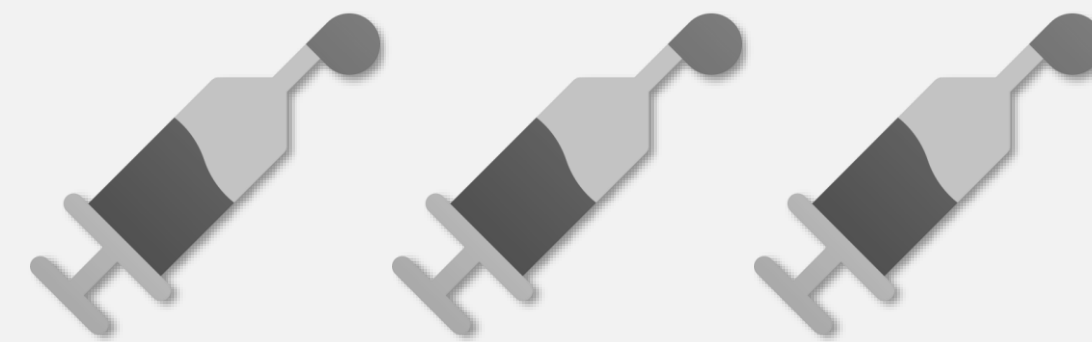


How to perform bolus thermodilution method

Tips and Tricks for Precise Measurement

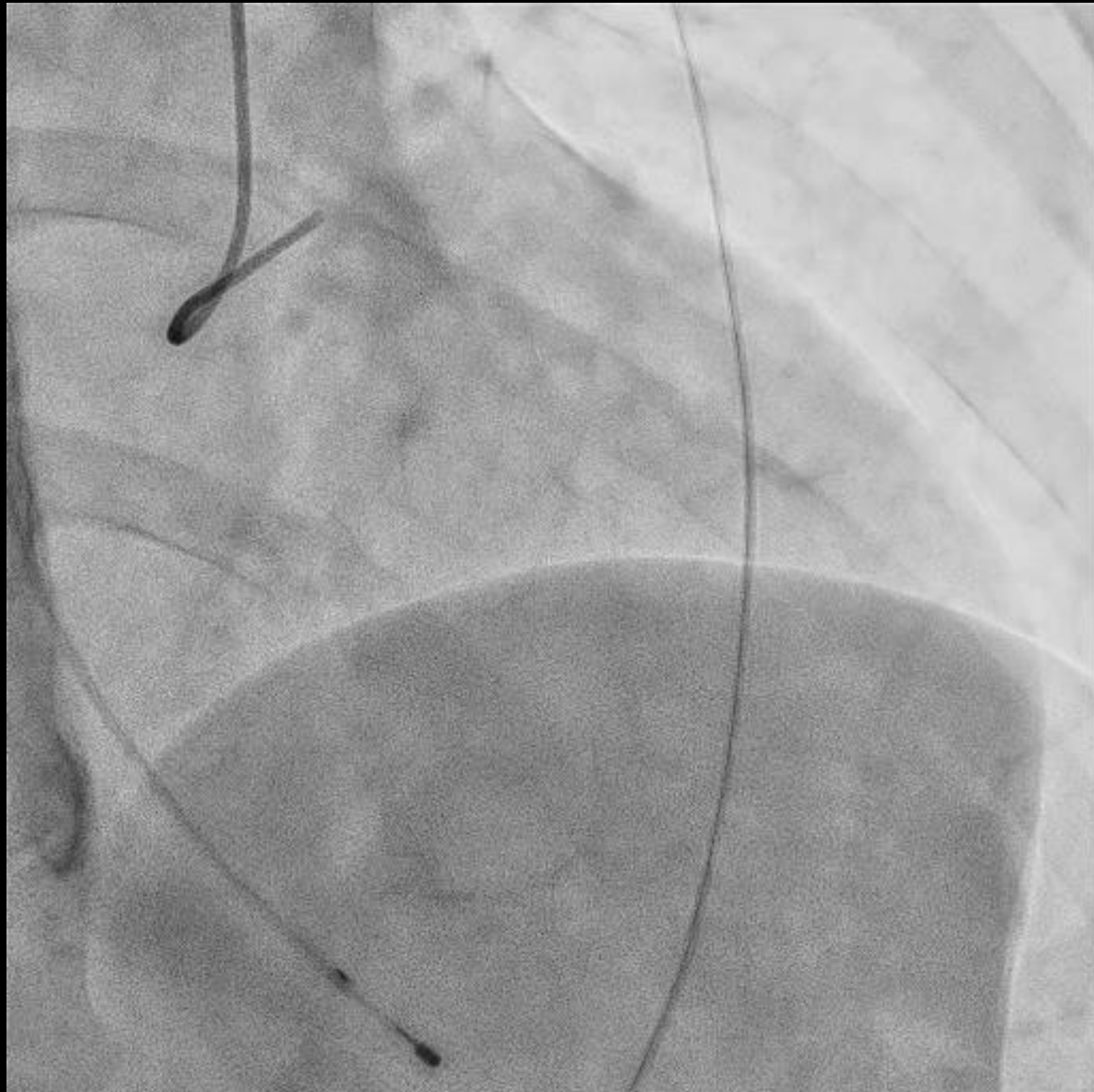


Hirohiko Ando
Aichi Medical University, Japan

COI Disclosure

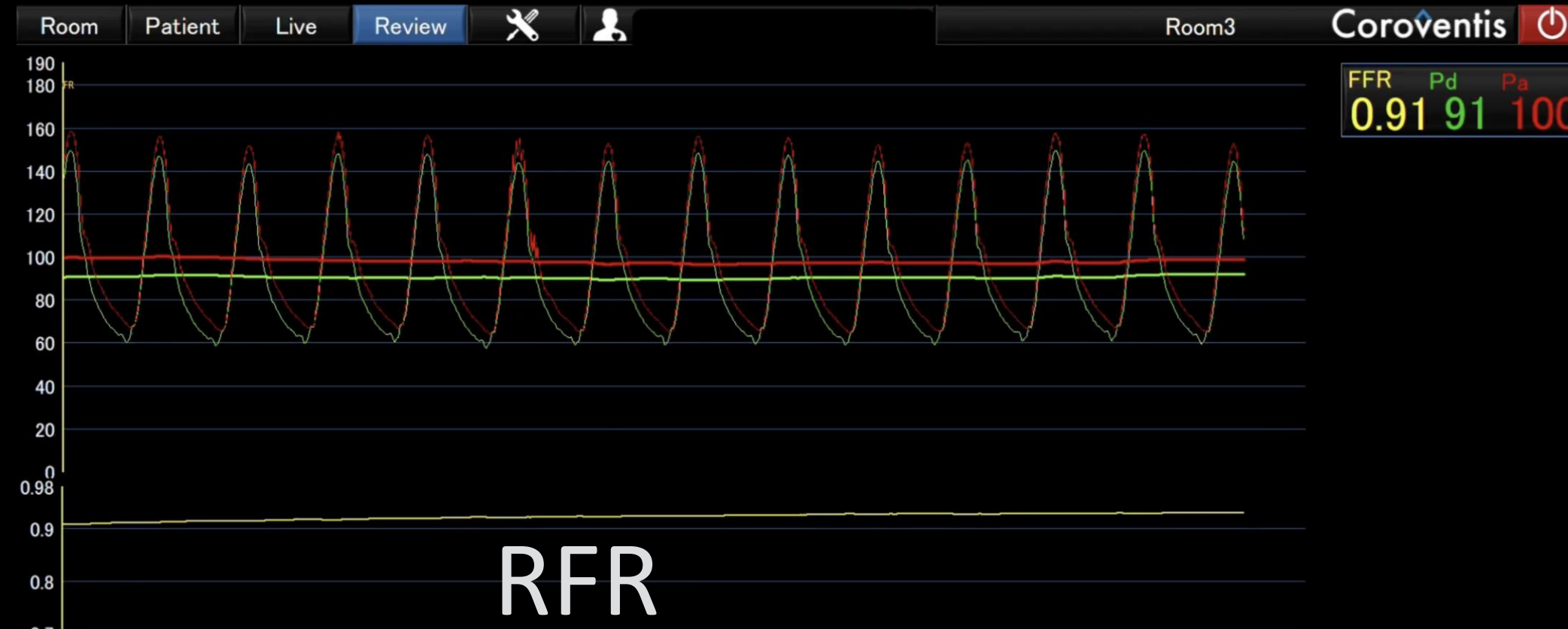
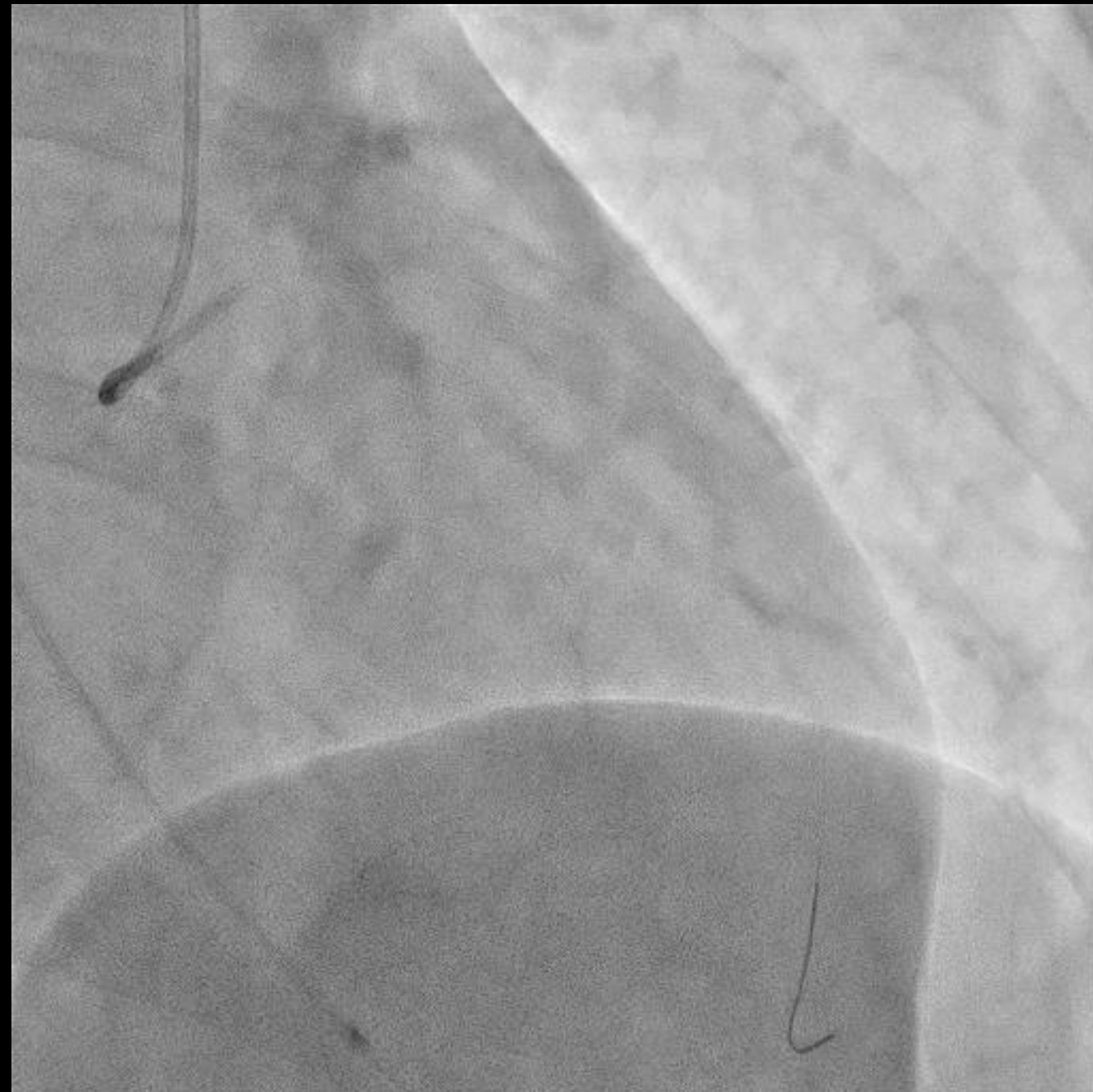
Hirohiko Ando

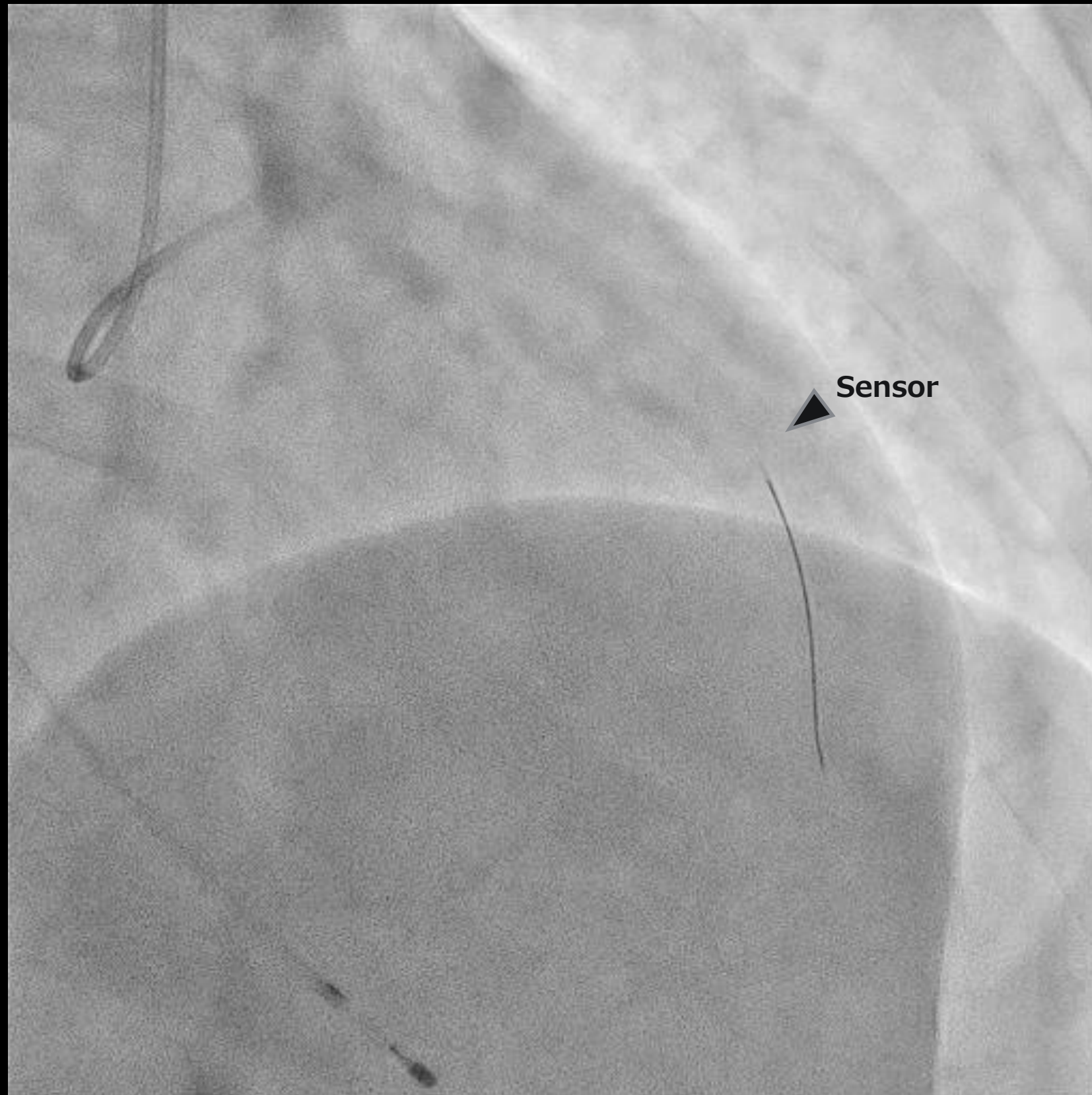
- ① **Consultation fees: Abbott, Terumo, Kaneka**
- ② **Stock ownership/profit: none**
- ③ **Patent fees: none**
- ④ **Remuneration for lecture: none**
- ⑤ **Manuscript fees : none**
- ⑥ **Trust research/joint research funds: none**
- ⑦ **Scholarship fund : Chukyo Geriatric Research Promotion Financial Group**
- ⑧ **Affiliation with Endowed Department : none**
- ⑨ **Other remuneration such as gifts: none**



