Absolute flow measurements in practice

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Background – our arsenal

- Coronary Flow Reserve (CFR)

- Fractional Flow Reserve (FFR)

- Index of Myocardial Resistance (IMR)

- Absolute Coronary Flow

Background – thermodilution

$$Q_b = Q_i\,[(T_b - T_i)/(T_b - T)](1.08)$$

- Q_b: Absolute blood flow
- Q_i: Flow of injection
- $T_b - T_i$: Temperature difference
- $T_b - T$: Temperature difference
- 1.08: Correction factor

Ganz, W et al. Circulation. 1971;44:181.

Background

$$Q_b = Q_i \left[(T_b - T_i)/(T_b - T)\right](1.08)$$

T_b set to zero and
values expressed as Δ

$$Q_b = Q_i \left[\Delta T_i/\Delta T\right](1.08)$$

Ganz, W et al. Circulation. 1971;44:181.
Aarnoudse et al. J Am Coll Cardiol. 2007;50:2294.

Background

$$Q_b = Q_i \, [\Delta T_i / \Delta T] \, (1.08)$$

Temperature sensor

Perfusion catheter

Ganz, W et al. Circulation. 1971;44:181.
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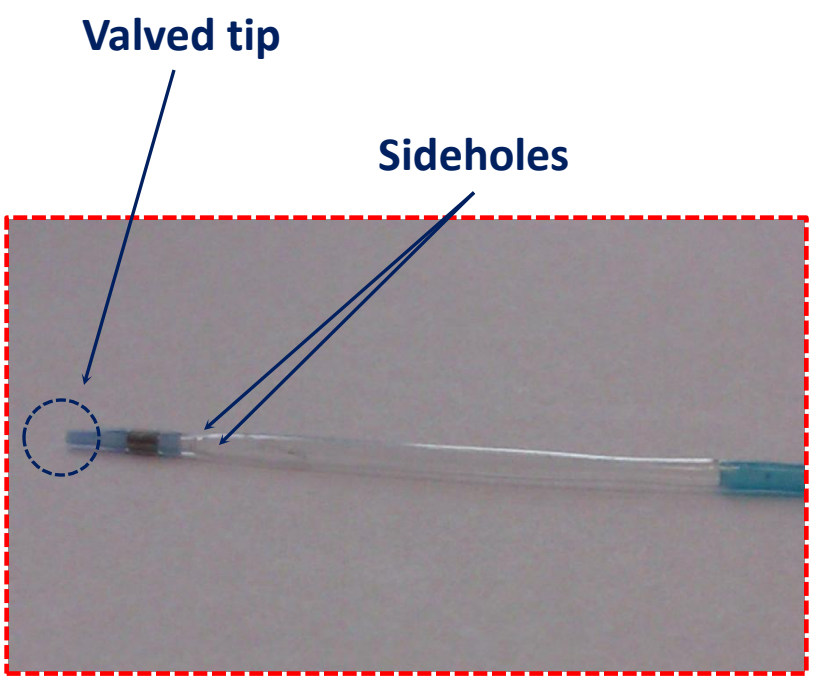
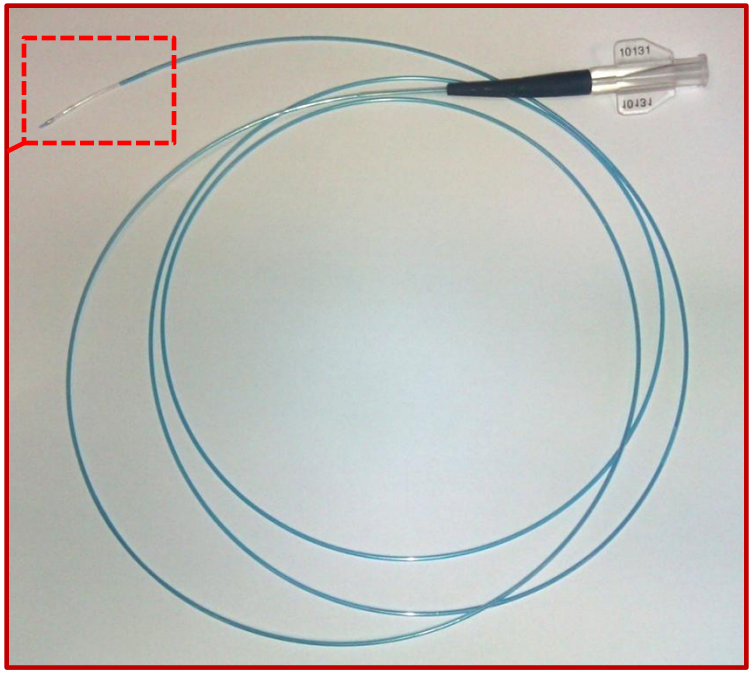
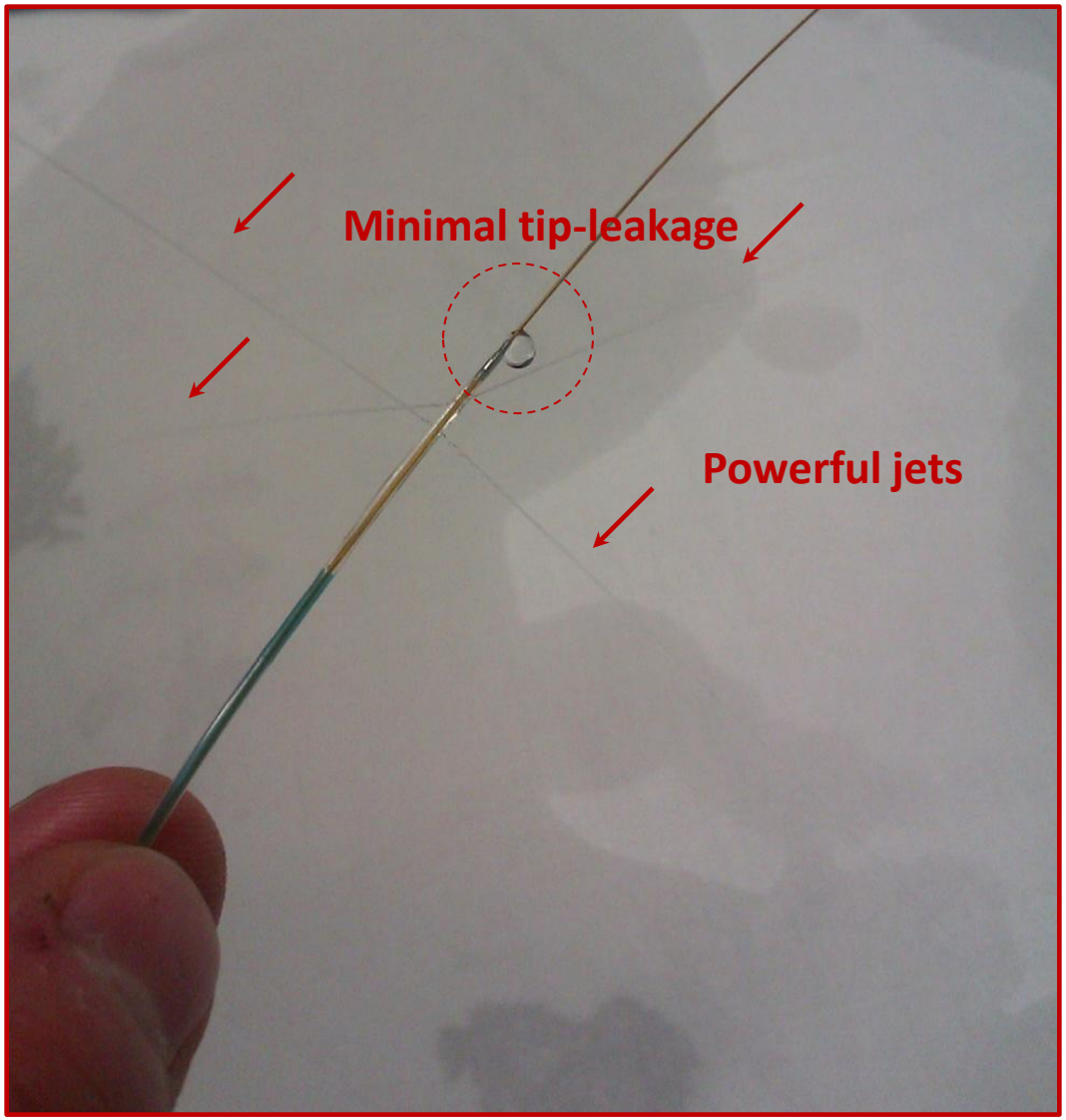
Method – CARAC™ perfusion catheter

- 3.3F outer diameter – 0.014” compatible
- Over-the-wire system
- Four sideholes positioned circumferentially 4.5mm back from the tip
- Special one-way valve at the tip for minimalizing tip-leaking, when wire is in place

