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Madrid Microcirculation Meeting

Madrid November 29-30, 2023 9th - 10th 2023

MRR in Clinical Practice

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MRR in Clinical Practice

Definition

Ratio of true microvascular resistance at rest to hyperemic microvascular reistance

$$MRR = \frac{True\,R_{\mu,rest}}{R_{\mu,hyper}}$$

$$MRR = \frac{Q_{max}}{Q_{rest}} \; x \; \frac{P_{a,\,hyper}}{P_{d,\,hyper}} \; x \; \frac{P_{a,\,rest}}{P_{a,\,hyper}}$$

CFR

Compensated for Epicardial resistance

Compensated for the Change in blood pressure

Practically…

$$MRR = \frac{Q_{max}}{Q_{rest}} \; x \; \frac{P_{a,\,hyper}}{P_{d,\,hyper}} \; x \; \frac{P_{a,\,rest}}{P_{a,\,hyper}}$$

CFR

Compensated for Epicardial resistance

Compensated for the Change in blood pressure

We need Pressure and Flow

Coronary flow is the single most important parameter for myofilamentary function

$$Q = \frac{\Delta P}{R}$$

➔ The heart will do whatever is possible to maintain Q, (be it at the cost of P and R)

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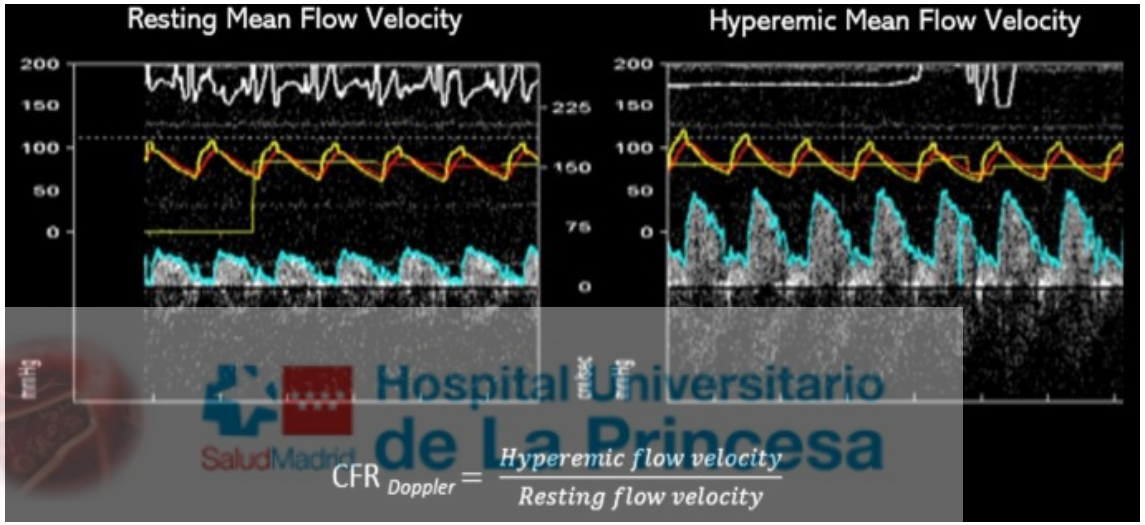
We are not good at measuring Q and R !

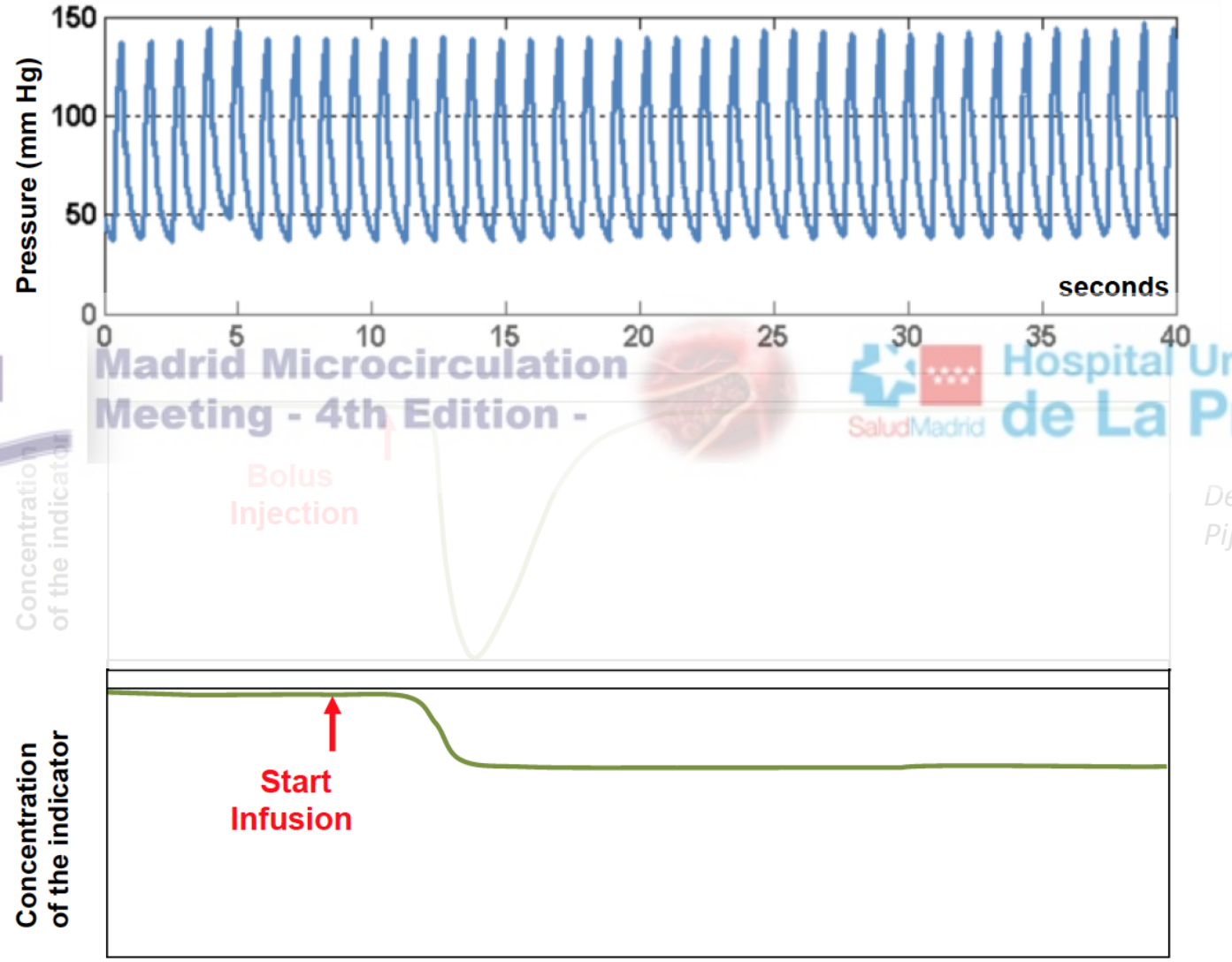
Doppler flow velocity (cm/s)



Bolus thermodilution T_{mn} (s)

