CHRONIC HEART FAILURE : WHAT ELSE COULD WE OFFER TO OUR PATIENTS?

Cardiac Rehabilitation Society of Thailand

ENHANCED EXTERNAL COUNTER PULSATION

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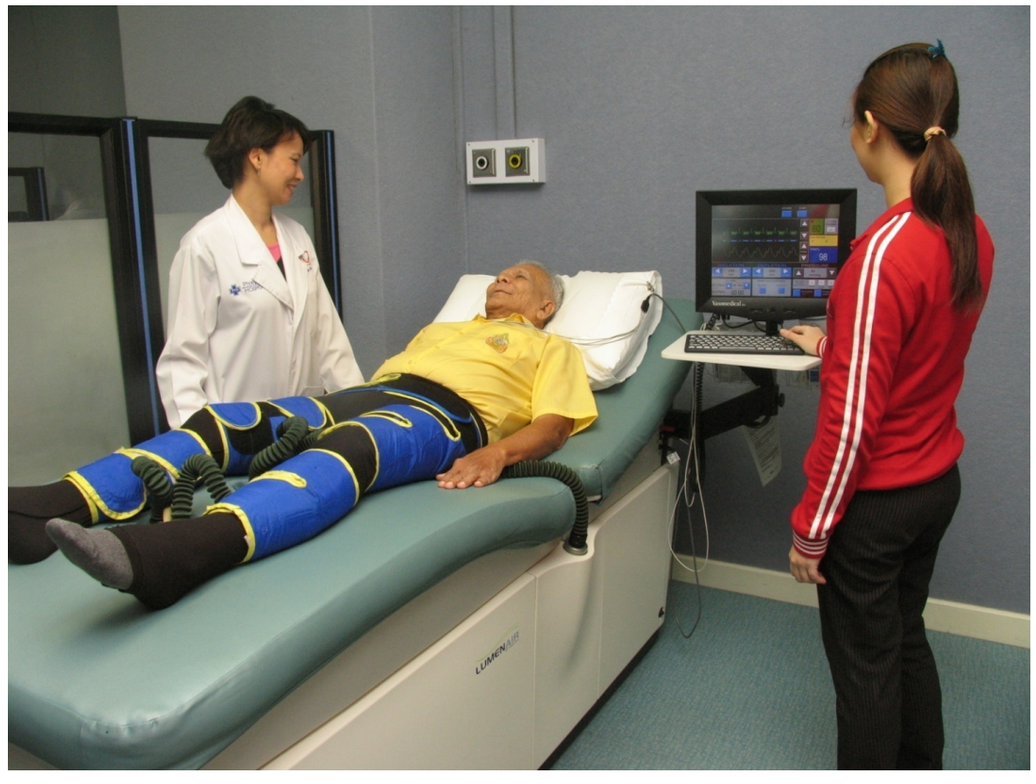


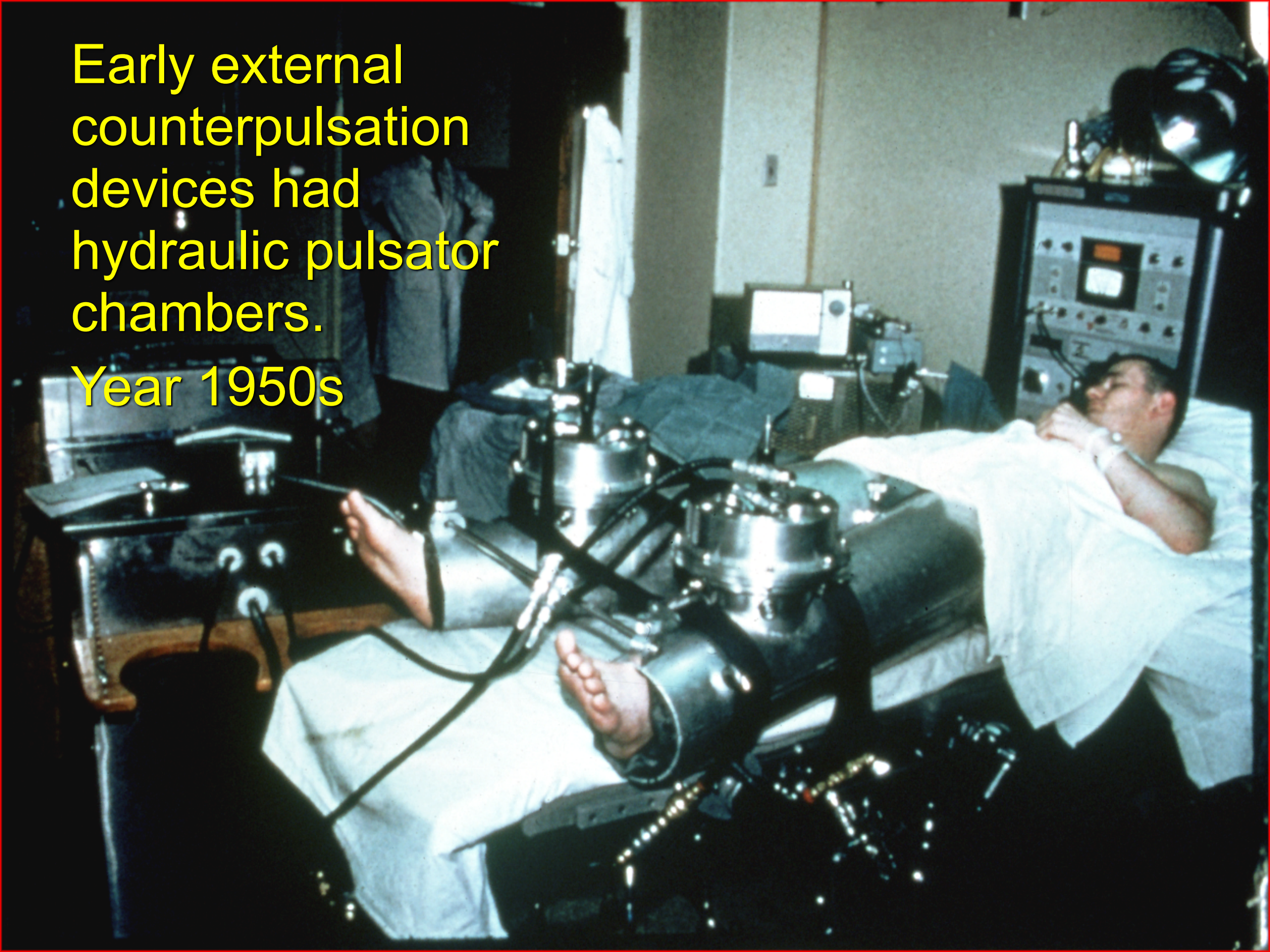
- What is EECP?
- Role of EECP in treatment for cardiac patients
- Role of EECP in treatment of heart failure patients
- Integrate EECP with cardiac rehabilitation program for heart failure patients

WHAT IS EECP?

