

SMART FLOW: a faster and valuable method for blood flow measurement in arteriovenous fistulas.

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BACKGROUND

Blood flow assessment with Duplex Doppler Ultrasound (DDU) is a valuable tool for hemodialysis vascular access surveillance according to K/DOQI guidelines; however, due to its operator-dependency and the technical difficulties associated to the procedure, it is scarcely applicable as part of the routine surveillance strategy. Smart Flow is a new tool available on Carestream Touch Prime ultrasound machines, which provides automated blood flow measurement, independently from the insonation angle. The aim of this study was to compare DDU and Smart Flow in routine vascular access surveillance in hemodialysis patients.

METHODS

Fourteen patients on chronic hemodialysis with a functioning arteriovenous fistula underwent the examination. Blood flow was measured on the brachial artery, as a mean of three measurements, with both Smart Flow and DDU, by a single trained operator. Measurements were performed with Carestream Touch Prime ultrasound machine for both techniques. Time needed to achieve three valid measurements of blood flow was recorded for each technique.

RESULTS

Mean age of examined fistulas was 84.1 ± 65.7 months. Measurements performed with Smart Flow and DDU showed a good positive correlation ($p < 0.0001$). Average time to perform the examination was significantly faster for Smart Flow (97 ± 32 seconds) than for DDU (205 ± 60 seconds) ($p < 0.0001$). Mean standard deviation (SD) for Smart Flow was 132.4 ± 108.6 ml/min, while mean SD for DDU was 182.1 ± 168.2 ml/min ($p = 0.24$). However, SD tended to increase with higher blood flow for DDU ($p = 0.0005$) but not for Smart Flow ($p = 0.09$).

