2022

A Quality Improvement Initiative Regarding Ondansetron in the Prevention of Spinal Anesthesia-Induced Hypotension

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Doctoral of Nursing Practice Project submitted
to the School of Nursing
at West Virginia University

in partial fulfillment of the requirement for the degree of

Doctor of Nursing Practice in
Nurse Anesthesia

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Morgantown, West Virginia
2022

Keywords: Zofran, Ondansetron, Spinal Anesthesia, Spinal Anesthesia-Induced Hypotension, Bezold-Jarisch Reflex

ABSTRACT

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Spinal anesthesia is an excellent choice as the primary anesthetic for lower abdominal, perineal, and lower extremity procedures. Spinal anesthesia boasts several distinct advantages over general anesthesia. However, it is important to note that spinal anesthesia does not come without risk. The most common adverse reaction of spinal anesthesia is hypotension. Anesthesia providers use several methods to combat the hypotension that is so commonly associated with spinal anesthesia. One emerging trend to prevent spinal anesthesia-induced hypotension (SAIH) is the administration of ondansetron, a serotonin 5-hydroxytryptamine3 antagonist. Evidence has shown that the administration of ondansetron just prior to spinal anesthesia administration may decrease the prevalence of SAIH by blocking the serotonin receptors in the heart, thus preventing the triggering of the Bezold-Jarisch Reflex, a triad of hypotension, bradycardia, and peripheral vasodilation. Despite the mounting evidence supporting the use of ondansetron to prevent this phenomenon, it has not been widely adopted as the standard of care. The purpose of this project was to translate evidence-based anesthesia care of patients undergoing spinal anesthesia into practice by increasing anesthesia provider knowledge regarding the efficacy of pre-spinal anesthetic ondansetron in attenuating SAIH. An educational in-service was delivered to anesthesia providers at a 292 private-bed community hospital in West Virginia regarding the efficacy of ondansetron in the mitigation of SAIH in an attempt to increase provider knowledge about the usefulness of this intervention. Nineteen anesthesia providers took part in the in-service. Pre- and post-intervention Likert surveys were delivered that assessed the providers' knowledge regarding the intervention, current use of the intervention in his or her practice, and willingness to adopt the intervention if sufficient evidence supports the change. It was concluded that the in-service increased provider knowledge regarding the use of ondansetron in the attenuation of SAIH and influenced an intended change in provider practice. Continuing education should be utilized to inform the evolution of evidence-based practice in anesthesia.

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Over 40 million anesthetics are given each year in the United States, and spinal anesthetics make up a large portion of this number (Kremers, et al., 2015). Spinal anesthesia is indicated for lower abdominal, perineal, and lower extremity procedures. Evidence has shown that spinal anesthesia in these cases has several advantages over general anesthesia including decreased cost, complications, infections, and improved pain control (Matsken Ko & Chen, 2015). Matsken Ko & Chen (2015) also state a significant decrease in deep vein thrombosis, pulmonary embolism, surgical time, and blood transfusion when spinal anesthesia is the primary anesthetic. While there is plenty of evidence supporting the use of spinal anesthesia in these procedures, it is also important to note that spinal anesthesia does not come without risk. Mounting evidence claims that a commonly used intraoperative medication, ondansetron, has been shown to mitigate one major risk associated with spinal anesthesia.

Problem Description

Hypotension is a common adverse reaction of spinal anesthesia. Hypotension is commonly described as a systolic blood pressure <80-90 mmHg or a 20% decrease in the patient's baseline systolic blood pressure. The incidence of hypotension following spinal anesthesia is estimated to occur in 15% to 33% of cases (Tubog et al., 2017). Spinal anesthesia causes venous and arterial vasodilation. Hypotension from spinal anesthesia is thought to be caused primarily by decreased systemic vascular resistance (SVR) and decreased central venous pressure (CVP) that results from sympathetic blockade, as well as redistribution of the central blood supply to the splanchnic circulation and lower extremities (Warltier et al., 2003). Additionally, this redistribution of blood along with parasympathetic dominance, leads to a low-

volume, hypercontractile ventricle. Cardiac hypercontractions can activate the serotonin receptors in the left ventricle, leading to activation of the Bezold-Jarisch Reflex (BJR), a triad of hypotension, bradycardia, and peripheral vasodilation (Nagelhout & Elisha, 2018). Hypotension causes inadequate perfusion to the vital organs of the body, placing a patient at risk for cerebrovascular accident, coronary hypoperfusion, and prerenal acute kidney injury. Intraoperative mean arterial pressure less than 55 mmHg during non-cardiac surgery is associated with increased risk for acute kidney injury and myocardial infarction (Brady & Hogue, 2013).

Anesthesia providers utilize several different techniques to mitigate the unwanted effects of spinal anesthesia on blood pressure. Some of the most commonly used techniques are fluid pre-loading, which has been associated with cardiopulmonary complications and urine retention, and prophylactic administration of vasopressors, as well as rescue administration of vasopressors once hypotension has occurred, although no single technique has proven to be adequately effective (Shin et al., 2018; Cyna et al., 2006). Vasopressor use is often effective, but it can cause negative effects. Vasopressor use is associated with organ ischemia, hyperglycemia, hyperlactatemia, increased myocardial oxygen demand, tachyarrhythmias, and fetal acidosis (Russell, 2013). It is preferred to prevent hypotension rather than to treat it. An emerging trend in the prevention of spinal anesthesia-induced hypotension (SAIH) is the use of ondansetron, a serotonin 5-hydroxytryptamine3 (5-HT3) antagonist. Evidence has shown that the administration of ondansetron just prior to spinal anesthesia administration may decrease the prevalence of SAIH by blocking the serotonin receptors in the heart, thus preventing the triggering of the Bezold-Jarisch Reflex (Nagelhout & Elisha, 2018).

