

# The Effectiveness of Enhanced External Counterpulsation (EECP) Therapy for Heart Disease Patients

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Abstract: According to the WHO, the estimated number of deaths by 2020 in the world, especially in developing countries, will be caused by chronic diseases, and 71% due to ischemic heart disease. EECP (Enhanced External Counterpulsation) is an FDA-approved non-invasive alternative therapy that is particularly beneficial for patients with heart disease. This study is a qualitative study, conducted at the wellness center of Royal Prima Hospital, June 2020, the number of samples as many as 15 respondents. Miles and Huberman's data analysis with the encoding used in the data analysis process is open encoding, axial encoding, and selective encoding. As a result of the study, the majority of respondents expressed chest pain (angina pectoris) expressed a decrease of 13 people (86.7%) and stated chest pain was no longer as much as 2 people (13.3%). In terms of quality of life, all respondents stated an increase in life, with an increase in physical activity that can be felt by the respondent. Concluded research, that EECP therapy provides effectiveness that reduces chest pain and improves the quality of life of respondents who have undergone therapy 35 times. In the future, more and more health facilities are providing EECP therapy facilities, especially in Medan.

## 1 INTRODUCTION

According to WHO data, the estimated number of deaths by 2020 worldwide, especially in developing countries, 75% will be caused by chronic diseases and 71% due to ischemic heart disease, (WHO Technical Report Series, 2013). The UK states coronary heart disease (CHD) is the leading cause of death. One in five men and one in six women die from CHD. Every year 101,000 people die from CHD, (Colin Tidy, d. 2012). Sudden cardiac death (SCD) events reach 400,000 cases per year in developed countries such as the United States.

Indonesia as a developing country, but the pattern of disease is already the same as the pattern of diseases of developed countries, CHD is still the most common disease-causing sudden death, (Yuniadi Y, 2019). From the data of the Indonesian Association of Cardiovascular Specialists (PERKI) 2019, it is reported that CHD (which is classified as circulatory system disease) is the main cause and the first of all deaths, which is 26.4%, this figure is four times higher than the death rate caused by cancer (6%). In other words, approximately one in four people who died in Indonesia were from CHD (Firdaus. I. 2019).

Sudden death is often caused by dangerous cardiac arrhythmias triggered by sudden blockages of the coronary arteries that have been narrowed due to plaque forming in the atherosclerosis process. The process of atherosclerosis, which is the main cause of CHD, begins from young adulthood, and the plaque that forms increases in age or time (Suherman.J, 2019). The main cause of plaque formation is an endothelial injury that lines the inside of the blood vessels. Factors that play a role in continuous endothelial injury are LDL (Low-Density Lipoprotein) levels, high cholesterol, hypertension, smoking, diabetes mellitus, and others (Insull W Jr, 2009).

There are currently several non-pharmacological alternative therapies for patients with or without heart failure, namely: neurostimulation (electrical stimulation of transcutaneous nerves and spinal medulla stimulation), EECP (Enhanced External Counterpulsation), laser revascularization techniques, gene therapy, and recent interventional procedures such as percutaneous in situ coronary artery bypass. However, a non-invasive and FDA-approved alternative therapy is EECP therapy. Where the target of EECP therapy is to open the existing

coronary artery collateral and form new blood vessels to provide blood supply to the blood-deficient heart muscle. EECP benefits more in people with narrowing of one or two major vessels. Unfortunately in Indonesia, not many choose this non-invasive therapy that has proven beneficial. That may be because there are still few facilities that provide EECP therapy and information about eeep therapy methods is still lacking.

This study aims to identify the effectiveness of EECP therapy against heart disease patients who are undergoing therapy and who have undergone EECP therapy. With the higher rate of morbidity and mortality of coronary heart disease, it is expected that later with this research, will add insight, public information about EECP therapy, so that it can be considered to the public in the treatment of CHD in addition to the treatment of CABG surgery or less invasive stent installation.

Several studies have been conducted to look at the effectiveness of EECP therapy, which is used as follows:

No	Research Title	Results
1	Effect of enhanced external counterpulsation therapy on myeloperoxidase in lowering cardiovascular events of patients with chronic heart failure Researcher's name: Starry H. Rampengan, etc Place and Time of Research: General Hospital of Prof Dr. R. D. Kandou, Manado Siloam Hospital, Manado Adventist Hospital, and Manado Jade Cardiovascular Clinic, January-December 2012 (Rampengan, S. H, 2015). Researcher's name: Starry H. Rampengan, etc Time and Place of Research: January 2014 and June 2015, Jade Cardiovascular Clinic, Manado, North Sulawesi, Indonesia (Rampengan, S. H, 2017).	EECP therapy lowers the MPO levels of GJK patients so that it can decrease cardiovascular events within 6 months of observation. The higher the MPO level correlated with the higher the incidence of cardiovascular events.

