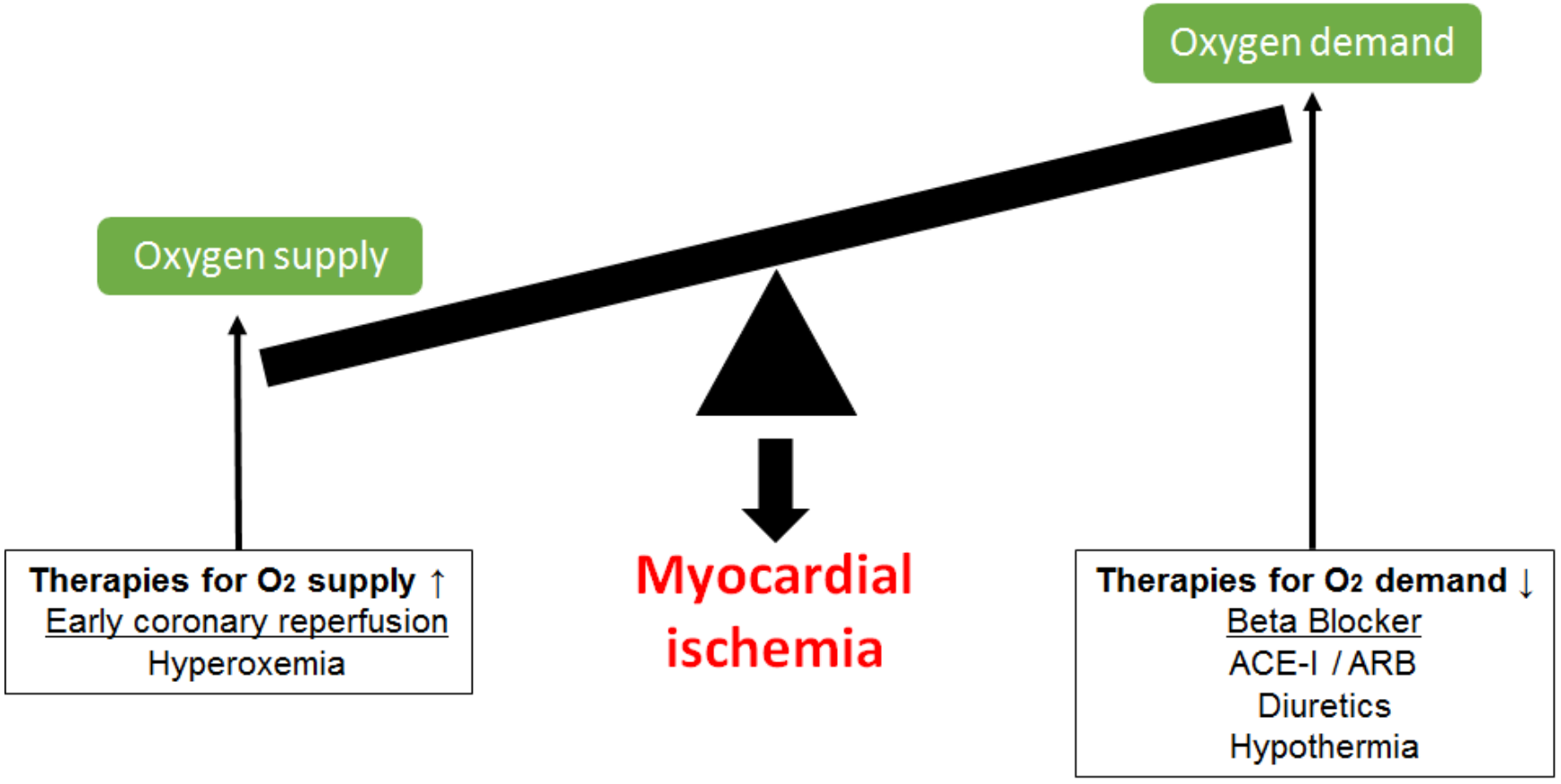
Basic science of Impella
–what can we learn from PV loop?-

Takahiro Arimura[1], Keita Saku[2], Takamori Kakino[3], Takuya Nishikawa[4], Genya Sunagawa[5], Kenji Sunagawa[2]

