Full study title: Hemodynamics Measurement in Radiofrequency Catheter Ablation

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Introduction/Background: Catheter ablation of cardiac arrhythmia is performed to offer symptomatic relief from a variety of atrial, ventricular and atrio-ventricular rhythms. Irrigated ablation catheters are commonly used for ablation of arrhythmias arising from the left heart and coronary sinus, to mitigate potentials risks of catheter ablation, including char formation on the catheter tip[2]. These catheters contain internal channels allowing for infusion of an external fluid directly to the tip of the catheter, where the fluid is sprayed through numerous end holes allowing for cooling of the catheter ablation tip[2,3]. Normal and half normal saline are the most commonly used irrigant fluids.

Fluid filled catheters are also the primary tool utilized to assess intravascular and intracardiac pressures and hemodynamics in the cardiac catheterization suite and intensive care unit. Intravascular hemodynamics allow assessment and diagnosis of a variety of cardiac conditions which are commonly found in patient undergoing catheter ablation, including congestive heart failure, diastolic dysfunction, and valvular heart disease[4]. However, the fluid filled catheters commonly used for these assessments are single lumen and generally have a minimal diameter of 5 French for intracardiac catheters. Principles of fluid mechanics are characterized by Poiseuille's law and Bernoulli's law, which suggest that the radius of the fluid filled catheter will impact the reliability of the reading. "Dampening" of pressure waveforms are observed in smaller diameter catheters and may lead to underestimation of peak pressure and overestimation of the nadir pressure gradient.

It is unknown if transduction of pressures from the tip of an irrigated ablation catheter will yield equivalent results compared to use of a single 5F lumen catheter.

The purpose of this study is to test the hypothesis that transduction of intracardiac pressures using an irrigated ablation catheter placed as standard of care for the ablation procedure is equivalent to transduction of pressures using a standard 5F balloon tipped PA catheter placed only for this research study.

Objectives:

The main objective of this study is to take intracardiac pressure measurements and pressure waveforms with both a "gold standard" balloon tipped pulmonary artery catheter placed for this study and an irrigated ablation catheter placed as standard of care for the procedure in order to evaluate the following 2 questions:

1. Determine accuracy of intracardiac pressure measurements as assessed by the balloon tipped pulmonary artery catheter and by an irrigated ablation catheter.
2. Determine accuracy of intracardiac pressure waveforms measured by the balloon tipped pulmonary artery catheter and by an irrigated ablation catheter.

Research Design: The study will occur in patients undergoing routine cardiac ablation of his/her arrhythmia with planned use of an irrigated ablation catheter. The irrigation port of the irrigated ablation catheter will be connected via a three way stop cock to the irrigation tubing via 1 port and to a pressure transducer via the second port (see figure 1). All ports will be flushed through to the tip of the catheter to ensure no air in the line, per standard protocol. The pressure transducer will be leveled and "zeroed" per routine using CARDIOLAB software. A 5F MPA catheter will be prepared in similar fashion to the ablation, without an irrigant line running. "Zero" will be confirmed by positioning each catheter next to each other and assessing for equal waveform values.

Ablation and catheter manipulation will be done per routine under the supervision of a qualified electrophysiologist. The pressure line will be left "off" with the stopcock during the EP study and ablation, and whenever pressure assessment is not being performed.

After completion of ablation/study, the ablation catheter will be serially positioned in the cardiac chambers (left OR right atrium, left OR right ventricle). Because pressure values, slopes and characteristics are similar between the atria and ventricles, all 4 chambers will not be sampled. The stop cock will be turned to the pressure transducer and waveforms will be stored corresponding to each chamber. Next, the catheter will be removed and replaced with a 5F balloon tipped PA catheter which will be positioned under fluoroscopic guidance in each previously evaluated chamber. The placement of the balloon tipped PA catheter and measurements for this study will take about 10 additional minutes.

Figure 1: Stop cock connected to irrigant port of ablation catheter. In current position, standard irrigant is flowing through catheter via manufacturer pump.

