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Absolute Flow Measurements by Thermodilution

First Data with a Novel Catheter

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$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad (mL/min)$$

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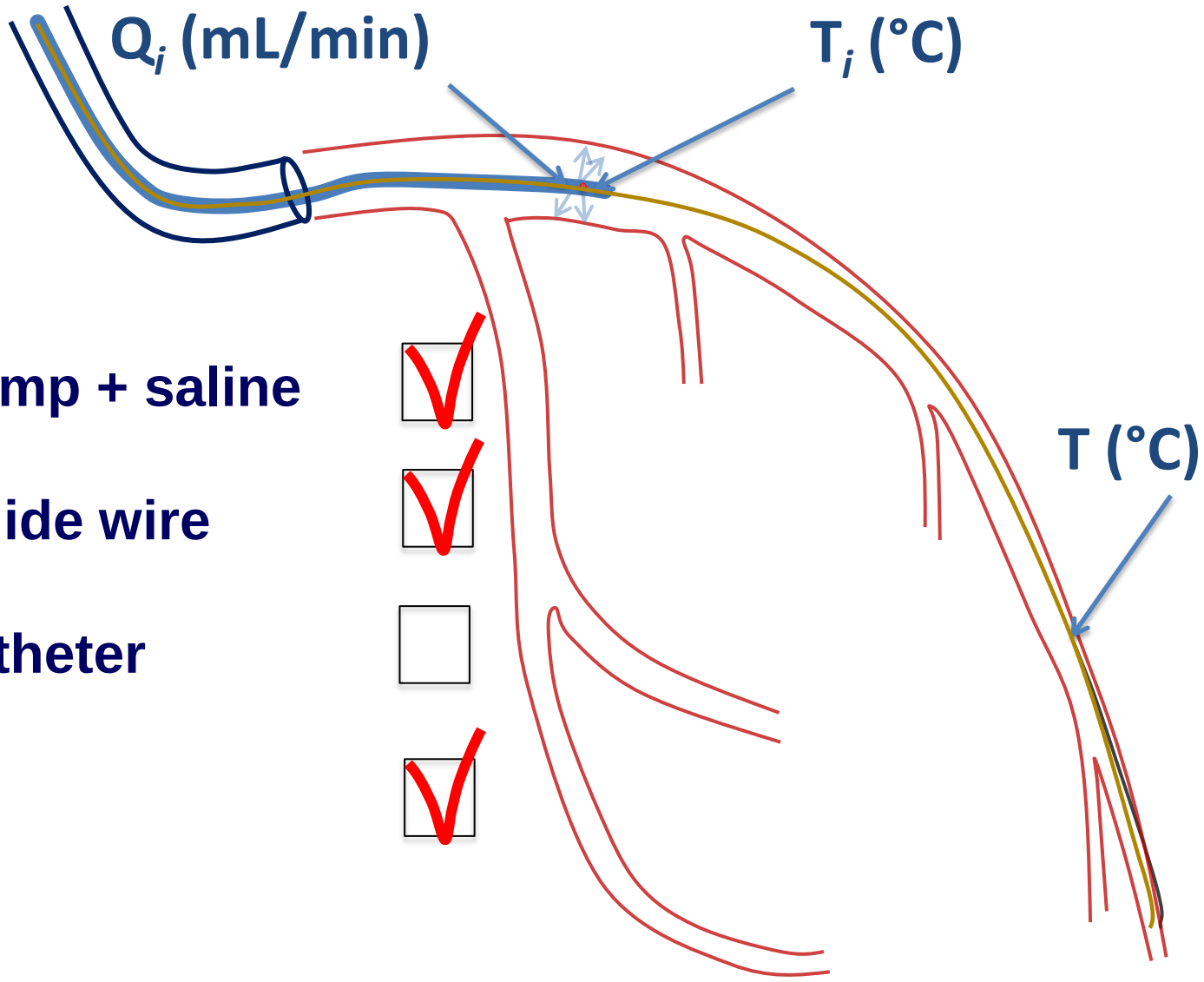
What do we need?



- Infusion pump + saline ☑
- Pr-Temp guide wire ☑
- Infusion catheter ☐
- Hyperemia ☑

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$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad \text{(mL/min)}$$

- New catheter
- Simplification
- Reproducibility in pts

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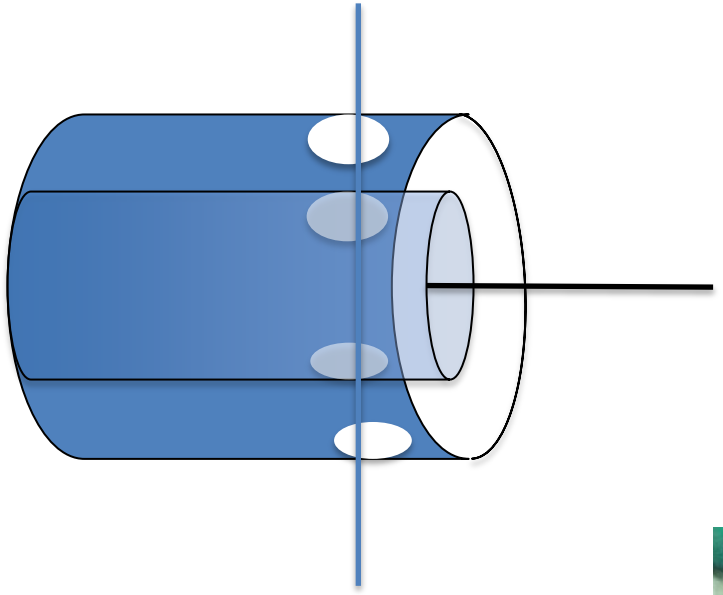
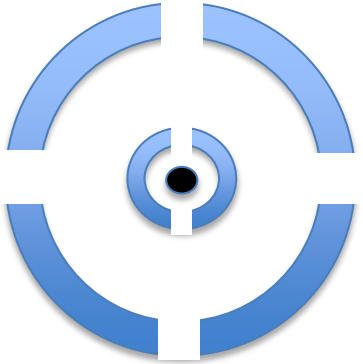
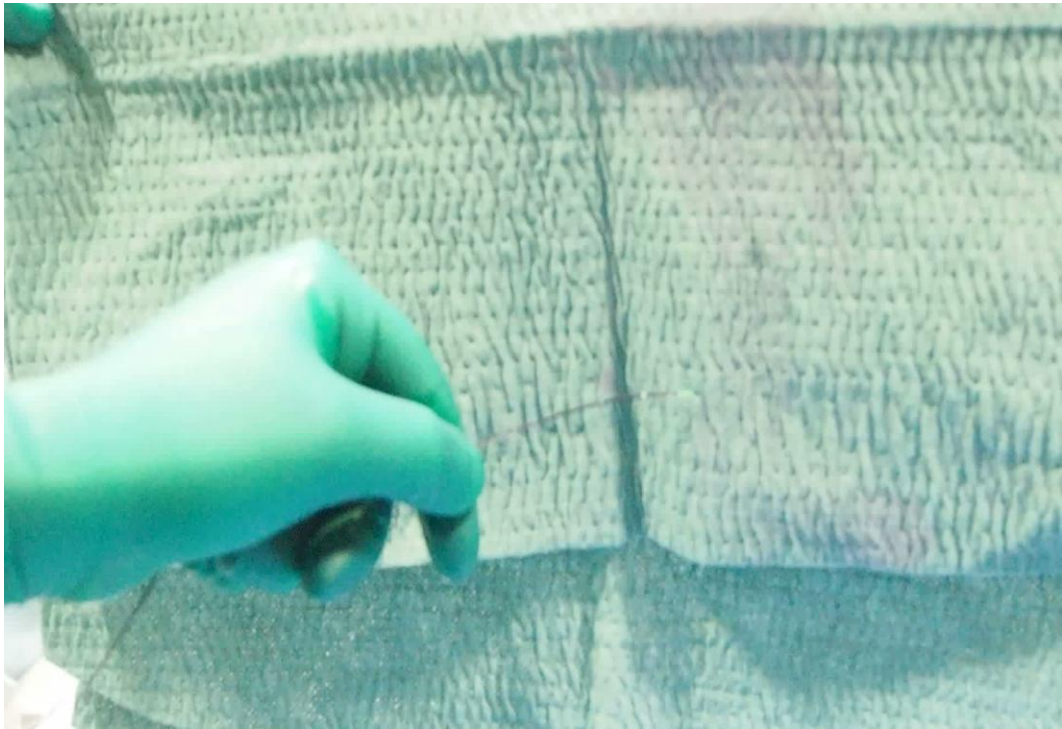




- Monorail infusion catheter with double lumen
- Inner lumen to measure the infusion temperature
- Outer lumen to infuse saline via side holes



