Dexmedetomidine for Cardiac Surgery Education Intervention

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October 14, 2023
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Abstract

**Introduction:** Cardiac surgery is the definitive treatment for many cardiac defects. Cardiac surgery is a high risk surgery that is associated with a systemic inflammatory response that can lead to increased morbidity and mortality postoperatively. Dexmedetomidine is a presynaptic alpha-2 agonist that reduces sympathetic outflow via negative feedback and has been shown to reduce this systemic inflammatory response. This is associated with improved postoperative outcomes. There was a knowledge gap on the benefits of dexmedetomidine in cardiac surgery amongst anesthesia providers.

**Methods:** An educational intervention was provided to the anesthesia staff on the current literature for the uses of dexmedetomidine in cardiac surgery. The retrospective chart review was completed five weeks prior to the intervention and five weeks after the intervention. Statistical analysis was carried out and results were presented to the anesthesia staff.

**Results:** This has led to increased usage of dexmedetomidine in cardiac surgery. Dexmedetomidine was used during cardiac surgery in 88% of cases prior to the intervention vs. 98.6% in the postintervention group.

**Discussion:** Dexmedetomidine has shown promising results in improving patient outcomes when used in cardiac surgery. By educating the cardiac anesthesia staff, the cardiac anesthetists have gained a better understanding of dexmedetomidine in cardiac surgery. This led to increased usage.

**Keywords:** Dexmedetomidine, cardiac surgery, and education
Introduction

Cardiac disease is the leading cause of death in our country for both men and women. According to the CDC 697,000 people died from heart disease in 2020. Heart disease is the cause for 1 in every 5 deaths in the United States. The cost from heart disease related care was about $229 billion (CDC, 2022). Of the patients hospitalized, 11.1%, where admitted for heart disease alone. This includes coronary artery disease (CAD), valvular defects, and congestive heart failure. Often these cardiac diseases require surgery for repair. In the United States, around 900,000 open heart surgeries are performed per year. The number continues to rise and is projected to reach 1.3 million per year by 2026. This includes coronary artery bypass grafting (CABG), valvular repair and replacement, and repair of the aorta (iData research, 2021). Despite cardiac surgery being the treatment for many of these cardiac diseases, there comes inherent risks with performing these procedures which lead to increased morbidity and mortality.

Background

While cardiac surgery can be a definitive treatment for many cardiac diseases, cardiac surgery does come with risks. The surgical procedure itself and activation of cardiopulmonary bypass expose the patient’s blood to a foreign circuit inducing systemic inflammatory response (Gravlee et al., 2019). Additionally, there is a risk for hypoperfusion and micro-emboli which may cause injury. Surgical trauma and cardiopulmonary bypass initiate a cascade or stress responses which leads to increased sympathetic nervous system stimulation, increased release of stress hormones, and increased release of inflammatory mediators. This stress response is associated with increased morbidity and mortality. Systemic inflammatory response can cause injury to all organs of the body including the kidneys, brain, lungs, and GI tract. Often the degree
of injury is relative to the amount of time the patient is on the cardiopulmonary bypass machine (Gravlee et al., 2019).

Dexmedetomidine is a highly selective presynaptic alpha-2 agonist that works by decreasing sympathetic outflow (Wang et al., 2019). By working on different areas of the body, dexmedetomidine exerts different effects. This includes sedation, analgesia, and anxiolysis. It has been found that dexmedetomidine through its sympatholytic action helps to mitigate the stress response. Dexmedetomidine does this by attenuating the hypothalamic-pituitary axis and sympathoadrenal response. It was found that the release of epinephrine, norepinephrine, cortisol, glucose, interleukin-6, tumor necrosis factor, and C-reactive protein are lower with the sympatholytic effects of dexmedetomidine when compared to a control group (Wang et al., 2019).

With cardiac surgery being high risk for postoperative complications due to surgical stress response and cardiopulmonary bypass, any intervention that can be done to mitigate this response may help prevent morbidity and mortality related to these procedures (Peng et al., 2021). Through dexmedetomidine’s sympatholytic action, it has been shown that initiating dexmedetomidine early and prior to going onto bypass, the stress response can be lessened. This is associated with lower rates of postoperative renal injury, heart block, major adverse cardiac events, delirium, sepsis, reintubation, 30-day readmission, new onset atrial fibrillation, and increased five-year survivability (Peng et al., 2021). Additionally, using dexmedetomidine throughout the surgery and into the postoperative period may be associated with reduced morphine equivalent requirements (Blaudszun et al., 2012).

