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An Educational Module for the Use of Magnesium to Decrease Postoperative Risk of Arrhythmias in Patients Undergoing Coronary Artery Bypass Graft Surgery: A Quality Improvement Project

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An Educational Module for the Use of Magnesium to Decrease Postoperative Risk of Arrhythmias in Patients Undergoing Coronary Artery Bypass Graft Surgery: A Quality Improvement Project

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Introduction

Problem Identification

Heart disease is the number one cause of death in the United States (U.S.), according to the American Heart Association (AHA).[1] There are approximately 500,000 open-heart surgeries performed yearly.[2] However, many complications can arise after an open-heart procedure, including infarction, ischemia, tamponade, dysrhythmias, cardiac failure, coagulopathy, and hemorrhage.[3] With the development of postoperative atrial fibrillation (AF) being a common complication, in patients undergoing coronary artery bypass graft (CABG) surgery, there is a 20-40% chance the patient will develop postoperative atrial fibrillation (POAF).[4]

When a patient develops POAF, they are at an increased risk of stroke by five times, and it also decreases the efficacy of the heart's pumping mechanism that could lead to heart failure, according to the National Health Services (NHS).[5] Current measures to help prevent this increased risk in CABG surgery patients include placing patients on a beta-blocker, amiodarone, and left atrial appendage closure.6 As an anesthesia provider, what can be done to help further reduce POAF in CABG patients? In this project, the goal is to see if intraoperative magnesium sulfate can help further reduce the chances of developing POAF in patients undergoing CABG surgery.

Background

CABG is a surgical procedure used to treat coronary heart disease by diverting blood around major stenosed arteries to improve blood flow and oxygen supply to the heart. There are approximately 500,000 CABG procedures done a year.[2] However, one major complication from a CABG procedure in POAF. POAF is new-onset atrial fibrillation with a peak effect 2-4 days postoperative.[6] The occurrence of POAF is approximately 35% in patients undergoing a cardiac

procedure.[6] It has consequences that include prolonged ICU stay, increased cost for treatment of AF, and an additional 2-5 days in the hospital.[6] POAF increases the patient risk of a stroke by 2-4 folds, increases reoperation due to bleeding and infections, can lead to cardiac arrest, cerebral complications, the requirement of a permanent pacemaker, and overall increased mortality 2-folds at the 30 day and 6-month mark. Currently, the management of patients on beta-blockers has lessened the risk of patients developing POAF. The use of amiodarone and clipping of the left atrial appendage has also decreased the patient's risk of developing complications from AF.[6] As an anesthesia provider, will magnesium sulfate further reduce the patient's risk of developing POAF after cardiac surgery?

Magnesium is an abundant mineral in the body present naturally in many foods we ingest. According to the National Institute of Health, magnesium is also a cofactor in more than 300 reactions that regulate biochemical reactions that include protein synthesis, muscle, nerve function, glucose control, blood pressure regulation, and help regulate normal heart rhythms.[7] In a systematic review done by Del Gobbo et al., they concluded that patients with higher serum magnesium levels had a significantly lower risk of cardiovascular disease and were also at a lower risk of ischemic heart disease caused by a reduced blood supply.[8] With magnesium being a natural mineral in the body and can help lower the risk of heart disease, why isn't intraoperative magnesium used by practitioners more common?

Scope of the Problem

AF is a common complication that can occur after CABG surgery. POAF can cause significant complications that include an increased stay at the hospital to complications leading to death. Currently, patients are pretreated with beta-blockers to reduce the chances of developing POAF, but the occurrence of developing this disease process is approximately 35%

for those undergoing a cardiac procedure.[6] Intraoperatively, the surgeon can clip the left atrial appendage, a specific area that clots can form if the heart goes into AF. Once a patient develops POAF, amiodarone can be given intravenously to convert the patient from AF to sinus rhythm.

In addition to the use of beta-blockers, magnesium sulfate can also be a helpful adjunct in preventing POAF. A randomized double-blinded study done by Bahremand et al. concluded that intraoperative magnesium sulfate effectively prevents postoperative arrhythmias following a CABG procedure.[9] A study was done by Naghipour et al. also concluded that intraoperative magnesium sulfate helped reduce the incidence of all types of arrhythmias after undergoing cardiac surgery.[11] The implementation of magnesium sulfate to help reduce arrhythmias provides a cost-effective and safe adjunct to improve patient outcomes.

Consequences of the Problem

Development of POAF after a CABG procedure can cause severe complications for the patient. POAF causes the heart to beat irregularly, thus leading to a reduced blood flow. With a reduced flow, formation of a clot can occur thus leading to a stroke, heart failure, and or other cardiac-related complications. Patients who develop POAF increase their chances of a stroke by 2 to 4-fold, increase the risk of bleeding, infections, and need of a permanent pacemaker.[6] On top of these complications, patients with POAF also incur an additional bill of $10-20K for treatment of POAF, increased intensive care unit (ICU) stay, and a prolonged hospital stay.[6] Overall, in the United States, it is estimated that over $1 billion is spent annually due to the complications of POAF after CABG surgery.[6]

Knowledge Gaps

In 2011 the American College of Cardiology Foundation (ACCF) and The American Heart Association (AHA) came out with a guideline for patients undergoing CABG surgery.

Based on the guidelines written by Hillis et al., anesthetic management is geared toward early recovery, early postoperative extubation, optimal levels of analgesia, and patient comfort throughout the perioperative and postoperative period.[11] Improvement in interdisciplinary communication can enhance patient safety, and use a fellowship-trained cardiac anesthesiologist trained in the use of the transesophageal echocardiography (TEE) to provide or supervise anesthetic care in patients who are to be considered high risk is highly recommended.[11] Historically, the management of CABG patients involves several anesthetic techniques, including volatile agents, high-dose opioids, and preoperative medications. In the 1970s and 1980s, high-dose opioids with benzodiazepine were commonly used. Still, it later became clear that volatile agents provided a level of protection in the setting of reperfusion of the heart and preventative in myocardial ischemia.[11]

The ACCF/AHA guidelines also provide guidelines for beta-blockers at least 24 hours before a CABG procedure to help reduce the incidence of clinical sequelae of POAF.[11] To help further decrease the incidence of POAF, intraoperative magnesium can be a cost-effective and safe adjunct to minimize postoperative complications further. In a randomized double-blinded clinical study done by Bahremand et al. in comparing 87 patients who received 3 grams of magnesium intravenous versus giving 87 patients 100 ml of isotonic 0.9% fluids, there was a reduced significance of arrhythmias in patients who received magnesium and no side effects of the drug was observed.[9]

Proposal Solution

There is currently no correct way to provide anesthesia for patients who undergo CABG procedures, but ACCF and AHA set forward a guideline. When considering an anesthetic plan for a patient, preoperative medications, intraoperative management, and postoperative

complications need to be evaluated. As an anesthesia provider, using magnesium sulfate intraoperatively as an adjunct can increase patient satisfaction, decrease the patient risk of developing POAF, reduce extended stay due to complications, and decrease the patient's cost of care. Before a patient undergoes open-heart surgery, patients will have taken a beta-blocker 24 hours of the procedure as it is known to help reduce the chances of the patient developing POAF and decrease the risk of sequelae related to this common complication.[11] The addition of giving IV magnesium intraoperative has also shown a significance at reducing the development of arrhythmias postoperatively.[9]

Summary of the Literature

The AHA states that heart disease is the number one cause of death in the U.S. With advancements in medicine, there are medical and surgical ways to help lessen or resolve these complications. One way is through the CABG procedure, which diverts blood around narrowed arteries and improves blood flow and oxygenation supply to the heart. However, there are complications in which postoperative arrhythmias are the most common with every process. A randomized, double-blind study by Naghipour et al. concluded that the use of magnesium significantly reduced the occurrence of postoperative arrhythmias who underwent cardiac surgery and overall reduced their hospital stay.[10]