Don't forget **nitrate** !

Resting Pd/Pa



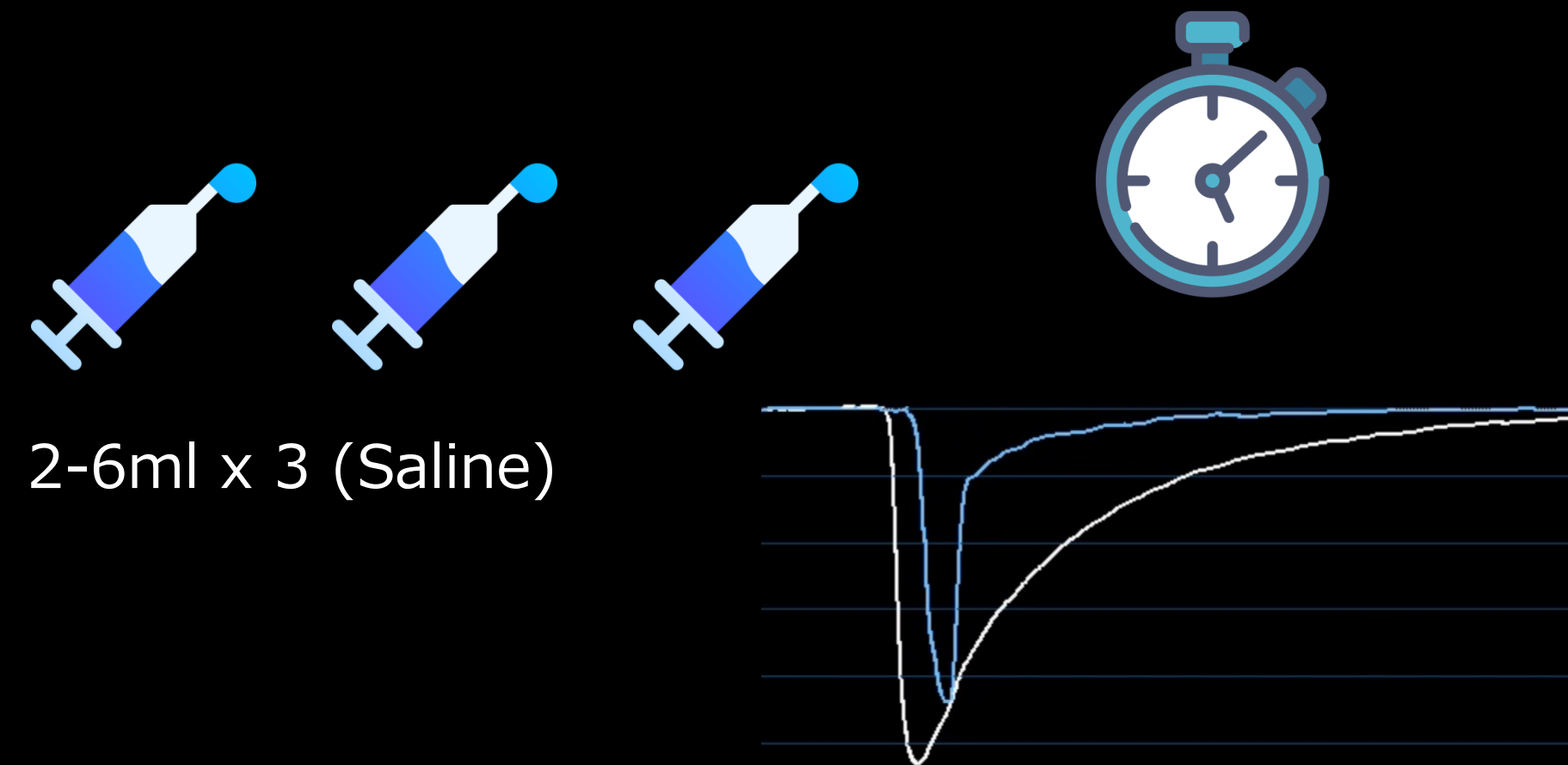
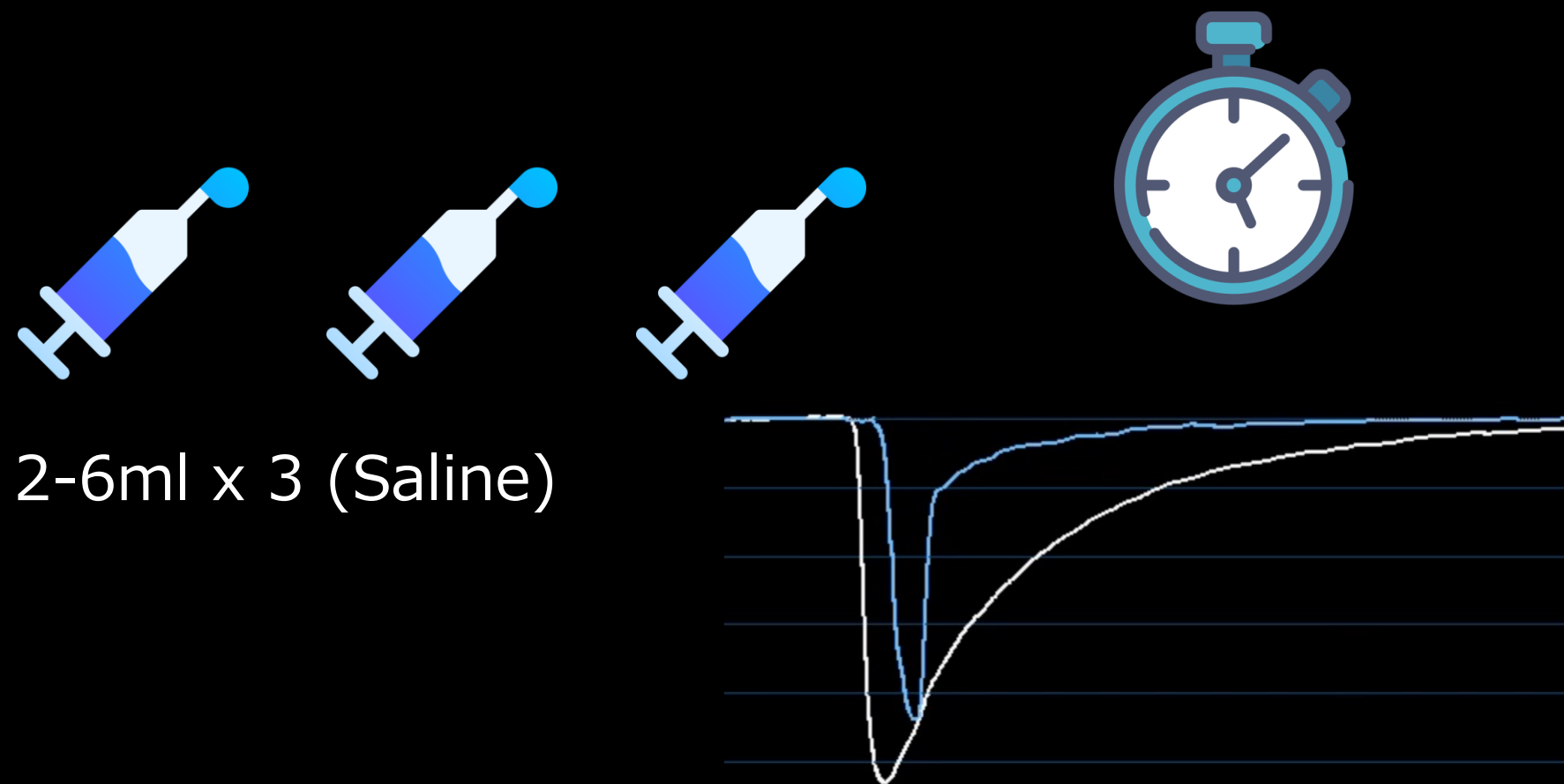


