A practical guide for building a highway between atria during transseptal puncture without radiation

Yuan Yuan[1,#], Deyong Long[2,#], Caihua Sang[2], Ling Tao[1], Jianzeng Dong[2], Changsheng Ma[2]

[1]Department of Cardiology, Xijing Hospital, Fourth Military Medical University; Xi'an-*China*
[2]Department of Cardiology, Beijing Anzhen Hospital, Capital Medical University; Beijin-*China*

Abstract

Objective: To investigate whether switching the ablation catheter between the right and left atria through transseptal puncture site can be accurately performed without fluoroscopy.
Methods: Forty patients with persistent atrial fibrillation (mean age, 60.2±7.4 years; 65% males) got "2C3L" approach were randomized in a 1:1 ratio to undergo either crossing interatrial septum guided by fluoroscopy (trackless group) or crossing septum guided by track image that was mapped by Carto3 system (track group).
Results: The three-dimensional image of the track could be mapped smoothly and shown clearly. No significant differences were found in the success rates between the two groups (100% vs. 100%, p>0.05). However, the procedure of crossing septum was completed without any fluoroscopy use in track group, which showed a shorter procedure time than trackless group (4±3 s vs. 20±10 s, p<0.01).
Conclusion: Visualizing the track passing through the puncture site using Carto3 system can guide the ablation catheter in safely crossing the intra-atrial septum quickly with zero fluoroscopy. *(Anatol J Cardiol 2017; 17: 470-2)*
Keywords: transseptal puncture, interatrial septum, atrial fibrillation, catheter ablation, fast anatomical mapping

Introduction

To gain access to the left side of the heart, a transseptal puncture (TSP) is required (1). At our center, a routine "2C3L" technique is used in patients with persistent atrial fibrillation (AF); this is a fixed ablation approach consisting of bilateral circumferential pulmonary vein antrum isolation and three linear ablation lesion sets across the mitral isthmus, left atrial roof, and cavotricuspid isthmus (2–4). Thus, the ablation catheter often needs to be switched between the left and right atria intentionally or unintentionally during ablation. The ablation catheter can be introduced into the left atrium through a puncture site using three-dimensional (3D) mapping system as well as fluoroscopy. In the present study, a track between biatrium through a puncture site was restructured using the former without the use of an x-ray and was referred to as a highway between the right and left atria.

Methods

Patient population

A total of 40 patients randomized in a 1:1 ratio; 20 patients in each group (mean age, 60.2±7.4 years; 65% males) with persistent AF undergoing TSP and catheter ablation at the Anzhen Hospital from September to October 2015 were recruited. The ablation catheter needed to be switched between biatrium in all patients. Searching for the puncture site was guided by fluoroscopy at right anterior oblique (RAO 30°) view in 20 patients (trackless group). Mapping the track between biatrium through puncture site using fast anatomic mapping (FAM) with Carto3 system (Biosense Webster, Diamond Bar, CA, USA) was applied in remaining 20 patients (track group). Procedure time refers to the time taken to switch catheter from right atrium to left atrium, namely the time needed for crossing intra-atrial septum. The study protocol was approved by the local Institutional Review Board. Informed consents were taken from all patients involved in the study.

The protocol of visualizing this track is as follows:

Step 1: Advance the SL1 Schwatz sheath and catheter into the left atrium. Tip the catheter outside of the sheath.

Step 2: Launch the FAM function of Carto3 system

Step 3: Fix the sheath with the left hand, and then, withdraw the catheter back into the sheath with the right hand smoothly until the catheter goes back into the right atrium; this is the procedure for FAM track.

[#]Yuan Yuan and Deyong Long equally to this work.
Address for correspondence: Changsheng Ma, Jianzeng Dong, MD, 2 An Zhen Rd, Chao Yang District, Beijing, 100029-*China*
Phone: +86 10 64456412 Fax: +86 10 64456078 E-mail: chshma@vip.sina.com, jz_dong@126.com
Accepted Date: 12.01.2017 **Available Online Date:** 09.03.2017

DOI:10.14744/AnatolJCardiol.2017.7525

Step 4: Stop FAM function when a 3D track image is mapped.

Step 5: Show the 3D track image when the catheter needs to be advanced into the left atrium in the RAO 30° and left anterior oblique 45° projections.

It is critical to ensure that the sheath and catheter are in the left atrium before FAMing and to keep the sheath fixed in the left atrium during the whole process of FAM. This means that the ablation catheter is moved within the lumen of the sheath. In other words, what we are FAM is outline of sheath. Besides that, the operator can also start from step 3 when FAMing the left atrium.

Statistical analysis

Data are presented as mean±standard error of the mean. The difference in processing time between the two groups was analyzed using Student's t-test and SPSS 10.0. A p value <0.05 was considered significant.

