

The impact of before and after CTO recanalization on FFR and CFR of the collateral donor artery:

A Case that FFR and CFR proved ischemia of collateral donor artery

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Case Presentation

A 70 year-old male was admitted to our hospital due to effort angina for 6-months. He had hypertension and past smoking history as coronary risk factors.

The treadmill exercise test showed significant ST-segment depression in the leads II , III , aVF, and from V2 to 5 in Bruce stage 3 with chest oppression.

Baseline Coronary Angiogram



Coronary angiogram showed the CTO lesion from the proximal to mid-RCA. The distal-RCA was filled through the well-developed collateral artery from the distal-LAD via apex. There was no significant stenosis in the LAD as a donor artery.

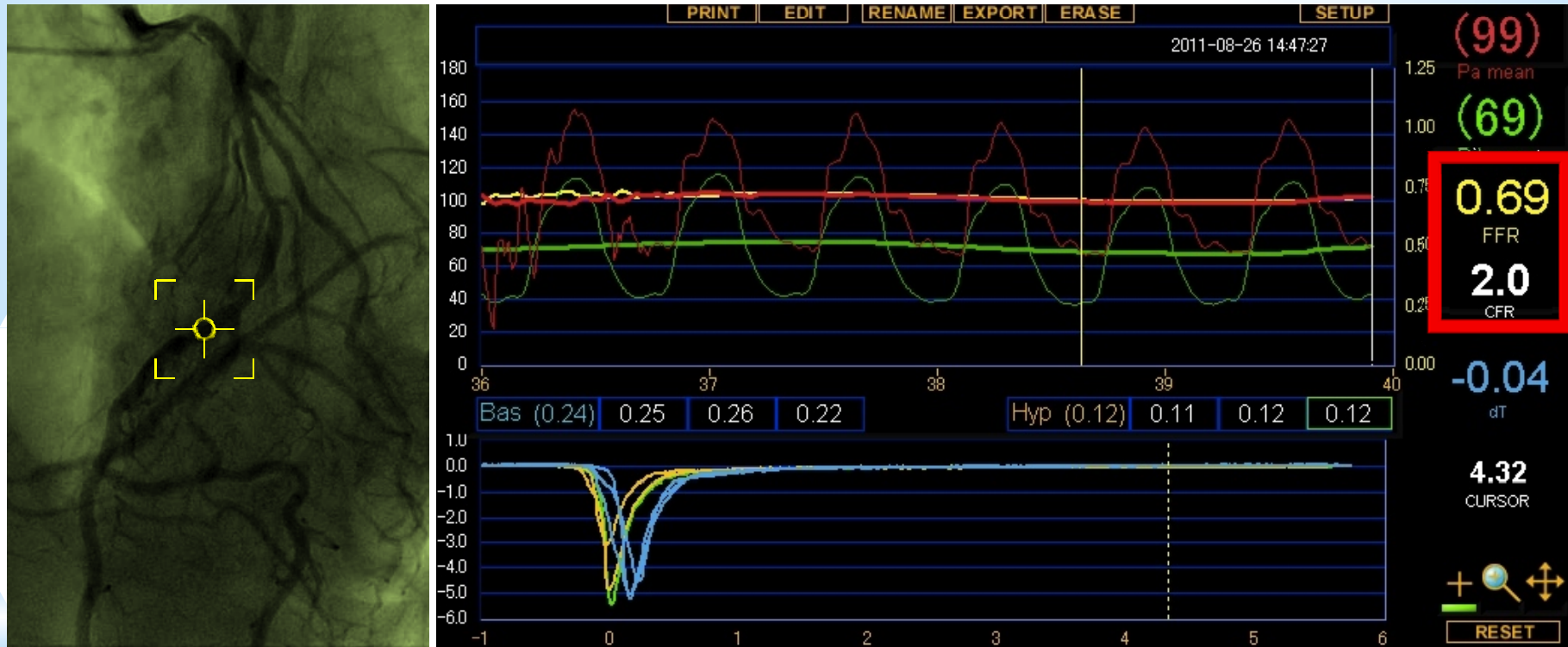
Baseline left ventricular angiogram



The LVG showed normal LV function without ventricular asynergy.

