ORIGINAL ARTICLE

Significant Improvement in Functional Status and Quality of Life in Heart Failure Patients who Received EECP

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ABSTRACT

Purpose: EECP therapy has been studied in refractory ischemic cardiomyopathy and heart failure patients with good results in the past. However, the mechanism and potential indications remain unexplored.

Methods: We did a retrospective analysis of defined end points in 60 heart failure patients who received EECP therapy at our center. Commonest indication of EECP therapy was significant diffuse coronary artery disease in patients who were not candidates for any revascularization therapy (95%) and continued to have symptoms despite maximal tolerated medical therapy. Majority of the patients were NYHA class III with mean age 64 years. The EECP therapy included daily sessions of 1-hour duration for 35 days. The Canadian Cardiovascular Society (CCS) angina class and the Medical Research Council (MRC) breathlessness scale were used to study improvement in symptoms. Quality of life indicators were (a) reduction in symptoms (b) improvement in activity (c) improvement in psychological parameters. The objective parameters studied were ejection fraction and 6-minute walk distance.

Results: There was a significant improvement in all study parameters after EECP therapy (Table 1).

Conclusions: EECP therapy is an excellent treatment option for heart failure patients who are at the end of the road in terms of medical and interventional therapies. Our hypothesis is that EECP therapy works not only through a mechanism of improved collateral circulation but also improves endothelial function with potential benefit in all vascular pathologies. Large randomized trials to validate the hypothesis are proposed. (J Clin Prev Cardiol 2013;2(1):8-16)

Introduction

There are several patients with ischemic heart disease who have received revascularization therapy in the past and/or are not candidates for any future coronary revascularization therapy. Viability studies in many of these patients reveal that a certain percentage of myocardium is hibernating and can theoretically be salvaged by restoring perfusion (1–15). Many of these patients continue to complain of angina-related symptoms. We have coined the term "No-option patients with coronary artery disease (CAD)" to identify this subgroup of patients.

Treatment options for these patients remain limited to a few anti-anginal agents along with standard medical management (16–18). Persistent angina or shortness of breath with poor quality of life and repeated hospitalizations are major problems that these patients face.

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EECP (enhanced external counter pulsation) is a technique that increases retrograde aortic blood flow during diastole (diastolic augmentation).This noninvasive compression device therapy involves application of sequential compression (300 mmHg) over legs and abdomen to direct blood flow toward the heart during diastolic phase of every heart beat.

The study was designed to assess improvement in functional capacity and quality of life in no-option patients with CAD on stable medical regimen who underwent EECP therapy.

Our hypothesis is that EECP therapy improves the functional capacity and quality of life in the no-option CAD patients by enhancing the blood supply into the coronaries against the closed aortic valve during diastole and improved microvascular circulation and collateralization in the heart.

Methods

Study design

We conducted a prospective nonrandomized single-center study at Medanta - The Medicity, a tertiary care center in the National Capital Region (NCR) in northern

India between 2011 and 2012.The data collection was performed using predefined case report forms by the EECP technician before and after completion of EECP. The data was reviewed and analyzed by an independent reviewer.

The authors reviewed the data, participated in the analyses and wrote the manuscript, and assume responsibility for the completeness and accuracy of the data and the analyses.

Study patients

Stage C and D heart failure patients with persistent symptoms who were prescribed EECP therapy were enrolled into the study. Majority of the patients had end-stage CAD as the reason of heart failure. Majority of the patients were NYHA class II and III (Fig. 1). Seventy percent of the patients were in the age group of 50–75 with mean age 63. Majority (93%) were males.

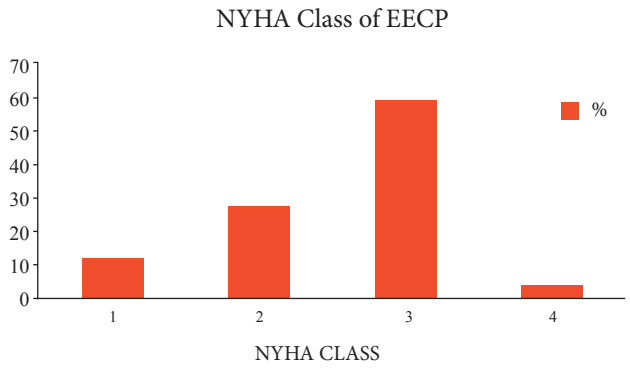

Figure 1. Distribution of patients based on NYHA classification at the beginning of EECP therapy.

