MAPPING

CASE SERIES

Utilizing 3D NavX for Transseptal Puncture as an Additional Safeguard: A Case Series

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ABSTRACT. Transseptal procedures can be associated with procedural related risk. We postulated that transseptal procedural risk and radiation exposure can be reduced utilizing the three-dimensional (3D) NavX mapping system to guide the transseptal needle during the transseptal puncture. All patients less than 30 years old who underwent transseptal procedures with the assistance of 3D NavX between January 12 2011 and December 31 2014 were retrospectively evaluated. Data included patient demographics, type of arrhythmia, 3D guidance use, procedure time, fluoroscopy time, complications, and post-procedure outcome. Transesophageal echocardiography and intracardiac echocardiography were not used to assist with transseptal punctures in this study. Before attempting the transseptal puncture, a steerable catheter was used to probe for a patent foramen ovale (PFO) using the previously generated 3D model as a reference. If a PFO was present, it was marked on the 3D NavX model and used as the transseptal access site. If a transseptal puncture was required, an alligator clip was connected to the transseptal needle hub, which was connected to the 3D NavX to allow needle tip localization once the needle tip touched the blood pool during the transseptal puncture. Tracking the needle tip was utilized in addition to standard techniques to further evaluate needle location during the puncture. Echo imaging was not used. Fifty-one patients less than 30 years of age were evaluated. A PFO was present in 14 patients. The remaining 37 patients underwent a transseptal puncture guided by 3D NavX in addition to standard techniques. The median procedure time was 107 min (range 52–346 min) from lidocaine injection to time of catheter removal. The median fluoroscopic time for the full procedure was 1.3 min (range 0.00–19.2 min, mean 2.33 min). There were no transseptal procedure-related complications. Localization of the transseptal needle tip during the transseptal puncture is feasible, and reduces radiation exposure and may reduce procedural risk.

KEYWORDS. Catheter ablation, fluoroless, pediatric, transseptal, three-dimensional mapping.

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Introduction

Transseptal procedures, utilized to access and ablate left-sided arrhythmias, are associated with risks including atrial perforation, pericardial effusion/tamponade, exposure to

radiation, and systemic embolization;¹ This, in part, has prompted the increasing use of transesophageal echocardiography (TEE) and intracardiac echocardiography (ICE) to assist with the transseptal puncture. These techniques likely improve safety but are also associated with increased costs, and have associated risks. Using 3D NavX (St. Jude, Minneapolis, MN) for guidance, the tip of the transseptal needle may be visualized on a 3D map to assist with the transseptal procedure and used in addition to other techniques. The focus of this study was to determine the safety and efficacy of the addition of a 3D guided left-atrial access approach.

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Methods

Between January 12 2011 and December 31 2014, retrospective data were evaluated in all patients less than 30 years old who had undergone transseptal procedures with the assistance of 3D NavX. Patients who had 3D mapping but did not have 3D mapping utilized for the transseptal puncture were excluded. Patient data including demographics, type of arrhythmia, 3D guidance use, procedure time, fluoroscopy time, and complications were collected and analyzed. Local Institutional Review Board approval was obtained for this project.

Procedural technique

Procedures were performed under general anesthesia using mechanical ventilation. The patients were prepped and draped in the standard fashion with 3D NavX Velocity patches (St. Jude, Minneapolis, MN) and 12-lead electrocardiogram electrodes were placed. A basic 3D geometry of the right atrium and coronary sinus (CS) was created using a steerable octapolar catheter that was then inserted into the CS. Additional catheters were placed using this geometry, and the baseline study was completed. If the arrhythmia substrate was suspected to reside on the left side of the heart, a steerable radiofrequency ablation catheter was used to probe for a patent foramen ovale (PFO). If a PFO was present, the site was marked on the 3D model and used as the transseptal site to access the left atrium (LA). If no PFO was present then preparation was made for a transseptal puncture using 3D mapping. An alligator clip attached to an electrode pin was connected to the transseptal needle (metal) hub and attached as a unipolar electrode to the 3D NavX. This allows a unipolar reference to be localized at the tip of the transseptal needle on the previously created 3D NavX map once the needle tip is advanced through the tip of the dilator (**Figure 1**). The transseptal puncture was typically preformed using pressure and fluoroscopic guidance in the standard fashion: staining the septum with a small amount of contrast to assist in localization while attempting to limit the fluoroscopy by

Figure 1: Fluoroscopic times for the complete study, and their frequency. The median fluoroscopy time for the complete procedures was less than 2 min.

evaluating the location of the needle tip on 3D NavX. If the location of the needle tip by either fluoroscopy or 3D NavX was felt to be inappropriate the procedure was restarted. ICE and TEE were not used. The ablation was performed in the standard fashion using a fixed curve or steerable long sheath advanced across the septum. After the ablation was completed, the ablation catheter was removed from the LA while being tracked on the 3D map as previously described to limit left atrial dwelling time.² If a mark had not been placed on the transseptal site during initial entry into the LA, a 3D tag was added to the transseptal site on the 3D model for re-access if needed.

