex™ ablation catheter at each point while the tip of the catheter was irrigated with 0.9% saline at a rate of 17 mL/minute. Individual RF delivery was applied for approximately 20 seconds until the elimination of the atrial potential. This was repeated if necessary up to a maximum of 30 seconds. After ablation, the catheter was moved to the next site along the line. This was continued until ablation of the standard set of lesions was complete. Characteristically, RF application resulted in rapid and complete atrial potential elimination and linear ablation was performed quite rapidly without residual potential. Bidirectional block was achieved and confirmed by differential pacing maneuvers (Figure 1B–D). The total procedure time, fluoroscopic time, and ablation time were 217, 61, and 82 minutes, respectively, which were shorter than the average durations for persistent AF ablation using a conventional irrigation tip catheter (255, 73, and 94 minutes, respectively). As expected, the irrigation volume was decreased by 1000 mL with the new catheter. There were no steam pops, charring, or coagulum formation during the procedure. The patient’s symptoms disappeared and continuous Holter electrocardiography recording showed no sustained AF at 3 months after ablation. Antiarrhythmic medications were discontinued after a 3 month blanking period.

Discussion

Open irrigated catheters have been developed to improve the efficacy and safety of RFCA and have become the standard ablation technique for AF. Saline irrigation from the catheter cools the electrode–tissue interface and enables the use of more power, which results in increased heating and deeper lesions while reducing the risk of thrombus formation. The efficacy of open irrigated catheters has been well documented in various types of arrhythmias. However, there are several concerns about the conventional irrigation catheter. First, because conventional open irrigated catheters have 6 irrigation ports circumferentially arranged at the distal tip of the ablation electrode, actual open irrigation of the catheter provides uneven saline perfusion that is mainly distributed away from the tissue–electrode interface when the catheter tip is parallel to the tissue. These differences in cooling may produce marked variations in lesion formation according to the catheter tip orientation. A more global distribution of irrigation channels across the ablating electrode would potentially provide uniform cooling of the catheter tip and predictable
Figure 1. A: The ablation lesion set included circumferential pulmonary vein isolation and roof line, posterior-inferior line, and anterior line ablation. B: Isolation of the posterior wall after roof and posterior-inferior line generation. Note that there is no atrial potential in the ablation catheter, which was located at the posterior wall. C, D: Confirmation of bidirectional block after anterior wall linear ablation by differential pacing from the left atrial (LA) appendage and LA septum. Bidirectional block of the LA anterior wall ablation was confirmed by the presence of double potentials along the ablation line and a conduction delay of \( > 100 \text{ ms} \) across the ablation line during differential pacing.
lesion formation irrespective of the electrode orientation. Second, although open irrigated tip catheters may reduce the incidence of coagulum formation and charring during ablation by active cooling, there is still a high potential for such events to occur in areas away from the irrigation channels, particularly where the electrode meets the shaft. This can cause high peak temperatures in this area and result in coagulum formation and charring. Introducing irrigation ports at the proximal end of the tip in addition to the distal end may reduce the incidence of coagulum development and charring and provide more effective cooling. Third, conventional irrigated tip catheters have rigid distal tips and cannot always adapt to cardiac anatomy due to the limited contact area. Therefore, ideal lesion formation is technically challenging and time consuming. Finally, open irrigated catheters carry the risk of fluid overloading in patients requiring multiple linear ablations over a long duration. A catheter with a lower fluid requirement can diminish these fluid overload issues in procedures involving AF. The Cool Flex™ is a new irrigation catheter with a unique design that was developed to overcome the limitations of conventional catheters as described above. In the present case, we experienced increased efficiency, shorter procedure time, and less fluid loading with the new ablation catheter in a patient with persistent AF. However, there is a paucity of data regarding the use of the Cool Flex™ catheter in AF ablation and there are persistent concerns about its safety. The Clinical Evaluation of Therapy™ Cool Flex™ Ablation Catheter for the Treatment of Paroxysmal Atrial Fibrillation has been conducted in Europe and more data on the efficiency, safety, and optimal RF power of the catheter are expected to be elucidated.

References