Brief Communication

Interrogation of Superior Vena Cava by Deep Transgastric Transesophageal Echocardiography Imaging: Clinical Applications

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ABSTRACT

The advantages of intraoperative deep transgastric interrogation by transesophageal echocardiography (TEE) of the superior vena cava (SVC) in comparison to the standard bicaval view was studied in pediatric cardiac surgical cases. The view was found to be helpful in obtaining additional data in pediatric cardiac surgical patients.

Keywords: Echocardiography, transesophageal; vena cava, superior; diagnostic imaging

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INTRODUCTION

Transesophageal echocardiography (TEE) is a reliable noninvasive method for imaging the superior vena cava (SVC).[1] Intraoperative TEE interrogation of the SVC by a modified deep transgastric view may provide clinically important information instantaneously.[2] In this case series, an attempt was made to identify the advantages of interrogating the SVC in a deep transgastric TEE view as compared to a mid-esophageal bicaval view. The Institutional Ethical Committee approval [SRC#CR8/2020] was obtained for the publication of this manuscript.

CASE REPORT

Perioperative TEE was performed in three children undergoing cardiac surgery with a preoperative diagnosis of a perimembranous ventricular septal defect (VSD), unbalanced atrioventricular canal defect (AVSD), and a superior sinus venosus atrial septal defect (SV-ASD), respectively [Table 1]. The standard guidelines were followed for obtaining the mid-esophageal bicaval TEE view.[3] The SVC, right atrium interrogation at the deep transgastric level was done by the clockwise rotation of the probe in the deep transgastric position, and opening the multiplane angle while maintaining the anteflexion [Videoclip 1].

The bicaval TEE view in the child with the VSD displayed no defect in the atrial septum [Figure 1a]. In the child with the SV-ASD, the view displayed SVC overriding the fossa ovalis [Figure 1a and b].

The deep transgastric interrogation with a Color Doppler blood flow map showed the venous return pattern [Figure 2a]. A pulse-wave Doppler signal analysis

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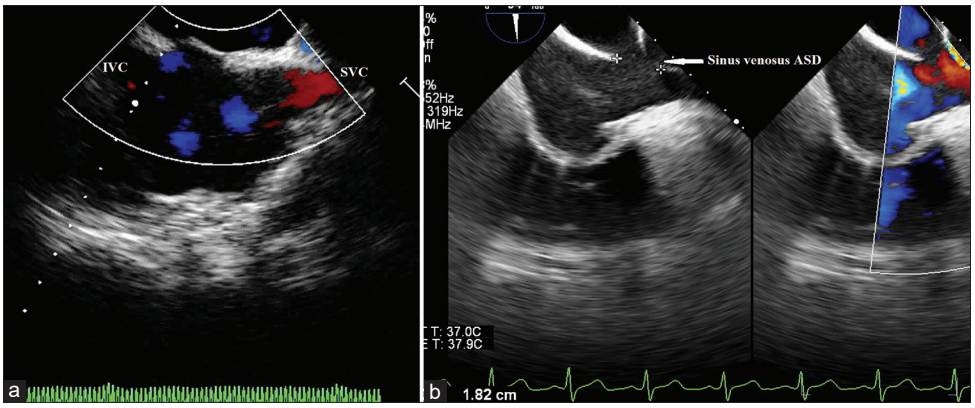

Figure 1: (a and b). A mid-esophageal bicaval transesophageal echocardiography view with a Color Doppler blood flow map showing the superior and inferior vena cava and the interatrial septum (a) and 2D echocardiography displaying the sinus venosus atrial septal defect (b)

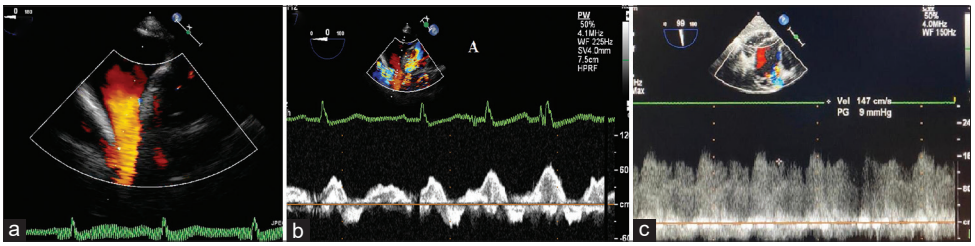

Figure 2: (a-c) Deep transgastric transesophageal echocardiography view of the superior vena cava showing a Color Doppler blood flow map of the venous blood flow through the superior vena cava (a), a view of the superior vena cava with the pulse-wave Doppler display (b), and a view of the superior vena cava with the continuous-wave Doppler analysis showing a residual gradient across the superior vena cava following the superior vena cava decannulation after the termination of the cardiopulmonary bypass (c)

