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Original Research Article

Effectiveness of Dobutamine in Decreasing Acute MR in Acute Myocardial Infarction

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Abstract:

Background: The Purpose of this study is to assess the Effectiveness of Dobutamine Intravenous Infusion in Acute Myocardial Infarction in Presence of acute Mitral Regurgitation.

Methods: This prospective pre post interventional study was carried out among 50 Patients admitted to Coronary care unit of the Department of Cardiology, KAPV Government Medical College, Trichy with first episode of acute Myocardial infarction in Presence of Acute Mitral Regurgitation within 24 hrs of Symptom onset were recruited for the study. Patient's Age and Gender and examine to identify the signs of Acute MR. Ecg and ECHO assessment of MR was performed as early as possible within 24 hrs of onset of symptoms.

Results: In the present study the mean age of the Patients was 63.7±12.4 and 62% of them were Male and 38% were Female. Among the study Participants, 12% had Anterior Wall Myocardial Infarction and 40% had Inferior and 48% have Inferoposterior wall Myocardial Infarction. In Acute MI With Acute MR after Dobutamine Infusion there is an increase in hemodynamic parameters of Heart Rate (p value 0.001), Systolic BP (p value 0.002), Diastolic Blood Pressure (p Value 0.001), Spo2 (p value – 0.001), S4 (p Value – 0.001). In the Present study there was also strong association that after Dobutamine infusion in Acute MI with Acute MR there was significant improvement of MR Which was substantiated by the following Echocardiographic Parameters of Jet Length (p value 0.001), Jet Area (0.003), ERO (p value 0.001), Vena contracta (p value 0.002), Cradiac output (p value 0.004), Ejection Fraction (p value 0.001), Regurgitant Volume (p value 0.002). Regurgitant fraction (0.001).

Conclusions: The comprehensive echocardiographic evaluation of Acute MR in the context of acute myocardial infarction, after dobutamine infusion has resulted in favourable Haemodynamics and recuded mortality. From the results of the present study, it can be said that dobutamine is a positive inotropic agent that works also as "medical annuloplasty" since it not only increases forward cardiac output but also decreases mitral anular size and mitral regurgitant volume effectively.

Keywords: Dobutamine Infusion, Acute Mitral Regurgitation, Acute Myocardial Infarction.

Introduction

Dobutamine is a cardio selective adrenergic agent that augments the myocardial contractility, Cardiac output and Myocardial Blood flow with minimal changes in Heart Rate or arterial Blood Pressure. Dobutamine not only improves the global performance of the heart, but also reduces the Infarct size. These salutary effects probably are causally related to the increase in Ischemic Myocardial Blood flow by Dobutamine. Mitral Regurgitation after Myocardial Infarction is the result of multi factorial Processes involving Local and global Left ventricular remodeling. The Prevalence of Mitral Regurgitation after Acute MI varies from 11 to 59%. Mitral regurgitation in Acute MI is often clinically silent; Therefore, it should be systematically evaluated by echocardiography. Standard colour Doppler imaging is a highly sensitive method to detect even milder degrees of Ischemic Mitral regurgitation. One unique advantage of echocardiography is that

it accurately quantifies the severity of Mitral Regurgitation by measuring the effective regurgitation orifice area and the regurgitation volume using Doppler methodology. It has been recently suggested that a reduction in Acute MR by Intravenous Dobutamine Infusion might predict a beneficial effect of Acute MR in Acute MI. The objective of the present study was to determine the effectiveness of Intravenous Dobutamine with significant Mitral Regurgitation in Acute Myocardial Infarction.

Materials and Methods

Study Design and Study Duration: This Prospective experimental study utilising pre post interventional design was carried out for one year between January 2023 and December 2023

Study Population: All Patients admitted to Coronary care unit of the Department of Cardiology, KAPV Medical College, Trichy with the first episode of Acute MI with significant Mitral regurgitation within 24 hours of symptoms onset were recruited for the study.

