Where Is the Bubble? A Case of Systemic–to–Pulmonary Venous Shunt in Superior Vena Cava Occlusion

Miro Asadourian, MD, Ambariz Bhullar, MD, Siri Kunchakarra, MD, and Ankit Rathod, MD, Fresno, California

INTRODUCTION

Superior vena cava (SVC) or inferior vena cava occlusion is typically an acquired condition. Thrombosis of the SVC is a well-known complication of central venous catheter placement.1-3 Obstruction of the SVC causes elevated pressure in the veins draining into the SVC and increased or reversed blood flow through collateral vessels.4 Systemic–to–pulmonary venous collateral pathway is an uncommon collateral pathway, with multiple patterns described previously. These patterns include the azygos-hemiazygos pathway, the internal and external mammary pathway, the lateral thoracic pathway, and the vertebral pathway. Regardless of the route or etiology of the pathway, the resulting right-to-left shunt leaves the patient susceptible to stroke, brain abscess, and high–cardiac output states.5 We report a case of systemic–to–pulmonary venous shunting with inconsistent echocardiographic findings depending on the route of agitated saline administration.

CASE PRESENTATION

A 30-year-old man with a medical history of end-stage renal disease on hemodialysis through a right femoral tunneled dialysis catheter, inferior vena cava occlusion status post grating and stenting, and calciphylaxis of the left hip and right shoulder was admitted for sepsis of the left hip and right shoulder. Sepsis was preceded by a high–cardiac output state.5 The patient underwent incision and drainage of the left hip abscess, and a high–cardiac output state.5 

Superior vena cava (SVC) or inferior vena cava occlusion is typically an acquired condition. Thrombosis of the SVC is a well-known complication of central venous catheter placement.1-3 Obstruction of the SVC causes elevated pressure in the veins draining into the SVC and increased or reversed blood flow through collateral vessels.4 Systemic–to–pulmonary venous collateral pathway is an uncommon collateral pathway, with multiple patterns described previously. These patterns include the azygos-hemiazygos pathway, the internal and external mammary pathway, the lateral thoracic pathway, and the vertebral pathway. Regardless of the route or etiology of the pathway, the resulting right-to-left shunt leaves the patient susceptible to stroke, brain abscess, and high–cardiac output states.5 We report a case of systemic–to–pulmonary venous shunting with inconsistent echocardiographic findings depending on the route of agitated saline administration.

From the Department of Medicine (M.A.) and Division of Cardiology, Department of Medicine (A.B., S.K., A.R.), University of California San Francisco Fresno, Fresno, California.

Keywords: Contrast echocardiography, Shunt, Vascular collateral, SVC occlusion

Conflicts of interest: The authors reported no actual or potential conflicts of interest relative to this document.

Copyright 2020 by the American Society of Echocardiography. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/).

482

https://doi.org/10.1016/j.case.2020.08.003
The chronic states of these collateral vessels could explain the asymptomatic SVC of this patient. However, this case leaves open the question of whether the laterality of contrast administration on echocardiography matters when describing extra- or intracardiac shunts. As mentioned previously, our case demonstrated contrast appearing in the left atrium first when using the right upper extremity for agitated saline injection. Interestingly, bubbles appeared in the right atrium when using the left upper extremity as the injection site. Although theoretical at this time, this inconsistency can be explained by collateral vessels between the distal right brachiocephalic vein and the azygos vein, possibly via the internal thoracic, as it resides on the right side of the chest cavity. Further collateral vessels between the azygos and bronchial venous system can provide the final pathway into the left system. The numerous bronchial venous complex (superficial and deep) plays a major role in this connection and providing the shunt. Although less likely, anomalous vein from the right innominate vein (brachiocephalic) to the left atrium was suspected as well but cannot be seen on existing imaging studies. Further extensive imaging, such as venography, would be required to characterize such findings. This was not performed in our patient, as he was asymptomatic, and further interventions would not have been appropriate per the vascular team.

CONCLUSION

The systemic–to–pulmonary venous collateral pathway is an uncommon collateral pathway, with multiple patterns described previously. These patterns include the azygos-hemiazzygos pathway, internal and external mammary pathway, lateral thoracic pathway, and vertebral...

Figure 1 Transthoracic echocardiography, four-chamber view, showing bubbles appearing in the left atrium and then the left ventricle, with none on the right side of the heart, when agitated saline was injected from the right arm (A, B). Transesophageal echocardiography similarly showed bubbles in the left atrium when contrast was injected from the right arm (C). The same view demonstrates bubbles in the right atrium when contrast was injected in the left arm (D).
pathway. In this case, collateral vessels were initially suggested after findings on bubble echocardiography that prompted further imaging, highlighting the importance of agitated saline studies as a valuable screening tool. It is important to recognize such unusual collateral vessels because the acquired right-to-left shunt, regardless of route, leaves patients susceptible to stroke, brain abscess, and a high–cardiac output state.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2020.08.003.

REFERENCES

1. Cihangiroglu M, Lin BH, Dachman AH. Collateral pathways in superior vena caval obstruction as seen on CT. J Comput Assist Tomogr 2001;25:1-8.
2. Madan AK, Allmon JC, Harding M, Cheng SS, Slakey DP. Dialysis access-induced superior vena cava syndrome. Am Surg 2002;68:904-6.
3. Theodoropoulos KC, Harties D, Monaghan MJ, Sado DM. Agitated saline contrast echocardiography reveals a systemic-to-pulmonary venous shunt. Echocardiography 2018;35:747-9.
4. Eren S, Karaman A, Okur A. The superior vena cava syndrome caused by malignant disease. Imaging with multi-detector row CT. Eur J Radiol 2006;59:93-103.
5. Wilson ES. Systemic to pulmonary venous communication in the superior vena cava syndrome. AJR Am J Roentgenol 1976;127:247-9.
6. Kapur S, Paik E, Rezaei A, Vu DN. Where there is blood, there is a way: unusual collateral vessels in superior and inferior vena cava obstruction. Radiographics 2010;30:67-78.