

Prophylactic Use of Magnesium Sulphate to Prevent Arrhythmias in Patients with Rheumatic Heart Disease Undergoing Closed Mitral Valvotomy

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Abstract:

Maintenance of sinus rhythm is superior to incidence of atrial fibrillation (AF) in patients with rheumatic heart disease undergoing Closed Mitral Valvotomy (CMV). The present study was done to evaluate the effect of prophylactic use of Magnesium Sulphate (MgSO₄), intravenously (i.v) soon after opening the stenosed Mitral Valve using Tubbs dilators by Surgeon, in patients undergoing CMV. One hundred and twenty patients with Mitral Stenosis (MS) (mitral valve area < 1cm²), normal mitral valvular apparatus, no mitral regurgitation, mitral score not more than 7/16 planned for CMV. These patients were divided in two groups of 60 each. Group (I) (n=60) received MgSO₄, 30 mg/kg diluted to 20 ml with normal saline soon after mitral valvotomy and Group - II (n=60) received 20 ml of normal saline. The standardized protocol for CMV was maintained for all the patients. Before surgery AF was observed in 56.67% of patients in group I and 48.33% of patients in group II (p=0.46). Postoperatively in ICU, 30% of patients in group I and 70% of patients in group II had AF (p<0.0001). A single prophylactic intra operative dose of i.v MgSO₄ decreased post valvotomy arrhythmia in comparison to placebo group. Thus, a single dose of intraoperative MgSO₄ can be used to decrease postoperative arrhythmias in patients of M.S undergoing CMV.

Key Words

Atrial Fibrillation(AF), Mitral Stenosis(MS), Magnesium Sulphate(MgSO₄), Closed Mitral Valvotomy(CMV)

Introduction

CMV is a well established method for treatment of rheumatic mitral stenosis. A number of large series have reported successful long term relief of symptoms after operation (1-4). Substantial long term improvement in the mitral valve area following closed valvotomy has been demonstrated (5). The indications for operation are well known and pre-operative factors indicating a successful result have been reported (6,7). AF has been reported to affect operative mortality adversely (8). AF after CMV occurs in 30% of patients during early postoperative period and the percentage increases to 40 -50% after valve surgery (9,10). AF is associated with increased thromboembolic complications(17-18%)and decreased cardiac output (11).

IV Mg SO₄ is used for supraventricular, ventricular and acute myocardial infarction related dysarrhythmias. Low serum concentration is independent risk factor for

AF after cardiovascular surgery which includes procedures like CMV, MVR, CABG. It is proposed as an efficient and safe agent in the treatment of AF. However, the therapeutic effect of Mg SO₄ in treatment of AF is controversial (12,13).

Therefore the present study was conducted to find effect of prophylaxis of MgSO₄ to prevent arrhythmias in patients with rheumatic valve disease (MS) undergoing CMV.

Material and Methods

This study was conducted in Department of Cardiothoracic Anaesthesia of Superspeciality, Government Medical College, Jammu over a period of last 4 years i.e, 2014-2018, where one hundred twenty patients of Isolated MS with MVA < 1 cm², no MR, normal Valvular apparatus, mitral score < 7/16 were

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included (14,15). The study was a prospective, randomized, placebo controlled trial. A written informed consent was obtained from all the patients one day prior to surgery.

The demographic record of patients included name, age, sex, occupation, marital status. A detailed history of breathlessness, palpitation, haemoptysis, chest pain, recurrent chest infection and easy fatiguability was taken. A special note about the history of rheumatic heart disease, joint pain and swelling, rheumatic prophylaxis, and other comorbid diseases like diabetes mellitus, hypertension was taken. Each patient was classified under New York Heart Association (NYHA) classification.

The study was conducted on the Adult patients > 20 years of age, with sinus rhythm/AF with stable haemodynamics.

Those excluded from the study included pregnant patients, thyroid disease, heart rate < 50/mt, NYHA class IV, sick sinus rhythm, moderate to severe MR, left atrial clot, distorted mitral valve apparatus, mitral valve score > 7/16.