In continuation of the use of magnesium to decrease the development of postoperative arrhythmias, Bahremand et al. came up with a very similar conclusion. Their double-blinded randomized control trial concluded that the use of magnesium effectively reduced the prevalence of postoperative arrhythmias and that use of magnesium should be used prophylactically.[9] Soliman and Abukhudair reached similar conclusions with their study. Soliman and Abukhudair concluded that magnesium provided a better cardioprotective effect on patients undergoing

cardiac surgery when compared to patients not receiving magnesium.[12] They also showed a correlation that magnesium led to a decrease in myocardial infarctions, and patients also required less pharmacological and mechanical support post cardiac surgery.[12]

Through the systematic review of the literature, it was evident that magnesium helped reduce the occurrence of POAF. In the study done by Fairley et al., they analyzed the administration of magnesium to reduce the risk of AF after cardiac surgery. Their study concluded that magnesium did reduce the developmental risk of arrhythmias in patients' post-cardiac surgery and recommended that magnesium be given due to the low cost, minimal risks, and the cardiac protective effect it provides.[13] One of the challenges they described in the study was the lack of clinical uniformity, methodological uniformity, and 13 out of the 35 studies selected were at high risk of bias.[13]

Lastly, the systemic review done by Salaminia et al. concluded that administration of magnesium could be safe and cost-effective in preventing cardiac arrhythmias.[14] In this study, some limitations included lack of uniformity of the trials with the dosage of magnesium and clinical setting, unable to subgroup and analyze patients on concurrent use of antiarrhythmic medications.[14] Lastly, the potential for bias cannot be ruled out. Salaminia et al. advise that further research should be done about the dose and timing of giving magnesium until this method is proven effective in preventing cardiac arrhythmias.[14]

Individual Studies

In the study by Naghipour et al., the authors wanted to explore ways to reduce the number of postoperative arrhythmias after heart surgery since it is a significant and common

complication.[10] It can lead to an increased risk for morbidity and mortality. The study focused on studying magnesium's effect on reducing postcardiac surgery arrhythmias. This double-blind, randomized controlled trial had a total of 160 participants who were randomly assigned to one of two groups. Group 1 received 30 mg/kg of magnesium in a 500 mL normal saline bag, while group 2 (control group) received 500 mL of normal saline. Inclusion criteria for this study included adults over the years of 18, normal sinus rhythm perioperative, and stable hemodynamics. Exclusion criteria for this study included patients with chronic AF, heart rate of less than 50, prior history of AF, previous history of cardiac surgery, recent MI of less than six weeks, current use of antiarrhythmics, ejection fraction of less than 30%, hyperkalemia of > 2.8 mmol/L, and pulmonary arterial hypertension with a mean > 30 mmHg. Naghipour et al. utilized Chi-square and Fisher's exact test to compare the occurrence of arrhythmias and comparison between the two groups.[10] Use independent t-test was used to compare surgical time, length of ICU stay, and length of hospital stay. Statistical significance was set at $P < 0.05$ was considered a significant finding. There was no statistical significance between the two groups regarding sex and age ($P=0.476$ and $P= 0.231$). The average surgical time between the two groups was 5.9 hours and 5.7 hours with the $P= 0.212$. There were no differences between the two groups in hemodynamic values during the postoperative course and arterial blood gas of potassium or ionized calcium ($P > 0.05$). However, there was a significant difference in the incidence of arrhythmias between the two groups ($P= 0.037$), with AF being the most common arrhythmia produced postoperatively.

Naghipour et al. concluded that the implementation of magnesium decreased the incidence of arrhythmias in patients who underwent cardiac surgery by 59%.[10] Intraoperative magnesium also significantly reduces hospital stay for patients undergoing cardiac surgery.

Compared to other studies similar to theirs, they tried to resolve imperfections by setting up the study as a double-blind, randomized trial that included all types of arrhythmias such as AF, ventricular fibrillation, ventricular tachycardia, and junctional rhythms. However, the study did have significant limitations, including patients on chronic use of beta-blockers, classification of the type of cardiac surgery, and failure to measure magnesium concentration in the patients studied.

To follow, in the study done by Bahremand et al., the authors' goal was to investigate the use of prophylactic magnesium in treating arrhythmias that occur following CABG surgery.[9] This study is a randomized, double-blinded study, which consisted of 174 patients undergoing the CABG procedure.[9] Patients were divided into one of two groups. Group 1 had 87 participants given 3 grams of magnesium in 100 mL of normal saline over 2 hours at five different times, including 12 hours before the operation, immediately following the procedure, and postoperative days 1,2 and 3. Group 2 (control group), which also contained 87 participants, received only 100 mL of normal saline over 2 hours five times, including 12 hours before the operation, immediately following the procedure, and postoperative days 1,2, and 3.

Bahremand et al. concluded that arrhythmias occurrence was significantly reduced in favor of the group who received magnesium (P= 0.013).9 While, there were no significant differences in other operative or postoperative measurements that included sex, age, and hemodynamics. Following the study, Bahremand et al. conclude that the prophylactic use of magnesium effectively prevents arrhythmias in patients undergoing CABG procedures.[9] However, if arrhythmias occur despite prior administration of magnesium, intervention with the help of amiodarone is preferred to correct this complication.

Soliman and Abukhudair (conducted a study to measure the effects of magnesium in patients with left ventricular hypertrophy undergoing cardiac surgery to improve patient outcomes and reduce postoperative complications.[12] The study's hypothesis is that perioperative magnesium will improve cardiac outcomes of patients undergoing cardiac procedures. This study is a double-blinded randomized study that includes 250 patients with left ventricular hypertrophy undergoing CABG surgery or aortic valve replacement under cardiopulmonary bypass. Patients were assigned to Group M (magnesium group) and Group C (control group). Group M received a continuous magnesium infusion at 15 mg/kg/h that was started 20 minutes before induction and maintained until after the first 24 hours postoperatively. In contrast, Group C received the same amount in normal saline. Exclusion criteria for this study included patients with acute myocardial infarct, mitral or tricuspid valve surgery, renal impairment, hepatic impairment, obstructive cardiomyopathy, previous mitral valve surgery, previous tricuspid valve surgery, congestive heart failure, and malfunctioning artificial heart valve.

Soliman and Abukhudair (2019) utilized the student's t-test to compare numerical variables between study groups. Use of the Chi-square test was performed for comparing categorical data, and use of Fisher's exact test was used when the expected frequency was <5.12. With $P < 0.05$, the evidence will be considered statistically significant. The two groups regarding demographic data, comorbidities, preoperative medication, and American Society of Anesthesia physical status score showed no significant differences. Many considerable differences between the two groups include increased mean arterial pressure (MAP) in Group C, increased systemic vascular resistance in Group C, and a significant decrease in pulmonary arterial blood pressure and peripheral vascular resistance.12 Between the two groups, there were no differences in cardiac bypass time, cross-clamping time, blood loss, transfused packed red blood cells,

neurological complications, renal complications, and hematocrit values (P> 0.05).[12] There was also a significant difference in ICU and hospital length stay in Group M versus patients in Group C.

Soliman and Abukhudair concluded that the implementation of magnesium produces a cardioprotective effect on patients with left ventricular hypertrophy undergoing major cardiac surgery.[12] Magnesium also helps decrease the incidence of perioperative myocardial infarction and arrhythmias, reduce pharmacological and mechanical support, and decrease ICU and hospital stay. Limitations for this study included a limit to a single center in gathering information and limited researchers on the discussion of the topic.

In the study by Fairley et al., the authors aimed to evaluate the efficacy of parenteral magnesium as a prevention or treatment of postoperative arrhythmias in patients undergoing cardiac surgery.[13] The second central concept the authors aimed to investigate was the association of magnesium in comparison with mortality and patient-centered care. The authors utilized MEDLINE, CENTRAL, and EMBASE as search engines with keywords specific to their research topic. Data from 1975 to October 2015 in the combination of search terms magnesium and cardiothoracic surgery yielded manuscripts of interest and were revied by two authors for potential relevance.