Oxygen supply-demand imbalance = Myocardial ischemia

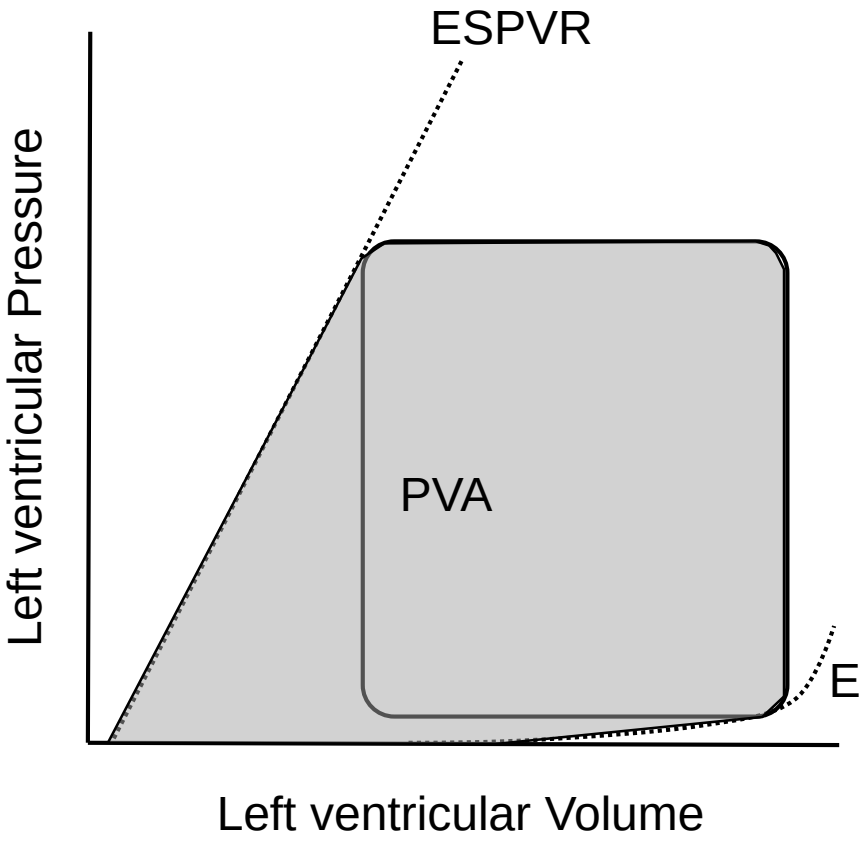


Reducing MVO_2 in MI is beneficial in the AMI therapy.

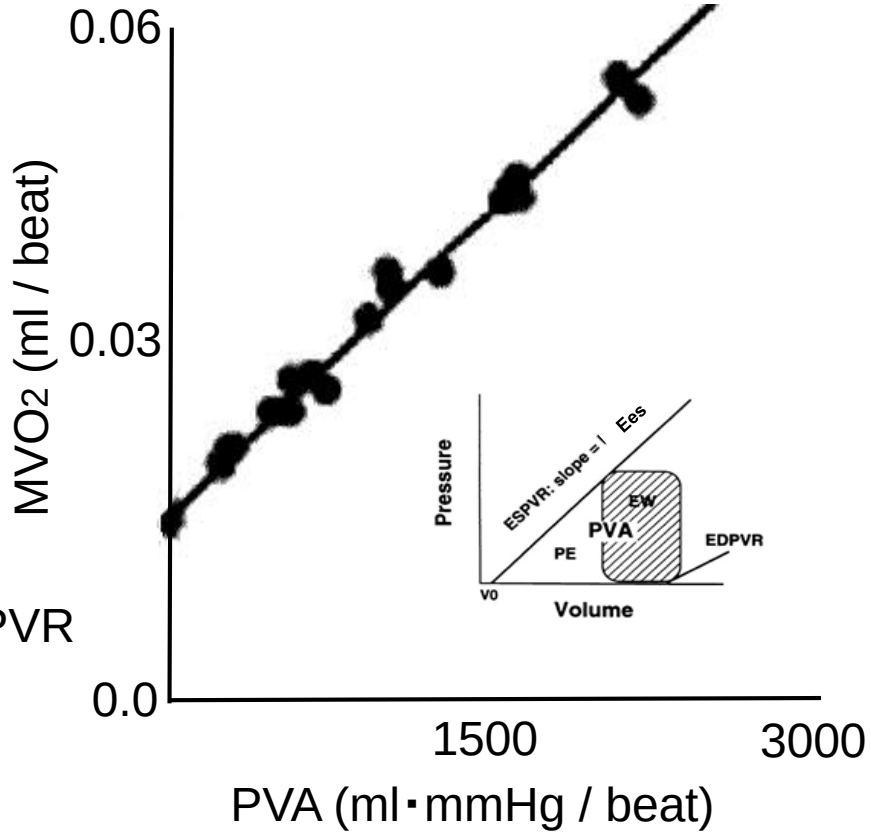
Modified from Kloner, *Circulation* 2013

Pressure-volume area (PVA) indicates myocardial oxygen consumption (MVO_2)

Pressure volume area; PVA

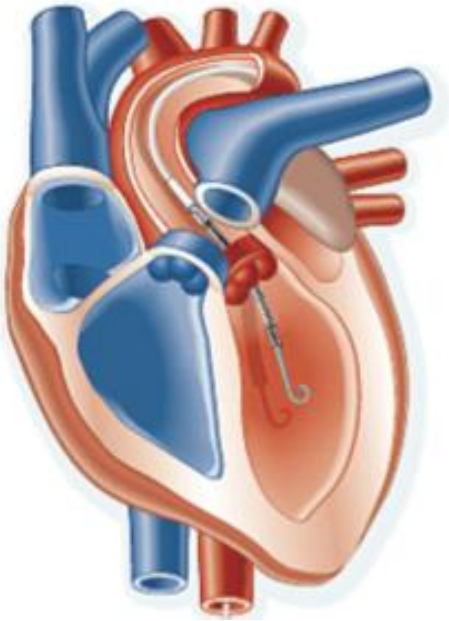


PVA-MVO_2 relationship



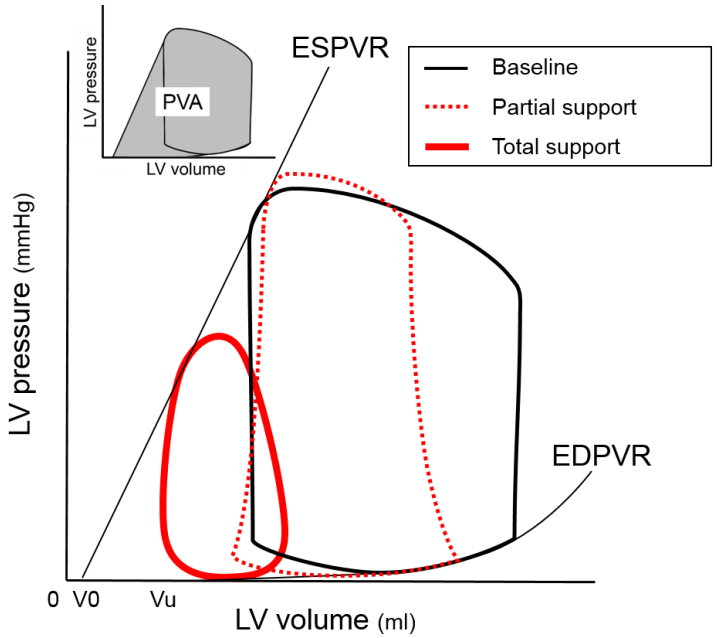
Suga H. *Circ Res*1983.