**Problem Statement**
Cardiac surgery is the definitive treatment for many cardiac diseases but comes with a considerable risk from the stress of surgery and initiation of cardiopulmonary bypass. This is due to the activation of a systemic inflammatory response. Dexmedetomidine can lower sympathetic outflow and potentially mitigate this inflammatory response, leading to improved postoperative morbidity and mortality (Peng, et al., 2021).

**Gap Analysis**

The local hospital is a 794 bed level one trauma center that is the primary hospital of the health system that serves northwest Ohio and southeast Michigan. At this hospital, there are four cardiothoracic surgeons that perform open heart surgery. This hospital averages 700 open heart surgeries per year and did 877 in 2022 (Promedica, 2023). The number of cardiac surgeries is projected to continue to rise in the future and is on pace to exceed that number in 2023. Currently, postoperative complications are consistent with risk associated with cardiac surgery. According to current literature, the implementation of dexmedetomidine prior to cardiopulmonary bypass can help to prevent these complications by mitigating the stress response induced by cardiac surgery and cardiopulmonary bypass (Peng et al., 2021). Currently there is not a protocol for dexmedetomidine in heart surgery at this facility. If the anesthesia team receives education regarding dexmedetomidine, there is potential to help lower morbidity and mortality in the cardiac surgery population.

**Review of Literature**

A review of literature was completed through Cochrane library, PubMed, and Google scholar. Key search words were dexmedetomidine, cardiac surgery, and post operative. Inclusion criteria were studies within the last five years (2016-2022), adults, humans, and open-heart surgery. Only level 1 and level 2 studies were included in this review of literature. This included
randomized controlled trials, meta-analysis, and cohort studies. Excluded from this review were articles older that five years, pediatrics, non-human, and minimally invasive cardiac surgeries. This search yielded 80 studies and after application of the inclusion and exclusion criteria, was narrowed down to nine articles. Additionally, information was gathered from Hensley's practical approach to cardiothoracic anesthesia (Gravlee et al., 2019).

Every cardiac surgery patient will undergo a systemic inflammatory response which is accentuated by the activation of cardiopulmonary bypass. The process of this inflammatory response is activated by contact of blood with a foreign surface, ischemia-reperfusion, splanchnic hypoperfusion, and gaseous/particulate micro emboli. After activation of the inflammatory process, there is a propagation stage which leads to inflammatory cascades throughout the body. This will lead to increased inflammatory mediator throughout the body leading to endothelium dysfunction. The consequences from propagation of inflammation leads to multiple organ injuries, coagulopathy, DIC, infection, and death. In addition to cardiopulmonary bypass causing inflammation, the stress response from the surgery itself causes increased catecholamine release, hyperglycemia, and activation of the renin angiotensin aldosterone system (Gravlee, et al., 2019).

Dexmedetomidine is a presynaptic alpha-2 agonist that reduces sympathetic out flow via negative feedback. It produces different responses depending on what part of the body it exerts its effects. As a sympatholytic, dexmedetomidine can reduce the inflammatory response by attenuating the hypothalamic-pituitary-adrenal (HPA) axis and the sympathoadrenal response. Dexmedetomidine infusions has been shown to lower levels of inflammatory markers. This includes epinephrine, norepinephrine, cortisol, glucose, interleukin-6, tumor necrosis factor, and C-reactive protein (Wang et al., 2019).
Acute kidney injury occurs in 20% of patients undergoing cardiac surgery. This can be caused by ischemia reperfusion injury, hemodynamic disturbances, and systemic inflammatory response (Ammar et al., 2016). Dexmedetomidine infusion is associated with reduced AKI following cardiac surgery. This has been evaluated with using tools such as the risk injury failure loss end stage kidney (RIFLE) criteria. In a meta-analysis that included 1,308 patients, 10.9% of patients in the dexmedetomidine group experienced AKI vs. 18.3% in the control group (Peng et al., 2020).