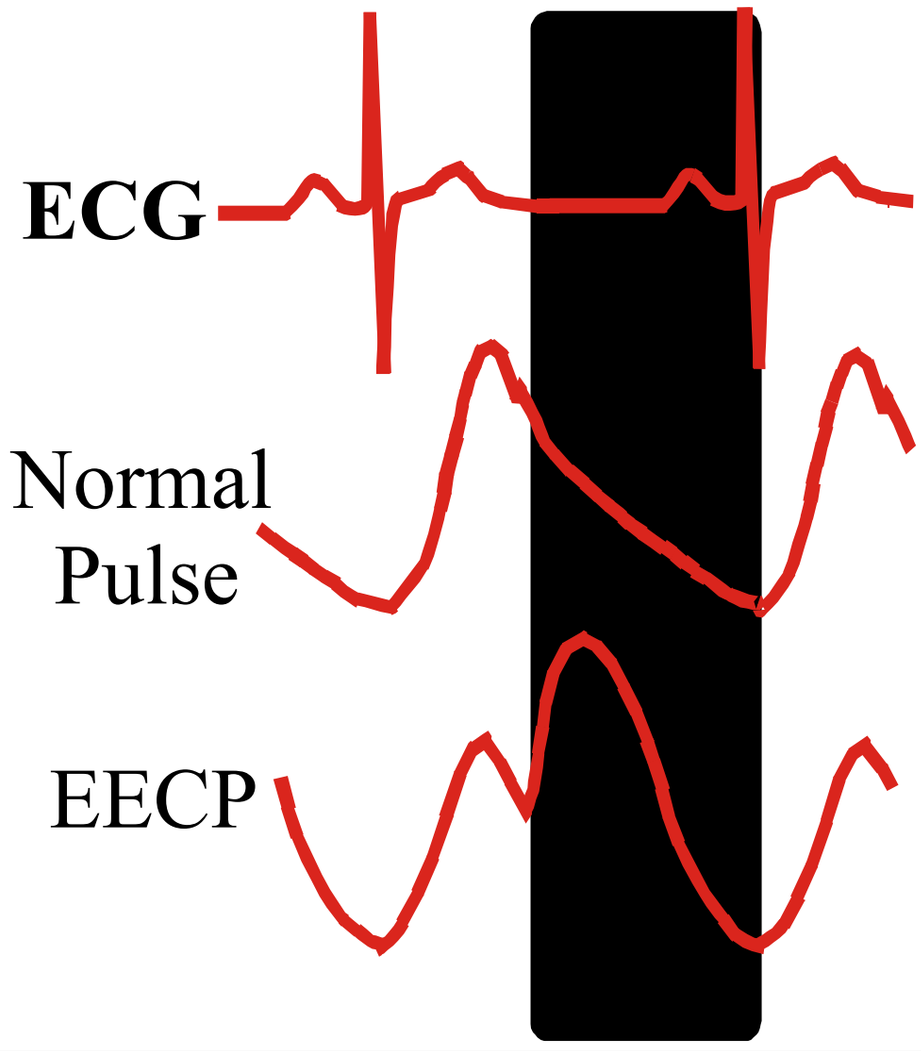
- Enhanced External CounterPulsation
- External CounterPulsation

Early external counterpulsation devices had hydraulic pulsator chambers.

Year 1950s



Diastolic Inflation:



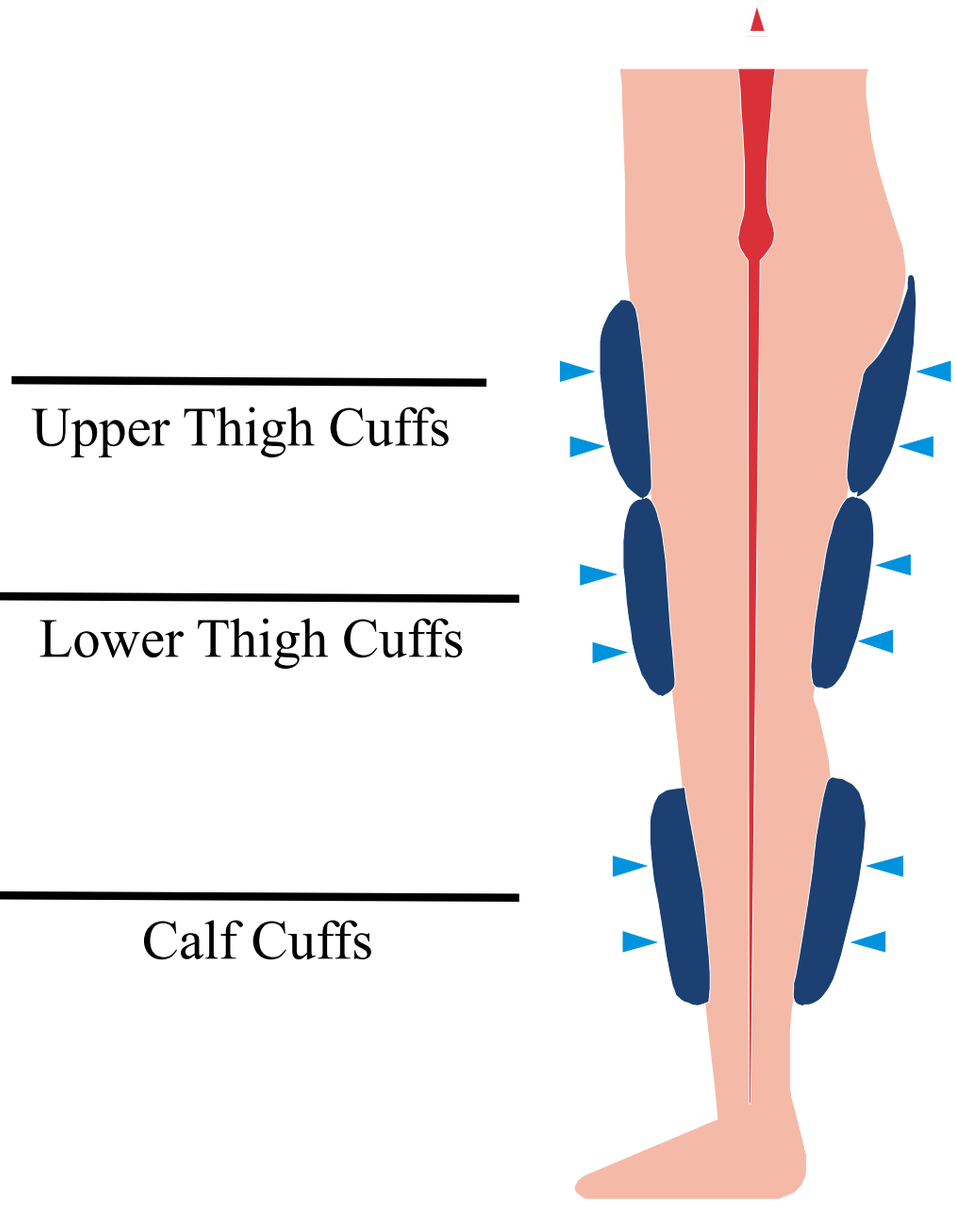
Effects:

Diastolic Augmentation → **Increase Coronary Perfusion**

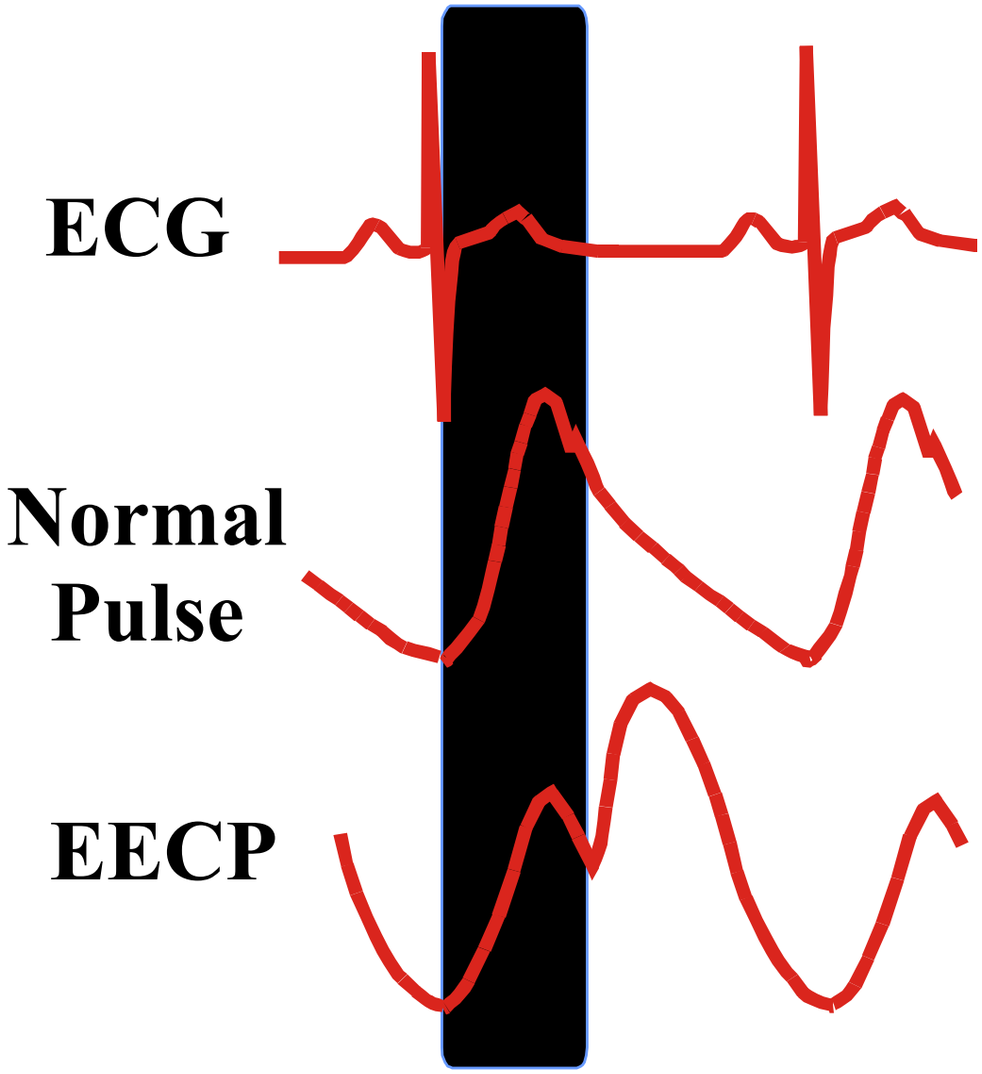
Increase Venous Return → **Increase Cardiac Output**

Diastolic Augmentation

Sequential inflate three Sets of cuffs at the Onset of diastole



Pre-Systolic Deflation:



Effect:

