Transoesophageal echocardiographic Doppler colour flow patterns of a normally functioning third-generation centrifugal left ventricular assist device

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A 75-year-old man with history of atrial fibrillation, ischaemic cardiomyopathy, and biventricular pacemaker implantable cardioverter-defibrillator presented with automated implantable cardioverter-defibrillator (AICD) discharge and worsened exertional dyspnoea and lower extremity oedema. Six months previously, he received a left ventricular assist device (LVAD) (HeartWare International Inc., Framingham, MA, USA), a third-generation, continuous flow centrifugal pump, for destination therapy. AICD interrogation revealed development of atrial flutter coincident with worsening heart failure symptoms. Power consumption and pump diagnostics showed no LVAD malfunction. Cardioversion of atrial flutter followed transoesophageal echocardiography (TEE) showing no intracardiac thrombus. Real-time three-dimensional TEE (Panel A; Supplementary data online, Movie S1) and colour flow Doppler (Panel B; Supplementary data online, Movie S2) demonstrated a long central column of turbulent blood flow entering the LVAD at the apex and becoming circular at the lateral surface because of centrifugal pump force, which appeared as two parallel jets on each echocardiographic imaging plane. Turbulent blood flow within the centrifugal pump and possible degradation of Doppler signals by presumed production of ultrasound frequency signals by the device precluded accurate assessment of the velocity profile by continuous flow Doppler (Panel C). Pulsed wave Doppler showed normal LVAD inflow (1.06 m/s) (Panel D). LVAD outflow cannula velocity was normal (1.7 m/s). Mild aortic regurgitation occurred; the aortic valve opened with every beat. The ventricular septum remained midline. Our case illustrates TEE Doppler colour flow patterns of a normally functioning third-generation (centrifugal flow) HeartWare LVAD (Panels E and F), which differ from those of first-generation (pulsatile flow) and second-generation (continuous axial flow) LVADs.

Supplementary data are available at European Journal of Echocardiography online.

Conflict of interest: none declared.

Panel A. Real-time three-dimensional transoesophageal echocardiography showing vague outline of short inflow cannula of HeartWare left ventricular assist device. LV, left ventricle; RV, right ventricle.

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Panel B. Transoesophageal echocardiography two-chamber biplane view with colour flow Doppler demonstrated a long central column of turbulent blood flow entering the left ventricular assist device at the apex and becoming circular at the lateral surface of the left ventricular assist device because of centrifugal pump force, which appeared as two parallel jets (arrows) on each echocardiographic imaging plane.

Panel C. Continuous wave Doppler velocity profile showing turbulence. Continuous flow Doppler could not accurately record the velocity profile because of the turbulent blood flow within the centrifugal pump and possible degradation of Doppler signals by the presumed production of ultrasound frequency signals by the device itself.

Panel D. Pulsed wave Doppler with sample volume slightly inside the left ventricular assist device inflow cannula showing a clear velocity profile.

Panel E. HeartWare left ventricular assist device showing impeller. [Adapted from HeartWare—miniaturized left ventricular assist devices—Media Center: images (Internet). Framingham (MA): HeartWare International, Inc.; c2011. Available from: http://www.heartware.com.au/irm/content/usa/media_images.html. Used with permission.]

Panel F. Implanted HeartWare left ventricular assist device. [Adapted from HeartWare—miniaturized left ventricular assist devices—Media Center: images (Internet). Framingham (MA): HeartWare International, Inc.; c2011. Available from: http://www.heartware.com.au/irm/content/usa/media_images.html. Used with permission.]