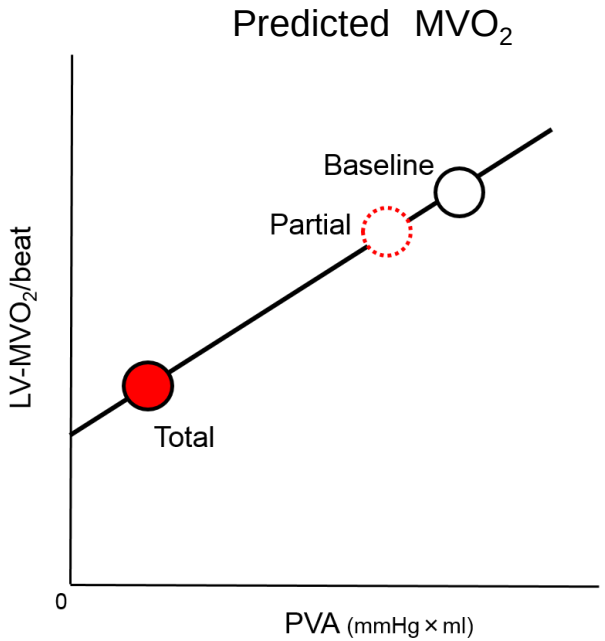
Percutaneous LVAD; Impella®

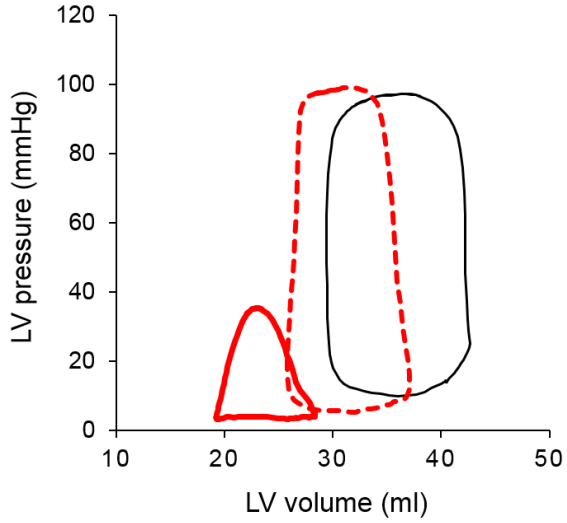


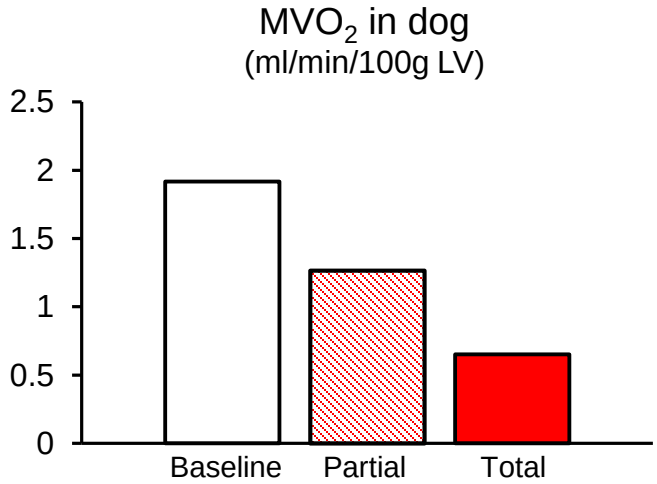
Quotation from homepage of Abiomed®

The effects of Impella on PVA-MVO_2









Sunagawa et al. JCTR 2018.

Impella® → AMI

Myocardial ischemia (3hrs)

