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The Impact Of EECP On Improving Exercise Capacity In Patients With Stable Ischemic Heart Disease Who Treated Medically Or Percutaneously Over One Year

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ABSTRACT

Objective: Enhanced External Counterpulsation (EECP) is a non-invasive therapy involving sequential inflation of external cuffs placed on the lower limbs in sync with the cardiac cycle. This method is primarily used to treat refractory angina (persistent for at least three months) in patients who do not respond to medical therapy, surgical intervention, or percutaneous coronary procedures.

Methods: A total of 91 patients with refractory angina who were either unresponsive to medical therapy, ineligible for surgical intervention, or had undergone PCI without symptom relief were enrolled in the study. Patients were selected from the Al-Najaf Cardiac Center and private clinics between January 2018 and December 2019. All participants underwent coronary angiography, and those with significant three-vessel disease (>70% stenosis in each vessel) were included.

Results: Over 12 months, 91 patients (32 women and 59 men) aged 45 to 80 years (mean 61 ± 8.2) were analyzed. Most patients completed an average of 26 EECP sessions (SD ± 7), with a response rate of 88.7%, as measured by symptom improvement based on Canadian Cardiovascular Society (CCS) classification. No significant difference in response to EECP was observed between the PCI group and those treated with medical therapy alone ($p = 0.87$, $p = 0.47$). Additionally, sex ($p = 0.185$), smoking history ($p = 0.67$), hypertension ($p = 0.4$), diabetes ($p = 0.12$), and age ($p = 0.26$) did not significantly impact the response to EECP.

Conclusion: EECP proved to be a safe and effective treatment for select patients with refractory angina who were unresponsive to conventional medical or surgical interventions.

Keywords: *Lipid nanoparticles, curcumin, antifungal therapy, targeted drug delivery, fungal infections, nanotechnology.*

1. INTRODUCTION

Refractory angina is defined as chronic stable ischemic heart disease lasting three months or more, unmanageable through medical therapy, surgical intervention, or PCI. EECP, a non-invasive technique, involves placing compressive cuffs on the lower limbs that inflate sequentially from distal to proximal during the cardiac cycle, mimicking the effects of an intra-aortic balloon pump. This therapy enhances venous return, improves coronary perfusion, and reduces vascular resistance, thereby alleviating cardiac workload and increasing systemic circulation.

EECP has been shown to improve endothelial function, reduce vascular stiffness, and enhance collateral blood flow. The International EECP Patient Registry has reported long-term benefits in heart failure patients, including decreased angin

symptoms, reduced nitroglycerin dependence, and improved quality of life. These benefits have been sustained for up to three years post-treatment.

While EECP has demonstrated efficacy in managing stable angina, its application is restricted by contraindications, including coagulation disorders (INR >2.5), severe COPD, cardiac arrhythmias, and significant peripheral vascular disease. Additionally, studies suggest that EECP reduces hospitalization costs, making it a viable option for future widespread adoption.

Study Objectives: To evaluate the efficacy of EECP in treating refractory angina in patients undergoing PCI versus those managed medically, with a focus on short-term outcomes.

Methods: A total of 518 patients with refractory angina who were unresponsive to medical therapy or ineligible for surgical intervention were initially considered. All underwent coronary angiography, and those with significant three-vessel disease were divided into two groups:

1. Patients deemed unfit for intervention or surgery.
2. Patients eligible for PCI on one or two vessels but experiencing persistent ischemic symptoms post-PCI.

After six weeks, only those with ongoing symptoms were included in the study, resulting in 91 enrolled patients (48 in the medical group and 43 in the PCI group). All were referred for EECP treatment eight weeks post-angiography.

Patients were treated according to standard guidelines, with comprehensive baseline data collected, including age, sex, blood pressure, glucose levels, renal function, and CBC results. Inclusion criteria required symptomatic angina despite medical therapy or intervention. Exclusion criteria included severe peripheral vascular disease, aortic aneurysm, severe aortic regurgitation, uncontrolled hypertension, and coagulopathies.