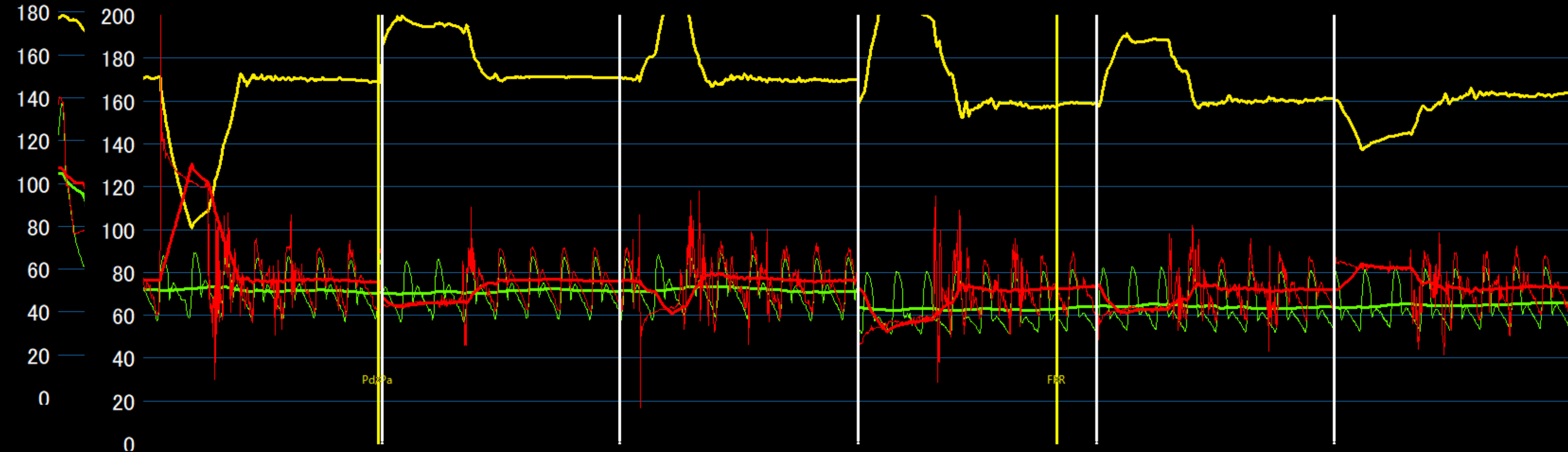
- Sensor position: at least **6cm** away from the catheter tip
- Size of Catheter: Greater than **6Fr** is ideal
Check for **co-axiality, pressure wave (dicrotic notch)**
- Injection : 2-6ml room temperature saline