Problem Statement

The use of spinal anesthesia elicits physiological changes, and of these physiological changes, hypotension is one of the most prevalent. It is well documented that acute hypotension can lead to negative and life-threatening consequences. Ondansetron administration prior to spinal anesthesia administration has not yet been widely adopted as a standard of care. This project aimed to translate evidence-based anesthesia care of patients undergoing spinal anesthesia by presenting this evidence to anesthesia providers, allowing them to make a more informed decision regarding their delivery of care to this large patient population.

Available Knowledge

A literature search was performed using the population, intervention, comparison, outcome (PICO) process (Larrabee, 2009) to develop the search question, "In anesthesia providers caring for patients undergoing spinal anesthesia, does the delivery of an educational in-service regarding the usefulness of ondansetron to mitigate SAIH compared to no educational in-service increase provider knowledge as well as intent to incorporate the proposed change into practice?" A critical appraisal of evidence was performed on all publications included in this proposal and synthesized to contribute to the proposed design and evaluation of this project.

The project co-investigator searched the Academic Search Complete, CINAHL with Full Text, Cochrane Library, Health Source: Nursing/Academic Edition, and MEDLINE electronic databases. Full text, English language articles from 2014 to 2020 with links to full text that evaluated the effectiveness of ondansetron administration prior to spinal anesthesia administration in the attenuation of SAIH met the criteria for review and selection. Keyword search combinations of spinal anesthesia, ondansetron or Zofran, hypotension, and SAIH were used. The search yielded 80 relevant hits, in which inclusion criteria reduced the number of

relevant articles to be included in this review of literature to eight: five randomized controlled trials, two systematic reviews with meta-analysis, and one meta-analysis.

Literature Review Synthesis

Critical appraisals of the seven relevant articles were performed. A comprehensive review of each publication will be presented in this section and include a summary of each publication included in this review, the purpose of each study, sample size and characteristics, outcome measures and findings, and recommendations from each publication. The measured parameters were consistent across the studies, and no extreme biases were noted during this review. An evaluation table of the evidence included in this literature review can be found in Table 1.

A meta-analysis conducted by Gao et al. (2015) was conducted to assess prophylactic effects of ondansetron on SAIH in obstetric and non-obstetric patients. Ten randomized clinical trials with a total of 863 participants were included in this meta-analysis. Ondansetron was given in doses of 8-12 milligrams (mg). Gao et al. found prophylactic ondansetron to reduce not only hypotension in obstetric and non-obstetric patients ($p = 0.002$ and $p = 0.0005$) but also bradycardia and vasopressor administration.

A prospective, randomized, controlled, double-blinded study conducted by Trabelsi et al. (2015) investigated the use of intravenous ondansetron versus a placebo for prophylaxis of hypotension after spinal anesthesia in parturients scheduled for elective cesarean section and its consequences on newborns. This study included American Society of Anesthesiologists (ASA) Physical Status classification I primipara patients. Eighty patients were included in the study with 40 patients being randomly assigned to both the control group and the intervention group. The intervention group received 4 mg of ondansetron five minutes prior to spinal anesthesia

administration. An arterial line was utilized to monitor blood pressure every two minutes. Hypotension was defined as a 20% or greater decrease from baseline or SAP less than 80 mmHg. The authors found that only 15 (37.5%) of the 40 patients who received ondansetron developed hypotension, while 31 (77.5%) participants in the placebo group developed hypotension ($p < 0.001$). The authors also discovered that the ondansetron group used an average of 5.10 mg of ephedrine for blood pressure rescue, while the placebo group used 12.90 mg of ephedrine ($p < 0.001$).

Owczuk et al., (2015) conducted a prospective, randomized, controlled, double-blind study in an attempt to verify the hypothesis that blocking type 3 serotonin receptors with intravenous ondansetron reduces the hypotension induced by spinal anesthesia. Fifty-three patients, aged 70 years and older, were included in the study. Twenty-six patients were randomly assigned to the ondansetron group that received 8 mg of ondansetron diluted with normal saline, and 27 patients were randomly assigned to the placebo group that received only normal saline. Hypotension was defined as SBP less than 90 mmHg or a 20 percent decrease from baseline. The authors found that SBP was significantly higher in the ondansetron group five minutes after the block was established, and MAP and DBP were significantly higher at post-block intervals of five, 10, and 15 minutes. The authors also found that ephedrine administration was significantly lower ($p = 0.049$) in the ondansetron group.

Heesen et al. (2016) conduced a systematic review and meta-analysis with meta-regression to determine whether 5-HT3 receptor antagonists, administered before the initiation of spinal anesthesia, mitigate SAIH. Seventeen trials (eight obstetric and nine non-obstetric) reporting on 1,604 patients were included in this review. The authors reported a 95% CI, 0.36-0.81, in the decreased risk for hypotension in obstetric and non-obstetric patients. The authors

determined that 5-HT3 receptor antagonists are effective in reducing the incidence of hypotension in patients undergoing spinal anesthesia.

A prospective, randomized, double-blinded, controlled study conducted by Karacaer et al. (2017) assessed the effect of prophylactic ondansetron on the incidence of SAIH and norepinephrine consumption. The study included 108 parturients with uncomplicated pregnancies undergoing elective cesarean delivery under spinal anesthesia. The parturients were randomly divided into two equal groups. The experimental group received 8 mg of ondansetron, and the control group received the same volume in normal saline. The authors defined hypotension as systolic blood pressure (SBP) less than 80% of baseline, and norepinephrine consumption was measured in milligrams. This study found no statistically significant difference in the incidence of patients with hypotension in the experimental group and the control group ($p = 0.767$). However, cumulative episodes of hypotension and norepinephrine consumption were significantly lower in the experimental group compared to the control group ($p = 0.009$). While this study found no significant difference in the number of patients who experienced SAIH among the two groups, it was discovered that patients who received 8 mg of prophylactic ondansetron consumed significantly lower amounts of norepinephrine.