Baseline FFR and CFR in the donor artery

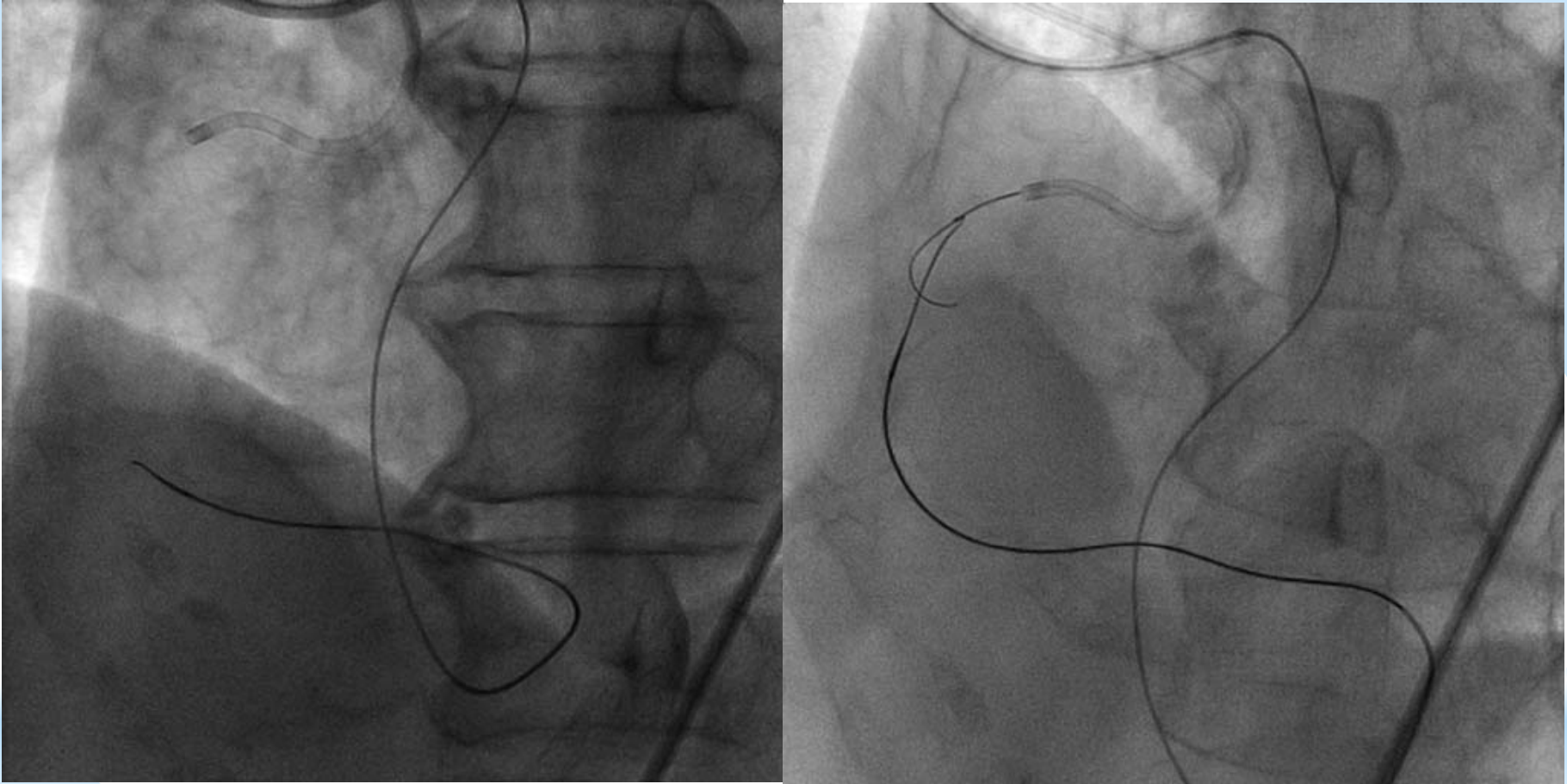
FFR and CFR in the mid-LAD



ATP 140 $\mu\text{g}/\text{kg}/\text{min}$ (Intravenous)

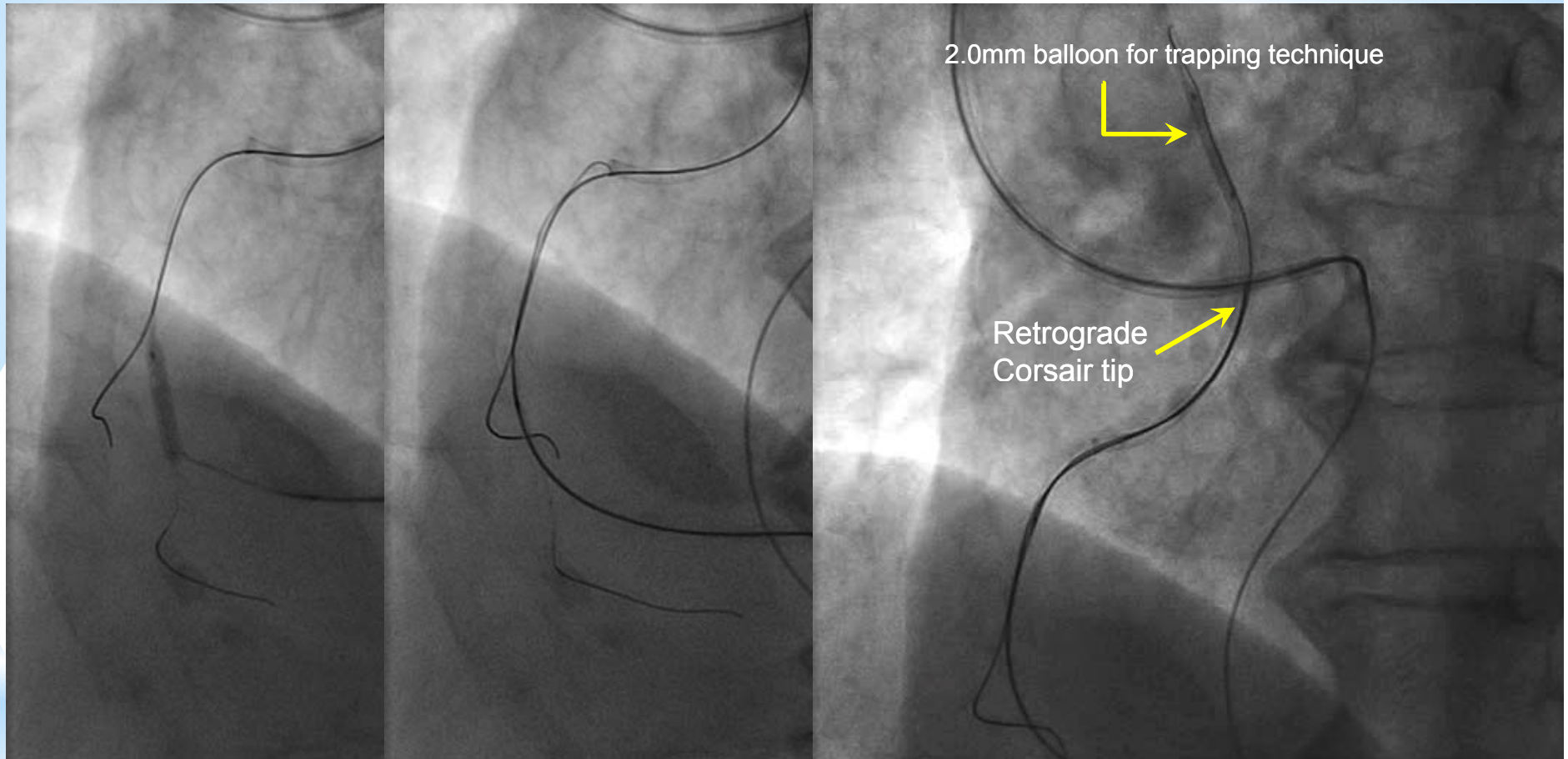
FFR and CFR in the mid-LAD was 0.69 and 2.0 despite there was no angiographic significant stenosis.

