Rebooting Atrial Fibrillation Ablation in the COVID-19 Pandemic

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Abstract

Background: Catheter ablation procedures for atrial fibrillation (AF) were significantly curtailed during the peak of coronavirus disease 2019 (COVID-19) pandemic to conserve healthcare resources and limit exposure. There is little data regarding peri-procedural outcomes of medical procedures during the COVID-19 pandemic. We enacted protocols to safely reboot AF ablation while limiting healthcare resource utilization. Objective: To evaluate acute and subacute outcomes of protocols instituted for reboot of AF ablation during the COVID-19 pandemic. Methods: Perioperative healthcare utilization and acute procedural outcomes were analyzed for consecutive patients undergoing AF ablation under COVID-19 protocols (2020 cohort; n=111) and compared to those of patients who underwent AF ablation during the same time period in 2019 (2019 cohort; n=200). Newly implemented practices included pre-operative COVID-19 testing, selective transesophageal echocardiography (TEE), utilization of venous closure, and same-day discharge when clinically appropriate. Results: Pre-ablation COVID-19 testing was positive in 1 of 111 patients. There were 0 cases ablation-related COVID-19 transmission, and 0 major complications in either cohort. Pre-procedure TEE was performed in significantly fewer 2020 cohort patients compared to the 2019 cohort patients (68.4% vs. 97.5%, p <0.001, respectively) despite greater prevalence of persistent arrhythmia in the 2020 cohort. Same day discharge was achieved in 68% of patients in the 2020 cohort, compared to 0% of patients in the 2019 cohort. Conclusions: Our findings demonstrate safe resumption of complex electrophysiology procedures during the COVID-19 pandemic, reducing healthcare utilization and maintaining quality of care. Protocols instituted may be generalizable to other types of procedures and settings.

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Key Words

COVID

Atrial Fibrillation

Catheter Ablation

Radiofrequency Ablation

Procedural Outcomes

Abbreviations

COVID-19 – Coronavirus Disease 2019

PPE – personal protective equipment

AF – atrial fibrillation

NYU – New York University

PCR – polymerase chain reaction

Introduction:

Coronavirus disease 2019 (COVID-19) resulted in curtailment of non-emergent medical care in order to limit exposure to patients and healthcare workers and preserve limited personal protective equipment (PPE) [1]. Meeting the challenges of peak COVID-19 infection resulted in reassignment of hospital beds and repurposing of personnel throughout the United States. Electrophysiology programs like ours, in accordance with recommendations collectively provided by professional societies[1,2] and local regulations prioritized urgent electrophysiological procedures during periods of high healthcare utilization related to COVID-19[3]. These efforts have helped to minimize patient and health care professional exposure by postponement of elective cases and careful management of urgent or otherwise time-sensitive conditions.

As local COVID-19 cases ebb and healthcare resource availability is less constrained, uncertainty remains regarding best practices for re-initiating less urgent procedures. In addition, there has been increasing recognition of morbidity and mortality associated with delays in cardiac care, including arrhythmia procedures such as ablation for those with severe symptoms from atrial fibrillation (AF) or atrial flutter[4].

Catheter ablation of AF is most frequently performed with overnight post-procedure monitoring. Rhythm control via cardioversion or catheter ablation is an important means of reducing AF related hospitalization[5]. The limited prior literature regarding the safety of same-day discharge following AF ablation has included procedures performed under conscious sedation[6], using Cryoballoon technology, and/or with 4 hour post-procedure bed-rest[6]. A minority of patients were discharged on the day of catheter ablation in a recent study reporting outcomes of same-day discharge following radiofrequency ablation of AF under general anesthesia[7]. We sought to implement policies and procedures to ensure safety of patients and healthcare workers, while reducing utilization of healthcare resources and maintaining quality of care for AF ablation performed under general anesthesia with high-frequency jet ventilation. We systematically evaluated acute and subacute outcomes of these interventions as a quality initiative.