Mean transit time measurements

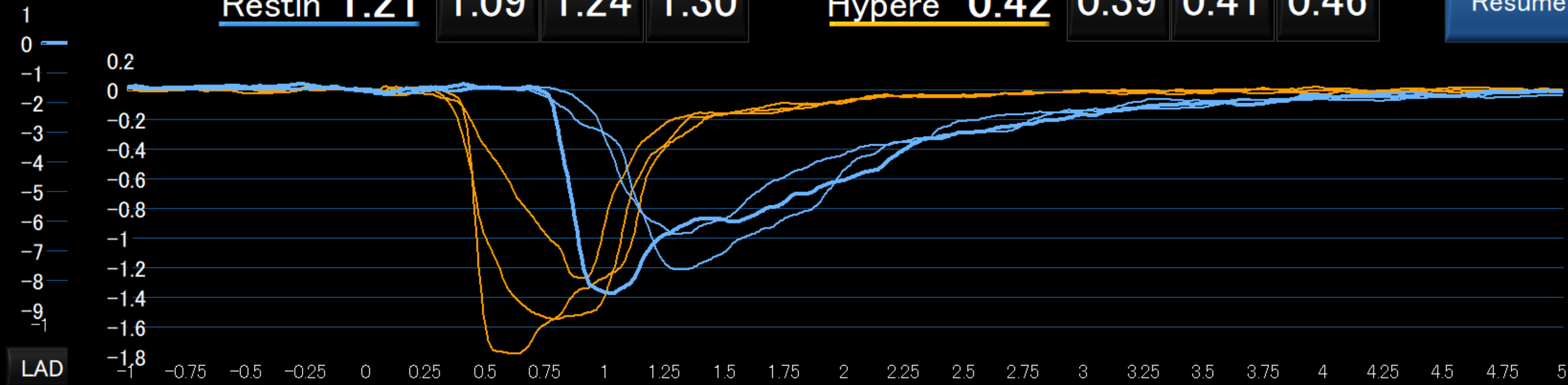
ATP
Nicorandil
Papaverine

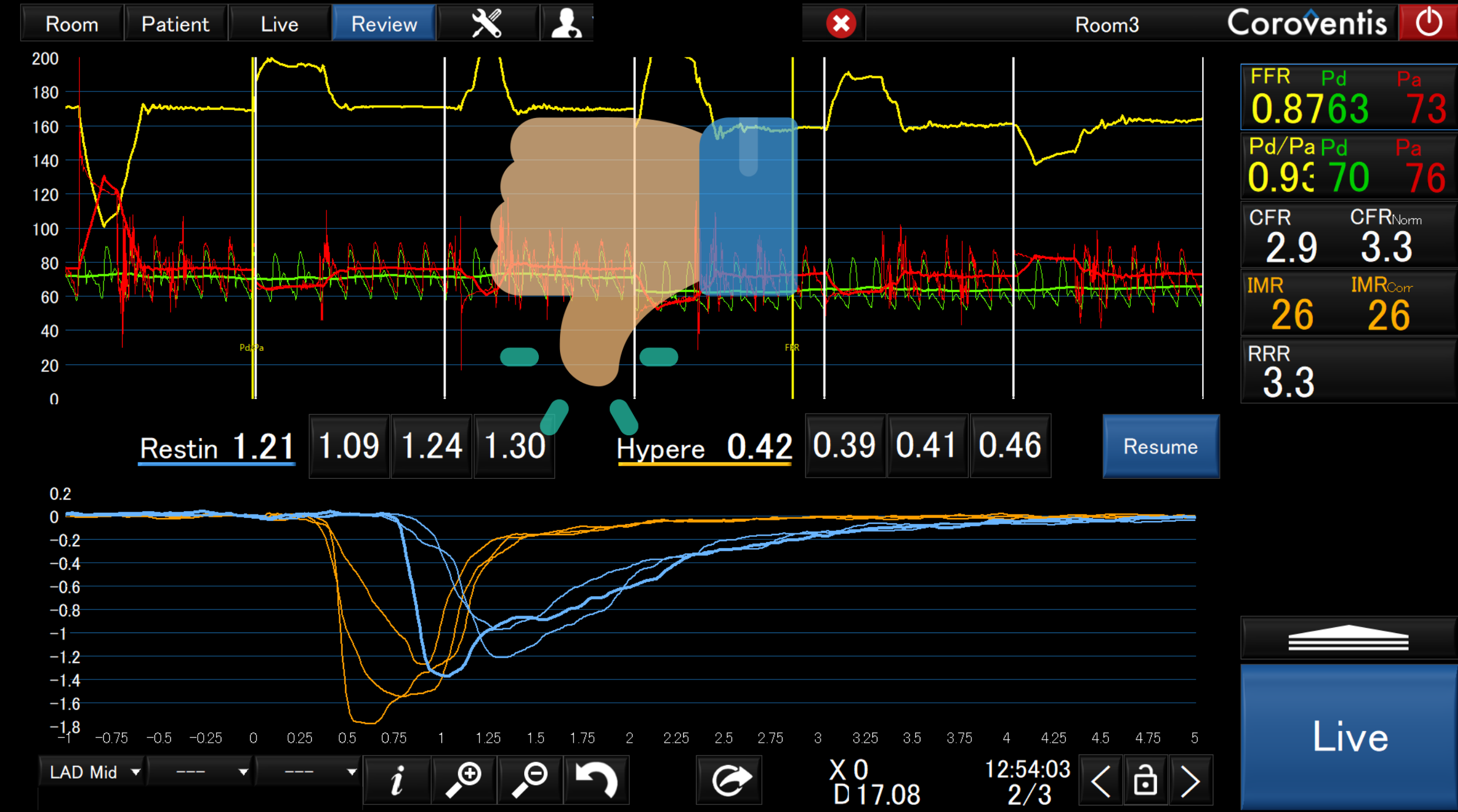
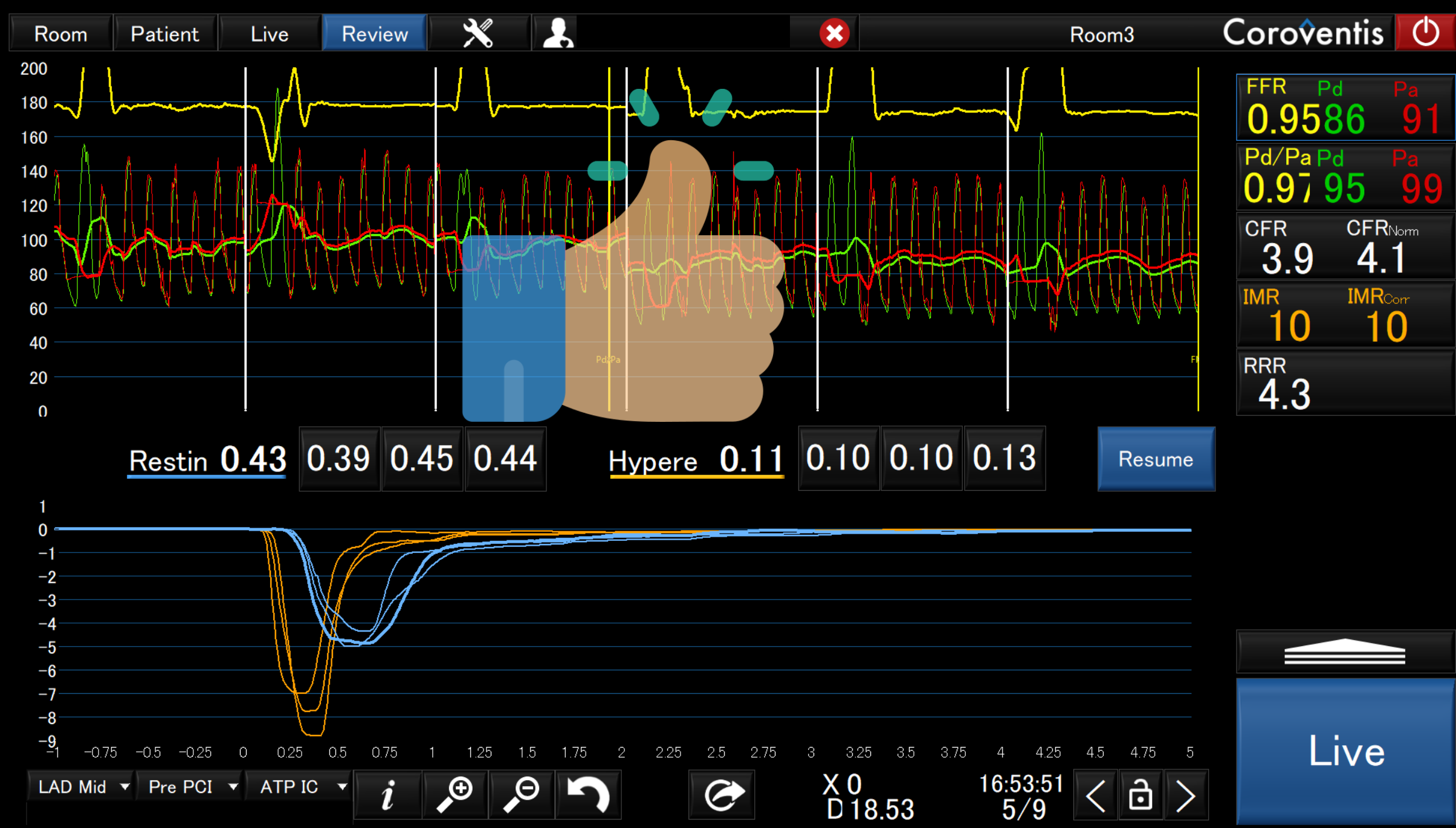




FFR	Pd	Pa
0.8763	73	73
Pd/Pa	Pd	Pa
0.93	70	76
CFR	CFR _{Norm}	
2.9	3.3	
IMR	IMR _{Corr}	
26	26	
RRR		
3.3		