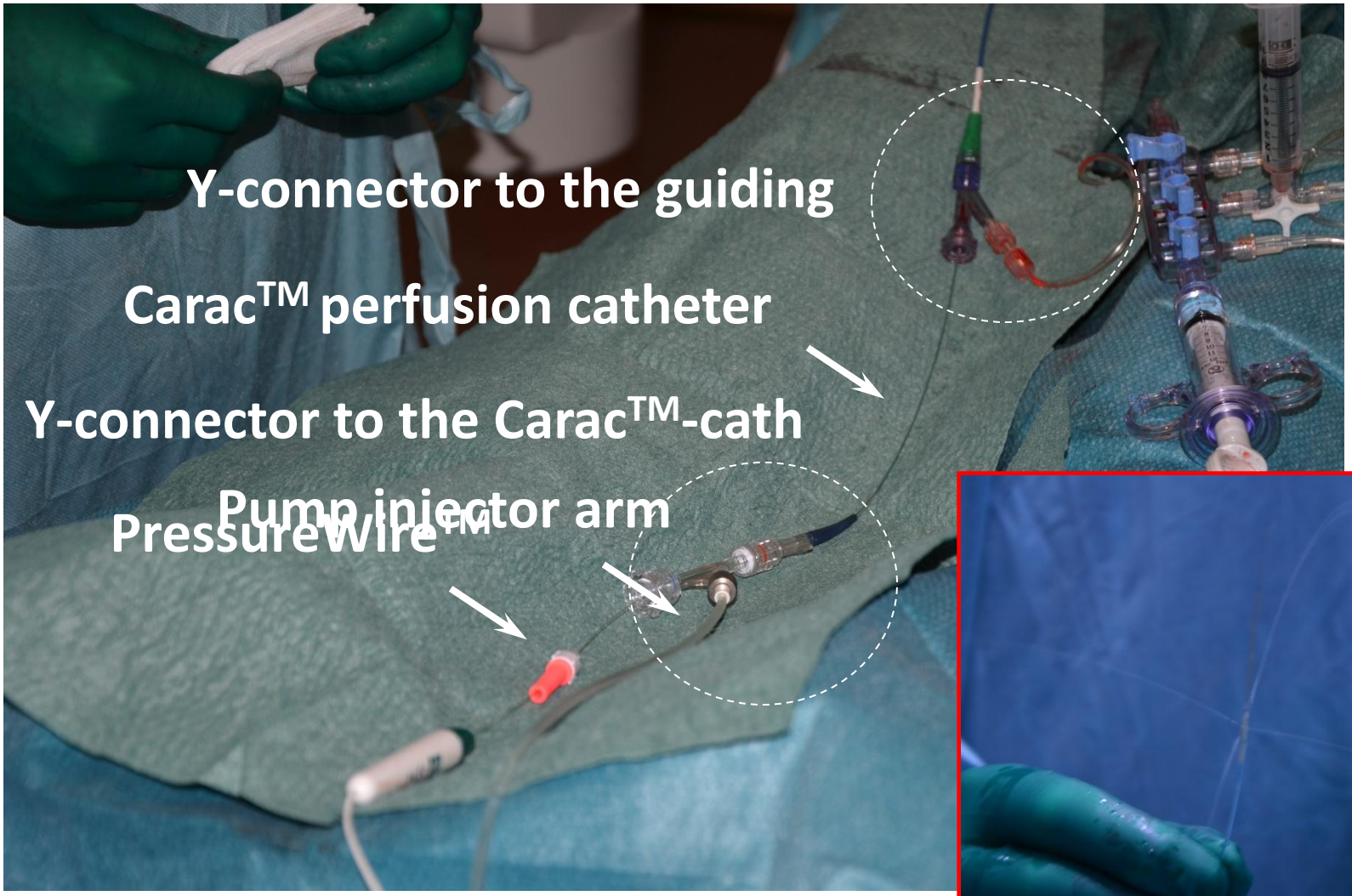




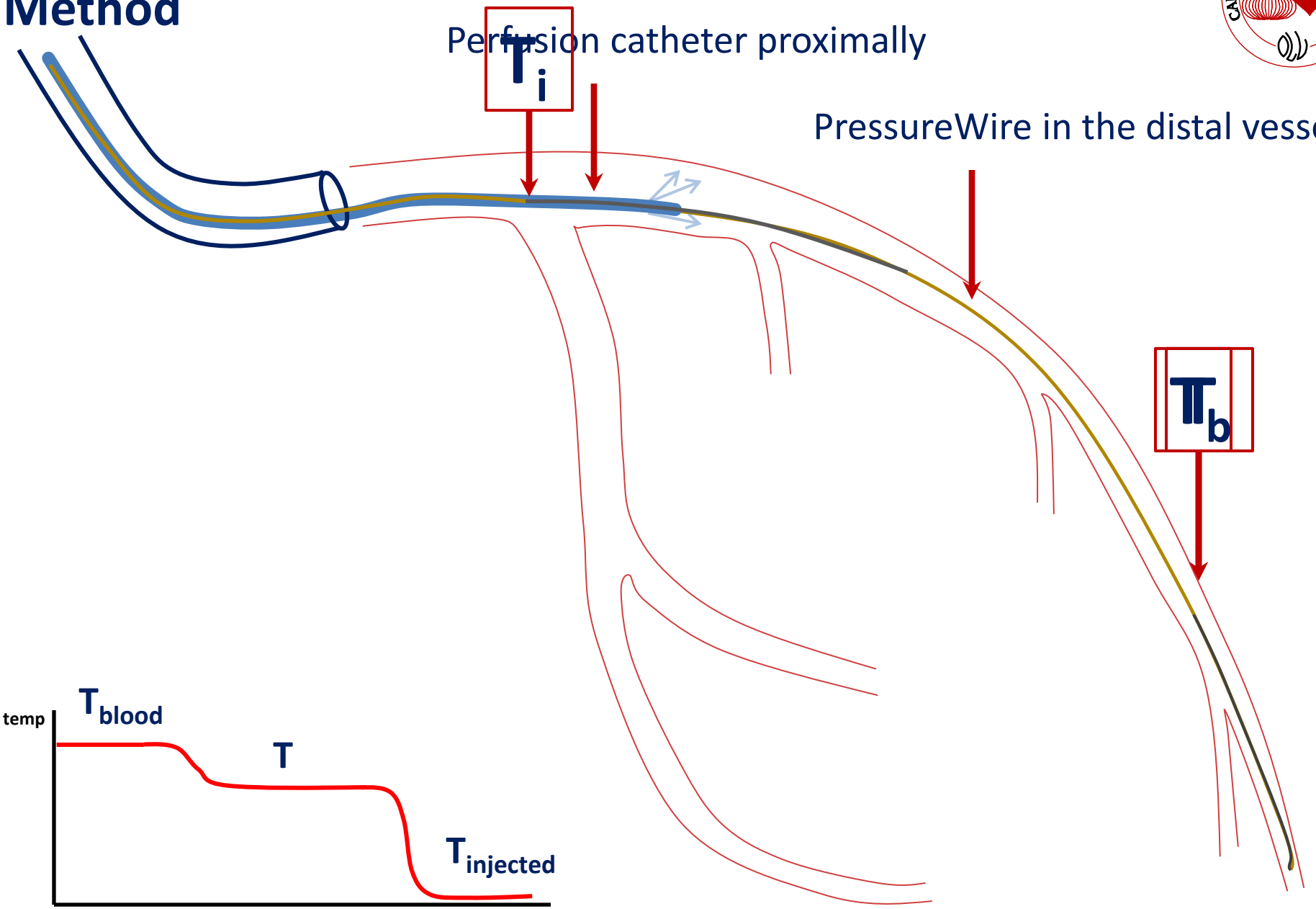
Method – CARAC™ perfusion catheter