Retrograde approach via the epicardial artery from the distal-LAD



Retrograde approach system was successfully reached the CTO distal site through the epicardial artery from the LAD via apex.
But the retrograde guidewire could not pass the CTO, and, kissing wire technique was unsuccessful.

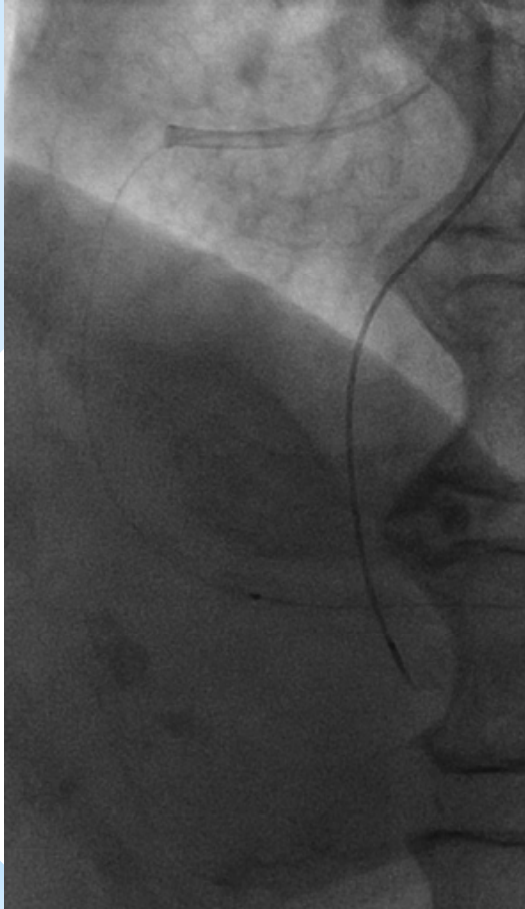
Reverse CART



Then, the reverse CART technique was attempted.

Following 3.0mm balloon dilatation in the CTO lesion, the retrograde guidewire was passed into the sub-intimal space to reach the proximal true lumen, and it was inserted into the antegrade guiding catheter.