Results

Fifty-one patients (median 15 years, range 5–29 years) underwent a transseptal procedure with the use of 3D NavX for transseptal access (**Table 1**). The PFO was probed and found patent in 14 patients (27%); therefore, although NavX was used, a transseptal puncture was not necessary. The remaining 37 patients underwent a transseptal puncture guided by 3D NavX. Arrhythmia substrates that were ablated included both atrial (accessory pathways and atrial ectopic rhythms) and ventricular arrhythmias. The median procedure time was 107 min (range 52–346 min). Fluoroscopy was used in 43 patients most often in order to aid in the transseptal puncture; the median fluoroscopic time was 1.3 min (range 0–19.2 min, which included patients with transseptal access via a PFO (**Figure 2**). There were no complications related to the transseptal puncture procedure, but two patients (3.8%) had documented minor post-procedural complications: one individual had a transient right bundle branch block, and the other had a hematoma occurring at the access site. Procedural success was 100% but arrhythmia recurrence was seen in four patients (7.8%). Of these four patients there was one patient with a left posterior septal pathway, and one patient with a left posterior lateral epicardial pathway (subsequently ablated in the CS). These two patients underwent a successful second ablation procedure. The two other patients had congenital heart disease and multiple arrhythmias. One patient had intra-atrial reentrant tachycardia and atrial ectopic tachycardia, including atrial activity from pulmonary vein sources that were isolated using radiofrequency ablation or a cryoballoon. The last patient had atrial ectopic rhythm and a left-sided pathway. Both remain on medications with adequate arrhythmia control post ablation.

Table 1: Patient demographics are noted below along with the range and median of each category.

	Median	Range
Age (years)	15	5–29
Gender	24 female/27 male	
Height (cm)	164.5	117–189
Weight (kg)	59.1	20–100
Procedure duration (min)	107	52–346

Figure 2: 3D NavX right atrial geometry. The green sphere represents the tip of the transseptal needle, which can be evaluated in relation to cardiac structures. The needle had passed through the atrial septum as confirmed by conventional fluoroscopy and 3D NavX. A catheter (yellow) is within the coronary sinus.

Discussion

Our experience shows that the use of 3D NavX is feasible and is a useful adjunct in obtaining transseptal access. While other centers have discussed the potential of 3D NavX to aid in transseptal puncture procedures, there have been no studies evaluating the procedural experience. We are encouraged by the recent Mansour et al.³ study evaluating the use of Mediguide (St. Jude, St Paul, MN), a electromagnetically guided 3D mapping system, which reported successful guiding with transseptal puncture in a smaller series of patients. Our experience, and the results of the Mansour et al. series, highlight the reduction in fluoroscopy and the safety and efficacy when utilizing 3D mapping systems for the facilitation of transseptal punctures. An advantage of this technique is that it can be performed without the additional cost, time, or risk of complications associated with ICE or TEE when 3D mapping is already being utilized.

As with any procedure, transseptal puncture has risks: aortic, atrial, or vena caval puncture resulting in tamponade have been described.¹ However, when performed by an experienced physician, the complication rate is quite low. Localizing the tip of the needle with 3D NavX allows tracking of the needle in relationship to cardiac structures, potentially reducing the risk of transseptal puncture. Owing to the infrequency of complications associated with transseptal punctures, we were unable to confirm a significant reduction in risk compared with the standard transseptal puncture; however, subjectively, the use of the 3D NavX allowed improved 3D localization of the transseptal needle compared with the fluoroscopic images. In a number of instances the transseptal procedure was restarted because of concerns about 3D localization of the transseptal needle noted on the 3D geometry. In particular, there were advantages in being

able to quickly rotate the 3D geometry to different views, allowing conformation of the needle position (as opposed to rotating the C-arm fluoroscopy camera). In a number of instances if the position was not felt to be appropriately centered on the foramen ovale, by either 3D mapping or fluoroscopy, repositioning was considered. As discussed in a previous paper by this group,² we also note that marking the transseptal site has the potential to also limit left atrial dwelling time, as longer left atrial dwelling time has been shown to be associated with subtle cognitive decline.⁴ We acknowledge the benefit of potentially reducing radiation exposure, the risks of which are well documented to both patient and catheterization laboratory staff alike.⁵

Conclusion

The 3D NavX transseptal puncture is feasible and can be a beneficial adjunct to transseptal procedures. It decreases the need for fluoroscopy, aids in needle localization, and can be performed without the added cost and complication risk of ICE or TEE. Additionally, the ability to mark the transseptal site may allow the left atrial catheter(s) to be removed immediately after ablation, which could potentially further reduce the risk of left atrial thrombus formation and embolization.

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