Majority of the patients had CAD (98%) with a hisorty of myocardial infarction in 45% and history of revascularization in 70%. Of these patients, 67%were hypertensive; 63% were diabetics and 20% were ative or past smokers (Fig. 2).

The selection criteria for EECP therapy was no-option patients with CAD, i.e., patients with significant CAD who were not able candidates for any revascularization therapy due to diffuse CAD or high preoperative risk (95%) and continued to have symptoms despite maximal tolerated medical therapy. Of these, there was history of recent episode of acute coronory syndrome in 58% patients. A small minority of patients had nonischemic cardiomyopathy with symptomatic left ventricular dysfunction (5%).

Enrollment criteria for EECP were extended to include patients that received EECP as a transition for planned revascularization (CABG/PCI) and patients that received 10–15 cycles of EECP as a reinforcement therapy after having completed 35 hours of EECP with good results previously.

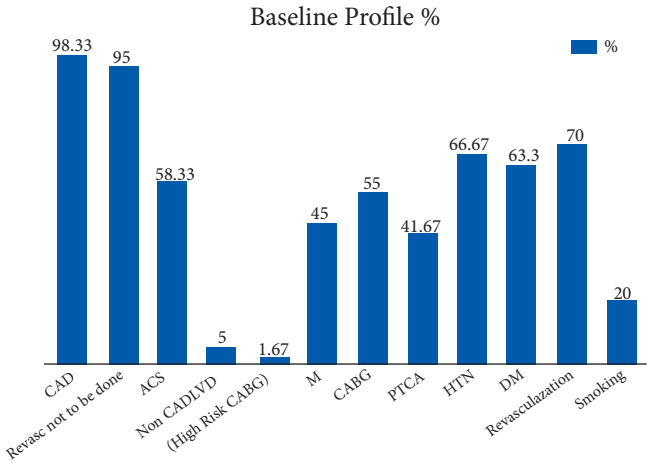

Figure 2. Baseline profile of patients enrolled for EECP therapy.

Study procedures

The prescribed therapy included daily therapy of 1-hour duration for 35 days *or* daily total therapy of 2-hour duration (with a gap of a few hours between each 1 hour therapy) for 17 days. Sixty patients completed the EECP therapy of 35 cycles.

The baseline profile of all patients was studied. An objective and subjective assessment of these patients was performed before starting EECP therapy. Their medications at the beginning of this treatment were reviewed to ensure that there was an adequate period of stable standard medical management for these patients before they were selected for EECP with no significant changes made during the therapy (Fig. 3). The objective and subjective assessment of these patients was performed again after completion of EECP therapy. Statistical analysis was performed to study improvement in these parameters after EECP therapy.

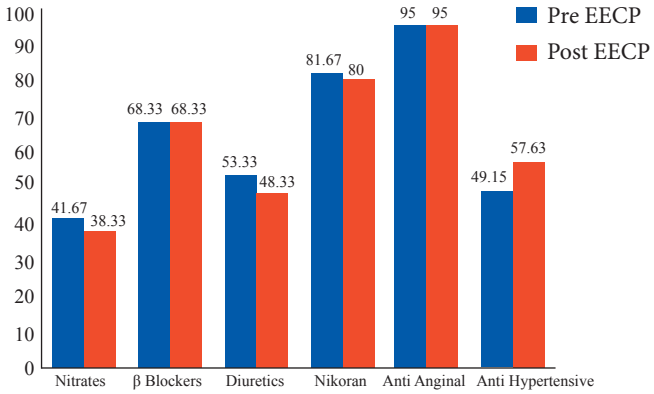

Figure 3. A comparison of medical therapy before and after EECP therapy.

