Handheld ultrasound device with continuous-wave doppler capability: is it feasible?

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Background/Introduction

Echocardiography is the key tool for the diagnosis and evaluation of valve disease, and has been the primary non-invasive imaging method for valve stenosis assessment. Aortic stenosis is the most common primary valve lesion requiring surgery or transcatheter intervention in Europe. The antegrade systolic velocity across the aortic valve, or aortic jet velocity, is measured using continuous-wave (CW) Doppler ultrasound and is of paramount importance for diagnosis and prognosis of such patients. Recent technological advancements have enabled the acquisition of echocardiographic images at the point of care by using small handheld ultrasound devices (HUDs); their availability and relatively low cost compared to the high-end, fully equipped systems have made these devices attractive to use for rapid medical decision making. However, the inability to quantify flow velocity has been a major drawback for HUDs, since the lack of spectral Doppler capability makes assessment of valvular pathology difficult.

Purpose

To evaluate the feasibility and accuracy of a novel HUD with CW Doppler capability to measure aortic jet velocity.

Methods

We prospectively included 43 consecutive patients who were referred to the outpatient specialist valve clinic of a tertiary hospital. All patients were scanned with both the Kosmos HUD (Echonous, Inc.) **(Figure 1)** and the standard echocardiography cart-based system (reference standard) in order to obtain CW Doppler signal across the aortic valve. The peak aortic jet velocity measurements used for the

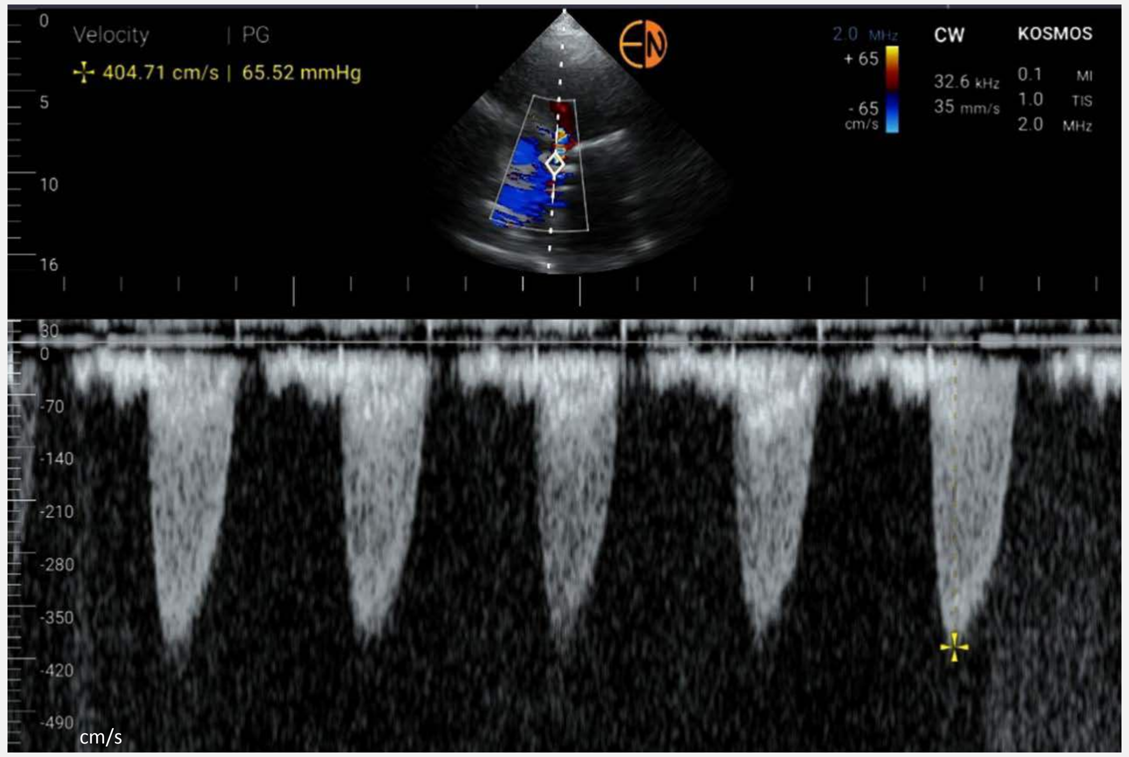

Figure 1: CW Doppler signal across the aortic valve obtained using the Kosmos HUD