The results of their systematic review found that 35 publications met their inclusion criteria. 13 studies were identified as high risk of bias, seven studies were identified as low risk of bias, and 15 studies were identified as unclear risk of bias. Of the 35 studies, 34 publications examined magnesium prophylaxis, and a study explored treatment. The systematic review found that most studies were at a high or unclear risk of bias and had significant heterogeneity in method, timing, and amount of magnesium given. They also found no mortality effects,

inconsistent effects, and no significant increase in adverse events. Fairley et al. also found that magnesium was associated with reduced development of AF, with the most effective approach being a bolus of 60 mmol of magnesium over 24 hours.[13]

The study concluded that the use of postoperative magnesium appears to reduce AF after CABG surgery and is free from significant adverse events.[13] However, they found insufficient evidence that the use of magnesium will prevent other arrhythmias after cardiac surgery.[13] Based on these findings, low cost and minimal risk of magnesium therapy, administration of magnesium to the patient after cardiac surgery is highly suggested.

In a study done by Salaminia et al., they aimed to evaluate the effect of magnesium administration on the incidence of cardiac arrhythmias after cardiac revascularization.[14] The authors utilized SID, Magiran, IranDoc, IranMedex, MedLib, PubMed, ISI, Web of Science, Scopus, and Google Scholar. Included in this study were studies that have the effects of magnesium on cardiac arrhythmias and mortality after cardiac surgery in both English and Farsi, with the time frame ranging from 1986 to 2017.

The results of their systematic review found that magnesium helped lower the occurrence of cardiac arrhythmias compared to the placebo group. Salaminia et al. also found out that magnesium consumption also helps decrease ventricular and supraventricular arrhythmias when compared to the placebo group.[14] However, they did find several limitations that included lack of uniformity in the amount of magnesium given and clinical setting, insufficient data about concurrent use of antiarrhythmics agents, and sample size and standard deviations could have also influenced the outcomes.

Individual Studies Chart

Author(s)	Purpose	Methodology/ Research Design	Intervention(s)/ Measures	Sampling/ Setting	Primary Results	Relevant Conclusions
Naghipour et al., (2016)	To analyze the effect of magnesium sulfate for the reduction of postcardiac surgery arrhythmia	Double-blind, randomized controlled trial Level I	A double-blind, randomized controlled trial was performed on patients who underwent cardiac surgery between January and September of 2014 to evaluate the occurrence of postoperative arrhythmias in patient who received magnesium (test group) compared to patients who received normal saline (control group).	For the study, 160 patients were included. Patient's age was greater than 18 years and divided into two groups, 80 in group 1 and 80 in group 2.	Review of resources utilizations reported a significant reduction in incidence of postoperative development of arrhythmias and a decrease in overall length of hospital stay for those patients who received magnesium intraoperatively.	The study concluded that magnesium significantly decreased the incidence of arrhythmias in patients who underwent cardiac surgery by 59%. Also, patients who received magnesium also significantly reduced their hospital length stay.
Bahremand et al., (2014)	To investigate the use of prophylactic magnesium in treating arrhythmias to may occur	Double-blind randomized controlled trial Level 1	A double-blind randomized controlled trial was performed on patient who underwent CABG procedure. Group	For the study, a total of 174 patients included in this study. Patients were divided into two groups,	Review of the study show that the prevalence of arrhythmia prevalence was reduced significantly in	The study concluded that use magnesium sulfate is effective at preventing arrhythmia that

	postoperatively following CABG procedure.		1 (test group) received 3 grams of magnesium in 100 mL of normal saline over 2 hours 12 hours prior to surgery, immediately after surgery and postoperative days 1, 2 and 3. Group 2 (control group) received only 100 mL of normal saline at 12 hours prior to surgery, immediate after surgery and postoperative days 1, 2, and 3.	87 in group 1 and 87 in group 2.	favor for the group that was pretreated with magnesium when compared to the control group. However, there was no difference in operative or postoperative measurements between the 2 groups.	can occur following CABG surgery. Magnesium should be used in prophylactic treatment since it may decrease arrhythmia at low doses.
Soliman and Abukhudair, (2019)	To investigate the use of perioperative magnesium to improve cardiac outcomes in patients with left ventricular hypertrophy who are undergoing cardiac surgery that includes	Double-blind randomized controlled trial Level 1	A double-blind randomized contrail trial was performed on patients with left ventricular hypertrophy undergoing cardiac surgery. Group M received magnesium at 15 mg/kg/hr with the	For the study, a total of 250 patients were divided into two groups, 125 in Group M and 125 in Group C.	Review of the study showed use of magnesium led to a significant improvement of left ventricular systolic function and helped decrease mortality compared to	The study concluded that use magnesium sulfate is effective at preventing arrhythmia that can occur following CABG surgery and AVR.

	CABG or aortic valve replacement on cardiopulmonary bypass (AVR).		infusion starting 20 minutes prior to induction and maintained until 24 hours postoperative of the procedure. Group C received an equal amount in normal saline.		those who received normal saline.	
Fairley et al., (2019)	To evaluate the efficacy of magnesium administration as prophylaxis or treatment of post-operative arrhythmias in patients undergoing cardiac surgery	Systematic literature review Level 1	Literature review conducted using MEDLINE, CENTRAL and EMBASE. Search was aimed at finding studies that identified magnesium and cardiothoracic surgery	Data was collected from 1975 to October 2015. The search was further limited to only adults undergoing cardiac surgery and excluded pediatric and obstetric studies.	Search on use of magnesium on cardiac surgery patients yielded 35 studies. 34 studies examined prophylaxis of magnesium in prevention of POAF and a single study was found in exploring treatment for POAF. The use of post-operative magnesium was associated with a reduction of POAF.	Post-operative magnesium administration reduced the risk of AF after cardiac surgery and was free of significant adverse events. Due to the low cost and minimal risk, it is recommended that use of magnesium should be appropriately recommended.

Salaminia et al., (2018)	To evaluate the effect of magnesium administration on the incidence of cardiac arrhythmias after cardiac revascularization	Systematic literature review Level 1	Literature review conducted using SID, Magiran, IranDoc, IranMedex, MedLib, PubMed, ISI, Web of Science, Scopus, and Goggle Scholar. The search aimed to evaluate the effect of magnesium sulfate on cardiac arrhythmias and mortality after cardiac surgery.	Total participants include 6,061 individuals, with 2987 in the magnesium group and 3074 in the placebo group.	Search on magnesium and the effects on post-operative arrythmias yielded a total of 22 published articles from 1986 to 2017 to be analyzed. The review showed that the total rate of cardiac arrhythmias was significantly lowered in the group receiving magnesium compared to the placebo group.	The study concludes that administration of magnesium could be safe, cost effective in the prevention of cardiac arrhythmias. Further research should be done about the dose and timing of giving magnesium in the prevention of cardiac arrhythmias.

Purpose/PICO Clinical Questions/Objectives

PICO Question or Purpose

Population (P): Patients undergoing CABG procedure

Intervention (I): Use of intraoperative magnesium sulfate

Comparison (C): No use of intraoperative magnesium sulfate

Outcomes (O): Decrease the occurrence of POAF

Primary DNP Project Goal

The primary goal of this project is to increase cardiac knowledge in anesthesia providers on the use of magnesium in reducing postoperative arrhythmias in patients undergoing CABG procedures. The site where the intervention will be implemented will include clinical areas where the student attends. The types of anesthesia providers will consist of a medical doctor (M.D.) of anesthesia, certified registered nurse of anesthesia (CRNA), and student registered nurse of anesthesia (SRNA). The implantation of the goal will include a pretest to test current knowledge, followed by a presentation, and ending with a posttest. Both pretest and posttest will be compared. The goal is to increase anesthesia providers' understanding of magnesium and its benefits for open-heart patients.

Goals and Outcomes

The goal is to this project is to educate anesthesia providers on the effects of magnesium sulfate on patients undergoing open-heart surgery. The acronym SMART will be used to refer to specific, measurable, achievable, realistic, and timely and will guide this project.[15] A short education intervention implementation will be measured with a pretest and post-examination. The goal is achievable within the timeframe set by the academic program. The project will be implemented throughout one semester, and results will be evaluated and disseminated the

following semester. The goal is to collaborate with anesthesia providers with the allowed student resources of time, intervention, pretest, and posttest. The objective will be achieved by the end of the academic semester.