Another systematic review and meta-analysis of randomized controlled trials by Tubog et al. (2017) was included in this literature review. The purpose of this study was to determine the efficacy of intravenous ondansetron in reducing the incidence of SAIH and bradycardia. Thirteen randomized controlled trials were included in the analysis. Nine of these studies included patients undergoing elective cesarean section, and four trials reported on patients undergoing a variety of surgical procedures in orthopedics, urology, and gynecology. Patients were divided into two groups. The experimental group received ondansetron at varying doses (2-8 mg) prior to

spinal anesthesia. The control group did not receive ondansetron prior to receiving spinal anesthesia. Nine studies defined hypotension as a decrease in SBP by 75% from baseline, SBP less than 80-90 mmHg, or both. One study defined hypotension as diastolic blood pressure (DBP) less than 60 mmHg. Two studies used mean arterial pressure (MAP) to define hypotension, but no values were given. The authors discovered that intravenous ondansetron reduced the incidence of hypotension in both the cesarean and all-procedure groups with a risk ratio (RR) of 0.64 and 95% CI of 0.45-0.90 and RR of 0.63 and 95% CI of 0.45-0.88, respectively. Findings of this study suggest that ondansetron mitigates the risks of SAIH.

A randomized controlled trial performed by Mohamed et al. (2018) compared the efficacy of the use of ondansetron alone compared to the combined use of fluid preload and vasoconstrictors to decrease the incidence of spinal hypotension. Ninety patients of ASA grade I between the ages of 18 and 45 years scheduled to undergo elective surgical procedures on the lower extremity or lower abdomen under spinal anesthesia were included in this study. The authors defined hypotension as a decrease of MAP more than 20% of the baseline or less than 70 mmHg. Patients in Group I received 4 mg of ondansetron 15 minutes before delivery of spinal anesthesia. Patients in Group II received preloading with 7.5mL/kg/min of Ringer's lactate over a 10-minute period preceding the spinal block followed by a bolus of 2.5 mg of ephedrine in the first and second minute and 2.5 mg of ephedrine every five minutes for the next 20 minutes after the injection of spinal anesthesia. The study showed the incidence of hypotension following spinal anesthesia in Group I was 17.6% versus 13.3% in Group II. The difference among the two groups were statistically insignificant ($p = 0.082$). However, the study demonstrated that the preemptive use of both combined fluid preload and vasoconstrictors and use of ondansetron

alone significantly decreased the incidence of SAIH. Furthermore, the study goes on to conclude that ondansetron can be used as a sole agent in decreasing the incidence of SAIH.

Wang et al. (2014) conducted a double-blind, randomized controlled trial to determine the optimal dosage of ondansetron for preventing maternal hypotension during cesarean delivery. They compared 2 mg, 4 mg, 6 mg, and 8 mg doses of ondansetron as well as a control group with only normal saline. One hundred and fifty women undergoing elective cesarean section were randomly divided into one of the five groups. Parturients were 18-35 years of age, were at 37-42 weeks of gestation, and classified as ASA grades I and II. In addition to hypotension, the authors also analyzed serum parameters in umbilical cord blood after delivery. Maternal blood pressure was measured by SBP, DBP, and MAP. Compared to the control group, the incidence of maternal hypotension was obviously but not significantly reduced in experimental groups receiving 2 mg and 8 mg of ondansetron ($p > 0.05$). However, the incidence of maternal hypotension was significantly reduced in experimental groups receiving 4 mg and 6 mg of ondansetron ($p < 0.05$). This study also discovered that consumption of phenylephrine in the group receiving 4 mg of ondansetron was significantly less than that in the control group ($p < 0.05$). Furthermore, the pH of umbilical cord blood was significantly higher in the group receiving 4 mg of ondansetron compared to the control group ($p < 0.05$), stating that the control group exhibited cord blood of an acidotic state. The authors suggest that 4 mg is the optimal dose due to the decrease in risk for maternal hypotension and the minimal effects on umbilical cord blood.

The small sample sizes of the randomized controlled trials in this review contribute to limitations of data interpretation. However, all three randomized controlled trials found statistically significant evidence, as well as clinically relevant evidence, supporting the use of

ondansetron administration prior to spinal anesthesia. The evidence suggests that ondansetron does contribute to attenuating SAIH as evidenced by the decreased amount of vasopressor consumption in each of the three randomized controlled trials reviewed. Additionally, the systematic reviews provide overwhelming evidence that ondansetron is effective in mitigating the effects of following spinal anesthesia in all-procedure patients and obstetric patients. This literature review finds appropriate evidence to support incorporating prophylactic administration of 4mg of ondansetron in all cases using spinal anesthesia to mitigate SAIH.

Rationale

The major theoretical framework that was utilized as a guide for this project was the Plan-Do-Study-Act (PDSA) model. This four-step model is a straightforward, iterative approach to quality improvement and can be easily adopted regardless of practice size or resources ("Plan-Do-Study-Act," n.d.). Furthermore, since the PDSA cycle is commonly used during the clinical improvement process, it is often familiar to clinical staff even though the actual terminology of the model may be unfamiliar. Therefore, the PDSA model proves itself to be useful in adapting and implementing research-based interventions, especially where incorporation of the intervention into day-to-day practice is a central question (Coury et al., 2017). Utilization of the PDSA model involves following a prescribed four-stage cyclic learning approach to adapt changes aimed at improvement (Taylor et al., 2014). During the "plan" stage of the model, a changed aimed at improvement is identified. Next, the "do" stage sees this change tested. The "study" stage evaluates the success of the change, and the "act" stage identifies adaptations and next steps to inform a new cycle. The four steps of the model mirror the scientific experimental method of forming a hypothesis, data collection to test the hypothesis, and interpreting the results of the experiment. The PDSA model is a strong theoretical framework for this project due to its

ability to incorporate rapid assessment and flexibility as feedback to ensure fit-for purpose solutions are developed.