Study outcomes

The Canadian Cardiovascular Society (CCS) angina class (19) and the Medical Research Council (MRC) breathlessness scale (20) were used to study improvement in patient symptoms after EECP therapy.

Three types of quality-of-life indicators were used to study improvement with EECP therapy – (a) reduction in symptoms; (b) improvement in activity; (c) improvement in psychological parameters.

The quality of life parameters used to assess patient's physical limitations include breathlessness, fatigue, chest discomfort and palpitations. Patients were asked about their perception of the extent to which these symptoms affect their activities of daily living plus social and recreational activities. Before and after EECP therapy, they were asked to quantify these symptoms on a scale of 1–10.

Activity scores on a scale of 1–10 were filled out based on patient's ability to walk and climb stairs before and after the treatment.

The psychological parameters (sleep, concentration and memory) were similarly quantified on a scale of 1–10 and compared before and after EECP therapy.

The objective parameters that were studied included ejection fraction (EF), systolic blood pressure, diastolic blood pressure and 6-minute walk distance (21–26).

Results

The treatment was well tolerated by most patients without limiting side-effects.

The CCS angina class improved significantly after completing EECP therapy (Fig. 4). Ninety percent of the patients showed reduced symptoms and improvement in angina class out of which 30% improved by 2 functional class and 31% improved by 3 functional class.

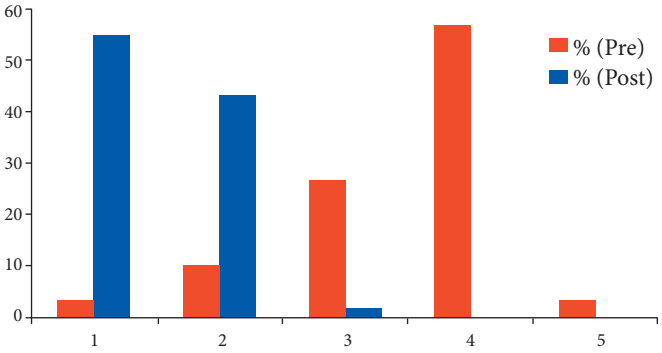

Figure 4. Canadian Cardiovascular Society (CCS) Functional Classification of Angina showing significant improvement in symptoms with EECP therapy.

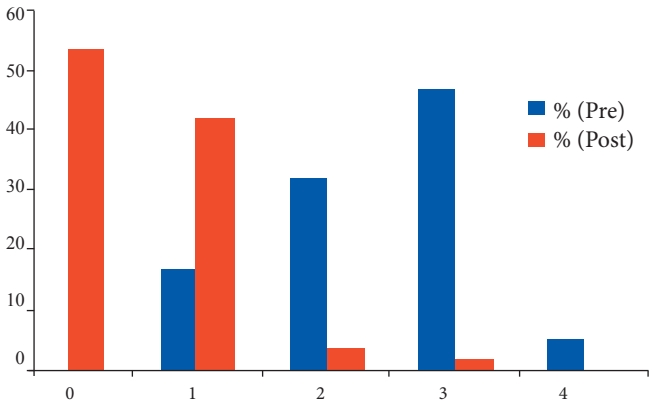

Figure 5. Medical Research Council (MRC) breathlessness scale showed significant improvement in symptoms with EECP therapy.

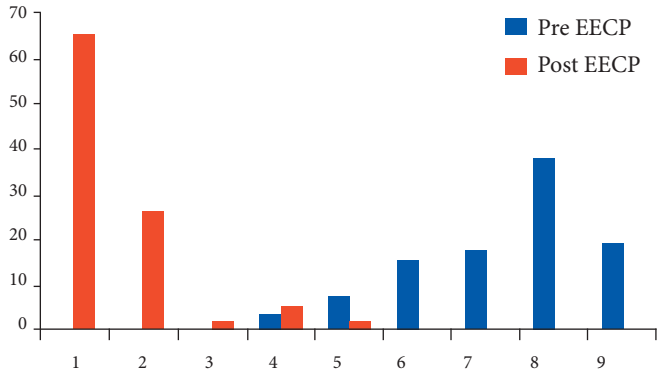

Figure 6. Improvement in quality of life due to reduced symptoms.

