Effectiveness of magnesium sulphate for prevention of atrial fibrillation after coronary artery bypass grafting

Abstract:

Introduction and background: Postoperative atrial fibrillation is the most common complication that develops after cardiovascular surgery and is associated with adverse outcomes. Magnesium is an essential element in the body, which is required as a cofactor for over 300 enzymatic reactions and reduced levels of magnesium in the blood have been found related with an increased risk of AF, both in ambulatory setting and after cardiac surgeries. Our study was aimed at determining role of prophylactic magnesium sulphate in preventing postoperative AF in subjects undergoing CABG. This would eventually improve the overall outcome of patients undergoing cardiovascular surgeries.

Objective: To compare efficacy of magnesium sulphate with control group for prevention of atrial fibrillation after coronary artery bypass surgery.

Study duration and setting: 6 months from November 2019 to April 2020 at Department of Cardiac surgery, Cardiac Center PIMS Islamabad.

Materials and methods: In the present study, enrolled a total of one hundred and twenty eight (n=128) patients of both gender between age 50-70 year who were planned for coronary artery bypass surgery. The trial was conducted in compliance with the international on Harmonization guidelines for good clinical practices and according to the declarations of Helsinki. All the patients were randomized by lottery method into group A, who were given intravenous injection of 200 mEq MgSO$_4$ in 100 ml of normal saline/day for 03 days and group B, who were given intravenous injection of 100 ml of normal saline only for 03 days. All the patients had continuous cardiac monitoring performed for 72 hours to observe for occurrence of AF. Occurrence of postoperative AF was compared in both groups by applying chi-square test, a p-value of <0.05 was considered as significant.

Results: There were 93.8% (n=60/64) males and 6.3% (n=4/64) females in group A and 90.6% (n=58/64) males and 9.4% (n=6/64) females in group B. Mean age of subjects in group A was 59.9 years ± 6.7 SD while it was 58.6 years ± 6.3 SD in group B. Mean baseline LVEF was 52.7% ± 8.1 SD in group A while it was 53.4% ± 5.9 SD in group B. Postoperative AF was observed in 12.5% (n=8/64) patients in group A while it was observed in 45.3% (n=29/64) patients in group B (p=0.001). When stratified for age and gender magnesium sulphate was found more effective in preventing postoperative AF in younger males (p=0.001).

Conclusion: In the present study, postoperative AF was developed in significantly lesser number of patients who received prophylactic magnesium sulphate as compared to placebo group. Magnesium sulphate was found more effective in preventing postoperative AF among younger males.

Significance of the study: AF was most commonly assessed post-operatively after cardiac surgery. Findings of our study suggest that Magnesium sulphate administration during CABG serves a prevalantive strategy for post-op AF.

Keywords: Atrial fibrillation • CABG • Magnesium sulphate
Introduction

Atrial Fibrillation (AF) may occur in early postoperative period after cardiac surgery and it may be manifested as a late complication. It occurs in about 15%-40% of patients undergoing CABG. The incidence is higher (approximately up to 60%) in patients who experience CABG combined with valve replacement. Atrial fibrillation after CABG is related to certain preoperative factors, which include prior degenerative changes in atrial myocardium and perioperative factors like an increase in phase-3 depolarization, dispersion of refractoriness of atria, enhancement in automaticity, shorter inter-atrial conduction time, reduced conduction velocity and fluid and electrolyte shifts. These electrophysiologic factors lead to and promote the development of AF [1].

Postoperative AF is associated with several adverse outcomes, which include increased cardiovascular, renal, and cerebral complications; increased cost of care and resource utilization; and reduced long-term survival [1]. It is accepted that the mean age of menopause through worldwide appraisal ranges from 45 to 55 years. Magnesium is an essential element in the body, which is required as a cofactor for over 300 enzymatic reactions and reduced levels of magnesium in the blood have been found related with an increased risk of AF, both in ambulatory setting and after cardiac surgeries. Several mechanisms are involved by which hypomagnesaemia promotes AF [2]. These include its effect on duration of action potential, atrioventricular conduction and on effective refractory period of atria. Administration of Magnesium prophylaxis for the prevention of POAF in the context of cardiac surgery appeared to confirm these beneficial results [3]. In a study conducted in 1996, Nurözler et al., aimed to assess the efficacy of prophylactic use of magnesium sulfate in reducing the occurrence of postoperative AF in patients undergoing CABG [4]. Two groups of 25 patients each were included in study. In one group (Study), magnesium was administered in a dose of 200 mEq during first five days after the surgery, while in the other group (Placebo) normal saline was given. Their results demonstrated that 4% of patients in the MgSO₄ group experienced AF as compared to 20% of patients who experienced AF in the control group (p<0.05) [5]. Post-operative AF is a complication with significant complications. Our study aimed at determining role of magnesium sulphate in preventing atrial fibrillation in patients after coronary artery bypass surgery [6]. The current study had assessed to determine the effectiveness of magnesium sulphate for prevention of atrial fibrillation after coronary artery bypass grafting. Atrial fibrillation is a major complication in CABG patients postoperatively. Most of the patient can develop life threatening arrhythmias postoperatively and increase the mortality rate. Magnesium sulphate is very effective for the management of atrial fibrillation in post-op patients.

Material and Methods

Study duration and place

Study was conducted over a period of 6 months, from November 2019 to April, 2020 at Pakistan institute of medical sciences department of Cardiac surgery.

Data collection tool

Data was collected through validated Performa which contain both open and close ended questions.

Sampling technique

Sample was collected by using Non probability convenient sampling method. SPSS was used for Statistical analysis of the data.

