Atrial fibrillation ablation performed in the developing world: A description of the first atrial fibrillation ablation performed in Cambodia

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Introduction

Atrial fibrillation (AF) ablation is a procedure that is performed routinely in advanced countries. Equipment such as 3D anatomic mapping systems, cryoablation, contact force sensing catheters, and general anesthesia with extensive monitoring are increasingly used to effectively perform these procedures. The cost of the disposable equipment alone for an AF ablation can exceed $10,000.[1] In countries in the developing world, with limited economic resources, these technologies may not be available. Similar to developed countries, the developing world is facing a global epidemic of AF. Unfortunately, in these countries this arrhythmia, particularly in women, is associated with high rates of mortality.[2] This mortality is often driven, in part, by the long-term access to therapies that may impact outcomes. An AF ablation, if successful, can impact arrhythmia-free survival and lower AF-related comorbidities.[3] Unlike antiarrhythmic medications for AF, an ablation offers potential as a singular therapy. As such, ablation procedures may have a unique impact on the natural history of AF in developing countries. However, undertaking an AF ablation with no prior institutional or country experience can pose unique challenges. This case study describes the first AF ablation procedure performed in Cambodia along with challenges of performing the case in a country with limited economic resources.

Case report

The patient is a 55-year-old Cambodian woman who had drug-refractory, symptomatic, nonvalvular AF. The patient had a history of hypertension as her primary risk factor for AF. She had an echocardiogram showing a left atrial size of 3.8 vcm^2 and a left ventricular systolic ejection fraction of 60% without left ventricular hypertrophy. The patient was placed on dabigitran for 1 month prior to the ablation procedure and this was discontinued 48 hours prior to the ablation. Dabigitran, rather than warfarin, was chosen because it is the only novel oral anticoagulant that is available in Cambodia. Warfarin is generally available in Cambodia, but the lack of routine access to prothrombin time measurements can make dosing and monitoring of the drug challenging. As such, when possible dabigitran is a preferred agent. The patient's antiarrhythmic, sotalol, was also discontinued 48 h prior to the scheduled procedure.

The case was performed at Calmette Hospital in Phnom Penh, Cambodia. The hospital has 1 cardiac catheterization laboratory that is used for both interventional cardiology and electrophysiology. The room is equipped with a monoplane Toshiba fluoroscopy system. There is also a GE Pruka Cardiolab recording system with 32 channels and a Bloom stimulator. Ablation energy was delivered via an IBI generator.

The patient underwent induction of deep conscious sedation. The right and left femoral veins were cannulated using a modified Seldinger technique. Two 8 French sheaths were inserted in the right femoral vein and 1 7 French sheath was inserted in the left femoral vein. Through the left femoral vein a duodecapolar catheter (Livewire; St Jude Medical, St Paul, MN) was advanced into the coronary sinus. The patient was given a bolus of 8000 units (U) of heparin and received an additional 1000 U hourly. A transesophageal echocardiogram (TEE) probe was easily advanced into the esophagus to assist with transseptal catheterization. Using fluoroscopy and TEE imaging, a Brockenbrough needle 1 was advanced into the left atrium. We confirmed the location by TEE imaging and the presence of the mean pressure recordings. An SL 1 sheath (St Jude Medical) was then advanced into the left atrium. This procedure was repeated for the second access site.

KEYWORDS Ablation; Atrial fibrillation; Cambodia; Developing world
ABBREVIATIONS **AF** = atrial fibrillation; **TEE** = transesophageal echocardiogram (Heart Rhythm Case Reports 2015;1:360–362)

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http://dx.doi.org/10.1016/j.hrcr.2015.06.010

KEY TEACHING POINTS

- Atrial fibrillation ablation can be performed in developing countries without the aid of expensive disposable equipment and a 3D anatomic mapping system.
- Atrial fibrillation ablation is an alternative therapy to patients in the developing world and can be offered as a safe and effective treatment option.
- Operators with experience in atrial fibrillation ablation are needed to train physicians in the developing world to perform the procedure.

Through 1 sheath a bidirectional irrigated tip catheter (Safire Blue; St Jude Medical) was advanced into the left atrium. Through the other a multipolar circular electrode catheter (Inquiry Optima; St Jude Medical) was inserted into the left atrium. The catheter was advanced deep into the pulmonary veins and the sheath was then advanced over the catheter to the pulmonary vein orifice. Contrast venography was performed in all 4 of the veins. The location and general anatomies of all veins were then drawn directly onto the fluoroscopy monitor for reference using a dry-erase marker (Figure 1).

The baseline rhythm was AF with a coronary cycle length of 150−200 ms. The circular mapping catheter was positioned near the pulmonary vein ostium as delineated by venography characteristics. The ablation strategy was ipsilateral vein isolation with a wide area of circumferential ablation lesion sets. Ablative injury was delivered at 30 W in a continuous manner along the anterior walls and reduced to 20 W for 20 s intervals along the posterior walls to perform pulmonary vein isolation. After entrance block was achieved the subsequent veins were targeted. After isolation of the left-sided pulmonary veins and during isolation of the right superior pulmonary vein, the patient converted to sinus rhythm. Ablation was continued until all veins were isolated. AF was not inducible at study completion. The total procedure time was approximately 6 h and the total flouroscopy time was approximately 1 h.