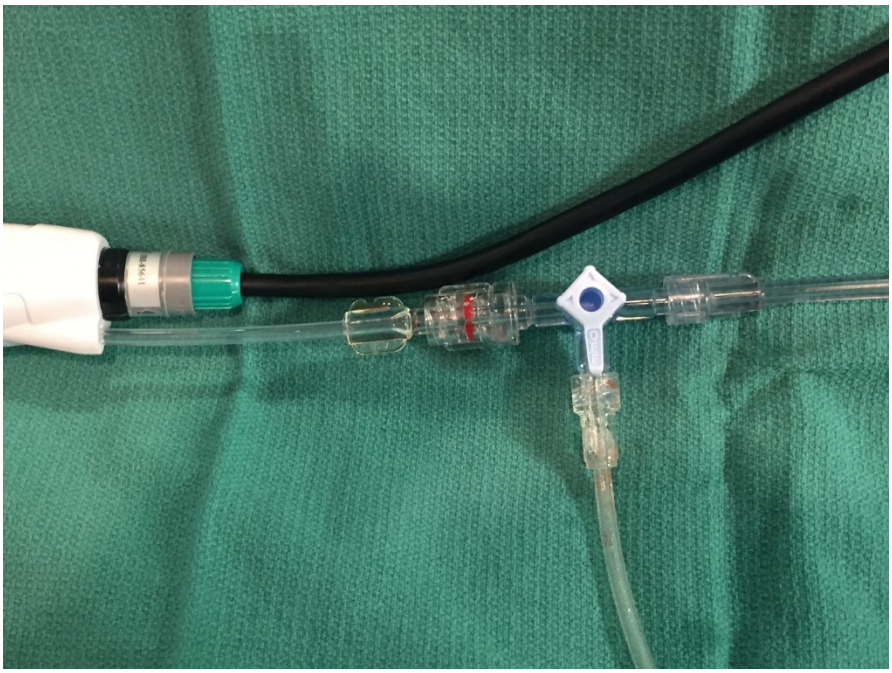
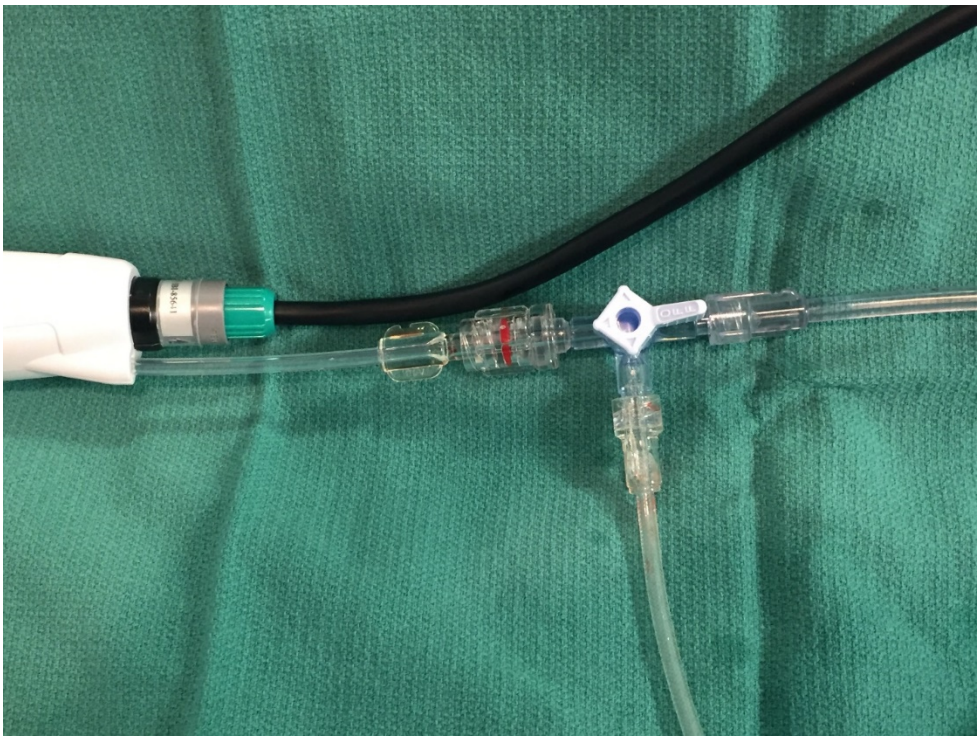


Figure 2: Stop cock is now turned to open the irrigant port to the pressure sensing line. In this configuration, pressure is transduced from the tip of the catheter.



Risks/benefits: Risks of this procedure are related to insertion of the balloon tipped pulmonary catheter into the heart. The catheter will be placed through access sites in the right and left femoral vein which are used for the ablation (no new vein access is required for this study)

Insertion risks include <1% risk of stroke, infection, damage to heart or valves or damage to conduction centers of heart.

Potential benefits to the subject include assessment and analysis of intracardiac pressures by the 'gold-standard' technique which can be useful in diagnosing conditions such as congestive heart failure, valve disease and diseases of the pericardium. Some patients develop shortness of breath after ablation procedures, and this can be prevented with assessment of intracardiac pressures after ablation. Although the purpose of this study is to assess the accuracy of these measurements from the ablation catheter, any unexpectedly abnormal patient findings such as elevated pressures or evidence of valve disease will be evaluated further per standard practice (echo, overnight observation, administering diuretic medications).