…

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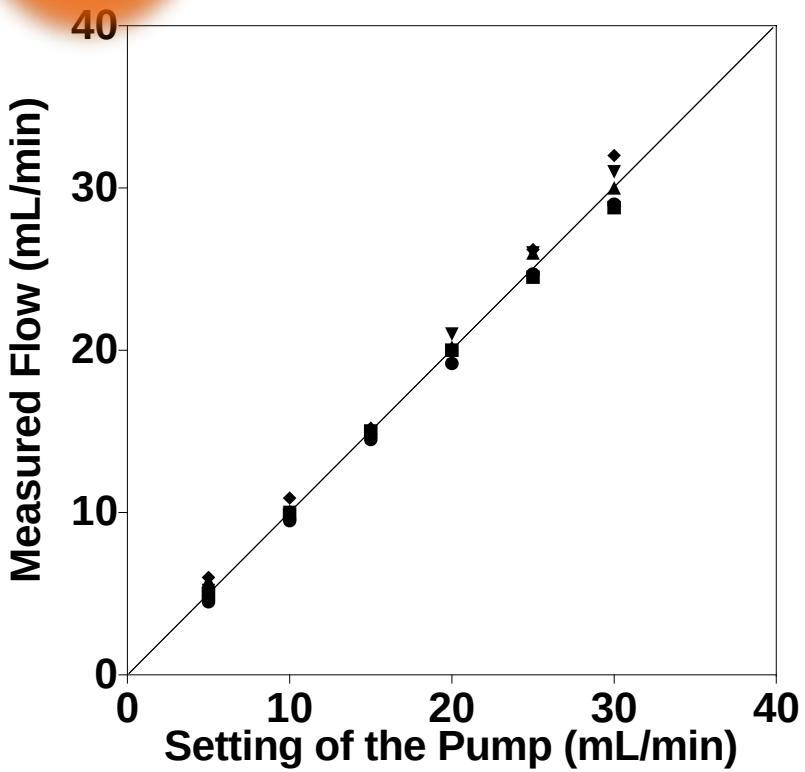
Is the volume (Q_i) delivered by the pump reliable ?

$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad (mL/min)$$



Conclusion: the pump delivers the exact flow

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$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad \text{(mL/min)}$$

- New catheter
- **Simplification**
- Reproducibility in pts

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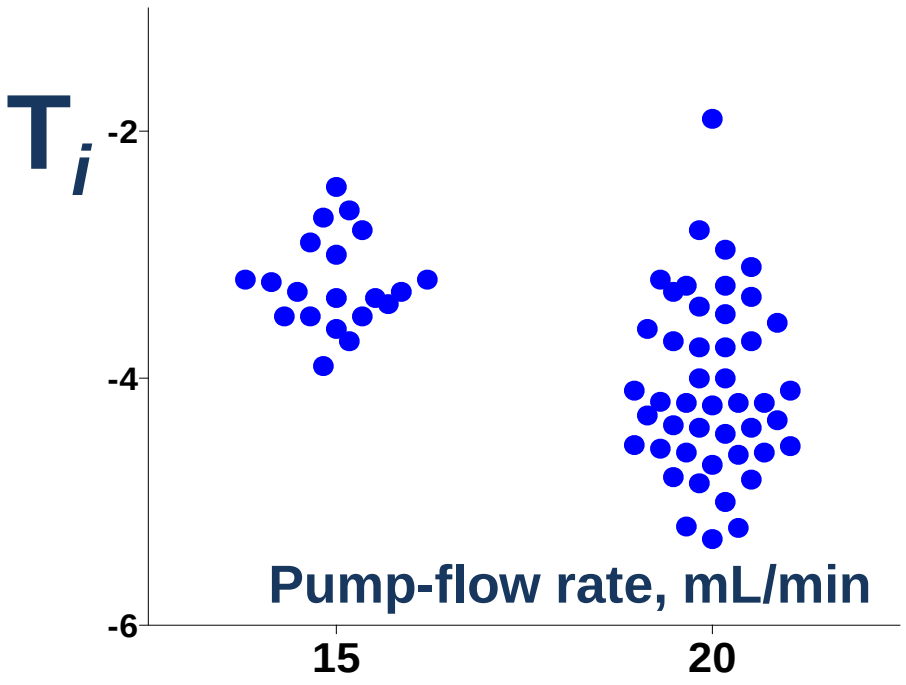
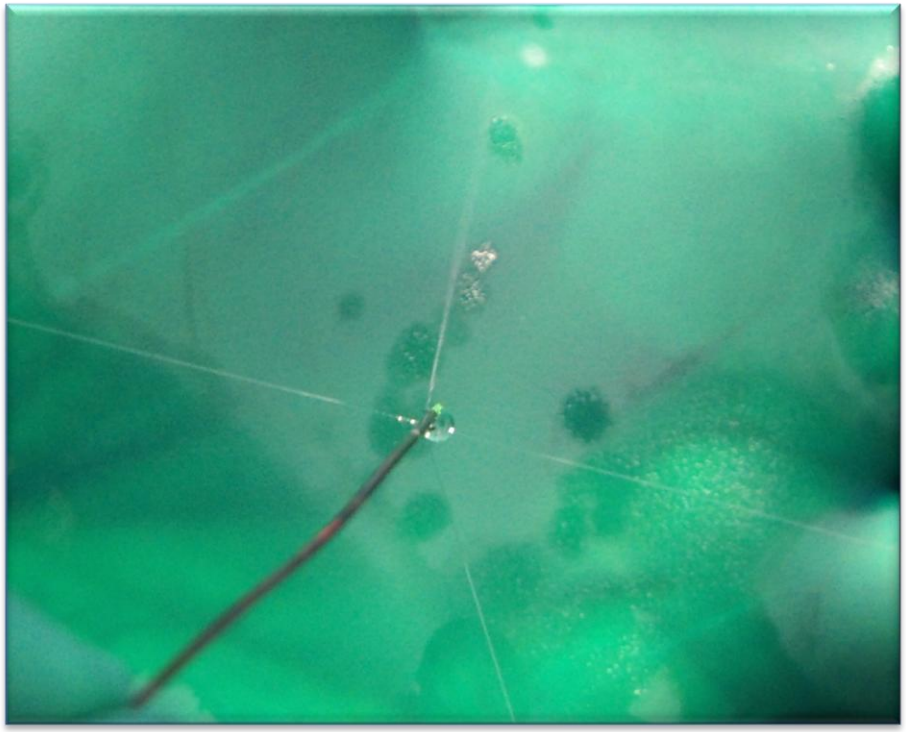
Is the temperature (Ti) constant for a given pump-flow rate?

