E-ISSN 2250-0944
ISSN 2250-1150
doi:10.31838/ijprt/15.2.94

Research Article

Adenosine Vs Verapamil: Treating No-Reflow Phenomenon in Individuals with Acute Coronary Syndrome Undergoing Percutaneous Coronary Intervention (PCI)

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Received: 16.05.25, Revised: 17.06.25, Accepted: 22.07.25

ABSTRACT

Background: A condition that results from an imbalance between coronary blood supply and myocardial oxygen demand is called acute coronary syndrome (ACS). The no-reflow phenomenon is one of the most challenging complications for ACS which occurs during percutaneous coronary intervention (PCI). A few microvascular dysfunction mechanisms are included in the pathophysiology of the no-reflow phenomenon. These medicines include two names that are commonly used; adenosine and verapamil. Adenosine is a strong drug which is used to activate special A2 receptors that eventually help in opening up small blood vessels in the heart. On the other hand, verapamil is also used to relax the small blood vessels. Through this drug, the amount of calcium that enters into the muscle cells in the vessel walls is reduced.

Objective: To compare the efficiency of adenosine with verapamil to treat no-reflow phenomenon in individuals with acute coronary syndrome undergoing percutaneous coronary intervention (PCI).

Study design: An observational study

Duration and place of study: This study was conducted in Peoples University of Medical and Health Sciences for Women Shaheed Benazirabad Nawabshah from August 2023 to August 2024

Methodology: This is an observational study which was performed in the Cardiology Department of the hospital. There were a total of 120 individuals who were a part of this study. They all were having an age of 18 years or older. All the participants of this study were having acute coronary syndrome (ACS). Along with this, they required percutaneous coronary intervention (PCI). All the patients were divided into 2 groups equally. Each group had 60 individuals. One group received intracoronary verapamil while the other group received adenosine.Variables such as IMR, TIMI, and FMD were expressed in terms of mean with standard deviations. To analyse the data, SPSS version 25 was used.

Results: There were a total of 160 people included in this research. They all were having an age of 18 years or older. All the participants of this study were divided into 2 groups with each group having 60 individuals. One group received intracoronary verapamil while the other group received adenosine. The majority of the individuals were males in both the groups. The average age of the verapamil group was 60 years while it was 61 years for the adenosine group.

Conclusion: In our study, both drugs, adenosine and verapamil, are effective but verapamil was found to be statistically significant in helping improve TIMI flow grades.

INTRODUCTION

A condition that results from an imbalance between coronary blood supply and myocardial oxygen demand is called acute coronary syndrome (ACS) [1]. It is a spectrum of clinical conditions. Acute myocardial ischemia is the one that causes these conditions. It includes STEMI (ST-segment elevation myocardial infarction), MSTEMI (non-ST-segment elevation myocardial infarction), and unstable [2]. ACS has very high mortality and morbidity rates which is why it is represented as a major

health issue worldwide [3]. The no-reflow phenomenon is one of the most challenging complications for ACS which occurs during percutaneous coronary intervention (PCI). Despite the re-opening of the epicardial coronary arteries, microvascular dysfunction takes place and no-reflow phenomenon occurs when myocardial perfusion remains inadequate. This phenomenon is linked with a number of clinical results such as arrhythmias, high mortality, and heart failure [4].

A few microvascular dysfunction mechanisms are included in the pathophysiology of the no-reflow phenomenon. These mechanisms include endothelial swelling, ischemic injury, microvascular spasm, and capillary plugging. These factors lead to impaired blood flow at the microvascular level [5]. Conventional angiography does not detect this dysfunction and it has important implications for patient prognosis. Small blood vessels in the heart is a huge problem that can be treated by taking specific medicines during the procedure [6]. These medicines include two names that are commonly used; adenosine and verapamil.

Adenosine is a strong drug which is used to activate special A2 receptors that eventually help in opening up small blood vessels in the heart [7]. With this drug, the small blood vessels relax and widen quickly which helps in blood flow. This medicine also has a benefit that it works for only a short time which makes it a flexible option in treating low blood flow in the small blood vessels during PCI. This helps the doctors to adjust the dose during the treatment. One of its drawbacks is that this drug does not work the same for every patient unlike other medicines such as verapamil. Research studies compare it directly with verapamil to find a better option for treatment [8].

On the other hand, verapamil is also used to relax the small blood vessels [9]. Through this drug, the amount of calcium that enters into the muscle cells in the vessel walls is reduced. Due to this function, verapamil is referred to as a calcium channel blocker. With this drug, the small blood vessels relax and widen quickly which helps in blood flow. Verapamil also has some drawbacks out of which one drawback is that it can weaken the pumping ability of the individual's heart. This can be a major problem for people who have heart problems.

Previous research studies have been conducted on individuals who had high or mixed blood pressure to treat the no-reflow problem in ACS patients [10]. However, this study used advanced tools like flow-mediated dilation (FMD) and Microcirculatory Resistance (IMR) to measure endothelial health and small blood vessel function. Therefore, this research was performed to compare adenosine with verapamil and understand which drug is more effective in treating individuals who have ACS and no-reflow phenomenon.