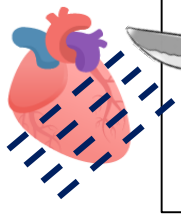
60min

60min

Impella support

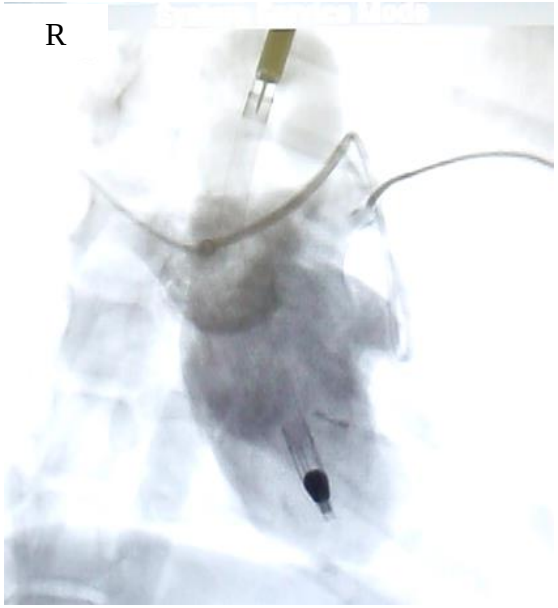
reperfusion

1 month assessment

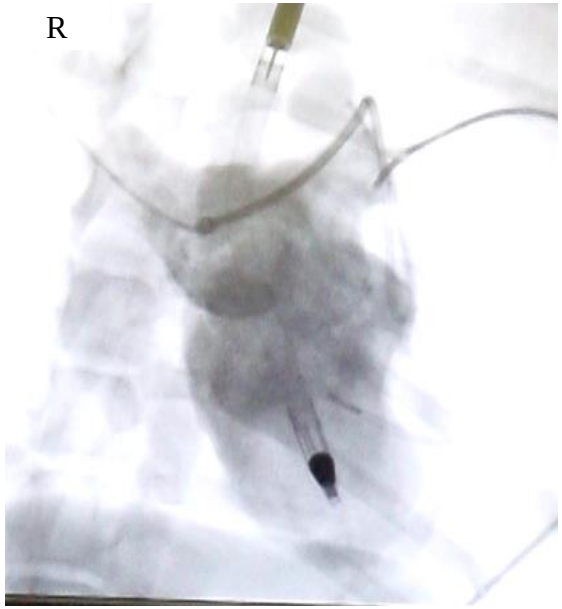


Infarct size
LVEF
E_{es}
LVEDP
NT-proBNP

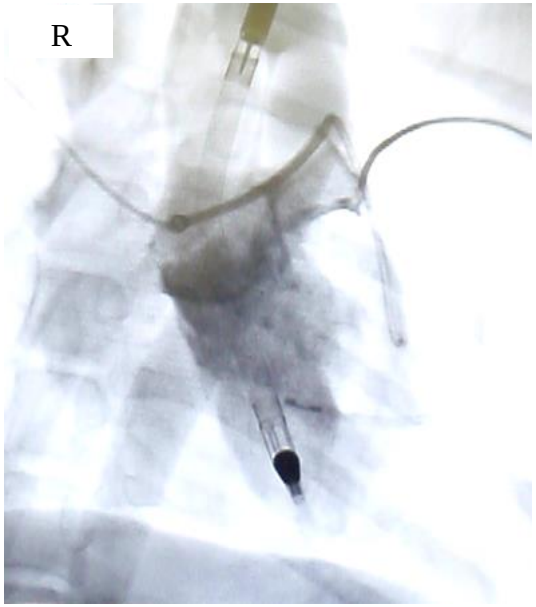
No support
(Control)