Definition of Terms

CABG

CABG is a surgical procedure used to treat coronary heart disease by diverting blood around major stenosed arteries to improve blood flow and oxygen supply to the heart.[3]

POAF

POAF is defined as new-onset AF with a peak effect of 2-4 days postoperative.[6]

Conceptual Framework of the Project

The conceptual framework used will be The Donabedian model. The Donabedian measures and assesses the quality of health care organizations based on three categories: structure, process, and outcome measure.[16] The setting of this project will be presented in a faculty lounge where all anesthesia providers will be invited to participate in the study. The process of the project will include a pretest, educational intervention, a posttest, and evaluation. Finally, the outcome will be measured by comparing pretest scores with posttest scores.

This project aims to improve the knowledge of anesthesia providers on the use of magnesium and its benefits in reducing POAF in CABG patients. The theoretical framework for this project will be based on Leininger's Culture Care Theory of Diversity and Universality. Leininger's Theory attempts to provide culturally nursing care based on cognitively based assistive, supportive, facilitative, or enabled acts or decisions tailored to fit the individual,

group's or institution's cultural values, beliefs, and lifeways.[17] Her Theory helped educate providers and guided them to provide culturally congruent care. The study is based on open-heart patients, so magnesium has many benefits overall. It can be applied to many different scenarios to help further benefit the patient undergoing a medical procedure.

Methods

Eligibility Criteria

The studies evaluated for the literature review were chosen based on the inclusion and exclusion criteria to discern the objectives best. Inclusion criteria included studies published within the past ten years, written in English and with full-text availability. Exclusion criteria included studies greater than ten years old and subjects less than 21 years old. Lastly, studies focused on intraoperative magnesium on cardiac procedure patients were emphasized. Database sources used for the research were accessed via the Florida International University (FIU) library services.

Information Sources

The databases utilized for the search included The Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and Embase. The Preferred Reporting Items further guided the literature review for Systematic Reviews and Meta-Analyses (PRISMA).

Search Strategy

The initial search yielded 46 articles. Key search terms were expanded to include: (Magnesium) AND (Coronary Artery Bypass Graft* OR CABG* OR Coronary Artery Bypass Graft Surgery* OR Cardiac Surgery) AND (Atrial Fibrillation* OR Afib* OR AF* OR Arrhythmia). To ensure the most relevant and latest articles were reviewed, only articles published within the past ten years and written in English were included. This yielded 21 articles

for CINAHL, PubMed Central, and EMBASE. The remaining 21 articles were retrieved and sent to the citation database for review. Five duplicate reports were removed, leaving sixteen articles for further consideration. Titles were excluded if they did not meet inclusion criteria.

Sixteen articles were reviewed and approved for a full review of the abstract. Of the sixteen articles, ten pieces met the criteria and were further analyzed by reading the full text. Only the articles that met the highest level of research were chosen, leaving five elements for summarization. Pieces that were removed included those that were meta-analysis and focused on education.

The five articles chosen for this literature review analyzed the critical concept of magnesium to reduce the chances of patients developing POAF after cardiac surgery. Three of the five authors, including Naghipour et al., Bahremand et al., and Soliman and Abukhudair, evaluated patients via a randomized controlled trial to explore effects and seek out significant differences in patients who received and did not receive magnesium during cardiac surgery. The remaining two studies are systematic reviews by Fairley et al. and Salaminia et al.

Methodology

Setting and Participants

This study will take place at an appointed facility per school policy. The facility will be in South Florida, and the providers themselves and the population they serve are of diverse backgrounds. The types of providers included in this study will be MDs, CRNAs, and SRNAs.

Description of Approach and Project Procedures

The DNP project intervention will begin with participants taking a pretest, followed by a program, and end with a posttest. Data will be collected before the educational intervention to

include demographics, years of practice, and previous training history. The training is expected to have a duration of 20 minutes.

Protection of Human Subjects

All anesthesia providers will be invited to participate via email. Suppose the Institutional Review Board (IRB) determines that this study poses more than minimal risk. In that case, participants will be consented via a HIPAA compliant online survey using such platforms as Qualtrics or Survey Monkey. Participants will have the right to withdraw their consent at any time. Benefits of participation will include improving knowledge, self-reflection, and how it affects their care. No identifiable data will be collected during the study. Data will be stored in a password-protected online database and only accessible to the primary investigator.

Data Collection

Demographic data to be collected will include gender, race, ethnicity, and education. Participants will be asked to provide numbers of years working in their field of practice. And finally, pretest and posttest scores will be recorded and documented.

Data Management and Analysis Plan

Data will be stored in a database, password-protected, and only used by the primary investigator. No direct identifiers will be collected. Pretest and posttest scores will be collected, scored, and compared before and after the intervention.

Results

Demographics

The demographics are shown in Table 1.

Table 1 Participant Demographics

Participant Demographics	
Total Participants	**8 (100%)**
Gender	
Male	4 (50%)
Female	4 (50%)
Age	
20-40	4 (50%)
41-60	4 (50%)
Ethnicity	
Hispanic	3 (37.5%)
Caucasian	2 (25%)
African American	1 (12.5%)
Other	2 (25%)
Medical Position	
CRNA	8 (100%)
MD	0 (0%)
Education	
Masters	6 (75%)
Doctorate	2 (25%)
Years Of Experience	
0-2 years	1 (12.5%)
3-5 years	2 (25%)
6-10 years	3 (37.5%)
11 years or more	2 (25%)

There were 8 participants in the pretest and posttest demographics and all 8 participants completed the study. The participants were male (n=4, 50%) and female (n=4, 50%). There were also a range of ethnicities represented: Hispanic (n=3, 37.5%), Caucasian (n=2, 25%), African American (n=1, 12.5%) and other (n=2, 25%). Information was obtained regarding the participant's role at the hospital. It was found that only CRNAs (n=8, 100%) participated in the study. The participants were questioned about the length of time practicing, findings that the practice period ranged: 0-2 years (n=1, 12.5%), 3-5 years (n=2, 25%), 6-10 years (n=3, 37.5%), and 11 years or more (n=2, 25%).

Pretest Magnesium and Cardiac Procedures

This section contains information regarding pretest knowledge of use of magnesium to decrease risk of postoperative arrhythmias in patients undergoing cardiac procedures. All participants (100%) were aware that the number one cause of death in the United States is heart disease. There were slightly more participants (62.5%) who knew about the cost associated with open heart surgery. Slightly less participants (37.5%) understood the percentage chance of a patient who underwent CABG surgery to develop arrythmias postoperatively. Half of the participants (50%) were able to identify the increased risk of development of stroke after surgery. All participants (100%) were aware of the complications of POAF. A minimal number of participants (12.5%) were able to identify how many cofactors magnesium is involved in. All participants (100%) had knowledge of magnesium being able to regulate biochemical reactions. Most participants (87.5%) understood adverse drug reactions to magnesium sulfate. Most participants (87.5%) can understand that magnesium is not the drug of choice of POAF. Finally, half of the participants (50%) were able to identify which channel magnesium effect of the heart.

Pretest Preventative Measures

Most participants (87.5%) were neither likely nor unlikely to use magnesium as a preventative measure for preventing POAF in patients who underwent a CABG procedure. However, this does not mean participants were convinced one way or the other. Based on the pretest, most participants remained neutral about this topic.

Pretest Recommendation to Apply in Practice

All participants (100%) were neither likely nor unlikely to recommend magnesium as a preventative measure to prevent development of POAF.