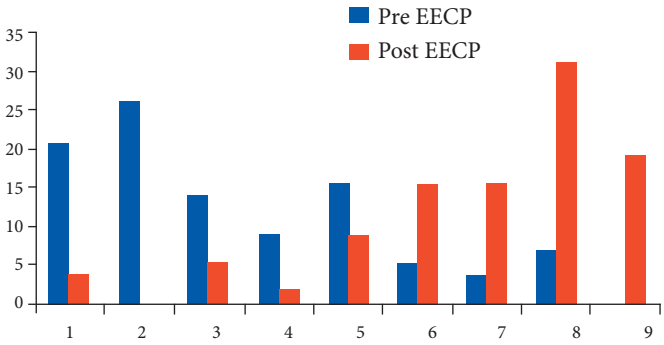

Figure 7. Improvement in quality of life due to increased activity.

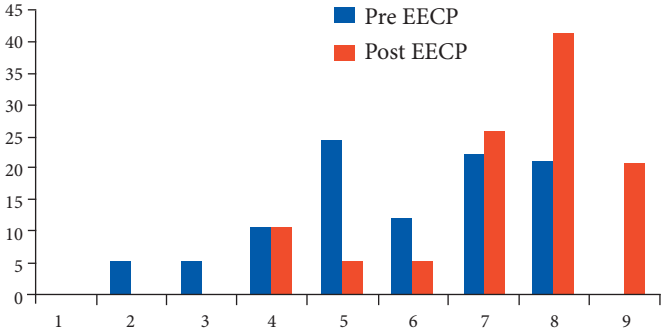

Figure 8. Improvement in quality of life due to improvement in psychological features.

The MRC breathlessness scale was used to study improvement in symptoms with EECP therapy (Fig. 5). Ninety-two percent of the patients showed reduced symptoms and improvement in dyspnea class out of whom 40% improved by 2 functional class and 32% improved by 3 functional class.

There was improvement in the quality-of-life indicators with reduced symptoms, increased activity and improved psychological features (Fig. 6–8) after completion of EECP therapy.

Improvement in 6-minute walk distance was noticed in 100% of the patients. The average 6-minute walk distance before EECP was 192 m that increased to 357 m after EECP (p<0.001). The maximum improvement was noticed in patients whose 6-minute walk before EECP was very short or they were unable to walk at all before this therapy (Fig. 9).

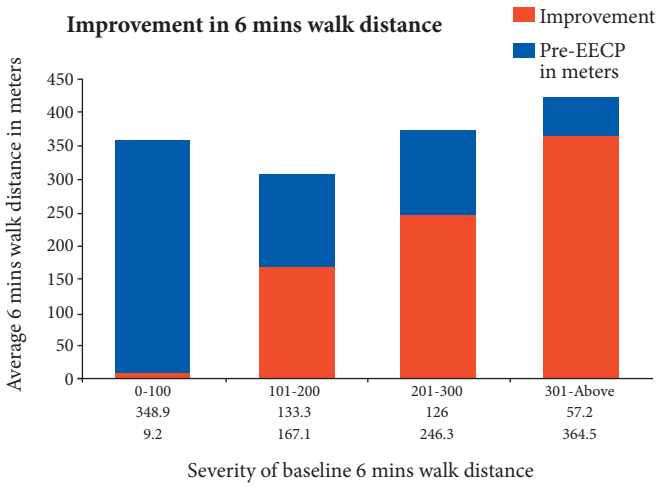

Figure 9. Six-minute walk distance improvement with EECP therapy.

Table 1.

Statistical significance of improvement in subjective and objective parameters.

Parameters	Pre-EECP	Post- EECP	Difference	*Z* value	*P* Value
Angina	2.4	0.5333	-1.86	13.74	<0.001 Significant
Dyspnea	2.4666	0.4666	-2.0	15.38	<0.001 Significant
QOL-Symptoms	7.3620	1.5172	-5.7	-24.66	<0.001 (Significant)
QOL-Psychological	5.8275	7.6206	1.7	8.37	<0.001 (Significant)
QOL-Activities	3.3620	6.8965	3.4	11.31	<0.001 (Significant)
EF	39.73	44.80	5.08	4.32	<0.001 (Significant)
Six-minute walk	250.16	379.13	120.37	7.23	<0.001 (Significant)

QOL, quality of life; EF, ejection fraction; EECP, enhanced external counter-pulsation.