= Surrogates

We are not good at measuring Q and R



De Bruyne B et al. Circulation 2002
Pijls NHJ et al. Circulation 2003

Aarnoudse W, De Bruyne B, Pijls NHJP et al JACC 2007 50;2294-2304

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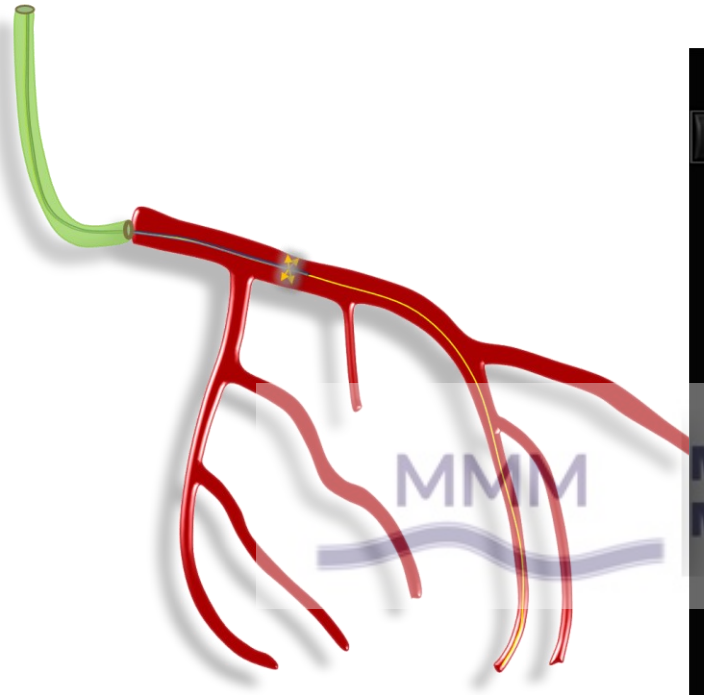
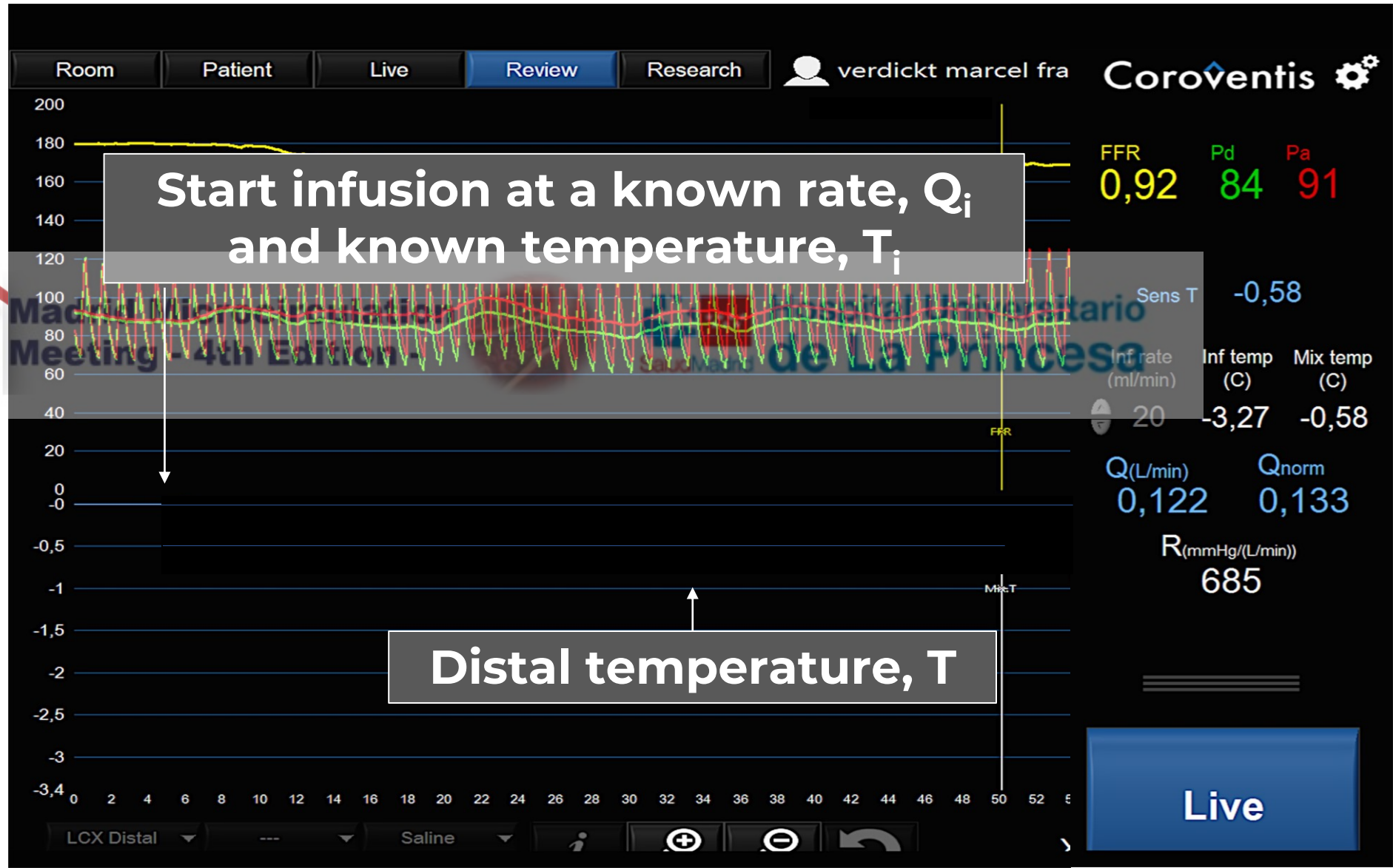
Continuous thermodilution for absolute Q & R measurements



$$Q = Q_i \times \frac{T_i}{T} \times 1.08$$



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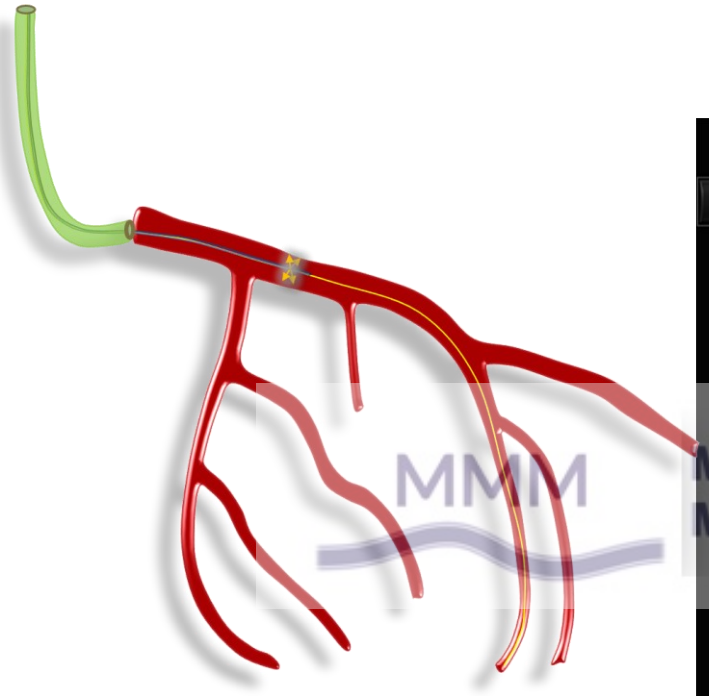

$$Q = Q_i \times \frac{T_i}{T} \times 1.08$$

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Continuous thermodilution for absolute Q & R measurements