Ethical consideration

The study was conducted after obtaining approval from Institutional review board of Bashir Medical Institute. Verbal informed Consent was also taken from the patients. The trial was conducted in compliance with the international on Harmonization guidelines for good clinical practices and according to the declarations of Helsinki [7].

Patient and public Awareness

Study was conducted after the approval of Review board committee and patients involvement. A written informed consent was taken from the patients. 128 patients were included in this study after meeting the inclusion criteria.

Data Analysis procedure

The data were entered in SPSS version 20. Descriptive statistics was used to calculate means ± SD for quantitative variables i.e. age. Frequencies with percentage were calculated for qualitative variables i.e. gender and occurrence of atrial fibrillation. Chi square test was applied for comparison of efficacy between both groups. Effect modifiers like age and gender were controlled by stratification. Post stratification chi-square test was applied. P value < 0.05 was considered significant.

Results

Demographic profile of enrolled patients

In the present study, we enrolled a total of one hundred and twenty eight (n=128) patients of both gender between age 50-70 year who were planned for coronary artery bypass surgery. All the patients
were randomized by lottery method into group A, who were given intravenous injection of 200 mEq MgSO$_4$ in 100 ml of normal saline/day for 03 days and group B, who were given intravenous injection of 100 ml of normal saline only for 03 days. All the patients had assessed through continuous cardiac monitoring performed for 72 hours to observe for occurrence of AF. There were 93.8% (n=60/64) males and 6.3% (n=4/64) females in group A and 90.6% (n=58/64) males and 9.4% (n=6/64) females in group B (Table 1). Mean age of subjects in group A was 59.9 years ± 6.7 SD while it was 58.6 years ± 6.3 SD in group B (Table 2). Different age groups are shown in (Table 3). Mean baseline LVEF was 52.7% ± 8.1 SD in group A while it was 53.4% ± 5.9 SD in group B (Table 4).

Postoperative atrial fibrillation

Postoperative AF was observed in 12.5% (n=8/64) patients in group A while it was observed in 45.3% (n=29/64) patients in group B. P-value estimated was 0.001, implying postoperative AF was developed in significantly lesser number of patients who received prophylactic magnesium sulphate as compared to placebo group (Table 5). When stratified for age (Table 6) and gender (Table 7) magnesium sulphate was found more effective in preventing postoperative AF in younger age group (p<0.001) and males (p<0.001).
coronary artery bypass surgery. In the present study, we enrolled a total of one hundred and twenty eight (n=128) patients of both gender between age 50-70 year who were planned for coronary artery bypass surgery. All the patients were randomized by lottery method into group A, who were given intravenous injection of 200 mEq MgSO$_4$ in 100 ml of normal saline/day for 03 days and group B, who were given intravenous injection of 100 ml of normal saline only for 03 days. All the patients had continuous cardiac monitoring performed for 72 hours to observe for occurrence of AF. Occurrence of postoperative AF was compared in both groups by applying chi-square test, a p-value of <0.05 was considered as significant.

Magnesium is an essential element in the body, which is required as a cofactor for over 300 enzymatic reactions. Magnesium supplementation may reduce the incidence of postoperative ventricular arrhythmias [9]. In a comprehensive systematic review Shepherd et al., assessed the clinical efficacy and cost-effectiveness of magnesium sulfate in comparison with placebo and sotalol for the prevention of postoperative [10] AF in subjects who underwent CABG. They selected 22 patients, which met their criteria of inclusion. All the selected trials reported comparison of magnesium sulfate with placebo or control. They did not find any trial comparing magnesium with sotalol [11]. The pooled data of more than one thousand patients comprised of magnesium group showed 21% had developed postoperative AF compared with 30% patients in the placebo/control group. They also reported AF was less likely to develop when a longer duration of prophylaxis was used, and the earlier that prophylaxis is started. No clear relationship between dose and AF was observed although a lower constant dose rate was associated with the lowest odds of AF [12]. Our study also in alignment with other similar studies on the subject. In a study conducted at Japan, Naito Y assessed effect of magnesium infusion as a prophylactic therapy on postoperative AF [13]. They assigned 62 patients either to IV magnesium or placebo (saline) group [14]. Their results showed that postoperative AF developed in 10.0% patients in magnesium group compared to 43.8% patients in the control group (p<0.01) [15]. In summary, based on the present study results and comprehensive review of literature on the subject, the available evidence strongly suggest that prophylactic use of magnesium sulphate results in significantly lower incidence of postoperative AF after cardiac revascularization surgery. The therapy is safe with no reported adverse events. In the present study, we did not compare the length of hospital stay associated with administration of magnesium and control group. We suggest future research in this regard. Further areas of research that should be investigated are relationship between dose rate, dose and timing of initiation of therapy, duration of prophylaxis and subject characteristics, such as degree of risk for AF. Economic analysis comparing magnesium with other therapies for being in use for prevention is another area for future research [16].

**Limitations of study**

It was included only adult patients not included pediatrics. It has a limited sample size and collect data from only one hospital.

**Conclusion**

In the present study, postoperative AF was developed in significantly lesser number of patients who received prophylactic magnesium sulphate. Magnesium sulphate was found more effective in preventing postoperative AF among younger males. As it plays an important role in cardiovascular health with relevance to the proper maintenance of cellular membrane potential, mitochondrial function and a key role in antioxidative pathways.

**Conflict of Interest**

We hereby confirm that there is no conflict of interest associated with publication.

**Acknowledgement**

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**Author's Contributions**

Attiya Hameed Khan and sajjad Ali shah participated in all aspects of the experiment and writing the manuscript. Attiya Hammmed Khan contributed to the proteomic analysis. Sajjad Ali Shah collects data. Hammad Ahmed and Attiya Hameed khan designed the experiment and contributed to the analysis and discussion of data. All authors read and approved the final manuscript.

**References**


