Patent Foramen Ovale Closure with Vena Cava Thrombus: You Need An Arm and A Neck!

Mohammed Qintar[1], Pedro Villablanca[2], James Lee[2], Dee Dee Wang[2], Tiberio Frisoli[2], Brian Oneill[2], William O'Neill[2], and Marvin Eng[3]

[1]Saint Luke's Mid America Heart Institute
[2]Henry Ford Hospital
[3]Henry Ford Health System

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Abstract

Trans-catheter PFO closure is typically done utilizing femoral access for both ICE and device deployment. We hereby report the first two cases of PFO closure through the jugular veins guided by ICE from the arm in patients without any femoral options.

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Authors: Mohammed Qintar MD MSc*, Pedro Villablanca MD MSc, James Lee MD, Dee Dee Wang MD, Tiberio Frisoli MD, Brian O'Neill MD, William W O'Neill MD, Marvin H Eng MD

Institutions: *Center for Structural Heart Disease, Division of Cardiology, Henry Ford Health System, Detroit, MI

Running title: PFO closure from RIJ and ICE from the arm

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Corresponding Author: Mohammed Qintar, MD MSc

Henry Ford Hospital, Center for Structural Heart Disease 2799 West Grand Blvd, Clara Ford Pavilion, 4th Floor Detroit, MI 48202**Phone**: 913-271-6163**Email:**mohammedqintar@hotmail.com

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ABSTRACT:

Trans-catheter Patent Foramen Ovale (PFO) closure is typically done utilizing femoral access for both intracardiac echocardiography (ICE) and device deployment. We hereby report the first two cases of PFO closure through the jugular veins guided by ICE from the arm in patients without any femoral options secondary to large burden of clot in the IVC. This novel technique can potentially save resources (anesthesia and TEE cardiologist), provide an option for patients without a femoral option and can avoid complications secondary to mechanical ventilation needed to perform TEE.

INTROCUTION

Trans-catheter Patent Foramen Ovale (PFO) closure is typically done utilizing femoral access and it is increasingly being performed guided by intra-cardiac echocardiography (ICE) rather than trans-esophageal echocardiogram (TEE). The procedure is considerably more challenging when femoral access is not feasible secondary to congenital or acquired causes. Few case reports have reported the use of the internal jugular veins to perform the procedure in special circumstances(1-3). These procedures have all utilized general anesthesia and trans-esophageal echocardiogram to guide the closure device deployment. We hereby report two cases of PFO closure through the internal jugular vein guided by intra-cardiac echocardiography (ICE) through a left basilic vein access and under conscious sedation.

CASE REPORT Our first patient is a 28 year old male with hypercoagulable state secondary to methylenetetrahydrofolate (MTHFR) mutation complicated by multiple deep venous thromboses (DVT) who had stopped taking anti-coagulation for few years. He is admitted to the hospital for acute DVT and multiple bilateral pulmonary emboli (PE). His vital signs showed sinus tachycardia at 110 bpm and a normal blood pressure. Further imaging with CT scan and lower extremity venous Doppler scans revealed bilateral lower extremity DVTs in femoral veins that extends into the inferior vena cava (IVC) with near occlusion of the IVC (Figure 1). An Echocardiogram showed a PFO with predominant right to left shunt and an enlarged right ventricle (RV). The left ventricular ejection fraction was normal and there were no other abnormalities on echocardiogram.

Our second patient is a 24 year-old female with history of history of recurrent DVTs and May-Thurner syndrome with left common iliac vein stenting who has not been taking anti-coagulation. She is admitted with acute multiple bilateral PEs with evidence of RV strain. Further imaging showed extensive thrombosis of her iliac venous system secondary to in-stent thrombosis. An Echocardiogram showed large PFO with bi-directional shunt.

For both cases, given the extensive clot burden in the ilio-femoral and IVC system, PEs and RV strain on echo, the decision was made to perform trans-catheter local thrombolysis using the EKOS catheter system. However, the presence of a large PFO with right to left shunting was concerning for paradoxical embolus, possible stroke or systemic embolus during manipulation of equipement. Thus, after multi-disciplinary team discussions, a PFO closure was planned prior to thrombolysis or any venous procedures for both patients.