Partial Impella

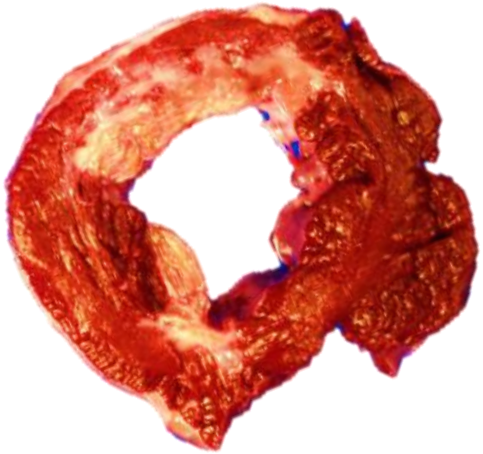


Total Impella

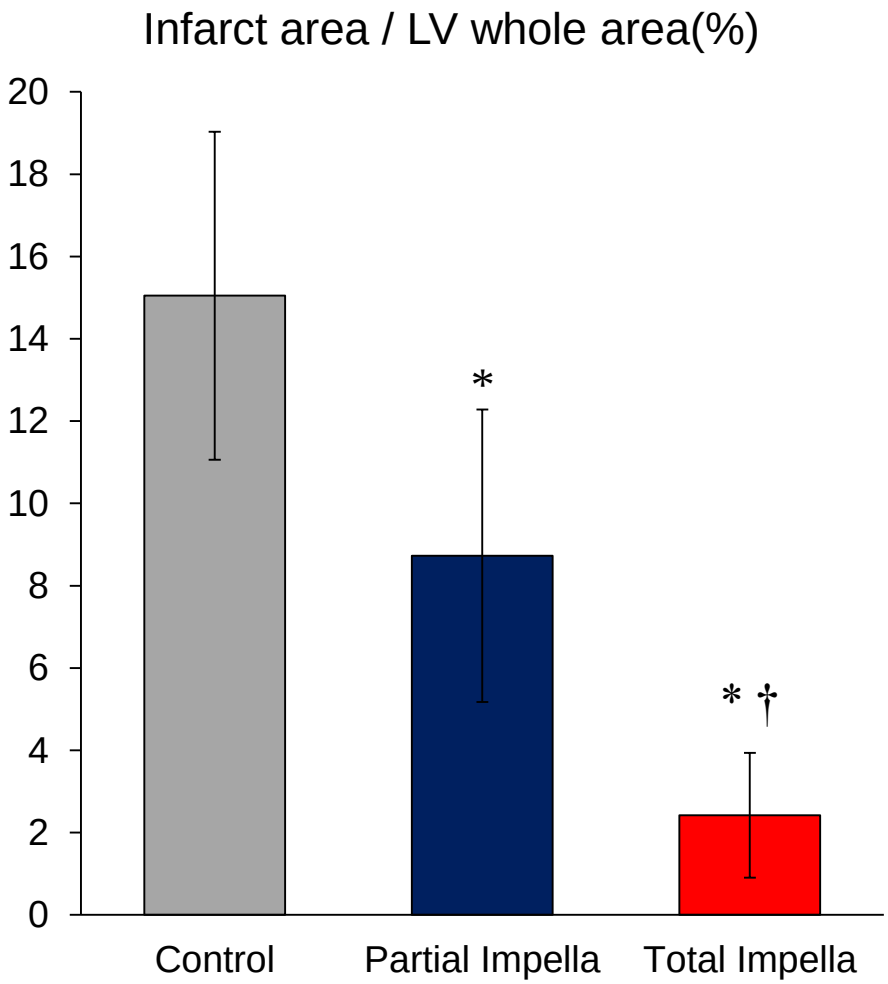


Impella® total support decreases infarct size

Control

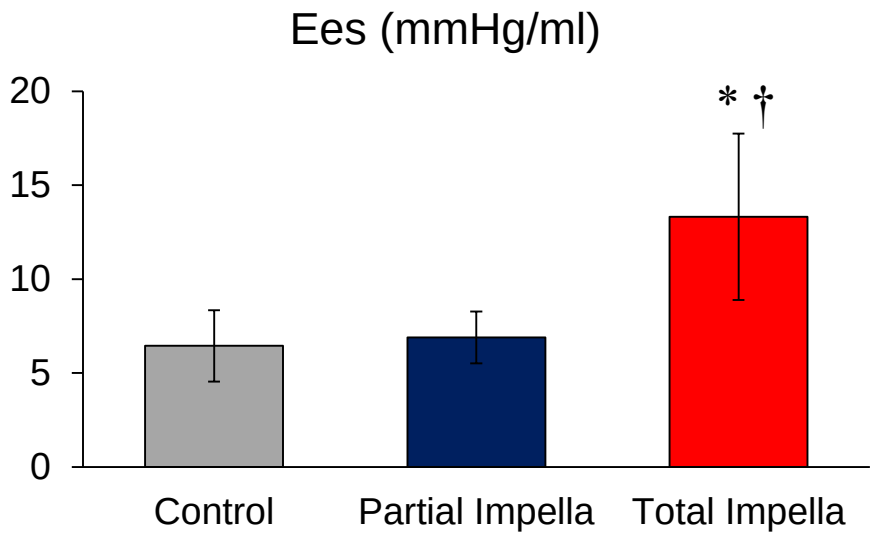


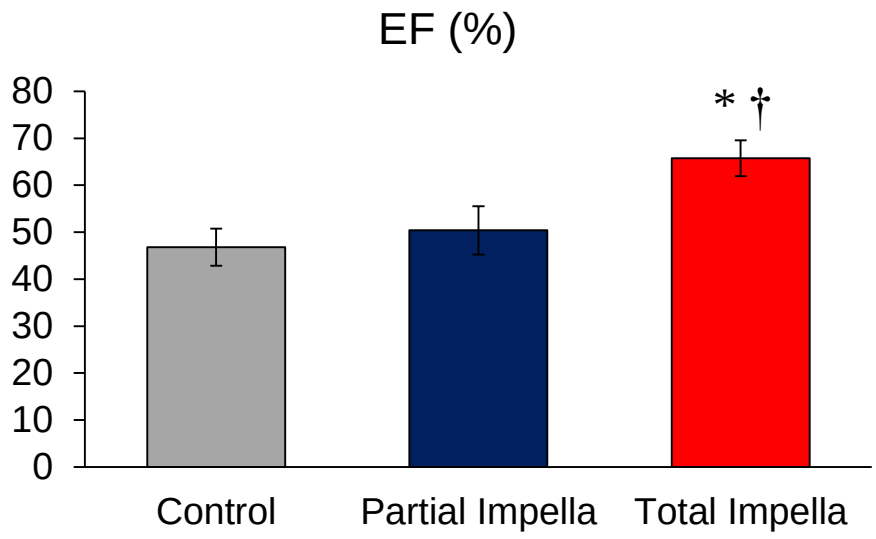
Total Impella

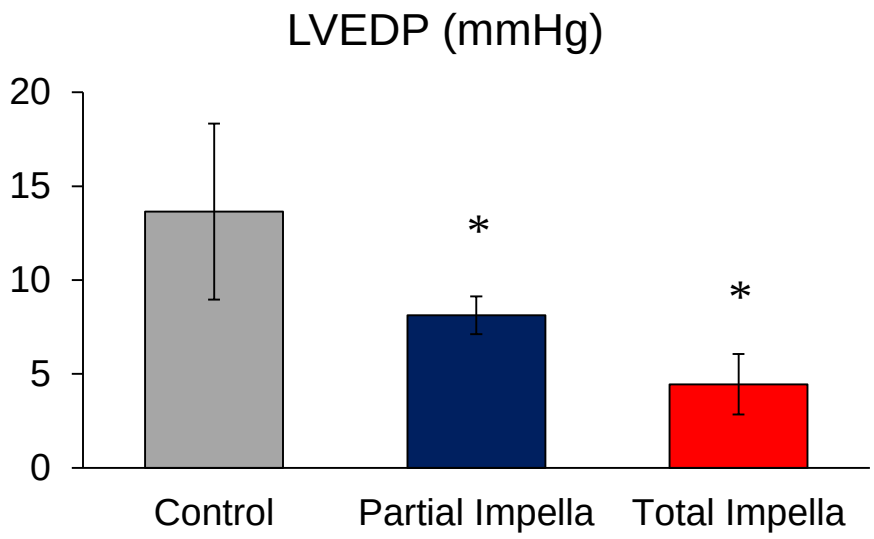


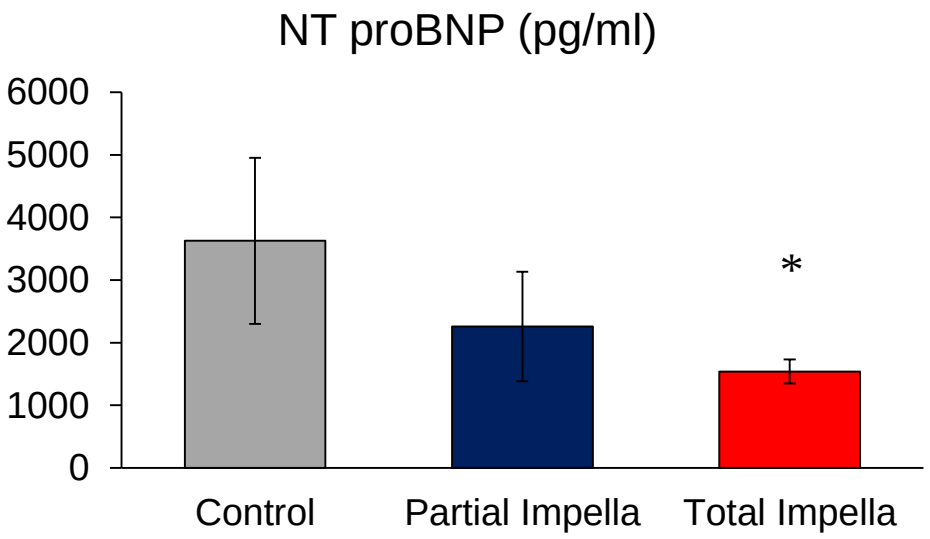
* P<0.05 vs Control
† P<0.05 vs Partial Impella

