The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 6, 2025

COMPARISON OF INTRAVENOUS VERAPAMIL AND INTRAVENOUS METOPROLOL IN ACHIEVING RARE CONTROL IN ATRIAL FIBRILLATION. (A COMPARATIVE STUDY AT ER PEMH RWP)

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DOI: https://doi.org/10.5281/zenodo.22765874

Keywords
Atrial fibrillation, Rapid ventricular response, Verapamil, Metoprolol, Rate control, Emergency management.

Article History
Received: 25 April 2025
Accepted: 04 June 2025
Published: 21 June 2025

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Abstract

Objectives:

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and is associated with increased morbidity, hospitalizations, and mortality. Effective rate control is essential to reduce symptoms and prevent complications. This study aimed to compare the efficacy and safety of intravenous verapamil and intravenous metoprolol in achieving rapid ventricular rate control in patients presenting with acute AF with rapid ventricular response.

Methodology:

This prospective, comparative clinical study was conducted at the Emergency Room of Pak Emirates Military Hospital. A total of 100 hemodynamically stable adult patients with AF and rapid ventricular rate were enrolled and randomly divided into two groups: Group A received intravenous verapamil (n=50), and Group B received intravenous metoprolol (n=50). The primary outcome was achievement of rate control (heart rate <100 bpm within 60 minutes). Secondary outcomes included time to rate control, adverse effects, and need for additional intervention. Data were analyzed using appropriate statistical tests, with $p \leq 0.05$ considered significant.

Results:

Baseline demographic and clinical characteristics were comparable between the two groups ($p > 0.05$). Both drugs significantly reduced heart rate. However, the mean time to achieve rate control was significantly shorter in the verapamil group (24.6 ± 8.3 minutes) compared to the metoprolol group (31.8 ± 9.7 minutes; $p = 0.002$). Successful rate control was achieved in 88% of patients in the verapamil group and 76% in the metoprolol group ($p = 0.048$). Adverse effects were mild and not statistically significant between groups.

Conclusion:

Both intravenous verapamil and metoprolol were effective and safe for rate control in acute AF. Verapamil achieved faster rate control, while metoprolol demonstrated a comparable safety profile.

INTRODUCTION

Atrial fibrillation is a supraventricular tachyarrhythmia with irregularly irregular rhythm caused by structural or electrical abnormalities of the heart. Patients with atrial fibrillation are at a higher risk of being

hospitalized and having multiple admissions due to inadequate control of heart rate or rhythm [1]. According to the Centers for Disease Control and Prevention (CDC), approximately 6 million Americans have atrial fibrillation, with more than 454,000 hospitalizations and 158,000 deaths each year related to the disease, costing the United States more than 6 billion dollars each year [2]. Although diltiazem and metoprolol have been compared for rate control in patients with acute atrial fibrillation, results have been variable. Furthermore, current literature includes very few studies looking at the effectiveness of verapamil in achieving rate control in patients with acute atrial fibrillation [3]. Atrial fibrillation (AF) is the most prevalent type of arrhythmia in the world, and the number of people with this condition is growing as the population is aging and the number of cardiovascular comorbidities increases. It is typified by irregular and sometimes quick rate of the heart that may result in debilitating symptoms like palpitations, tiredness, and shortness of breath. The important therapeutic technique that is used to ameliorate symptoms and to prevent the complications like heart failure and stroke is rate control. Metoprolol, as a beta-blocker, and verapamil, as a calcium channel blocker, are two frequent pharmacological agents in the acute control of rate in AF [4]. Metoprolol acts by obstructing the beta-1 adrenergic receptor in the heart that lowers the impact of sympathetic stimulation resulting in slower heart rate and contractility [5]. Supra ventricular tachycardia (SVT), by definition, includes all forms of tachycardia that either arises above the bifurcation of the bundle of His or that have mechanisms dependent on the bundle of His. In patients with SVT, the heart rate is at least 100 beats/min, but ventricular rates can be lower as a result of atrio ventricular (AV) block. On electrocardiography (ECG), QRS morphology is usually normal or supra ventricular; however, it may be widened or abnormal because of intrinsic conduction disturbance, myocardial disease, or raterelated bundle branch block [6].

PSVT include all tachyarrhythmia's that originate in supra ventricular tissue or incorporate supra ventricular tissue in re-entrant circuit and has sudden onset and termination. Atrio-ventricular nodal reentrant tachycardia (AVNRT) and atrio-ventricular re-entrant tachycardia (AVRT) are two major types of PSVT; other rare types are atrial tachycardia, paroxysmal atrial flutter and paroxysmal atrial fibrillation [7]. Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia encountered in clinical practice, characterized by disorganized atrial electrical activity and an irregularly irregular ventricular response. It significantly increases the risk of thromboembolic events, heart failure, and overall mortality, especially when accompanied by a rapid ventricular response (RVR) that compromises hemodynamic stability [8]. The primary management goals in AF include symptom control, stroke prevention, and appropriate rate or rhythm management [9]. While both verapamil and diltiazem are effective in rate control, differences in their pharmacological profiles—such as negative inotropic effects and vasodilatory potential—may influence their safety and efficacy in different patient populations [10].