Patient Selection

Inclusion Criteria

1. Patients Presenting with Acute Myocardial Infarction.
2. KILLIP Class II / III Symptoms.
3. Patients with Ischemic MR.
4. Systolic Blood Pressure with more than or equal to 100 mmhg.

Exclusion Criteria

1. MR due to Mitral valve Prolapse.
2. MR Caused by Intrinsic Mitral valve lesion, other cardiac diseases such as Congenital defect, Pericardial diseases, HOCM.
3. Systolic Blood Pressure less than 90 mm hg.
4. Malignant Arrhythmia.
5. Killip Class IV.

ECG Assessment of Acute MI (in absence of LVH and LBBB)

ST Elevation: New ST elevation at the J point in two contiguous leads with the cut points: ≥ 0.1 mV in all leads other than leads V2 – V3 where the following cut points apply: ≥0.2 mV in Men ≥40 years; ≥ 0.25 mV in men < 40 years, or ≥ 0.15 mV in Women.

ST Depression and T Wave Changes: New horizontal or down – sloping ST depression≥ 0.05 mV in contiguous leads and or T wave inversions ≥ 0.1 mV in two contiguous leads with Prominent R wave or R/ S ratio > 1.

Mitral Regurgitation Assessment by Echo: Following admission all patients underwent a comprehensive conventional echocardiographic evaluation. Standardizing is views recommended by the American society of Echocardiography (ASE) were utilized during the examination. Two dimensional echocardiography was performed in the Parasternal Long axis, short axis, apical four – and two chamber views before dobutamine infusion with Acute MI with significant MR and after Dobutamine infusion.

LV systolic function was quantified at baseline by echocardiographic analysis in the apical views according to the modified Simpson's rule. MR was evaluated by colour flow Doppler imaging in Parasternal Long axis, apical views. The gain settings were standardized initially by increasing the settings until colour signals were seen outside the flow area and then reduced until these extraneous signals disappeared.

The optimized gain signals and depth were maintained for each patient throughout the study. From these the total regurgitant jet area was calculated. Vena contracta was calculated as the narrowest portion of a jet that occurs at or just downstream from the orifice & is measured in PLAX, Apical views.

MR Regurgitant volume & EROA were estimated by PISA method. Regurgitant Fraction was estimated by MV regurgitant volume / MV flow x 100. Cardiac output estimated by Stroke volume x Heart rate.

Dobutamine Infusion Protocol: Dobutamine was administered intravenously at a dose of 5 mcg/kg/min and increased to 20 mcg/kg/min and the dose was titrated at 3-minute intervals in increments of 5 mcg/kg/min. The titration was continued to a maximum dose of 20 mcg/kg/min or until undesirable side effects appeared, such as ischemia, hypotension, or ventricular arrhythmia.

The ECG was continuously monitored, and blood pressure was measured at the beginning of each 3-minute stage.

Statistical Analysis: The collected data was entered in MS excel sheet. Categorical data were expressed in frequencies and percentage. Data are presented as mean ± SD and n (%), t-test applied for the continuous variables, Mc Nemar's chi square test applied for the categorical variable. A p value of < 0 .005 accepted as statistically significant.

