

Feasibility of remote technical support for electrophysiological ablation procedures during the current COVID-19 pandemic

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Aims

The treatment of heart rhythm disorders has been significantly impacted by direct consequences of the current COVID-19 pandemic, as well as by restrictions aimed towards constraining viral spread.

Methods and results

Usually, catheter ablations of cardiac arrhythmias are guided by electro-anatomic mapping (EAM) systems. Technical staff with medical training, or medical staff with technical training, are needed to assist the operator. Travel restrictions due to the current COVID-19 pandemic have limited the in-person availability of technical support staff. To overcome these limitations, we explored the feasibility of a trans-atlantic remote technical support for EAM, with an internet-based communication platform, for complex electrophysiological ablation procedures.

Conclusion

Our first experience, based on nine ablation procedures of different arrhythmias, highlights the feasibility of this approach. Remote support for EAM might therefore facilitate continuous care for patients with arrhythmias during the COVID-19 pandemic, particularly in insular settings. Beyond COVID-19-related challenges, this approach will likely play a greater role in the cardiology field in years to come, due to its significant advantages.

Graphical Abstract



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Keywords

Remote support • Electro-anatomic mapping system • Arrhythmias • Catheter ablation
• COVID-19 • Telemedicine

Introduction

The COVID-19 pandemic with more than 282 million infections and more than 5,4 million deaths worldwide (December 2021) is a global challenge.^{1,2}

The treatment of heart rhythm disorders has been impacted by direct consequences of the disease itself, as well as restrictions aimed towards constraining SARS-CoV-2 viral spread.³ The number of cardiac procedures performed has decreased since pandemic onset.^{4,5}

Usually, catheter ablations of cardiac arrhythmias are guided by EAM (electro-anatomic mapping) systems.⁶ Technical staff with medical training, or medical staff with technical training, are needed to apply this technology in clinical routine. Travel restrictions due to the current COVID-19 pandemic have limited the onsite availability of technical support staff.

To overcome these limitations, we aim to explore the feasibility and safety of a trans-atlantic remote technical support for EAM, via an internet-based communication platform, during complex electrophysiological ablation procedures in an insular setting.

Methods

Patients with different tachyarrhythmias, admitted for ablation procedures in our electrophysiology (EP) lab between October 2020 and February 2021, were included. All patients provided written informed consent prior to participation. All study procedures complied with the Declaration of Helsinki and concurred with the ethical standards of the University Hospital of Martinique's Institutional Review Board (IRB; reference number MR-004).

Patients were studied under general anaesthesia. Remote support by an internet-based communication platform was used to support EAM of EP ablation procedures. As communication platform, we used Microsoft Teams to establish a remote connection between the EP lab of our centre at the University Hospital of Martinique (French overseas territory, Caribbean region) and the technical support engineer based in Mainland France, about 7000 km across the Atlantic Ocean. Computers on both sides were equipped with loudspeakers, headphones, and microphones (Figure 1). During the procedures, mapping (geometry, activation, voltage) and tagging of the ablation sites were performed using the EAM systems NavX Ensite (Abbott, St. Paul, MN, USA) with the help of remote technical support. The camera in the EP lab was directed towards the screen of the EAM system, which was then simultaneously displayed on the screen of the remote technical support engineer. The EAM system was manipulated by a nurse who could communicate via Microsoft Teams with the technical support whenever needed (Figure 1).

Acute procedural success was defined according to procedure type: pulmonary vein isolation with proven entry and exit block for patients with atrial fibrillation; evidence of bidirectional block for patients with typical atrial flutter; non-inducibility for patients with VT and left atrial flutter.

Patients were routinely seen for a follow-up visit in the outpatient clinic 4–12 weeks after the procedure.

Statistical analysis of patients' characteristics and procedural data was performed with SPSS 20.0.0.

Results

Patient characteristics

Overall, 9 (25%) out of a total of 36 ablation procedures were conducted with remote support for EAM during the study period. These nine patients were predominantly male (77.8%) with a mean age of 62 ± 14 years and different arrhythmias (atrial fibrillation, left atrial flutter, typical right atrial flutter, and ventricular tachycardia; Table 1).

Procedure characteristics

Sound and imaging transmission between the EP lab and the remote technical support via the internet communication platform were of good quality and stable during all procedures.