Method – CARAC™ perfusion catheter

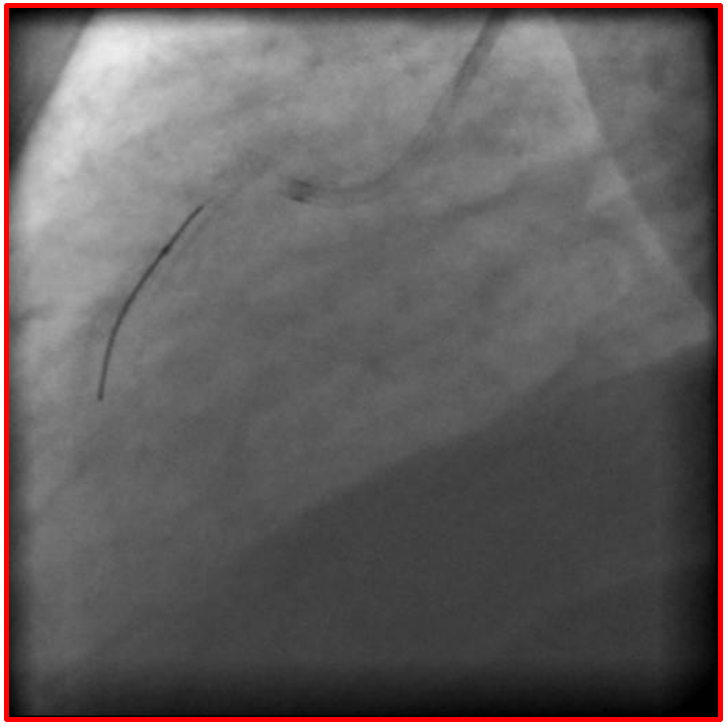


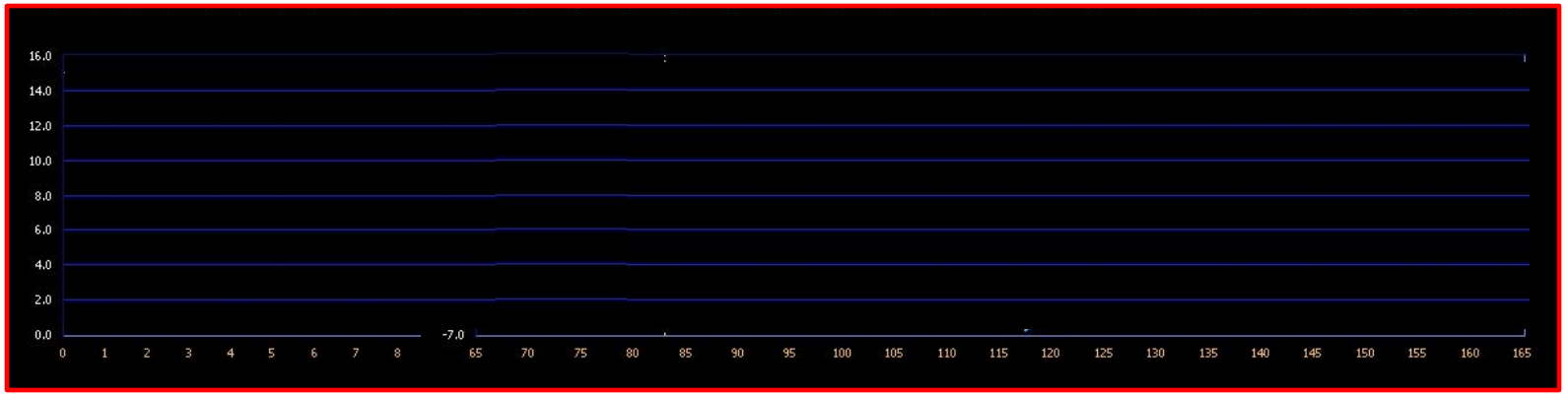
Method