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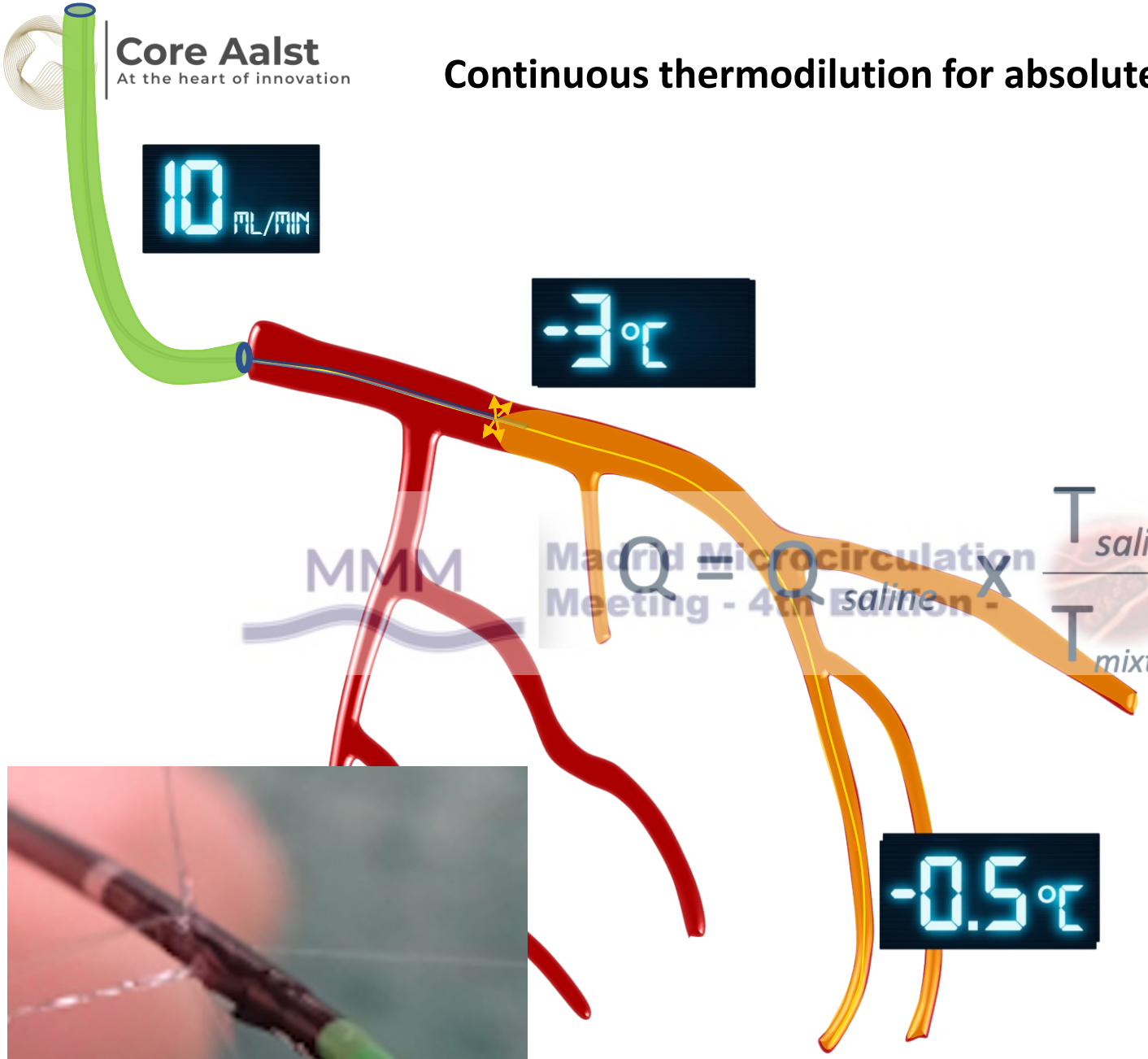
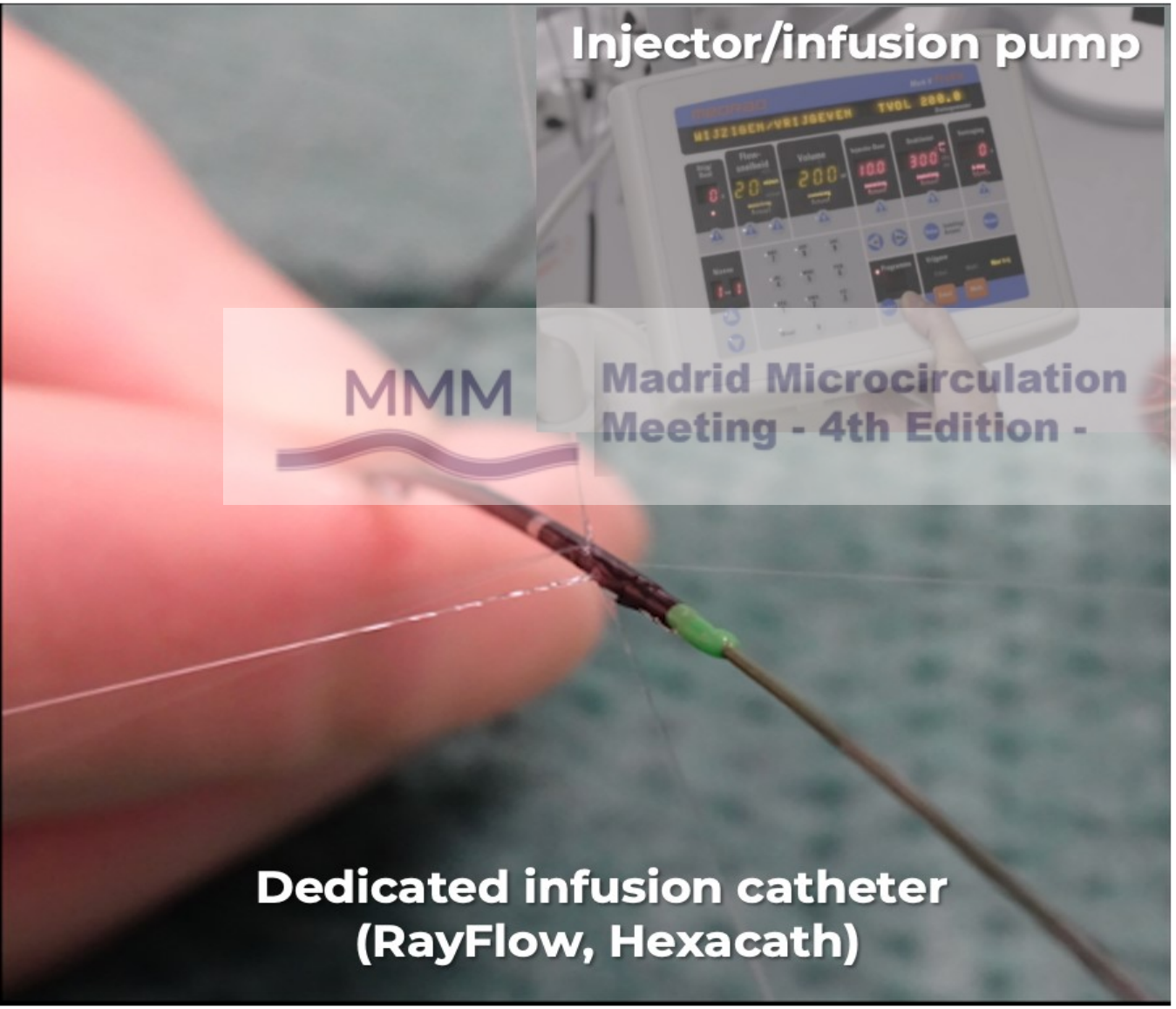