Another guiding theoretical framework was Duffy's Model of Caring. Duffy (2018) describes the importance of working with interprofessional teams to contribute to positive patient outcomes. The model implies that developmental discussions, facilitation of learning opportunities, and communication within the interprofessional team provides affirmative fuel for creating success and positive change. In congruence with Duffy's model, this project aimed to translate evidence into familiar terms, demonstrate how the evidence contributes to patient outcomes, describe the intervention, and provide examples that can contribute to team-based, patient-centered care that optimizes value.

For the purposes of this project and to align with the PDSA and Duffy models, the identified change aimed at improvement was to increase awareness and knowledge among anesthesia providers regarding ondansetron as an effective agent in attenuating SAIH when administered prior to spinal anesthesia. In the "do" stage, this project provided an educational in-service about the usefulness of ondansetron in mitigating SAIH. Evidence from the aforementioned publications were presented to anesthesia staff, a question-and-answer session was conducted, and comments and concerns were considered and addressed by the presenter. The success of the change was evaluated through a pre- and post-survey that evaluated anesthesia provider knowledge of the usefulness of ondansetron in mitigating SAIH prior to the educational in-service and upon completion of the in-service. The post-survey also assessed the anesthesia provider's intent to incorporate the information into his or her practice when caring for patients undergoing spinal anesthesia. Finally, the "act" stage involved refining the in-service, based on what was learned from the surveys as well as during the delivery of the in-

service. New methods of information delivery, as well as anesthesia provider feedback and perceptions, will be considered for future in-services.

Specific Aims

The specific aims of this project were: 1) to increase anesthesia provider awareness and knowledge regarding the use of ondansetron to mitigate SAIH through an approximately 20-minute-long educational in-service and 2) to present the evidence mentioned in this project's review of literature in a manner that may influence the participants to implement this proposed change into practice

Methods

Context

The population focus of this project was anesthesia providers at a 292 private-bed community hospital in West Virginia. The outcome evaluated was an increase in anesthesia provider knowledge regarding the usefulness of ondansetron during spinal anesthesia, ondansetron's mechanism of action in preventing SAIH, the application of the intervention for optimal results, and determining the participant's intent to incorporate the proposed change into practice.

Intervention

This quality improvement project strived to answer the question: Will an educational in-service regarding prophylactic ondansetron administration to attenuate SAIH increase anesthesia provider knowledge and impact practice? Research suggests quality improvement training can improve skills and knowledge among health professionals that may be associated with improvements in care processes (Worsley, 2016). The project co-investigator collaborated with the CRNA consultant for the project as well as the community hospital's Chief CRNA to deliver

an educational in-service regarding the use of ondansetron to mitigate hypotension in patients undergoing spinal anesthesia. Success of the intervention was determined by pre- and post-surveys that assess an increase in anesthesia provider knowledge regarding the intervention as well as intent to incorporate this intervention into practice.

The educational in-service was conducted during a monthly staff meeting to promote anesthesia staff attendance. The in-service was held in a classroom that accommodates 40 occupants and was equipped with a large presentation monitor and necessary cable hook-ups for a personal computer. Prior to the presentation, a five question Likert survey was conducted to assess the provider's knowledge regarding the application of ondansetron to mitigate SAIH, ondansetron's mechanism of action in mitigating SAIH, the optimal dosing of ondansetron for SAIH, whether or not they currently applied this intervention in their individual practice, and their willingness to change their practice if the in-service provided sufficient evidence to make a change. Providers were instructed to omit any identifying information on the surveys. Evidence regarding the intervention was then be delivered by the project co-investigator in a PowerPoint presentation that lasted approximately 20 minutes. The PowerPoint presentation was developed, stored, and accessed at the time of the in-service on the project co-investigator's personal laptop computer. Time was be allotted at the end of the presentation for questions and comments from those in attendance. Upon completion of the question-and-answer session, a post-intervention survey was distributed. The post-survey assessed the presentation's success in enhancing anesthesia provider knowledge along with intent to incorporate the intervention into the providers' practice.

Gaps in Evidence

After discussions with several anesthesia providers, the need to increase provider knowledge regarding this evidence-based intervention was identified so that providers may make a more informed decision regarding their delivery of spinal anesthesia care to this patient population. Upon further investigation, no evidence was identified that quantified the use of an educational in-service to address a lack of knowledge and utilization of this evidence-based practice among anesthesia providers. This quality improvement project may provide sufficient evidence that an educational in-service regarding the use of ondansetron to attenuate SAIH contributes to improved patient care achieved by anesthesia provider practice change for patients undergoing spinal anesthesia.

Feasibility Analysis

Needs Assessment

After interviewing several Certified Registered Nurse Anesthetists (CRNAs), lack of anesthesia provider knowledge regarding the usefulness of ondansetron in the attenuation of SAIH was identified as a problem among anesthesia staff at a 292 private-bed community hospital in West Virginia. Stakeholders for this project include the project investigator and co-investigator, the community hospital's Chief CRNA, and a CRNA employed by the community hospital who acted as the consultant for this project.