Each EECP session lasted one hour, with most patients completing 30 sessions. Treatment response was assessed using CCS grading before and after EECP, along with echocardiographic evaluations at six months and one year.

2. RESULTS

Of the 91 patients, 59 were men and 32 were women. Most completed an average of 26 EECP sessions. After treatment, 88.7% showed symptomatic improvement.

No significant difference was observed between the PCI and non-PCI groups in response to EECP ($p = 0.87$) or echocardiographic parameters ($p = 0.47$). Similarly, age ($p = 0.26$), sex ($p = 0.185$), smoking status ($p = 0.67$), hypertension ($p = 0.4$), and diabetes ($p = 0.12$) did not significantly impact EECP outcomes.

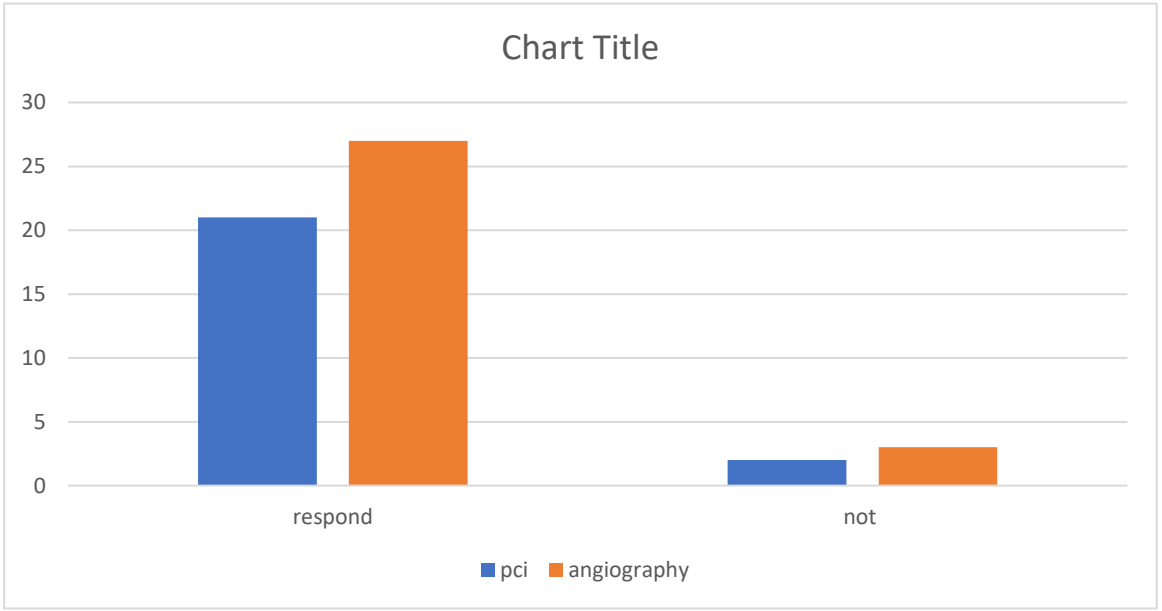

Figure 1: Relation of PCI group and angiography only group in response to EECP,

P-value = 0. 87**.**

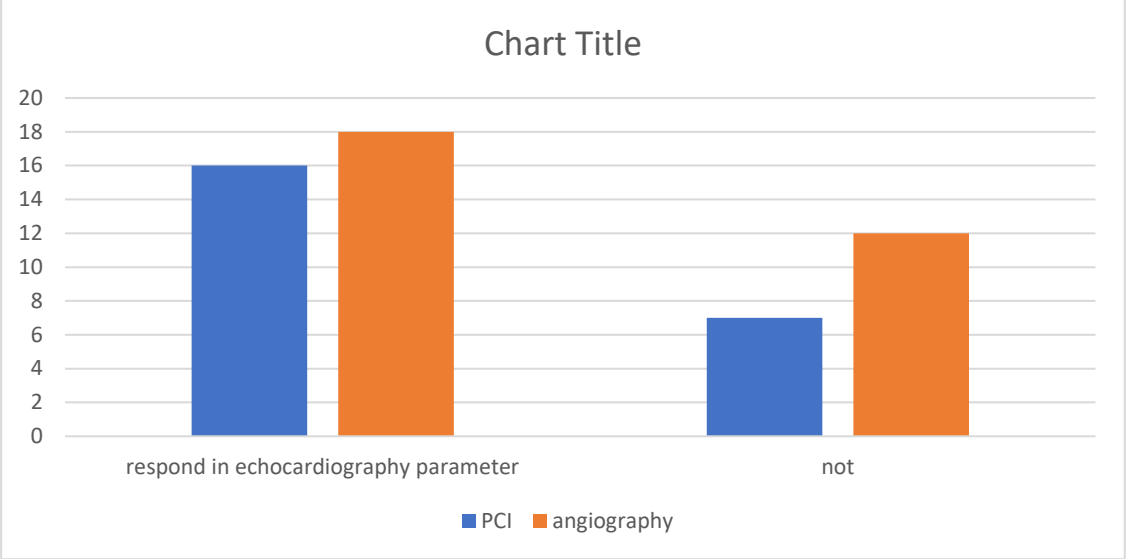

Figure 2: Relation of PCI group and angiography only group in response to echocardiography parameter, P-value = 0.4.

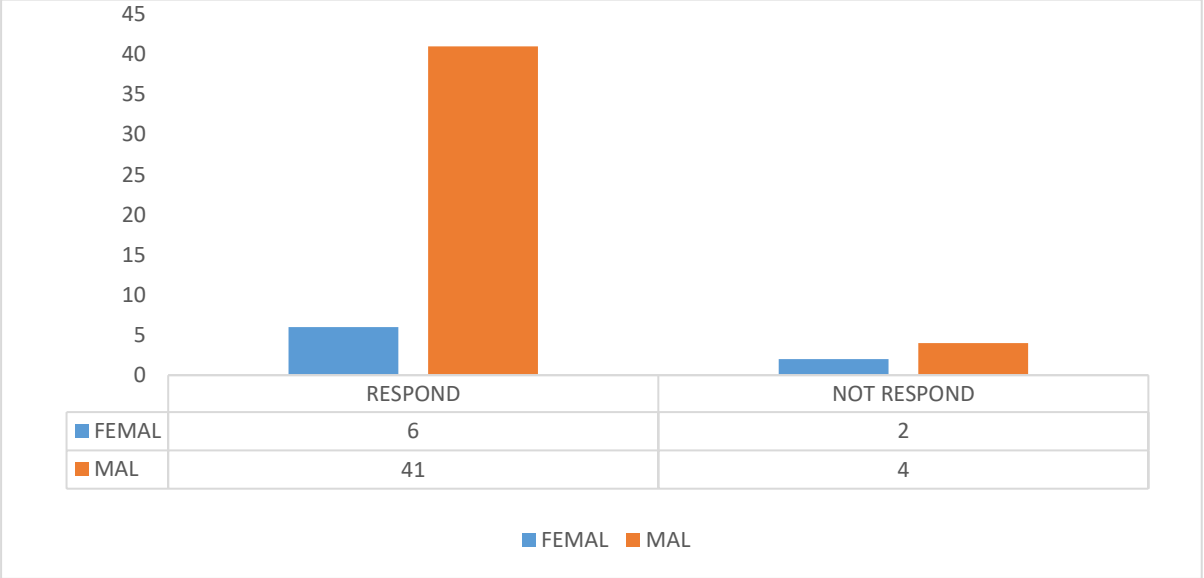

Figure 3: Sex and response to EECP, P-value = 0.185.

