

The Diagnostic Disagreement Between FFR, iFR and pCFR in a Patient with Low Blood Pressure and Cardiac Output

Yuetsu Kikuta, MD; Junichi Matsuda, Master of
Informatics; Seiichi Haruta, MD, FACC

Fukuyama Cardiovascular Hospital
and The University of Tokyo, Japan



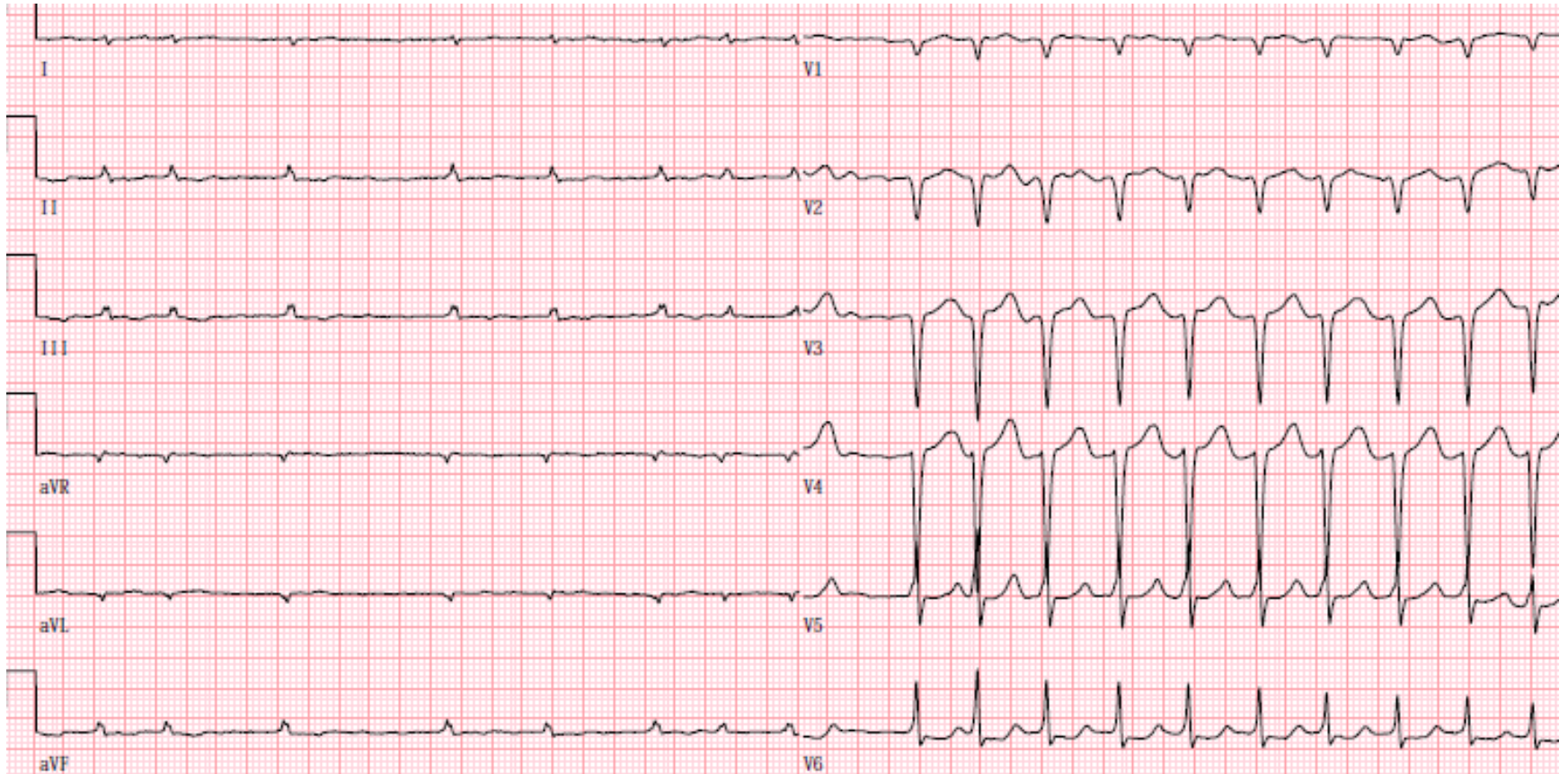
Case presentation

Chief Complaints: orthopnea

Past History of Illness: CRF on hemodialysis

Present History of Illness: On June 26th 2014, a 65-year-old male on hemodialysis was admitted to our hospital due to orthopnea. His S1 was loud, and rumble following opening snap was audible.