Initiating dexmedetomidine in cardiac surgery can also be protective to the heart itself. When used during cardiac surgery, patients have lower levels of myocardial-specific proteins including troponin and CK-MB. This was seen 12 hours, 24 hours, and 36 hours postoperatively (Ammar et al., 2016). Postoperative atrial fibrillation occurs in 15%-40% of patients undergoing cardiac surgery (Jing et al., 2022). Those who experience new onset atrial fibrillation following cardiac surgery have double the risk of mortality (Almassi et al., 2014). Patients who are started on dexmedetomidine for cardiac surgery experience 4% lower incidence of new onset atrial fibrillation (Jing et al., 2022).

Initiating dexmedetomidine in cardiac surgery has been associated with improved outcomes. Five-year survivability was shown to be higher in a dexmedetomidine group when compared to a control in cardiac surgery. In a retrospective cohort study conducted by Peng et al. of 2068 patients, morbidity and mortality was assessed in dexmedetomidine vs. control groups undergoing cardiac surgery. When dexmedetomidine was initiated at a rate of 0.007 µg/kg/min prior to cardiopulmonary bypass or immediately after, it was found that the dexmedetomidine group had an improved five-year survivability of 13% vs. 20% (p<0.001). Additionally, the authors found lower incidence of heart block, major adverse cardiac events, delirium, sepsis,
reintubation, 30-day readmission, and new onset atrial fibrillation. All these improved in the dexmedetomidine group with statistical significance p<0.01 (Peng et al., 2021).

Dexmedetomidine is a sympatholytic medication that is safe to use in cardiac surgery. In a meta-analysis evaluating the hemodynamic changes of running dexmedetomidine in cardiac surgery, 1,730 patients were evaluated. There was only a 1.74 reduction in mean atrial pressure. However, there was no increased incidence of hypotensive events. There was no significant change in central venous and pulmonary artery pressures. Heart rate was found to be lower by 2.12 which is cardio-protective by lowering demand and increasing supply to the heart. There was a decreased rate of tachyarrhythmias. It was also found that there was no difference in cardiac index levels. ICU stay was significantly reduced along with the rates of postoperative delirium (Wang et al., 2018).

Evidence-based Practice: Verification of Chosen Option

The intervention was an educational presentation for anesthetists on the cardiac team regarding current literature on the use of dexmedetomidine in cardiac surgery. Topics that were discussed included the inflammatory process related to cardiac surgery, consequences of the inflammatory response, mechanism of action for dexmedetomidine, dexmedetomidine’s role in preventing systemic inflammation related to surgery, and the benefits of using dexmedetomidine in cardiac surgery. Cardiac surgery is associated with a systemic inflammatory response and by implementing an educational intervention for the anesthetists on the cardiac team, the cardiac anesthetists have a better understanding of the benefits of dexmedetomidine in cardiac surgery and the use dexmedetomidine to help mitigate this inflammatory response resulting in improved postoperative patient outcomes.

Theoretical Framework
The theoretical framework that will guide this project is the synergy model for patient care. This is a middle-range theory that was developed by the American Association of Critical Care Nurses (AACN) to be a guide for nurse competencies and patient needs (AACN). This is a framework that was created to guide nurses in maintaining and advancing their competencies based on patient needs. As patient needs change, so does the level of competency needed to care for these patients. When the patient and the nurse are changing coherently to adapt to each other, they are in a system of synergy. As the level of care changes based on the changes of patient, the nurse and patient synergistically influence each other for the nurse to provide better care. The model has eight characteristics that include: stability, vulnerability, resiliency, participation in care, participation in decision making, predictability, complexity, and resource availability. The patient and nurse influence each other to change, creating synergy. This model is used to influence the development of curriculum and education of the nurse based on the changing needs of the patient (S. Swickard et al., 2014).

The cardiac surgery patient population is at high risk for postoperative complications. Furthermore, there is a lack of knowledge about new interventions that can help these patients. This educational intervention has provided evidence-based information and strategies, that when implemented has helped to improve patient outcomes. An educational intervention provided to the cardiac anesthesia staff has guided the staff to practice in the best interest of this specific patient population. After the intervention, a retrospective chart review was completed to evaluate for effectiveness of the intervention. A diagram of how the patient, nurse and system interact influenced by the synergy theoretical framework has been a guide for this project is provided in appendix A.

