Flow measurement in dialysis shunts

Sir,

In a recent technical note, Zanen et al. reported poor agreement between different Doppler flow measurements in dialysis shunts, such as conventional Doppler (CD), quantitative colour velocity index (CVI-Q) and ultrasound dilution (DU) [1]. In particular, results of CD measurements did not correlate with those obtained with CVI-Q and DU, respectively.

We share the experience of the investigators that values of measured blood flow vary between different commercial Doppler ultrasound systems. We found that flow measurements differ between machines and even between different ultrasound probes with the same machine [2]. Therefore absolute values of measured blood flow volume should be interpreted with caution.

Blood flow (Qb) (flow volume/min) is calculated by the cross sectional area of the vessel (A) and the time average velocity (TAV) according to the formula:

\[ Q_b = TAV \times A \times 60 \]

Many Doppler ultrasound machines automatically calculate the blood flow volume. However, the Phillips P700 machine, used by the authors [1], does not provide TAV. Consequently, the authors used the mean maximal velocity (MV) derived from the pulsatility index for the calculation of the blood flow. However, MV and TAV are definitely not identical. Pulsatility index (PI) of a flow pattern is calculated by the P700 machine from peak systolic velocity (PSV), end-diastolic velocity as well as from mean maximal velocity (MV) according to the formula:

\[ PI = (\frac{PSV}{EDV} - EDV) / MV \]

PSV, EDV and MV are obtained from the maximal Doppler frequency shifts covering the 95% percentile of the Doppler frequency spectrum which correlates well with the maximal velocity in the centre of the vessel. In contrast, TAV is calculated from mean velocities in the whole vessel diameter. In non-turbulent flow, the MV of maximal velocity is about twice that of the TAV [3,4].

In conclusion, flow calculations with CD as performed by Zanen et al. overestimate the real flow about twice, which is clearly demonstrated in the Figures of their paper [1]. Therefore, it is not surprising that the authors could not find any correlation between CD and the other two methods of flow volume determination, such as DU and CVI-Q.

2. Hollenbeck M. *Farbkodierte Duplexsonographie von Transplantatnieren*. Pabst Verlag, 1996