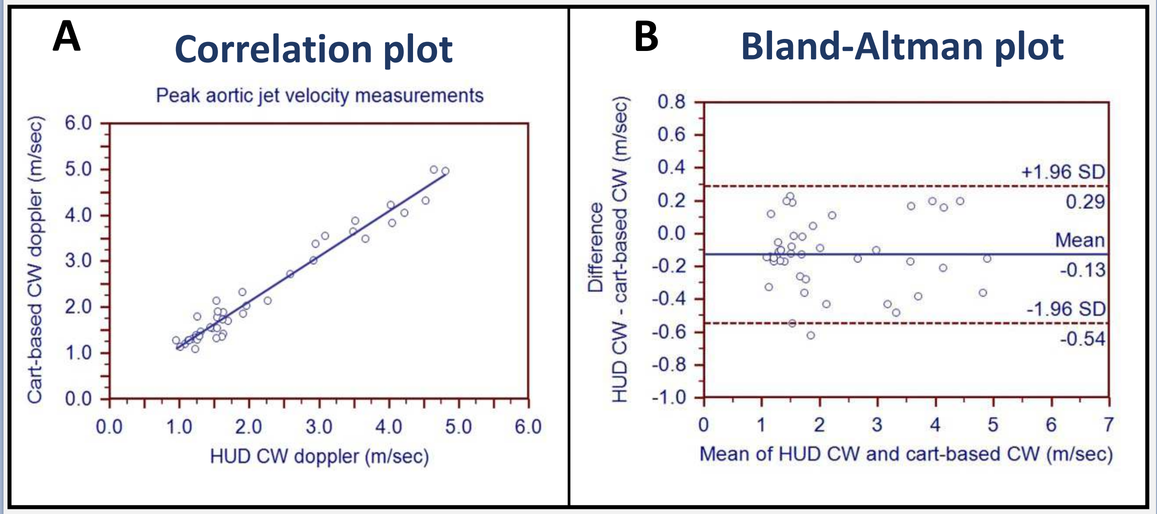

Figure 2: Linear regression (A) and Bland-Altman analysis (B) to assess agreement between Kosmos device CW Doppler and the standard cart-based system CW Doppler measurements

Methods (continued)

analysis were acquired from the apical five-chamber view by both techniques and were compared to assess inter-method agreement using linear regression and Bland-Altman analysis.

Results

The acquisition of CW Doppler signal using the Kosmos HUD was feasible in 42 out of 43 patients (mean age 65 ±15 years old, 58% male). Among them, there were 12 patients (29%) with peak aortic jet velocity >3 m/s (which is the cut-off to define at least moderate aortic valve stenosis). The peak aortic jet velocity was measured as 2.15 ±1.16 m/s with the HUD CW Doppler and 2.28 ±1.16 m/s using the cart-based system CW Doppler. There was excellent correlation between the HUD CW Doppler and the reference standard with a correlation coefficient r=0.98, 95%CI 0.97-0.99, p<0.001, **(Figure 2A)**. The corresponding Bland-Altman plot showed a small underestimation bias of -0.13 m/s (p<0.001), with limits of agreement ±0.42 m/s for the peak aortic jet velocity **(Figure 2B)**. Of importance, for the subgroup of patients with aortic jet velocity >3 m/s the correlation remained excellent (r=0.92, p<0.001).

Conclusion

A novel HUD with CW Doppler spectral analysis was able to provide aortic jet velocity measurements similar to the standard cart-based echocardiography systems, including patients with high aortic jet velocities. Such expanded capabilities of HUDs show clinical potential and may lead to the improvement of the assessment of valvular pathology at the point of care.