2	Quality of life improvement of chronic heart failure patients after the effect enhanced external counterpulsation (EECP) therapy Researcher's name: Starry H. Rampengan, etc Time and Place of Research: January 2014 and June 2015, Jade Cardiovascular Clinic, Manado, North Sulawesi, Indonesia (Rampengan, S. H, 2017).	The WHO-5 questionnaire resulted in false before and after EECP therapy, but in the EECP group showed statistically significant differences ( $p < 0.05$ ). The WHO-5 questionnaire attributes the results to a significant increase in feeling cheerful and in good spirits ( $p = 0.03$ ) and waking up feeling refreshed ( $p = 0.030$ ) in the EECP group compared to the fake group. Conclusion: EECP therapy is effective for reducing depression thus improving quality of life in CHF patients
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Nearly a century and a half ago, researchers at Harvard University began experiments with counterpulsasi. They have proven that this technique can meaningfully reduce the workload and oxygen consumption of the left ventricle. In 1953, Kantrowitz et al. described diastolic changes as the cause of increased coronary blood flow. Birtwell et al. in the USA began the development of this technique, he first implemented the concept by developing an artery pulsator counter. Zheng et al. reported for the first time the advantages of using external counterpulsation in the 1980s, he used pneumatic counterpulsation tools.

Lawson et al. at the State University of New York, Stony Brook, analyzed several open studies of EECP use between 1989-1998, using objective and subjective viewpoints. These studies show that, although open and not random, EECP users statistically produce progress on exercise tolerance. This is evidenced by thallium stress tests, which show partial or total healing from coronary perfusion defects. In 1999 for the first time, Arora et al. Report the results of the multicenter Study of Enhanced External Counterpulsation (MUST-EECP) double-blind randomized placebo-controlled test. Since then, EECP therapy has emerged as an effective, non-invasive, and reliable alternative therapy for patients with angina, even those with heart failure (Insull W Jr, 2009). According to Prof. Peter Kabo, in Indonesia, the first person to promote EECP is Prof.

Dr. Syukri Karim. They did a simple study and the results showed that EECP improved the manifestations of CHD tested with ECG, treadmill test, or talcum scintigraphy. In 1997, Indonesia was the only country in Southeast Asia to have an EECP. But currently, EECP has been used in Malaysia, Hong Kong, Taiwan, Philippines, and Singapore as one way of countermeasures cardiovascular (Suherman.J, 2019).

EECP tools work regulated by computers based on the patient's electrocardiogram to increase arterial diastolic blood pressure thereby improving diastolic blood flow in the coronary, cerebral, and renal arteries, as well as stimulating diuresis and natriuresis (Insull W Jr, 2009). In 2002, the FDA approved EECP therapy for patients with heart failure due to myocardial ischemic. EECP (Enhanced external counterpulsation) therapy is a non-invasive therapy using three sets of pneumatic cuffs wrapped around the calves, thighs, and hips. Air filling and emptying in cuffs is regulated according to the heart cycle based on a computer-controlled ECG.

At the time of diastole onset, three sets of cuffs are filled with air quickly with adjustable pressure, sequentially starting from the calf, then the thigh, and the last in the hip. Thus the blood from the lower limbs is squeezed back and channeled to the base of the aorta (counterpulsation). The increased diastolic pressure increases the perfusion pressure of the coronary artery, opens the existing collateral vessels and shear stress that occurs in the coronary artery will improve endothelial dysfunction.

Patients who will benefit from EECP therapy include patients with angina attacks that cannot be overcome by pharmacological therapy (refractory angina) and limiting their activity to avoid angina symptoms. Patients with coronary anatomy are not suitable or at high risk for revascularization therapy. EECP therapy is also not a great choice for patients with microvascular angina (cardiac syndrome X) and diabetic Mellitus patients with coronary heart disease. The target of EECP therapy is to open the existing coronary artery collateral and form new blood vessels to provide blood supply to the blood-deficient heart muscle. EECP benefits more in people with narrowing of one or two major vessels. If narrowing has occurred in the 3 main coronary vessels then EECP therapy should be done after CABG.

Guidelines for EECP therapy are:

1. Therapy is carried out daily for one hour, a week 6 times to 36 times.
2. All drugs are consumed as prescribed, except diuretic drugs should not be taken before therapy as it will interfere with therapy.