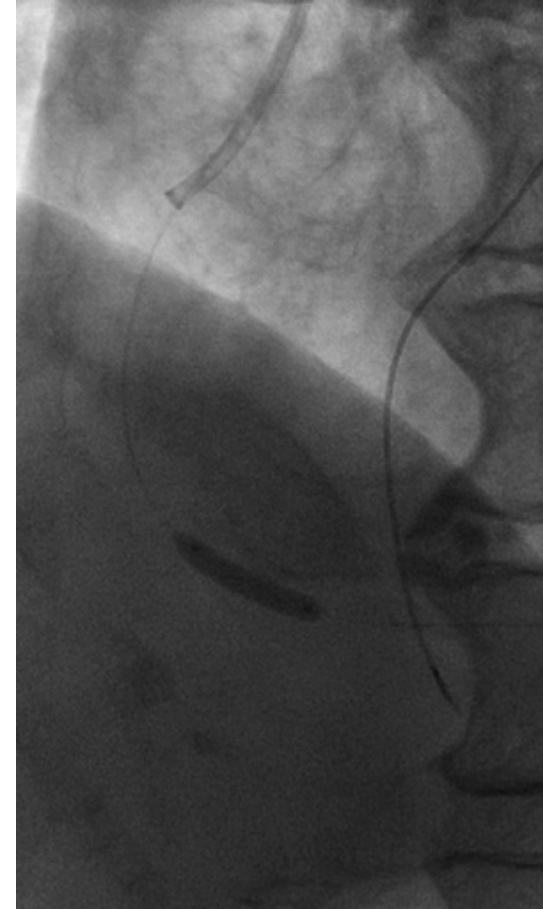
Predilatation



1.25x8mm

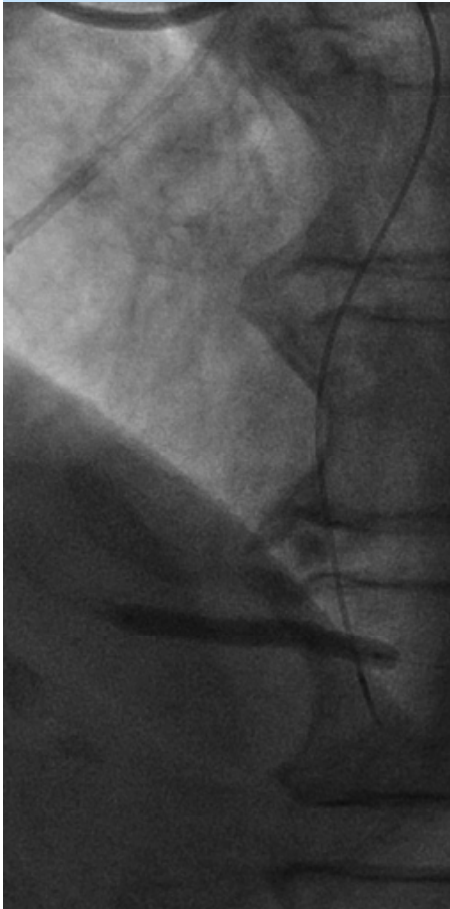


2.0x15mm



3.0x15mm

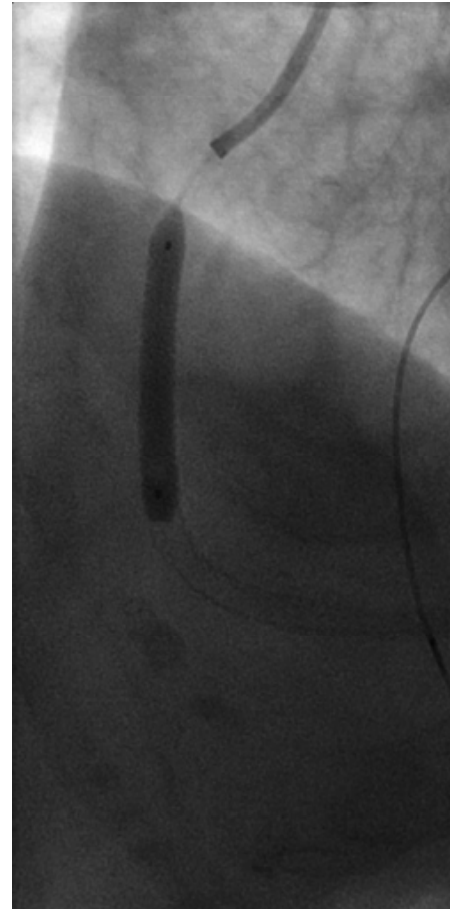
Stenting



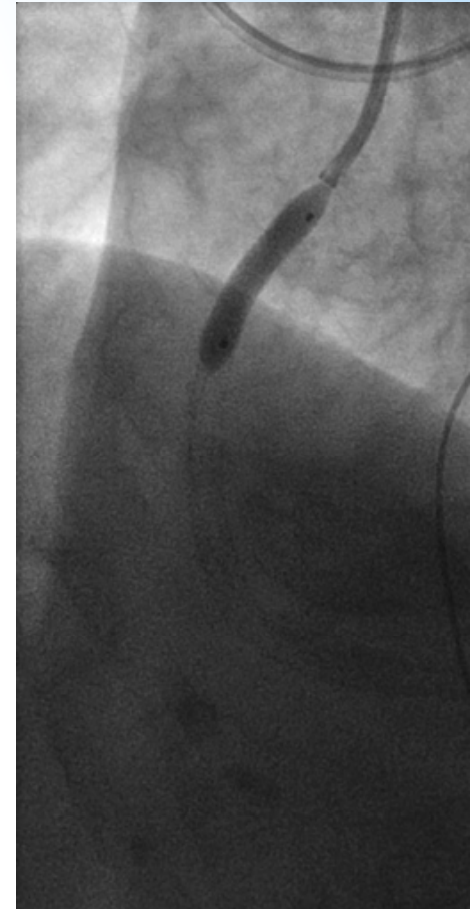
Xience V
3.0x28mm



Promus
3.5x28mm

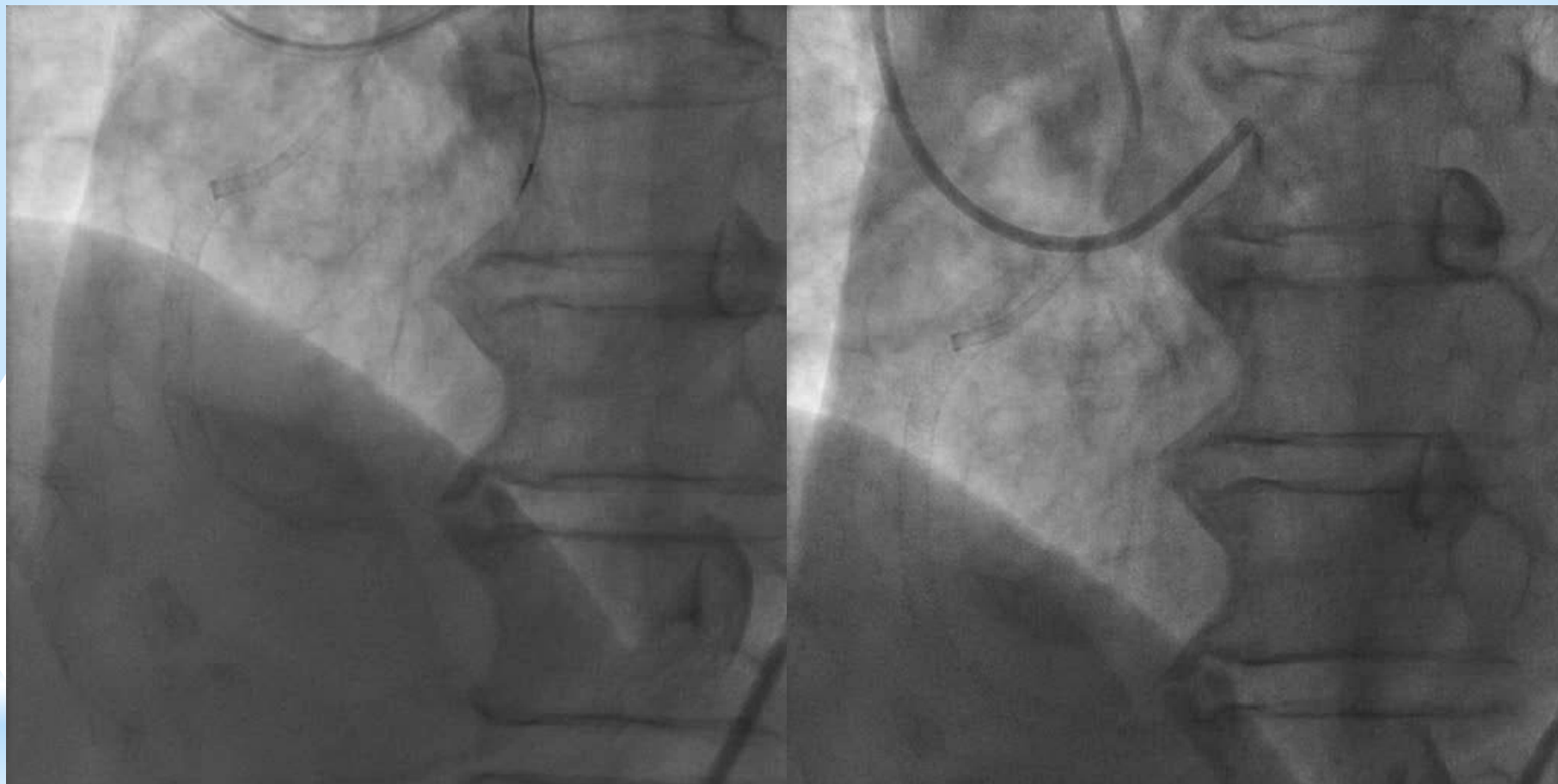


Xience V
3.5x28mm