Goals, Objectives, and Expected Outcomes
The primary outcome was to provide education by presentation to the anesthetists on the cardiac team about the consequences of cardiac surgery and how dexmedetomidine can help to mitigate these adverse outcomes based on current evidence. Following the education intervention, a retrospective chart review was completed to evaluate if the education intervention was effective for the anesthetist. This was done by evaluating if the anesthetist chose to include dexmedetomidine in their plan of care. A retrospective chart review was completed for five weeks after the education intervention and compared to the same five weeks in the previous year prior to the intervention. The expected outcome was that providers would choose to initiate dexmedetomidine in cardiac surgery. Additionally, patient outcomes were evaluated based on if the provider chose to use dexmedetomidine during their anesthetic. Patient outcomes assessed included postoperative renal function using the RIFLE criteria, incidence of new onset atrial fibrillation, and mortality. This was done via retrospective chart review comparing the same times. Expected outcomes from following the intervention was a reduced incidence of postoperative renal failure and new onset atrial fibrillation. If the education intervention was effective in providing education to the providers to use dexmedetomidine during their anesthetic, then there will be a reduction in postoperative renal failure, NOAF, and mortality (K. Peng et al., 2021).

**Methods**

At this facility, there was a need for an updated understanding on the current literature regarding the use of dexmedetomidine for cardiac surgery. By implementing an educational intervention, the current cardiac anesthesia staff was updated on the current literature. After educating the anesthesia staff at the local hospital, providers now have a better understanding for
incorporating dexmedetomidine into their plan or care. With this, according to current literature, there should be an improvement in postoperative patient outcomes (K. Peng et al., 2021).

**Project Design**

The basis of this project is the implementation of an education intervention. At the local hospital, the cardiac anesthesia team meets once per month for a journal club. At journal club, current peer reviewed literature is discussed to help improve the practice of the team. For this education intervention, this meeting was used to present the current literature for use of dexmedetomidine in cardiac surgery. The information was presented during this meeting using a PowerPoint© presentation and the AACN synergy model design as a theoretical framework.

In the presentation, objectives were clearly defined prior to presenting the information. Each objective was addressed during the presentation. The first objective was used to explain the need for cardiac surgery and the risks that come with cardiac surgery. This included discussion of how cardiac surgery causes a systemic inflammatory response. Additionally, consequences of the inflammatory response were discussed. This helped to validate the need for an intervention to help reduce the inflammatory response. The next objective that was discussed included an in-depth review of dexmedetomidine and its mechanism of action. Furthermore, the rationale for how dexmedetomidine can reduce the stress response thus reducing systemic inflammation was provided. Next a review of literature about how dexmedetomidine has been shown to reduce systemic inflammation. After this, the use of dexmedetomidine in cardiac surgery was discussed. This included when to start it and the rationale for starting the medication based on current evidence. After the presentation is finished, the floor was opened to any questions. All questions were answered in an open floor discussion.
After the literature was presented, a retrospective chart review was completed to evaluate if providers chose to implement dexmedetomidine into their plan of care. The retrospective chart review was completed for five weeks following the education intervention. Additionally, if providers chose to use dexmedetomidine, postoperative patient outcomes were evaluated. This included postoperative renal function using RIFLE criteria, incidence of new onset atrial fibrillation, and mortality. For comparison, data was collected retrospectively for the same time one year prior in August of 2022 vs. August of 2023.

Data that was collected was organized into an excel spreadsheet for organization. This data was then statistically analyzed. Post-intervention data was compared to data prior to the intervention. Data was evaluated for statistical significance using a two-sample t-test for comparing all outcomes. After the results were analyzed, they were interpreted for discussion. The results were discussed with the cardiac anesthesia staff at the following journal club.

**Project Site and Population**

The project site was a local 794 bed level one trauma center. The education intervention took place in the cardiovascular conference room where the monthly journal club is held. In addition to physical attendance, participants were able to call into this meeting via phone conferencing. Anesthesia staff were asked to attend this presentation. This included both Certified Registered Nurse Anesthetists (CRNA) and the physician anesthesiologists. The cardiac anesthesia staff was essential as they are the target of the educational intervention. The CRNA is the provider who will be in the room with the patients for the entire procedure. It was up to the cardiac CRNAs to incorporate this new knowledge into their plan of care. Pre and post intervention retrospective chart review were completed in the hospital.
Following the education intervention, the use of dexmedetomidine for cardiac surgery was evaluated for all adult patients undergoing open heart surgery. This included CABG, valve repair/replacement, and repair of the aortic arch. Furthermore, off pump CABG was included in the review of data. Minimally invasive procedures such as electrophysiology, structural heart, and cardiac cath-lab cases were excluded. Additionally, pediatric patients under the age of 18 were not considered when implanting this practice change. Thoracic cases such as thoracotomies and robotic lung procedures were also excluded.