The mean EF before EECP was 39.73. The mean EF increased to 44.8 after EECP. The improvement in EF was statistically significant (p <0.001).

There was an overall significant improvement in the quality of life of heart failure patients after EECP therapy as indicated by the subjective and objective parameters analyzed in our study (Table 1). Subjective parameters include improvement in angina, dyspnea, heart failure symptoms, activity levels and psychological features. Objective parameters that showed improvement include EF and 6-minute walk.

Discussion

There have been several advancements in medical and device therapy to prolong survival and decrease morbidity and mortality in these patients (16–18). If feasible, revascularization is the initial treatment of choice for ischemic cardiomyopathy.

The use of ACE inhibitors/ARBs (26–32) β-blockers (33–41) and aldosterone-antagonists (42–47) has been shown to improve survival in clinical trials. Resynchronization therapy (48–50) improves EF and has been shown to prolong survival and improve symptoms. Cardiac defibrillators (51–55) have been shown to prevent sudden death and prolong survival.

Appropriate use and titration of diuretic regimens is considered the cornerstone of management of acute exacerbations of heart failure – even though the long-term effect of diuretics on survival might be deleterious. Digoxin (56–62), ACE inhibitors/ARBs and β-blockers also improve symptoms. New agents like sinus node inhibitor ivabradine (63,64) have been studied in heart failure patients and are currently only recommended as an adjunct if β-blockade does not sufficiently reduce the heart rate.

Nitrates, calcium channel blockers and ranolazine are the FDA-approved anti-anginal agents available in the USA. Other than that, new anti-anginal agents nicorandil and trimetazidine are currently in use in Asia and Europe.

However, heart failure patients continue to have a very poor quality of life with persistent symptoms, limited activity and recurrent hospitalizations. The disease burden of heart failure has been identified worldwide as huge.

There is a lot of interest in the academic circles to develop treatment strategies that not only prolong survival but also improve quality of life and reduce hospitalization in these patients.

Even though EECP therapy has been available for over 30 years, its use in clinical practice is not widespread (65). This is in-spite of the fact that the trials that have been done in the past have shown promising results (66–72). However, these trials were small in size and even though there was significant improvement in the treatment arm, they failed to influence clinical practices. The therapeutic benefits of EECP have not been explored in large randomized controlled trials. However, EECP therapy is US FDA approved and is used at select centers worldwide as one of the options in refractory angina and heart failure.

In our center, EECP therapy was prescribed to 100

patients with symptomatic heart failure out of which 60 completed the treatment. The retrospective analysis on these patients showed that there was significant improvement in all parameters that were studied. There was improvement in dyspnea and angina class in all patients. Their quality of life improved significantly. The 6-minute walk test and EF also showed significant improvement.

Most of the patients who were studied had ischemic cardiomyopathy. However, the few patients with nonischemic cardiomyopathy also showed improvement with this therapy. Our hypothesis is that EECP therapy works not only through a mechanism of improving collateral formation but also improves endothelial function via increased nitric oxide activity and reduced inflammation and oxidative stress (73–78). If this theory holds true, then the potential indications of EECP therapy might expand to include patients with nonischemic cardiomyopathy, peripheral vascular disease, chronic kidney disease, cardiorenal syndromes, diabetes mellitus and cerebral vascular diseases (79–83).

Conclusion

The authors believe that EECP therapy is an excellent treatment option for heart failure patients who are at the end of the road in terms of medical and interventional therapies.

The potential benefits of this therapy might be partially attributed to improved endothelial function. This expands the potential indications of this therapy to include all vascular pathologies.

Large randomized trials with interdisciplinary collaboration to study all the potential benefits of this therapy need to be planned and executed in the future.

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