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Practical Tips and Tricks

Practical tips and tricks for assessing prosthetic valves and detecting paravalvular regurgitation using cardiac CT

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ABSTRACT

Paravalvular leaks are an uncommon but serious complication of prosthetic valves. Transthoracic echocardiography is used in the assessment of prosthetic valves but can be limited by acoustic shadowing from the prosthesis and poor acoustic windowing. Small case series have previously shown cardiac CT to have promising results in detecting paravalvular leaks. We assessed 32 valves in our institution on cardiac CT using echocardiography results as standard and developed methods for improved evaluation of prosthetic valves. These include optimizing prescan drug therapy for heart rate control, optimum window and center adjustments, and carefully selected image planes to best demonstrate the valve ring and valve annulus. Recognition of surgical material is also important to recognize. In this review, we provide a detailed description of these techniques with imaging examples of prosthetic valve evaluation using cardiac CT.

1. Introduction

Prosthetic valve surgery is an important part of treatment for valve dysfunction.[1] Paravalvular leaks are an uncommon complication occurring in <1% of cases, but if moderate to severe, typically require surgical repair.[2] Worsening heart failure or signs of severe hemolysis are highly suggestive of malfunction. To assess complications and as part of ongoing surveillance, patients typically undergo transthoracic echocardiography.[3] Although studies have shown reasonable accuracy in diagnosing prosthetic complications, acoustic shadowing from the prosthesis metal and poor acoustic windowing can make evaluation problematic.[4]

More recently, cardiac CT has been suggested as a viable alternative imaging tool to evaluate prosthetic valves. Several studies have examined the utility of cardiac CT for various complications including valve thrombosis, pannus formation, suture loosening, and endocarditis with good results.[5–8] In our experience, evaluating paravalvular leaks on cardiac CT can be challenging. In this article, we describe our experience in

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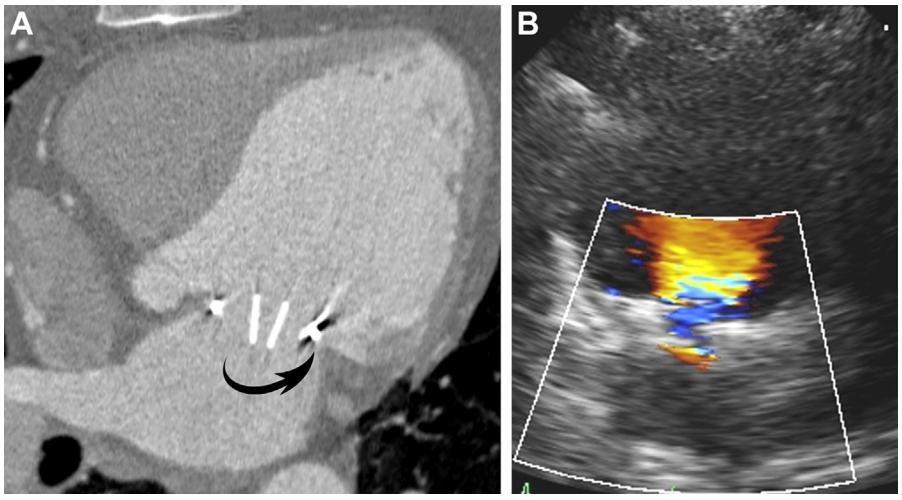

Fig. 1 – A 62-year-old man with a St. Jude mitral valve replacement. (A) Cardiac CT was scored as positive for paravalvular leak because of the apparent channel (*arrow*) between the lateral aspect of the valve ring and the mitral annulus. This was a false-positive result as a transthoracic echocardiograph (B) demonstrated no paravalvular leak.

assessing 32 prosthetic valves (18 aortic, 13 mitral, and 1 tricuspid) in our institution using cardiac 64-slice CT. We highlight several techniques we find helpful in optimizing evaluation for paravalvular leaks.

2. Windowing

Windowing is an essential element of prosthetic valve assessment on CT, but despite seeming obvious, it has proved to be problematic in previous studies.[5] A very soft window with considerable windowing adjustments is needed to minimize beam hardening. In our cohort, we found this was achievable for almost all valve types but required careful modifying to deal with beam hardening artifact. Awareness that beam hardening is most accentuated where the valve leaflet or leaflets connect to the valve ring helps to minimize overcalling paravalvular leaks in these regions (Fig. 1). Ball and cage models were not evaluable for paravalvular leaks because of extreme beam hardening artifact from the thicker metal struts found in these models. Currently, we do not recommend cardiac CT for paravalvular leak evaluation in this valve subtype. Aside from ball and cage valves, valve model did not seem to adversely affect image quality in our cohort, and this reflects similar findings in other studies, in which cardiac CT image quality has been found to be robust across several valve models (Figs. 2 and 3).[9] Recent work suggests iterative reconstructions may reduce beam hardening artifact from

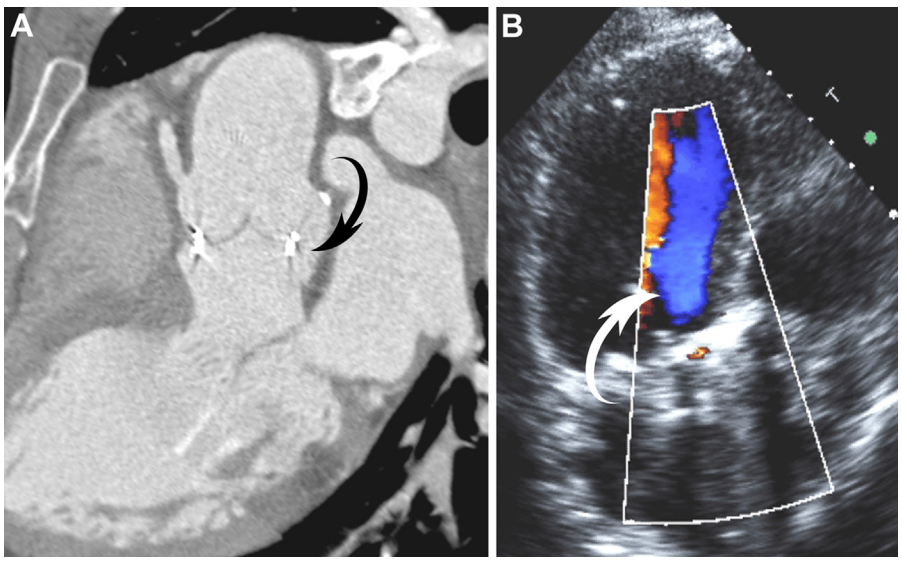

Fig. 2 – A 64-year-old man with a bioprosthetic aortic valve replacement presented with progressive breathlessness. (A) Cardiac CT demonstrated a large paravalvular leak (*arrow*) on the left atrial side of the valve with a regurgitant area of 0.9 cm^2. (B) Echocardiography confirmed a large paravalvular leak (*arrow*).