CASE REPORT

Zero-fluoroscopy transseptal puncture guided by right atrial high-density precision mapping

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Atrial fibrillation (AF) ablation requires access to the left atrium (LA) via transseptal puncture (TSP). Although zero-fluoroscopy procedures have received increased attention from electrophysiologists over the last decade, few studies have investigated the safety and efficacy of TSP using the zero-fluoroscopy technique. Here, we report a zero-fluoroscopy TSP guided by right atrial (RA) high-density precision mapping in a patient with AF using an electroanatomical mapping (EAM) system.

Case

A 65-year-old patient presented with AF. His 12-lead electrocardiogram showed fast AF. The echocardiogram documented a normal atrioventricular diameter and cardiac function. Atrial thrombosis was excluded with transesophageal echocardiography (TEE). After discussion with the patient, we decided to take radiofrequency ablation as the treatment method, and the zero-fluoroscopy technique was performed during the whole procedure, including TSP. The consent inform was obtained from the patient.

Preparation

Right femoral venous accesses were obtained. A 6F and 8.5F introducer sheath (NaviEase; Synaptic Medical, Beijing, China) were inserted in the femoral vein separately. In order to perform TSP with the EAM system as guidance, 2 clip-pin cables were used to connect the J-type guidewire and TSP needle (AKS; Synaptic Medical) to the EAM system for navigation. One side of each connector was clipped onto the guidewire (Figure 1A) or TSP needle (Figure 1B), while the other side was connected to the pin-box (Figure 1C). The tip of the guidewire or TSP needle could thus be visualized on the EAM system as a bipolar electrode.

KEYWORDS Atrial fibrillation ablation; Zero-fluoroscopy; Transseptal puncture; Electroanatomical mapping; Fossa ovalis (Heart Rhythm O[2] 2024;5:194–197)

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Mapping the RA and fossa ovalis

A multipolar catheter (PentaRay NAV; Biosense Webster, Diamond Bar, CA) was inserted into the RA via the 8.5F introducer sheath, and was used to create the 3-dimensional (3D) shell of the RA, coronary sinus (CS), superior vena cava (SVC), inferior vena cava (IVC), and tricuspid annulus (TA) by using the fast anatomical mapping module integrated in the EAM system (CARTO3 V7; Biosense Webster). Meanwhile, combined with CONFIDENSE electrical mapping module, the high dense precision voltage of RA was mapped. A decapolar catheter was subsequently inserted from the right femoral vein and placed in the CS via 6F introducer sheath without fluoroscopy as the IVC, TA, and CS were created. The point at which the biggest His bundle (HIS) potential was recorded and used as a landmark. The fossa ovalis (FO) is the thinnest part of RA, and the point of atrial voltage <0.5 mV was tagged as the central FO (Figures 2A and 2B).

TSP procedure guided by the EAM system

The multipolar catheter was advanced to SVC with the 8.5F sheath, then the catheter was withdrawn and exchanged to the J-type guidewire and the dilator. As the extracardiac end of the guidewire was connected to the EAM system, we were able to visualize the tip of guidewire until it reached the SVC (Figure 3A). Subsequently, the guidewire was exchanged to the TSP needle. Once the needle tip was advanced to the level just at or slightly (<2 mm) out of the dilator tip, it became visible in the EAM system (Figure 3B). Under the direction of the EAM system, the sheath-dilator-needle assembly was slowly pulled down until the jump sign was present, which indicated that the tip of TSP needle had slipped into the FO (Figure 3C). The position of TSP needle tip was adjusted to point to the central FO, then gentle forward pressure was applied to cross the FO (Figure 3D). As the TSP needle tip was visible in the 3D EAM system and its relative position to RA structures was displayed and tracked on the geometry, the entire TSP process was visualized on a real-time basis. Successful access to the LA was confirmed by the tactile feedback of breakthrough and the oxygenated blood drawn from the needle. The TSP process was completed.

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KEY FINDINGS

- With the traditional transseptal puncture method, both the physician and patient have to be exposed to x-ray radiation, which can be avoided by using this novel method.
- In our setting, a PentaRay multipolar mapping catheter combined with CONFIDENSE intelligent high-precision mapping technology was used to create the 3-dimensional shell and voltage of right atrium and fossa ovalis, which spent less time and was more accurate for anatomic and voltage mapping compared with the previous method.
- Once the need of fluoroscopy for transseptal puncture is unnecessary, the majority of catheter ablation procedures can be totally performed with zero-fluoroscopy under the guidance of electroanatomical mapping.