Methods:

All elective procedures in New York City were cancelled following an executive order on March 16, 2020, and on June 8, 2020 all New York City Hospitals were authorized to resume elective procedures. In the period between March 16, 2020 and June 8, 2020, as safety protocols were enacted and healthcare resources became more available, medically necessary, non-emergent procedures were performed after detailed discussion of risks and benefits with patients. Patients were prioritized based on severity of AF related symptoms, cardiomyopathy risk, and frequency of AF related healthcare utilization.

Baseline characteristics and clinical outcomes were evaluated in two cohorts of consecutive patients undergoing catheter ablation of AF or prior AF-ablation related atrial arrhythmia at New York University (NYU) Langone Health. The 2020 cohort included 111 patients that underwent catheter ablation between April 15, 2020 and June 15, 2020 with COVID-19 related policies and procedures in-effect, and the 2019 cohort included 200 consecutive patients that underwent catheter ablation between April 15, 2019 and June 15, 2019. All electrophysiology lab staff underwent COVID-19 nasal polymerase chain reaction (PCR) testing and were monitored for new COVID-19 infection symptoms throughout the study period. In-hospital time was defined as time from presentation to the electrophysiology lab pre-operative area to the time of discharge from the hospital.

COVID-19 Related Interventions

Interventions to ensure the safety of patients and healthcare workers while reducing utilization of healthcare resources in 2020 cohort included:

- Pre-operative COVID-19 nasal PCR
- Appropriate personal protective equipment use by all hospital staff
- Periprocedural mask use by all patients
- Case-by-case assessment for omission of pre-ablation transesophageal echocardiography (TEE)
- Post-ablation echocardiographic pericardial evaluation to rule-out pericardial effusion
- Venous closure of two, unilateral venous access sites to allow ambulation 2 hours after sheath removal[8]
- Same day discharge when clinically appropriate
- Staged re-introduction of limited visitors with monitoring for appropriate PPE

Electrophysiology Study and Ablation

Data collection and analysis were performed according to protocols approved by the NYU Langone Health Institutional Review Board. Surface and intracardiac electrograms were digitally recorded and stored (EP Workmate, Abbott Medical, Inc.,). Non-fluoroscopic 3-dimensional mapping was performed using the Carto 3 (Biosense-Webster, Inc.,) mapping system.

All procedures were performed under general anesthesia with high frequency jet ventilation. A 7-French 20-pole catheter (Daig DuoDeca 2-10-2, Abbott Medical, Inc.) was used with the distal poles placed within the coronary sinus and the proximal electrodes located along the tricuspid annulus in the lateral and inferior right atrium. For left atrial mapping and recording, a 10- or 20-pole circumferential PV mapping catheter (Lasso, Biosense-Webster, Inc.), or a five-spline mapping catheter (PentaRay Nav, Biosense-Webster, Inc.) was utilized. Left atrial three-dimensional anatomy and voltage mapping was created with manipulation of the multi-electrode mapping catheter. Ablation was performed in each group with an open-irrigated, 3.5-mm RFA catheter (Thermocool SMARTTOUCH SF, Biosense Webster Inc.). Ablation lesions were generated in a power-controlled mode applying 35 to 50 W for 6 to 30 seconds per lesion during irrigation at a rate of 8 to 15-mL/min while maintaining a goal ACT of > 350 seconds. A waiting period of 30 minutes, followed by administration of adenosine, was utilized to confirm pulmonary venous entrance and exit block. A major complication is a complication that results in permanent injury or death, requires intervention for treatment, or prolongs or requires hospitalization for more than 48 hours[9]. All patients received in-person or telehealth post-procedure follow-up 10 to 20 days after discharge, and all patient charts were reviewed 30 days after discharge.