Results

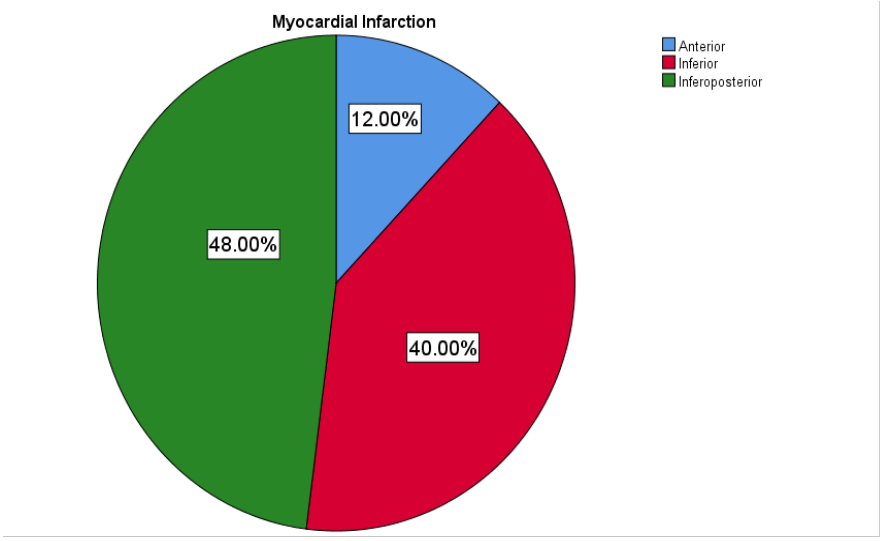

Figure 1: Pie chart showing the type of Myocardial Infarction (n=50)

In the present study, the figure 1 showing the percentile distribution of type of Myocardial infarction. Among the study Population, 12% had anterior wall Myocardial infarction, 48% Inferoposterior wall myocardial infarction, 40% had inferior wall Myocardial infarction.

Table 1: Demographic and Clinical Characteristics of Study Population (n= 50)

Demographic	**Value**
Age	63.7±12.4
Gender	
Male	31(62%)
Female	19(38%)
Myocardial Infarction	
Anterior	6(12%)
Inferior	20(40%)
Inferoposterior	24(48%)
Risk factors	
Smoking	22(44%)
Alcohol	18(36%)
T2DM	21(42%)
Hypertension	25(50%)
Hypercholesterolemia	18(36%)
Killip Class	
Class II	23(46%)
Class III	28(56%)

Data are presented as n, mean ± SD, or n (%). In the Present study, Table 1 shows the mean age of the patients was 63.7±12.4 and 62% were Male and 38% were Females. Risk factors were assessed for this Patient, among them Smokers were 44%, 36% were Alcoholic, 42% were T2DM, 50% Were Hypertensive and 36% have Hypercholesterolemia. Among 50 Patients, 46% were Class II and 56% were Class III.

Table 2: Hemodynamic measurements before and after Dobutamine infusion in Acute MI with MR (n=50)

Hemodynamics	**Before Mean (SD) (OR) n (%)**	**After Mean (SD) (OR) n (%)**	**Test statistics**	**P value**
Heart Rate (beats/min)	83.4±8.3	94.6±7.6	23.09	0.001
Systolic Blood Pressure (mmHg)	113±9	121.8±15.8	4.77	0.002
Diastolic Blood Pressure (mm Hg)	77.4±4.4	87.4±4.4	35	0.001
SPO2	93.8±4.3	98±1	6.65	0.001
S4*	16(32)	2(4)	50	0.001

Data are presented as mean ± SD and n (%), t-test applied for the continuous variables, *McNemar test applied for the categorical variable. In the Present study, Table 2 shows the Hemodynamic

measurements before and after Dobutamine infusion in Acute MI with MR. Baseline Heart rate in Acute MI before Dobutamine administration was 83.4±8.3 and after Dobutamine administration was 94.6±7.6 which shows an increase in Heart rate with significant difference (p value of 0.001). Systolic BP in acute MI before Dobutamine administration was 113±9 and after Dobutamine administration was 121.8±15.8 which shows increase in Systolic BP with significant difference (p value of < 0.005). Diastolic Blood Pressure before Dobutamine administration was 77.4±4.4 and after Dobutamine administration was 87.4±4.4 which shows an increase in Diastolic BP with significant difference (p value 0.001). SPO2 before dobutamine administration was 93.8±4.3 and after Dobutamine administration was 98±1 and showed significant difference with p – value (0.001). S4 was also improved after Dobutamine administration with statistical significance of p value (0.001).