**Measurement Instruments**

While this project was designed to provide education only, data was collected to evaluate the effectiveness of the education. This data was collected with a retrospective chart review. The data was collected from the electronic medical records, and as medication administration and patient outcomes are always documented in every patient’s medical record, this project only looked at information routinely documented as part of the patient hospitalization.

Postoperative outcomes were also evaluated in this project. This included incidence of new onset atrial fibrillation, renal failure, and mortality, all of which are routinely included in the patient’s medical record. New onset atrial fibrillation was assessed by reviewing the patient’s discharge summary and if the patient was diagnosed with paroxysmal/new onset atrial fibrillation prior to discharge. Additionally, renal function was evaluated using the RIFLE criteria tool. The RIFLE criteria provide a score based on the patient’s creatinine, glomerular filtration rate, and urine output. Based on these values, the patient’s renal status is categorized as risk (R), injury (I), failure (F), loss of kidney function (L), or end stage renal failure (E) (Peng et al, 2020). A table of the RIFLE criteria can be found as appendix B. Values for assessing renal function were collected from postoperative day 1 values. Lastly, mortality was evaluated by assessing if the
patient expired in the postoperative period until discharge. If the patient expired during the surgery or after discharge, the patient was not included in the mortality rates related to this data collection.

**Data Collection Procedures**

Following IRB approval, the intervention started with collection and interpretation of current literature on the use of dexmedetomidine in cardiac surgery. Next, a Power Point presentation was made that goes into detail the need for dexmedetomidine in cardiac surgery and the benefits of using it. Permission was obtained from the head of journal club to present to the group. Once a date was picked, all anesthesia providers were invited to attend. After the material was presented, all questions and concerns were answered. After the education intervention, a retrospective chart review was conducted to evaluate for effectiveness of the education five weeks following the education intervention. Additionally, pre-intervention data was collected for the same five-week period one year prior to the intervention. Once all data was collected, statistical analysis using a two-sample t-test, to determine the effectiveness of the education intervention was done.

No patient identifiers were used in the data collection process. All patient data collected was stored in a secure password protected Excel© spreadsheet. In place of patient identifiers, each patient was assigned a number to help categorize their data. This spreadsheet was stored in the secure password protected cloud service UA BOX.

**Data Analysis**

All collected data was entered into an Excel© spread sheet and separated by pre-education and post-education intervention groups. This included the total number of usages of dexmedetomidine in cardiac surgery. This data was compared by evaluating the total number of
cases in which dexmedetomidine was used for the pre-education intervention vs post education intervention.

Number of incidences of new onset atrial fibrillation (NOAF) were evaluated. The pre and post groups were compared by evaluating total number of patients who experienced NOAF. Additional data collected was an evaluation of postoperative renal function. The RIFLE criteria (appendix B) were the basis for data collection. Serum creatinine, glomerular filtration rate (GFR), and urine output numbers were collected and placed into the spreadsheet. Statistical significance was evaluated by calculating p values through a two-sample t-test to assess if the education intervention was significant in having providers use dexmedetomidine in cardiac surgery. The patient fell into the risk, injury, or failure group based on their serum creatinine, GFR, and urine output. The data was collected for both preoperative and postoperative period to determine if there was a change in RIFLE criteria following the cardiac surgery. The pre-education and post-education intervention groups were compared to evaluate for improvement, worsening, or no change in renal function. Again, p values were found to determine statistical significance. Lastly, mortality was evaluated between the pre and post education intervention groups. The total number of postoperative deaths were compared.

**Cost-Benefit Analysis/Budget**

The cost of this project was minimal to no cost at all. First the creation of the education presentation did not have any cost. Presenting the education during an already planned journal club meeting did not add any costs. Data input into the spreadsheet also did not cost anything. Data was interpreted in the Excel© spreadsheet using necessary functions to calculate the totals, averages, and p-values. Interpretation of the results also had no cost. Lastly, presenting the results to the CRNAs did not have cost.
Timeline

Following IRB approval, work began on the educational presentation immediately. The coordinator of the monthly journal club meeting was approached to ask permission to present the presentation. Once permission was obtained, a date was set for the presentation. Invitations were sent out to the cardiac anesthesia staff to attend the journal club, along with the presentation topic. Once the presentation was given, the floor was open to questions. Five weeks after the presentation, a retrospective chart review was completed. Use of dexmedetomidine, renal function criteria, incidence of new onset atrial fibrillation, and mortality data was collected and stored into a spreadsheet. Statistical analysis was completed using functions in the spreadsheet. This included totals, averages, and p-values. Once the statistical analysis was completed, interpretation of the results was completed. Lastly, the results along with discussion were presented to the cardiac anesthesia staff. A timeline of the project can be found in appendix C.