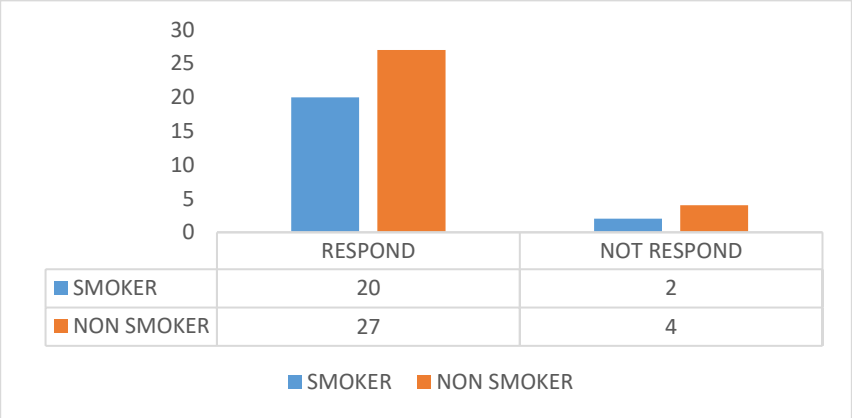

Figure 4: Smoker response to EECP, P-value = 0.67.

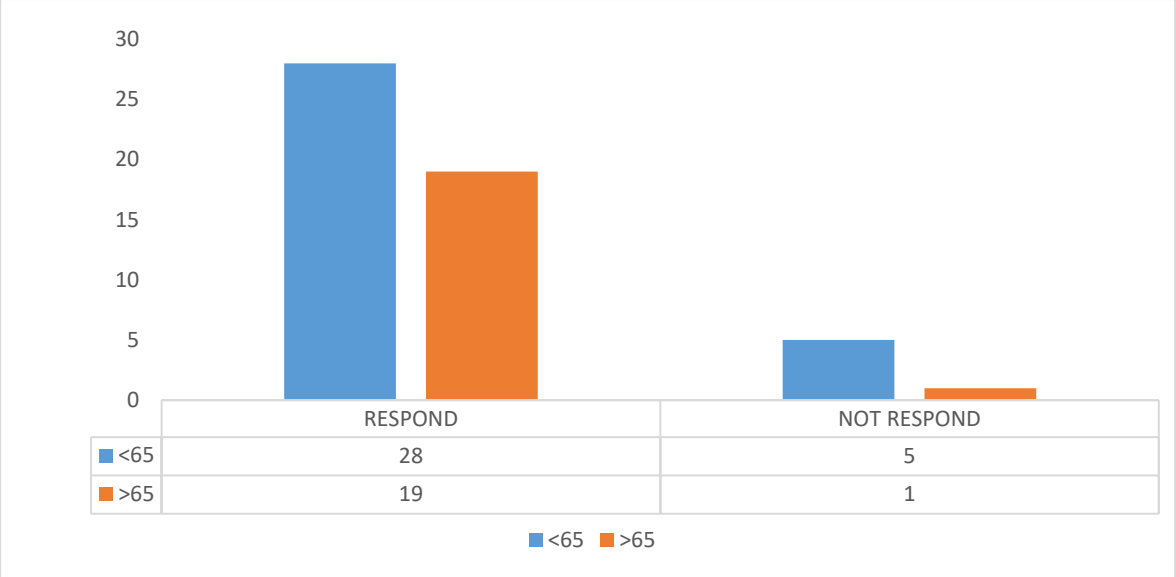

Figure 5: Age and response to EECP, P-value < 0.26.