$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad (mL/min)$$





T_i is not constant and should be measured in each patient

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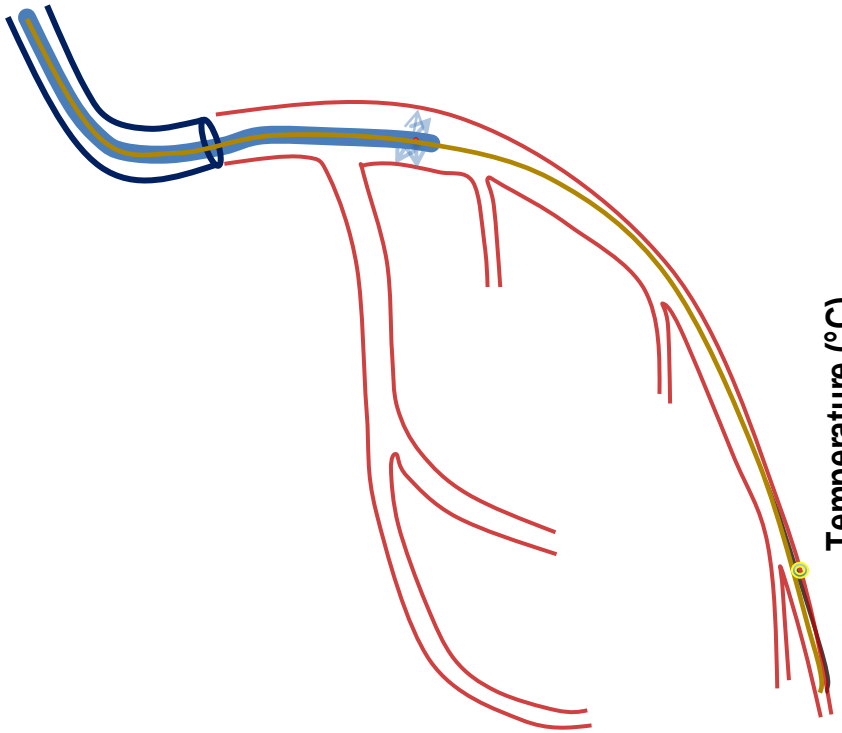
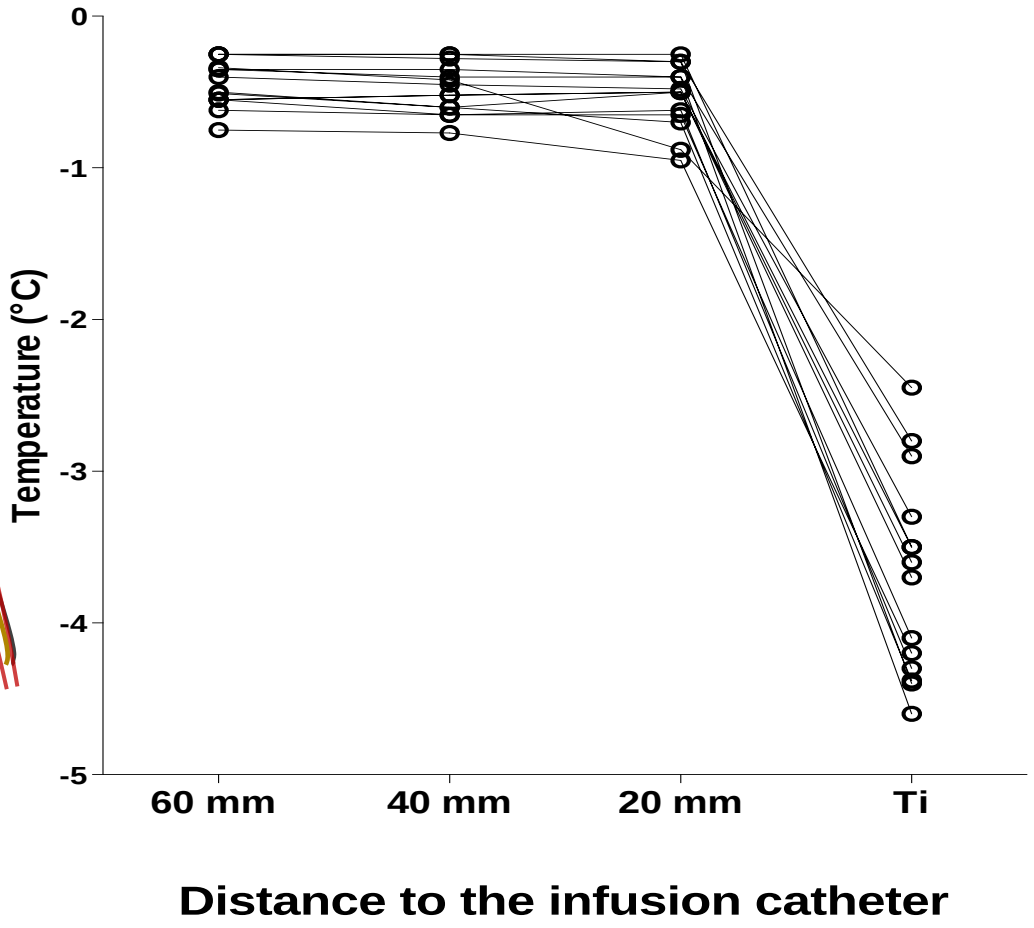
Is there an influence of the distance between infusion catheter and sensor ?





Provided the sensor is placed at least 4-8 cm from the perfusion catheter, its exact position does not matter

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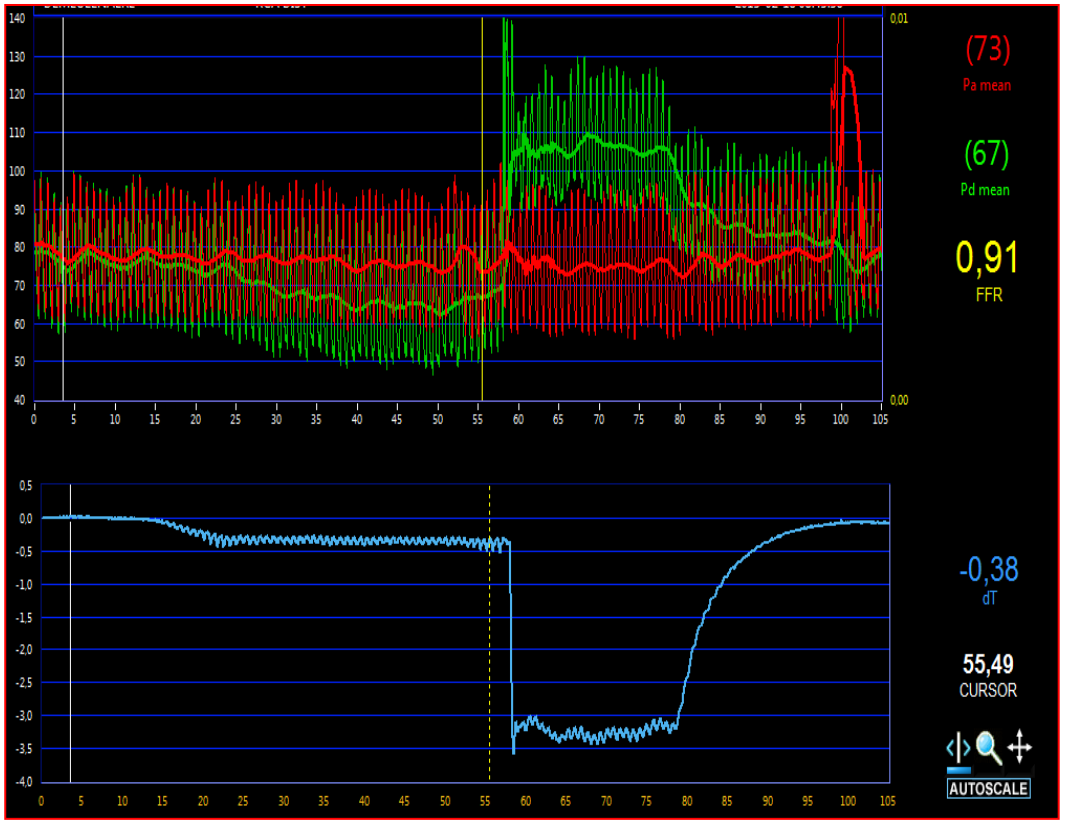
Hyperemia

$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad (mL/min)$$

Only during hyperemia



➔ Is the perfusion of saline itself not a hyperemic stimuli ?

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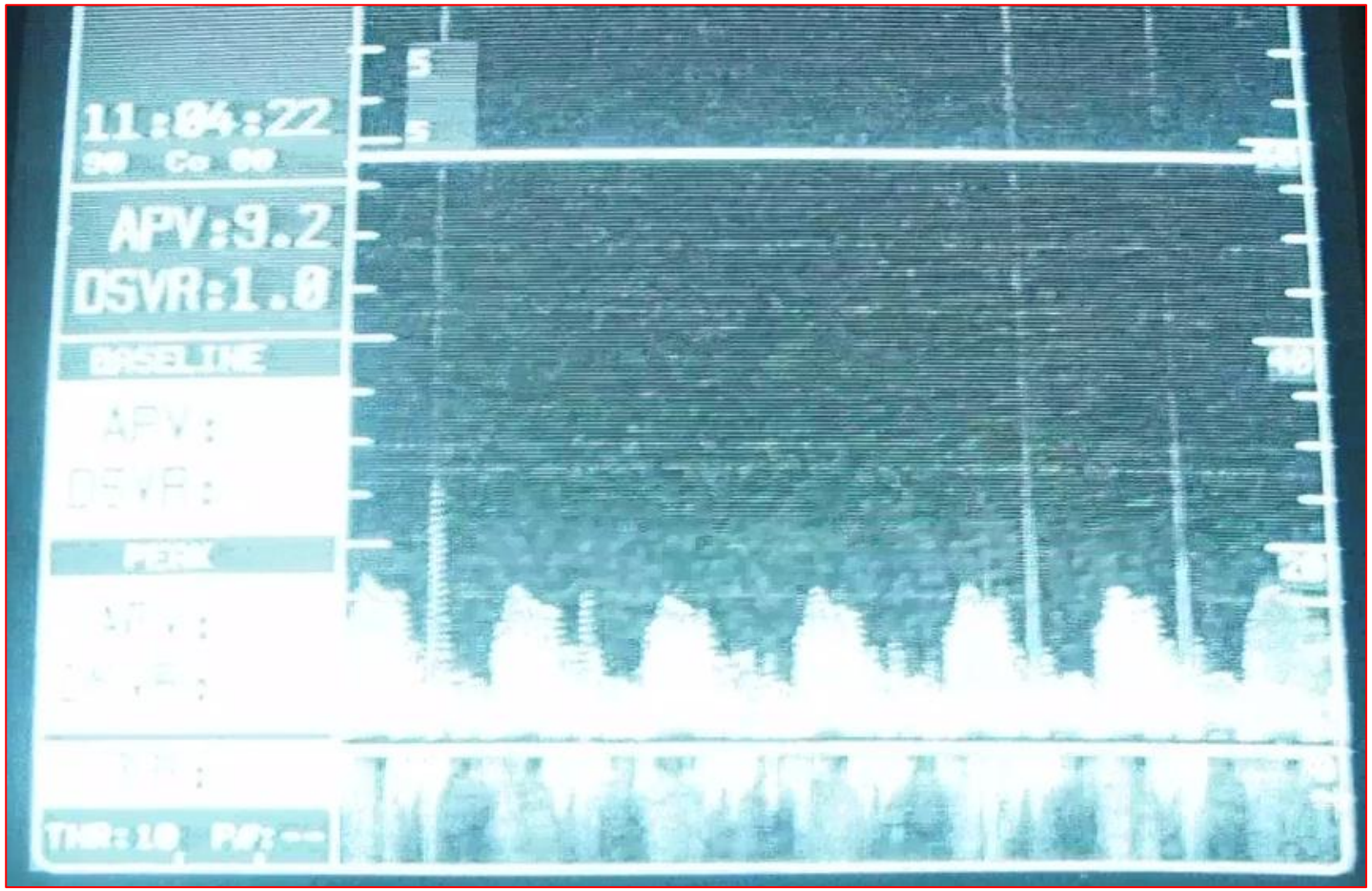
Doppler Flow Velocity Measurements