Results

The 3-D track image could be quickly mapped and clearly shown by Carto3 system (Fig. 1, 2). Crossing septum needed to be performed three to four times on an average in each patient who underwent "2C3L" approach. No significant differences were found in the success rates between the two groups (100% vs. 100%, p>0.05). However, the puncture site often needed to be searched for several times in trackless group but only once in track group. The procedure was performed within a mean duration of 20±10 s in trackless group but 4±3 s in track group. Compared with trackless group, the procedure time guided by the track image in track group was reduced significantly (p<0.01). In addition, zero-fluoroscopy time was achieved in all patients in track group. No iatrogenic complications occurred in both groups.

Discussion

TSP and catheter ablation are commonly required in the treatment of left atrial arrhythmia (AF, atrial tachycardia, and atrial flutter). But the atrial septum often needs to be recrossed by the catheter; the catheter also needs to be switched between biatrium during ablation, such as diagnosis and treatment of complicated atrial arrhythmia (5, 6) or incautiously falling into the right atrium.

Sometimes crossing the septum through puncture site may be more difficult because of distorted atrial septum, atrial septal occlude, inability to locate the fossa ovalis, or increased septal thickness caused by the previous puncture (7, 8). Furthermore, the puncture site cannot be directly identified. Therefore, showing the track between biatrium will be helpful in accurately locating this channel and prevent blind poking. Besides that, zero-fluoroscopy approach is welcomed by both patients and doctors (9). Obviously, the catheter can be rapidly and accurately advanced into the left atrium along the track that we presented with zero fluoroscopy. Our results suggest that visualization of the track is a more practical method for locating the puncture site and shortening the procedure time; it has become a regular approach at our center (10–12).

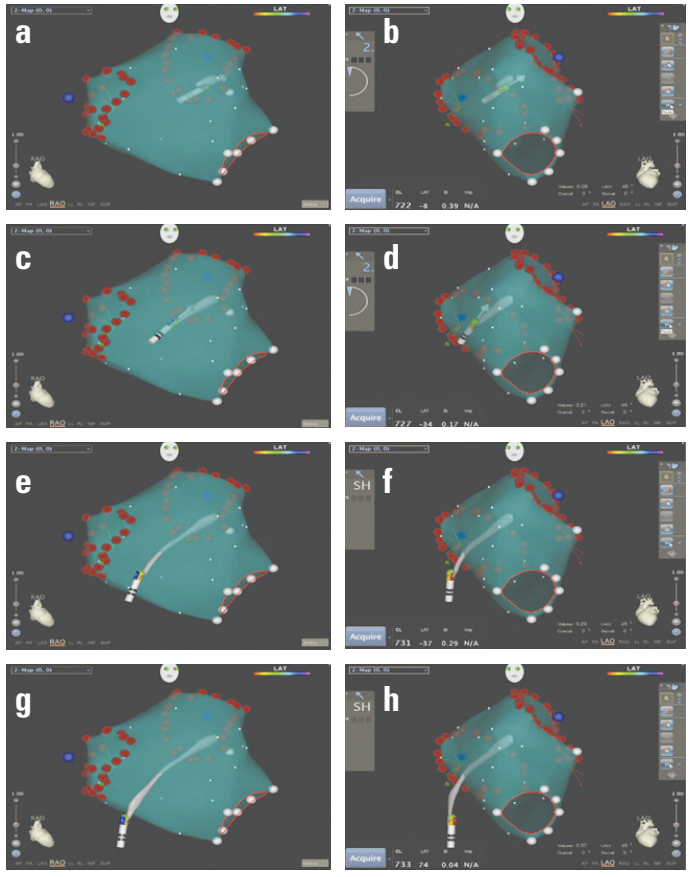

Figure 1. Procedure of mapping the track. The endocardial shell of the left atrium was represented on a semi- transparent background. The distal of SMARTTOUCH (ST) catheter was positioned inside the left atrium and outside the SL1 sheath at RAO 45°and LAO 45° view. Meanwhile, the track (white bar) was mapped using FAM function with Carto3 system (a and b). Fixing the sheath and pulling the catheter back into the sheath spontaneously (c and d). Pulling the catheter pass through the puncture site and back to the right atrium (e–h)