ECG



AFib, 109 bpm, poor R in chest leads.

CXR



CTR = 61%

congestive

+pleural effusion

**(Insufficient
dehydration due
to low cardiac
function)**

Echocardiogram



**MVA = 0.9 cm²
(planimetry,
proximal
isovelocity
surface area).**

Swan-Ganz catheterization

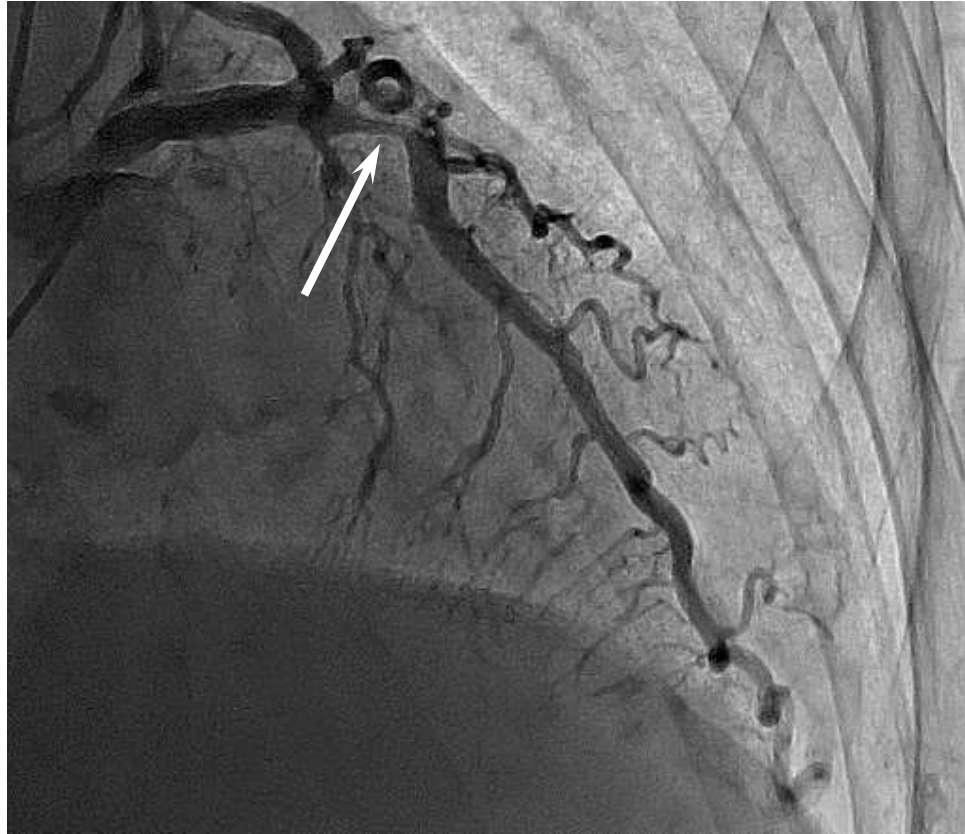
MVA = 0.89 cm² (from simultaneous PCW and LV measurement).

CO/CI = 3.72/2.22.

PCW (a/v/m) = 27 / 27 / 25 mm Hg.

