

A case of thyroid storm with incessant ventricular tachycardia complicated by left atrial thrombus

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Introduction

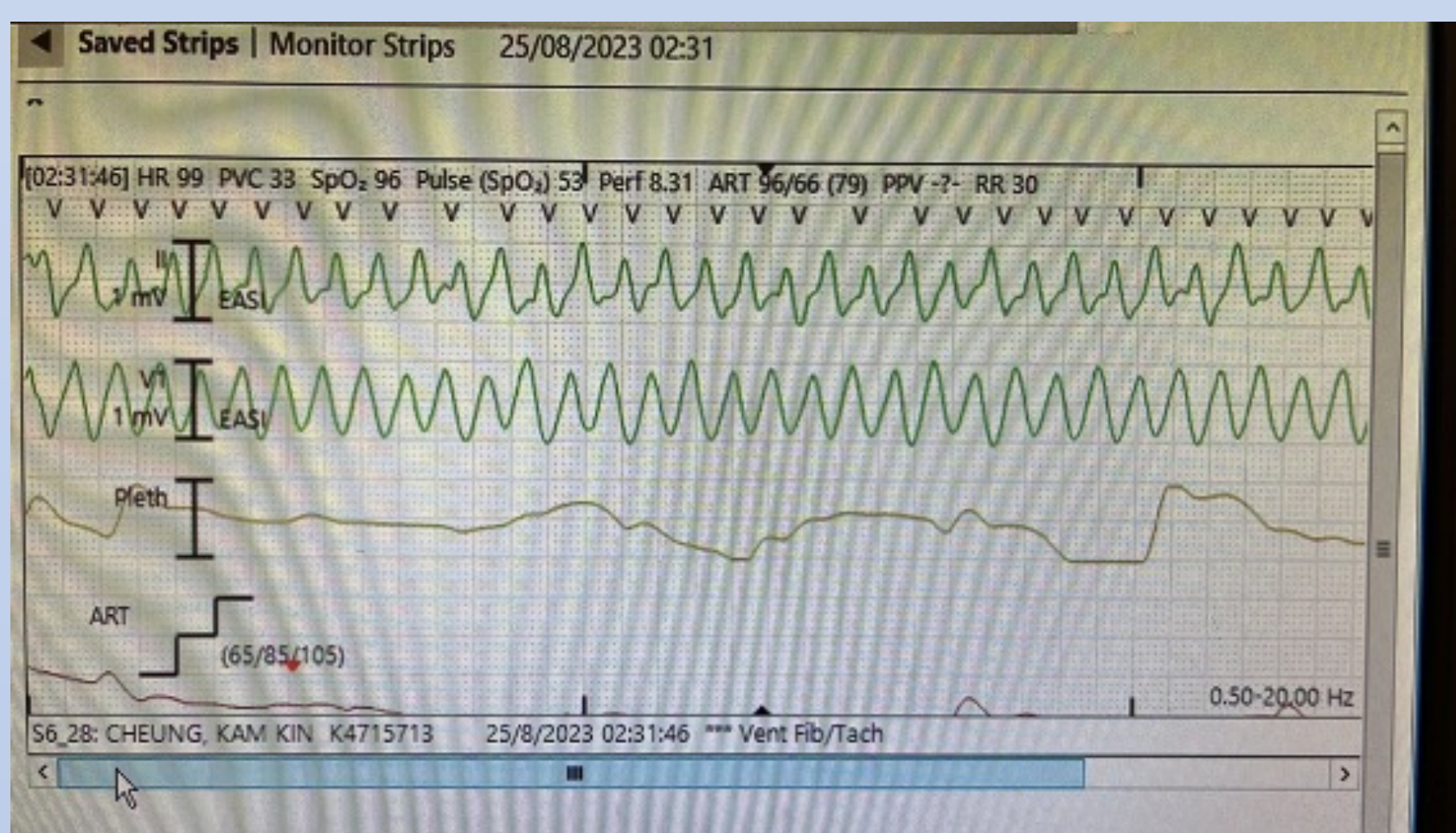
We report a case of thyroid storm with incessant ventricular tachycardia (VT) requiring Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) for circulatory support, as well as Double Sequential External Defibrillation (DSED) for the incessant VT. The case was complicated by left atrial (LA) thrombus resulting from closed aortic valve (AV) and thus blood stasis, requiring Impella for left ventricle (LV) venting. Fortunately, the patient survived with a favourable neurologic outcome due to early recognition of intracardiac thrombus and early implementation of salvage therapies.