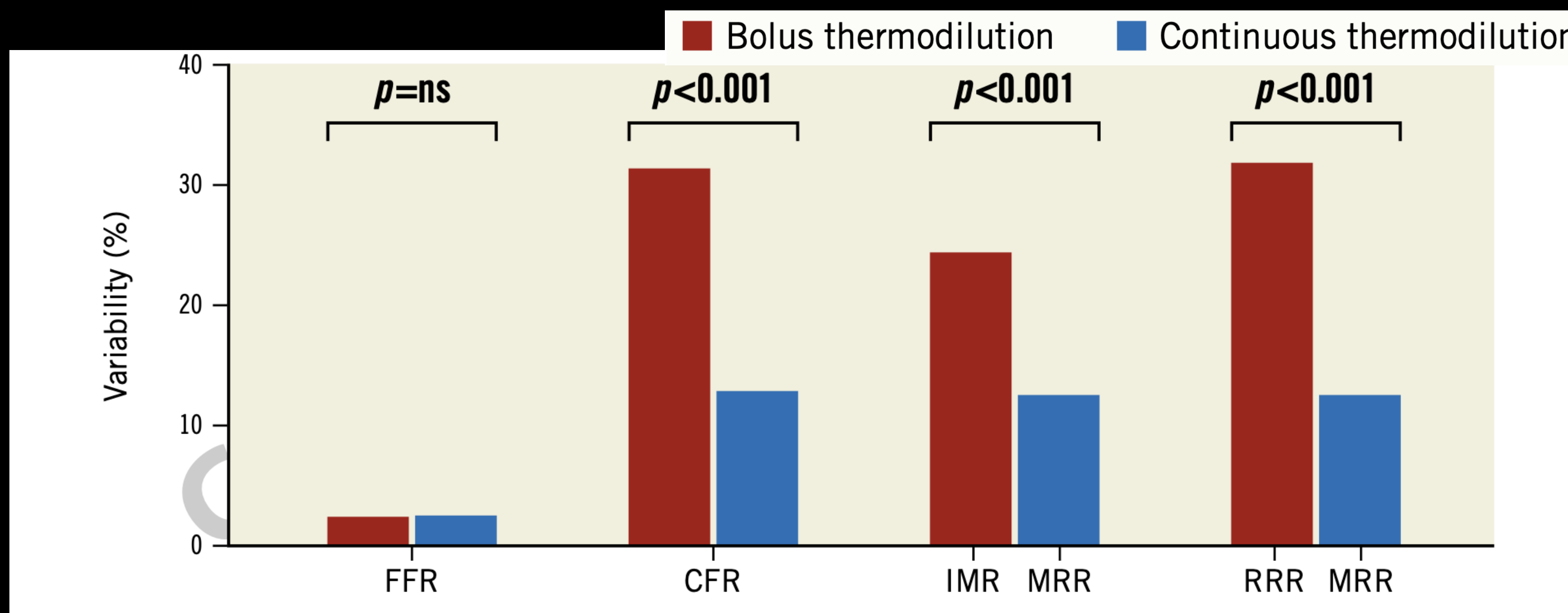
Restin 1.21 1.09 1.24 1.30 Hypere 0.42 0.39 0.41 0.46 [Resume](#)



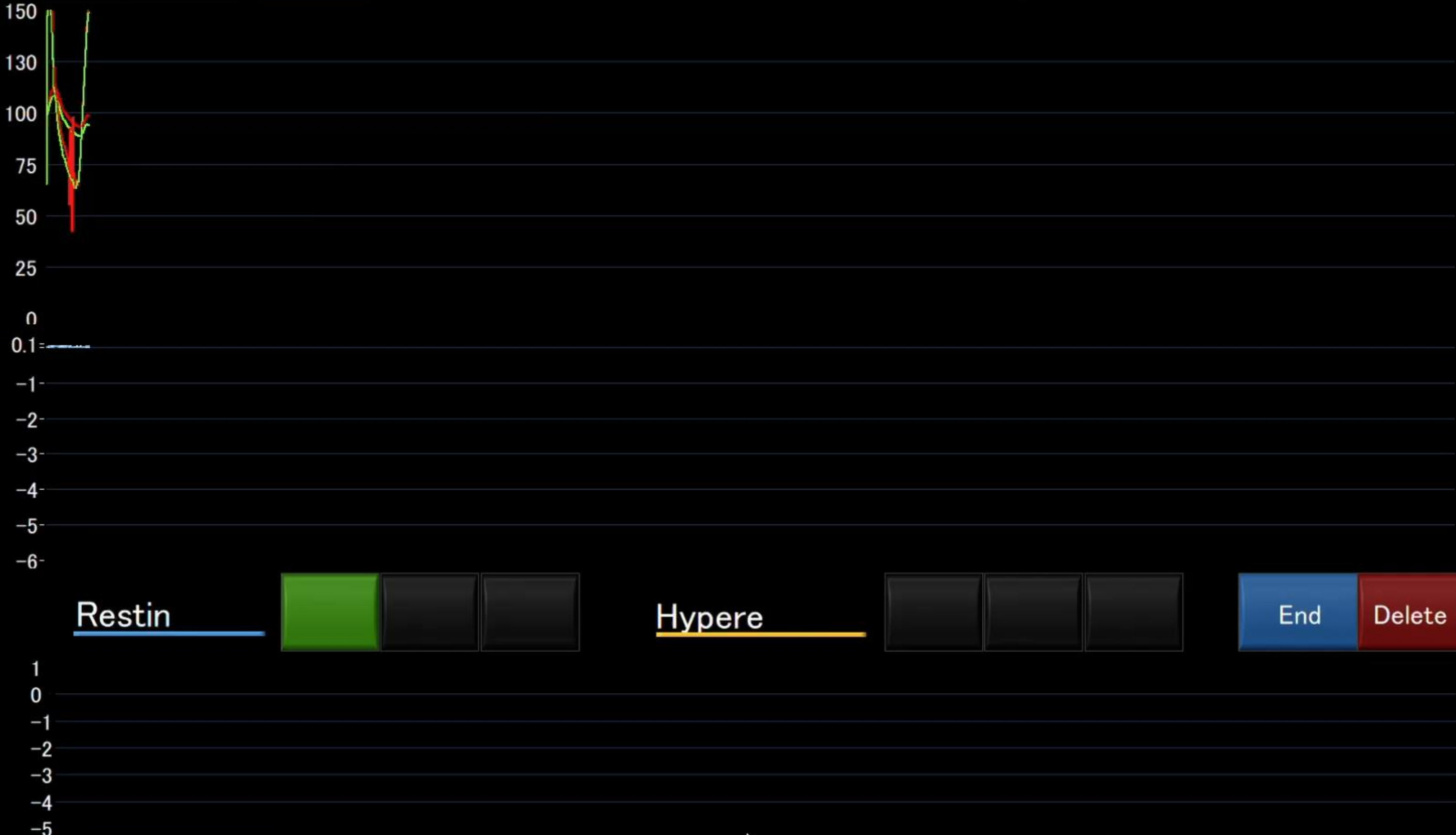


Reproducibility is the most crucial factor for making precise CMD measurements

Poor reproducibility with the bolus thermodilution method



The accuracy of the bolus thermodilution method highly depends on the operator's technique