DISCUSSION

For both of our patients, femoral access was not feasible secondary to large clot burden and fear of paradoxical embolus while inserting equipment in the femoral-iliac venous system. Options for access for PFO closure device includes: 1) trans-jugular and 2) trans-hepatic. The procedure could be done with TEE guidance although ICE has been the predominant imaging modality for PFO closures in the US. Options for access for ICE catheter include: 1) trans-jugular, 2) trans-hepatic or 3) left upper extremity venous access.

TEE requires general anesthesia and requires another operator to perform, thus we decided to perform the procedure with ICE guidance through the left upper extremity venous system utilizing the jugular vein for PFO closure.

Since trans-hepatic access can be complex, we elected to use the arm and the jugular veins to perform these procedures.

PROCEDURAL TECHINQUE

Left basilic vein and right internal jugular vein access was obtained using ultrasound guidance (Figure 2a). A regular J wire was advanced through the basilic vein to the right atrium and was exchanged to an Amplatz Extra stiff wire overwhich a 10 Fr x 40 cm Cook sheath was advanced to right atrium. A St Jude ICE catheter (Abbott Vascular, Santa Clara, CA) was advanced to the right atrium and was passively exposed (Figure 2b). ICE was used to take detailed images of the intra-atrial septum and the PFO tunnel (Video 1).

The treating team should understand that ICE images are inverted compared to when ICE is used from the femoral side.

A short 9 Fr sheath was placed in the RIJ access. A small curl Agilis deflectable (Abbott Vascular, Santa Clara, CA) catheter and an angled glide wire was used to cross the septum (Video 2). In the first patient, the Agilis catheter was used to deploy the PFO closure device. In the second patient, the Agilis catheter was exchanged to TorqVue 120° sheath (Abbott Vascular, Santa Clara, CA) using an Amplatz Extra stiff wire in the pulmonary vein (Figure 3). A 35 mm PFO closure device (Abbott Vascular, Santa Clara, CA) is advanced to the left atrium through the TorqVue sheath (Figure 4) and deployed in the usual manner under ICE and flouro guidance (Figure 5 and Video 3). ICE was used to study the intra-atrial septum and once satisfied with the result, the device can be released (Video 4). ICE is used again to interrogate the PFO closure device (Figure 6).

ADVANTAGES AND LIMITATIONS

Many advantages exist to this novel technique. First, this can avoid mechanical ventilation in patients who can potentially be managed with conscious sedation that can save resources for the hospital. Moreover, these patients could potentially have issues with general anasethsia (side effects of medications and hemodynamic instability in the presence of large PEs and RV strain) and mechanical ventilation and perhaps would be better to avoid. Second, it does not require the presence of another cardiologist to perform TEE.

ICE from the arm could be challenging to interpret because it will be inverted. One way to go around that is to use the "invert" button on the echo machine. Operators familiar with ICE should have no problem with performing and correctly interpreting ICE from the arm. Closure of the 10 Fr basilic vein access could theoretically be an issue; however, we have closed both patients with pressure dressing and a co-band without any complications.

CONCLUSION

We hereby report the first two cases of PFO closure through the jugular veins guided by ICE from the arm in patients without any femoral options secondary to large burden of clot in the IVC. This novel technique can potentially save resources (anesthesia and TEE cardiologist), provide an option for patients without a femoral option and can avoid complications secondary to mechanical ventilation needed to perform TEE.

Keywords: PFO, IVC thrombus, ICE from the arm, RIJ PFO closure

Key clinical message:

This novel technique can potentially save resources (anesthesia and TEE cardiologist), provide an option for patients without a femoral option and can avoid complications secondary to mechanical ventilation needed to perform TEE.

Author contributions:

Mohammed Qintar MD MSc*, Marvin H Eng MD: Performed procedure, wrote manuscript

Pedro Villablanca MD MSc Tiberio Frisoli MD, Brian O'Neill MD, William W O'Neill MD: Manuscript writing, critical editing, data collection

James Lee MD, Dee Dee Wang MD: Reviewed images and videos, critical editing

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FIGURE LEGENDS

Figure 1. Extensive clot burden in the IVC prohibiting access from femoral veins

FIGURE 2: Access and sheath insertion

Figure 2a: Left basilic vein access followed by inserting a 10 x 40 cm Cook sheath and ICE

Figure 2b: Inserting a 10 x 40 cm Cook sheath and ICE

Figure 3: A wire is used to wire the pulmonary vein, an MP diagnostic catheter is advanced over the wire to the pulmonary vein and exchanged for a Amplatz stiff wire, overwhich the TorVue sheath is advanced across the PFO