Potential benefits not to the subject include improved safety and monitoring during ablation procedures for future patients undergoing ablation.

Data to be collected: The patients' demographics, ablation indication, and prior echocardiogram study (when available) will be retrieved from chart review. The systolic, diastolic, and mean pressure values and wavform tracings for each heart chamber assessed will be collected during the procedure.

Data Storage: Data will be stored on Emory HIPAA compliant servers. All documents and information will be password protected with no information saved to personal computers.

Patient selection: Study patients will be recruited among all patients older than 18 years old undergoing elective ablation for an arrhythmia at Emory University Hospital. Up to 15 patients will be enrolled in order to obtain a minimum of 10 useable comparison datasets.

Informed Consent: Following education on the study protocol, patients will be offered the option to enroll. Informed consent will be obtained by approved research personnel in a private area. If the patient agrees to participate, consent will be documented. Consent will occur the day of the scheduled ablation procedure.

Compensation for time and effort: There is no compensation for participation in this study. This research will add about 10 minutes to the standard of care procedure. .

Data analysis: The systolic, diastolic and mean pressure values for each chamber assessed will be compared between the RF ablation catheter derived measurement and the MPA catheter measurement. Measurements will be made in duplicate for each value. Comparison will be made using T – Test and a Kappa statistic.

Waveforms will be compared using a MACLAB system, by determining a mean gradient between the two wavforms. These values will be compared using a T –Test. All analyses will be performed using Microsoft Excel and Graphpad Prism.

Safety: Positioning of both catheters (ablation catheter and PA catheter) will be done under continuous ultrasound guidance to ensure positioning of the catheter without secondary damage to the heart, heart valves or heart muscle. Fluoroscopy and 3-dimensional computer mapping will be used or immediately available for use in assisting positioning when needed. All catheter manipulation will be done by an experienced, Board certified cardiologist with greater than 10 years of experience in PA catheter manipulation and positioning (AS).

The tip of the PA catheter has a balloon which will be inflated whenever advancing the balloon forward. This reduces risk of perforation as the catheter will bounce off the walls of the heart when encountered.

The catheter will be primarily position with use of guiding catheters which are already position in the chamber of interest(s) for the purpose of the catheter ablation procedure itself. This will also help minimize risk and time associated with PA catheter manipulation.

Equipment necessary to treat potential complications of catheter manipulation such as fluid or bleeding around the heart will be immediately available in the procedure suite. Operators will be experienced and qualified to perform stabilizing and treating procedures in case of such emergency.

Safety analysis: Safety assessments will consist of monitoring and recording all adverse events and serious adverse events. While they are not anticipated, adverse events will be summarized using the frequency of subjects for each level.

Data and Safety Monitoring Plan: Oversight of the progress and safety of the trial will be provided by the PI. Adverse events are not anticipated, but any occurring will be reported to Emory IRB policies and procedures.

Monitoring will be conducted on-site as self-monitoring using the Emory IRB (CTAC) self-monitoring tool. Self-monitoring will occur after the first subject is enrolled and will also occur after 5, 10, and 15 subjects (study completion) have been enrolled. As stated the CTAC self-monitoring tool will be followed, with special emphasis on examining procedural safety

associated with the PA catheter manipulation and ensuring compliance with the measurement technique as stated in the protocol. Any reportable safety event or reportable protocol deviation will be promptly reported to the Emory IRB.

Confidentiality: Patients will be assigned an identifier number. Data will be stored on a secure drive supported by Emory healthcare. Only pertinent members of Emory Healthcare/ SOM who have undergone HIPAA training will have access to the spreadsheet. PHI information including the informed consent forms will be stored in a locked space in the PI's office.

References:

1. Page RL et. al. 2015 ACC/AHA/HRS guideline for the management of adult patients with supraventricular tachycardia: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol 2016;67;e27–115.

2. Thomas SP et. al. A comparison of open irrigated and non-irrigated tip catheter ablation for pulmonary vein isolation. Europace. 2004 Jul;6(4):330-5.

3. Chinitz LA et. al. Safety and efficiency of porous-tip contact-force catheter for drug-refractory symptomatic paroxysmal atrial fibrillation ablation: results from the SMART SF trial. Europace. 2018 Nov 1;20(FI_3):f392-f400. doi: 10.1093/europace/eux264.

4. Nossaman BD, et. al. History of Right Heart Catheterization: 100 Years of Experimentation and Methodology Development Cardiol Rev. 2010 Mar–Apr; 18(2): 94–101.