LA geometry creation

Once the tip crossed the FO, which was observed by the EAM system, the needle was routinely exchanged to long guidewire (tip visible), which was advanced to the left pulmonary vein area, and then the SL1 sheath was advanced to the LA over the wire. The ablation catheter was introduced into the LA via SL1 sheath to create the 3D geometry of the LA without fluoroscopy guidance as a routine method. Then, AF ablation was performed.

Discussion

Zero-fluoroscopy procedures have recently become feasible in catheter ablations due to the development of contact force–sensing catheters, EAM, TEE, and intracardiac echocardiography (ICE). TSP is the key step of this procedure. With use of the TSP method, the zero-fluoroscopy method can be performed in 3 ways, with TEE, ICE, or total 3D technique.[1–3] However, first, patients have to be sedated with the use of TEE, which increases the risk of hypotension, prolonged periods of weaning from mechanical ventilation, and postinterventional delirium. Second, the procedure is expensive because of the additional cost of anesthesia. In addition, TEE can cause damage to the esophageal mucous membrane, which aggravates esophageal lesions by ablation energy, increasing the incidence of atrioesophageal fistula and risk for life-threatening complications. Studies have also shown that TSP can be performed under the direction of ICE.[2] However, ICE does not allow a panoramic view of the RA and continuous chasing of the needle tip throughout the entire TSP process. The information ICE provides is insufficient for operators, and the use of ICE decreases the safety of associated procedures. Besides, ICE also increases the additional costs. Recently, we reported total 3D technique–guided TSP,[3] which avoids the shortness of TEE and ICE. However, the ablation catheter was used to create the 3D shell of the RA, and it took a long time to map the FO by point-by-point mapping. Moreover, the low-voltage for FO obtained may be inaccurate due to the tissue contact problem by ablation catheter. Here, we documented for the first time, to the best of our knowledge, carrying out zero-fluoroscopy TSP guided by RA

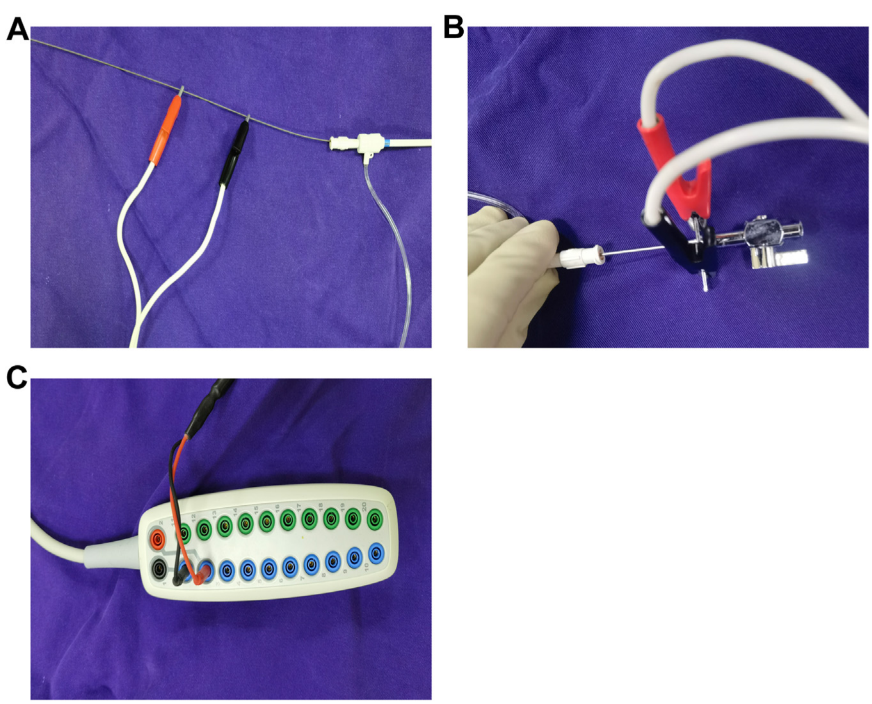

Figure 1 Connecting the guidewire or the transseptal puncture needle to the electroanatomic mapping system. The connection between the (A) guidewire or (B) transseptal needle (C) with the pin-box.

