

Assessment of cardiac device position on supine chest X-ray in the intensive care unit

Introduction and applicability of the Aortic Valve Location Ratio

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BACKGROUND

The use of intra-cardiac assist devices (e.g. Impella) is expanding and optimal functioning requires correct positioning of these devices. The aortic valve is an important landmark for positioning. It would be of great value if the device position could be determined accurately by bedside plain supine chest X-ray, as X-rays are performed regularly. We introduce a method to evaluate device position in the intensive care unit (ICU).

METHODS

Supine anterior-posterior chest X-ray of patients with an aortic valve prosthesis (n=473) were analyzed to determine the location of the aortic valve. Several ratios with a possible relation to the aortic valve location were analyzed. The Aortic Valve Location (AVL) ratio, defined as the distance between the carina and the aortic valve, divided by the thoracic width, was found to be the best performing ratio. The AVL ratio was validated using computed tomography images of patients with angina pectoris without known valvular disease (n=95).

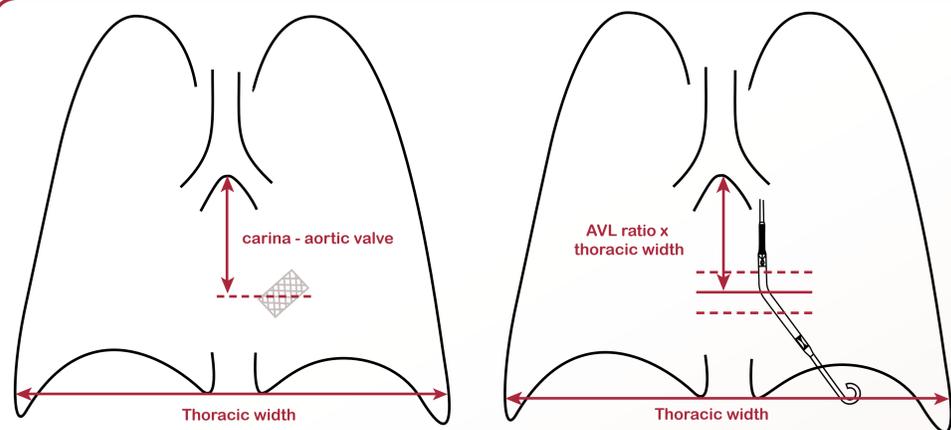


Figure 1: Measurements on the supine chest X-ray which define the aortic valve position.

Figure 2: Schematic image of aortic valve location estimation using the aortic valve location ratio of 0.25 ± 0.05 times the thoracic width for female and 0.28 ± 0.05 times the thoracic width for male.