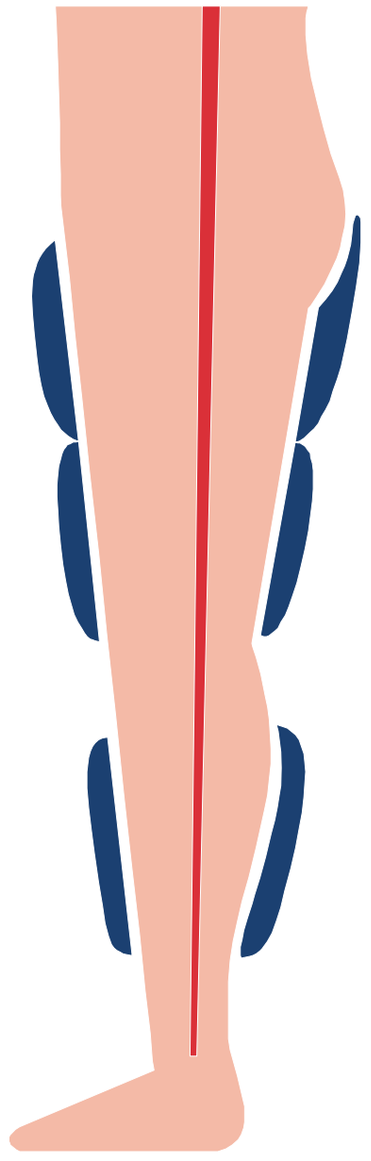
Systolic Unloading

↓

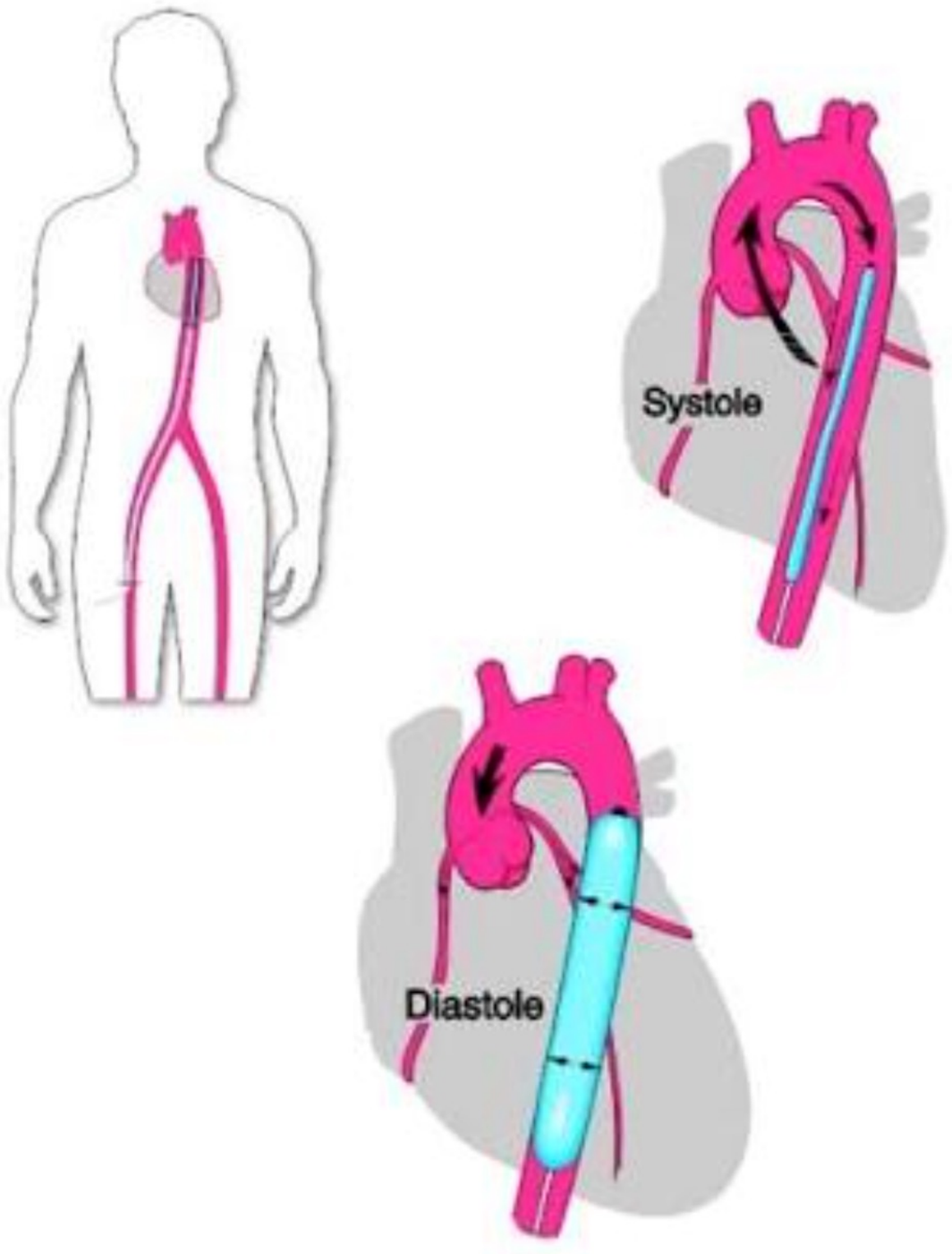
Reduce Cardiac Workload

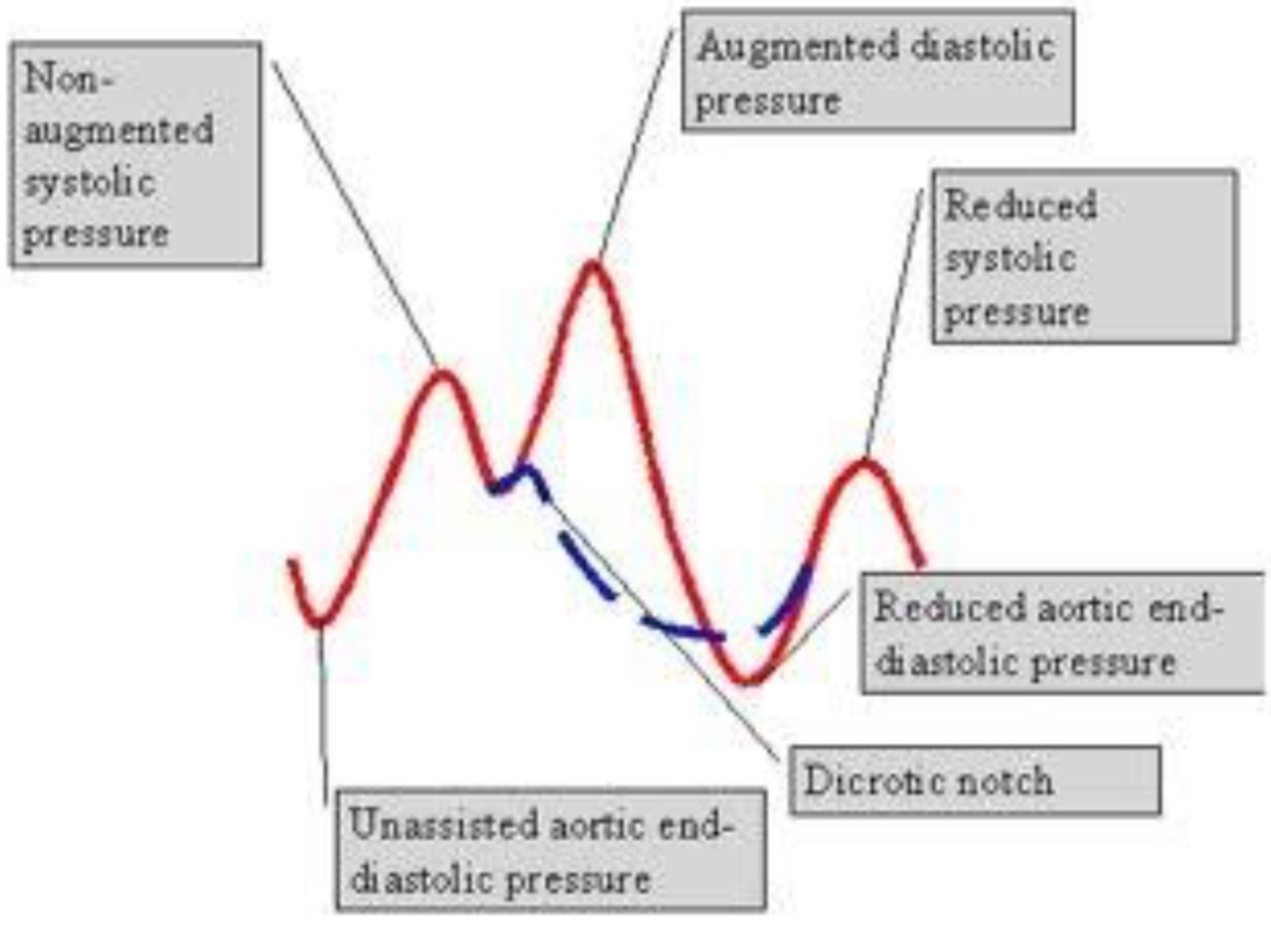
Systolic Unloading

Simultaneously deflate all Three sets of cuffs at the end of diastole

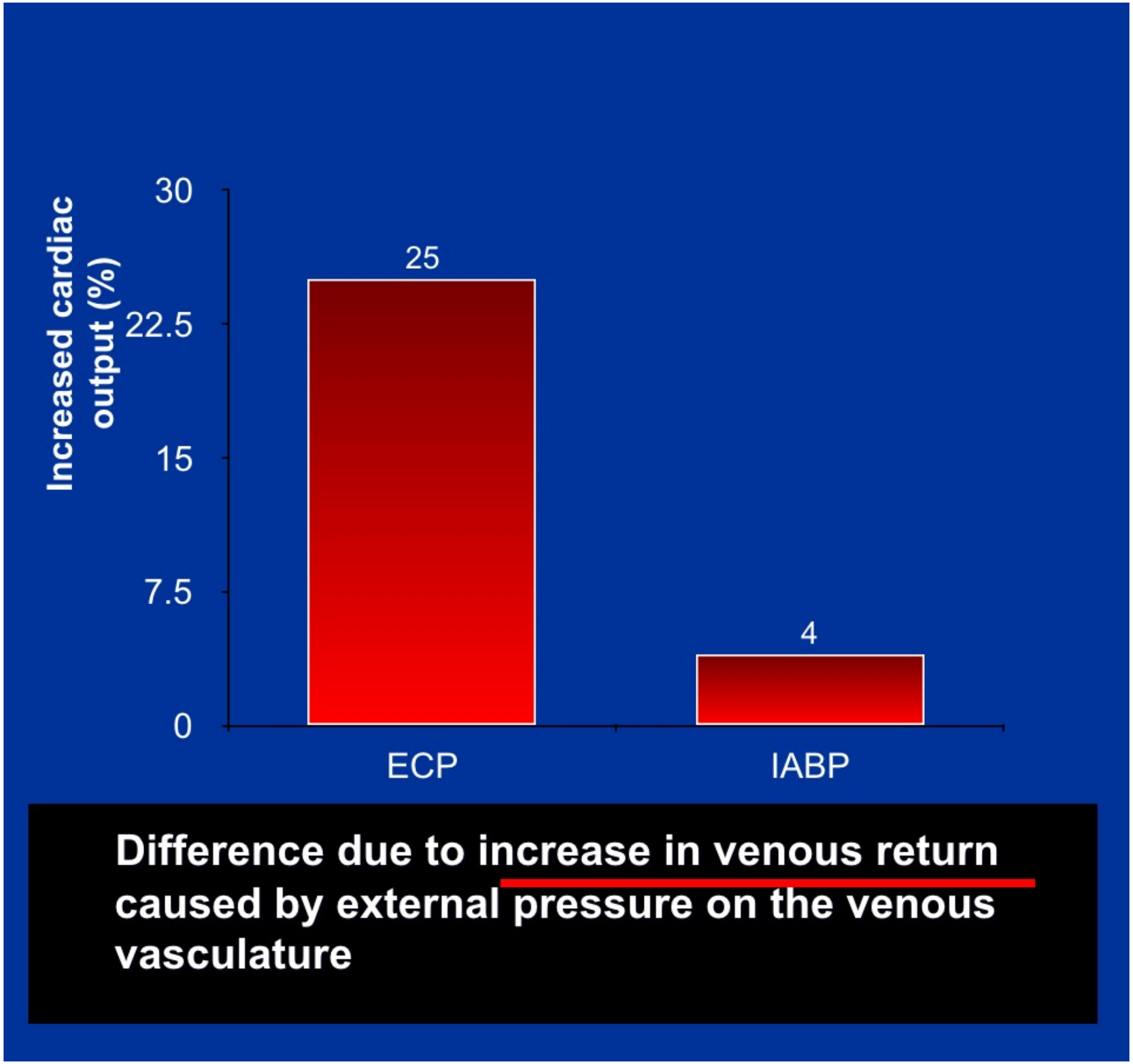


INTRA AORTIC BALLOON PUMP (IABP)





EECP VS INTRA AORTIC BALLON PUMP (IABP)



