NRG™ RF powered transseptal needle: a useful technique for transcatheter atrial septostomy and Fontan fenestration: report of three cases

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Abstract

Transseptal puncture (TSP) is a frequently performed procedure for gaining access to the left atrium for catheter ablation, hemodynamic assessment of the left heart, left ventricular assist device implantation, percutaneous left atrial appendage closure or mitral valvuloplasty during childhood and adulthood. The standard technique for transseptal puncture applies mechanical pressure on the ***fossa ovalis*** with a Brockenbrough needle. However, this method is not feasible when the fossa ovalis is thick and aneurysmatic. In such patients, the radiofrequency ablation energy systems can be offered as a better alternative for TSP. Here, we aimed to demonstrate the outcome of transseptal puncture performed with an NRG™ RF powered transseptal needle in three patients.

KEY WORDS: transseptal puncture, transseptal needle, pulmonary hypertension

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INTRODUCTION

The transseptal atrial approach is often preferred when left heart catheterization is indicated in child or adult cases [1]. In accessing the left atrium during the catheter ablation, hemodynamic assessment of left heart, left ventricular assist device implantation, percutaneous left atrial appendage closure, and mitral valvuloplasty procedures, transseptal puncture (TSP) is commonly used [2-5]. Even if the transseptal needle is accurately positioned on the fossa ovalis, interventionalists in cardiology may encounter difficulty in performing a transseptal needle puncture when the interatrial septum (IAS) is fibrous, abnormally thick or when the septum has significant anatomical variations [6]. In patients, especially in pulmonary hypertension (PH) patients, who require interventions at sites close to the complex anatomical structures, radiofrequency energy systems can be preferred as they provide full control of the puncture site and exert a minimal thermal effect on the surrounding tissue. To the best of our knowledge, atrial septostomy and Fontan fenestration by radiofrequency (RF) energy via an NRG needle have not been reported [7].

PATIENTS

General and procedural characteristics of patients are presented in Table 1.

Patient 1

Due to the concomitant presence of exertional syncope associated with PH, and similar patients reported in the literature with a fatal course, an atrial septostomy procedure was decided to perform. Prior to the procedure, 100 units/kg of intravenous heparin was administered [1]. After placement of a 6 Fr sheath, the pressures were recorded and the oximetric study was completed. Introduced from the left femoral vein, the 0.032 inch guide wire was moved into the superior vena cava, an 8 Fr transseptal long sheet was placed over the guide wire right after. An NRG™ RF Transseptal Needle Curve 1 (NRG-71-C1, 71 cm, Baylis Medical Company Inc. Montreal, Canada) was then moved along through the sheath until it reached to the tip of dilator. Tools was carried into the right atrium altogether and fixed to the central region of the IAS. After the needle position was confirmed with the help of

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TABLE 1. General and procedural characteristics of patients

	Patient 1	Patient 2	Patient 3
Age (years)	14	12	27
Weight (kg)	32	37	30
Gender	Male	Female	Male
Diagnosis	PH	PH	Fontan operation due to TA, TGA, VSD and HRV
NYHA functional class	III	III	IV
RF enerji	10 W (1 times)	10 W (2 times)	10 W (1 times)
Created defect size	7 mm	6 mm	7 mm
Pre-procedural SaO2	99%	98%	89%
Post-procedural SaO2	89%	94%	80%

PH: pulmonary hypertension, TA: tricuspid atresia, TGA: transposition of great arteries, VSD: ventricular septal defect, HRV: hypoplastic right ventricle.