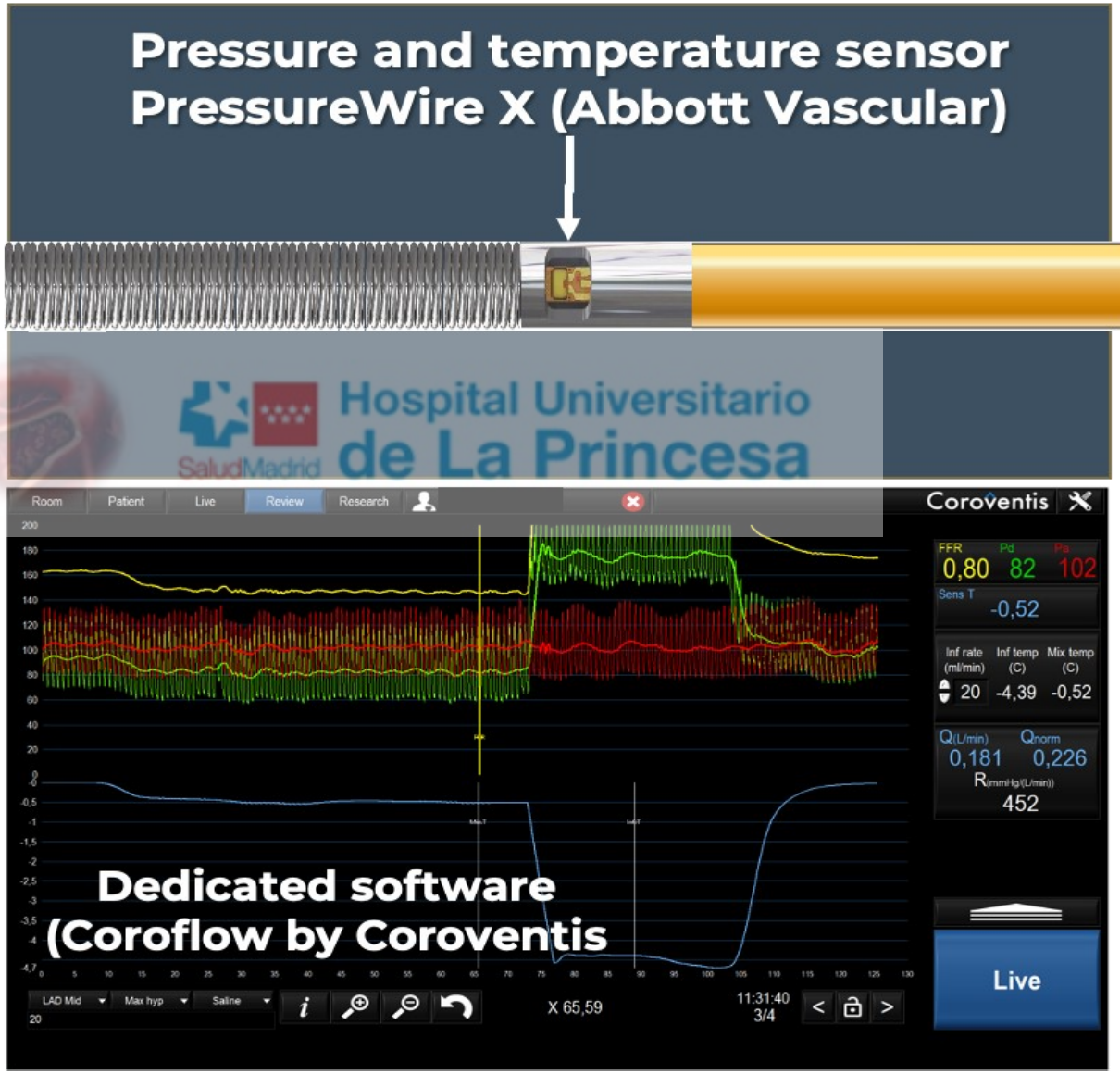
$$Q = Q_{saline} \times \frac{T_{saline}}{T_{mixture}} \times 1.08$$

Q = 65 mL/min

Continuous thermodilution for absolute Q & R measurements

Practicalities





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Continuous thermodilution for absolute Q & R measurements