Patients were randomly divided in two groups: Group-I (received MgSO₄, 30 mg/kg diluted with normal saline up to 20 ml) and Group-II (received just 20 ml normal saline as placebo group)

Written informed consent 1 day prior to surgery was taken informing about the risk factors involved associated with surgical procedures and anesthesia. All patients received tab. Alprazolam 0.5 mg and tab. Aciloc 150mg, night before surgery and on the day of surgery at 6 am with sip of water. Patients who were on digoxin and dylor, was stopped 24 hours prior to surgery. Morning serum electrolytes on the day of surgery was advised. Rest all drugs for other associated comorbid diseases were continued.

Patients were shifted to operation theatre, 5 lead ECG was attached, with lead II & V5 on the monitor. Baseline heart rate and rhythm were noted, followed by inserting 20 G arterial cannula in radial artery to monitor beat to beat variability of blood pressure after infiltration of 2% xylocaine with insulin syringe. Non invasive blood pressure cuff was attached, SPO₂ probe attached on right index finger.

All the invasive and non invasive lines were inserted on right hand. After local anaesthetic infiltration peripheral line was inserted and ringer lactate started at very slow rate, as fluid loading may lead to pulmonary oedema in such patients.

Preoxygenation was done atleast for 3 minutes,

followed by induction with 1 mg of injection midazolam. inj. ondansetron 4 mg, Inj. Etomidate (0.4 mg/kg) and Inj. Rocuronium 1 mg/kg. after 1 minute., once patients eye lash reflex is lost patients were intubated with appropriate sized tube after spraying larynx with 10% Xylocaine (2 puffs) with video laryngoscope. During our induction and intubation all parameters of patients were kept, as far as possible to base line, so as to avoid any tachycardia, hypertension or hypotension, so called smooth induction and intubation. Patients were maintained on Inj. rocuronium, 50% O₂ & 50% air and sevoflurone followed by insertion of right internal jugular vein catheter and urinary catheterization to measure urine output.

Left lateral thoractomy was done by surgeons, left atrial atriatomy was done, followed by left ventricular(LV) nick and dilation of LV apex with hagers dilator. Tubbs dilator was inserted from LV and surgeons could feel the positioning of tubbs dilator through left atrium by surgeons index finger.

Once the surgeon was ready and anaesthetist was informed that they are going for dilation, 100% oxygen was given to the patient, both carotids were compressed with pressure so as to avoid any emboli to carotid circulation. Once procedure was over Inj. MgSO₄, 30 mg/kg diluted to 20 ml given to Group-I patients and placebo to Group-II. Inotropes were started at appropriate dose to keep blood pressure and heart rate under normal values. Once the patient was haemodynamically stable and hemostasis was achieved, patients were reversed with Inj. Neostigmine (0.05 mg/kg) and Inj. Glycopyrrolate (0.01 mg/kg). Patient was awakened, all vital parameters were stable, patients were shifted to intensive care unit(ICU) for post-operative monitoring.

Results

One hundred and twenty patients were enrolled in two groups. Group-I received (60 pts) Mg SO₄ diluted to 20 ml saline and Group-II (60 pts) received NS 20 ml. All patients completed the study and rendered for post-operative monitoring and assessment. There was no significant difference in the baseline characteristics of the patients comorbidities, anaesthesia technique, type of procedure used in two groups (*Table 1*).

During pre-operative period, incidence of sinus rhythm and AF in both the groups were comparable (P=0.46, table 2). At the end of surgical procedure and during the time of discharge, there were significantly higher frequency of AF in Group-II as compared to Group-I (P<0.001 and P=0.002) respectively (*Table 2*).