Figure 1 The operator showing the ostium of the left upper pulmonary vein with the borders that were drawn with dry-erase marker.

Discussion

Several challenges were noted during the case, in comparison to an AF ablation performed in the developed world. In contrast to the equipment available in most developed nations, there is limited anesthesia technology, ultrasound imaging, and pharmacology available in Cambodia. In addition, a 3D anatomic mapping system is not available in Cambodia.

General anesthesia is frequently chosen in the developed world for sedation for AF ablations. In Calmette Hospital, the only anesthesia machine was being used concurrently in another case. Therefore, conscious sedation with a laryngeal mask airway and manual resuscitator−assisted ventilation was chosen. The patient received total intravenous general anesthesia with a combination of versed, fentanyl, and propafol. The patient remained hemodynamically stable throughout the case, with the exception of mild hypotension. As the only pressor available was phenylephrine, this was chosen and titrated to achieve a mean systolic blood pressure of 60 mm Hg.

Another unique challenge in Cambodia is the limited ultrasound equipment and experience to guide catheter-based procedures. In the developed world, an intracardiac ultrasound catheter is frequently advanced into the right atrium to visualize the intraatrial septum and locate the site of transseptal puncture. Rather, a TEE probe was borrowed from the cardiothoracic operating room and used to guide the transseptal puncture. The probe was then removed and returned to the operating room where it was directly needed for another case. Additional monitoring, including in the setting of mild hypotension, was performed using fluoroscopic imaging.

Anticoagulation is essential to minimize thromboembolic complications during AF ablation. Frequent monitoring of activation clotting times is critical in the safe use of heparin anticoagulation. Multiple factors can influence heparin kinetics during ablation and, as such, empiric dosing is limited. In this case, heparin was infused but there was no method to assess the activation clotting time. Therefore, the patient was given a bolus with a weight-based estimate of 8000 U of heparin prior to the transseptal puncture and then infused 1000 U every hour. To minimize the impact of tool-adherent thrombus, the sheaths were pulled back into the right atrium.

A 3D anatomic mapping system is frequently used in the developed world to locate the pulmonary veins, understand the left atrial anatomy, guide ablation, and minimize radiation exposure. Since there are no 3D mapping systems available in Cambodia, a pulmonary venogram at a fixed left anterior oblique angulation was performed with both long sheaths in ipsilateral veins. The venogram was performed and then the outline of the veins was traced directly on the screen. This gave a general guide to the operators of the pulmonary vein location. The circular mapping catheter was

expanded to reference the ostium and provided a dynamic general map of the anatomic location. The challenge with these alternative guidance approaches was that we became more reliant on fluoroscopy. The total exposure was more than 5 times that reported in most experienced centers in the United States.

Unfortunately, we did not have access to an esophageal temperature probe. In addition, the anesthesia status impeded the use of an esophageal probe. In this regard, the lighter anesthesia was helpful, as pain perception was used to determine if esophageal injury was developing. Fortunately, the patient did not report any pain. However, subjective reporting of esophageal pain has significant limitations in accuracy and reliability. Conscious sedation rather than general anesthesia has been shown to reduce risk of esophageal injury.[4] As such, ablation lesions on the posterior wall were limited to 20 W for 20 s each.

The challenges present in Cambodia were, in part, overcome by the experience of the operators. Combined, 2 of the operators have performed over 1000 AF ablations. When initially developed, AF ablation was performed with fluoroscopy only, without 3D anatomic mapping.[5] Fluoroscopy-guided ablation procedures, however, can expose both patients and medical staff to potentially deleterious doses of radiation. In addition, the position of multiple catheters, including the ablation catheter, can be determined and previous areas of ablation can be marked with 3D anatomic mapping. Owing to the overwhelming advantages of 3D anatomic mapping, ablation with fluoroscopy is no longer routinely performed in the developed world. In fact, in some centers the procedure is performed without the aid of fluoroscopy.[6] Given the limited technology, the experience of the first 2 operators was essential in completing the case. In order to perform these cases in the developing world, operators with experience will be essential to the training of physicians in the developed world. Once trained, operators in the developing world can perform this procedure without the aid of 3D anatomic mapping.

Postoperatively, the patient remained hemodynamically stable and was arrhythmia free. As is the custom in the country, the patient remained as an inpatient as long as she had any chest discomfort symptoms. For the first few days she reported symptoms of pericardial pain. On day 3 postablation, the patient became chest pain free and was eventually discharged. Upon presentation for her 3-month follow-up, she remained AF free and off antiarrhythmic drug therapy. Since her CHADS2 score was 1, her dabigatran was discontinued.

Conclusion

In summary, this case illustrates that there are limitations in resources that are present in the developing world, but that a complex ablation such as AF ablation can be performed safely and successfully. Despite the lack of an anesthesia machine and ultrasound imaging equipment and a 3D anatomic mapping system, the procedure could still be performed. We hope that this case serves as a guide to help electrophysiologists in developing countries that are considering AF ablation.

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