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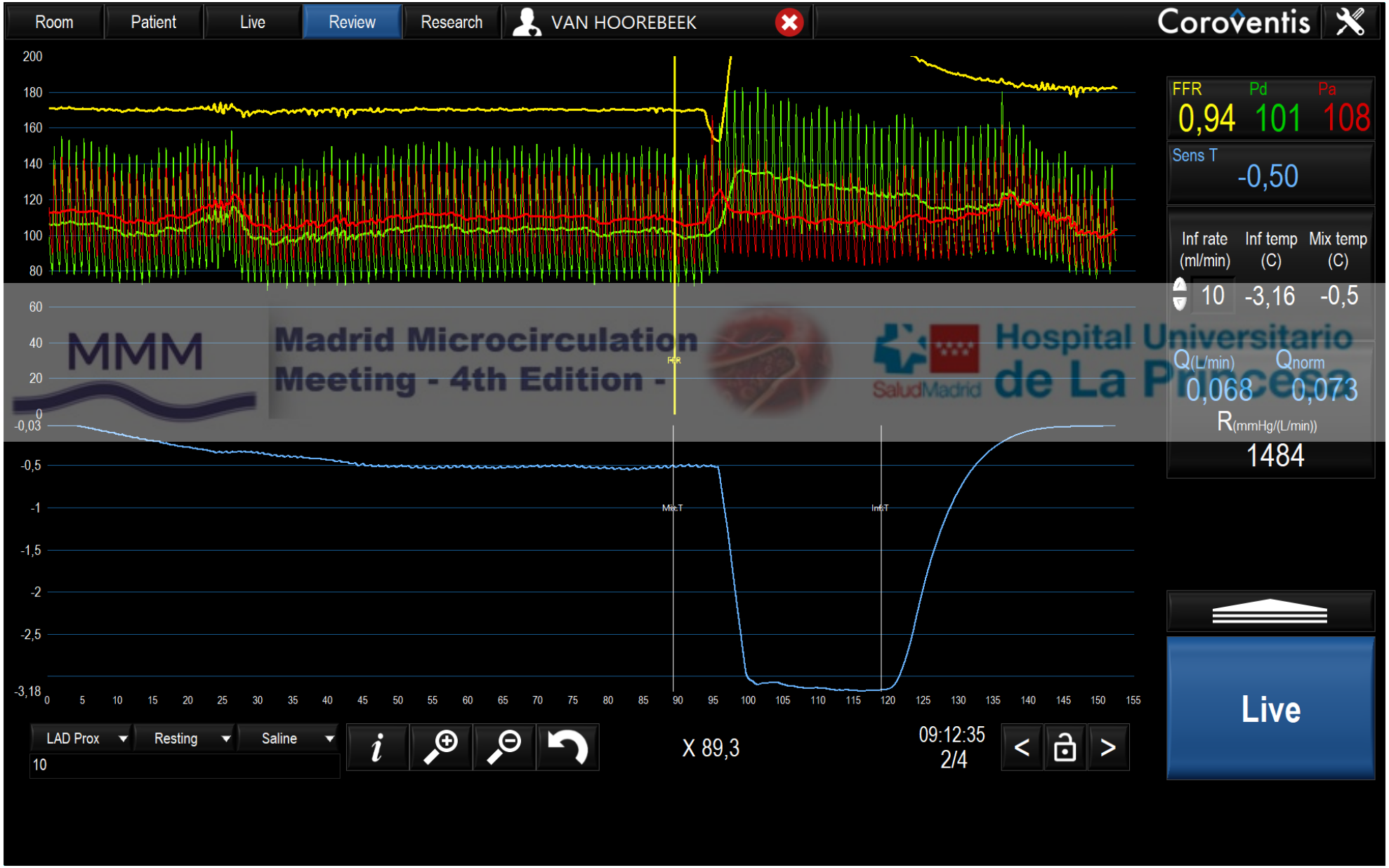
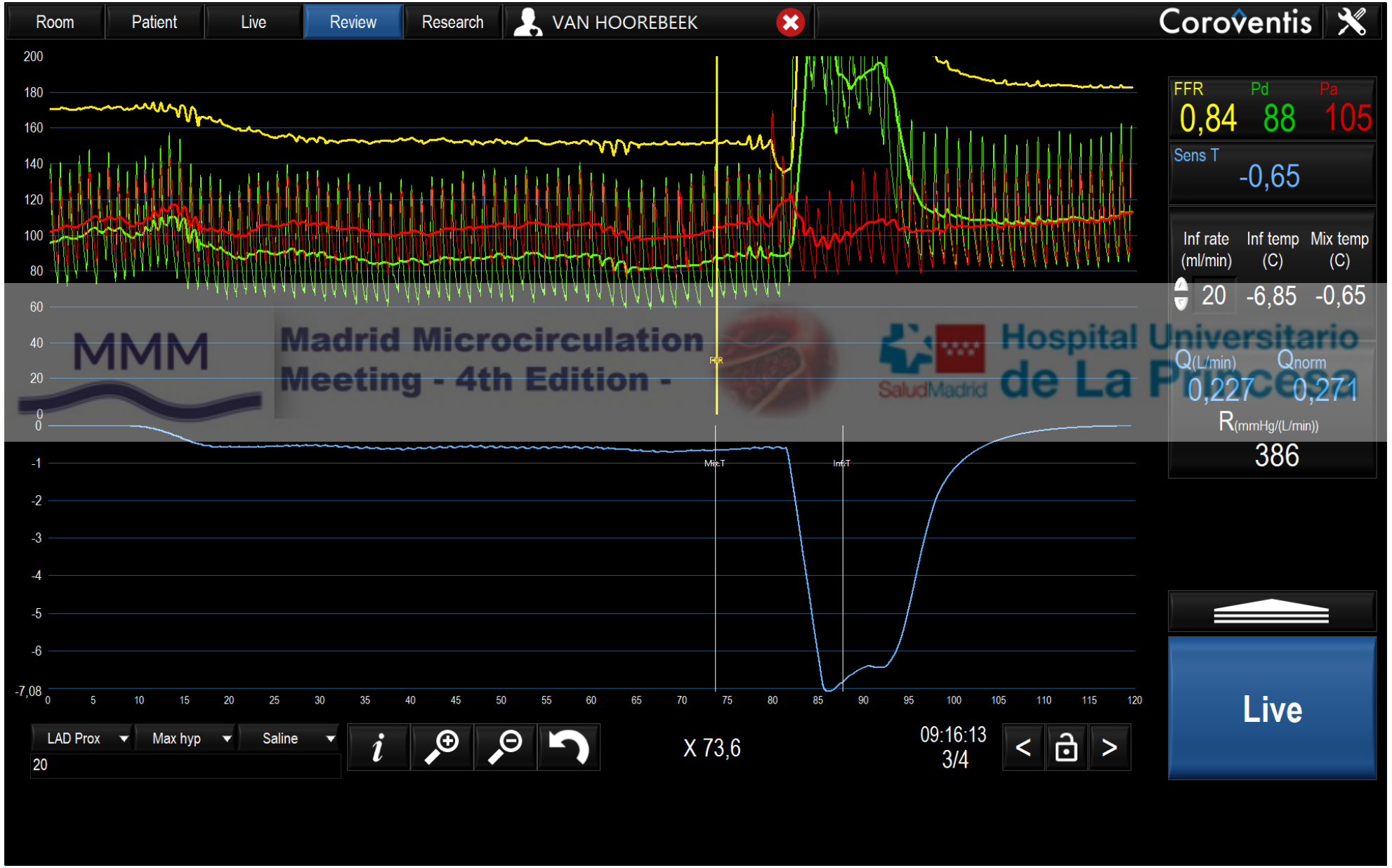


Continuous thermodilution for absolute Q & R measurements



De Bruyne, Pijls, Collet, Fearon et al JACC 2021,78:1541

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Continuous thermodilution for absolute Q & R measurements