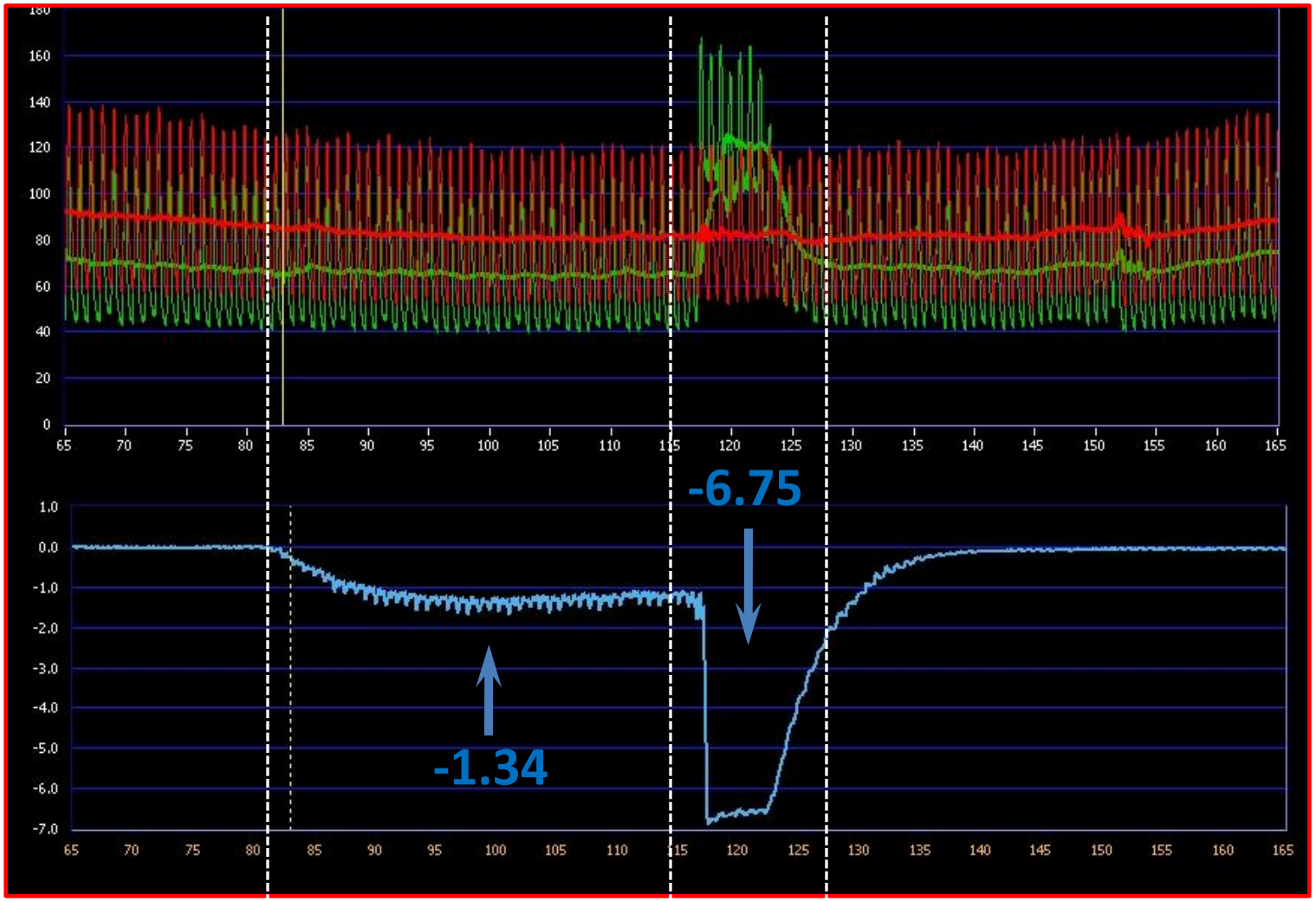
Method

$$Q_b = Q_i\,[\Delta T_i/\Delta T](1.08)$$



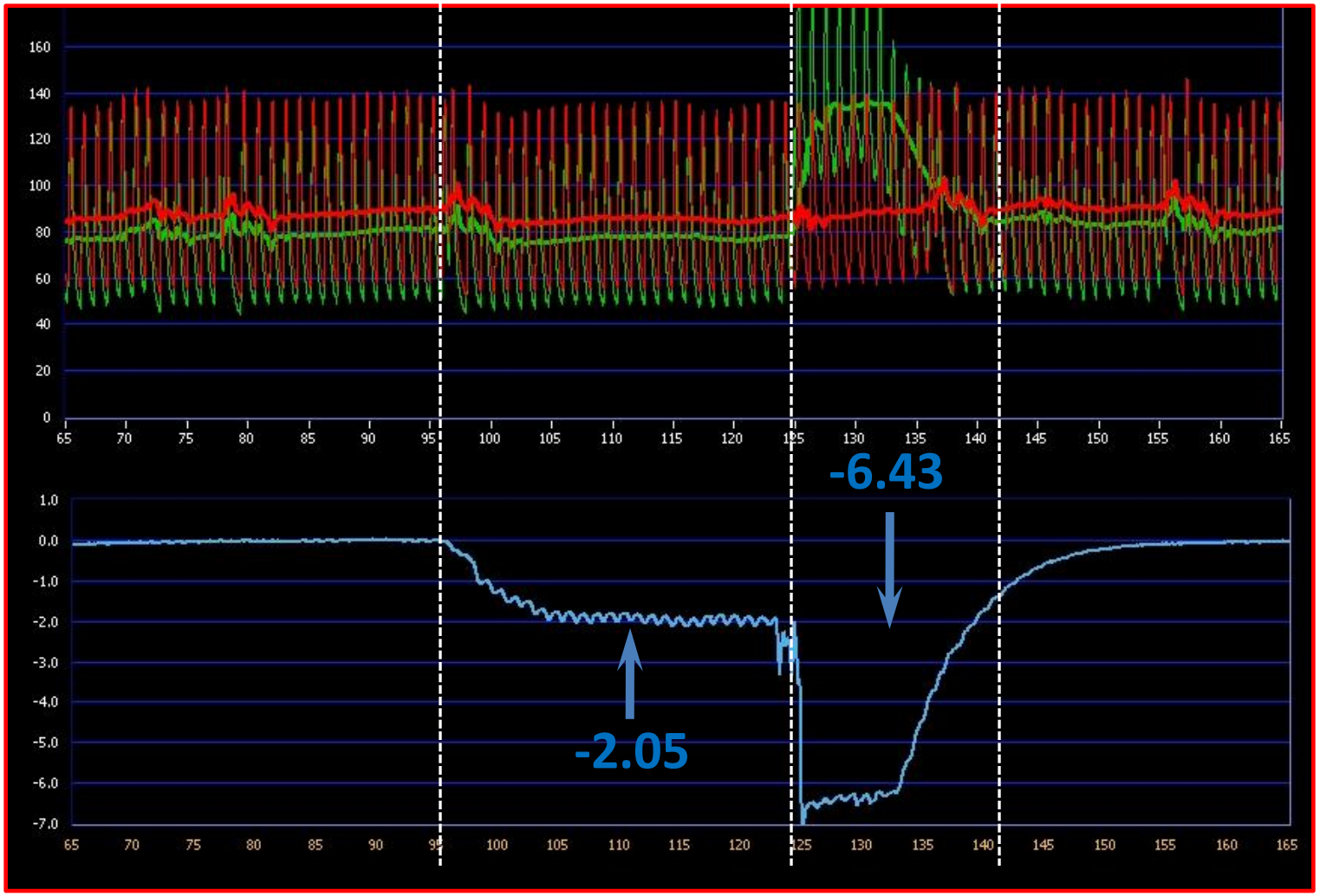


Method



$$Q_b = \frac{P_a}{R_{min}} \left(1 - \frac{P_d}{P_a}\right) \left(1 - \frac{\bar{P}_v}{P_a}\right) (1.08)$$