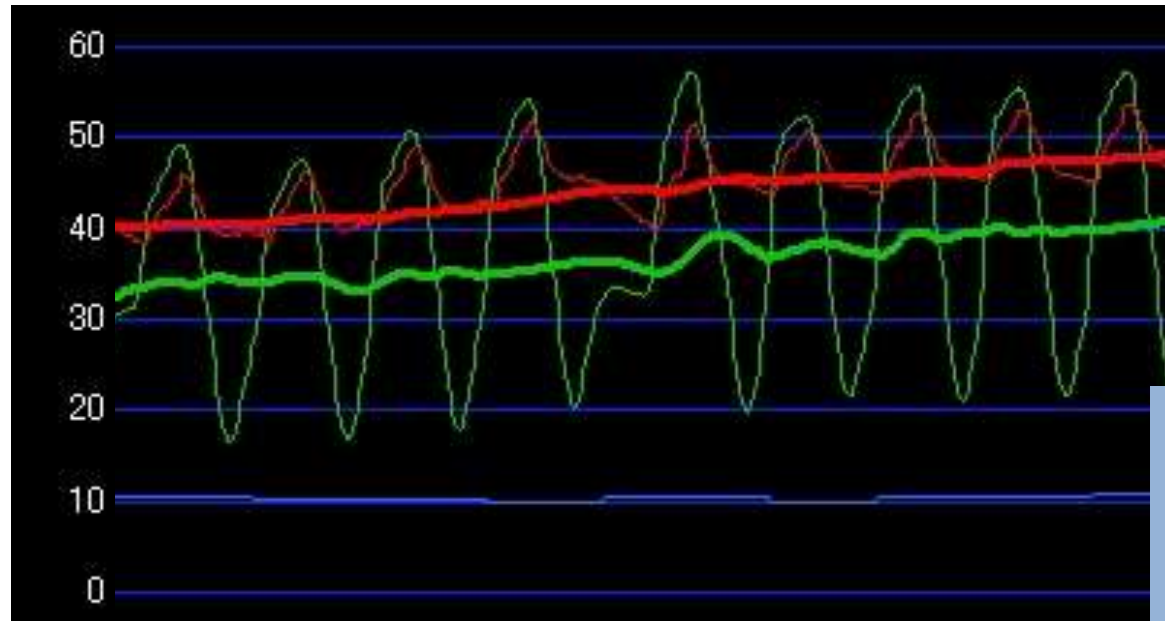
RA (a/v/m) = 20 / 21 / 18 mm Hg.

Coronary angiogram



A 5F diagnostic catheter was engaged, his angiogram showed a moderate stenosis of the mid LAD (arrow). We assessed coronary physiology with SJM system.