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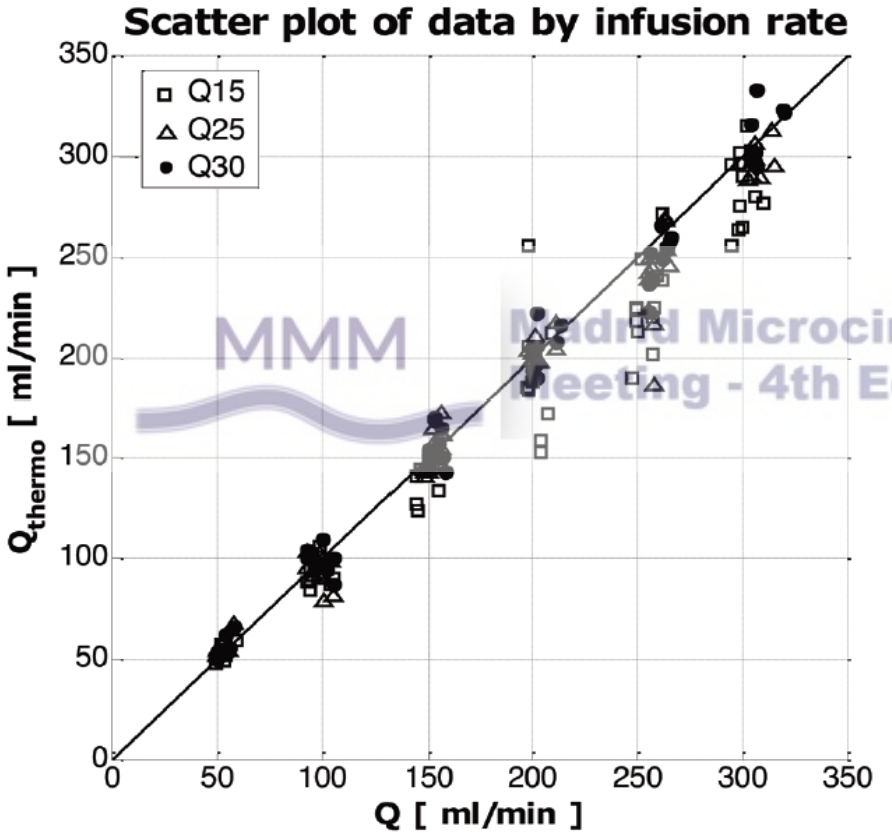
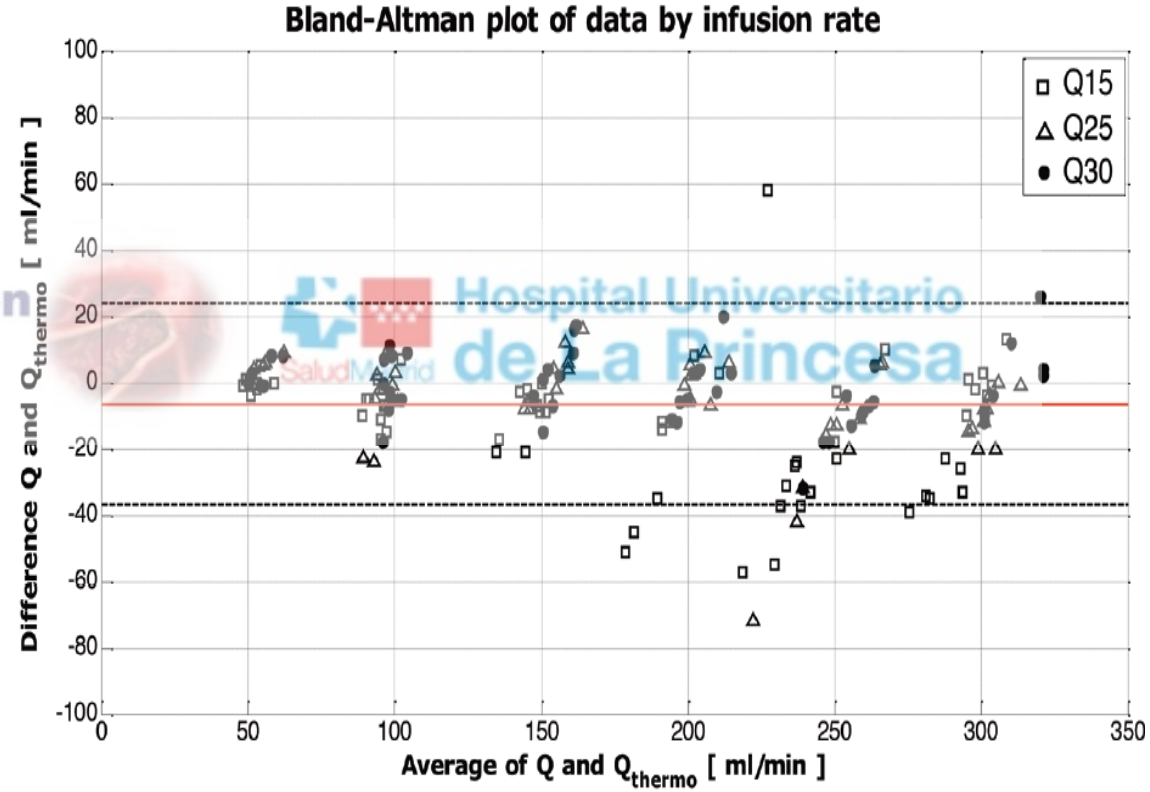
Accurate ?

= How close is a measurement to its agreed (correct) value ?

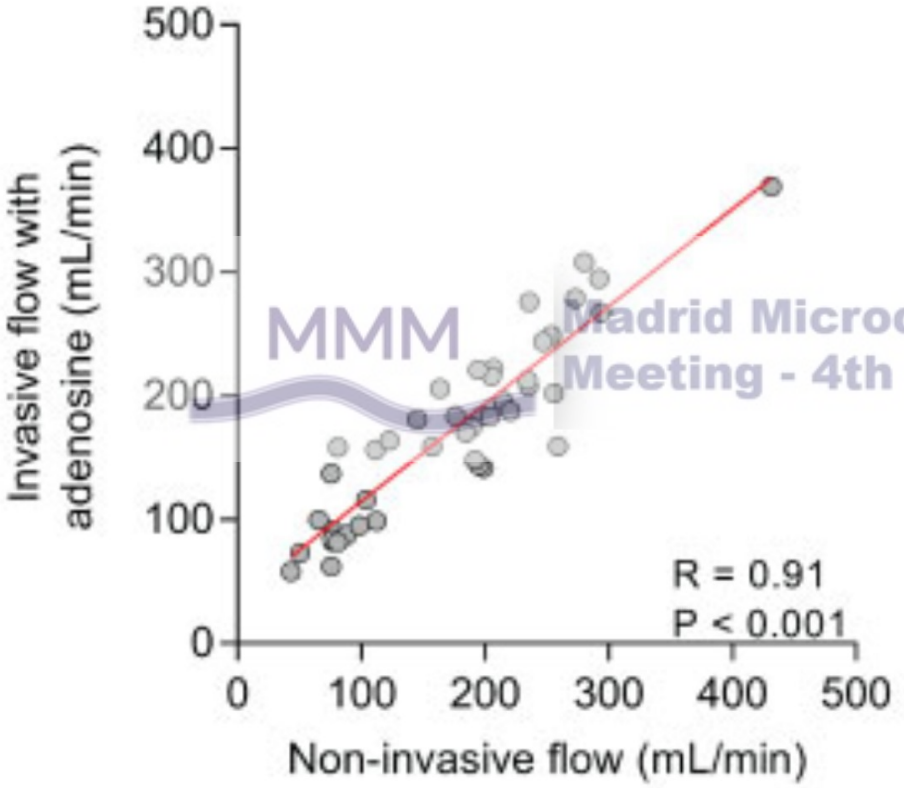
Accuracy:
In Vitro Model versus Continuous Thermodilution