Pa 160/42
93

Pd 154/63
89

EQUALIZE 2

Pd/
0.95

Tem **0.00**

CFR **0.0**

IMR **0**

Zero Temp

Start

? CFR/IMR ▼

LAD Mid ▼ Post PCI ▼ 30 s ▼

♥ 85

Mean transit time at resting condition

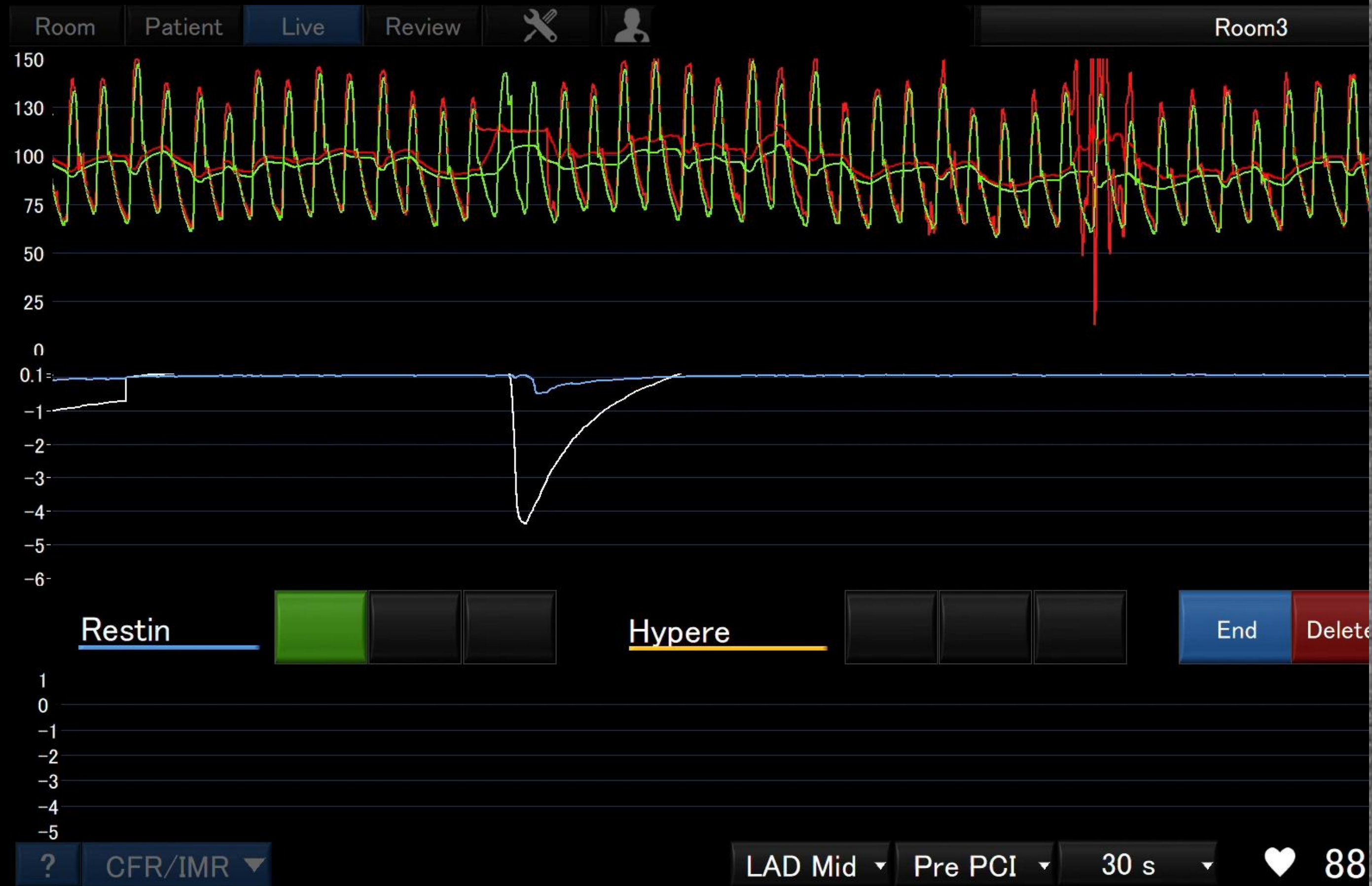


Checkpoint

- Really resting condition? (sufficient injection interval)
- Wire movement during injection
- Backflow from Y-connector
- Catheter jumping
- Any arrhythmia?



Case with suboptimal measurements



AF case

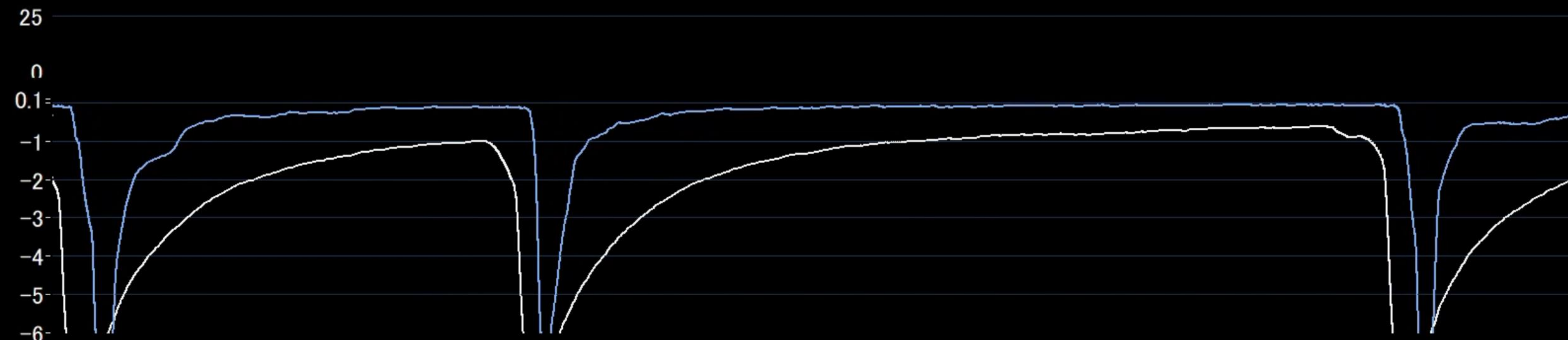
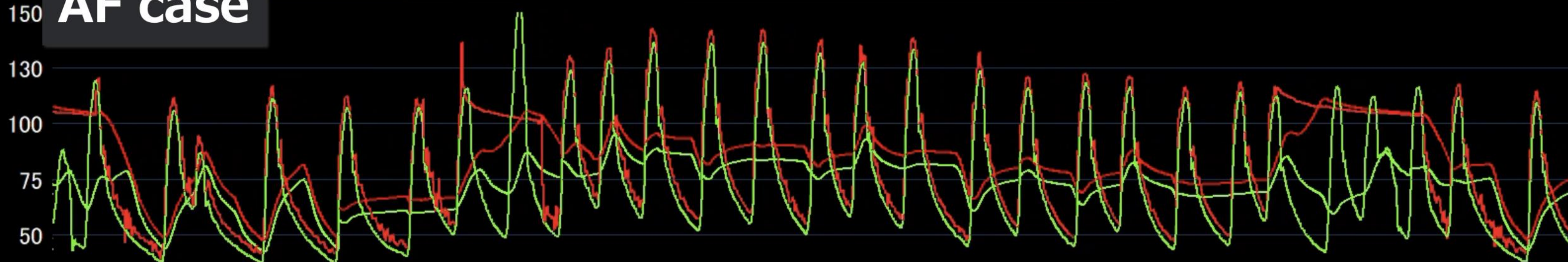
Live

Review



Room3

Coroventis



Restin 0.68

0.80

0.78

0.46

Hypere

End

Delete

Pa 118/41

47

Pd 112/38

43

EQUALIZE 0

Pd/ 0.90

Tem -0.55

CFR Inf

IMR 0

Zero Temp

Wait...

?