Impella® total support prevents heart failure after AMI









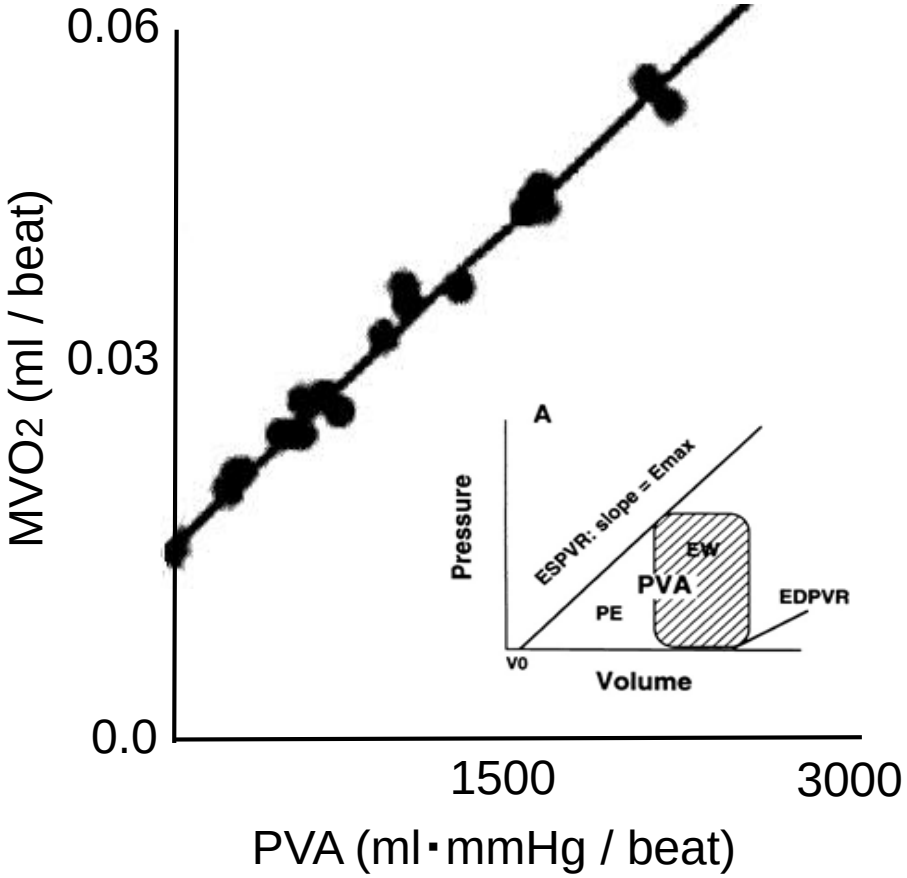
* P<0.05 vs Control, †P<0.05 vs Partial Impella

Arimura T, Kakino T et al, *AHA 2015* Abstract 14058

HR reduction decreases MVO_2 much more

$$MVO_2/beat = \alpha PVA + \beta$$

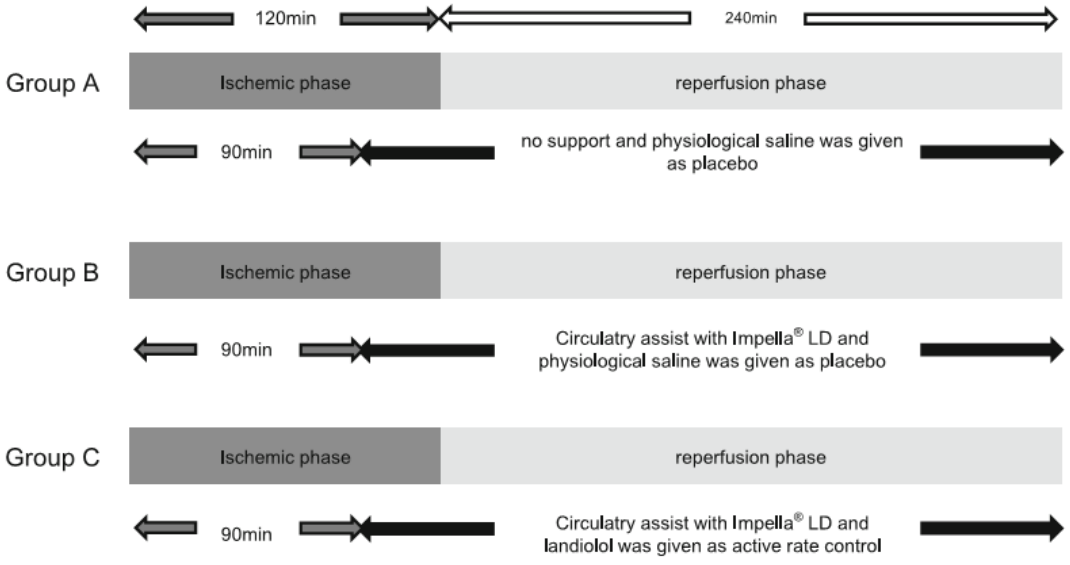
$$MVO_2/min = A \cdot PVA \cdot HR + B \cdot HR + C$$