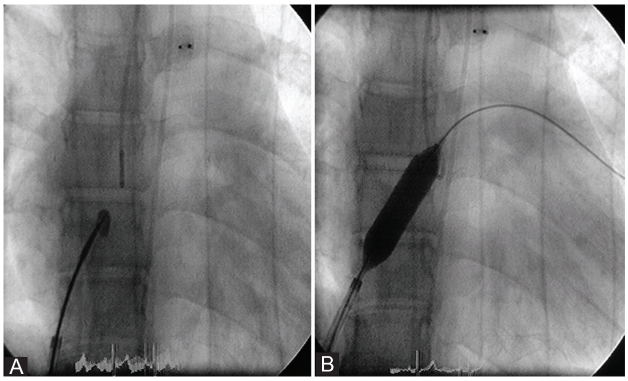

FIGURE 1. (A) The needle position for TSP was confirmed with support of the injection of contrast material (patient 2). The contrast spot illustrates atrial septum. (B) Dilatation was applied with a Z-med II 13 mm X 4 cm balloon on anterior-posterior projection (patient 2).

transthoracic echocardiography (TTE) images and contrast material injection, TSP was started to be performed with the Baylis RF generator device applying 10 W of energy for 2 seconds. After the first occasion RF energy was applied, we were able to pass into the left atrium where left atrial pressure was measured. Needle was confirmed to be in the left atrium with TTE images and contrast material injection, and then it was exchanged with a 0.032 inch guide wire, which was advanced into pulmonary vein. A Z-Med II balloon was moved along the guide wire across the interatrial septum. The dilatation of interatrial septum was completed under TTE and angiography guidance, first with a Z-med II 8 mm X 4 cm balloon, followed by a Z-med II 10 mm x 4 cm and then Z-med II 13 mm x 4 cm balloons. Before the dilatation, the right and the left atrium pressures were 8 mmHg, 5 mmHg respectively, whereas the pressure in both atria was 7 mmHg after the procedure was completed.

Patient 2

The TSP operation was performed in a similar fashion with the first patient (Figure 1). However, 10 W of RF energy for 2 seconds for a second time was needed to be applied since the septostomy could not be accomplished at the first try. Due to the failure in achieving adequate dilatation with the Z-Med 8 mm X 3 cm balloon, the procedure was repeated with a Z-Med 10 mm X 3 cm and then Z-Med 12 mm X 3 cm balloon. An interatrial defect of 6 mm with a right-to-left shunt was determined with the angiography and TTE after the procedure.

Patient 3

The patient was complaining of exertional dyspnea, syncope and an increase in the edema at the lower extremities which was due to protein-losing enteropathy resistant to therapy in recent months. The patient underwent transcatheter Fontan fenestration under the guidance of TTE and intracardiac echocardiography (ICE). The ICE catheter was advanced to lateral tunnel through the left femoral vein. With ICE and contrast material injection, the fenestration was found to be closed. After the needle was withdrawn from the vena cava superior (VCS), it was placed under ICE guidance onto the region where fenestration once was present, and the fenestration was performed again as described previously. After entering the atrium, balloon dilatation was performed in the fenestration region first with a Z-Med 8 mm x 4 cm, followed with a Z-Med 10 mm x 4 cm and then Z-Med 13 mm x 4 cm balloons. The angiogram, TTE and ICE, performed after the procedure all showed a right to left shunt with a 7 mm-aperture (Figure 2).

During the 2-year-follow-up after the procedure, patient 1 and 2 remained stable at NYHA Class III heart failure and did not complain of exertional syncope again. Nevertheless, patient 3 passed away due to cardiopulmonary failure deteriorated during a period of severe pneumonia which he suffered 8 months after the procedure.

DISCUSSION

Since its first implementation by Ross et al. [2] in 1959, there has been significant progress in the TSP technique. The TSP procedure has been accomplished by Brockenborough needle or RF energy systems [8,9]. Recently, RF has been used to form an atrial septal defect [10] and dilate the chronic obstruction of the pulmonary artery [11].