Figure 4: The PFO occluder device is advanced like usual through the TorqVue sheath

Figure 5: Deployment of the PFO occluder device using ICE and flouro guidance

Figure 6: After releasing the PFO occluder device, the device can be seen stable and in excellent position

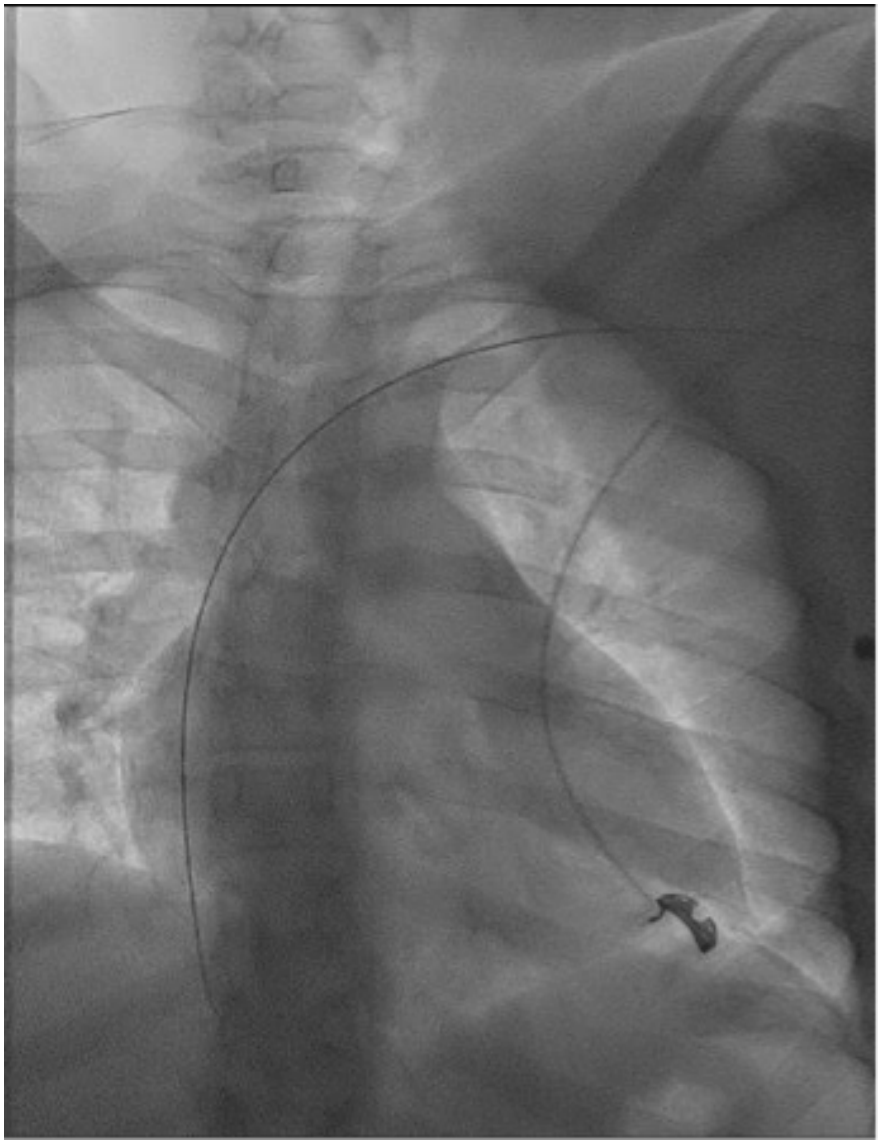
Videos legends:

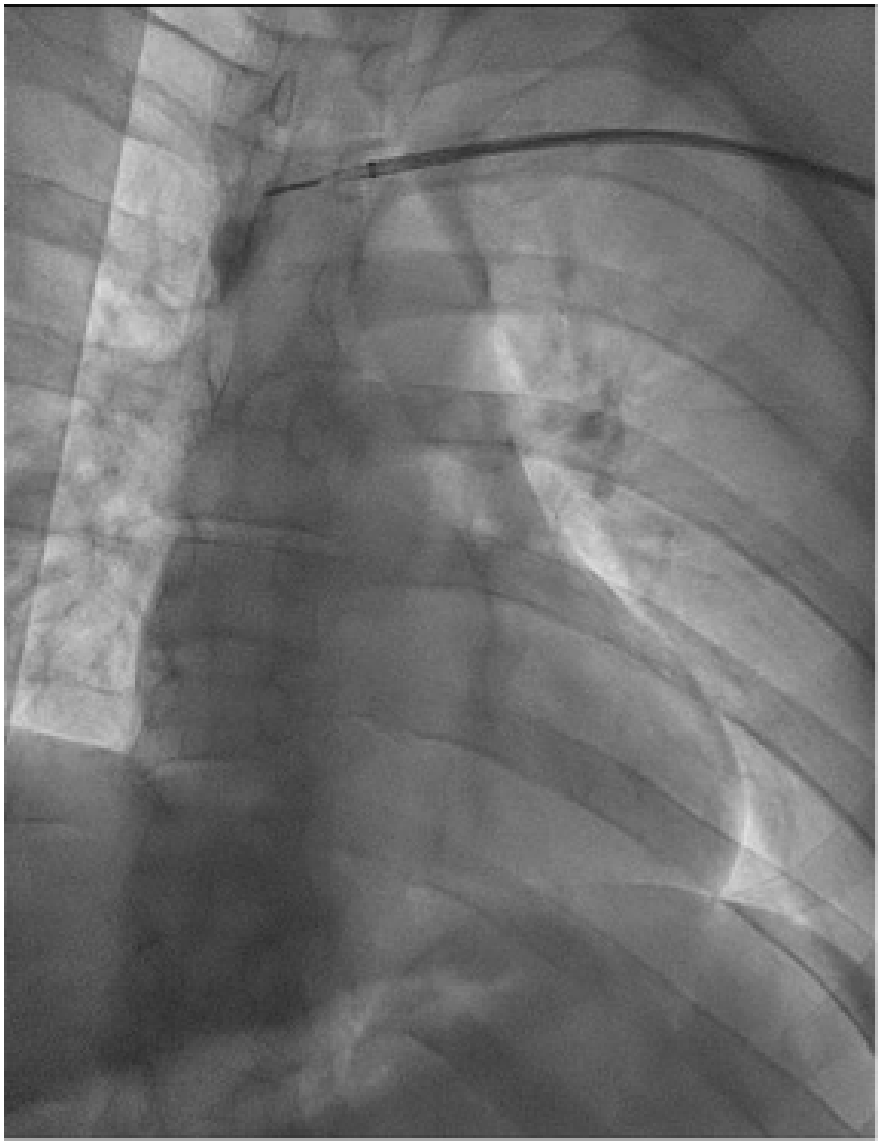
Video 1: ICE pictures of the intra-atrial septum. To the right of the screen is the IVC and to the left of the screen is the SVC.

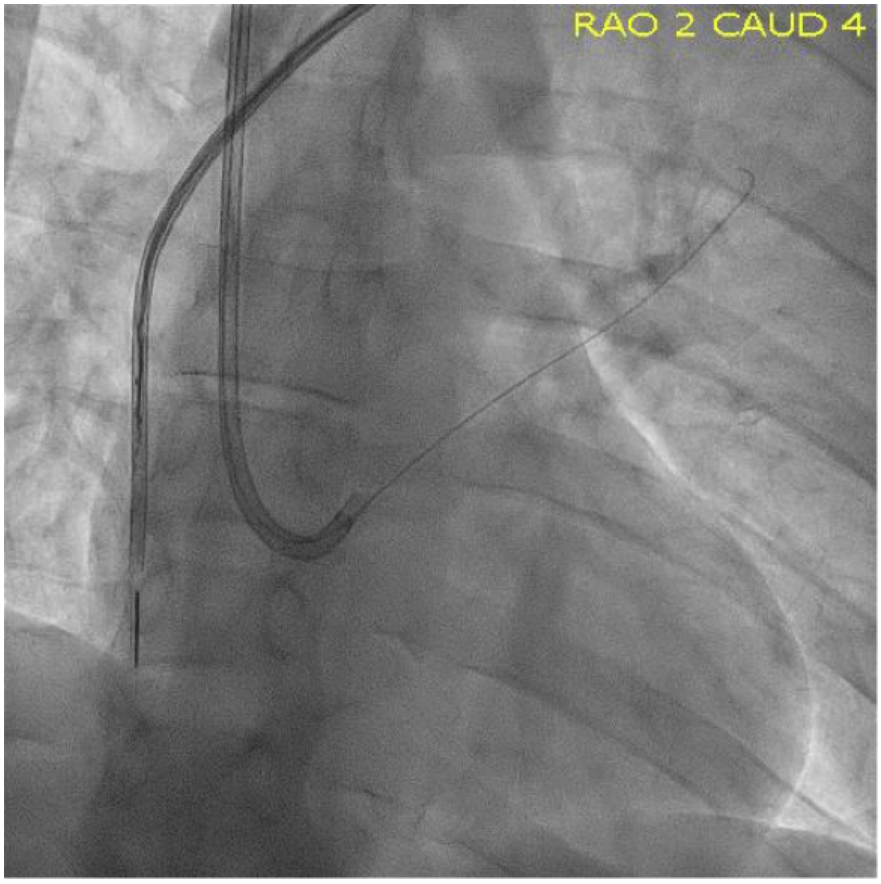
Video 2: Agilis deflectable sheath is across the PFO