Upon further assessment of implementation needs, no regulations were identified that may conflict with the project. Furthermore, no extraordinary privacy, confidentiality, or security issues were determined. After discussion with the established consultant for this quality improvement project, implementation of the educational session component of this project would not place any additional demands on staff or have any impact on workflow. The surgical

department at the key site facility has regular meetings on the first Monday of every month which provided an ideal opportunity for the implementation of this project. These meetings are typically reserved for in-services and departmental issues such as quality improvement. Meetings occur in classrooms that were equipped with all of the technological components needed for this project. The educational in-service was delivered through a PowerPoint presentation that was created, stored, and accessed from the project co-investigator's personal computer.

Marketing and SWOT Analysis

The needs assessment of this project also included a SWOT analysis that identified several strengths, weaknesses, opportunities, and threats. Some strengths of this project are that workflow, staffing needs, and costs were not impacted. The cost of 4 mg/2 mL of ondansetron is $0.28 - $1.35 per milliliter (Lexicomp Mobile Apps, n.d.). Furthermore, ondansetron is a pregnancy Category B drug and is frequently prescribed to pregnant women to reduce pregnancy-related nausea and vomiting (Parker et al., 2018). An additional strength of this project includes the enhancement of CRNA knowledge regarding current evidence-based practice. Weaknesses identified in this project include the presenter having no personal experience with ondansetron administration in the attenuation of hypotension during spinal anesthesia administration. Another weakness that was anticipated during the implementation of this project was that department productivity may be impacted since all departmental business must be completed during this monthly meeting. However, this was also deemed as an opportunity. Knowing that the anesthesia department routinely meets every first Monday morning of the month provided an ample opportunity to implement the intervention with collaboration from the hospital's Chief CRNA and project consultant. Another opportunity considered during this SWOT analysis was the opportunity to provide this continuing education

to the anesthesia department regarding the effectiveness of ondansetron in mitigating hypotension under spinal anesthesia. This education can broaden the providers' knowledge of the care of this patient population. Threats identified during the SWOT analysis included pandemic-related precautions which have restricted department meetings, lack of anesthesia provider trust in the presenter due to the student presenter's lack of experience, inattention of anesthesia staff during the intervention, and reluctance of the anesthesia providers to translate this knowledge into their practice.

Budget and Financial Plan

A budget plan was developed by the project co-investigator. Total anticipated costs associated with this quality improvement project are minimal. Because the educational in-service will take place during a regularly scheduled monthly meeting within the anesthesia department, no administrative costs are anticipated. This project did hinder department or Operating Room productivity, and it did not have any impact on anesthesia provider workflow. The cost for educational materials and project supplies were minimal and at the project co-investigator's expense. A light breakfast was provided by the project co-investigator in the classroom before the in-service to increase anesthesia provider attendance. No travel, marketing, or other expenses related to this project were identified.

Personnel

Stakeholders for this project included anesthesia staff attending the educational in-service, the project's consultant, and patients at the West Virginia community hospital undergoing spinal anesthesia.

Technology

Materials used for the delivery of the proposed educational in-service included the project co-investigator's personal computer and a large monitor with all essential cable hook-ups in the classroom that the in-service was held. The project co-investigator created a PowerPoint presentation on her personal computer. The PowerPoint presentation was stored and delivered from the same computer. Surveys were hard-copy, paper surveys.

Sustainability of the Proposed Project

Sustainability will likely be satisfied by anesthesia providers transferring this knowledge to new CRNA hires as well as future student registered nurse anesthetists. Another potential source of sustainability would result from the inclusion of this in-service presentation with the educational content required annually for anesthesia staff at this institution.

Congruence with the Organization's Strategic Plan

This project aligned with the key site's mission statement. The West Virginia community hospital's mission statement addresses the values and goals of the organization. The organization's mission statement states: "to enhance the healthy status of the citizens of North Central West Virginia by pursuing spiritual, charitable, scientific and educational goals in providing safe, quality care and treatment without discrimination as to gender, race, color, religion, age, national origin, disabilities or financial status" ("The Future of Healthcare is Here," n.d.). This quality improvement educational session intended to broaden the knowledge of anesthesia providers in the care of patients undergoing spinal anesthesia, and by doing so, will contribute to the facility's mission of providing quality care.

Evidence of Key Site Support

Discussions were ongoing with the project's key consultant and the hospital's Chief CRNA leading up to the time of intervention. The mission statement of the community hospital clearly expresses support for this type of intervention. Written support was obtained from the hospital's Chief CRNA.

Project Timeline

West Virginia University Internal Review Board approval was granted in November 2020. Project implementation and data collection occurred in April 2021. Data analysis occurred in September of 2021.

Ethical Considerations

Participation in the educational in-service delivered to anesthesia providers was encouraged but in no way required. Participation was strictly voluntary. Identifying information of anesthesia providers who chose to participate in the educational in-service was omitted from surveys. No risks of this project's intervention were identified. The proposal for this quality improvement project was submitted for consideration to the IRB at WVU and was granted approval of this research. There were no financial or other conflicts of interest concerning the project and its implementation site or project researcher.

Measures

Measurable Project Objectives

The main objective of this project was to enhance anesthesia provider knowledge regarding the use of ondansetron prior to spinal anesthesia to attenuate the hypotension prevalent among this anesthetic technique. An additional objective to be evaluated was the anesthesia provider's intent to incorporate the proposed change into practice. Both objectives were

measured with qualitative data gathered from the aforementioned post-survey. Increasing anesthesia provider knowledge and awareness regarding this intervention should empower providers to adapt their practice in order to deliver higher quality, evidence-based anesthesia care to patients undergoing spinal anesthesia.