Today, in addition to the conventional techniques, atrial septostomy interventions with RF energy via the NRG™ RF transseptal needle are less traumatic and have a lower complication rate. The NRG™ RF transseptal needle is 71 cm long, and has options of wide curve (NRG-71-C1) and standard curve (NRG-71-C0). In our patients, the Baylis® RF generator device was used as a source of RF energy. The Baylis® RF generator device gives a higher voltage for the vaporization of the

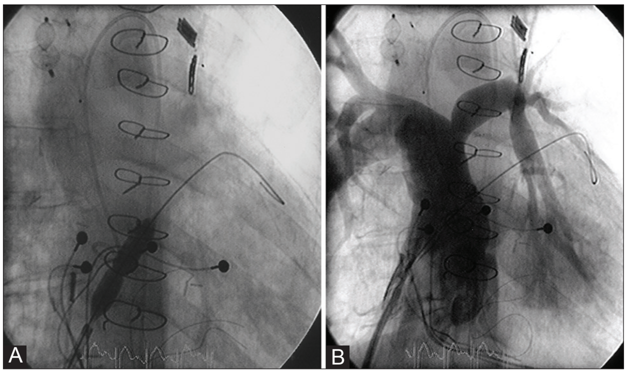

FIGURE 2. (A) Balloon dilation was performed in the region of fenestration with a Z-Med II 8 mm x 4 cm balloon (patient 3). (B) Anterior-posterior lateral tunnel angiography showed right to left shunt with contrast injection after the procedure (patient 3).

intracellular fluid, compared to the standard low-power RF devices, and this is a significant advantage of the Baylis® RF generator device. The RF energy with 10 W for two seconds was applied in each patient according to manufacturer recommendations [12].

Atrial septostomy is a palliative treatment and recommended as a time-saving method for patients with PH waiting for transplantation. Moreover, reports have stated improving survival rates with atrial septostomy [13,14]. Atrial septostomy can relieve the load on the right ventricle by creating a right-to-left shunt, and increase the left ventricular preload and the cardiac output. Despite the decrease of the systemic oxygen saturation, the systemic oxygen transport capacity increases as a result of the increase in systemic blood flow. During the procedure, the width of the defect might be set according to systemic oxygen saturation, in which the reduction should not be more than 10 % [15-17].

A small number of patients undergoing atrial septostomy via NRG™ RF transseptal needle have been reported in the literature. Smelley et al. [12] reported 35 TSPs using a NRG™ RF powered transseptal needle among 41 TSP patients who underwent left-sided catheter ablation (mean age 51 years). In five of the 41 TSPs, the needle crossed into the left atrium before RF energy was delivered. The RF powered needle accomplished TSP in 35 of the remaining 36 punctures. In the one remaining patient, the TSP with the powered needle was unsuccessful. However, the TSP was completed subsequently using a standard needle. Two patients experienced complications of a transient right atrial thrombus. There were no major complications, and TSP via a novel RF powered transseptal needle had a success rate of 40/41 (98%). Another study was performed by Fromentin et al. [6] in which they compared the conventional approach with the NRG RF transseptal needle approach on the first attempt at TSP for left atrial access. TSPs using the RF needle were successful on all patients at the first attempt whereas four patients in the conventional approach group required an extra intervention with an RF transseptal needle. One patient suffered from tamponade close to the end of the procedure using the RF needle. One patient from the conventional group experienced an IAS dissection during the contrast injection.

In the literature, RF energy has been used for forming Fontan fenestration to treat protein-losing enteropathy [7] and for providing the recanalization of occluded vessels and baffles [10,18]. To the best of our knowledge, this was the first case with Fontan fenestration performed with an NRG™ RF needle in the literature. We believe that the NRG needle can be easily applied in regions close to complex anatomical structures, as it was in our patients, and furthermore it requires less mechanical power, meaning less possible contact with surrounding structures.

CONCLUSION

In conclusion, the use of an NRG transseptal needle could be useful in patients with PH or in patients who are in need of lateral tunnel Fontan fenestration by providing more control over the puncture and lower risk of arrhythmia, while also decreasing the cell stimulating environment.

DECLARATION OF INTEREST

We declare no conflict of interest.

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