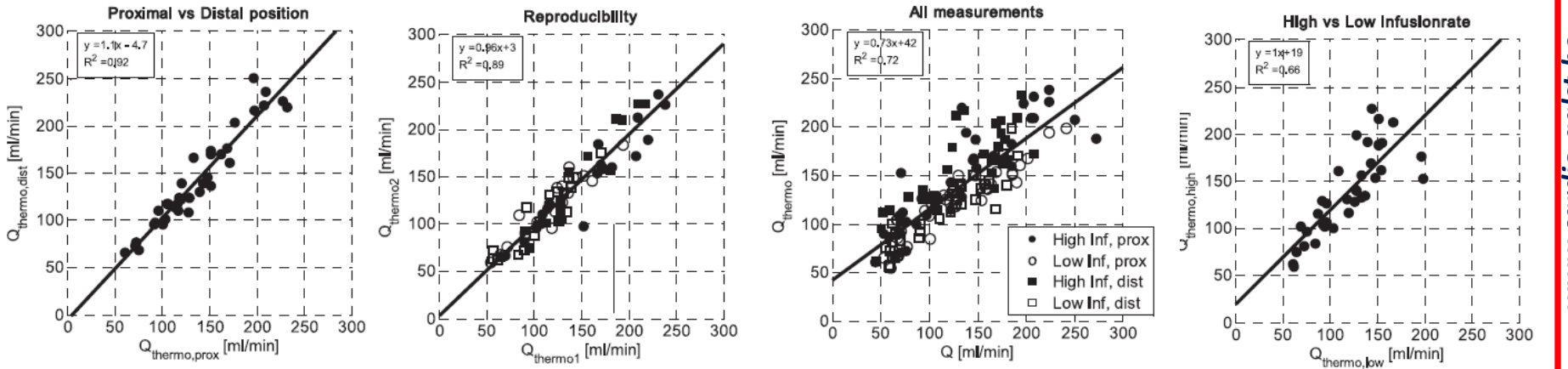
Method



$$Q_b = \frac{P_a \cdot [\Delta T / \Delta t]_{max}}{[\Delta T / \Delta t]_{max}} \cdot (1.5 \cdot 0.81)$$

Validation in dogs (n=5)

- Four different level of stenosis (mild/moderate/severe/very severe)
- Double-measurement for testing reproducibility
- Sensor 3 cm versus 6 cm distal to the tip
- Infusion rate in two ranges: 8 to 15 ml/min and 15 to 25ml/min



Courtesy of Aarnoudse et al.

www.cardio-aalst.be

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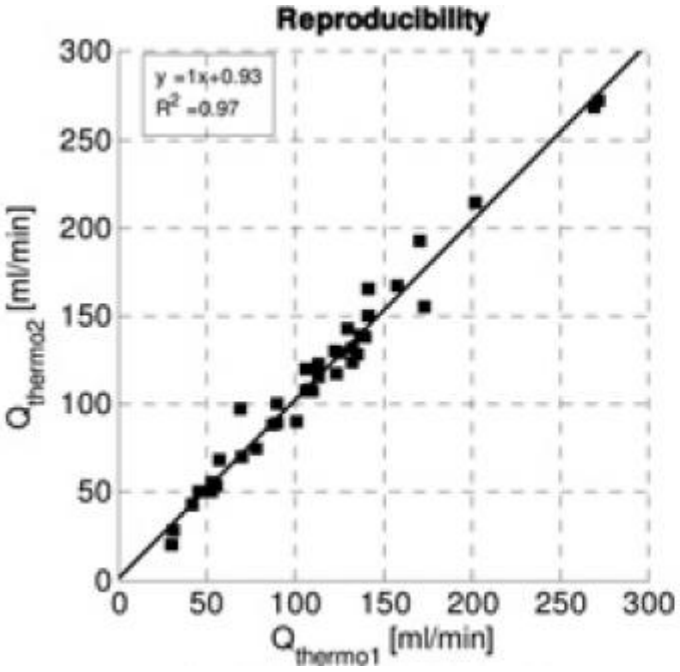
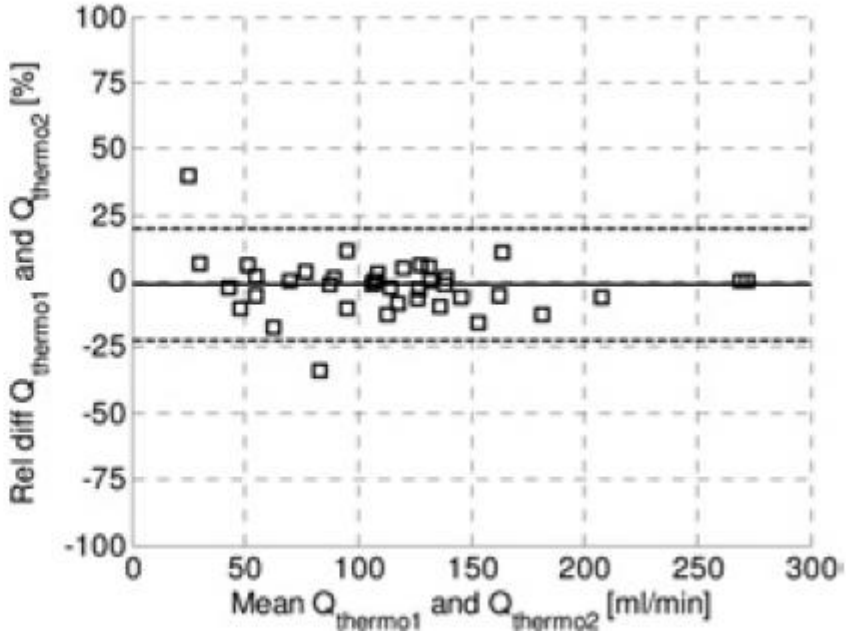
First-in-man tests