Table 1: Demographic data of Group-I (Magnesium Sulphate) and Group-II (Normal Saline)

Variables	Group-I (MgSo4) (n=60)	Group-II (Normal saline) (n=60)	Statistical inference
Mean age \pm Standard deviation, years	43.18 \pm 11.21	42.79 \pm 10.92	t=0.19; p=0.84*
Sex (Female : Male)	34:26	31:29	p=0.71*
Mean height \pm Standard deviation, cm	158.38 \pm 5.53	159.62 \pm 5.78	t=1.20; p=0.23*
Comorbidities:			
Diabetes mellitus	22 (36.67%)	19 (31.67%)	p=0.70*
Hypertension	26 (43.33%)	21 (35.00%)	p=0.45*
Smoking	12 (20.00%)	14 (23.33%)	p=0.82*
Left ventricular function (EF), %	50.79 \pm 4.61	51.21 \pm 5.05	t=0.47; p=0.63*
NYHA Class:			
Class-II	29 (48.33%)	32 (53.33%)	p=0.71*
Class-III	31 (51.67%)	28 (46.67%)	
Type of Mitral Valve Disease:			
Mitral stenosis	60 (100.00%)	60 (100.66%)	p=1.00*

* : Not Significant
** : Significant

Table 2: Comparison of Incidence of Sinus Rhythm and Atrial Fibrillation in the two Groups at Pre-operative, Post-operative and at the time of Discharge.

Variables		Pre-operative (n=60) No. (%)	Post-operative ICU (n=60) No. (%)	At the time of Discharge (n=60) No. (%)
Group-I	Sinus rhythm	26 (43.33)	42 (70.00)	40 (66.67)
	Atrial (Mg SO4) fibrillation	34 (56.67)	18 (30.00)	20 (33.33)
Group-II	Sinus rhythm	31 (51.67)	18 (30.00)	19 (31.67)
	Atrial (Saline) fibrillation	29 (48.33)	42 (70.00)	41 (68.33)
Statistical inference		p=0.46*	p<0.0001**	p=0.0002**

* : Not Significant
** : Significant

Discussion

Post-operative cardiac arrhythmias are a frequent complication of surgical procedure like CMV and even MVR. To improve the care of patients undergoing CMV, effective prophylactic measures should be taken to prevent post-operative AF.

The present study observed that age, gender,

comorbidities like diabetes, hypertension, anesthetic technique, type of procedure were not significantly related to the development of post-operative AF (P>0.05). These results are similar to those of Mathew *et al.* (16). Tiryakioglu *et al.* study showed that prophylactic use of Mg SO4 was effective in preventing arrhythmia following

CABG, (17). which are similar to our study where in Group-I, AF reduced by 26.67% from pre-operative to post-operative period, while in Group-II, AF increased by 21.67%.

Patients were monitored for 48 hours in ICU for any kind of arrhythmia. Our study did not witness any significant incidence of hypotension on bradycardia in either of the group. Before discharge of patients, incidence of AF was also significantly low in group I as compared to group II ($p=0.0002$). Like our study, Alghamdi *et al.* also found a highly significant reduction in relative risk of AF with the addition of MgSO₄ (18). Mohamed *et al.* also concluded that the prophylactic use of magnesium sulphate in patients with rheumatic heart disease undergoing isolated cardiac valve replacement surgery can reduce the incidence of post operative AF (19). Naghipour *et al.* offered the prophylactic use of magnesium in patients undergoing cardiac surgery, they noticed a significant decrease in the incidence of all types of post cardiac surgery arrhythmias and hospital length of stay in these patients (20).

Conclusion

I.V prophylactic MgSO₄ is effective in prevention of arrhythmias following CMV in patients with mitral valve disease with or without AF. The dose of MgSO₄ (30 mg/kg) is well tolerated and more effective in these patients.