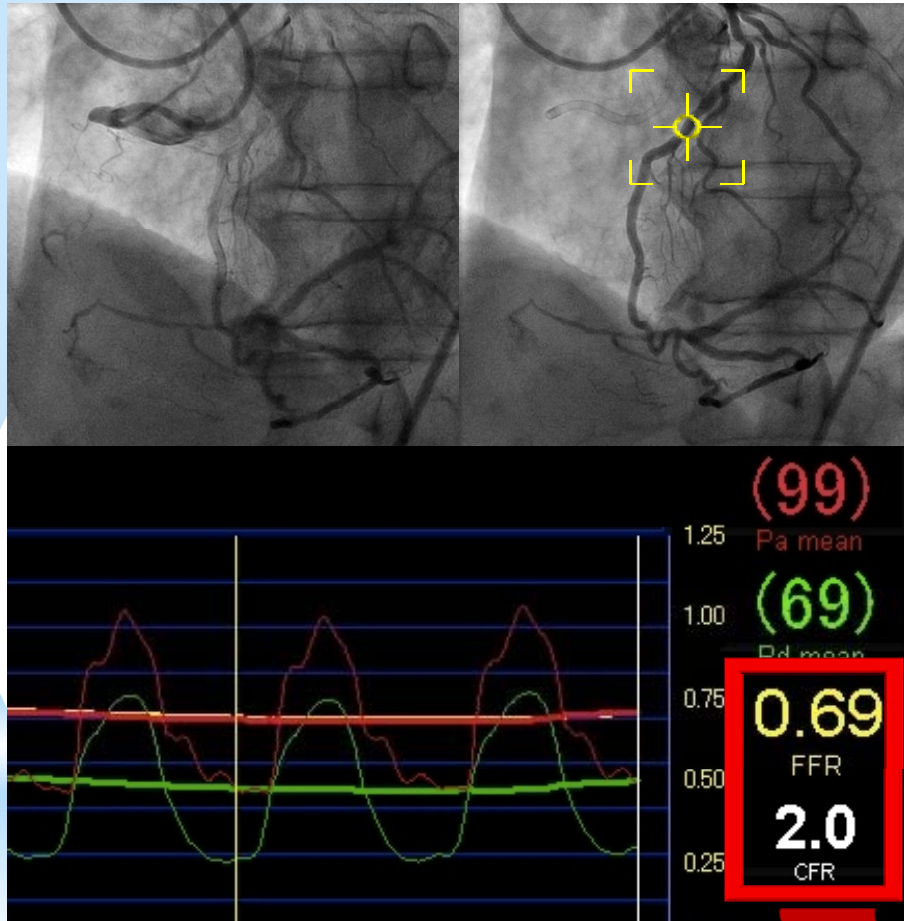
Promus
3.5x18mm

Final Angiogram

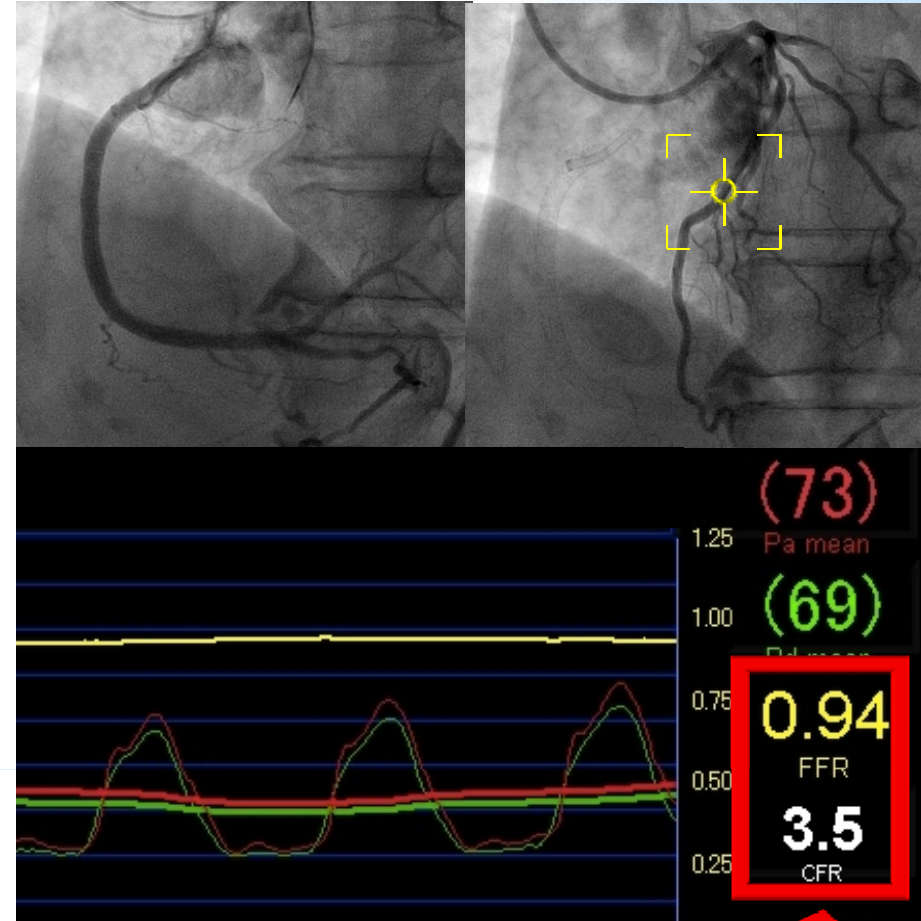


Results of FFR and CFR in the LAD

Baseline



After CTO-PCI



Discussion

The factors influenced coronary circulation

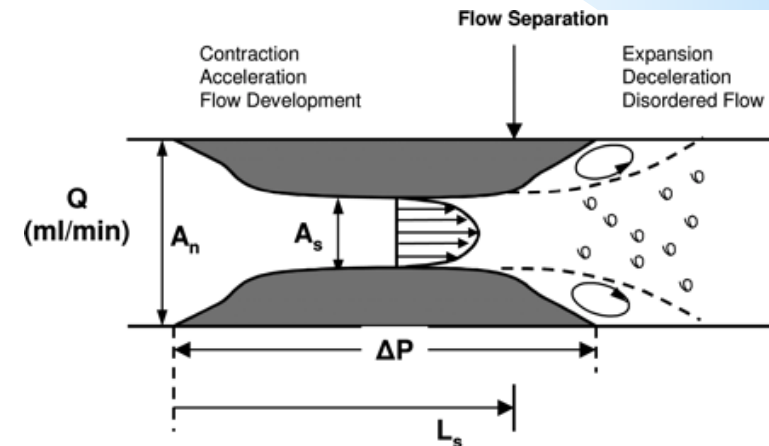
1. Lesion characteristics

- 1) Degree of diameter stenosis
- 2) Reference vessel diameter
- 3) Lesion morphology, eccentricity, and length
- 4) Plaque burden, characteristics
- 5) Lesion surface roughness

(Erosion, Ulcer, Dissection, Thrombus, Calcification, etc.)

2. Flow characteristics

- 1) Flow volume
- 2) Viscous friction
- 3) Flow separation, turbulence and eddies