- 35 patients, 42 coronary arteries





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Conclusions

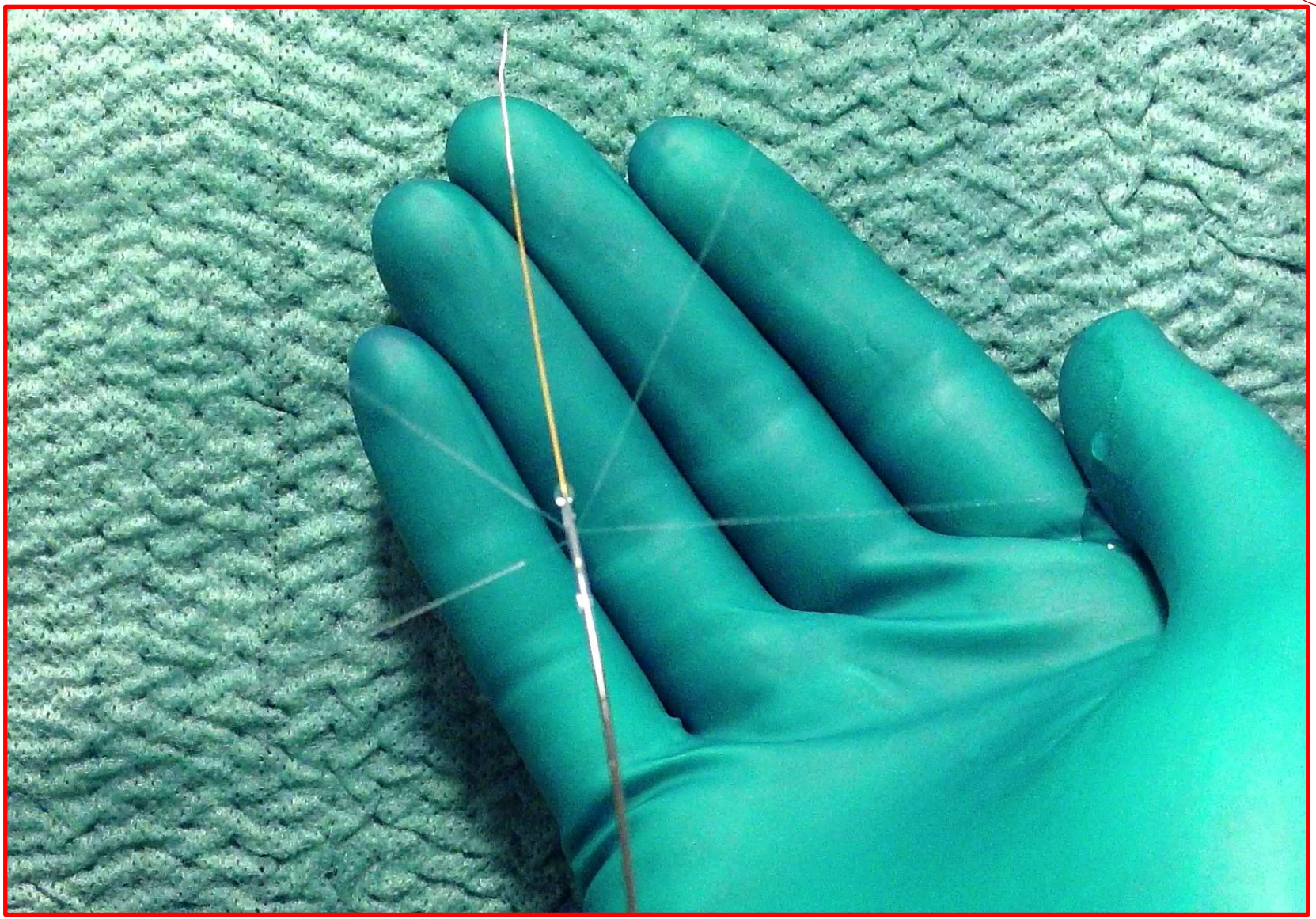
- Measurement of absolute flow is feasible

- Method is based on continuous thermodilution

- Measurements are accurate and reproducible

- Perfusion catheter needs to be improved

Next concept - monorail



Next concept - monorail

Thank you for your attention