Table 3: Echocardiographic measurements before and after Dobutamine infusion in Acute MI with MR (n=50)

ECHO findings	Before Mean (SD)	After Mean (SD)	Test Statistic	P value
Jet area(cm^2)	7.4±2.1	5.5±1.8	11.22	0.003
Jet length	30.2±8.6	40.2±9.9	13.22	0.001
Vena Contracta	0.5±0.08	0.3±0.1	14.93	0.002
EROA	0.3±0.06	0.4±0.1	9.19	0.001
Cardiac Output	4.8±0.15	4.3±0.2	17.56	0.004
Ejection Fraction	48±3.9	44.4±3.6	6.65	0.001
Regurgitant Volume	45.9±7.4	55±6.8	15.96	0.002
Regurgitant Fraction	41±5.1	48.4±4.6	13.62	0.001

Data are presented as mean ± SD, t-test applied for the continuous variables

Table 3 shows the comparison of echocardiographic Parameters of Acute MI with Acute MR before Dobutamine and After Dobutamine infusion. Jet area was 7.4±2.0 before Dobutamine infusion and 5.5±1.8 after Dobutamine Infusion which shows significant decrease in Jet area with p value (0.003). Jet Length was 30.2±8.6 Before Dobutamine infusion and 40.2±9.9 after Dobutamine Infusion respectively, signifying a noteworthy distinction (p value -0.001). The Vena contracta was 0.5±0.08 before Dobutamine infusion and 0.3±0.1 after dobutamine infusion showed significant difference (p value – 0.002). The EROA before dobutamine infusion was 0.3±0.06 and after Dobutamine infusion was 0.4±0.1 showed significant difference (p value – 0.001). The Cardiac Output was 4.8±0.15 before Dobutamine infusion and cardiac output to 4.3±0.2 after Dobutamine infusion showed significant difference (p value -0.004). The Ejection fraction before Dobutamine infusion was 48±3.9 and after Dobutamine infusion was 44.4±3.6 showed statistical significance (0.001). The Regurgitant Volume before Dobutamine infusion was 45.9±7.4 and after Dobutamine infusion 55±6.8 shows a noteworthy distinction (p value – 0.002). The Regurgitant Fraction before Dobutamine infusion was 41±5.1 and After Dobutamine infusion was 48.4±4.6 showed significant difference (p value – 0.001)

Discussion

This study was designed to determine whether Dobutamine infusion in doses sufficient would improve the clinical parameters of the patients with Acute Mitral Regurgitation following Acute MI. In the Present study, the mean age of the patients was 63.7±12.4 and 62% were Male and 38% were Females. Among the study Population, 12% had anterior wall Myocardial infarction, 48% Inferoposterior wall myocardial infarction, 40% had inferior wall Myocardial infarction. In our present study dobutamine infusion improved acute mitral regurgitation and haemodynamic parameters. Dobutamine infusion was started at 5 mcg/kg/min and increased to 20 mcg/kg/min according to the clinical status of the patient. The mechanism of Acute MR consists of (1) Apical tethering of mitral leaflets due to the outward displacement of the Papillary muscle by local LV remodeling or global LV remodeling and dilatation, which is accompanied by restricted systolic leaflet motion, and (2) Mitral annulus dilatation secondary to LV enlargement, which causes incomplete mitral valve coaptation associated with normal leaflet motion.

The incidence of FMR in patients with inferior myocardial infarction is higher than in those with anterior myocardial infarction3 because FMR is associated with more-severe geometric changes in the mitral valve apparatus and with greater displacement of posterior PM caused by localized inferior basal LV remodeling. Dobutamine improved myocardial contractility and augmented the movement of the inferior segment toward the fibrosa so that tethering of the mitral valve and FMR were reduced. The findings of dobutamine-induced reduction in Mitral regurgitation supported the relationship between the inferior myocardial dysfunction and Mitral regurgitation.