Evaluation Plan

An evaluation plan was created by the project co-investigator that included the project's specific aim, the population focus of the intervention, the outcome to be measured, and data collection methods relevant to the outcome. Data for this project was collected with pre- and post-surveys that assessed the success of the educational in-service delivered by the project co-investigator. Results of the data collection may be applied to future offerings of this in-service.

No instruments of measurement were identified that complimented data collection pertaining to this project, so instruments were constructed by the project co-investigator in collaboration with the project investigator and CRNA consultant. The instruments developed for data collection for this project were pre- and post- intervention Likert surveys consisting of five questions on a 5-point scale for each instrument. These surveys can be found in Appendix C. Because these surveys were constructed by the project's team, their validity and reliability could not be determined. These surveys were conducted prior to the in-service and immediately upon the in-service's completion. In order to enhance data collection, hard copies of both surveys were distributed to and collected from the anesthesia providers.

Analysis

Data collected from the surveys was analyzed using International Business Machine's (IBM, 2020) Statistical Product and Service Solutions (SPSS) with the assistance and guidance of a statistics expert. The pre- and post-intervention surveys contained ordinal variables, and a

Mann-Whitney U test was conducted to draw inferences between pre- and post-intervention survey data. P values of <0.05 for statistical test analyses indicated a statistically significant result. Surveys were assessed for participation and completeness.

Results

Nineteen CRNAs participated in this quality improvement initiative. Sample size for data analysis was 19, a 100% response rate. A Mann-Whitney U test was conducted to evaluate the statistical significance of the results. Results were considered significant if p-value was <0.05. This intervention showed overwhelming effectiveness in increasing provider knowledge regarding the use of ondansetron in the attenuation of SAIH. The results also showed overwhelming effectiveness in influencing a practice change among the anesthesia providers who participated. The educational in-service increased provider knowledge regarding management of SAIH with a statistical significance of <0.001. The in-service also increased knowledge about the use of ondansetron to attenuate SAIH with a statistical significance of <0.001. The in-service increased provider knowledge regarding the optimum dosing of ondansetron and intent to incorporate the intervention into future practice with statistical significance of <0.001 for both assessments. 100% of participants reported they were willing to make changes to their practice if evidence supported a change, and 100% of participants indicated that the in-service provided sufficient evidence to influence a change in anesthesia practice.

One barrier that was identified during the question and comment portion of the in-service was regarding the anesthesia care delivery model at the community hospital. The CRNAs at the community hospital practice under a team model in which they work under the medical direction of an anesthesiologist. Several CRNAs voiced concerns about whether or not their attending

anesthesiologists would be accepting of ondansetron given prior to a spinal anesthetic in parturients undergoing cesarean section. It is recommended that anesthesiologists attend future in-services, and more information is delivered regarding the safety of ondansetron administration during pregnancy.

Unintended Consequences and Missing Data

The project's intervention and data collection were conducted as designed; thus, no unintended consequences were identified. Given the 100% response rate, no missing data was identified. However, the sample size of this study was relatively small and only accounted for roughly 70% of the CRNAs employed by the community hospital. In order to increase the sample size and data collection, the in-service could have been delivered via a pre-recorded presentation that was delivered to each provider's e-mail address. In such case, surveys would have been conducted through a digital platform. This method, however, may not deliver a high participation rate due to the inconvenience of watching the presentation during the provider's free time and completing the surveys.

Discussion

Summary

Strengths of the project included the simplified intervention and data collection, timeliness of data collection, and a foundation for sustainability by including the in-service in annual or onboarding education. According to the data collected in this project, anesthesia providers indicated an intent to incorporate the use of ondansetron to mitigate SAIH. This change could provide an avenue for future investigators to conduct further studies regarding the intervention's effectiveness and contribute to future evidence-based practice. The minimal disruption in workflow was also an identified strength. One last strength related to this quality

improvement project was the positive feedback from participants regarding the quality and delivery of the education.

Interpretation

The outcomes of this intervention satisfied the project's aims and proved the intervention to be successful. The observed outcomes were even better than anticipated outcomes, as provider knowledge was statistically significantly increased in all categories and all participants reported that they were willing to make changes to their practice based on the information that was presented in the intervention. No additional costs were associated with the implantation of this quality improvement initiative.

Limitations

As noted above, the CRNAs at the community hospital practice under the medical direction of an anesthesiologist. This could potentially prove as a limiting factor in the CRNA carrying out the intervention in their practice. Another limitation that was noted was the limited reach of anesthesia providers at the community hospital. Not all CRNAs employed by the hospital were given the opportunity to participate in the in-service. To address this, the in-service could have been advertised prior to implementation, giving each CRNA an opportunity to attend. Also, each CRNA could have been scheduled a time to attend the in-service, but this would have dramatically affected workflow and increased costs for the organization.

Other limitations included the study's generalizability. The study site was chosen due to the lack of provider awareness regarding ondansetron's usefulness in the mitigation of SAIH. Outside of this particular community hospital, it is unclear whether this quality improvement project would be useful elsewhere. However, it can be ascertained that in-services such as this

one regarding evolving evidence-based practices are likely to enhance provider knowledge and influence practice changes.

The internal validity of the study was identified as another possible limitation. Due to the small sample size, statistical results were weakened. Furthermore, existing relationships between the project's co-investigator and study participants may have influenced the participants' survey responses. Conversely, the co-investigator's lack of clinical experience with ondansetron's use in the attenuation of SAIH may have impacted the participants' responses.

Conclusion

This quality improvement project was proven effective in addressing anesthesia provider knowledge deficit regarding management of SAIH, the use on ondansetron to attenuate SAIH, ondansetron's mechanism of action to attenuate SAIH, as well as influencing a practice change among providers who attended the in-service. It is recommended to include the in-service during the onboarding process for new hires in order to address gaps in knowledge. The in-service may be expanded to additional hospitals, pending an identified gap in knowledge. Follow-up evaluation regarding the actual incorporation of the intervention in practice is also recommended to contribute to further evidence-based practice.

