Enhanced External Counterpulsation for Treatment of Coronary Microvascular Dysfunction

The Christ Hospital Health Network
Women's Heart Center

Miyoki Kawamoto, BS, Sophia Villa, BS, Jessie Fox, PharmD, Namrita D. Ashokprabhu, BS, Danielle Tapp, PhD, Christian Schmidt, MS, Odayme Quesada, MD

Background

- Coronary microvascular dysfunction (CMD) is an increasingly recognized mechanism in several cardiovascular diseases including angina with non-obstructive coronary arteries (ANOCA) and heart failure.
- CMD is associated with symptoms that impair functional capacity and quality of life and increased risk of major adverse cardiovascular events (MACE).
- Coronary functional angiography (CFA) is the gold standard for diagnosis of CMD and differentiates between endothelial-independent and -dependent mechanisms.
- EECP is a non-invasive treatment that involves applying external inflatable cuffs to the lower extremities to increase blood flow during diastole (diastolic augmentation and increased preload), followed by deflation during systole (decreased afterload).

Methods

- A retrospective registry-based cohort study of patients having undergone CFA who had any abnormal finding and completed EECP treatment.
- CFA was performed using the Doppler-tipped guidewire method or pressure guidewire with a temperature sensor (Thermodilution method).

Abnormal CFA findings include:

- Endothelial-independent CMD (Coronary Flow Reserve (CFR) < 2.5 in response to intracoronary adenosine).
- Endothelial-dependent CMD (coronary blood flow (CBF) < 50% or no change in vessel diameter in response to 54mcg intracoronary acetylcholine).
- Microvascular (<90% constriction) or epicardial (>90% constriction) spasm in response to 108 mcg intracoronary acetylcholine.

EECP Treatment

- One hour per day, five days per week, for seven weeks, with patients undergoing thirty-five sessions during a typical course.

Statistical Analyses

- CCS angina class, 6MWT, and SAQ were evaluated pre- and post- EECP treatment. A paired Student's t-test and Wilcoxon signed-rank test were utilized as appropriate.

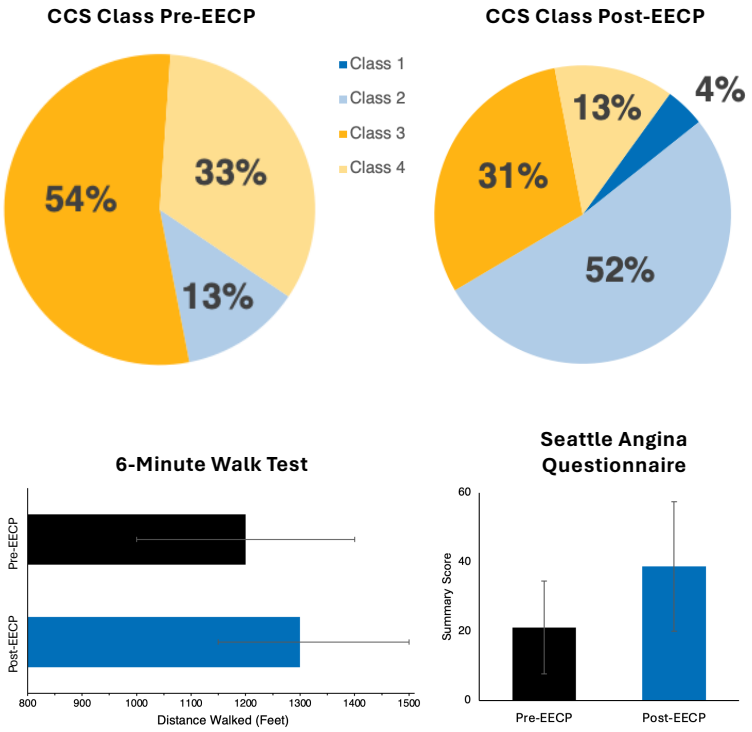
What is Known

EECP has demonstrated improvements in CFR and symptoms of microvascular angina in patients diagnosed with CMD by noninvasive modalities

What is New

Our objective is to assess the efficacy of EECP treatment in a cohort of patients having any confirmed Coronary Functional Angiography abnormality

Results



Results Cont'

- 30 patients were included in the analyses
- 77% female; 57.8±11.9 years
- Breakdown of abnormal CFA findings included:
  - 75% with endothelial-independent CMD (median CFR 2.0)
  - 64% with endothelial-dependent CMD
  - 43% with spasm
- CCS class improved from a median of 3 to 2 post-EECP (p<0.001)
- Post-EECP, patients gained a median of 100 feet on 6MWT (p=0.001)
- Post-EECP, average improvement in SAQ score was 17.6 points (p<0.001)

Demographics	Value
Sex, n (% female)	23 (77)
Age (mean, SD)	57.8 ± 11.9
BMI (mean, SD)	31.3 ± 6.9
Number of EECP Treatments (mean, SD)	35.0 ± 2.4
Diagnosis to EECP (days) (mean, SD)	287 ± 216
Endothelial independent CMD, n (%)	21 (75)
Endothelial dependent CMD, n (%)	18 (64)
*Mixed Disease, n (%)	19 (63)
CFR, median (IQR)	2.0 (1.6, 2.4)
Epicardial Spasm, n (%)	13 (43)
Epicardial Spasm Alone, n (%)	5 (17)

*Mixed Disease (Endothelial-independent CMD + [Endothelial-dependent CMD, microvascular spasm, or epicardial spasm])

Past Medical History	N, (%)
CAD, n (%)	6 (20)
INOCA, n (%)	5 (16)
ANOCA, n (%)	21 (66)
Hypertension, n (%)	22 (69)
Dyslipidemia, n (%)	29 (91)
Diabetes, n (%)	5 (16)
HFrEF, n (%)	2 (6)
HFpEF, n (%)	9 (28)

Outcome	Pre-EECP	Post-EECP	p-value
CCS Class, median (IQR)	3 (3,4)	2 (2,3)	<0.001
6MWT, median (IQR)	1200 (1000, 1400)	1300 (1150, 1500)	0.001
SAQ, (mean, SD)	21.1 ± 13.3	38.7 ± 19.2	<0.001

BMI: Body Mass Index; CAD: Coronary Artery Disease; INOCA: Ischemia with No Obstructive Coronary Arteries; ANOCA: Angina with No Obstructive Coronary Arteries; HFrEF: Heart Failure with Reduced Ejection Fraction; HFpEF: Heart Failure with Preserved Ejection Fraction; CCS: Canadian Cardiovascular Society; 6MWT: 6-Minute Walk Test; SAQ: Seattle Angina Questionnaire

Conclusions

In patients with CMD, EECP therapy reduces symptom burden and improves exercise tolerance and quality of life. EECP should be considered as a management option in patients with CMD.