Ethical Considerations

The University of Alabama (UA) Institutional Review Board (IRB) approval was obtained prior to initiating the project. No patient identifying information was collected during the data collection in accordance with HIPPA. All data collected was stored securely in a password protected spreadsheet. Additionally, the spreadsheet was stored in a password protected cloud service, UA BOX. All patients were labeled by number instead of patient identifiers. The patients were labeled as pre or post intervention and a number. For example, pre-intervention patient 1 was labeled as P1 and post intervention patient was labeled as 1.

Results

Once the final patient undergoing cardiac surgery in the month following the education intervention was discharged, data collection and interpretation was completed. In the
preintervention group, there was a total of 51 patients vs. 74 patients in the post intervention group. One patient in the post intervention group was excluded from analysis as they expired in the operating room due to ischemic myocardial contracture. This left 73 patients for data analysis in the post intervention group. In the preintervention group, 45 out of the 51 (88%) cases adjunctive dexmedetomidine was used vs. 72 of 73 (98.6%) in the postintervention group. The average GFR in the preintervention group was 54.8 vs. 55.9 (p < 0.104) in the postintervention group. The average creatinine in the preintervention group was 1.26 vs. 1.15 (p < 0.23). Average urine output in the preintervention group was 1797.6 mL vs. 3131.2 mL (p < 0.005). RIFLE criteria was used as a tool to evaluate postoperative renal function. Patients were divided into different classifications based on their renal function and the RIFLE tool. In the preintervention group vs. the postintervention groups, 34 (66.7%) vs. 63 (86.3%) had no risk of renal injury, 6 (11.8%) vs. 2 (2.7%) had risk for injury, 8 (15.7%) vs. 4 (5.5%) fell into the injury classification, and 3 (5.9%) vs 3 (4.1%) of patients classified as renal failure. The incidence of atrial fibrillation in the preintervention group was 13 (26%) vs. 19 (26%) in the post-intervention group. The incidence of postoperative mortality in the preintervention group was 2 (3.9%) vs. 2 (2.8%) in the postintervention group.

**Interpretation/Discussion**

The goal of this project was to evaluate the effectiveness of an education intervention based on the current literature for the use of dexmedetomidine in cardiac surgery. According to the results of this analysis, the intervention was effective. Based on the results of this data, the use of adjunctive dexmedetomidine during cardiac surgery went up 10% indicating efficacy of the education intervention. There was only one patient of the 73 undergoing cardiac surgery in the postintervention group that did not have dexmedetomidine used during the case.
Secondary outcomes were measured as patient outcomes in the preintervention group vs. the postintervention group. This resulted in an improvement in GFR, creatinine, and urine output. There was an increase in average GFR and urine output along with an average decrease in serum creatinine levels postoperatively. However, these values were not improved with statistical significance as the p-value was greater than 0.05 in all three categories. According to RIFLE criteria, there was less risk and actual injury to kidney function postoperatively. This was evident by improved RIFLE criteria in the intervention group. The incidence of atrial fibrillation was not affected in the intervention group as there was no change in percentage of patients who experienced postoperative atrial fibrillation (26% vs. 26%). The occurrence of postoperative mortality was 2 patients in both the control and intervention groups.

This was an effective quality improvement project as the education resulted in an increase in the usage of dexmedetomidine for cardiac surgery. Additionally, there was no cost to this project as all data analysis was completed in Excel©. The results of this intervention were presented to anesthesia group during the next journal club meeting. Again, anesthetists were given the option to attend in person or call into the meeting. All questions were answered after the presentation of the data.