In our study the after dobutamine infusion there is statistically significant improvement in the Heart rate, systolic BP, Diastolic BP (P value< 0.005). Similar findings was observed in the study done by Thomas. A.Gillepsie et al among 100 patients experiencing acute MI with acute MR. In the present study there is a strong association of presence of clinical parameters such as SpO_2, LV S4 in Acute MI with MR and following its improvement with dobutamine Infusion. This finding suggests a potential association between Dobutamine infusion and clinical improvement in patients presenting with Acute MR in myocardial infarction.

In the present study the following Echocardiac parameters Mitral regurgitation Jet area, Jet length, vena contracta, EROA, Regurgitant volume, Regurgitant fraction were compared with before and after Dobutamine infusion in patients with acute MR in myocardial infarction. There was a statistically significant decrease in Echocardiographic Mitral regurgitant parameters. Similar findings were observed in the study conducted by Tatsumi et al in 2010 where 51 patients with Acute functional MR treated with low dose dobutamine infusion showed improvement in Echocardiac parameters of Mitral regugitation.

Consequently, a Improvement in Cardiac output and LV ejection fraction with decreased in hospital Mortality and early discharge after Dobutamine infusion were observed in our study. This is because the dobutamine causing enhanced cardiac contractility (ionotrophic effect) Beta agonist properties of dobutamine contribute to the increase in cardiac output. Lower-dose infusions of dobutamine indirectly mediated vasodilation because of baroreceptor activation resulting from enhanced ventricular contractility and consequent increase in pulse pressure.

Identification of Acute mitral regurgitation is critical in the risk stratification and optimization of treatment approaches for patients afflicted by acute MI. Particularly, the mortality rate for acute IWMI 48% & IPWMI 40% and AWMI 12 % due to acute Mitral Regurgitation were reduced after Dobutamine infusion. The positive Ionotrophic effect as well as ionodilator effect of dobutamine decreases the severity of functional mitral regurgitation leading to decreased in hospital Mortality, decresed length of stay in hospital

Limitations

The study was performed on relatively small sample size. Invasive Haemodynamic assessment of MR was not done. Variables in this study were measured on a single plane, which is not sufficient for assessing the relationship between valve geometry and LV regional function. It is generally assumed that the larger the jet area the greater the severity of MR. However, technical & anatomical factors may influence the colour jet area It has been demonstrated that gain settings, pulse repetition frequency, transducer frequency, scanning dept and filter settings can all influence the colour doppler jet area, EROA, Vena contracta. The patients were followed up only during their stay in hospital, So long term mortality benefit after dobutamine infusion cannot be validated. Furthermore Acute MI patients with cardiogenic shock & arrhythmia with concomitant mitral regurgitation having high mortality were not included in our study

Conclusion

The comprehensive echocardiographic evaluation of Acute MR in the context of acute myocardial infarction, after dobutamine infusion has resulted in favourable Haemodynamics and reduced mortality. The Echocardiographic Severity of Acute MR In Acute MI like JET length, JET area, EROA, Regurgitation Volume, Regurgitation Fraction decreased following dobutamine infusion. Furthermore the Heart Rate, Systolic BP, Diastolic BP, Ejection Fraction have been Substantially improved after Dobutamine infusion. From the results of the present study, it can be said that dobutamine is a positive inotropic agent that works also as “medical annuloplasty” since it not only increases forward cardiac output but also decreases mitral anular size and mitral regurgitation volume effectively. Therefore, when treating patients with acute myocardial infarction associated with significant mitral regurgitation, dobutamine infusion should be highly useful.