Procedural findings & Clinical course

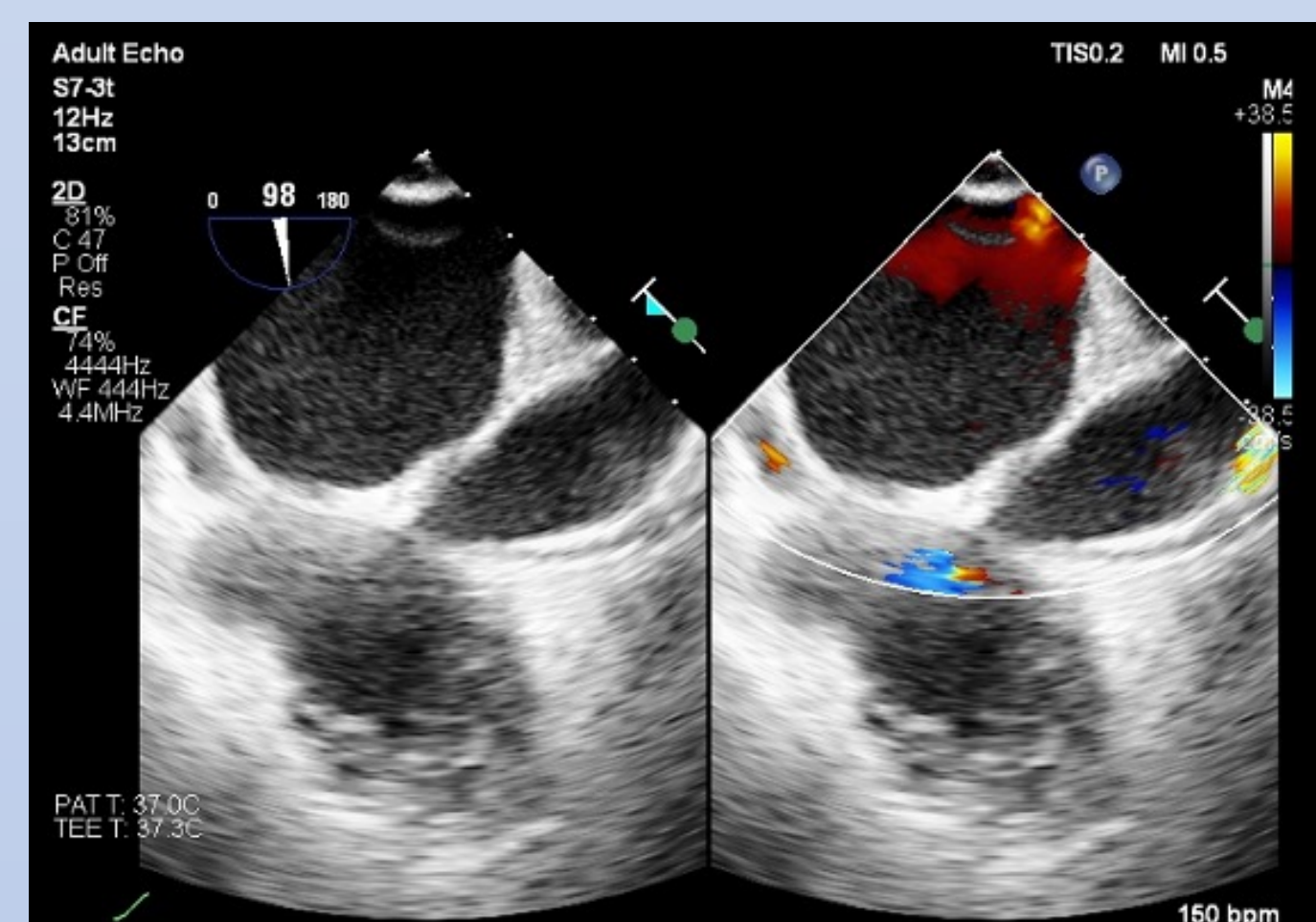
A 47-year-old man was initially admitted for COVID pneumonitis with fever, tachycardia and respiratory failure, and he was later transferred to the intensive care unit. He was noted to have elevated troponin with transient ST segment elevation on ECG. Coronary angiogram revealed mid-LAD 70% stenosis, with stenting performed. Before thyroid function test results became available, he developed frequent runs of VT that degenerated into a non-perfusing ventricular fibrillation (VF) rhythm. Medications and overdrive pacing failed to terminate the tachycardia. After unsuccessful rounds of defibrillation with circulatory collapse, emergency ECMO circuit was started. In view of persistent fever, tachycardia, altered mental status and lab result showing biochemical hyperthyroidism, it became apparent that thyroid storm was the chief diagnosis. Corticosteroids, Lugol's iodine, propylthiouracil and esmolol were initiated.