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Appendix A

Table 1

Literature Review Synthesis Table

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
2014	Wang et al., Efficacy of prophylactic intravenous ondansetron on the prevention of hypotension during cesarean delivery: a dose-dependent study, China	to determine the optimal dosage of ondansetron for preventing maternal hypotension during cesarean delivery	One hundred and fifty parturient women scheduled for elective cesar-ean section were randomly assigned to five groups (n=30). Patients, aged 18-35 years, were at 37-42 weeks of gestation and classified as American Society of Anesthesio-logists (ASA) grade I-II	Double-blind randomized controlled trial Maternal blood pressure was measured by SBP, DBP, and MAP Maternal heart rate was measured in bpm Serum parameters in umbilical cord blood were analyzed after delivery	Independent: IV1: Group S: saline group IV2: Group O2: 2 mg Ondansetron IV3: Group O4: 4 mg Ondansetron IV4: Group O6: 6 mg ondansetron IV5: Group O8: 8 mg Ondansetron Dependent: DV1: maternal BP DV2: maternal heart rate DV3: serum parameters in cord blood	Compared with group S, the incidence of maternal hypotension was obviously but not significantly reduced in groups O2 and O8 ($P > 0.05$), but significantly reduced in groups O4 and O6 ($P < 0.05$) No bradycardia or vomiting were observed in groups O4, O6, and O8, but was observed in Group S the consumption of phenylephrine in group O4 was significantly less

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
						than that in group S ($P < 0.05$) The gas analysis results from umbilical arterial blood showed that there were no significant differences in pH, Pco2, PO2, Hco3-, or base excess ($P > 0.05$ the pH of the umbilical venous blood was significantly higher in group O4 compared with group S ($P < 0.05$)
2015	Gao et al., Effects of prophylactic ondansetron on spinal anesthesia-induced hypotension: a meta-analysis, China	To assess prophylactic effects of ondansetron on spinal anesthesia-induced hypotension in obstetric and non-obstetric	10 randomized clinical trials with 863 participants	Meta-analysis Hypotension defined as 20% or greater decrease from baseline or SAP in 9 studies, and	Independent: IV1: patients receiving ondansetron prior to spinal IV2: patients who did not receive	Ondansetron reduced incidence of hypotension in the obstetric and non-obstetric groups, p = 0.002 and p = 0.0005, respectively

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
		patients		<90 mmHg in 1 study. Bradycardia was not defined Vasopressor use was measured in amounts given of phenylephrine and ephedrine	ondansetron prior to spinal Dependent: DV1: systolic blood pressure DV2: Heart rate DV3: total use of vasopressors	bradycardia after prophylactic ondansetron was 0.27 (95% CI 0.16 to 0.47, P<0.0001) for fixed effect model analysis and 0.34 (95% CI 0.19 to 0.61, P=0.0003) for random effects model analysis, indicating that prophylactic ondansetron significantly reduced the incidence of bradycardia caused by spinal anesthesia (95% CI -2.02 to -0.40 mg), suggesting ephedrine used was decreased in patients using ondansetron

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
						(95% CI -57.46 to -4.87 μg, P<0.05) suggests that phenylephrine use was decreased in patients receiving ondansetron.
2015	Trabelsi et al., Effect of Ondansetron on the Occurrence of Hypotension and on Neonatal Parameters during Spinal Anesthesia for Elective Caesarean Section: A Prospective, Randomized, Controlled, Double-Blind Study, Tunisia	to investigate the use of intravenous ondansetron for prophylaxis of hypotension after spinal anesthesia in parturients scheduled for elective caesarean section and its consequences on newborns' parameters	ASA I primipara patients undergoing elective C-Section at term, 80 total patients, exclusion criteria were emesis gravidarum, contraindication to spinal anesthesia (patient refusal, unstable hemodynamic, and coagulation abnormalities), chronic hypertension or preeclampsia, morbid obesity, and/or any study drugs allergy	Prospective, randomized, controlled, double-blinded study. Arterial line was used to monitor blood pressure. Systolic, diastolic, and mean arterial pressures were measured. Hypotension was defined as a 20% or greater decrease from baseline or SAP less than 80Heart rate was also measured. Bradycardia was defined as a 30%	Independent IV1: Group O received 4 mg IV ondansetron in 10 mL saline 5 minutes prior to spinal. IV2: Group S received 10 mL saline (placebo) DV1: Systolic Arterial Pressure DV2: Diastolic Arterial Pressure DV3: Mean Arterial Pressure DV4: heartrate	SAP, DAP, MAP higher in Group 0 4-10 minutes after spinal. Fewer patients in the O group experienced hypotension as compared to those in the S group: 15 (37.5%) and 31 (77.5%) ($P < 0.001$). the average consumption of ephedrine intraoperatively was 5.10 °æ 7.78 mg in group O while it was 12.90 °æ 9.24 mg in group S with a

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
				drop in HR or HR 45 or less		significant difference (*P* < 0.001). HRs were similar in both groups and bradycardia was observed in 6 patients in group O (15%), whereas it was more frequent in the S group (15 cases, 37.5%) with a significant difference (*P* = 0.022). Atropine consumption of in group S was 0.12 °æ 0.22 mg. No atropine was required in group O.
2015	Owczuk et al., Ondansetron attenuates the decrease in blood pressure due to spinal anesthesia in the elderly: a double blind, placebo-controlled study	To verify the hypothesis that blocking type 3 serotonin receptors with intravenous ondansetron reduces the hypotension	ASA I-III patients age 70 and older without contraindication to subarachnoid block or ondansetron administration. Patients were	Double-blind, randomized controlled trial. NIBP measurements were used. Hypotension was defined as SBP <90 mmHg or a	Independent IV1: Ondansetron group received 8 mg IV ondansetron in 10mL saline 5 minutes prior to spinal.	SBP was significantly higher 5 minutes after the block was established in the ondansetron group. MAP and DBP were