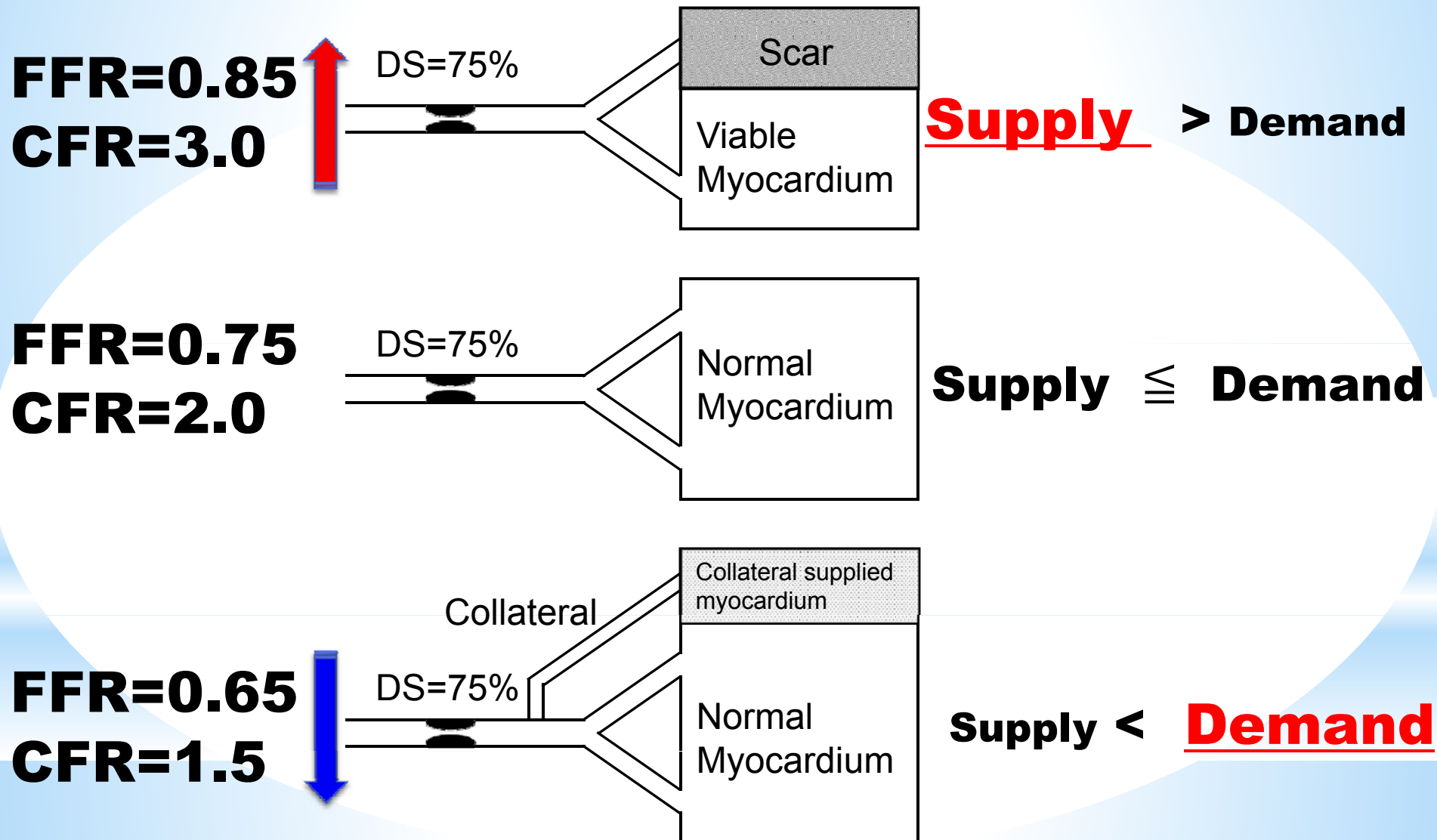


Kern et al. Circulation. 2006;114:1321-1341

3. Myocardial demand

- 1) Extent of perfusion area
- 2) Myocardial viability
- 3) Quantity of myocardium

FFR and CFR depends on the extent of perfusion area



Why does the increase and decrease of demand affect FFR and CFR?

Why does the increase and decrease of demand affect the FFR?