3. Patients do not eat or drink 2 hours before therapy.
4. The patient empties the bladder before therapy begins.
5. The patient wears cotton trousers that fit perfectly.
6. The patient's blood pressure and pulse frequency are checked before and after therapy.
7. ECG, heart rate frequency, and oxygen saturation and plethysmograph monitored during therapy

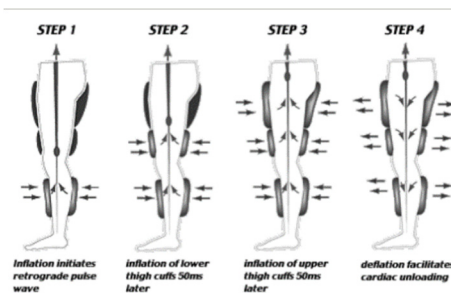


Figure 1. EECP (Rampengan, S. H, 2017) Therapy Stage Diagram

Steps 1-3 of air are pumped in succession shortly after pistol Step 4 air is sucked simultaneously shortly before pistol.

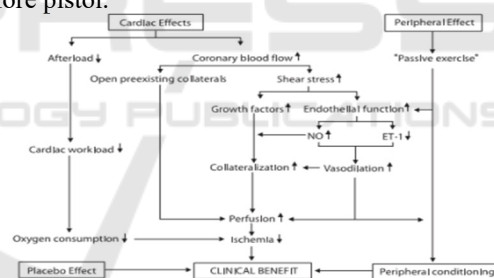


Figure 2. Mechanism of eecp therapy clinic benefits

## 2 RESEARCH METHODS

This research was conducted with a qualitative approach. This means that the data collected is not in the form of numbers, but rather it comes from interview scripts, field notes, personal documents, memo notes, and other official documents, so the purpose of this qualitative research is to portray the empirical reality behind the phenomenon in-depth, detail and complete. This research was conducted at the Royal Prima Wellness Center Hospital 5th Floor, in 2019. The population is all coronary heart patients undergoing therapy at Wellness Center Rs Royal Prima Medan. From the initial survey, data found that

the average coronary heart patient undergoing EECP therapy is 5-7 people per month. Therefore, researchers determined the number of samples as many as 15 patients, this is because every one patient takes about 7 to 8 weeks to complete EECP therapy following EECP therapy guidelines. So that later this research can be completed according to the schedule that has been determined.

The data source in this study was the subject from which the data was processed, primary data being direct data from patients using semi-structured interview techniques and documentation. Secondary data is data from the patient archives at the Wellness Center of the Royal Prima Hospital and previous research literature to strengthen the results of the research and complete the information that has been collected through in-person interviews with informants.

The data analysis techniques used in this study use Miles and Huberman interactive model data analysis techniques that include data reduction, data display, and conclusion drawing/ verification (Saldana. et al, 2014).

Here's an explanation:

a. Data Reduction

At this stage, researchers are sorting through the results of interviews and documentation that are still complex and unstructured so that, researchers obtain data relevant to the study's problems.

b. Display Data Display data is the presentation of data into the corresponding matrix. In qualitative research, display data or data presenters can be done in the form of briefs, charts, and relationships between categories, flowcharts, and the like. Withdrawal of Conclusions or Verification In concluding, researchers begin to look for the meaning of the data that has been collected (Sugiyono. 2008).

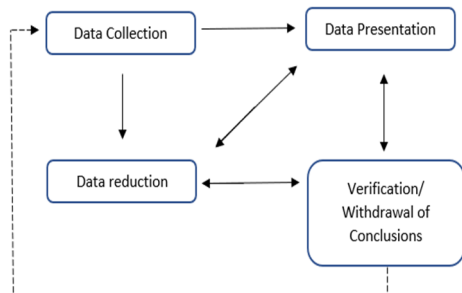


Figure 3. Miles and Huberman Interactive Data Analysis Model

The results of the study were conducted to 15 respondents, the majority of patients of the male gender (>65%), the age of the majority of respondents over 50 years (80%), in terms of education, the majority of respondents are highly educated (60%), in terms of employment, the majority of respondents are self-employed, namely (46.7%), for more details can be seen in Table 1.