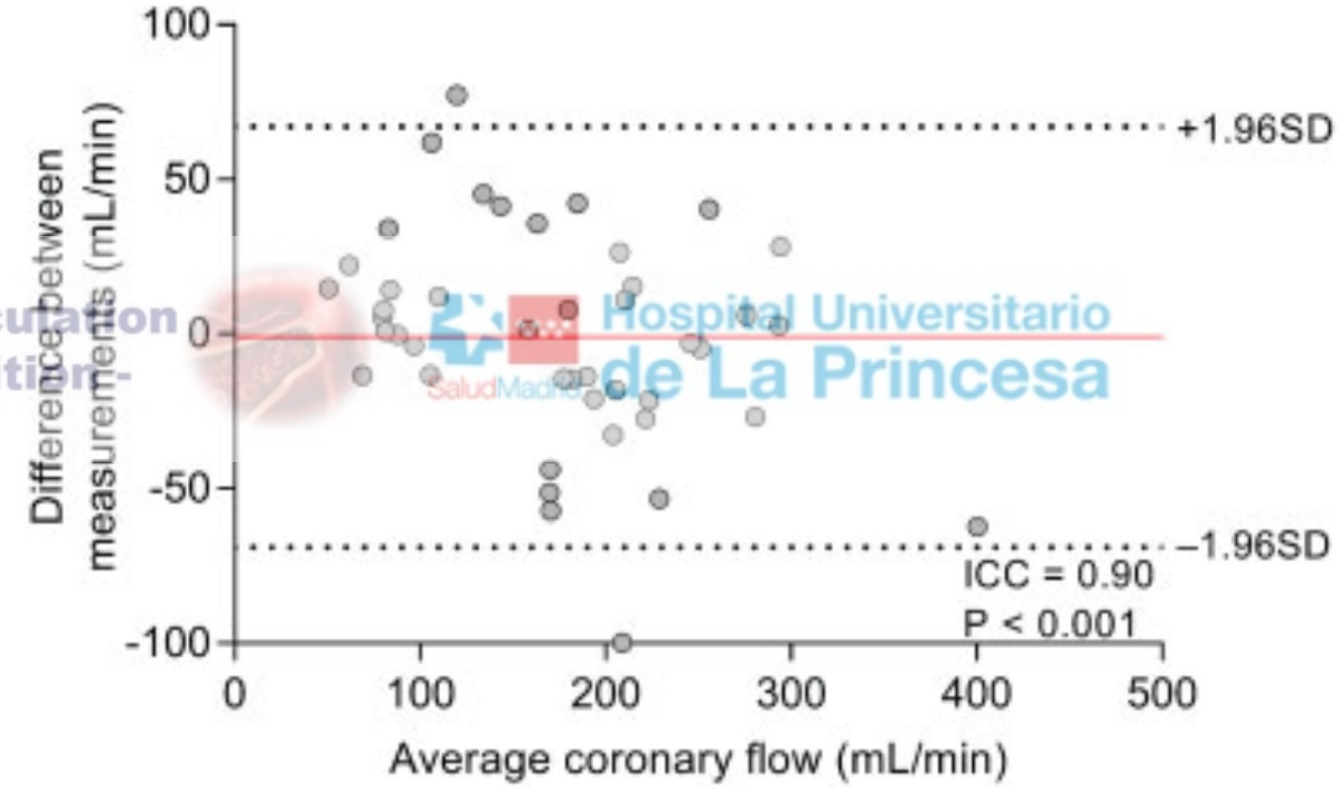




Van 't Veer M, Toth G et al EuroIntervention 2016

Accuracy:
PET versus Continuous Thermodilution





Everaars H. et al. European Heart Journal (2019) 40, 2350–2359

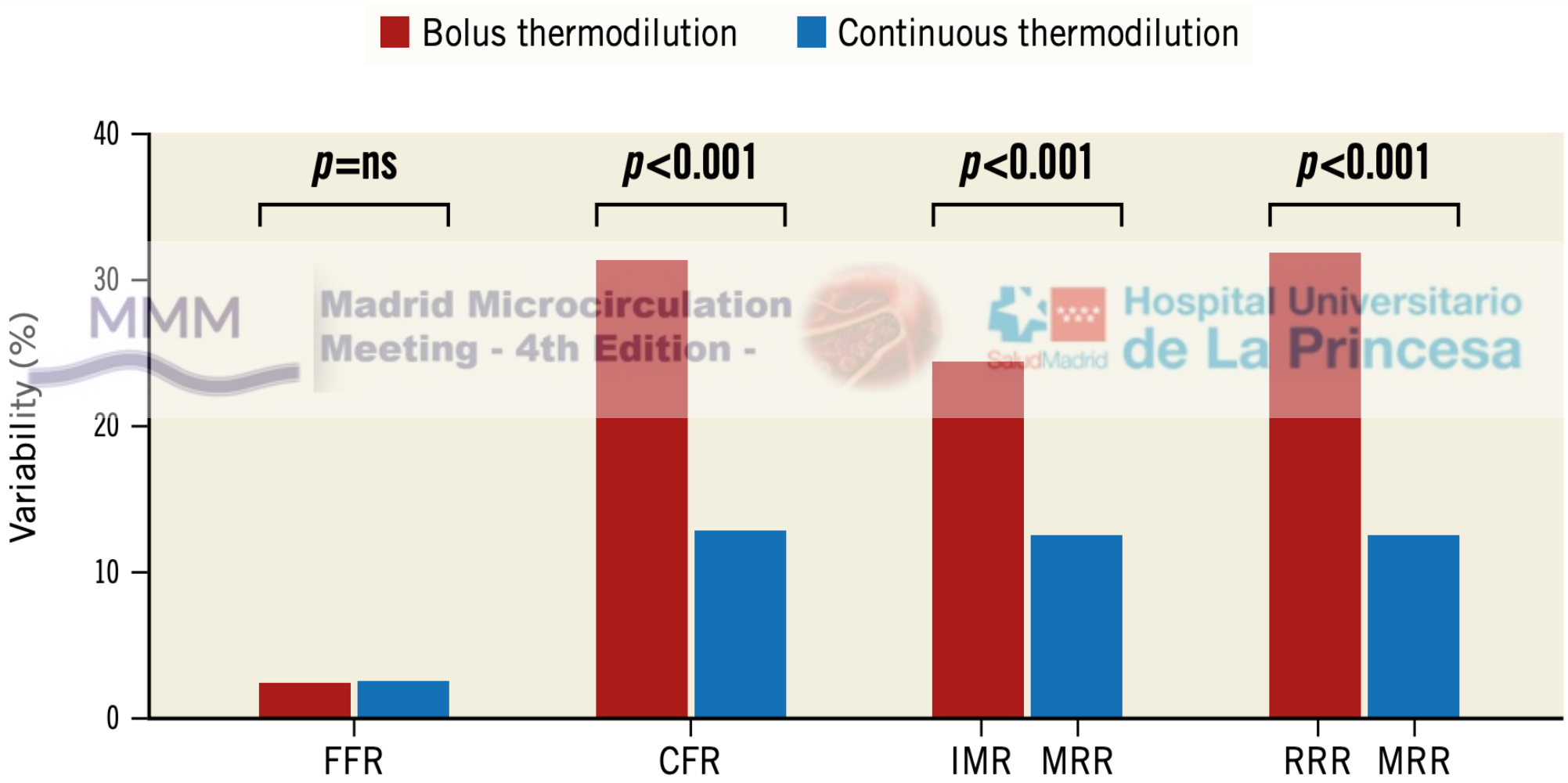
Continuous thermodilution for absolute Q & R measurements

Precise ?

(Repeatable/Reproducible)

= How close are two or more measurements to each other ?

Precision:
Repeatability of Continuous Thermodilution



Gallinoro E, De Bruyne B et al. EuroIntervention 2023; and JACC cv interv 2023, in press