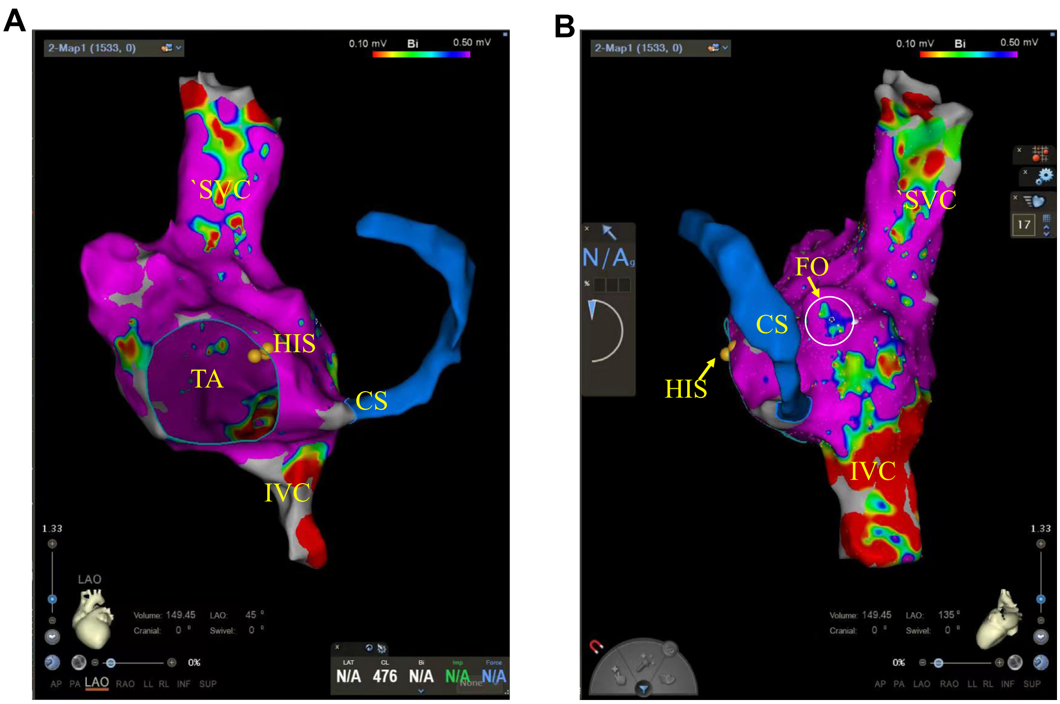

Figure 2 Three-dimensional shell of the right atrium and electrographic fossa ovalis (FO). The blue and green labeled low voltage area in the white circle is the electrographical FO. The orange dots represents the His bundle (HIS) potential location. A: Left anterior oblique 45° projection; B: left anterior oblique 135° projection. CS = coronary sinus; IVC = inferior vena cava; SVC = superior vena cava; TA = tricuspid annulus.