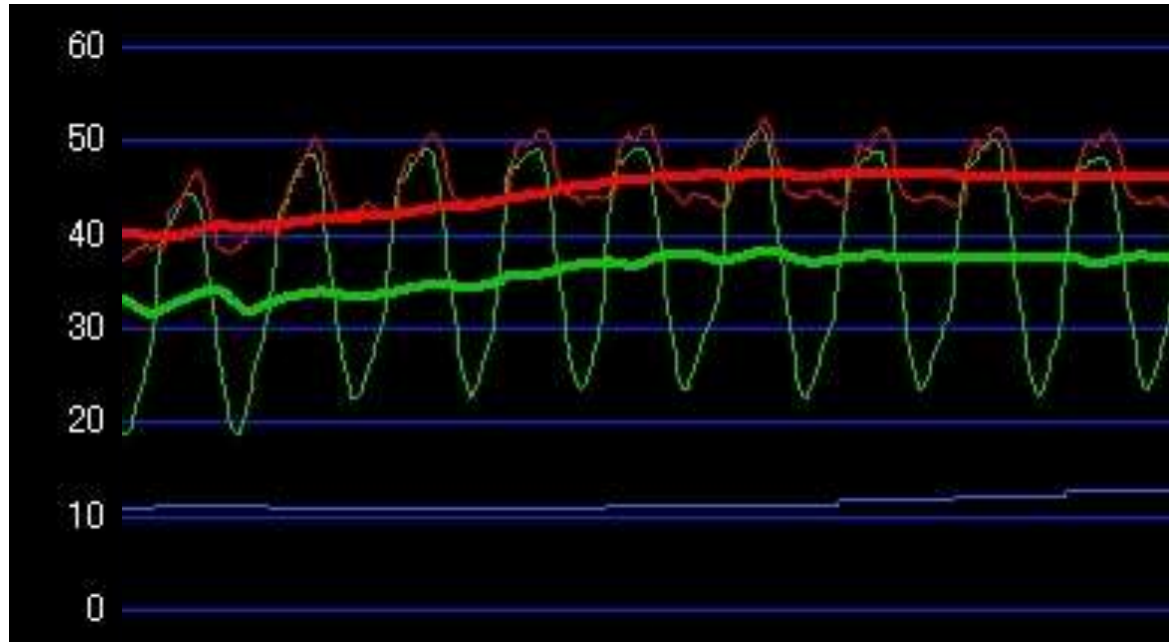
The waveforms of Pd and Pa at rest



RadiAnalyzer
Xpress
(St. Jude Medical,
St. Paul, MN)

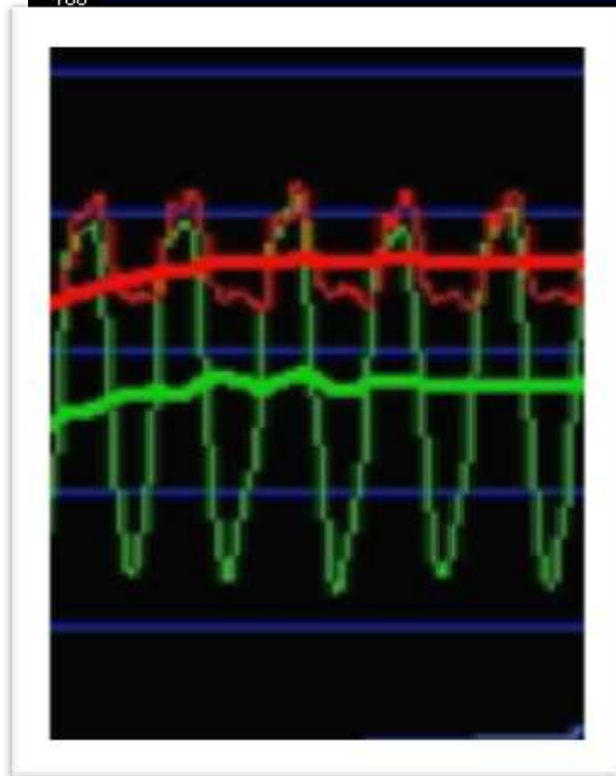
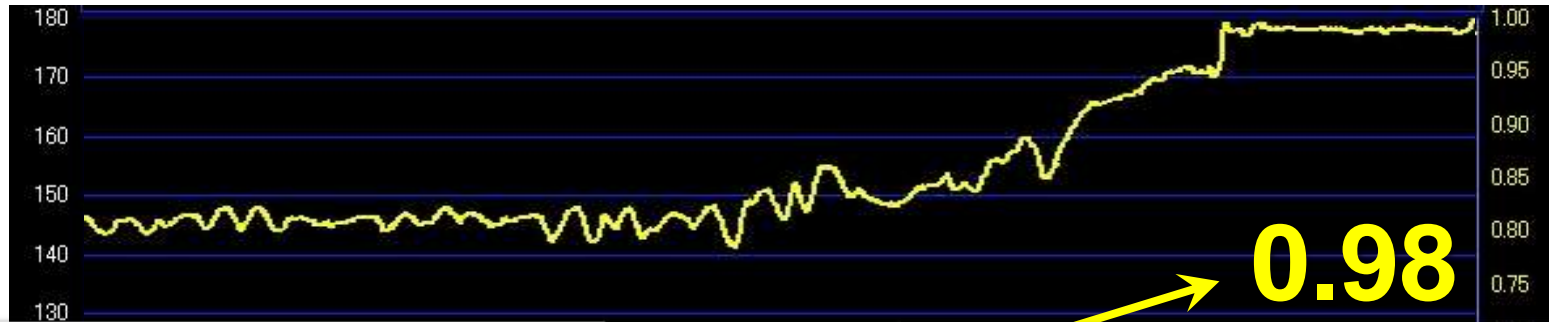
Pd (green waves) seemed much lower than Pa (red waves) in cardiac diastole. iFR was 0.69 (95% CI 0.62-0.75) using a workstation at The University of Tokyo. BP was as low as usual, 54/36 mm Hg at rest.