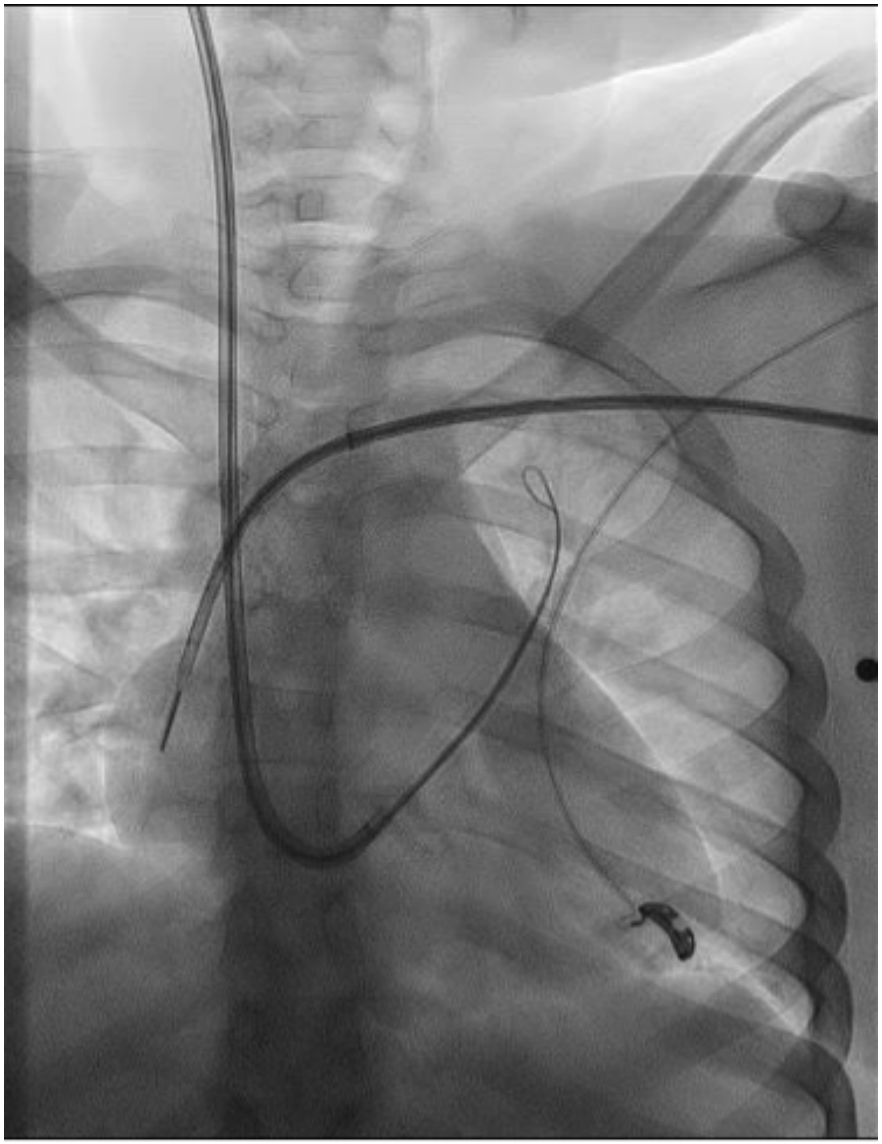
Video 3: Deployment of the PFO occluder device using ICE and flouro guidance