While this was a quality improvement project to evaluate the effectiveness of an education intervention, further data collection would yield more reliable results. This could include data collection for one-year pre and post intervention as opposed to five weeks. Additionally, more data could be collected on the patients postoperatively such as long-term incidences of renal dysfunction, atrial fibrillation, and mortality. Furthermore, there needs to be more studies done to evaluate the effectiveness of dexmedetomidine in cardiac surgery. While there have been significant results in current literature, this is still considered a newer
intervention in the last 5-10 years. Further research should include multi-center randomized controlled trials with large number of participants. This would help to further validify the use or to not use dexmedetomidine in cardiac surgery.

Conclusion

Cardiac surgery is the definitive treatment for different heart defects that can become life threatening if left untreated. However, cardiac surgery is associated with high postoperative risk due to a systemic inflammatory response that is caused by incision, sternotomy, and initiation of cardiopulmonary bypass. Dexmedetomidine is a presynaptic alpha-2 agonist that reduces sympathetic outflow. When started prior to surgical stimulation, there is an association of reduced inflammatory markers and improved postoperative outcomes. By educating the cardiac CRNAs with an education presentation, they have been informed on current literature related to the use of dexmedetomidine for improving postoperative outcomes in cardiac surgery. This resulted in an increased usage of dexmedetomidine, thus improving patient postoperative outcomes.
References


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doi:10.1111/jcpt.13527

doi:10.1093/ckj/sfs160


Appendix A

The AACN Synergy Model used as a theoretical framework for an education intervention.

Problem Identified: Knowledge gap amongst CRNAs for improved postoperative outcomes of cardiac

Perform literature review for solution  
Perform Gap-analysis of current facility

Identify theoretical  
Identify who needs this education  
Determine current practice at facility

Create way to present literature to key cardiac CRNAs

Perform retrospective chart review to evaluate effectiveness of education intervention  
Evaluate patient outcomes in response to intervention

Evaluate and interpret the

Present findings

Note. The AACN Synergy Model is used as the theoretical framework for an educational intervention showing the intercommunication between the nurse, patient, and system and how they influence each other to change. This creates a system of synergy that improves patient outcomes. This dynamic model is adaptable based on the changing needs of the patient and learner.
Appendix B

Criteria for Acute Kidney Injury

<table>
<thead>
<tr>
<th>Class</th>
<th>GFR</th>
<th>UO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>↑ SCR × 1.5 or ↓ GFR &gt;25%</td>
<td>&lt;0.5 mL/kg/h × 6 h</td>
</tr>
<tr>
<td>Injury</td>
<td>↑ SCR × 2 or ↓ GFR &gt;50%</td>
<td>&lt;0.5 mL/kg/h × 12 h</td>
</tr>
<tr>
<td>Failure</td>
<td>↑ SCR × 3 or ↓ GFR &gt;75% or if baseline SCR ≥353.6 μmol/L (≥4 mg/dL)</td>
<td>&lt;0.3 mL/kg/h × 24 h or anuria × 12 h</td>
</tr>
<tr>
<td>Loss of kidney function</td>
<td>Complete loss of kidney function &gt;4 weeks</td>
<td></td>
</tr>
<tr>
<td>End-stage kidney disease</td>
<td>Complete loss of kidney function &gt;3 months</td>
<td></td>
</tr>
</tbody>
</table>

Note. Classification of acute kidney injury as defined by the Acute Dialysis Quality Initiative group. Designated classification of Risk, Injury, Failure, Loss of kidney function and End-stage kidney disease (RIFLE) based on glomerular filtration rate (GFR), urine output (UO), and serum creatinine (SCR) (J. Lopes & S. Jorge, 2013).
Appendix C

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Literature Review</th>
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</thead>
<tbody>
<tr>
<td>September 2022-April 2023</td>
<td>Literature Review</td>
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<tr>
<td>April 2023</td>
<td>Development of proposal</td>
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<td>April 2023</td>
<td>Development of presentation</td>
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<td>April 2023</td>
<td>Development of data collection tool</td>
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<td>Institution IRB submission</td>
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<td>June 2023</td>
<td>Institution IRB approval</td>
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<td>UA IRB submission</td>
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<tr>
<td>June 2023</td>
<td>UA IRB approval</td>
</tr>
<tr>
<td>July 2023</td>
<td>Presentation of education</td>
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<tr>
<td>August-September 2023</td>
<td>Retrospective data review</td>
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<tr>
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<td>Analysis of data</td>
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<td>September 2023</td>
<td>Dissemination of findings</td>
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<td>Completion of manuscript</td>
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