The waveforms of Pd and Pa during hyperemia

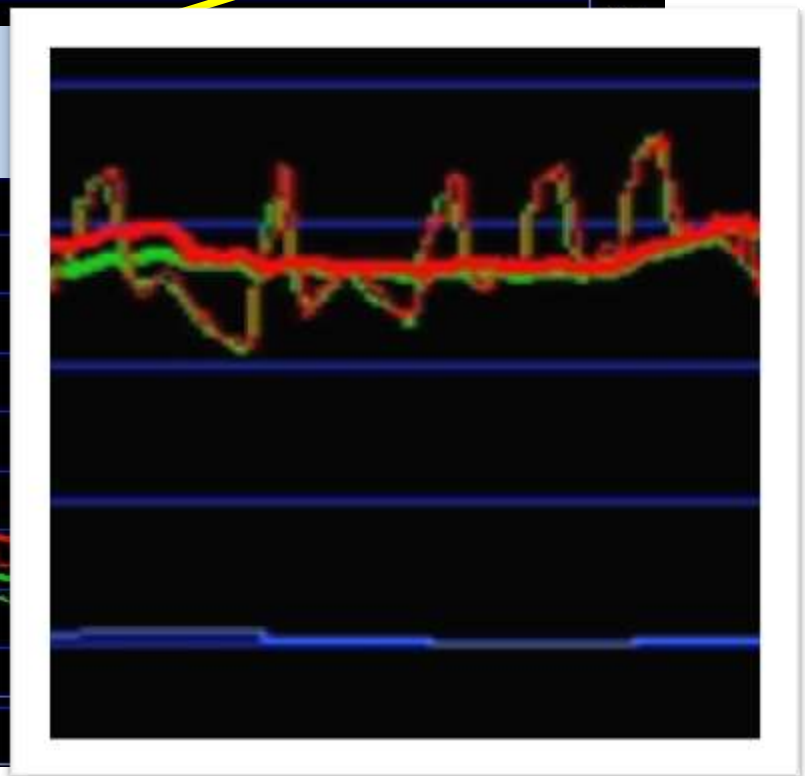


Pd (green waves) seemed much lower than Pa (red waves) in diastole during hyperemia with 12-mg papaverine. On-line FFR was 0.81, off-line FFR was also 0.81 (95% CI 0.80-0.82), and pressure-derived CFR was 1.08 (95% CI 1.03-1.12).

The waveforms during pullback



0.81



Treatment

We decided he had a significant LAD lesion, so he underwent MVR and CABG for LAD (LITA graft).

The operators told us “the bleeding during LAD suture was a little, although some coronary arteries with positive FFR in other patients bleeds much during the suture.”

After the operation, he has been free from dyspnea or congestion.

Our Findings

- 1) FFR was negative (0.81).**
- 2) iFR was positive (≤ 0.75).**
- 3) pCFR seemed positive (≤ 1.12).**
- 4) The waveform seemed positive.**

Our Findings

- 5) Low CO/CI = 3.7/2.2 due to MS.**
- 6) Congestive HF (PWP 25/RA 18).**
- 7) BP was 54/36 mm Hg at rest.**

Discussion 1

FFR is the gold standard.

Hyperemia is mandatory.