References

1. Grigioni F, Enriquez-Sarano M, Zehr KJ, Bailey KR, Tajik AJ. Ischemic mitral regurgitation: long-term outcome and prognostic implications with quantitative Doppler assessment. Circulation. 2001; 103:1759–1764.
2. Blondheim DS, Jacobs LE, Kotler MN, Costacurta GA, Parry WR. Dilated cardiomyopathy with mitral regurgitation: decreased survival despite a low frequency of left ventricular thrombus. Am Heart J. 1991; 122:763–771.
3. Izumi S, Miyatake K, Beppu S, Park YD, Nagata S, Kinoshita N, Sakakibara H, Nimura Y. Mechanism of mitral regurgitation in patients with myocardial infarction: a study using real-time two-dimensional Doppler flow imaging and echocardiography. Circulation. 1987; 76:777–785.
4. Kono T, Sabbah HN, Rosman H, Alam M, Jafri S, Goldstein S. Left ventricular shape is the primary determinant of functional mitral regurgitation in heart failure. J Am Coll Cardiol. 1992; 20:1594–1598.
5. Yiu SF, Enriquez-Sarano M, Tribouilloy C, Seward JB, Tajik AJ. Determinants of the de-

gree of functional mitral regurgitation in patients with systolic left ventricular dysfunction: a quantitative clinical study. Circulation. 2000; 102:1400–1406.
6. Otsuji Y, Kumanohoso T, Yoshifuku S, Matsukida K, Koriyama C, Kisanuki A, Minagoe S, Levine RA, Tei C. Isolated annular dilation does not usually cause important functional mitral regurgitation: comparison between patients with lone atrial fibrillation and those with idiopathic or ischemic cardiomyopathy. J Am Coll Cardiol. 2002; 39:1651–1656.
7. Lancellotti P, Lebrun F, Pierard LA. Determinants of exercise-induced changes in mitral regurgitation in patients with coronary artery disease and left ventricular dysfunction. J Am Coll Cardiol. 2003; 42:1921–1928.
8. Kaul S, Spotnitz WD, Glasheen WP, Touchstone DA. Mechanism of ischemic mitral regurgitation. An experimental evaluation Circulation. 1991; 84:2167–2180.
9. Keren G, Laniado S, Sonnenblick EH, Lejemtel TH. Dynamics of functional mitral regurgitation during dobutamine therapy in patients with severe congestive heart failure: a Doppler echocardiographic study. Am Heart J. 1989; 118:748–754.
10. Ennezat PV, Maréchaux S, Le Tourneau T, Lamblin N, Bauters C, Van Belle E, et al. Myocardial asynchronism is a determinant of changes in functional mitral regurgitation severity during dynamic exercise in patients with chronic heart failure due to severe left ventricular systolic dysfunction. Eur Heart J. 2006; 27:679–683.
11. Keren G, Katz S, Strom J, Sonnenblick EH, LeJemtel TH. Dynamic mitral regurgitation. An important determinant of the hemodynamic response to load alterations and inotropic therapy in severe heart failure. Circulation. 1989; 80:306–313.
12. Enriquez-Sarano M, Seward JB, Bailey KR, Tajik AJ. Effective regurgitant orifice area: a noninvasive Doppler development of an old hemodynamic concept. J Am Coll Cardiol. 1994; 23:443–451.
13. Heikkila J: Mitral incompetence complicating of acute myocardial infarction. Br Heart J 1967;29:162-169
14. Helmcke F, Nanda NC, Hsiung MC, et al: Color Doppler assessment of mitral regurgitation with orthogonal planes. Circulation 1987; 75: 175-183.
15. Thomas JD, Liu C-M, Flachskampf FA, et al: Quantification of jet flow by momentum analy- sis: An in vitro color Doppler flow study. Circu- lation 199O; Bl: 247-259.
16. Shell WE, Sobel BE: Protection of jeopardized ischemic myocardium by reduction of ventricular afterload. N Engl J Med 291: 481-486, 1974
17. Miller RR, Awan NA, Maxwell KS, et al: Combined dopamine and nitroprusside therapy in congestive heart failure\p=m-\greater augmentation of cardiac performance by addition of inotropic stimulation to afterload reduction. Circulation1977; 55:881-884.
18. Tuttle RR, Pollock GD, ToddG, et al: The effect of dobutamine on cardiac oxygen balance, regional bloodflow, and infarction severity after coronary artery narrowing in dogs. Circ Res 1977; 41:357-364.