Enhanced external counter pulsation: the Howard County experience in the first 18 patients

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ABSTRACT: *Enhanced external counter pulsation is a non-invasive therapy that uses sequentially inflated pneumatic cuffs on the lower extremities to enhance coronary artery diastolic flow and decrease left ventricular afterload. We studied its effect on 18 patients with persistent angina despite maximal medical, surgical and catheter-based interventions. After enhanced external counter pulsation all subjects improved their functional class. Treatment with enhanced external counter pulsation improved functional class significantly from baseline 3.1 ± 0.6 to 1.6 ± 0.5 ($p<.001$). These results are consistent with the national experience. Growing physician awareness, recent Medicare approval status, and subsequent reimbursement will hopefully increase the use of this therapy.*

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Background

Coronary artery diastolic augmentation was described by Kantrowitz and Kantrowitz at the Massachusetts Institute of Technology in 1953. These investigators correctly proposed that increased diastolic coronary perfusion pressure would result in increased coronary blood flow. In addition, Sarnof demonstrated that left ventricular work and myocardial oxygen consumption depend directly on end diastolic pressure.[1] William Birtwell, an electrical engineer, developed an early intravascular arterial pulsator, which drew off blood during systole and returned it during diastole. Richard Gorlin, M.D., named this technique counterpulsation.

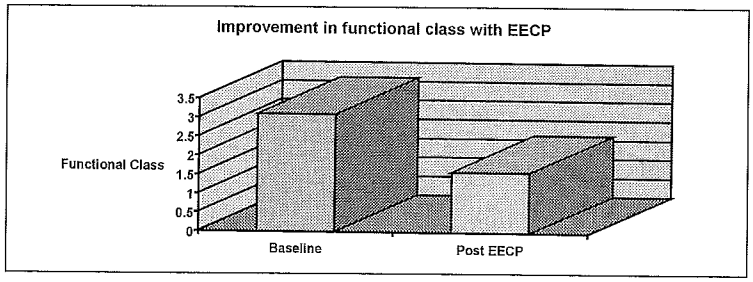

FIGURE 1. Improvement in functional class after treatment with EECP.™

The intraaortic balloon pump is the modern counterpulsation technique most familiar to the medical community. It is an intravascular device that inflates a balloon in the aorta during diastole and deflates it during systole. This both increases diastolic coronary perfusion and decreases impedance to cardiac output.[1]

Less familiar to the medical community is the modern external counter pulsation device. In 1995, the FDA approved a pneumatic external counterpulsation device (Vasomedical, Inc., U.S.) known as enhanced external counterpulsation (EECP™). EECP™ uses equipment designed to inflate and deflate three sets of pneumatic cuffs positioned on the patient's lower extremities. The cuffs inflate sequentially from the calves to the buttocks in diastole and deflate simultaneously just before systole.

The hemodynamic effects of EECP™ are multiple and continue to be evaluated. Using finger plethysmography it has been demonstrated that the systolic pressure wave diminishes and the diastolic pressure wave significantly increases and becomes higher than the systolic wave. Left main coronary blood flow measured with transesophageal echocardiography has been shown to increase significantly up to 42% during EECP™.[3] Tc 99 MIBI scans performed before and after EECP™ have demonstrated improved perfusion both at rest and exercise.[3] Angiographic studies suggest that EECP™ may increase or improve collateral blood flow.[4]

The present study was performed to evaluate functional class change in a group of patients with chronic stable angina treated with EECP™.

Methods

Howard County General Hospital became the first regional center in Maryland for use of EECP™ in 1997. Since that time 24 patients (19 men, 5 women) have been enrolled. The patients' ages ranged from 45 to 93 years with a mean age of 65 years. Twenty-three patients had prior angioplasty or stenting and 16 patients had prior CABG. One patient had neither catheter-based intervention nor CABG.

Patients with chronic exertional angina, demonstrated by exercise testing or thallium perfusion studies, and with optimal medical and surgical therapy were enrolled. Specific exclusion criteria were: clinical congestive heart failure, severe aortic insufficiency, myocardial infarction within three months, severe peripheral vascular disease, recurrent deep vein thrombosis, and bleeding diatheses. Patients with atrial fibrillation and/or pacemakers were excluded.

Prior to enrollment in EECP™, the patients were assigned a functional class I-IV as defined by the Canadian Cardiovascular Society. Patients continued their current medical regimens. Patients underwent EECP for a total of 35 hours with a one-hour daily treatment.

Statistical analysis

Effects of EECP™ were assessed by paired T test. A probability value less than .05 was considered significant. Data are expressed as mean +/- SEM.

Results

After EECP™ all subjects improved their functional class. Treatment with EECP improved functional class significantly from baseline 3.1±0.6 to 1.6±0.5 ($p<.001$) (**Figure 1**). The most improvement was seen from functional class IV to II in one subject only. There were no adverse effects with treatment.

Discussion

This first experience with EECP™ at Howard County General Hospital demonstrates the significant quality of life improvement that has been demonstrated in prior studies and the MUST-EECP trial. EECP is continuing to demonstrate measurable physiologic benefit with decreased ischemic burden, improved coronary blood flow, and enhanced diastolic coronary flow. In addition, remarkable clinical benefit has been demonstrated with improved exercise tolerable and functional class. As with other proven therapies, the greatest concern with EECP™ remains underutilization. With the recent Medicare approval status, the financial burden to the patient will be reduced. Hopefully this financial change and increased physician awareness will allow this population, suffering from ischemia, greater access to EECP™ and improved quality of life.

References

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