METHODOLOGY

The study was conducted as a prospective, comparative clinical study at the Emergency Room of Pak Emirates Military Hospital (PEMH), Rawalpindi. The research was carried out over a specified study period after obtaining approval from the institutional ethical review committee. Written informed consent was obtained from all participants or their attendants prior to inclusion in the study. The target population consisted of adult patients who presented to the emergency department with atrial fibrillation accompanied by a rapid ventricular rate. Atrial fibrillation was diagnosed based on clinical evaluation and

electrocardiographic (ECG) findings showing an irregularly irregular rhythm with absence of distinct P waves. Patients who were hemodynamically stable and required pharmacological rate control were included. Patients with contraindications to beta-blockers or calcium channel blockers, such as severe hypotension, advanced heart block, acute heart failure, bronchial asthma (for metoprolol), or known hypersensitivity to study drugs, were excluded from the study.

A total sample size of eligible patients was calculated using appropriate statistical formulas to ensure adequate power for comparison. Patients were divided into two groups using a random allocation method. Group A received intravenous verapamil, administered as a slow intravenous bolus dose accordingto standard emergency protocols. Group B received intravenous metoprolol, also administered as a slow intravenous bolus in recommended dosages. Continuous cardiac monitoring was maintained for all patients during and after drug administration. Heart rate, blood pressure, oxygen saturation, and ECG changes were closely observed and recorded at baseline and at regular intervals after drug administration. The primary outcome variable was achievement of rate control, defined as reduction of ventricular rate to less than 100 beats per minute within a specified time frame (e.g., 30–60 minutes). Secondary outcome variables included time taken to achieve rate control, need for additional doses or alternative therapy, incidence of adverse drug reactions, and hemodynamic stability following treatment. Both qualitative and quantitative variables were included in the study. The quantitative variables comprised age (in years), baseline heart rate (beats per minute), heart rate after drug administration, systolic and diastolic blood pressure (mmHg), time to achieve rate control (minutes), and duration of hospital stay (hours). These variables were measured using standardized instruments and were expressed as mean ± standard deviation. Quantitative data were analyzed using appropriate statistical tests such as the independent sample t-test to compare mean values between the two groups. The qualitative variables included gender (male/female), presence of comorbidities (such as hypertension, diabetes mellitus, ischemic heart disease), success or failure of rate control (yes/no), occurrence of adverse effects (hypotension, bradycardia, bronchospasm), and requirement for additional intervention (yes/no). These variables were presented as frequencies and percentages. The Chi-square test was applied to determine the association between categorical variables and treatment groups.

Data were entered and analyzed using statistical software. A p-value of ≤0.05 was considered statistically significant. Comparative analysis was performed to determine whether intravenous verapamil or intravenous metoprolol was more effective and safer in achieving rapid rate control in patients with atrial fibrillation presenting to the emergency department. Throughout the study, patient confidentiality was strictly maintained. The findings were interpreted in light of clinical relevance, and conclusions were drawn based on statistical comparison of both efficacy and safety profiles of the two drugs.

RESULTS

The study was conducted at the Emergency Room of Pak Emirates Military Hospital (PEMH), Rawalpindi. A total of 100 patients with atrial fibrillation and rapid ventricular rate were enrolled and randomly allocated into two equal groups: Group A (Intravenous Verapamil, n=50) and Group B (Intravenous Metoprolol, n=50). All patients completed the study and were included in the final analysis. There was no statistically significant difference between the two groups in terms of baseline demographic and clinical characteristics ($p > 0.05$), indicating comparability at baseline. The mean age in the verapamil group was 58.4 ± 12.6 years, while in the metoprolol group it was 60.1 ± 11.8 years. Baseline heart rate was 148.3 ± 14.2 beats per minute (bpm) in Group A and 150.7 ±

15.1 bpm in Group B. Baseline systolic and diastolic blood pressures were also comparable between the two groups. Following drug administration, both groups showed a significant reduction in heart rate. However, the mean time required to achieve rate control was significantly shorter in the verapamil group (24.6 ± 8.3 minutes) compared to the metoprolol group (31.8 ± 9.7 minutes), with a p-value of 0.002. The overall success rate in achieving rate control (heart rate <100 bpm within 60 minutes) was 88% in the verapamil group and 76% in the metoprolol group (p = 0.048). Adverse effects were observed in both groups but were generally mild. Hypotension occurred more frequently in the verapamil group (12%) compared to the metoprolol group (6%), whereas bradycardia was slightly more common in the metoprolol group (8%) compared to the verapamil group (4%). These differences were not statistically significant (p > 0.05). The need for additional intervention was higher in the metoprolol group (20%) compared to the verapamil group (10%).