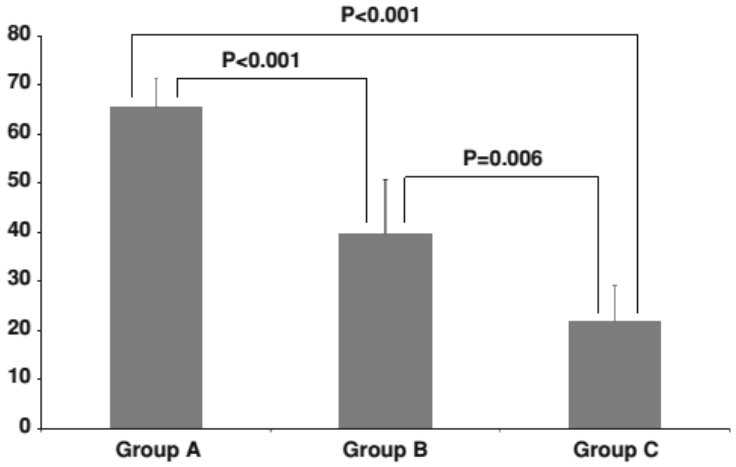
Impella with β blocker reduces infarct size

The effect of combined treatment with Impella® and landiolol in a swine model of acute myocardial infarction

Isamu Yoshitake · Mitsumasa Hata · Akira Sezai · Satoshi Unosawa · Shinji Wakui · Haruka Kimura · Kin-ichi Nakata · Hiroaki Hata · Motomi Shiono



MI size (%)

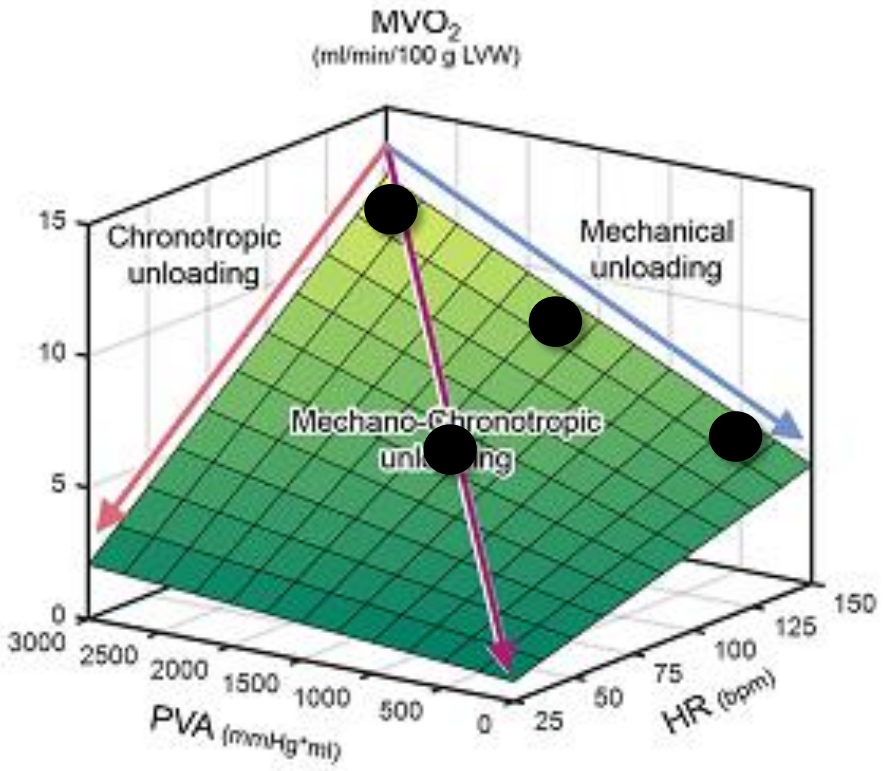


Yoshitake et al. J Artif Organs 2012.