Discussion 1

With normal coronary venous pressure,

$$\text{FFR} = (P_d - P_v) / (P_a - P_v) = P_d / P_a = 0.81$$

When coronary venous pressure or RA pressure is elevated, CVP correction of FFR could be vital (De Bruyne B et al. 2012):

$$\text{cFFR} = (P_d - P_v) / (P_a - P_v) =$$

Discussion 1

With normal coronary venous pressure,

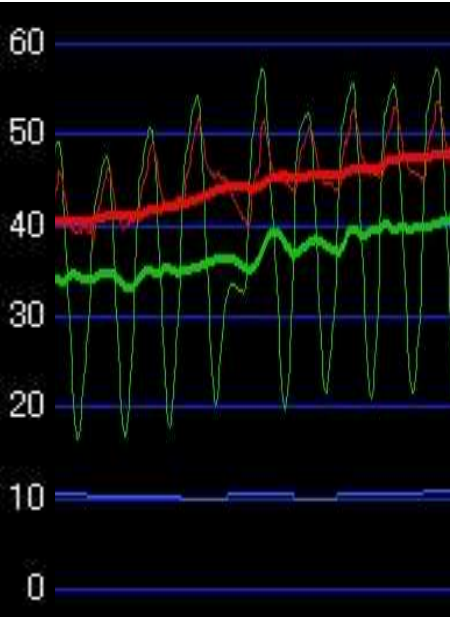
$$\text{FFR} = (P_d - P_v) / (P_a - P_v) = P_d / P_a = 0.81$$

When coronary venous pressure or RA pressure is elevated, CVP correction of FFR could be vital (De Bruyne B et al. 2012):

$$\text{cFFR} = (P_d - P_v) / (P_a - P_v) = 0.67 \text{ (95\% CI 0.66-0.69)}$$

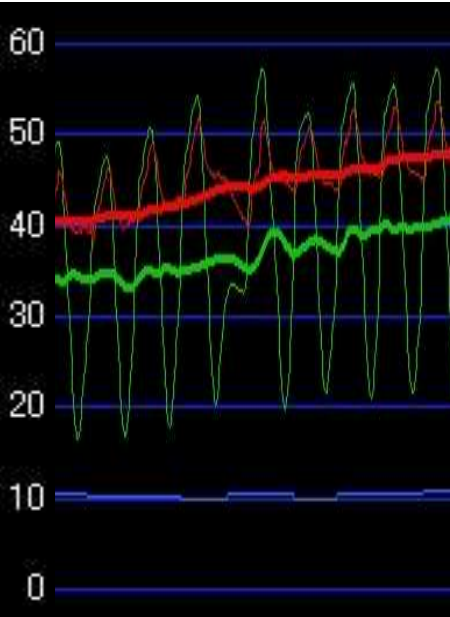
Discussion 2

Pd/Pa

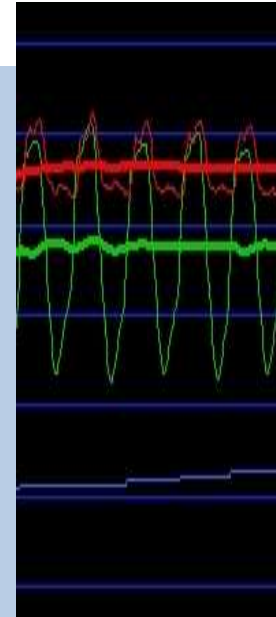


0.83.

Pd/Pa



(R) was 0.81.



I believe 100% of the maximal hyperemia has been achieved.

Discussion 2

In patients with low BP, paradoxical vasoconstriction of microvasculature has been reported to take place. This phenomenon makes it difficult to achieve the maximal hyperemia.

**(Gould et al. AJC 1974, Circulation 1975
JACC 2012, EuroIntervention 2012,
3 papers on JACC 2013)**

Discussion 3

Pressure-derived CFR was 1.1 or lower.

iFR was reported to be more closely correlated with Coronary Flow Reserve than FFR.

(Circ Cardiovasc Interv 2014).

Conclusions

We experienced negative FFR despite positive iFR, pCFR, and the waveform from LAD pressure trace in a patient with low BP, low CO/CI, and elevated RA pressure.