Doppler Ultrasound: Hands-on Experiment

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Measurements performed on the 28th of October 2025 at 14:15 using a GE Vivid E95 medical ultrasound scanner. The majority of our allotted time for the experiment was spent familiarizing ourselves with the user interface of the ultrasound machine, rather than optimizing the measurements. Hence, the results presented here are primarily for illustrative purposes. They are not necessarily the best measurements acquired, but rather the ones we were actually able to save during the session.

I. IMAGE OF CAROTID ARTERY

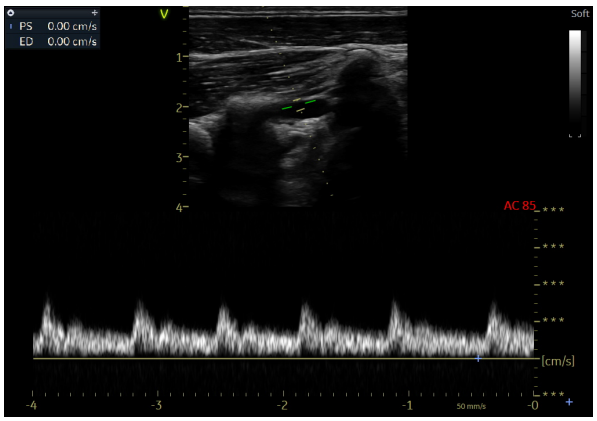

FIG. 1. Doppler image showing the blood velocity inside the carotid artery

II. ANGLE CORRECTION

The angle correction is used to specify the angle between the ultrasound beam and the direction of blood flow. This angle is crucial for accurate velocity measurements, as the Doppler shift depends on the cosine of this angle. We need to compensate for this angle to obtain the true velocity of blood flow. On screen we made sure the green line is aligned with the direction of blood flow, which in this case is parallel to the walls of the artery.

III. VELOCITY MEASUREMENTS

We were not able to save the best acquired velocities to file, but our best measurements, as far as I remember, were approximately:

- **Peak systolic velocity (PS)**: 100 cm/s
- **End diastolic velocity (ED)**: 40 cm/s

IV. SCALING AND ALIASING

When we set the velocity range of the image to 70% of the peak systolic velocity, aliasing artifacts became apparent in the velocity plot. These artifacts occur because the actual blood velocity exceeds the set scale, causing the Doppler signal to wrap around and create false representations of velocity. We were not able to save this image.

V. STEER ANGLE

The steer angle is the angle at which the ultrasound beam is directed relative to the transducer using beamforming techniques. The doppler shift is measureable in the direction of the blood flow, so ideally the transducer would be set at an angle of 0 degrees to the blood flow. However, this is not possible due to obvious anatomical constraints. The transducer is, in practice, held orthogonal to the blood flow direction, and there is no doppler shift measurable in this direction. Therefore, we must electronically steer the beam to an angle where there is a measurable doppler shift. We can not steer the beam to be perfectly aligned with the blood flow, but we can get close. The final offset is then corrected for using the angle correction feature described above.

VI. TRIPLEX MODE IMAGE

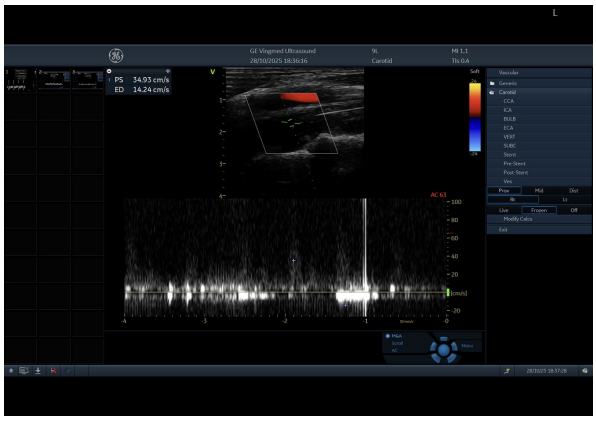

FIG. 2. B-mode, color flow imaging and PW-Doppler (triplex mode) of the carotid artery