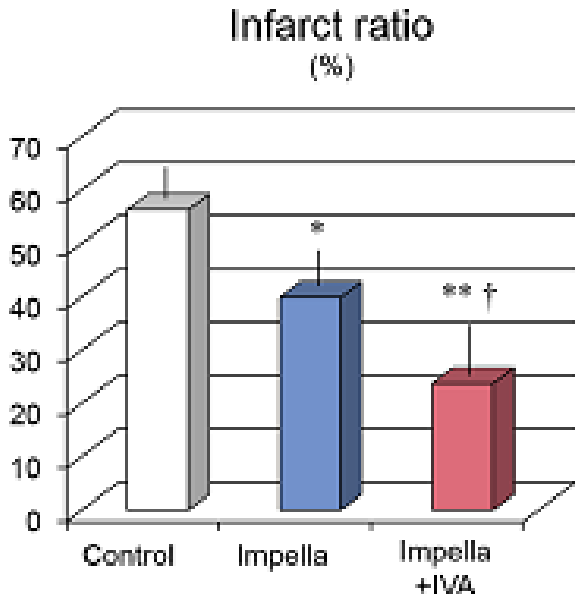
Impella + ivabradine

Mechano-chronotropic Unloading During the Acute Phase of Myocardial Infarction Markedly Reduces Infarct Size via the Suppression of Myocardial Oxygen Consumption

Genya Sunagawa[1] · Keita Saku[2] · Takahiro Arimura[1] · Takuya Nishikawa[1] · Hiroshi Mannoji[1] · Kazuhiro Kamada[1] · Kiyokazu Abe[3] · Takuya Kishi[2] · Hiroyuki Tsutsui[1] · Kenji Sunagawa[4]



- Dog
- 3 hrs MI and 3 hrs reperfusion
- Treatment started from 1 hr after MI
- Partial support with Impella CP



Sunagawa et al. JCTR 2018.

Summary

Imbalance of O_2 supply and demand

↓

Suppression of MVO_2 reduces infarct size

↓

Impella total support maximizes MVO_2

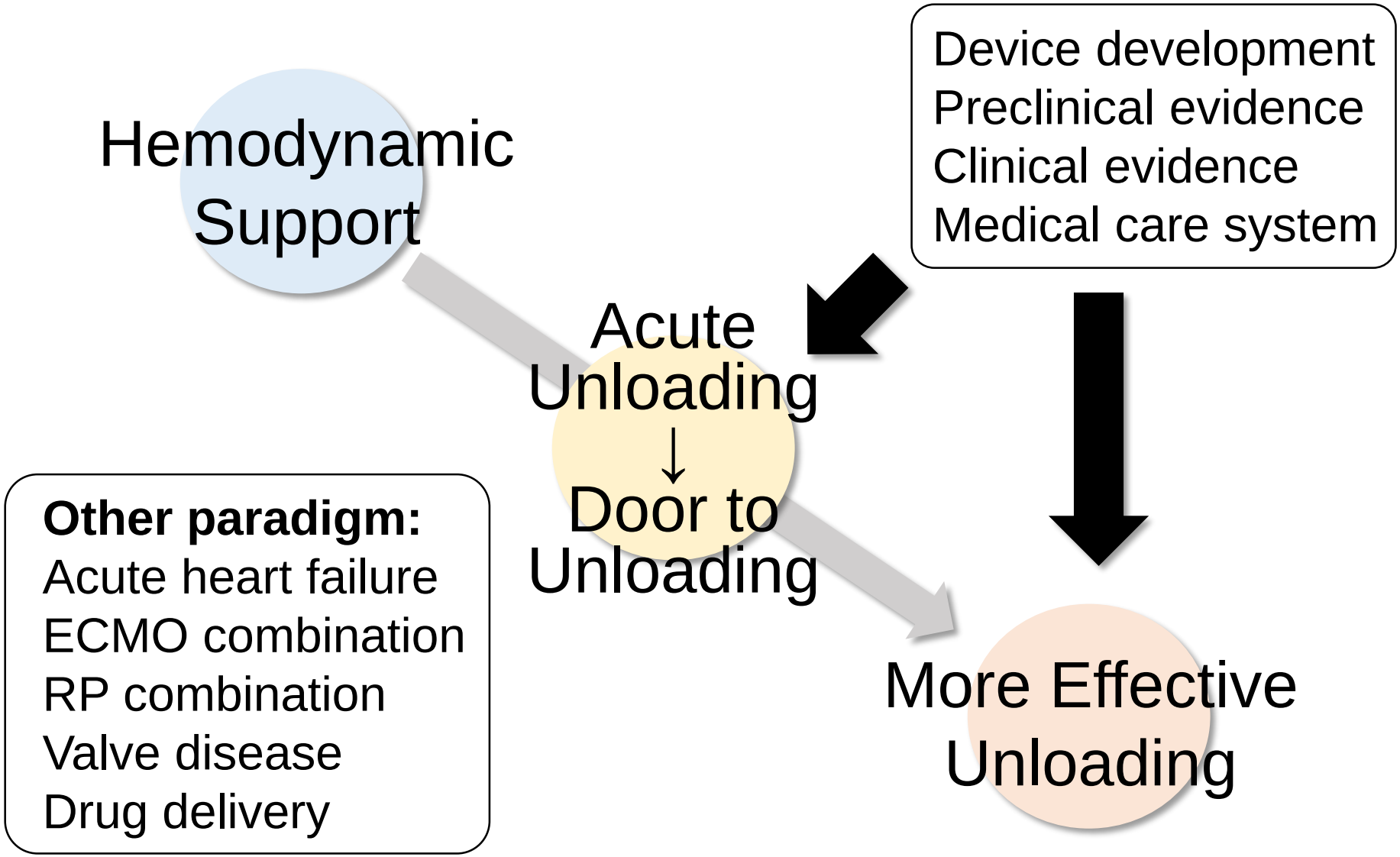
↓

Impella total support minimizes infarct size

↓

Mechano-chronotropic unloading further reduces MVO_2 and infarct size

Impella beyond hemodynamic support



✓実際の講演スライドは未発表データを含むため、内容を一部改訂させて頂いております。
✓スライド6枚目に動画がございますが、閲覧をご希望の方は、info@circ-dynamics.jpにご連絡ください。