Posttest Magnesium and Cardiac Procedures

This section contains information regarding posttest knowledge of use of magnesium to decrease risk of postoperative arrhythmias in patients undergoing cardiac procedures. All participants (100%) were aware that the number one cause of death in the United States is heart disease. All participants (100%) knew about the cost associated with open heart surgery. Most participants (62.5%) understood the percentage chance of a patient who underwent CABG surgery to develop arrythmias postoperatively. Most of the participants (87.5%) were able to identify the increased risk of development of stroke after surgery. Almost all participants (87.5%) were aware of the complications of POAF. A minimal number of participants (37.5%) were able to identify how many cofactors magnesium is involved in. All participants (100%) had knowledge of magnesium being able to regulate biochemical reactions. All participants (100%) understood adverse drug reactions to magnesium sulfate. All participants (100%) can understand that magnesium is not the drug of choice of POAF. Finally, most of the participants (75%) were able to identify which channel magnesium effect of the heart.

Posttest Preventative Measures

Half of the participants (50%) were neither likely nor unlikely to use magnesium as a preventative measure for preventing POAF in patients who underwent a CABG procedure. Based on the posttest, participants varied more than the pretest. After the posttest, participants had more of an opinion on use of magnesium to prevent measures for POAF.

Posttest Recommendation to Apply in Practice

Half of the participants (50%) were neither likely nor unlikely to recommend magnesium as a preventative measure to prevent development of POAF. Compared to the pretest, there was more variability when recommending magnesium to other colleagues.