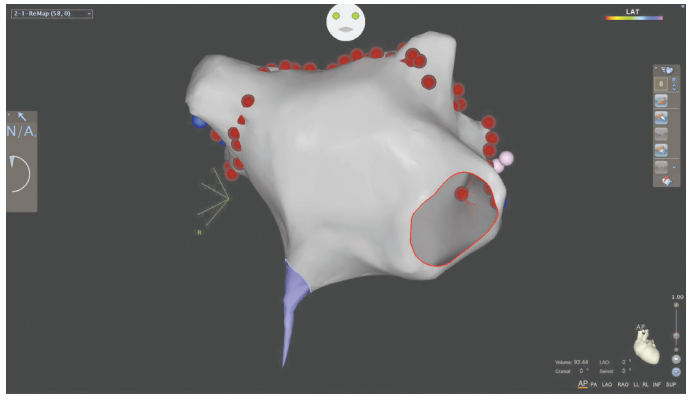

Figure 2. The endocardial shell of the left atrium was created by FAM function with Carto3 system. The track (blue bar) was mapped by pulling the ST catheter out of the left atrium pass through the puncture site

Study limitations

Our study population consisted of only 20 patients in each group; therefore, this is a small number from which to make inferences regarding speed values. Moreover, the operators at our center are relatively experienced, so additional studies are required to validate this technique in the novice.

Conclusion

Mapping of the track between biatrium allows a significant reduction in fluoroscopy times during radiofrequency ablation procedures for complicated atrial arrhythmias and makes the procedure of crossing interatrial septum safe, simple, and fast.

Acknowledgments: This work was supported by the National Natural Science Foundation of China (81470464, 81530016 and 81270261).

Conflict of interest: None declared.

Peer-review: Externally peer-reviewed.

Authorship contributions: Concept – D.L., J.D., C.M.; Study design – D.L., J.D., C.M.; Supervision – D.L., J.D., C.M.; Fundings – J.D., C.M.; Materials – J.D., C.M.; Data collection and/or processing – Y.Y., C.S., L.T.; Analysis and/or interpretation – Y.Y., D.L., C.S.; Literature Review – Y.Y., D.L., C.S.; Writer – Y.Y., D.L., C.S., L.T.; Critical Review – Y.Y., D.L., C.S., L.T.

References

1. Earley MJ. How to perform a transseptal puncture. Heart 2009; 95: 85-92.
2. Dong JZ, Sang CH, Yu RH, Long DY, Tang RB, Jiang CX, et al. Prospective randomized comparison betweena fixed '2C3L' approach vs. stepwise approach for catheter ablation of persistent atrial fibrillation. Europace 2015; 17: 1798-806.
3. Klimek-Piotrowska W, Hołda MK, Koziej M, Hołda J, Piątek K, Tyrak K, et al. Clinical anatomy of the cavotricuspid isthmus and terminal crest. PLoS One 2016; 11: e0163383.
4. Cho Y, Lee W, Park EA, Oh IY, Choi EK, Seo JW. The anatomical characteristics of three different endocardial lines in the left atrium: evaluation by computed tomography prior to mitral isthmus block attempt. Europace 2012; 14: 1104-11.
5. Morady F, Oral H, Chugh A. Diagnosis and ablation of atypical atrial tachycardia and flutter complicating atrial fibrillation ablation. Heart Rhythm 2009; 6: S29-32.
6. Alhajiri A, Ramadan MM, Senior R. Left atrial enlargement causing dysphagia and weight loss: a rare contraindication for catheter ablation therapy in a patient with complex atrial arrhythmia. Int J Cardiol 2014; 177: e111-2.
7. Klimek-Piotrowska W, Hołda MK, Koziej M, Piątek K, Hołda J. Anatomy of the true interatrial septum for transseptal access to the left atrium. Ann Anat 2016; 205: 60-4.
8. Gul EE, Baranchuk A, Glover BM. A Guide to Transseptal Access. Can J Cardiol 2016 Oct 21. Epub ahead of print.
9. Lim HE, Choi CU, Na JO, Choi JI, Kim SH, Kim JW, et al. Effects of iatrogenic myocardial injury on coronary microvascular function in patients undergoing radiofrequency catheter ablation of atrial fibrillation. Circ Arrhythm Electrophysiol 2013; 6: 318-26.
10. Winkle RA, Mead RH, Engel G, Patrawala RA. The use of a radiofrequency needle improves the safety and efficacy of transseptal puncture for atrial fibrillation ablation. Heart Rhythm 2011; 8: 1411-5.
11. Chen K, Sang C, Dong J, Ma C. Transseptal puncture through Amplatzer septal occluder device for catheter ablation of atrial fibrillation: use of balloon dilatation technique. J Cardiovasc Electrophysiol 2012; 23: 1139-41.
12. Rodriguez-Manero M, Martinez-Sande JL, Fandino R, García-Seara J, Chierchia GB, Fernández-López XA, et al. Fluoroscopic integration of the cardiac computed tomography as a guide for transseptal puncture during atrial fibrillation ablation: A feasibility study. Int J Cardiol 2015; 184: 274-5.