Table 1. Overview of Research Respondents, by Age, Gender, Education and Employment Status

Variable Characteristics	Sum	Percentage (%)	
Age	< 40 years	1	6.7
	40 s/d 50 years	2	13.3
	> 50 years	12	80.0
Gender	Male	10	66.7
	Female	5	33.3
Job	PNS, BUMN, TNI, Government	2	13.3
	Private Employees	6	40.0
	Self-employed	7	46.7
Education	Higher Education (S1, S2, S3)	9	60.0
	High school	6	40.0

Table 2: Overview of Research Variables

Research Variables	Sum	Percentage (%)	
Therapy EECP	< 35 Times	5	33.3
	≥35 Times	10	66.7
Chest Pain	Reduced Chest Pain	13	86.7
	Chest Pain Is Gone	2	13.3
Quality of Life	There Are Improvements	15	100

From table 2, it can be seen by current and current respondents who have undergone therapy for <35 times as many as 5 (33.3%), who have undergone therapy ≥35 times as many as 10 (66.7%). Respondents who expressed chest pain decreased by 13 people (86.7%), and who stated chest pain was no longer there (never relapsed) as many as 2 people (13.3%). In terms of quality of life, all respondents

stated that the quality of life there was an increase of 15 people (100%).

From the results of the study, respondents stated that the symptoms of chest pain (angina pectoris) were reduced, and some claimed to have never felt or experienced chest pain. The researcher's assumption, that respondents who are and have undergone EECP therapy have felt the benefits of such therapy. Whereas we know, the target of EECP therapy is to open up existing coronary artery collateral and form new blood vessels to provide blood supply to the blood-deficient heart muscle. EECP benefits more in people with narrowing of one or two major vessels. So it can be concluded EECP therapy has effectiveness in the treatment of patients who have coronary heart disorders.

This is in line with research conducted by Darren PC. Et al, 2008, found that EECP is effective in reducing plasma levels of alpha tumor necrosis factor (TNF- $\alpha$ ), monocyte protein chemoattractant-1 (MCP-1), and these changes are in parallel with reducing chest pain symptoms. Of the quality of life variables, all respondents stated that this therapy was shown to improve their quality of life, judging by the patient's passion and joy to undergo therapy. Because according to the patient, after undergoing therapy, their sleep at night is very good, so in the morning the patient feels very healthy. Also, seen from some respondents' statements, after EECP therapy, patients felt the physical improvement was increasing. Where before undergoing therapy, some respondents can only walk a few meters, after undergoing therapy, patients can already increase the intensity of exercise (walking) more than before undergoing therapy.

There was one respondent, who had previously been unable to walk again (already in a wheelchair), after undergoing therapy 35 times, that respondent had improved, where the respondent was already able to walk even though he was still bricked up and helped to walk. This research is in line with the results of research conducted by Rampengan, S. H, 2015, wherein his research stated EECP therapy is safe and effective as well as beneficial on improving quality of life in patients with chronic heart failure as shown by the increased walking distance in the six-minute walking test.

The downside of EECP therapy, there are some complaints received by researchers from respondents, namely concerning the problem of the time it takes to complete the therapy is felt long enough, namely 35 times therapy for 35 days (1 day, therapy 1 hour). Where if the patient does not live on schedule, then the therapy should be repeated from the initial count, to achieve maximum results. And the facilities that

provide EECP therapeutic facilities are still limited. However, because the respondent immediately felt a good effect starting from the first therapy, the respondent felt the weakness of the time was considered not a big problem. Some statements from patients who have undergone therapy for 35 times, continue therapy, with schedule settings 1 therapy every 1 week, to still be able to maintain their health condition. According to the respondent's assumption, with this follow-up therapy, this is done to prevent the possibility of chest pain as early as possible.

Placebo from the results of this study, according to respondents who have undergone therapy, said that although EECP therapy is very helpful to overcome chest pain but to get the most results, respondents must also follow the treatment given by the doctor, consume additional vitamins, and also no less important, namely the support of the family in the treatment of their disease.

### 3 CONCLUSIONS AND SUGGESTIONS

#### 3.1 Conclusions

In the conclusion of this study, the majority of patients stated that after undergoing EECP therapy, chest pain or angina was less than 13 people (86.7%), even respondents also stated chest pain was no longer there. In terms of quality of life, all respondents stated an improvement in the quality of life of 15 people (100%), characterized by an increase in physical activity that can be done by respondents after undergoing therapy. EECP therapy is a non-invasive for patients with coronary heart disease, whether it has undergone revascularisation or not. For patients who experience coronary heart disease because of complications from DM type2, because with the presence of EECP therapy then a small probability of revascularisation action.

This therapy is hilly to improve the quality of life of the sufferer, visible from the spirit and joy of patients to undergo such therapy. Since the result of EECP therapy can make the heart perfusion better and open the collateral blood vessels that have been and are thought to form new collateral vessels.

#### 3.2 Suggestions

Because of the limited researchers in the deep dive into the effectiveness of EECP therapy until laboratory tests, researchers hoped for the future,

researchers could continue with the research by collaborating with more clinical teams. Expected for the future, more health facilities that provide EECP therapy facilities, especially in the city of Medan.

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