Journal of the American College of Cardiology Vol. 33, No. 7, 1999

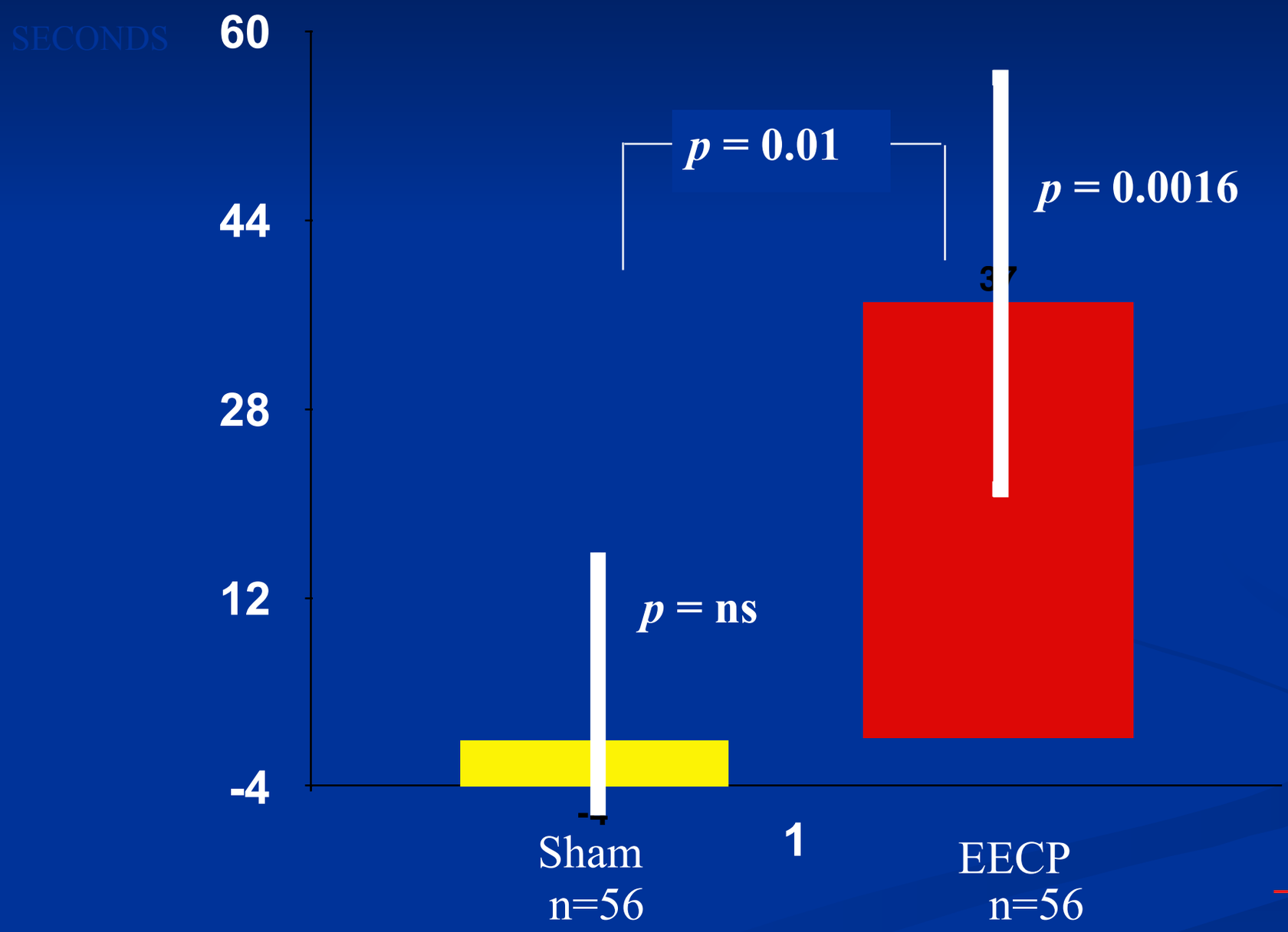
The Multicenter Study of Enhanced External Counterpulsation (MUST-EECP): Effect of EECP on Exercise-Induced Myocardial Ischemia and Anginal Episodes

Prospective, randomized,double blinded, controlled efficacy and safety trial (JACC 1999)

Significantly Improve:

Time to ST-Depression, Angina Count, QOL

MUST-EECP Results:
*Time to Exercise-induced Ischemia



* Adjusted mean of change from baseline

Perfect Heart Institute
at Piyavate

MUST-EECP: Daily Angina Counts

MUST-EECP

Arora RR, et al. *J Am Coll Cardiol* 1999;33:1833-40

LONG TERM EFFECT OF EECP IN TREATING CAD

- RCT: 255 pts (1997-2006)
- Hx of angina with lesion of major coronary > 50% / post-MI / post-PCI
- 125 control: 130 EECP (1 hr/day; 36 sessions)

- **1st MACE: CAD death, MI, stroke**
- **2nd : PCI, bypass, severe cardiac arrhythmias and hospitalization of angina**

- Mean FU 63.8 months

Long Term Effects of EECP

Results (EECP/Control)

	EECP	Control	P Value
1st Outcome (MACE)	7.7%	21.6%	P = 0.02
Non-fatal MI	0.77	6.4	P = 0.02
CVD death	3.07%	9.6%	P = 0.03
2nd Outcome	16.1%	32.8%	P = 0.002

INTERNATIONAL EECP PATIENT REGISTRY
Phase I

92 Centers

- **82 in United States**
- **5 in Europe**
- **5 Other international**

5222 patients enrolled

5718 courses of EECP therapy

Data on File: Department of Epidemiology, Graduate School of Public Health, University of Pittsburgh

Two-Year Clinical Outcomes After Enhanced External Counterpulsation (EECP) Therapy in Patients With Refractory Angina Pectoris and Left Ventricular Dysfunction (Report from the International EECP Patient Registry) (Am J Cardiol 2006;97:17–20

2 years follow up

- 55% of patients still maintain the benefit of less angina
- The 2-year survival rate was 83%, and the major adverse cardiovascular event-free survival rate was 70%.
- 43% had no reported cardiac hospitalization
- 81% had no reported congestive heart failure events

Two-Year Clinical Outcomes After Enhanced External Counterpulsation (EECP) Therapy in Patients With Refractory Angina Pectoris and Left Ventricular Dysfunction (Report from the International EECP Patient Registry) (Am J Cardiol 2006;97:17–20)

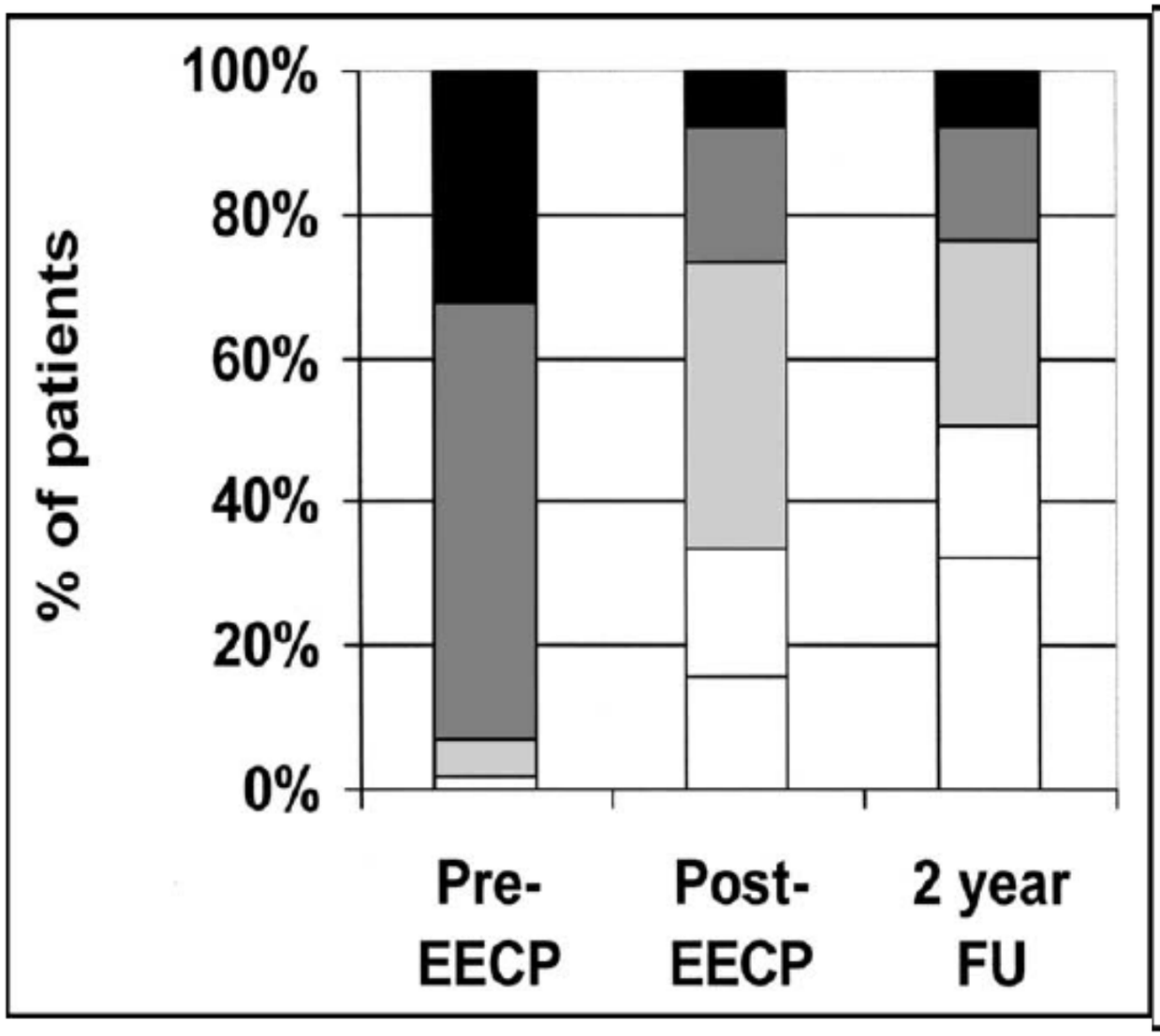


Figure 1. Angina classes 0 *(white bars)*, I *(pale gray bars)*, II *(medium gray bars)*, III *(dark gray bars)*, and IV *(black bars)* before EECP (n = 363), after EECP (n = 358), and at 2-year follow-up (FU; n = 265).