References

1. Ellis LB, Singh JB, Morales DD, Harken DE. Fifteen to twenty year study of one thousand patients undergoing closed mitral valvotomy. *Circulation* 1973;48:357-64.
2. Brock R. Long -term results after closed mitral valvotomy. *Isr J Med Sci* 1975;11:122-29.
3. John S, Krishnaswami S, Jairaj PS, Cherian G, Muralidharan S, Sukumar IP. The profile and surgical management of mitral stenosis in young patients. *J Thorac Cardiovasc Surg* 1975;69:631-38.
4. Fraser K, Turner MA, Sugden BA. Closed mitral valvotomy. *Br Med J* 1976;2:352-53.
5. Heger JJ, Wann LS, Weyman AE, *et al.* Long term changes in mitral valve area after successful mitral commissurotomy. *Circulation* 1979;59:443-48.
6. Ankeney JL. Indications for closed or open heart surgery for mitral stenosis: review of 152 operated cases. *Ann Thorac Surg* 1967;3:389-405.
7. Ellis LB, Benson H, Harken DE. The effect of age and other factors on the early and late results following closed mitral valvuloplasty. *Am Heart J* 1968;75:743-51.
8. Grantham RN, Daggett WM, Cosimi AB, *et al.* Transventricular mitral valvotomy; analysis of factors influencing operative and late results. *Circulation* 1974;50(S2):200-12.
9. Shrivastava R, Smith B, Caskey D, Reddy P. Atrial fibrillation after cardiac surgery: does prophylactic therapy decrease adverse outcomes associated with atrial fibrillation. *J Intensive Care Med* 2009;24(1):18-25.
10. Tapio H, Jari H, Kimmo M, Juha H. Prevention of atrial fibrillation after cardiac surgery. *Scand Cardiovasc J* 2007;41:72-78.
11. Alpert JS, Peterson P, Godtfredsen J. Atrial fibrillation. natural history, complications and management. *Annu Rev Med* 1988;39:41-52.
12. Rajagopalan B, Narasimha D, Bhatia A, *et al.* Efficacy of intravenous magnesium for cardioversion of atrial fibrillation. *Circulation* 2014;130(S2):A13495.
13. Cook RC, Yamashita MH, Kearns M, *et al.* Prophylactic magnesium does not prevent atrial fibrillation after cardiac surgery: a meta-analysis. *Ann Thorac Surg* 2013;95:533-41.
14. Baumgartner H, Hung J, Bermejo J, Chambers JB, Evangelista A, Griffin BP, *et al.* Ecocardiographic assessment of valve stenosis :EAE/ASE recommendations for clinical practice. *J Am Soc Echocardiogr* 2009;22(1):1- 23.
15. Wilkins GT, Weyman AE, Abascal VM, Block PC, Palacios IF. Percutaneous balloon dilatation of the mitral valve: analysis of echocardiographic variables related to outcome and mechanism of dilatation. *Br Heart J* 1988;60(4):299-308.
16. Mathew JP, Fontes ML, Tudor IC, Ramsay J, *et al.* A multicenter risk index for atrial fibrillation after cardiac surgery. *JAMA* 2004;291(14):1720-29.
17. Tiryakioglu O, Demirtas S, Ari H, Tiryakioglu SK, Huysal K, Selimoglu O, *et al.* Magnesium sulphate and amiodarone prophylaxis for prevention of postoperative arrhythmia in coronary by-pass operations. *J Cardiothorac Surg* 2009;4:8.
18. Alghamdi AA, Al-Radi OO, Latter DA. Intravenous magnesium for prevention of atrial fibrillation after coronary artery bypass surgery: a systematic review and meta-analysis. *J Card Surg* 2005;20:293-99.
19. Mohamed FN, Abdallah EE, Ibrahim AS, El-Minshawy AM, Elmelegy TT. Magnesium sulphate for prophylaxis against post operative atrial fibrillation after isolated valve replacement surgery in adult patients with rheumatic heart disease : a randomised controlled trial. *J Anesth Clin Res* 2018;9(3):810.
20. Naghipour B, Faridaalae G, Shadvar K, Bilehjeni E, Khabaz AH, Fakhari S. Effect of prophylaxis of magnesium sulfate for reduction of postcardiac surgery arrhythmia: Randomized clinical trial. *Ann Card Anaesth* 2016;19:662-67.