Statistical Analysis

The statistical analysis was performed using Stata version 14.0 (StataCorp LLC, College Station, TX). Descriptive statistics were used to summarize demographic characteristics. Continuous variables were assessed for normality with the Kolmogorov-Smirnov test. All normally distributed data were analyzed using an unpaired Student t test. A 2-tailed P value < 0.05 was considered statistically significant. Data found to be non-normally distributed were analyzed using Mann–Whitney U test. Comparisons of proportions between different groups of patients were carried out using a Chi square and Fisher's exact test.

Results

Baseline Characteristics

Baseline characteristics of the 2020 cohort and the 2019 cohort are displayed in Table 1. Patients in the 2020 cohort were more likely to have prior history of stroke/transient ischemic attack (TIA) in comparison to the 2019 cohort (14% and 6%, p=0.03), and more often presented with persistent atrial arrhythmia (50% and 32% respectively, p<0.01). On the first day of the study period (4/15/20), there were 9,282 COVID-19 tests performed in New York City, of which 4,368 (38%) were positive tests[10]. On the last day of the study period (6/15/20) there were 25,754 COVID-19 tests performed in New York City, of which 639 (1.7%) were positive tests[10].

Procedural outcomes

All 111 patients in the 2020 cohort underwent preoperative COVID-19 nasal polymerase chain reaction (PCR) testing, of whom 1 (0.9%) asymptomatic patient tested positive. Following detailed discussion of risks and benefits with patient and healthcare staff, the procedure was completed in this patient without acute complication. COVID-19 nasal PCR testing was performed on the day of the procedure in 29 of 111 patients (26%), and 1-3 days prior to the procedure in 82 of 111 patients (74%). At 30 days follow-up, 0 of 110 (0%) patients of 2020 cohort were diagnosed with new COVID-19 infection. Fewer patients underwent preoperative TEE in 2020 compared to 2019 (76 of 111 patients (68.4%) vs. 195 of 200 patients (97.5%), respectively, p<.001).

Same day discharge was achieved in 76 of 111 patients (68.4%) in the 2020 cohort compared to 0 of 200 patients (0%) in the 2019 cohort. Overnight observation was required in 35 of 111 patients (31.6%) patients. The most common reason for overnight observation was late procedure end time (n = 13, Table 3). Median 2020 cohort in-hospital time was significantly shorter than that of the 2019 cohort (12h [IQR 11h – 26h] vs. 29h [IQR 28h – 31h], $p < 0.001$, Figure 1).

There were no major complications in either cohort, and there was no significant difference in overall procedure-related complications at 30 days between the 2020 cohort and the 2019 cohort (5.4% and 4.5% respectively, p=0.71, Table 2). Two patients (2%) developed heart failure exacerbation requiring hospitalization or emergency room visit in the 2020 cohort compared to 3 patients (1.5%) in the 2019 cohort (p=0.83).

Discussion:

The COVID-19 global pandemic continues regional resurgence despite containment efforts. Following the initial peak of local infection in New York City, as healthcare resource availability allowed resumption of non-emergent procedures, we instituted measures to ensure patient and hospital staff safety while reducing healthcare resource utilization. Our key COVID-19 pandemic related interventions included: 1) COVID-19 nasal PCR testing for all electrophysiology lab staff, and for all patients within 72 hours prior to a scheduled ablation procedure, 2) Reducing pre-procedure TEE utilization, 3) Utilization of a venous closure device to facilitate early ambulation and same-day discharge, 4) staged re-introduction of limited visitors with monitoring for appropriate PPE.

The main findings of our reboot of AF ablation in the setting of significant local COVID-19 prevalence are: 1) Zero new COVID-19 infections in patients 30 days post ablation, 2) Zero cases of new COVID-19 infections amongst electrophysiology lab staff, 3) Same day discharge achieved in 68% of patients in the 2020 cohort,

compared to 0% of patients in the 2019 cohort, 4) Significantly reduced median duration of hospitalization in the 2020 cohort compared to the 2019 cohort (12h vs. 29h, p<0.001, respectively), 5) Significantly reduced utilization of pre-procedure TEE in the 2020 cohort compared to the 2019 cohort (68.4% vs. 97.5%, p <0.001, respectively) despite greater prevalence of persistent arrhythmia in the 2020 cohort.