Table 2 Pretest/Posttest Knowledge

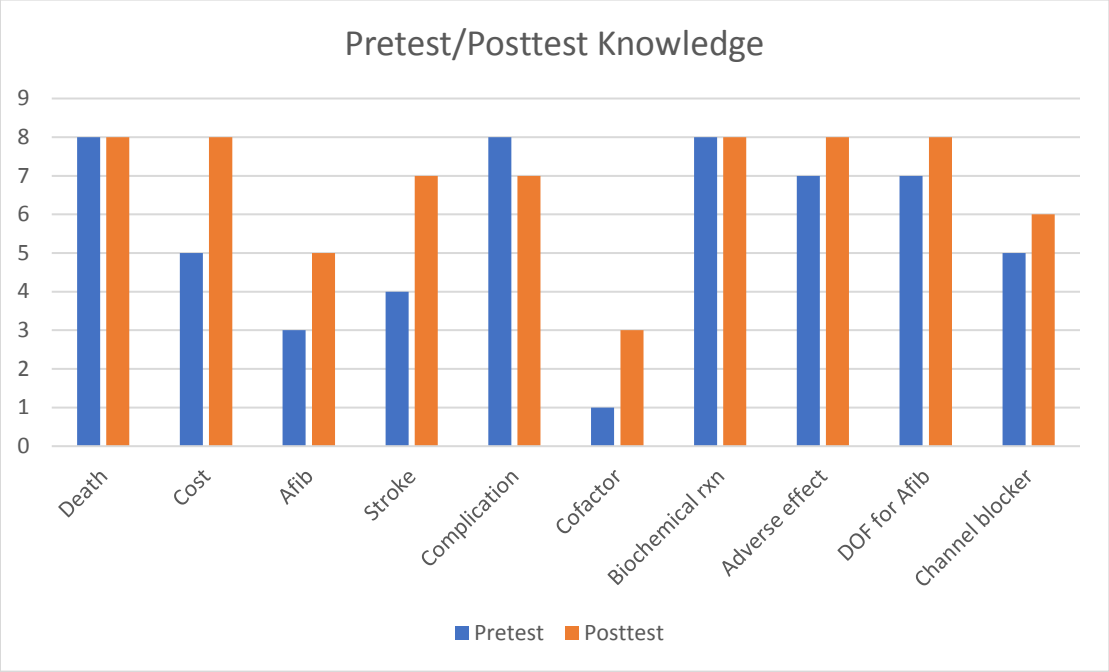


Table 3 Average Overall Pretest Versus Posttest Score

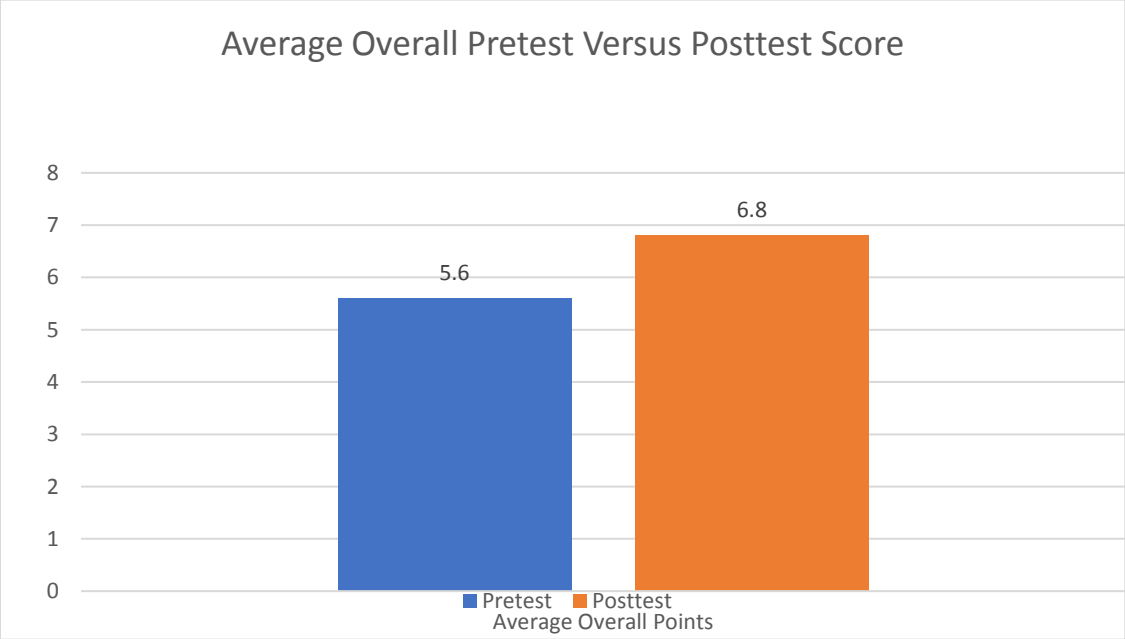


Table 4 Preventative Measure

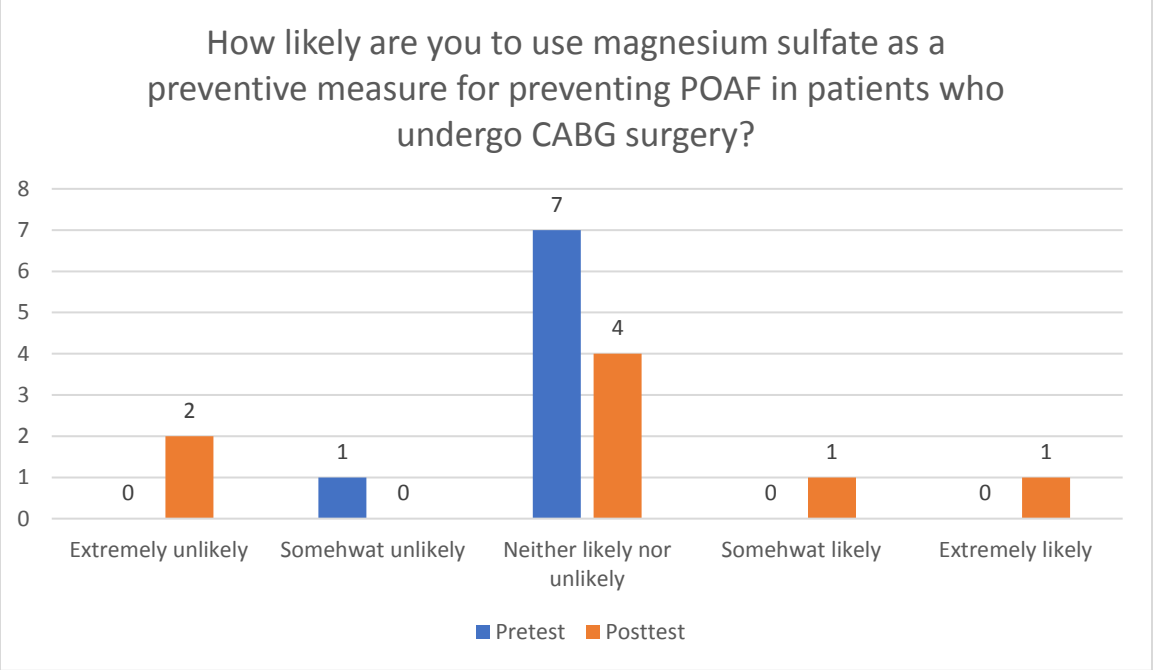
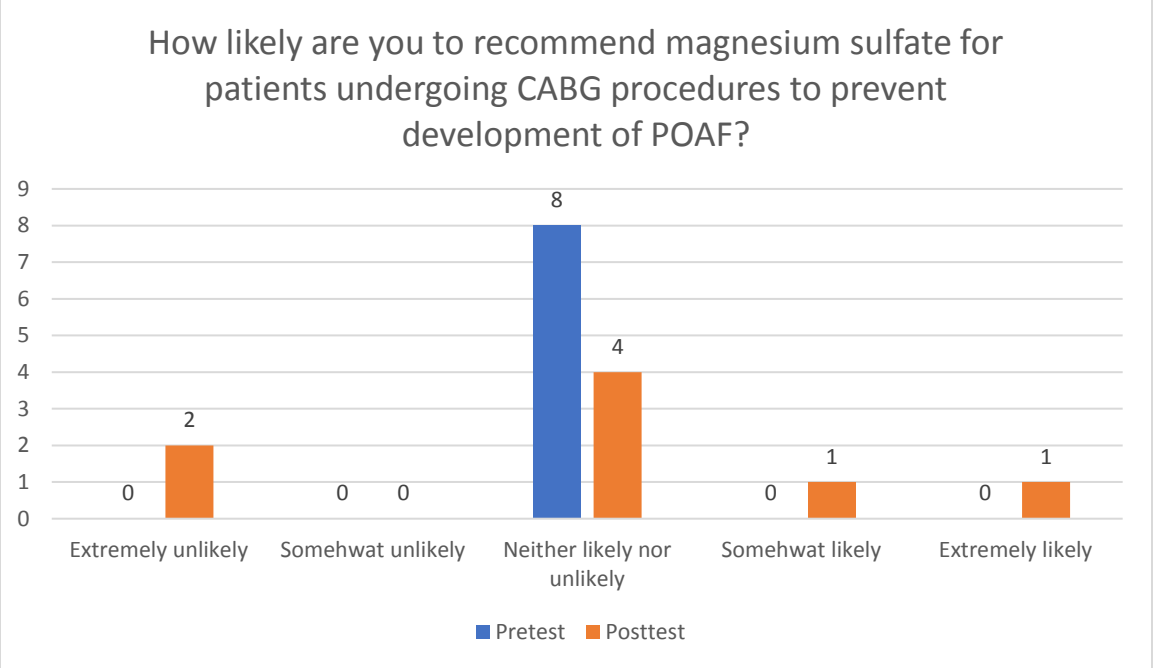


Table 5 Recommendation to Apply in Practice



Discussion

Limitations

Limitations include small sample size, single system, email invitation, self-selection bias, and online PowerPoint delivery. A bigger sample size would be recommended for a more accurate representation of the population. The sample population also came from a single health care group in which only CRNAs participated in the survey. Other anesthesia providers included in this population would be MDAs and AAs. Since the invitation was sent out via email, not all providers will check their emails daily, and with the survey being entirely voluntary, self-selection bias is also present. With the application of an online PowerPoint delivery, scores were improved when comparing pretest and posttest.

Discussion of results with Implications to Advanced Nursing Practice

The use of a valid hypothesis can have many positive implications. Use of magnesium to help reduce POAF in CABG patients, however as a health care provider, how will this information help improve the quality of care given to other patients. The use of magnesium has many benefits, including antiarrhythmic, a muscle relaxant, helps as an adjunct to anesthesia, helps with constipation, acid reflux, and many more things. A better understanding of medication can help provide a better outcome for patients undergoing surgery. The effect of this training was to demonstrate that a short intervention would improve knowledge and provide a positive impact for the anesthesia provider. This current study can enhance the existing literature, which lacks the use of intraoperative magnesium in preventing POAF in patients undergoing CABG surgery. The sample of this population will be unique because of the multicultural diversity of the Florida population and its collaboration with MDs, CRNAs, and SRNAs.

Conclusion

Overall, magnesium should be used prophylactically to prevent postoperative arrhythmias in patients undergoing cardiac surgery. This measure should be set as a standard of practice unless contraindicated to improve patient outcomes and patient safety. This effort will help reduce the prevalence of postoperative arrhythmias post-surgery, leading to fewer complications such as stroke, infarction, ischemia, tamponade, dysrhythmias, cardiac failure, coagulopathy, bleeding, and mortality. The patient will also have a reduced stay in the ICU, hospital length stays, and require a reduced number of medications postoperatively.

In conclusion, the information obtained from the five studies will help establish the groundwork for a quality improvement project that focuses on reducing postoperative arrhythmias in patients undergoing cardiac surgery. By utilizing the latest evidence-based research, quality improvement is expected to improve surgical outcomes and patient satisfaction.

References

1. American Heart Association. (2021). 2021 *Heart disease and stroke statistics update fact sheet at-a-glance.* https://www.heart.org/-/media/phd-files-2/science-news/2/2021-heart-and-stroke-stat update/2021_heart_disease_and_stroke_statistics_update_fact_sheet_at_a_glance.pdf
2. Lifespan. (2018, July 18). *The evolution of heart surgery*. https://www.lifespan.org/lifespan-living/evolution-heart-surgery
3. Jaffe, RA. (2014). *Anesthesiologist's manual of surgical procedures*. Wolters Kluwer Health
4. Benedetto, U., Gaudino, M.F., Dimagli, A., Gerry, S., Gray, A., Lees, B., Flather, M., & Taggart, D.P. (2020). Postoperative atrial fibrillation and long-term risk of stroke after isolated coronary artery bypass graft surgery. Circulation, 142, 1320-1329. https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.120.046940
5. National Health Services. (2021, May 17). *Overview atrial fibrillation*. https://www.nhs.uk/conditions/atrial-fibrillation/
6. Greenberg, J.W., Lancaster, T.S., Schuessler, R.B., & Melby, S.J. (2017). Postoperative atrial fibrillation following cardiac surgery: a persistent complication. European Journal of Cardio-Thoracic Surgery, 54(4), 665-672. https://doi.org/10.1093/ejcts/ezx039
7. National Institutes of Health. (2021). *Magnesium*. https://ods.od.nih.gov/factsheets/Magnesium-HealthProfessional/
8. Del Gobbo, L.C., Imamura, F., Wu, J.H.Y., Otto, M.C., Shiuve, S.E., Moazaffarian, D. (2013). Circulating and dietary magnesium and risk of cardiovascular disease: a

systematic review and meta-analysis of prospective studies. *American Journal of Clinical Nutrition*, 98, 160-173. https://pubmed.ncbi.nlm.nih.gov/23719551/