Table 1: Demographic data

Age	Weight	Sex	Diagnosis	Surgery proposed
1 year	6 kg	F	Ventricular septal defect	Intracardiac repair
1 year 6 months	10 kg	M	Atrioventricular septal defect	Intracardiac repair
3 years	12 kg	M	Unbalanced atrioventricular septal defect	Bidirectional Glenn shunt

was also feasible [Figure 2b]. The position of the tip of a central venous catheter tip that was inserted through the left internal jugular vein in one of the children was ascertained [Figure 3a]. An agitated saline contrast injected into the left upper limb excluded the presence of a left SVC in the child with unbalanced AVSD undergoing a bidirectional Glenn shunt [Figure 3b]. In the same child, a considerable length of superior vena cava was visualized [Figure 3c]. In the child with partial anomalous pulmonary venous drainage and a superior sinus SV-ASD, it was possible to interrogate a considerable length of SVC. The deep transgastric view could display simultaneously the SV-ASD as well as a secundum ASD in the same frame [Figure 3d].

In pediatric cardiac surgical patients, direct SVC cannulation is done in the authors' institution to facilitate venous drainage from SVC as per the cardiac surgical protocol. On one such occasion, a residual gradient in the SVC following decannulation of a directly inserted cardiopulmonary bypass venous cannula was detected during intraoperative TEE examination in the deep transgastric view. A Color Doppler blood flow map across the SVC following the removal of the directly inserted venous cannula showed turbulence and a continuous-wave Doppler signal analysis revealed a residual gradient that was immediately corrected by the surgeon [Figure 2c].

DISCUSSION

The deep transgastric imaging of the SVC may be useful both to the anesthesiologists and cardiac surgeons. The view may allow the optimal Doppler beam alignment as the SVC and the right atrium would be in the ideal plane for the Doppler beam interrogation. The SVC is a tubular structure about 7 cm long that is formed by the confluence of the right and left innominate veins.[4] A large extent of the distal SVC may be visualized preoperatively as well as postoperatively that may be advantageous during surgical procedures like a bidirectional Glenn operation. The Color Doppler blood flow mapping and pulse-wave Doppler signal analysis may be possible to visualize the venous return patterns as well as to identify the residual pressure gradients across the SVC-right atrial junction.

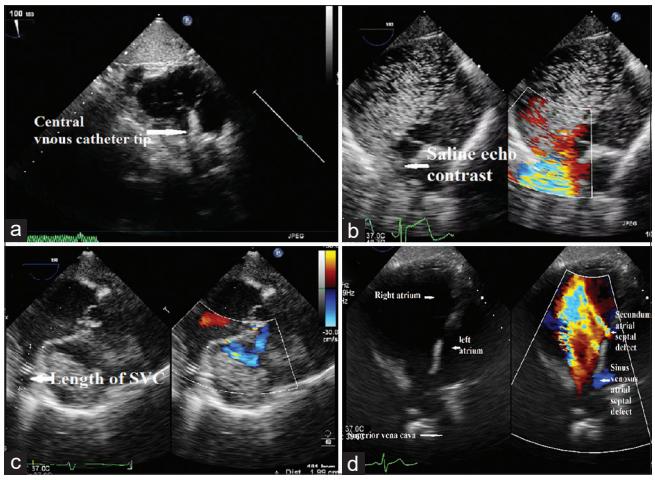

Figure 3: (a-d) Deep transgastric 2D transesophageal echocardiography view of the superior vena cava displaying the position of the tip of a central venous catheter (a), a view of the superior vena cava showing an echo contrast entering the right atrium following a contrast injection into the left upper limb (b), a view of the superior vena cava in a patient with a single ventricle displaying the longer length of the superior vena cava that could be used for a Glenn creation (c), and a view of the superior vena cava displaying the sinus venosus atrial septal defect and a secundum atrial septal defect (d)

The deep transgastric imaging of the SVC may also be useful in identifying the presence of a left SVC when the LSVC is opening into the coronary sinus and when there is no bridging vein between the left and right SVC. A four-chamber TEE view may display a dilated coronary sinus. An agitated saline injection into the left upper arm veins or into the left-sided central veins may display the saline contrast entering the right atrium directly and not through the right SVC that may be appreciated in the deep transgastric TEE view.

In conclusion, the deep transgastric TEE view of the SVC is clinically useful. The probable difficulties that may be encountered that would interfere with proper visualization are (i) poor contact of the probe with the cephalad aspect of the stomach, (ii) air in the stomach, (iii) use of inadequate contact jelly, and (iv) lack of experience. There is a deep learning curve that can be a practical impediment but once honed, it could be a really useful adjunct to our routine transesophageal views.

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Conflicts of interest
There are no conflicts of interest.

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