- at rest,
- after 200 µg of IC adenosine,
- during incremental infusion-rates of saline (5, 10, 15, 20 mL/min)



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Doppler Flow Velocity Measurements

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Impaired Coronary Vasodilator Reserve in the Immediate Postcoronary Angioplasty Period: Analysis of Coronary Artery Flow Velocity Indexes and Regional Cardiac Venous Efflux

MORTON J. KERN, MD, FACC, UBEYDULLAH DELIGONUL, MD,
MICHEL VANDORMAEL, MD, FACC, ARTHUR LABOVITZ, MD, FACC,
CALAPATHIRAO V. GUDIPATI, MD, GREGORY GABLIANI, MD, JOSEPH BODET, MD,
YOGESH SHAH, MD, HAROLD L. KENNEDY, MD, FACC

St. Louis, Missouri

The ratio of peak hyperemic/basal mean coronary flow velocity, an index of coronary vasodilator reserve, immediately after coronary angioplasty normalizes in <50% of patients. To evaluate other indexes of coronary vasodilator flow or artery flow velocities, but did result in significantly higher papaverine responses after angioplasty. Mean and phasic coronary velocity, diastolic coronary flow velocity integral and measured great cardiac vein flow ratios were

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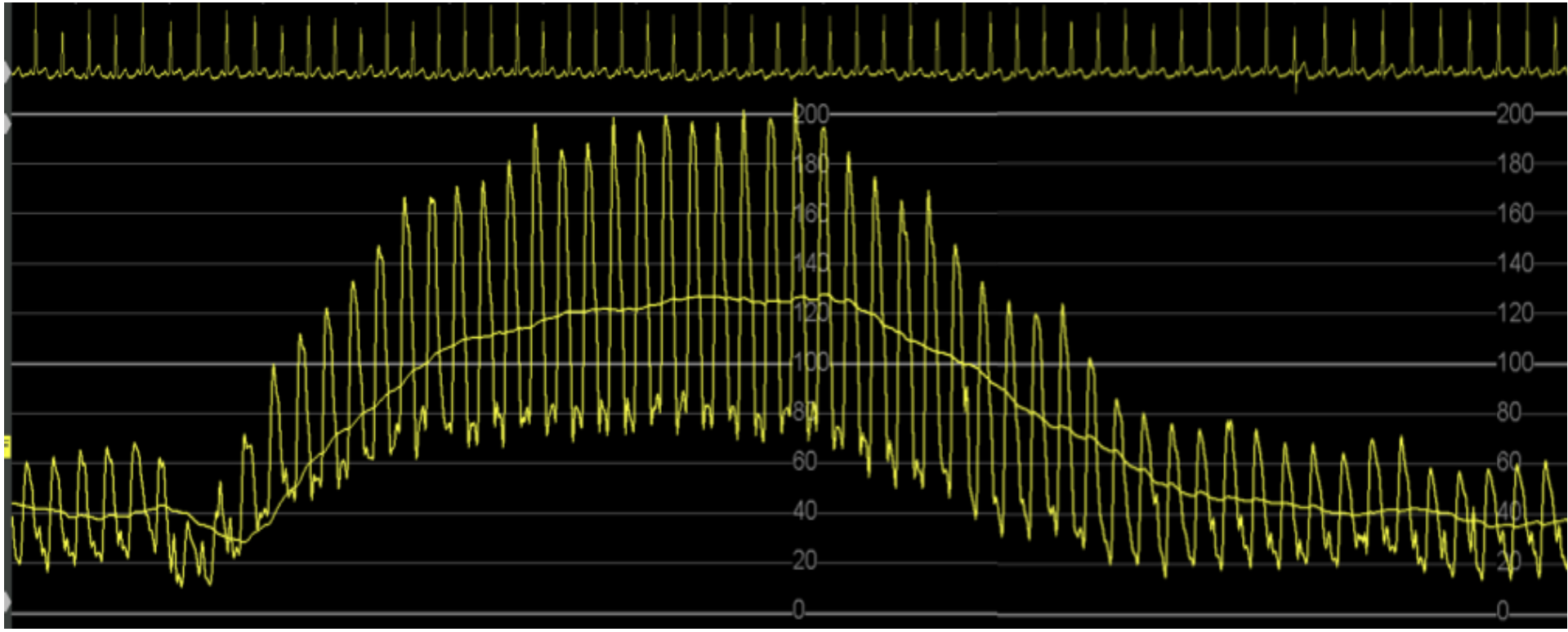

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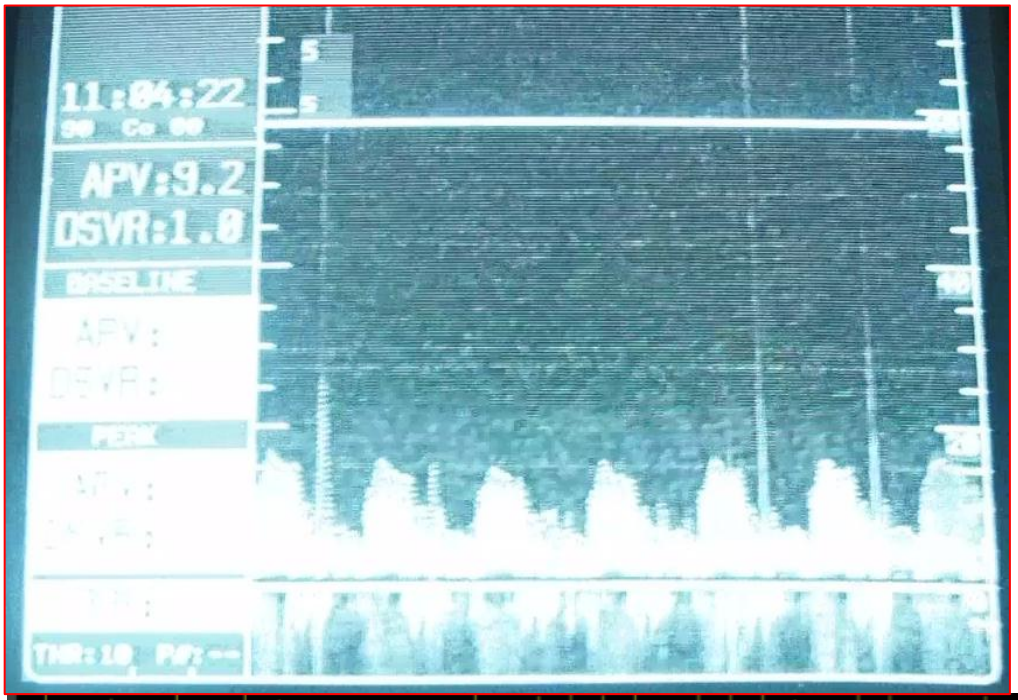
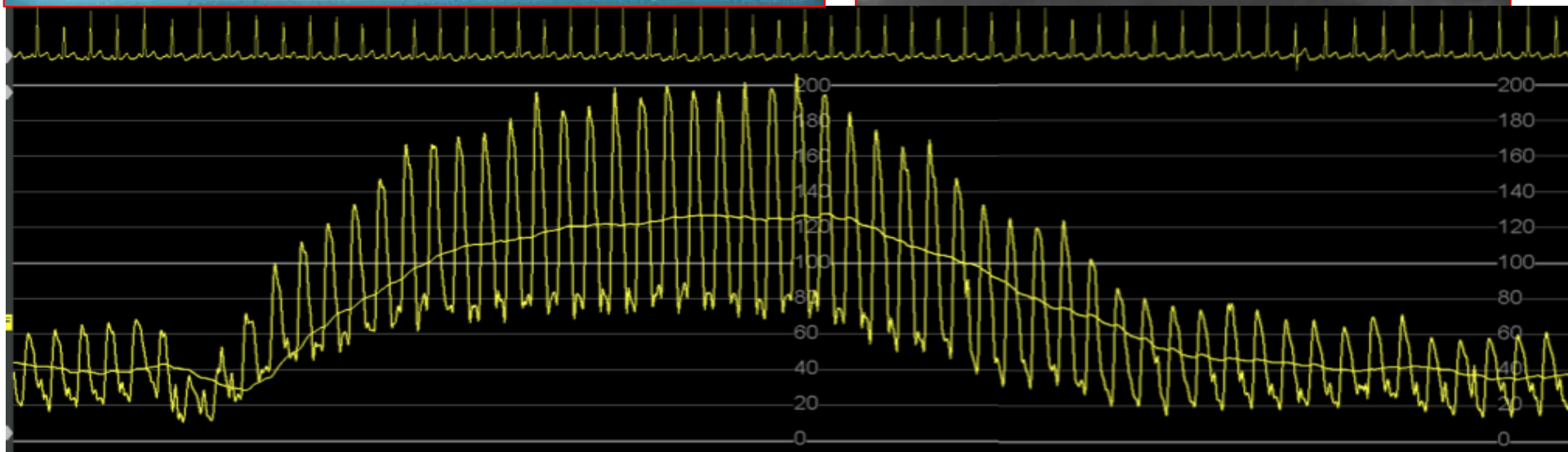
Flow Velocity Measurements Adenosine IC