FFR Concept



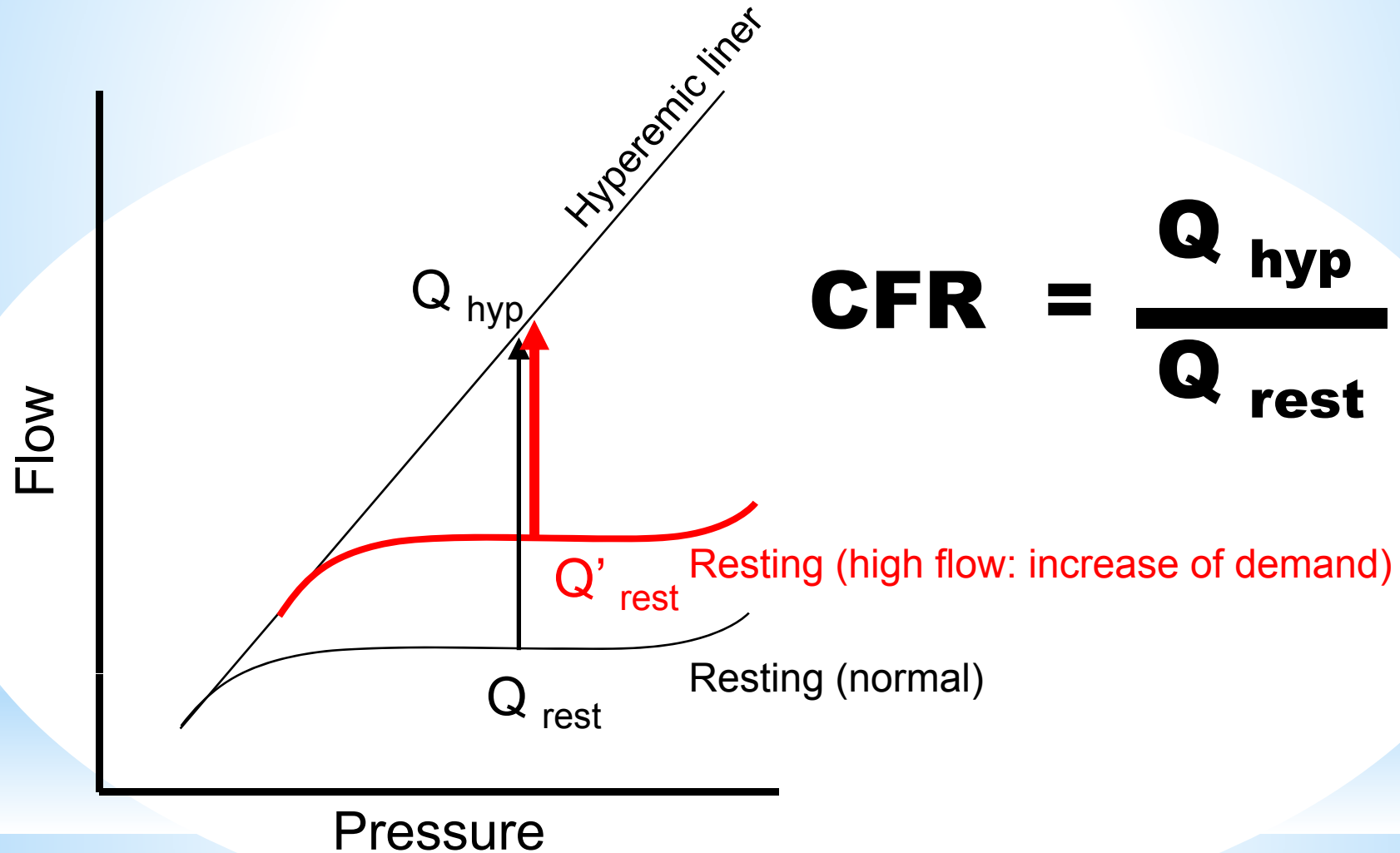
Hydraulic equation

$$\Delta P = Q \times R$$

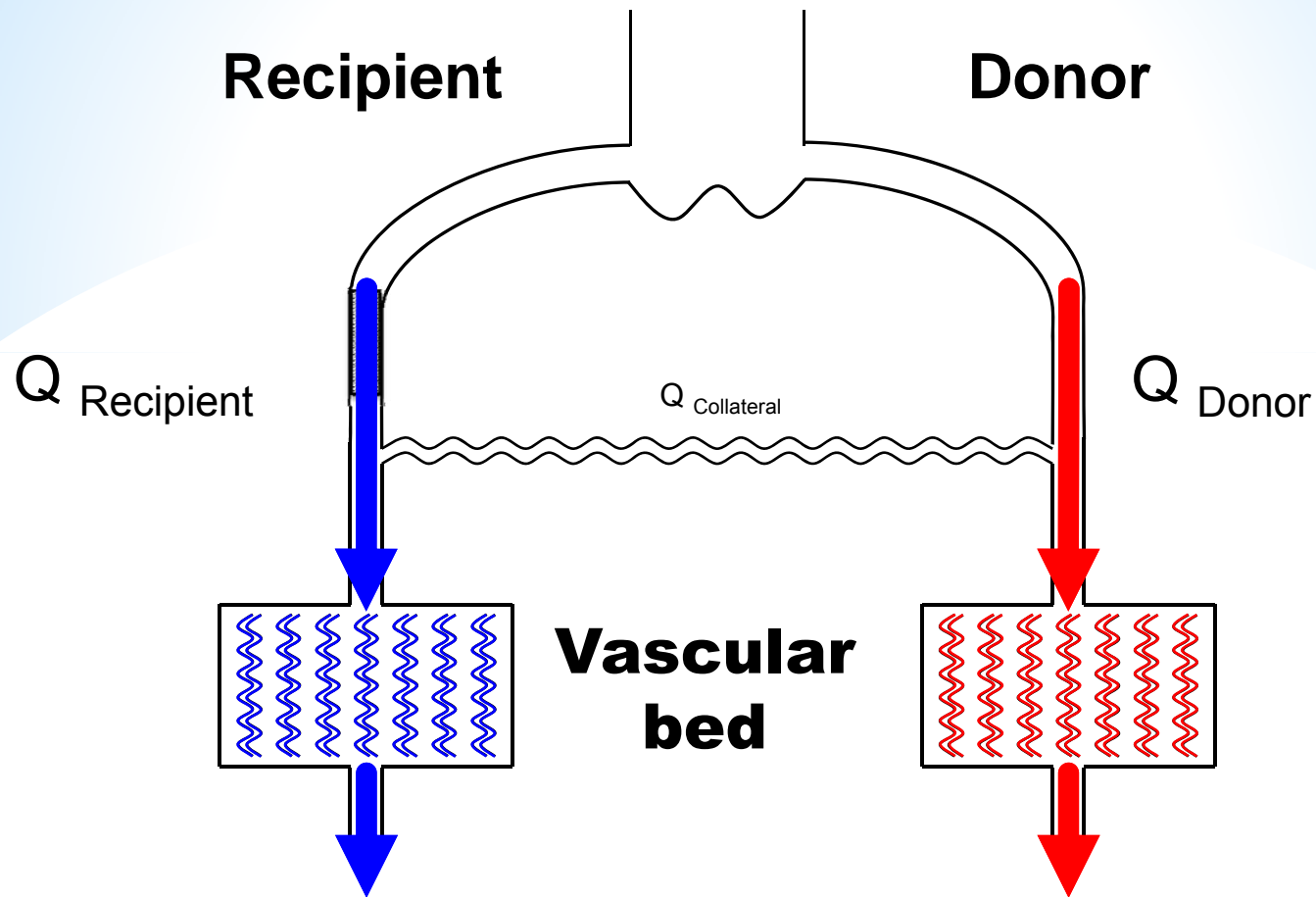
Pressure gradient = Blood flow x Resistance

$$\text{FFR} = \frac{P_d}{P_a} = \frac{P_a - \Delta P}{P_a}$$

Why does the increase and decrease of demand affect the CFR?



After CTO-PCI



Matching supply and demand normalizes coronary circulation

Take Home Message

A CTO may lead to not only regional myocardial ischemia of the culprit area but also secondary ischemia of the donor artery area by coronary steal phenomenon.

Measuring coronary circulation physiology will be helpful as an ischemic diagnostic tool in a collateral donor artery to a CTO.