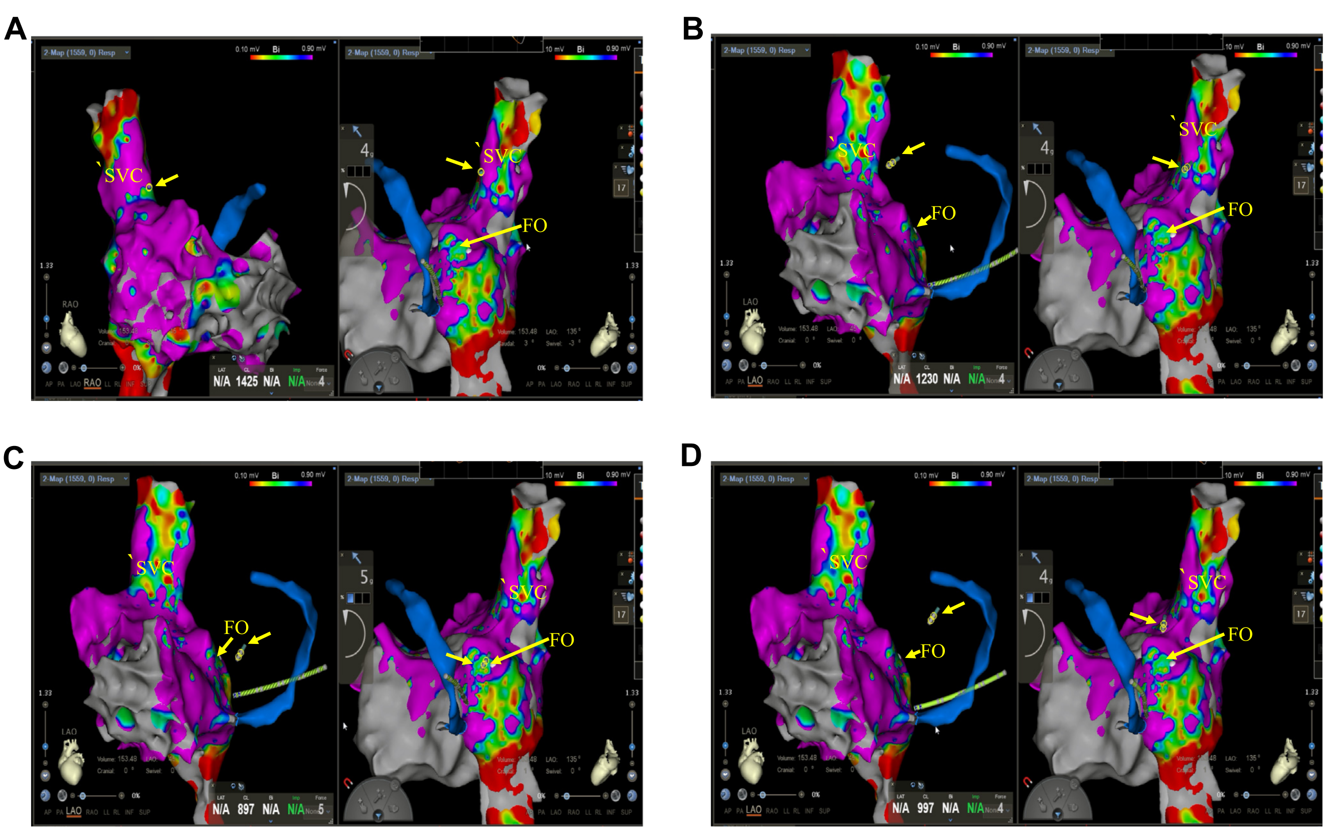

Figure 3 Transseptal puncture procedure guided by electroanatomical mapping system. **A**: The tip of guidewire (yellow circle) was placed into the SVC. The long sheath was placed into the SVC through the guidewire, which was then replaced with the transseptal needle. B: The tip of the needle was inserted into the SVC (yellow circle). C: The sheath-dilator-needle assembly was withdrawal slowly until the jump sign was present, which presented that the tip of the transseptal needle (yellow circle) had slipped into the FO. D: The position of transseptal needle tip (yellow circle) was adjusted to point to the FO central, then gentle forward pressure was applied to cross the FO. Abbreviations as in Figure 2.

high-density precision mapping. In our setting, a PentaRay multipolar mapping catheter combined with CONFIDENSE intelligent high-precision mapping technology was used to create the 3D shell and voltage of the RA, CS, SVC, IVC, TA, HIS potential, and FO, which took less time and was more accurate for anatomic and voltage mapping compared with the previous method. Depending on the proficiency of operators, the TSP process in our case took 18 minutes. With this technique, we could have a 3D view of the entire RA and neighbor structures, while electrographic information helps in identifying the central FO and other landmarks. The LA landing zone on the other side of the FO can be estimated through the FO, HIS marker, and CS boundary. The distance to advance the TSP needle after breaking through can be justified by real-time, continuous visualization of the TSP needle tip on the 3D image. All of this can ensure the safety during puncture procedure. However, future efforts should focus the validation of electrographically mapping the FO by ICE.

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Ethics Statement: The research reported in this article adhered to CARE case report guidelines.

References

1. Erden İ, Erden EÇ, Golcuk E, et al. Impact of transesophageal echocardiography during transseptal puncture on atrial fibrillation ablation. J Arrhythm 2016; 32:170–175.
2. Baykaner T, Quadros KK, Thosani A, et al. Safety and efficacy of zero fluoroscopy transseptal puncture with different approaches. Pacing Clin Electrophysiol 2020; 43:12–18.
3. Yu R, Liu N, Lu J, et al. 3-Dimensional transseptal puncture based on electrographic characteristics of fossa ovalis: a fluoroscopy-free and echocardiography-free method. J Am Coll Cardiol Intv 2020;13:1223–1232.