METHODOLOGY

This is an observational study which was performed in the Cardiology Department of the hospital. There were a total of 120 individuals who were a part of this study. They all were having an age of 18 years or older. All the participants of this study were having acute coronary syndrome (ACS). Along with this, they required percutaneous coronary intervention (PCI). The requirement for the inclusion criteria was being normotensive. It means that at the time of PCI, the individuals should have a diastolic blood pressure between 80-85 mmHg and a systolic blood pressure between 120-130 mmHg. The Ethical Review Committee approved this research.

Exclusion criteria: Individuals who had a history of prior coronary bypass treatment were not a part of this research. Moreover, those who had hypersensitivity, cardiogenic shock, chronic renal failure, and hemodynamic instability were also not a part of this study.

All the patients were divided into 2 groups equally. Each group had 60 individuals. One group received intracoronary verapamil while the other group received adenosine. The TIMI flow grade was used to examine the blood flow in the heart after treatment. Blood vessel health and small blood vessel function were measured (before and after the treatment). Those who had serious heart problems were getting followed-up for six months. Data was gathered using the clinical records and follow-ups. To remove biases, the participants were selected using the inclusion criteria. Doctors were also blinded and differences between both the groups were adjusted.

Variables such as IMR, TIMI, and FMD were expressed in terms of mean with standard deviations. To analyse the data, SPSS version 25 was used. T-tests were also conducted on continuous data. Moreover, chi-square tests were also conducted on categorical data. Statistical adjustments were made if there were any baselines differences between both the groups. A significant p-value was considered to be below 0.05.

RESULTS

There were a total of 160 people included in this research. They all were having an age of 18 years or older. All the participants of this study were divided into 2 groups with each group having 60 individuals. One group received intracoronary verapamil while the other group received adenosine. The majority of the individuals were males in both the groups. The average age of the verapamil group was 60 years while it was 61 years for the adenosine group. Table number 1 shows the distribution of males and females in both the groups.

Table No. 1

Gender	N	%
Verapamil Group (n=60)		
• **Male**	32	53.3
• **Female**	28	46.7
Adenosine Group (n=61)		
• **Male**	31	51.6
• **Female**	29	48.4

Table number 2 shows the baseline features of the participants. Note that all the values are expressed in terms of average.

Table No. 2

Features	Verapamil	Adenosine	p-value
Age (yrs)	60	61	0.45
IMR Pre (units)	30.2	29.7	0.74
TIMI	2.1	2.0	0.62
FMD Pre (%)	3.1	3.0	0.55

Table number 3 shows the efficiency of treatment on microvascular resistance and endothelial function.

Table No. 3

Features	Verapamil	Adenosine	p-value
FMD Post (%)	4.1	3.9	0.15
IMR Post (units)	18.5	19.2	0.29
Post treatment TIMI	2.9	2.7	0.03

DISCUSSION

This research was performed to compare two common drugs' efficiency (adenosine and verapamil) in treating the no-reflow phenomenon. This was performed among the normotensive individuals who were having acute coronary syndrome (ACS). These patients were undergoing PCI. In our study, both drugs,

adenosine and verapamil, are effective but verapamil was found to be statistically significant in helping improve TIMI flow grades which is an important measure of myocardial perfusion. Previous research studies have also demonstrated the benefits of verapamil with similar clinical situations as ours [11-15].

The role of intracoronary pharmacotherapy has been underscored in recent studies in enhancing coronary perfusion during PCI [16]. Similar to our study, Saif et al. also stated that rather than adenosine, verapamil helps in coronary flow and lower down the incidence of no-reflow in people who have ACS [17]. On the other hand, a meta-analysis was performed by Nguyen et al. on the efficacy of adenosine [18]. That research revealed the effectiveness of adenosine in mitigating microvascular obstruction. Both research have similar results to our study which says that both the drugs are effective and they help in myocardial perfusion issues.

All TIMI flow grades were improved with verapamil; it was also observed that verapamil might provide a more robust initial response in normotensive patients to manage no-reflow. These results align with the study of Jaffe et al. whose study found similar advancements in coronary flow after using verapamil [19]. Moreover, another study conducted by Khan et al. compared adenosine with epinephrine [20]. They revealed that adenosine is more effective in certain clinical situations. However, the results of our research indicates that verapamil is more effective in myocardial perfusion improvement.

The outcomes of our study shows different effects of both the pharmacological drugs (adenosine and verapamil) and their implications for clinical practice. By comparing both the drugs after the treatment, verapamil was found to be statistically significant. There was a trend of greater reduction in microvascular resistance by verapamil and endothelial function was also improved. However, these were found not to be statistically significant. Both the groups had similar incidence of adverse cardiac events.

Our study also has some limitations. The treatment was chosen by the doctor instead of being randomly assigned because this was an observational study. This might affect the outcomes even though mostly steps were taken carefully to reduce bias and gather data. Moreover, the sample size was also small because it might not be enough to spot smaller differences. Lastly, the follow-up period was also not enough. It was just a six-month period which might not help enough to see long term effects of the medicines.

CONCLUSION

In our study, both drugs, adenosine and verapamil, are effective but verapamil was found to be statistically significant in helping improve TIMI flow grades.

Funding Source

This study was conducted without receiving financial support from any external source.

Conflict in the Interest

The authors had no conflict related to the interest in the execution of this study.

Permission

Prior to initiating the study, approval from the ethical committee was obtained to ensure adherence to ethical standards and guidelines.

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