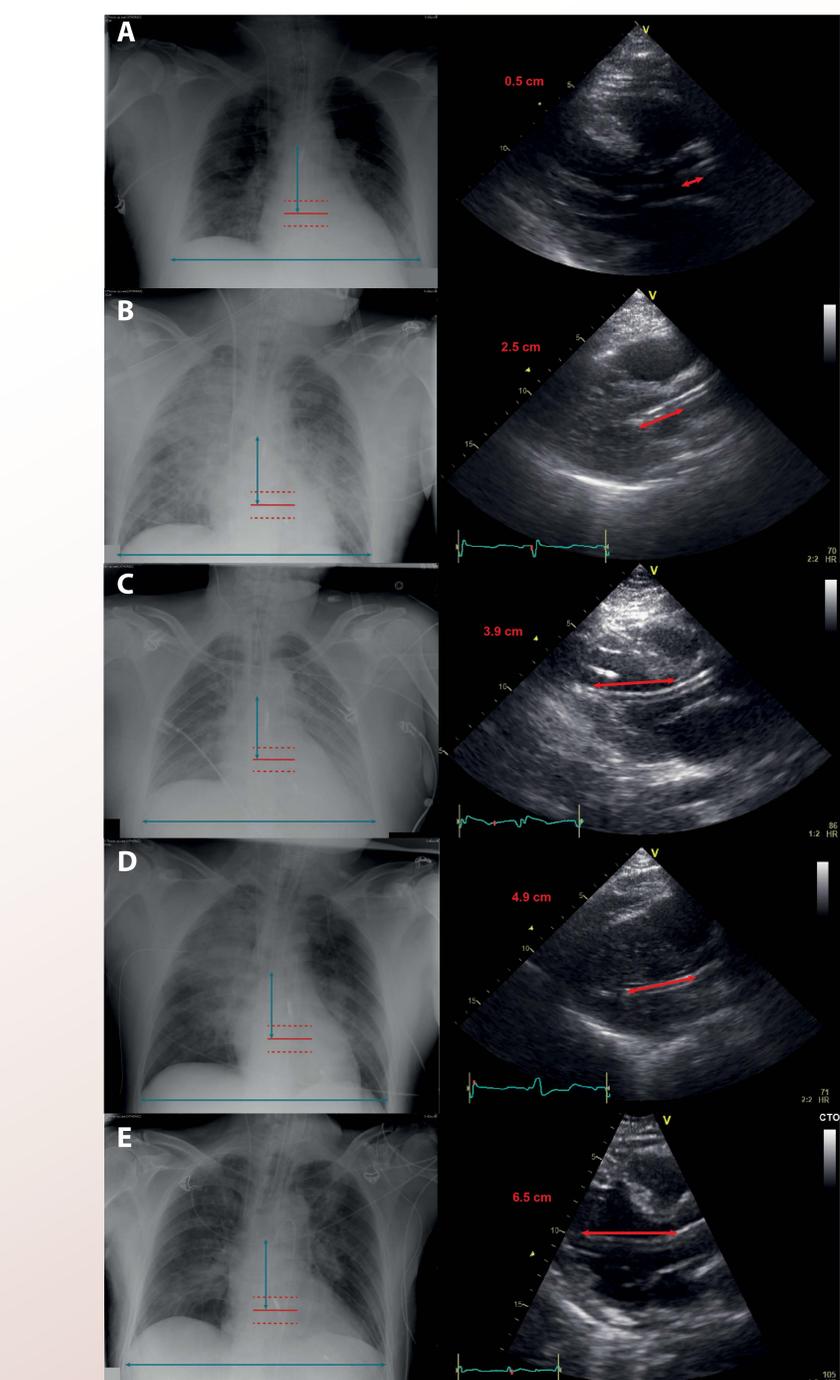


Figure 4: Examples of Impella position on supine chest X-ray images and corresponding echocardiography.

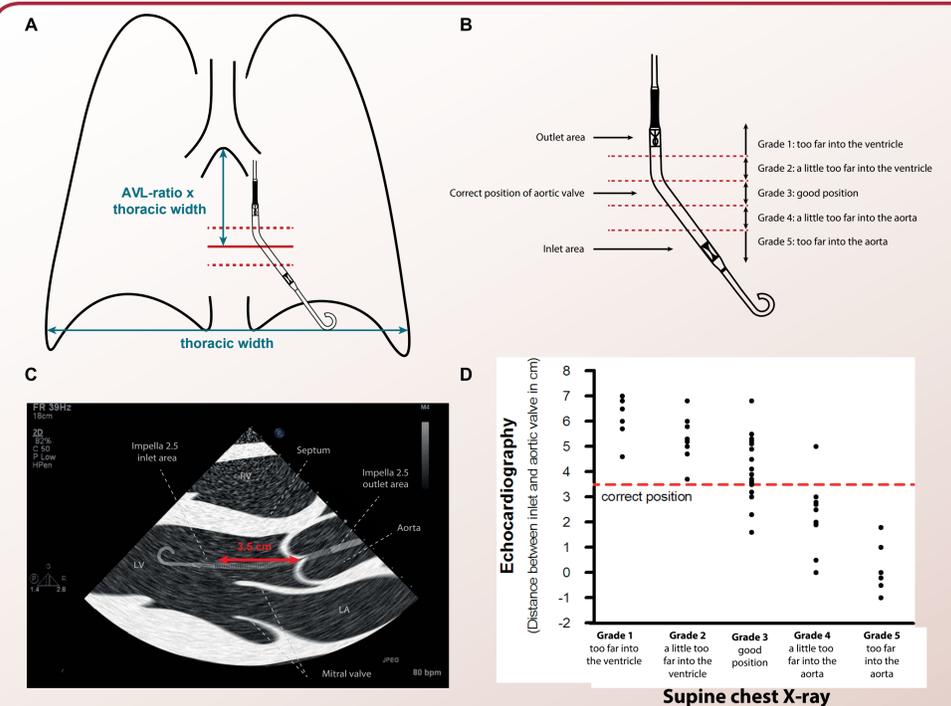


Figure 3: A) Aortic valve location (AVL) estimation using the AVL ratio times the thoracic width. B) Aortic valve position score: when correctly positioned, the aortic valve is just proximal to the Impella curvature. C) Schematic image of a transthoracic echocardiogram (parasternal long axis) of the Impella catheter in the correct position (inlet area 3.5 cm below the aortic valve annulus). D) Comparison of Impella position by echocardiography compared to supine chest X-ray.

RESULTS

The AVL ratio determines the location of the aortic valve caudal to the carina, at a distance of the thoracic width times 0.25 ± 0.05 for male patients and times 0.28 ± 0.05 for female patients. There was a good correlation between cardiac device position (Impella) assessed with the AVL ratio and with echocardiography (n=53), fig 3.

CONCLUSIONS

The Aortic Valve Location Ratio enables accurate localization of the aortic valve on supine chest X-ray. This tool is easily applicable and can be used for assessment of cardiac device position in patients on the ICU.

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