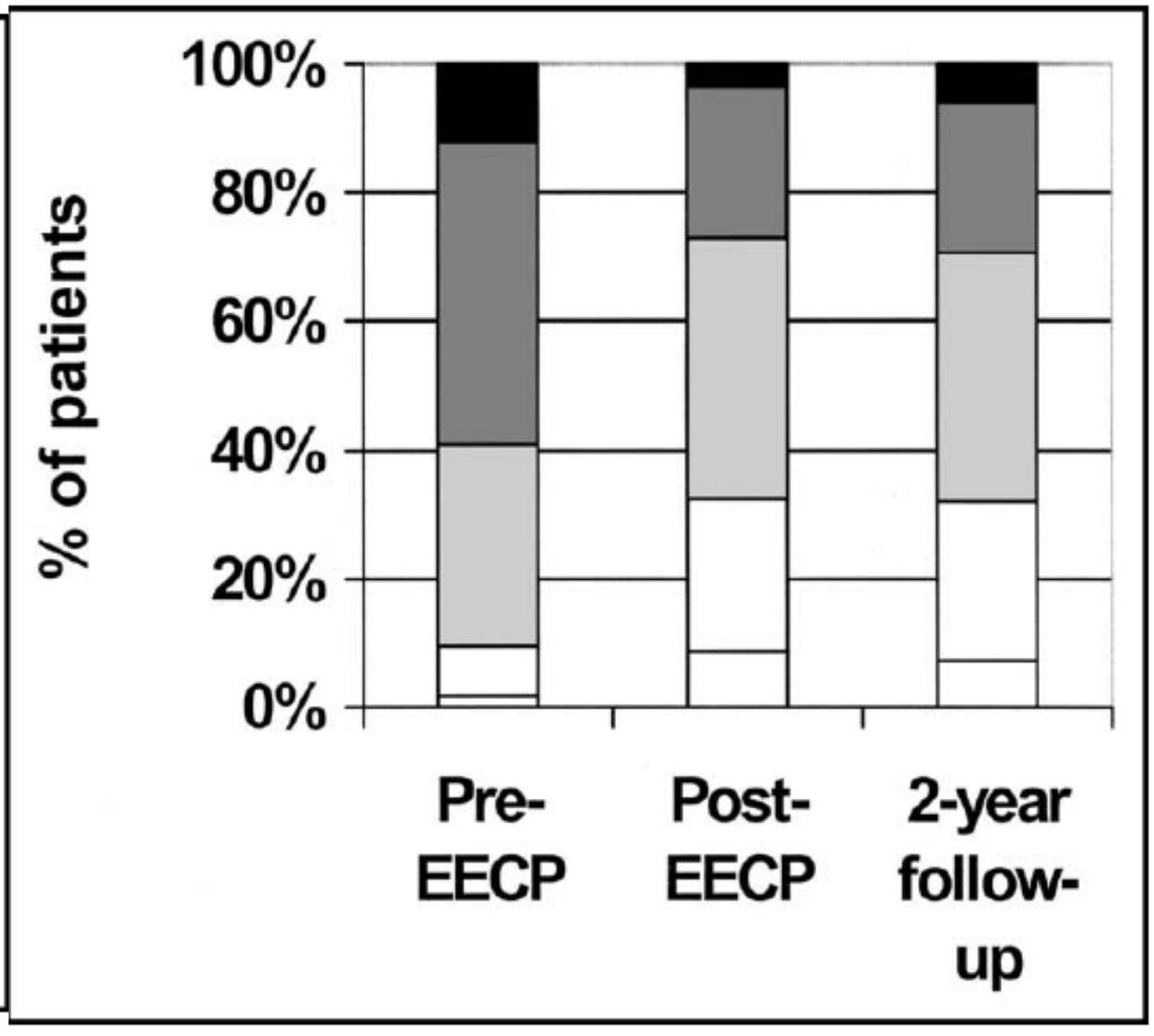


Figure 2. Quality of life rated as poor *(black bars)*, fair *(dark gray bars)*, good *(medium gray bars)*, very good *(pale gray bars)*, and excellent *(white bars)* before and after EECP and at 2-year follow-up.

PEECH TRIAL

- Prospective Evaluation of Enhanced External Counterpulsation in Congestive Heart Failure
- Randomized Controlled Trial

93 EECP & optimal medication

94 optimal medication

- Mean LVEF 26% ; Ischemia 2/3
  - **Ex duration increase > 60 sec (35.4% vs 25.3%) at 6 months (p = 0.016)**
  - **QOL (Minnisota Living with HF Questionaire) at 1 wk, 3 mo significantly improve but not at 6 mo**
- Peak VO2 increase > 1.25 ml/kg/min: non sig. diff

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Evaluation of left ventricular systolic and diastolic regional function after enhanced external counter pulsation therapy using strain rate imaging

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KEYWORDS
EECP;
Tissue Doppler imaging;
Ventricular function;
Coronary artery disease

Aims Enhanced external counter pulsation (EECP) is a non-invasive and non-pharmacological therapy for patients with symptomatic coronary artery disease (CAD). There are, however, insufficient data to support the effectiveness of EECP in improving the myocardial mechanical properties of patients with refractory stable angina. We aimed to assess the effects of EECP on myocardial mechanical properties and cardiac functions in CAD patients not eligible for surgical or percutaneous revascularization procedures.

Methods and results Twenty patients in New York Heart Association (NYHA) functional Class III and IV angina were evaluated. The mean age of the patients was 63 $\pm$ 9 years, and 65% were male. A comprehensive echocardiographic study including an evaluation of the tissue Doppler-based parameters of systolic and diastolic functions was performed before and after the termination of the protocol. EECP was carried out 1 h per day, 5 days per week, for 7 weeks. EECP resulted in a significant increase in peak late diastolic transmitral inflow velocity (0.75 $\pm$ 0.14 vs. 0.83 $\pm$ 0.20 m/s, $P < 0.05$), propagation velocity (42.35 $\pm$ 6.25 vs. 46.00 $\pm$ 5.68 cm/s, $P < 0.05$), peak early diastolic velocity of mitral annulus (5.35 $\pm$ 1.79 vs. 5.95 $\pm$ 1.10 cm/s, $P < 0.05$), peak systolic velocity (2.51 $\pm$ 0.28 vs. 2.67 $\pm$ 0.26, $P < 0.05$), and early diastolic velocity (3.24 $\pm$ 0.18 vs. 3.52 $\pm$ 0.26 cm/s, $P < 0.01$) of all middle segments, peak late diastolic velocity of all basal (4.48 $\pm$ 0.58 vs. 4.75 $\pm$ 0.70 cm/s, $P < 0.05$) and middle segments (2.82 $\pm$ 0.66 vs. 3.25 $\pm$ 0.46 cm/s, $P < 0.01$), peak systolic strain rate of all basal (0.76 $\pm$ 0.07 vs. 0.99 $\pm$ 0.08 1/s, $P = 0.001$) and middle segments (0.75 $\pm$ 0.09 vs. 0.94 $\pm$ 0.09 1/s, $P < 0.001$), peak systolic strain of basal (11.64 $\pm$ 1.51 vs. 13.97 $\pm$ 1.52%, $P < 0.01$) and middle segments (11.81 $\pm$ 1.15 vs.13.73 $\pm$ 1.57%, $P < 0.001$), and left ventricular (LV) ejection fraction (40.25 $\pm$ 12.72 vs. 46.25 $\pm$ 12.97%, $P < 0.001$).There was also a significant decrease in the ratios of transmitral E/A (0.92 $\pm$ 0.41 vs. 1.08 $\pm$ 0.46, $P < 0.05$) and E/Ea (12.61 $\pm$ 4.22 vs. 15.44 $\pm$ 6.96, $P < 0.05$) after EECP therapy. A significant reduction in NYHA angina class ($\geq$ 1 angina class) was seen in the patients, who completed treatment.