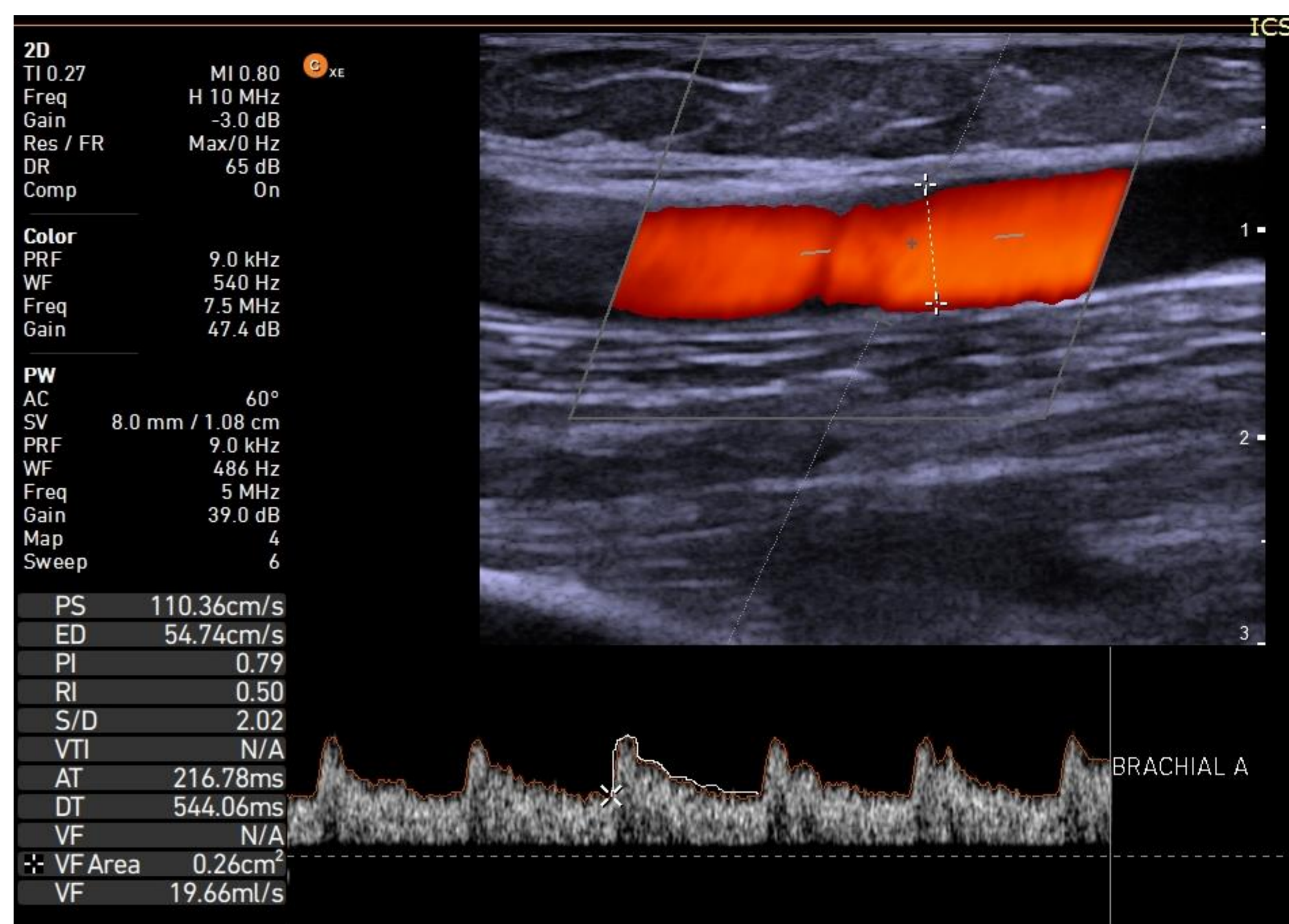


Figure 1. Blood flow measurement in brachial artery with Doppler Duplex Ultrasound. Measure is strongly operator-dependant, needing appropriate manual adjustment of steering, PRF, gain and insonation angle.

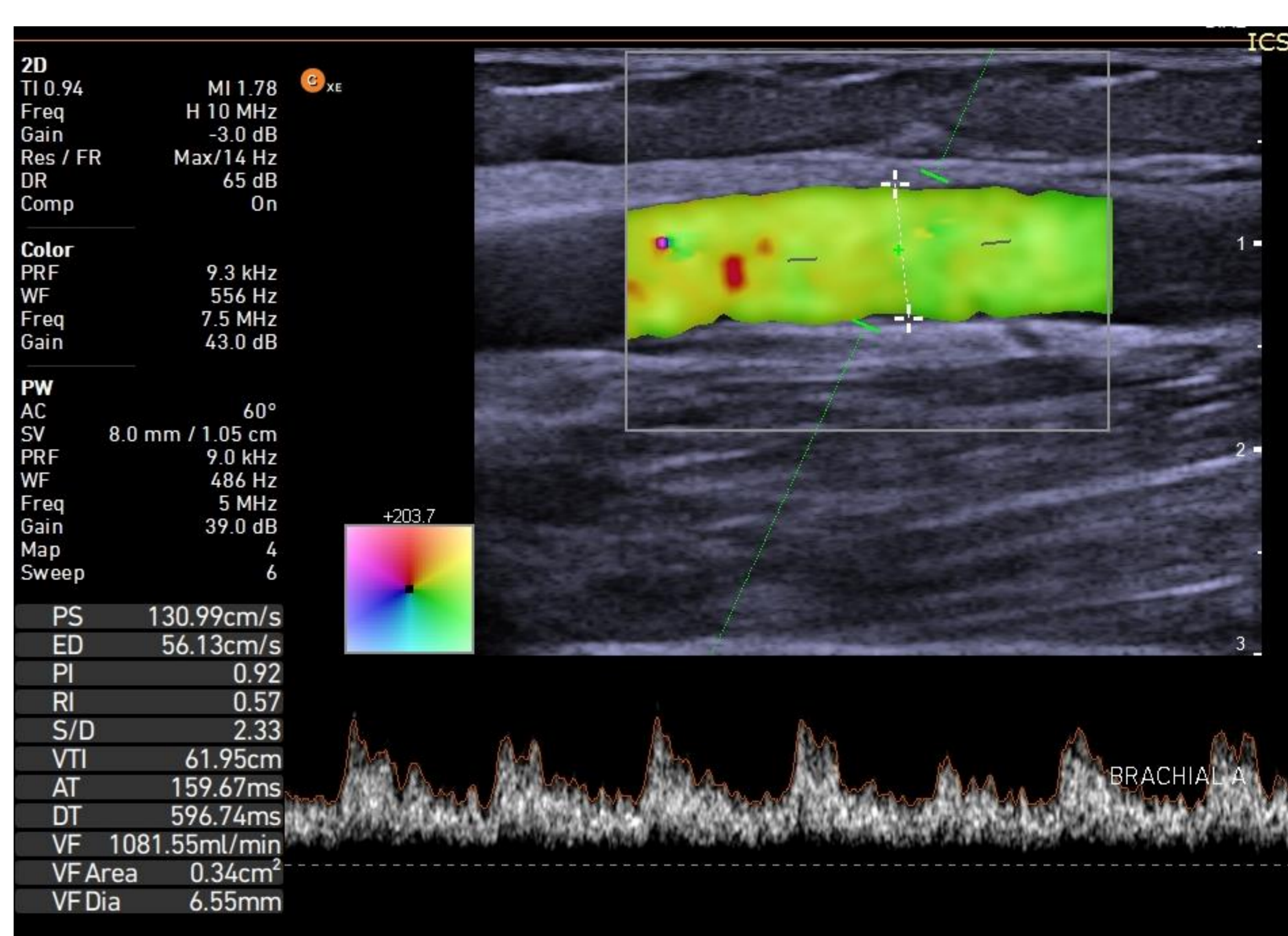
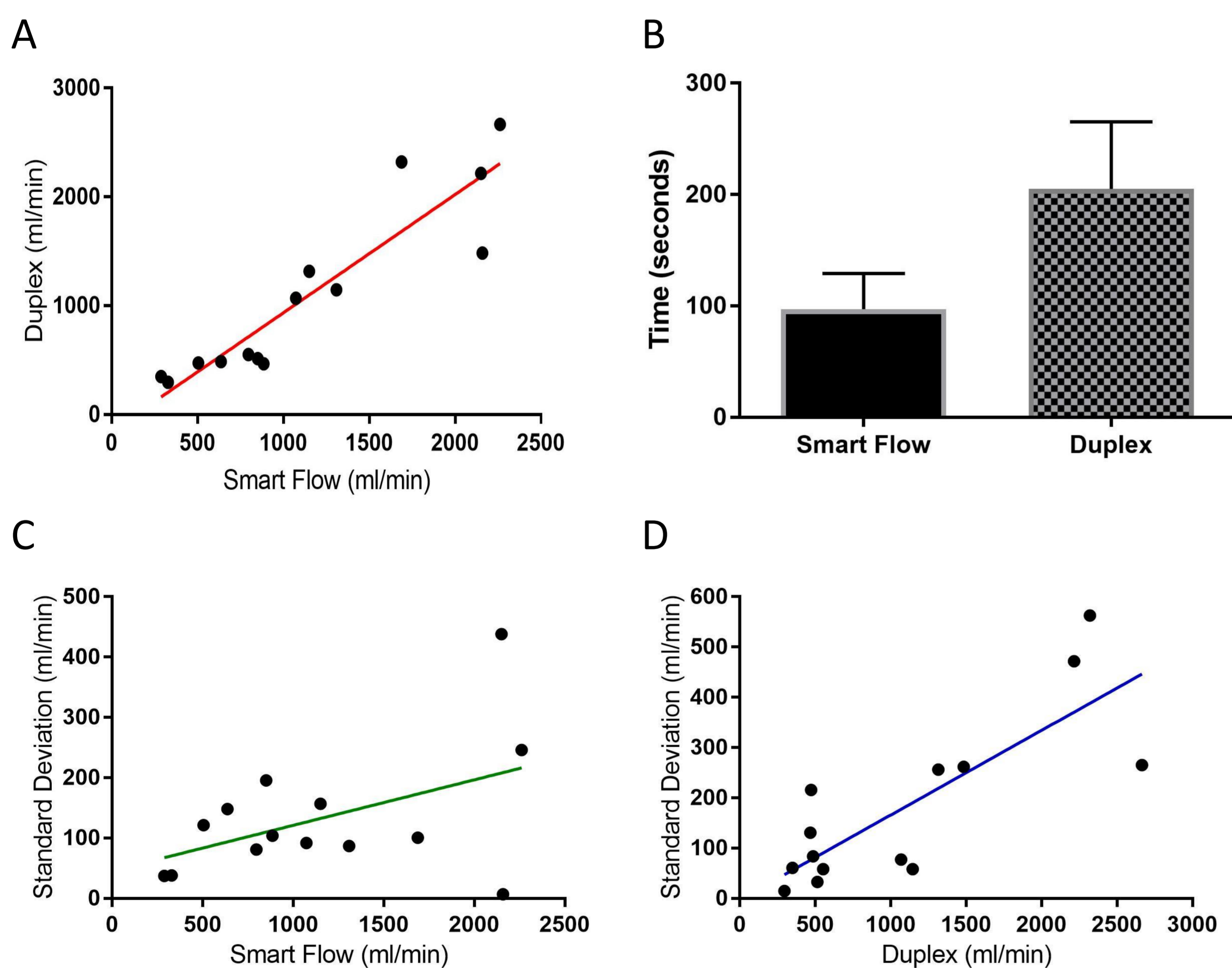


Figure 2. Blood flow measurement with Carestream Smart Flow technology. The direction of blood flow is detected automatically, making thus the measurement independent from the insonation angle. Other parameters are adjusted automatically by the ultrasound machine.



- A. Correlation between blood flow measurement performed with Doppler Duplex Ultrasound and Smart Flow.
- B. Average time spent for three blood flow measurement with Doppler Duplex Ultrasound and Smart Flow
- C. Correlation between blood flow measured with Smart Flow and standard deviation
- D. Correlation between blood flow measured with Doppler Duplex Ultrasound and standard deviation

CONCLUSIONS

Smart Flow is comparable to Duplex Doppler Ultrasound for blood flow assessment in arteriovenous fistulas, allowing the examination to be performed in less than half of the time. Reproducibility of the results seems to be comparable between the two techniques, but Smart Flow showed a better performance for higher blood flows. Thus, Smart Flow may represent a simple, fast and reliable tool for routine hemodialysis vascular access surveillance.