In contrast to prior reports of same-day discharge after AF ablation, all patients in our 2020 cohort underwent radiofrequency ablation under general anesthesia with high-frequency jet ventilation. Additionally, 2020 cohort patients had a higher prevalence of comorbidities including stroke/TIA, and persistent atrial arrhythmias when compared to patients in the 2019 cohort. Despite these patient characteristics and accelerated post-ablation discharge, there was no significant difference in the procedure related complications between cohorts. The advantage of same day discharge was two-fold. First, this reduced the probability of patients' COVID-19 exposure and second, it reduced the need for overnight observation beds which could be potentially utilized for patients with acute illnesses during the pandemic.

Limitations

This is a single-center, non-randomized, observational study, thus the generalizability of these findings remains unclear. While outcomes are reported for a single procedure type, radiofrequency ablation of atrial fibrillation under general anesthesia is a complex procedure performed in patients with substantial comorbidities.

Conclusion:

Our findings demonstrate safe resumption of complex electrophysiology procedures, reducing healthcare utilization and maintaining quality of care. COVID-19 pandemic related interventions that we undertook to "reboot" AF ablation in the electrophysiology lab may be generalizable to other types of procedures and settings.

Perspectives

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Tables and Figures Table 1: Baseline characteristics

	All patients (n = 311)	**2020 (n = 111)**	**2019 (n = 200)**	**P**
Age (yrs)	66 + 11	67 + 10	66 + 12	0.4
Male (%)	205 (66)	77 (69)	128 (64)	0.6
BMI (Kg/m^2)	29 + 6	29 + 6	29 + 6	1
Creatinine (mg/dL)	1.0 + 0.3	1.0 + 0.3	1.0 + 0.3	0.2
LA diameter (cm)	4.3 + 0.7	4.0 + 0.7	4.3 + 0.7	0.3
Ejection Fraction (%)	58 (10)	58 (12)	58 (9)	0.7
CHA_2DS_2-VASc	2.4 + 1.7	2.0 + 1.6	2.4 + 1.7	0.8
Hypertension (%)	188 (61)	71 (64)	117 (59)	0.5
Diabetes (%)	45 (15)	12 (11)	33 (16)	0.2
Coronary Disease (%)	57 (18)	20 (18)	37 (18)	0.9
Stroke or TIA (%)	27 (9)	15 (14)	12 (6)	0.03
Heart Failure (%)	48 (15)	16 (14)	32 (16)	0.7
Persistent AF (%)	121 (39)	56 (50)	65 (32)	<0.01

Table 2: Procedure related complications

	2019 n=200 (%)	**2020 n=111 (%)**	**P value**
Major Complications	0 (0)	0 (0)	1
CHF exacerbation	3 (1.5)	2 (1.8)	0.8
Transient Ischemic Attack	1 (0.5)	0 (0)	0.9
Access site hematoma	1 (0.5)	1 (0.9)	0.7
Pericarditis	1 (0.5)	1 (0.9)	0.7
Anesthesia related	3 (1.5)	2 (1.8)	0.8
All complications	9 (4.50)	6 (5.4)	0.7

Data presented as number of patients (%). CHF: congestive heart failure

Table 3: Reasons for overnight observation in 2020

Reason for overnight observation	**Number of patients**
Late procedure end time	13
Patient preference	4
Groin access site bleeding	3

Reason for overnight observation	Number of patients
Discharge planning	2
Anesthesia complications	3
Escort unavailable	2
Vasovagal episode	2
Post-operative bradycardia	2
Urinary retention	2
Pulmonary edema	1
Post-operative hypotension	1

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Figure 1. Scatter plot displaying length of stay in hours for the 2020 cohort of atrial fibrillation ablation patients under COVID-19 protocols and the 2019 cohort of atrial fibrillation ablation patients under usual care.