9. Bahremand, M., Mohammad, R., Sedigheh, K., Gholam, R.M., Gholam R.S., & Samira, M. (2015). Efficcacy of prophylactic use of magnesium sulfate for prevention of post-operative arrhythmias in coronary artery bypass graft operations. *Health Services*, 36(4), 24-29. https://mj.tbzmed.ac.ir/Article/9455
10. Naghipour, B., Faridaalaee, G., Shadvar, K., Bilehjani, E., Khabaz, A.H., & Fakhari, S. (2016). Effect of prophylaxis of magnesium sulfate for reduction of postcardiac surgery arrhythmia: randomized clinical trial. Annals of Cardiac Anaesthesia, 19(4), 662-667. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5070326/
11. Hillis, L.D., Smith, P.K., Anderson, J.L., Bittl, J.A., Bridges, C.R., Byrne, J.G., Cigarroa, J.E., DiSesa, V.J., Hiratzka, L.F., Hutter, A.M., Jessen, M.E., Keeley, E.C., Lahey, S.J., Lange, R.A., London, M.J., Mack, M.J., Patel, M.R., Puskas, J.D., Sabik, J.F. … Winniford, M.D. (2011). 2011 accf/aha guideline for coronary artery bypass graft surgery. Circulation, 124, 652-735. https://www.ahajournals.org/doi/10.1161/CIR.0b013e31823c074e
12. Soliman, R., & Abukhudair, W. (2019). The perioperative effect of magnesium sulfate in patients with concentric left ventricular hypertrophy undergoing cardiac surgery: a double-blinded randomized study. Annals of Cardiac Anaesthesia, 22(3), 246-253. https://www.annals.in/article.asp?issn=0971-9784;year=2019;volume=22;issue=3;spage=246;epage=253;aulast=Soliman
13. Fairley, J.L., Zhang, L., Glassford, N.J., & Bellomo, R. (2017). Magnesium status and magnesium therapy in cardiac surgery: a systematic review and meta-analysis focusing

on arrhythmia prevention. Journal of Critical Care. 42, 69-77. https://doi.org/10.1016/j.jcrc.2017.05.038

14. Salaminia, S., Savehmiri, F., Angha, P., Savehmiri, K., & Motedaven, M. (2018). Evaluating the effect of magnesium supplementation and cardiac arrhythmias after acute coronary syndrome: a systematic review and meta-analysis. BMC Cardiovascular Disorders. 18(129). https://bmccardiovascdisord.biomedcentral.com/articles/10.1186/s12872-018-0857-6
15. Moran, K., Burson, R., & Conrad, D. (2020). *The doctor of nursing practice project* (3rd ed.). Burlington, MA: Jones & Bartlett Learning.
16. Donabedian, A. (1988) The quality of care: How can it be assessed? *The Journal of the America Medical Association, 260*, 1743-1748
17. Leininger, M. & McFarland, M. R. (2006). *Culture care diveristy and universality: A worldwide nursing theory* (2nd ed.) Sudbury, MA: Jones & Bartlett

Appendix IRB Approval

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Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Vicente Gonzalez
CC:	Henry Huynh
From:	Elizabeth Juhasz, Ph.D., IRB Coordinator EJ
Date:	April 6, 2022
Protocol Title:	**"Use of Magnesium to Decrease Postoperative Risk of Arrhythmias in Patients Undergoing Coronary Artery Bypass Graft Surgery: An Educational Module"**

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #:	IRB-22-0131	**IRB Exemption Date:**	04/06/22
TOPAZ Reference #:	111462		

As a requirement of IRB Exemption you are required to:

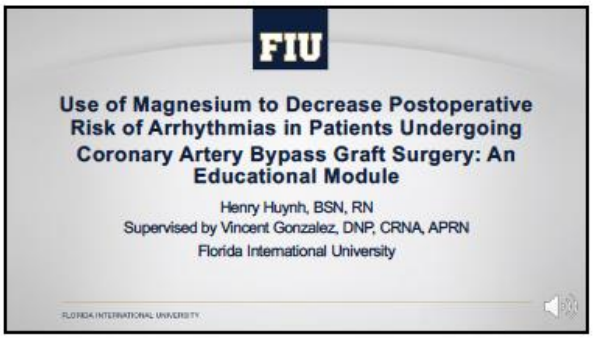
1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

EJ

Educational Module Presentation



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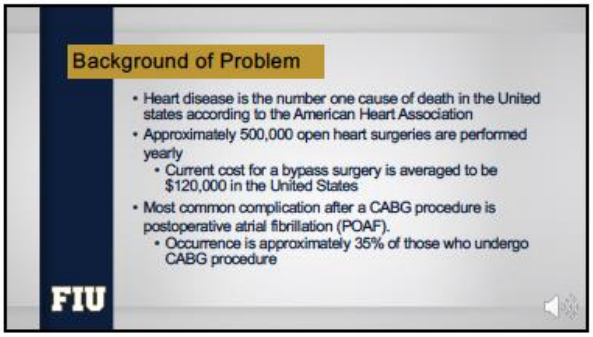

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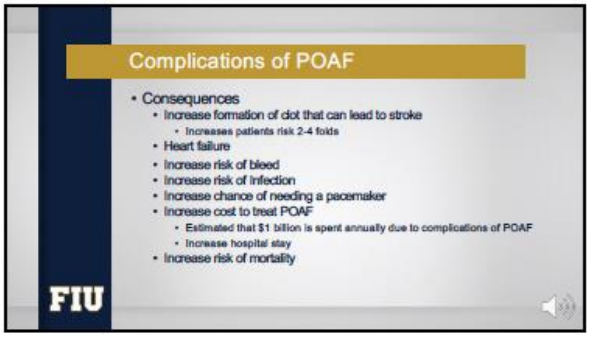

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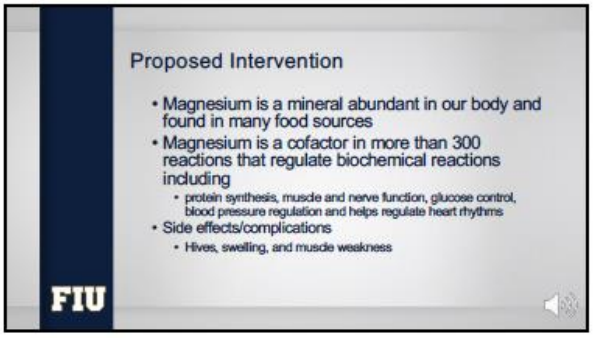

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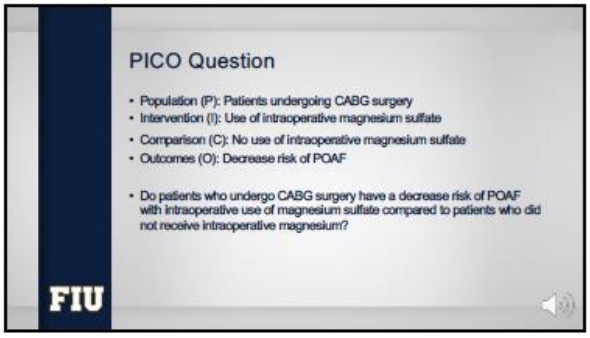

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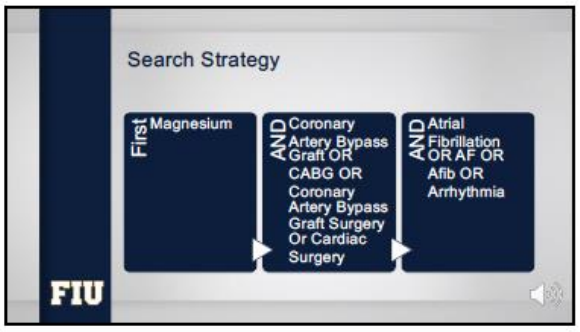
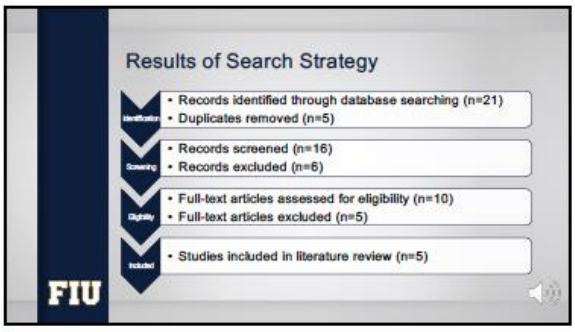

Search Strategy
First
Magnesium
AND
Coronary Artery Bypass Graft OR CABG OR Coronary Artery Bypass Graft Surgery Or Cardiac Surgery
AND
Atrial Fibrillation OR AF OR Afib OR Arrhythmia
FIU