CFR/IMR

LAD Mid

Step

30 s

39



Hyperemia



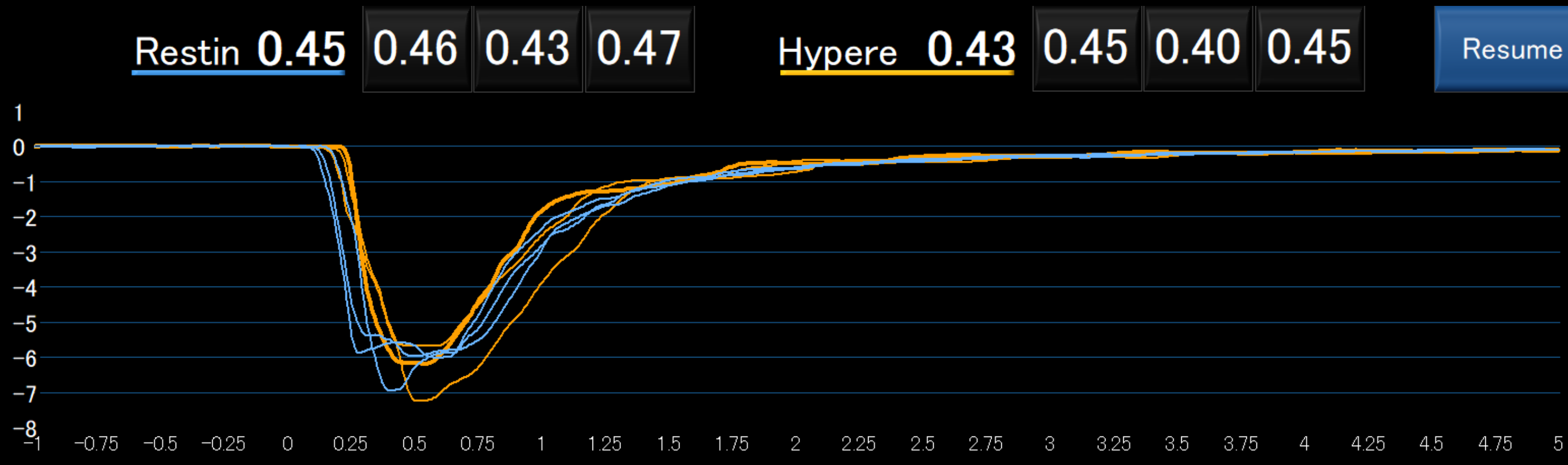
Hyperemic agent

Agent	Route	Time to hyperemia	Duration	Effect of caffeine
ATP (adenosine)	IV	2-3 min	Always in use	Yes
Papaverine	IC	15 sec	30-60 sec	No
Nicorandil	IC	15 sec	20-30 sec	No

Fluctuation in IV ATP



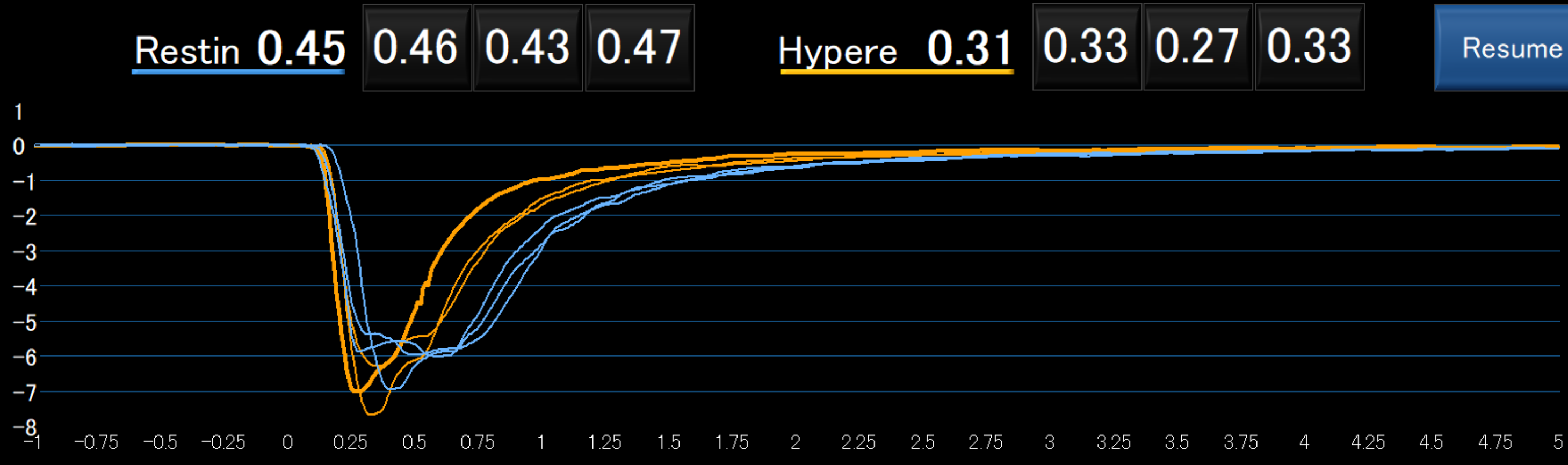
ATP 180 μ g/kg/min iv



FFR	Pd	Pa
0.53	36	67
Pd/Pa	Pd	Pa
0.67	71	106
CFR	CFR _{Norm}	
1.0	2.0	
IMR	IMR _{Corr}	
15	12	
RRR		
2.4		



Nicorandil 2mg ic add on



FFR	Pd	Pa
0.52	35	68
Pd/Pa	Pd	Pa
0.67	71	106
CFR	CFR _{Norm}	
1.5	2.8	
IMR	IMR _{Corr}	
11	8	
RRR		
3.5		

Caffeine might have blocked the effect of ATP

Mean transit time at hyperemic condition



Checkpoint

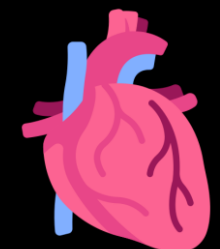
- **Same wire position as in resting condition**
- **Hyperemia should be at its maximum level**

Checkpoints in CMD Measurements



Catheter

- Engage of catheter
- Co-axiality
- Jumping motion
- Loose Y-connector



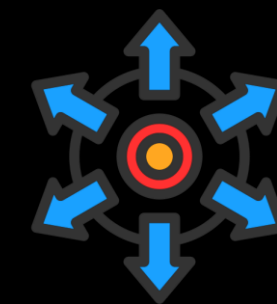
Coronary artery

- Distance of PW sensor
- Severe stenosis
- Movement of PW
- LCX



Saline

- Warmed saline



Hyperemia

- (Rest) Residual hyperemia
- (Rest) Short interval of injection
- (Hyp) Fluctuation in iv ATP



Other

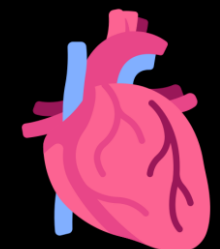
- Arrhythmia

Checkpoints in CMD Measurements



Catheter

- Engage of catheter
- Co-axiality
- Jumping motion
- Loose Y-connector



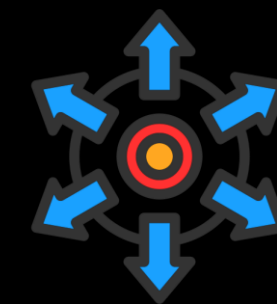
Coronary artery

- Distance of PW sensor
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- LCX



Saline

- Warmed saline



Hyperemia

- (Rest) Residual hyperemia
- (Rest) Short interval of injection
- (Hyp) Fluctuation in iv ATP



Other

- Arrhythmia

Modifiable issues

Take Home Message

Optimal CMD management always starts with precise measurement and accurate interpretation.