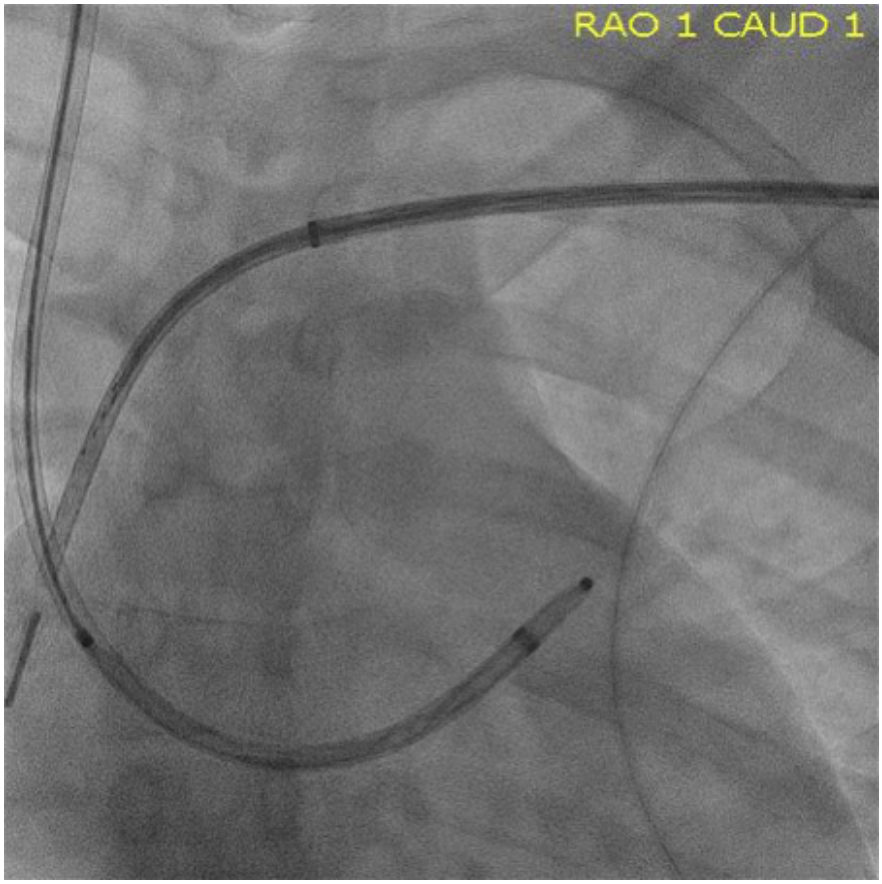
Video 4: Device is released in usual manner

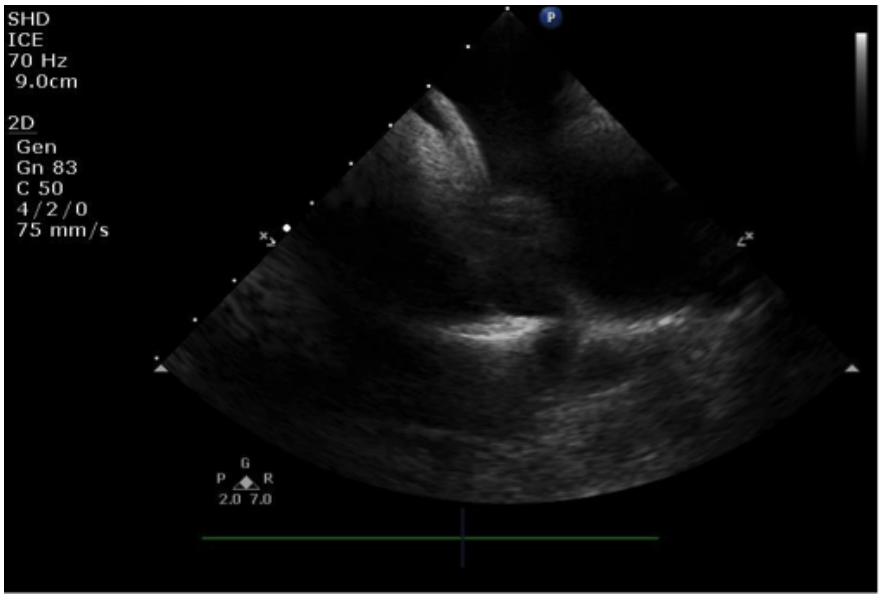












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