Conclusion EECP therapy seemed to improve both regional and global LV systolic and diastolic functions in patients with chronic angina pectoris.

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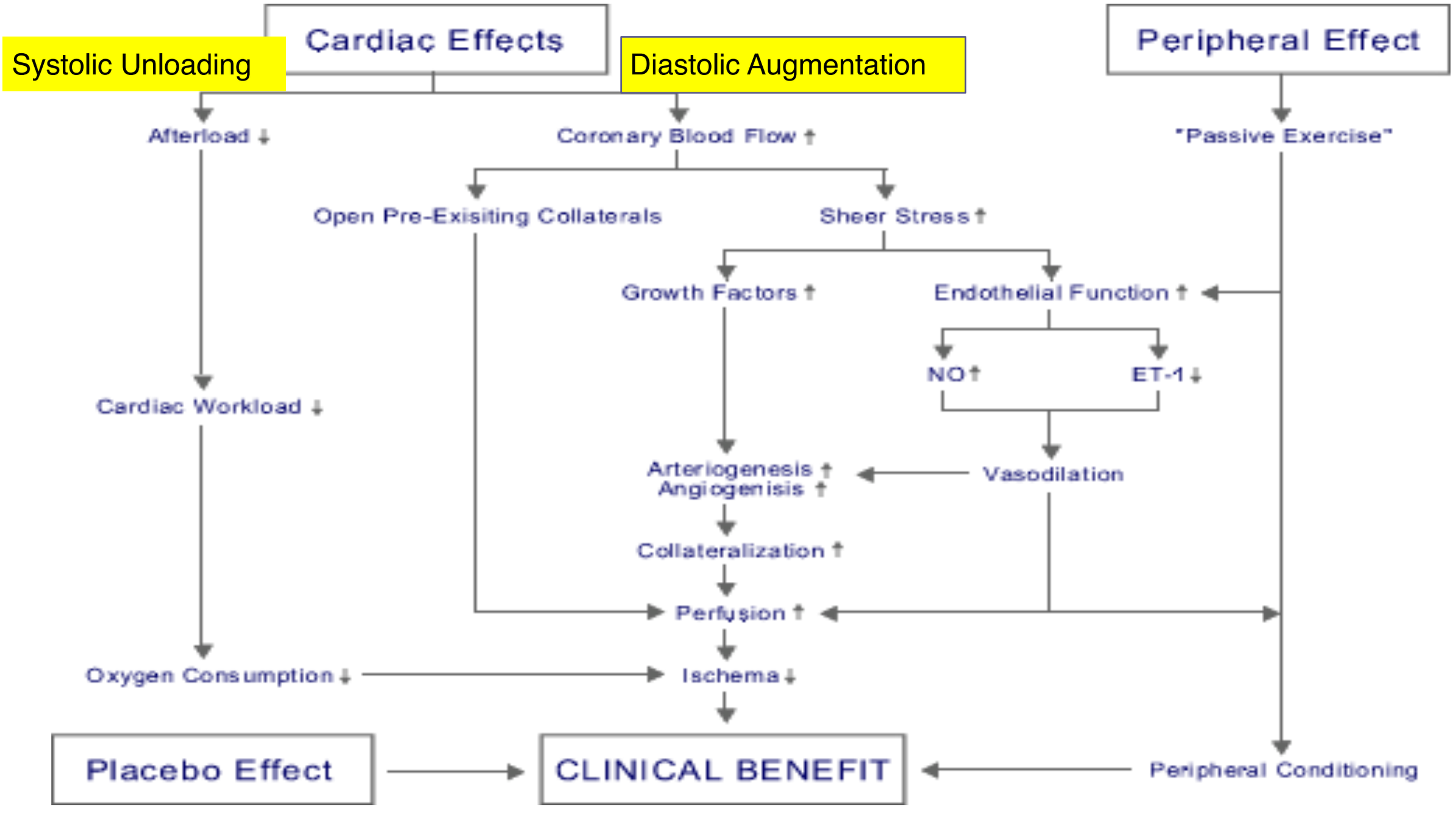
Beneficial effects of EECP



BENEFITS OF EECP

HEMODYNAMIC AFFECTS

DIASTOLIC AUGMENTATION; SYSTOLIC UNLOADING

Clinical effects

- Decrease the use of anti-anginal drug
- Improve functional class & anginal symptoms
- Increase exercise time & time to ST depression
- Improve quality of life
- Improve myocardial perfusion

MECHANISM OF SUSTAIN CLINICAL BENEFIT OF EECP

PHYSIOLOGIC EFFECTS

- Recruitment of coronary collateral vessels
- Angiogenesis
- Improve endothelial function
- Training effect : passive exercise
- Others: yet unknown mechanisms

MECHANISM OF SUSTAIN CLINICAL BENEFIT OF EECP

TRAINING EFFECTS OF EXERCISE

- Increase exercise capacity
- Reduce sympathetic activity
- Improve endothelial function
- Myocardial adaptation
- Peripheral adaptation
- Risk factors modification

TREATMENT REGIMEN

- A total of 35 hours is required
- Regimen:1 or 2 hours daily
- At least 5 days per week for 4 to 7 weeks

CONTRAINDICATION

- **Arrhythmias that interfere with machine triggering**
- **Bleeding diathesis: INR > 2.5**
- **Within 2 weeks after CAG or arterial puncture**
- **Decompensated Heart Failure**
- **Venous disease (phlebitis, varicose veins, stasis ulcers, prior or current DVT or PE**

CONTRAINDICATION

- **BP > 180/110 mmHg**
- **Severe PAD (increase risk of thromboembolism, reduced vascular volume and muscle mass may prevent effectiveness)**
- **Aortic aneurysm requiring surgical repair or dissection**
- **Moderate or severe Aortic Insufficiency**
- **Severe COPD (no safety data in Pulmonary Hypertension)**
- **Pregnancy**

CASE STUDY

- Male 52 years old; Heart Failure
- Ischemic Cardiomyopathy
- Coronary Angiogram: severe stenosis of LAD, LCx, RCA
- LV gram: Estimated EF 25%, hypokinesia of posterobasal, anyrrobasal, anteroapical, Akinesia of inferior LV, Aneurysm at apical LV
- Denied invasive procedure
- Functional class III, s3 gallop, pitting edema both leg
- Medication: diuretic, antiplatelet, angiotensin II antagonist, digoxin,

RESULT PRE & POST EECP 35 SESSIONS

	Pre EECP	Post EECP
6 MWT test	422M	429M
NT-pro BNP	8,330	4,360
Symptoms	FC III	FC II

EXERCISE STRESS ECHO (AUGUST 2016)

- LVEF 26%
- Bruce exercise program stage IV
- Exercise 9.30 minute, 10.9 METs, max
- Positive exercise stress echo

What's the future of EECP treatment for CHD patients?

Currently

Medication+RF

↓

PCI, CABG

↓

EECP/Other

1st Next Step?

Medication+RF

↙ EECP

↘ PCI, CABG

2nd Next Step

Medication+RF

↓

EECP

↓

PCI,CABG

Eventually?

Medication+RF and EECP as 1st Prevention

↓

PCI/CABG