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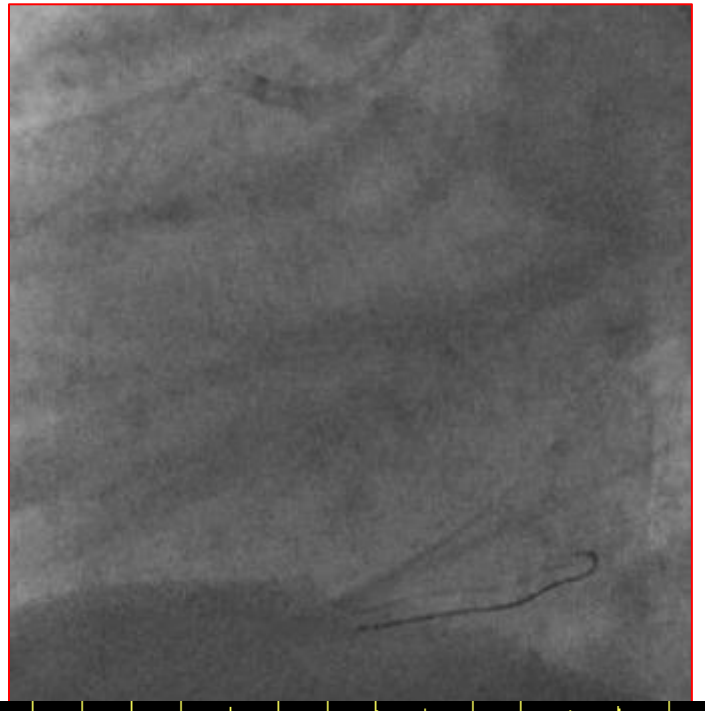
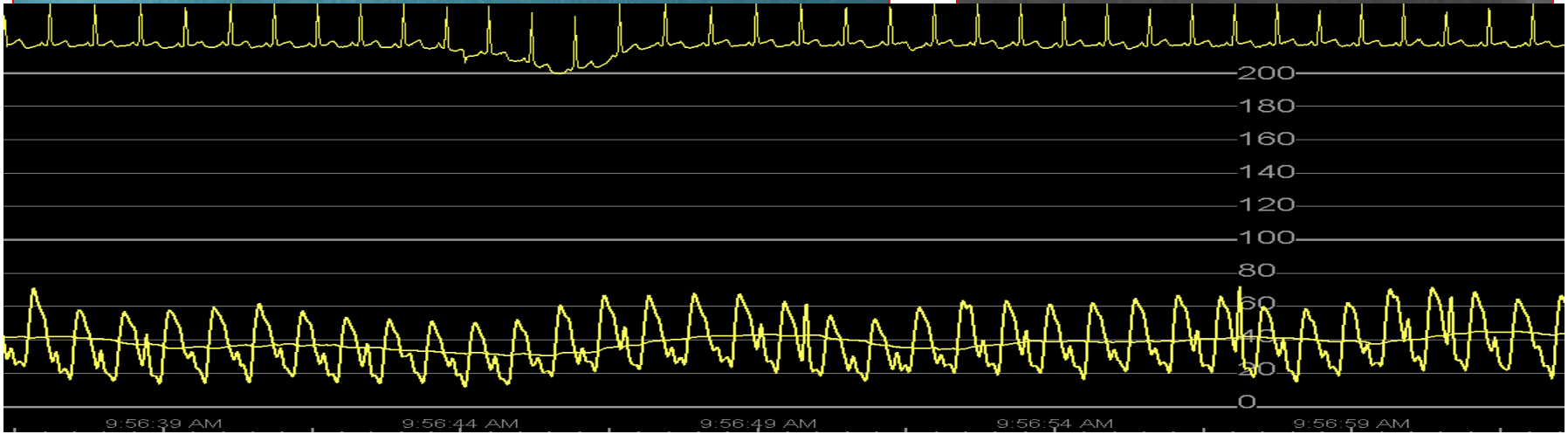
Flow Velocity Measurements Saline 5 mL/min





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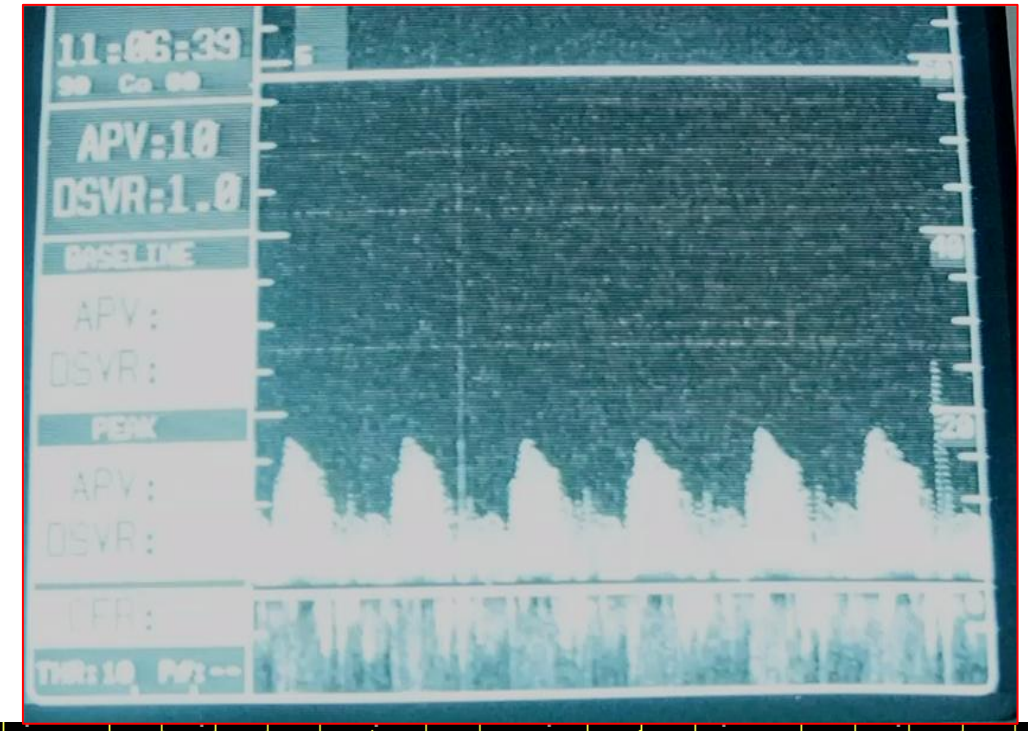
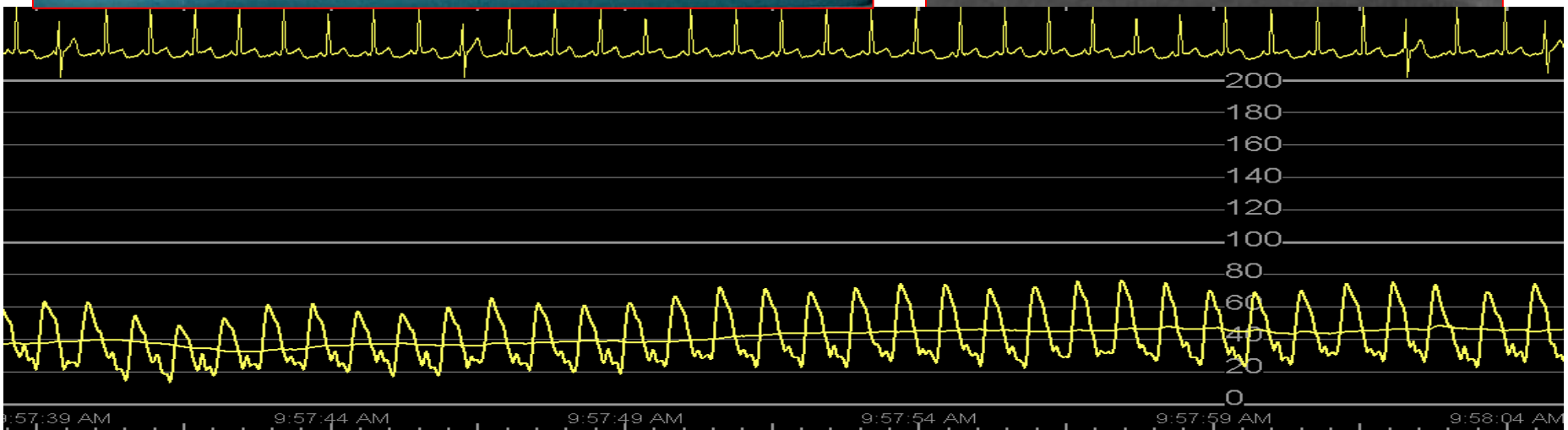
Flow Velocity Measurements Saline 10 mL/min