Table 1: Comparison of Quantitative Variables Between Verapamil and Metoprolol Groups

Variable	Verapamil (n=50) Mean ± SD	Metoprolol (n=50) Mean ± SD	p-value
Age (years)	58.4 ± 12.6	60.1 ± 11.8	0.47
Baseline Heart Rate (bpm)	148.3 ± 14.2	150.7 ± 15.1	0.39
Heart Rate after 60 min (bpm)	92.6 ± 10.4	98.8 ± 12.1	0.01
Time to Achieve Rate Control (min)	24.6 ± 8.3	31.8 ± 9.7	0.002
Systolic BP after treatment (mmHg)	112.5 ± 14.6	118.2 ± 13.9	0.04
Duration of Hospital Stay (hours)	18.4 ± 6.2	20.7 ± 7.5	0.08

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Table 2: Comparison of Qualitative Variables Between Verapamil and Metoprolol Groups

Variable	Verapamil (n=50) n (%)	Metoprolol (n=50) n (%)	p-value
Male Gender	30 (60%)	32 (64%)	0.68
Hypertension	28 (56%)	26 (52%)	0.68
Diabetes Mellitus	18 (36%)	20 (40%)	0.67
Ischemic Heart Disease	14 (28%)	16 (32%)	0.66
Successful Rate Control	44 (88%)	38 (76%)	0.048
Hypotension	6 (12%)	3 (6%)	0.29
Bradycardia	2 (4%)	4 (8%)	0.40
Additional Intervention Required	5 (10%)	10 (20%)	0.16

Overall, intravenous verapamil demonstrated a statistically significant faster rate of achieving ventricular rate control compared to intravenous metoprolol, with a slightly higher success rate. However, both drugs were found to be effective and relatively safe for rate control in atrial fibrillation in the emergency setting.

DISCUSSION

This study was conducted at the Emergency Room of Pak Emirates Military Hospital (PEMH), Rawalpindi. A total of 100 patients

presenting with atrial fibrillation and rapid ventricular rate were enrolled and randomly assigned into two equal groups: Group A (intravenous verapamil, n = 50) and Group B (intravenous metoprolol, n = 50). All participants completed the study and were included in the final analysis. There was no statistically significant difference between the two groups regarding baseline demographic and clinical characteristics (p > 0.05), indicating that both groups were comparable at the start of the study. The mean age in the verapamil group was 58.4 ± 12.6 years, whereas in the metoprolol group it was 60.1 ± 11.8 years. Similarly, the baseline heart rate was 148.3 ± 14.2 beats per minute (bpm) in Group A and 150.7 ± 15.1 bpm in Group B. Baseline systolic and diastolic blood pressures were also comparable between the two groups. After drug administration, a significant reduction in heart rate was observed in both groups. However, the mean time required to achieve rate control was significantly shorter in the verapamil group (24.6 ± 8.3 minutes) compared to the metoprolol group (31.8 ± 9.7 minutes), with a p-value of 0.002. The overall success rate in achieving rate control (defined as heart rate <100 bpm within 60 minutes) was 88% in the verapamil group and 76% in the metoprolol group (p = 0.048).

Adverse effects were noted in both groups but were generally mild. Hypotension occurred more frequently in the verapamil group (12%) than in the metoprolol group (6%), while bradycardia was slightly more common in the metoprolol group (8%) compared to the verapamil group (4%). These differences were not statistically significant (p > 0.05). Additionally, the requirement for further intervention was higher in the metoprolol group (20%) than in the verapamil group (10%). In comparison with other studies, research conducted in 2025 reported that intravenous metoprolol and verapamil were both effective for rate control in acute atrial fibrillation. Verapamil was found to act more rapidly, whereas metoprolol demonstrated a comparatively safer profile, particularly in patients with underlying heart disease. The choice between the two agents was recommended to be individualized based on patient-specific factors, including comorbidities and susceptibility to adverse effects ([11, 13, 16]). Similarly, a study published in 2021 found no significant difference in achieving rate control when intravenous diltiazem, metoprolol, or verapamil were used. The authors concluded that any of these three agents could be utilized for rate control, although they emphasized the need for further research to determine the most effective option ([12, 15]). Furthermore, a study conducted in 2014, while focusing on paroxysmal supraventricular tachycardia (PSVT), reported that although both drugs showed high efficacy, adenosine was more effective than verapamil in terminating PSVT ([14]). Although this finding relates to a different arrhythmia, it highlights the variability in drug efficacy depending on the specific clinical scenario. Overall, the findings of the present study were consistent with previously published literature, demonstrating that both intravenous verapamil and intravenous metoprolol were effective in achieving rate control in atrial fibrillation. However, verapamil achieved rate control more rapidly, while metoprolol showed a relatively favorable safety profile in certain patient populations.

CONCLUSION

Atrial fibrillation remains a significant cause of morbidity and hospital admissions worldwide, necessitating prompt and effective rate control. In this study conducted at Pak Emirates Military Hospital, both intravenous verapamil and intravenous metoprolol were found to be effective in achieving ventricular rate control in patients with atrial fibrillation and rapid ventricular response. Verapamil demonstrated a faster onset of action and a higher rate control success rate, whereas metoprolol showed a comparatively favorable safety profile in certain patients. Therefore, the selection of either agent should be individualized based on patient

characteristics, comorbidities, and risk of adverse effects.

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