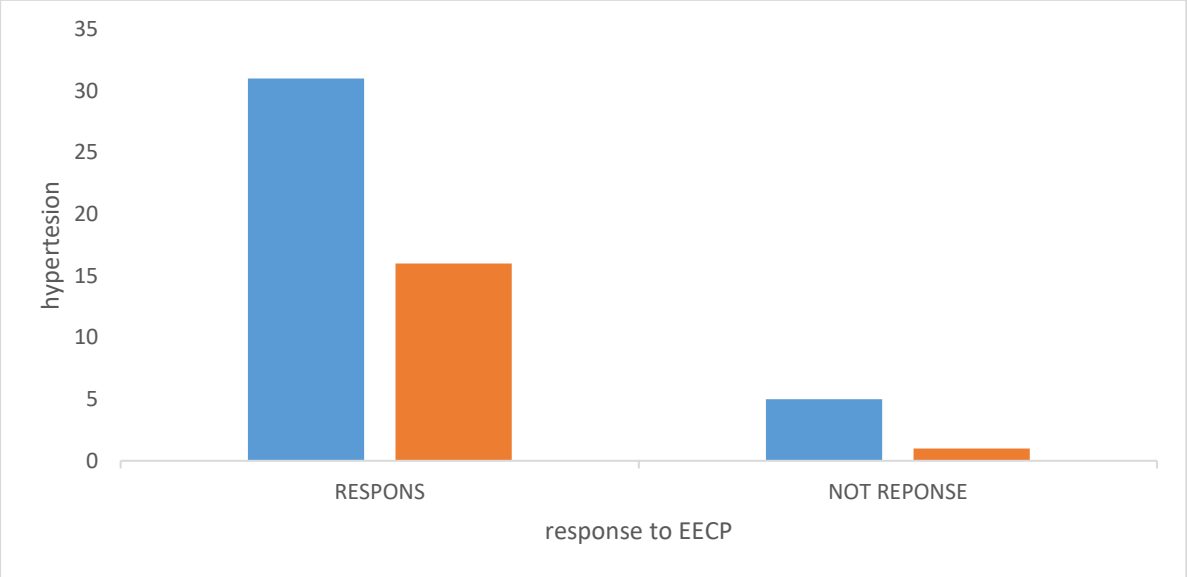

Figure 6: Hypertension and response to EECP, P-value < 0.4

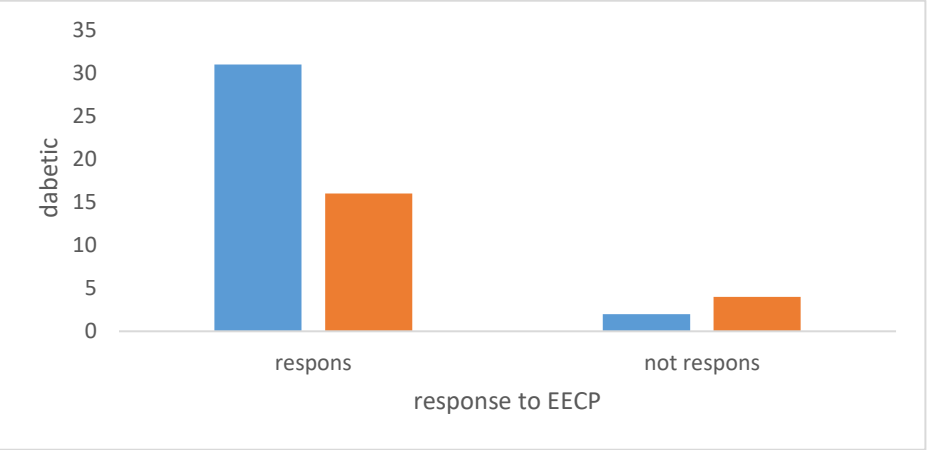

Figure 7: Diabetic and response to EECP, P-value < 0.12.

3. DISCUSSION

Most study participants had diffuse coronary artery disease confirmed via angiography. Some underwent PCI, while others were ineligible for the procedure. Given their persistent symptoms, they were referred for EECP therapy, which resulted in significant symptomatic relief, particularly in those classified as CCS3 and CCS4.

After completing EECP sessions, most patients improved to CCS1 or CCS2, with sustained benefits observed at one-year follow-up, consistent with previous studies. The improvements noted may not solely result from increased myocardial perfusion but also from secondary effects similar to those seen in physical rehabilitation.

Long-term benefits of EECP include enhanced endothelial function, angiogenesis, neurohormonal modulation, and exercise training effects. The International EECP Patient Registry has reported sustained symptom relief for up to five years post-treatment.

This study found no added benefit of PCI for three-vessel disease patients in terms of EECP response or echocardiographic improvement. Furthermore, both diabetic and non-diabetic patients exhibited significant symptomatic relief and improved quality of life post-EECP.

Conclusion:

1. PCI for single-vessel disease in three-vessel patients does not improve EECP response or echocardiographic outcomes.
2. EECP is a safe and effective treatment for select patients with refractory angina unresponsive to medical therapy or ineligible for intervention.
3. EECP provides long-lasting symptomatic relief, with benefits persisting for at least one year.

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