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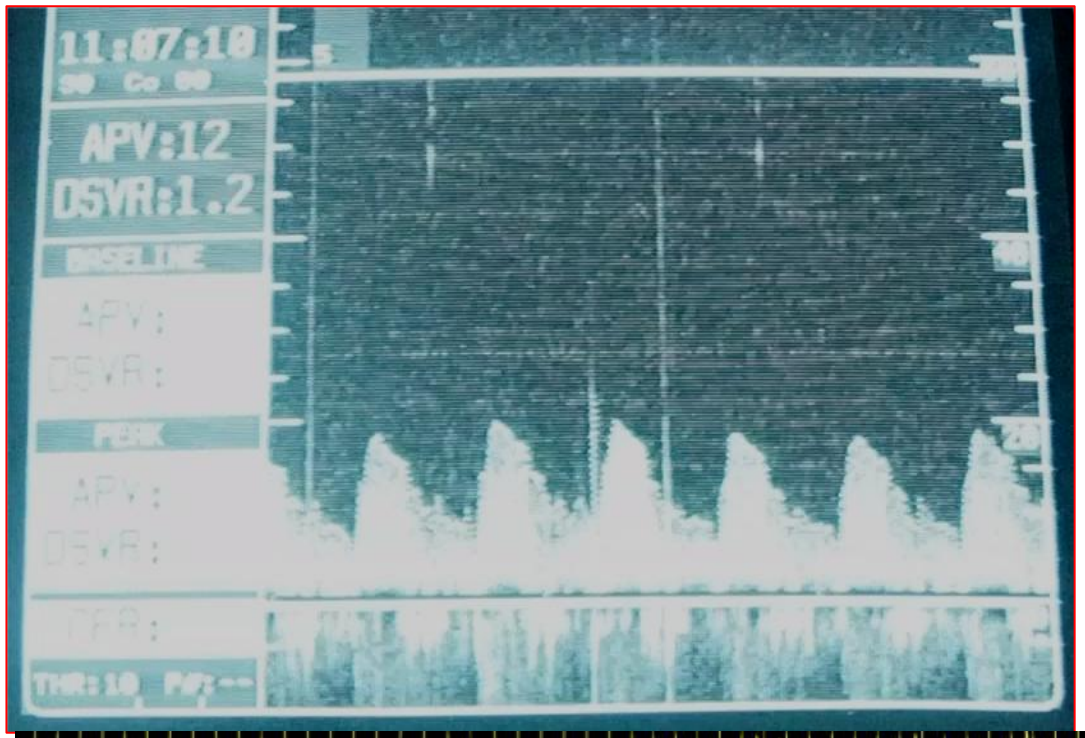
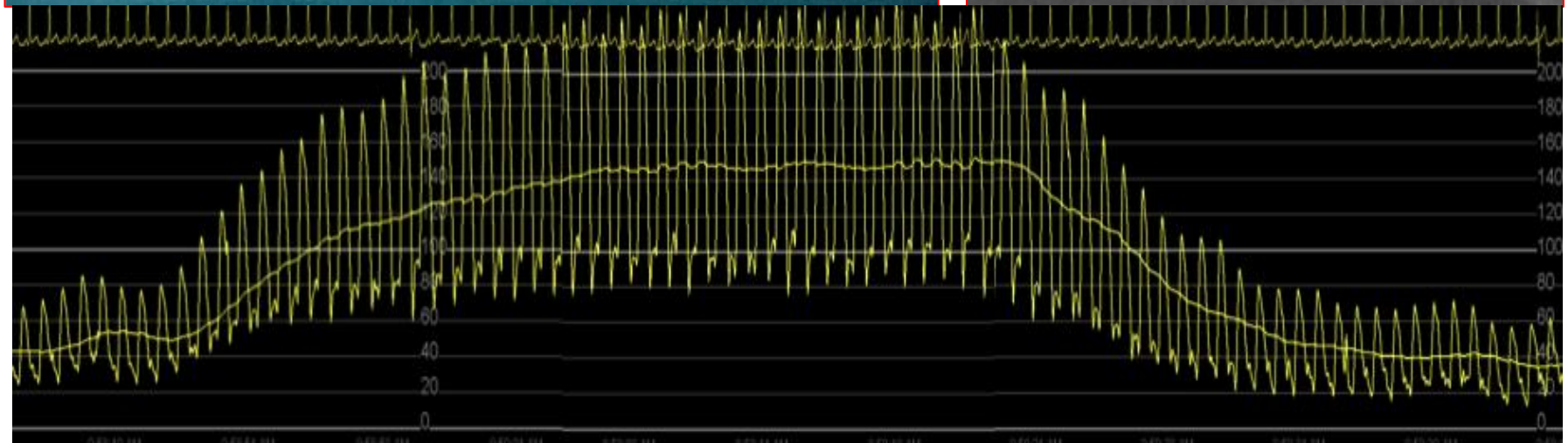
Flow Velocity Measurements Saline 15 mL/min





