Velocity Estimation of the Main Portal Vein with Transverse Oscillation

This study evaluates if Transverse Oscillation (TO) can provide reliable and accurate peak velocity estimates of blood flow in the main portal vein. TO was evaluated against the recommended and most widely used technique for portal flow estimation, Spectral Doppler Ultrasound (SDU). The main portal vein delivers blood from the bowel to the liver, and patients with certain liver diseases have decreased flow in the portal vein. Errors in velocity estimation with SDU are well described, when the beam-to-flow angle is >70 degrees. TO estimates the flow angle independently and is not limited by the beam-to-flow angle. It is less operator depended, as no angle correction is necessary. TO measurements were performed with a 3 MHz convex probe (BK medical 8820e, Herlev, Denmark) connected to the experimental ultrasound scanner SARUS (Synthetic Aperture Real-time Ultrasound Scanner). SDU velocity measurements were performed with a commercial ultrasound scanner (BK 3000, BK Ultrasound, Herlev Denmark) and a convex probe (BK ultrasound 6C2, Herlev, Denmark). Ten healthy volunteers were scanned, and recordings of the portal flow during 3-5 heartbeats were conducted with an intercostal and subcostal view. Intercostal TO peak velocities were not significantly different from SDU peak velocities (TO=0.203m/s, SDU=0.202m/s, p=0.94). Subcostal and Intercostal obtained TO values were not significantly different (intercostal mean TO=0.203m/s, subcostal mean TO=0.180m/s, p=0.26). SDU values obtained intercostal and subcostal were significantly different (intercostal mean SDU=0.202m/s, subcostal mean SDU=0.320m/s, p<0.001). Standard deviation for TO beam-to-flow angle was 10.3°- 91.5°, indicating a large beam-to-flow angle variability in the portal vein. This can affect the peak velocity estimation, and is not addressed in SDU. The TO convex array implementation provides the first vector velocity measurements below 60mm (mean 89mm), and is a useful alternative for flow estimation in abdominal ultrasound. It may provide new information of abdominal fluid dynamics and yield both velocity and angle estimates for a more realistic flow characterization.