Figure 1 Illustration of the remote support for the electro-anatomic mapping system. This figure symbolically illustrates the remote support for the electro-anatomic mapping system. It displays the onsite operator performing a complex ablation procedure in the electrophysiology lab with the patient and an anaesthesiology nurse next to the head of the patient. It also displays the electrophysiology nurse manipulating the electro-anatomic mapping system and the remote electro-anatomic mapping support engineer assisting the procedure in real time from a distant working place. During the procedure, the operator and the electrophysiology nurse directly communicate with each other, whereas the communication between the operator and the electrophysiology nurse with the remote electro-anatomic mapping support engineer is enabled by the internet communication platform.

Table 1 Description of baseline patient and procedural characteristics during electrophysiological ablation procedures using remote electro-anatomic mapping technical support

Patient number	Gender	Age (years)	Arrhythmia	Type of procedure	Procedure time (min)	Fluoroscopy time (mins)	Fluoroscopy dose (cGycm ²)	Ablation time (mins)	Acute procedural success	Complications
1	Male	73	AF, Aflu	PVI, CTI	190	16:45	683.5	28:06	Yes	No
2	Male	83	Left Aflu	Anterior mitral isthmus line	195	9:56	214.2	9:00	Yes	No
3	Male	62	AF	PVI	145	7:54	217.2	15:27	Yes	No
4	Male	63	Aflu	CTI	120	6:42	327.7	17:52	Yes	No
5	Male	64	VT in non-compaction cardiomyopathy	VT ablation	225	22:35	1208.5	29:25	Yes	No
6	Female	77	Aflu, inferior vena cava occlusion	CTI via right axillary vein	180	49:49	1096.7	5:46	Yes	No
7	Male	45	AF, Aflu	PVI, CTI	105	6:51	309.0	15:54	Yes	No
8	Female	46	AF	PVI	145	8:43	100.8	23:09	Yes	No
9	Male	47	Aflu	CTI	60	2:08	77.5	3:04	Yes	No

University Hospital of Martinique, October 2020 to February 2021.

AF, atrial fibrillation; Aflu, typical atrial flutter; CTI, cavotricuspid isthmus; left Aflu, left atrial flutter; PVI, pulmonary vein isolation; VT, ventricular tachycardia.

Accuracy and stability of the maps (geometry, voltage, activation), assessed solely on the basis of the operators' experience, were also deemed of sufficient quality. No map shift was observed.

Mean procedure time was 152 ± 52 min. Mean fluoroscopy time and dose were respectively $14:35 \pm 14:31$ min:s and 470.6 ± 425.7 cGycm². Acute procedural success was obtained in nine out of nine procedures. No complication occurred during the intervention and during the follow-up period.

Discussion

The purpose of this study is to describe the feasibility of combining two established technologies for EP ablation procedures: an EAM system and an internet-based communication platform.

The initial motivation behind exploring the possibility of remote support for EAM was COVID-19-related travel restrictions, which impeded in-person presence of the EAM technical support. The distance between our centre on the French Caribbean island of Martinique and the technical support in mainland France is about 7000 km.

For these, first nine cases in our series, we observed relatively long procedure and fluoroscopy times. Reasons were procedures with difficult anatomy, a team at the beginning of the learning curve in terms of EAM with remote support and minor technical problems. As we continue to apply this approach in the future, we will likely reduce both procedure and fluoroscopy times.

We did not observe complications either during the procedures or the follow-up period. Nevertheless, a larger number of patients and a longer follow-up is needed to evaluate the safety of this method. The efficacy of the latter could also not be sufficiently evaluated due to the small number of patients and a lack of randomization.

An important issue in telemedicine is security. Whereas no software can guarantee complete security against unknown threats, it is important to incorporate technologies to make internet communication platforms less vulnerable. The internet communication platform Microsoft Teams features a multifactor authentication with encrypted data and may therefore be considered as relatively safe.⁷ A software solution allowing a complete integration of remote access to the EAM system may further improve benefits and accessibility.

A malfunction of the EAM system would have affected procedure completion and safety. Nevertheless, this risk is independent of the use of internet-based remote communication to guide the EAM system.

Conclusion

Our first experience with remote support for EAM for complex electrophysiological ablation procedures shows the feasibility of this approach. A remote support for EAM may therefore facilitate continuous care for patients with arrhythmias during the COVID-19 pandemic. Beyond COVID-19-related challenges, this approach will likely play a greater role in the cardiology field in years to come, due to its potentially significant advantages.

Conflict of interest: none declared.

Data availability

The data underlying this article are available in the article

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