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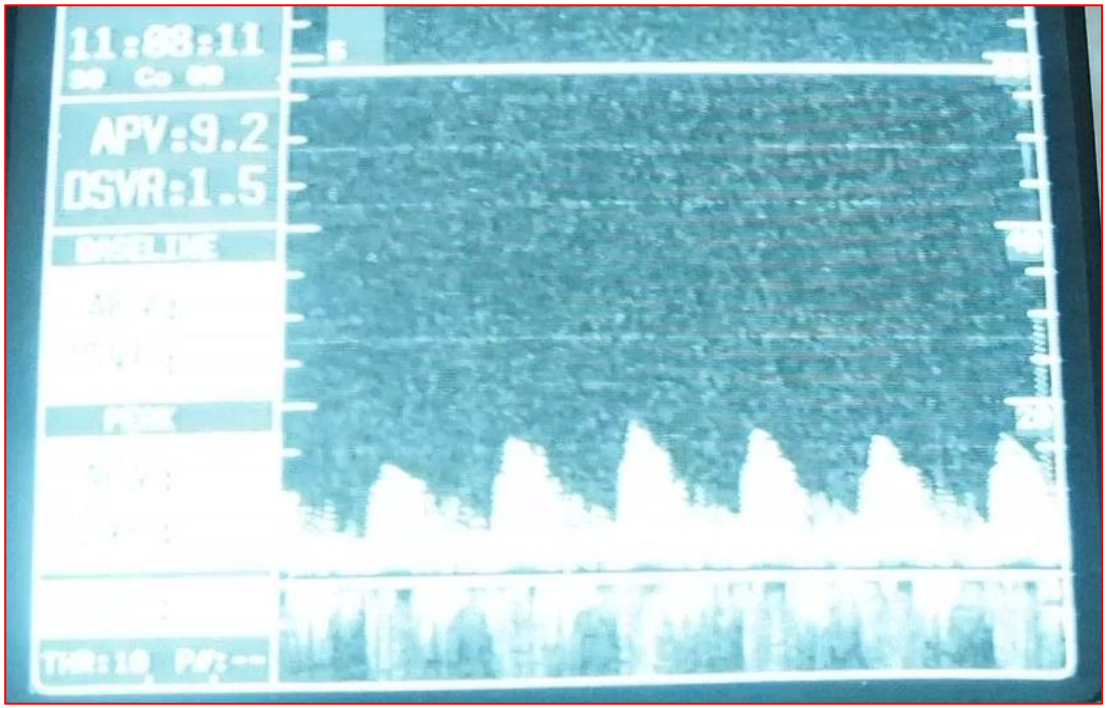
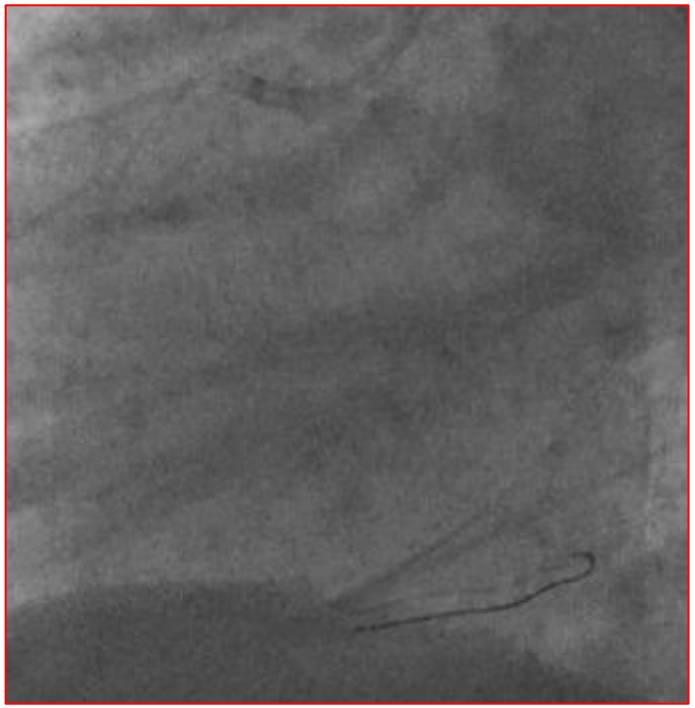
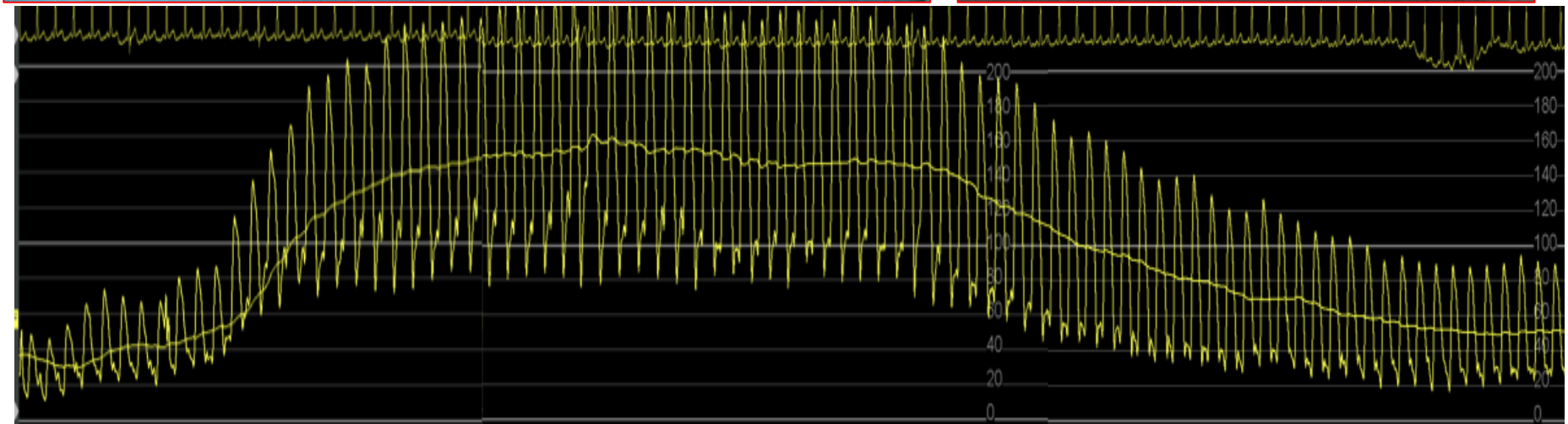
Flow Velocity Measurements Saline 20 mL/min







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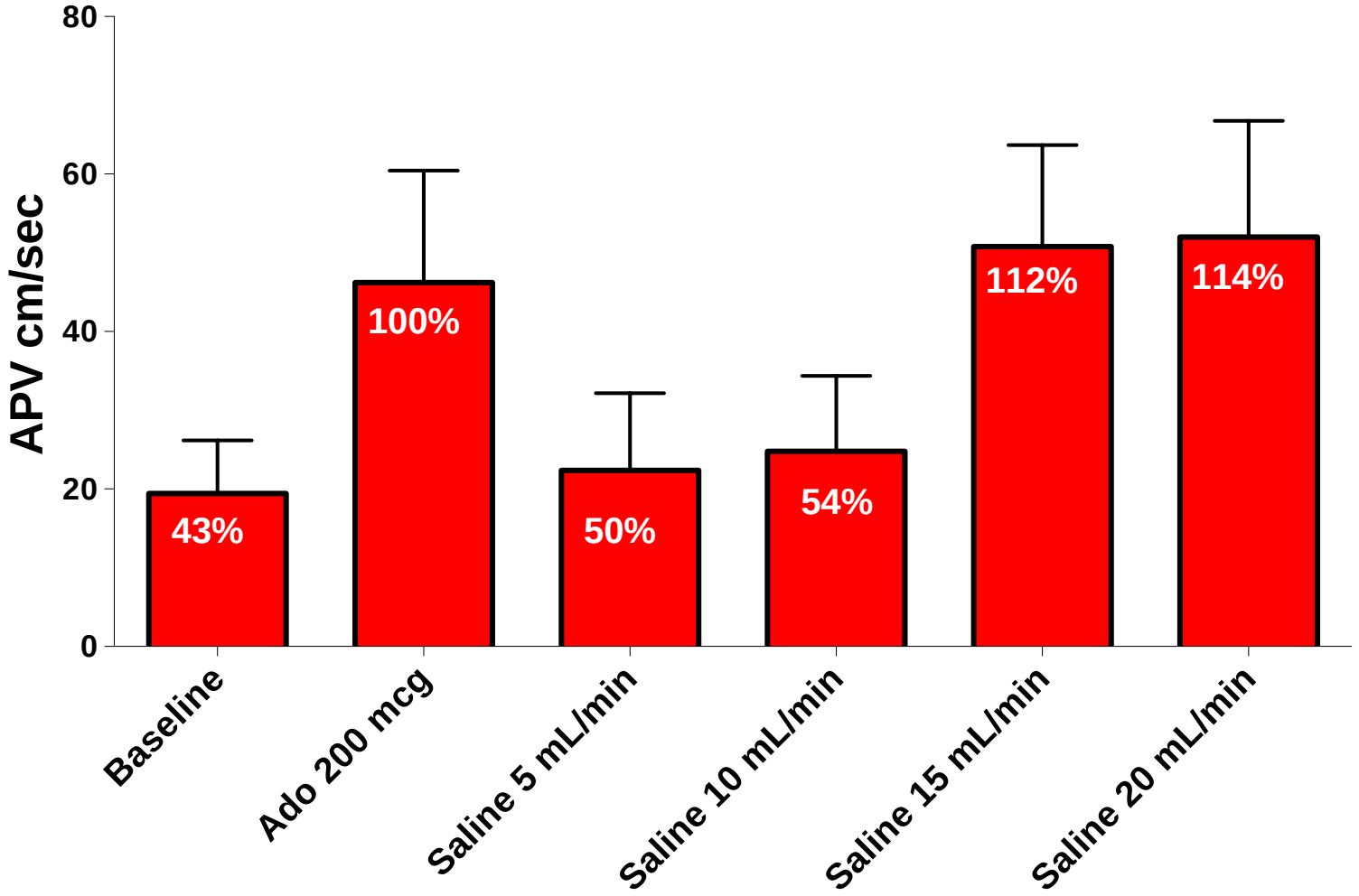
Saline induces Maximal Hyperemia



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$$Q = Q_i \times \frac{T_i}{T} \times 1.08 \quad (mL/min)$$