What soon caught the team's attention was the aortic valve not opening on echocardiogram. Invasive arterial pressure tracing showed a flat line with minimal pulsatility. Implantation of Impella-CP was thus requested but there was difficulty achieving enough blood flow for venting. The story was further complicated by trans-esophageal echocardiogram (TEE) showing dense spontaneous echo contrast (SEC) with a layer of formed thrombus in the LA. Cardiothoracic surgery was consulted for surgical venting and de-clotting, but the request was turned down as open-heart surgery was deemed ultra-high risk.

Heparin was increased to target higher activated clotting time (ACT) level. A technique described for refractory VF called rapid sequential shocks from two defibrillators (DSED) was trialled. Together with loading doses of amiodarone, the VT terminated, and the patient was brought back to sinus rhythm. Eventually, repeated TEE showed resolution of LA thrombus, with improved biventricular contractility. The patient made significant steps toward recovery with decannulation of mechanical circulatory support (MCS) and survived without evidence of major embolic events.



Incessant VT



LA Thrombus

Learning point

There has been increasing use of ECMO as short-term mechanical support for refractory cardiogenic shock. However, thrombosis remains a much-feared complication despite the use of anticoagulation therapy. This is the result of activation of blood coagulation upon contact between blood and large surface area of non-endothelial bio surface of ECMO surface, as well as the high shearing forces in the pump and membrane oxygenator¹.

In addition, LV distention and closed AV are not uncommon phenomena in VA-ECMO, which could lead to blood stasis and thrombus formation, resulting in fatal thromboembolic complications. In VA-ECMO, there is retrograde aortic flow and thus increased afterload in the aorta. This could lead to LV distention. In particular, with the already impaired LV function, the LV may not be able to generate sufficient power to eject the blood, and the AV would remain closed throughout the cardiac cycle if aortic pressure is higher than the LV end-diastolic pressure (LVEDP)². Therefore, rapid echo recognition of an aortic valve, intracardiac SEC or thrombus is an integral part of decision-making for the need of LV venting strategies; it has been demonstrated in studies that LV venting is associated with an increased success of weaning and reduced short-term mortality especially if done early³. Examples of established methods of LV venting include Intra-aortic balloon pump (IABP), Impella and open surgical placement of LV vent.

Conclusion

Thyroid storm is a rare cause of circulatory collapse. VA-ECMO has been successfully leveraged as the last resort to tide over such patients. During management of VA-ECMO support, especially during persistent arrhythmias and LV dysfunction, a high clinical suspicion and prompt recognition of the need of LV venting is of paramount importance before major thromboembolic complications occur. This case showcased the sequence clinical decision-making, guided in no small part by clinical judgment and echo, in ensuring a satisfactory outcome in patients on MCS.

Reference

1. Zeibi Shirejini, S., Carberry, J., McQuilten, Z. K., Burrell, A. J. C., Gregory, S. D., & Hagemeyer, C. E. (2023). Current and future strategies to monitor and manage coagulation in ECMO patients. *Thrombosis journal*, 21(1), 11.
2. Cevasco, M., Takayama, H., Ando, M., Garan, A. R., Naka, Y., & Takeda, K. (2019). Left ventricular distention and venting strategies for patients on venoarterial extracorporeal membrane oxygenation. *Journal of thoracic disease*, 11(4), 1676–1683.
3. Al-Fares, A. A., Randhawa, V. K., Englesakis, M., McDonald, M. A., Nagpal, A. D., Estep, J. D., Soltesz, E. G., & Fan, E. (2019). Optimal Strategy and Timing of Left Ventricular Venting During Veno-Arterial Extracorporeal Life Support for Adults in Cardiogenic Shock: A Systematic Review and Meta-Analysis. *Circulation. Heart failure*, 12(11), e006486.