Automatska kvantifikacija zapisa Doppler ehokardiografije — donosi li dodatne podatke o ventrilulskoj funkciji?

Automated quantification of Doppler traces — can it provide additional data on ventricular function?

Davor Milčić*1, Maja Čikeš 1, Hrvoje Kalinić2, Sven Lončarić2
1 Klinički bolnički centar Zagreb, Zagreb, Hrvatska
2 Fakultet elektrotehnike i računalstva, Zagreb, Croatia

In everyday clinical practice, a detailed analysis of Doppler echocardiography traces is often limited by a high frequency workload in the echocardiographic laboratory. Currently, basic measurements of aortic outflow Doppler traces are routinely obtained by manual tracking of Doppler traces, predominantly providing data on valvular flows. Manual tracking of the traces is often cumbersome, time-consuming and dependent on the expertise of the cardiologist. However, automatic trace delineation should reduce the required time needed for data analysis, while not increasing the measurement error.

We have developed an image segmentation method based on the extraction of Doppler traces from the ultrasound image. Initially, the image is converted and pre-processed to obtain only the forward velocities while the velocity envelope is detected automatically using thresholding. Next, the onset and the end of the aortic flow were indicated manually, thus isolating the flow profile. In order to smooth the Doppler trace, the constraint was implemented forcing the trace to be piecwise polynomial. Such automated analysis was applied to aortic continuous wave velocity traces in patients with coronary artery disease and patients with aortic stenosis (AS). From the modelled signals, several parameters describing their shape were extracted among which the asymmetry of the velocity profile. The asymmetry factor was defined as the normalized difference of area under the curve of left and right half of the spectrum so that a lower asymmetry factor corresponded to more symmetrical, later peaking flow. In coronary artery disease, we have demonstrated that decreased overall LV contractility results in a more symmetrical outflow velocity profile while in AS a symmetrical profile suggests not only higher grade AS, but appears to be related to reduced LV function and predicts recovery after aortic valve replacement.

Studies based on such an image segmentation method demonstrated that additional data obtained by automatic trace analysis would provide relevant clinical data on LV function, aiding in diagnostics and further patient management strategies.

Keywords: Doppler echocardiography, left ventricle function, aortic valve, coronary heart disease.

*Corresponding author — E-mail: d.milicic@mail.inet.hr