- New catheter
- Simplification
- **Repeatibility**

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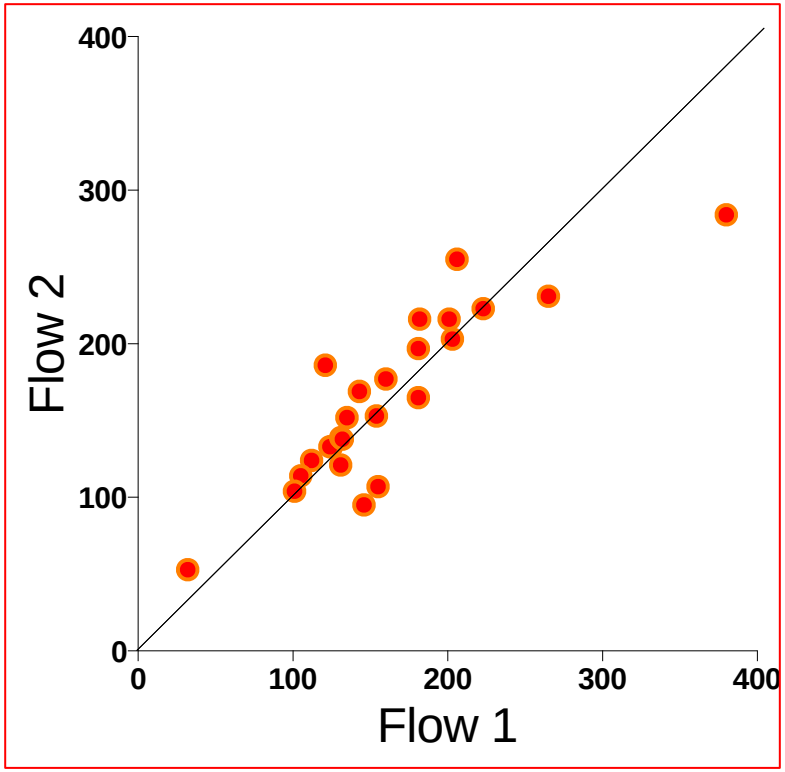
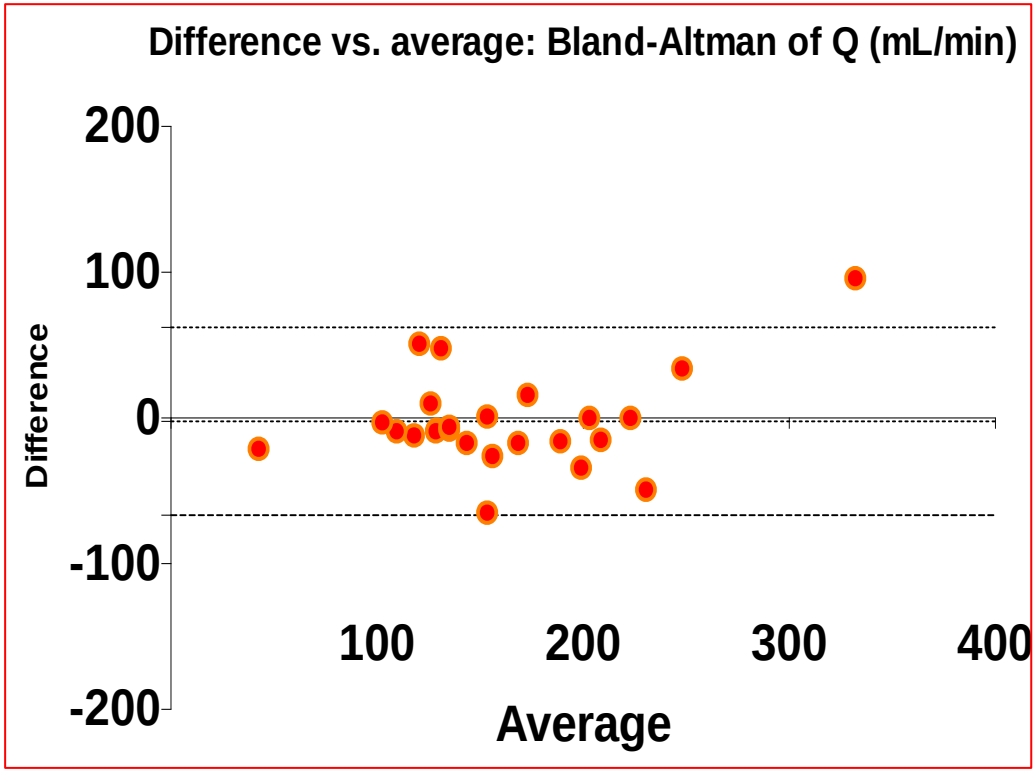
Test / Re-Test Repeatability for Flow (mL/min)





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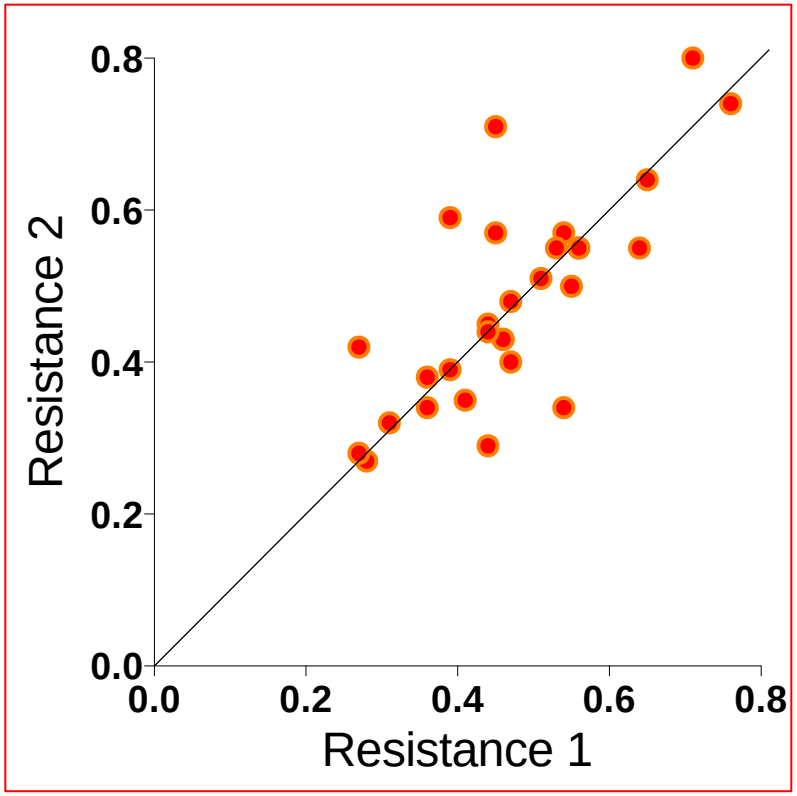
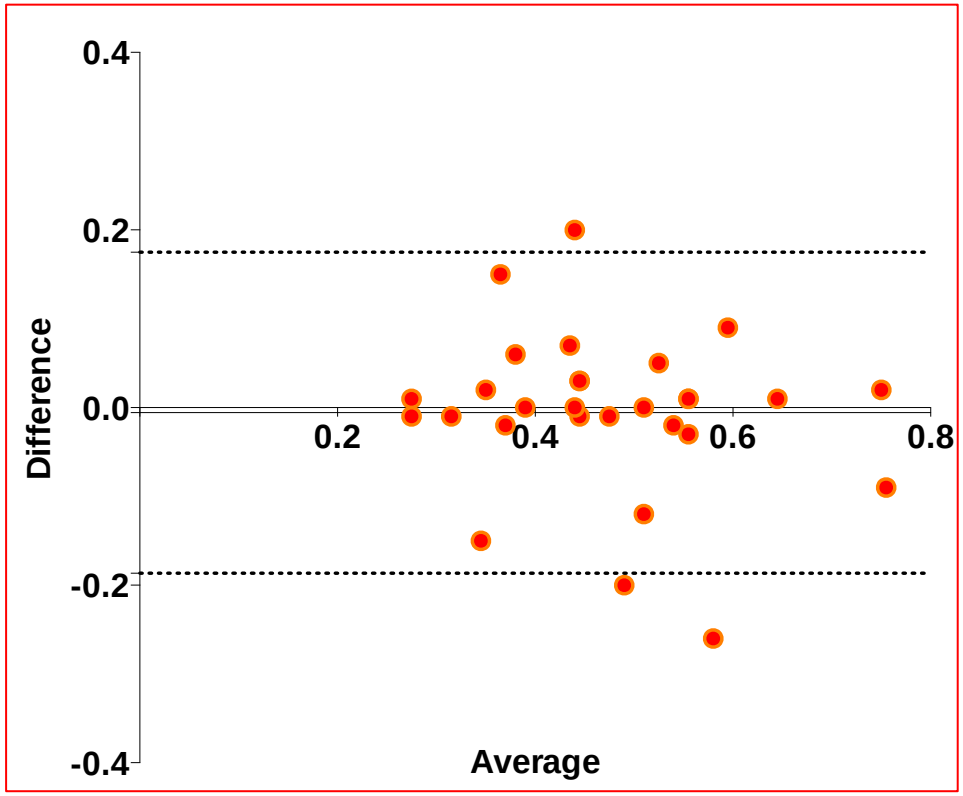
Test / re-test Repeatability for Resistance (mm Hg.min.mL^{-1})





Conclusions

1. It is possible to measure absolute coronary blood flow and minimal microvascular resistance

2. Time needed is ± 1 minute (5 to 15 minutes all in), good repeatability

3. Intrapatients measurements of microvascular resistance: effect of medications, mechanistic studies of the microvasculature, MI's, etc, …

Limitations

1. Invasive, room occupied by the catheter,

2. Myocardial mass is unknown

3. Flow and pressure are not measured at the exact same spot