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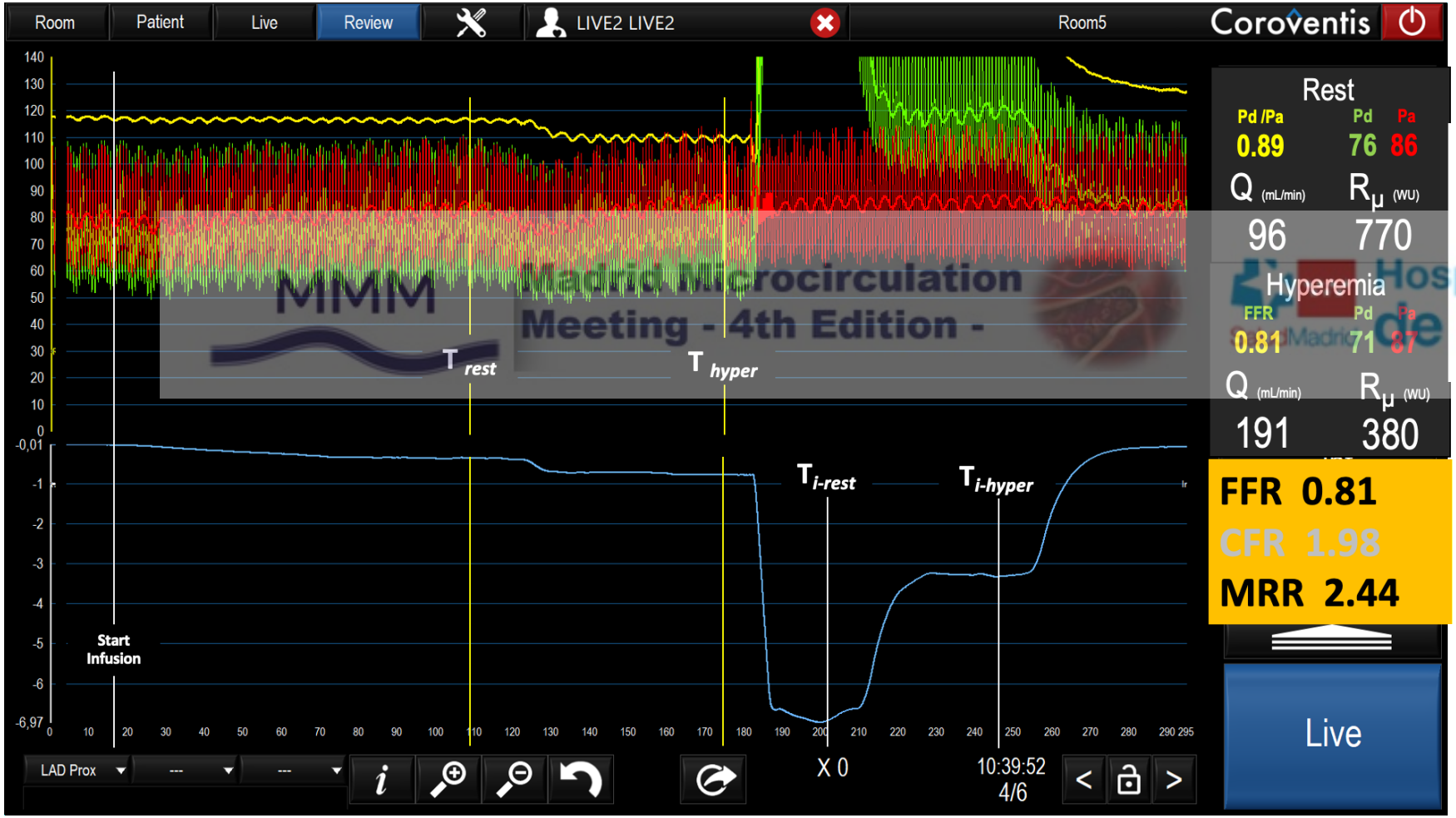
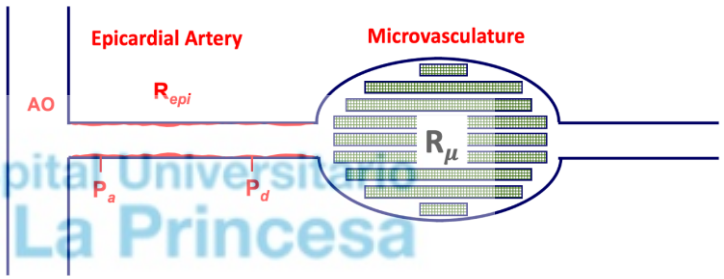
MRR is *specific* for the Microcirculation



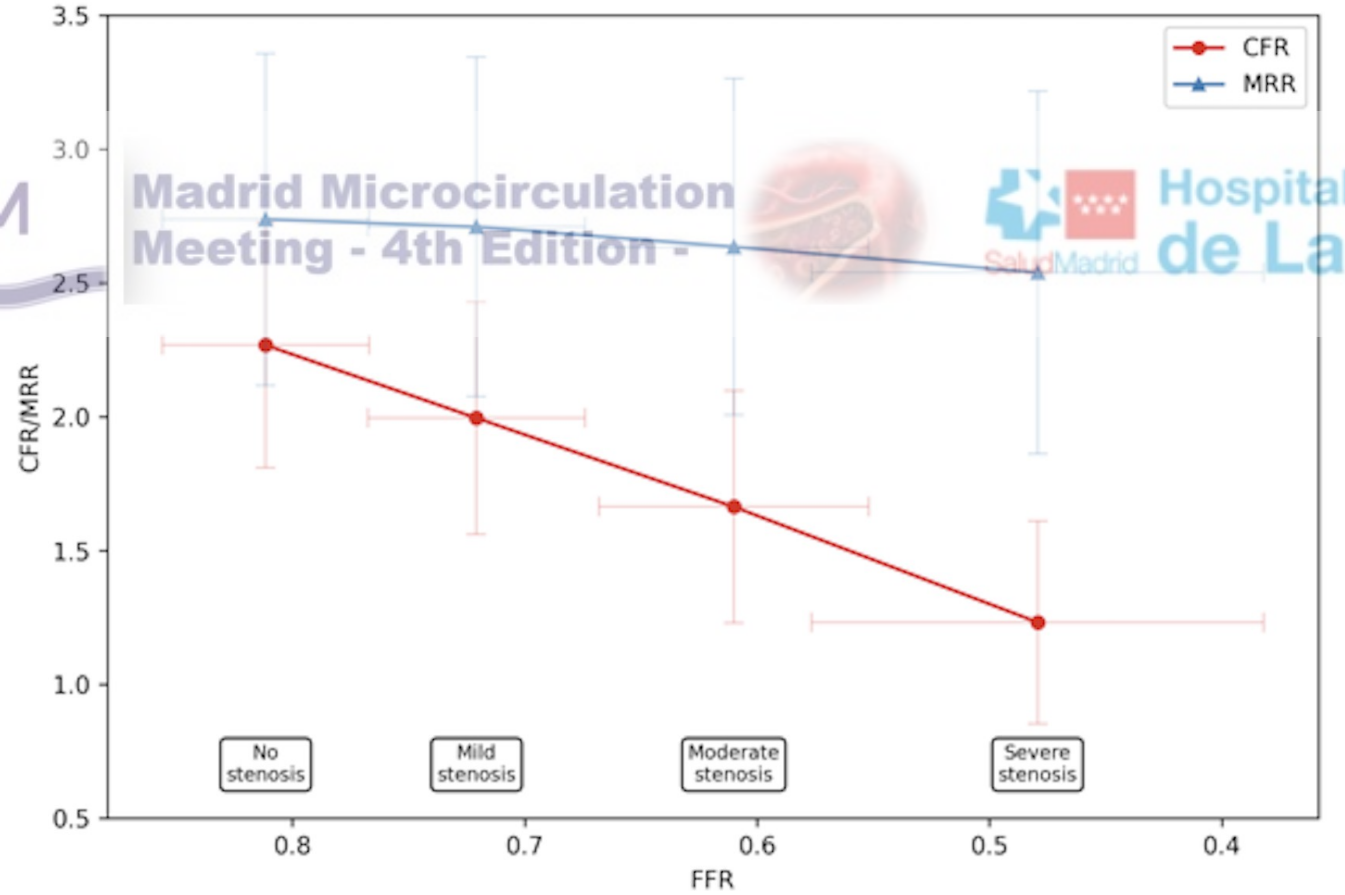


$$MRR = \frac{CFR}{FFR} \times \frac{P_{a,\,rest}}{P_{a,\,hyper}}$$

De Bruyne, Pijls, Collet, Fearon et al JACC 2021,78:1541

Is MRR Dependent of Epicardial Stenosis?

Controlled, Graded, Epicardial Stenosis



Mahendiran T, Bertolone DT, De Bruyne B, preliminary results

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Proxi versus original?

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