7


Results of Search Strategy
Identification
• Records identified through database searching (n=21)
• Duplicates removed (n=5)
Screening
• Records screened (n=16)
• Records excluded (n=6)
Eligibility
• Full-text articles assessed for eligibility (n=10)
• Full-text articles excluded (n=5)
Included
• Studies included in literature review (n=5)
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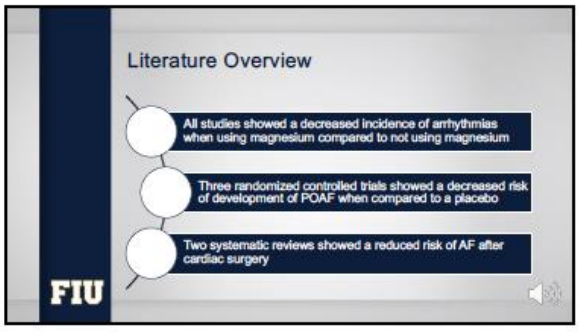
Literature Overview
All studies showed a decreased incidence of arrhythmias when using magnesium compared to not using magnesium
Three randomized controlled trials showed a decreased risk of development of POAF when compared to a placebo
Two systematic reviews showed a reduced risk of AF after cardiac surgery
FIU

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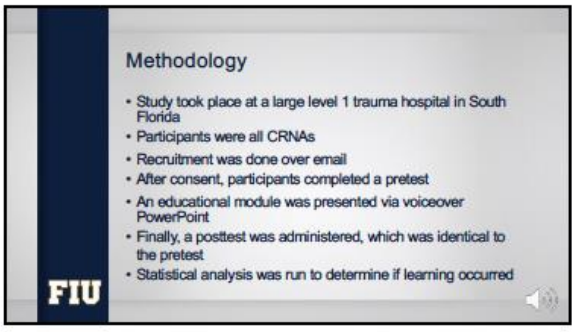
Methodology
• Study took place at a large level 1 trauma hospital in South Florida
• Participants were all CRNAs
• Recruitment was done over email
• After consent, participants completed a pretest
• An educational module was presented via voiceover PowerPoint
• Finally, a posttest was administered, which was identical to the pretest
• Statistical analysis was run to determine if learning occurred
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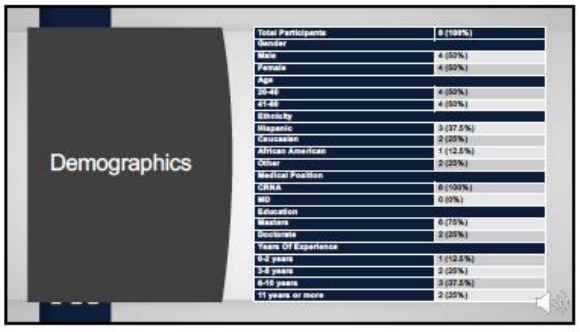
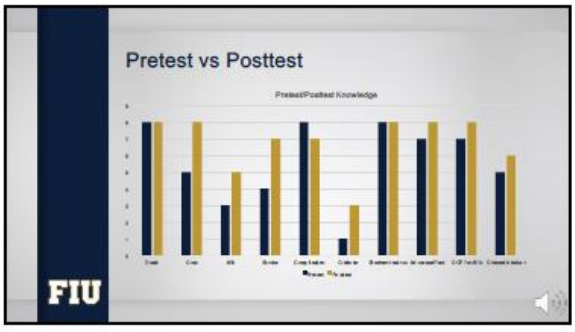
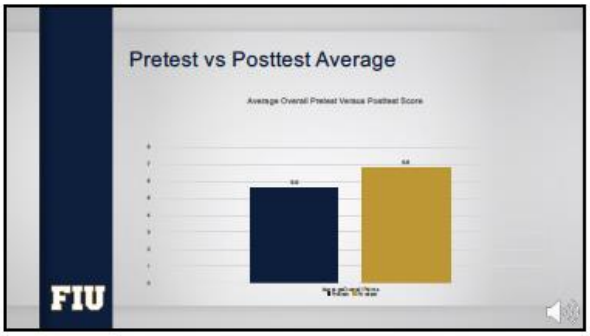

Demographics
Total Participants 8 (100%)
Gender
Male 4 (50%)
Female 4 (50%)
Age
31-40 4 (50%)
41-50 4 (50%)
Ethnicity
Hispanic 3 (37.5%)
Caucasian 2 (25%)
African American 1 (12.5%)
Other 2 (25%)
Medical Position
CRNA 8 (100%)
MD 0 (0%)
Education
Masters 6 (75%)
Doctorate 2 (25%)
Years Of Experience
0-2 years 1 (12.5%)
3-5 years 2 (25%)
6-10 years 3 (37.5%)
11 years or more 2 (25%)

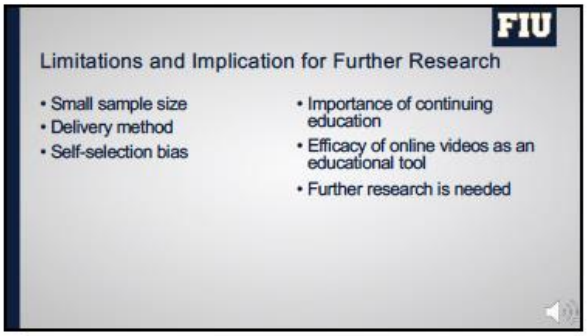
11


Pretest vs Posttest
Pretest/Posttest Knowledge
FIU

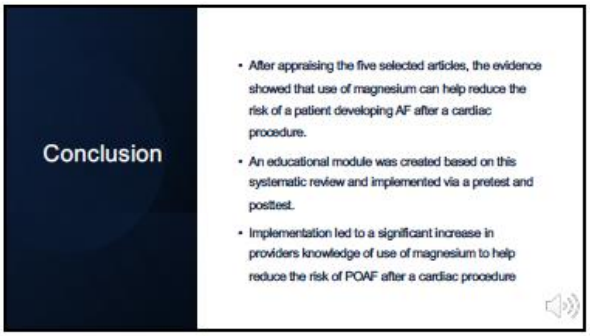
12


Pretest vs Posttest Average
Average Overall Pretest Versus Posttest Score
FIU

13


FIU
Limitations and Implication for Further Research
• Small sample size
• Delivery method
• Self-selection bias
• Importance of continuing education
• Efficacy of online videos as an educational tool
• Further research is needed

14


Conclusion
• After appraising the five selected articles, the evidence showed that use of magnesium can help reduce the risk of a patient developing AF after a cardiac procedure.
• An educational module was created based on this systematic review and implemented via a pretest and posttest.
• Implementation led to a significant increase in providers knowledge of use of magnesium to help reduce the risk of POAF after a cardiac procedure

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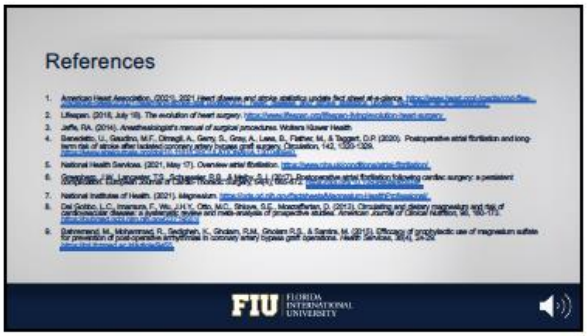
References
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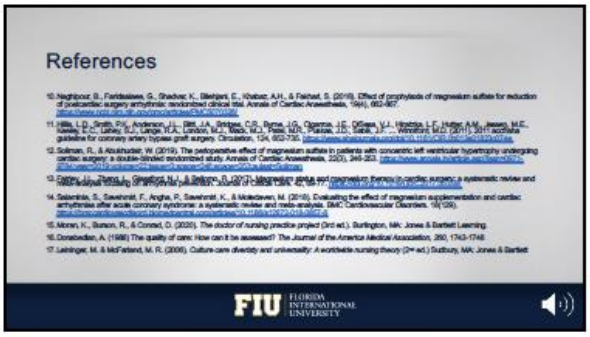
References
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