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
		induced by spinal anesthesia	randomized into the ondansetron group, which received 8 mg of IV ondansetron diluted in 10mL of normal saline 5 minutes prior to the block and the placebo group, which received only 10mL of normal saline. Fifty three total patients were included in the study. here were no significant differences in the patient age, body weight, height, sex, ASA classification and the frequency of cardiovascular disorders between the groups.	SBP decrease of >20%. Measurements were recorded at 5, 10, and 15 minutes after subarachnoid block administration.	IV2: Placebo Group received 10mL NS 5 minutes prior to spinal anesthesia. DV1: Systolic Arterial Pressure DV2: Mean Arterial Pressure	significantly higher at post-block intervals of 5, 10, and 15 minutes in the ondansetron group. Ephedrine was administered to 12 (44.4%) of individuals in the placebo group and to 5 (19.2%) in the ondansetron group ($p = 0.049$)
2016	Heesen et al., Prevention of Spinal Anesthesia-Induced Hypotension	to determine whether 5-hydroxytryptamine3 (5-HT3) receptor	Seventeen trials (8 obstetric, 9 non-obstetric) reporting on 1604 patients	Systematic Review and Meta-analysis and Meta-regression	Independent: IV1: obstetric patients receiving prophylactic ondansetron	Prophylactic use of ondansetron in the non-obstetric and obstetric groups showed

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
	During Cesarean Delivery by 5-Hydroxytryptamine-3 Receptor Antagonists: A Systematic Review and Meta-analysis and Meta-regression, Switzerland	antagonists, administered before the initiation of spinal anesthesia, mitigate hypotension		Hypotension as defined by the studies' authors	IV2: non-obstetric patients receiving prophylactic ondansetron IV3: obstetric patients not receiving prophylactic ondansetron IV4: non-obstetric patients not receiving prophylactic ondansetron DV1: incidence of hypotension among obstetric and non-obstetric patients	decreased risk for hypotension, RR 0.54, 95% CI 0.36–0.81, I2 = 79%.
2017	Karacaer et al., Does prophylactic ondansetron reduce norepinephrine consumption in patients undergoing cesarean section	assess the effect of prophylactic ondansetron on the incidence of SAIH, norepinephrine consumption, and adverse effects	108 parturients with uncomplicated pregnancies undergoing elective cesarean delivery under spinal	Prospective, randomized, double-blinded, controlled study Hypotension defined as SBP	Independent: IV1: Group O (n = 54) received 8 mg ondansetron Intravenously IV2: Group S received (n=54) were	There was no significant difference in the incidence of patients with hypotension in the saline (n = 47, 87%) and ondansetron

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
	with spinal anesthesia?, Turkey		anesthesia. The parturients were divided into two groups randomly	less than 80% of baseline Bradycardia defined as HR < 60 Norepinephrine consumption measured in mg	given the same volume (4 ml) of saline (group S) to establish the double-blind nature of the study. Dependent: DV1: SBP DV2: HR DV3: Norepinephrine consumption	groups (n = 48, 88.9%) (p = 0.767). However, cumulative episodes of hypotension and norepinephrine consumption were significantly greater in group S than in group O (p = 0.009 and p = 0.009, respectively) Bradycardia was observed in 11 (20.4%) patients in group O and 6 (11.1%) in group S (p = 0.186).
2017	Tubog et al., Effects of Ondansetron on Attenuating Spinal Anesthesia–Induced Hypotension and Bradycardia in Obstetric and Nonobstetric Subjects:	to determine the efficacy of intravenous (IV) ondansetron in reducing the incidence of SIH and bradycardia	Thirteen RCTs were included in this analysis, totaling 1,225 subjects	Systematic review and meta-analysis of randomized controlled trials (RCTs) hypotension as a decrease in	Independent: IV1: Group O received ondansetron at varying doses prior to spinal IV2: Group S did not receive	Intravenous ondansetron reduced the incidence of hypotension in both the all-procedure analysis group

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
	A Systematic Review and Meta-Analysis, United States			systolic blood pressure (SBP) by 75% to 80% of baseline, SBP less than 80 to 90 mm Hg, or both. One study defined hypotension as diastolic blood pressure less than 60 mm Hg. Two studies used mean arterial pressure to define Hypotension Bradycardia was defined in beats per minute. In 3 studies, bradycardia was defined as less than 40 to 45/ min, in 5 studies as less than 50/min, and in 2 studies as less than 60/min. One study used	ondansetron prior to spinal	(RR, 0.64; CI, 0.45-0.90) and cesarean delivery group (RR, 0.63; CI, 0.45-0.88). For bradycardia, IV ondansetron resulted in reduced risk (RR, 0.31; CI, 0.19-0.50). Findings suggest that IV ondansetron may mitigate the risks of SIH and bradycardia following spinal anesthesia

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
				2 criteria to define bradycardia: either a 30% drop from baseline or a severe decline below 45/min. Two studies did not specifically define bradycardia		
2018	Mohamed et al., Ondansetron Is an Effective Alternative to Decrease the Incidence of Postspinal Hypotension in Healthy Subjects Undergoing Infra-Umbilical Surgeries Compared To Combined Volume Loading and Vasoconstrictors: Randomized Controlled Trial, Egypt	To compare the efficacy of the use of ondansetron alone compared to the combined use of fluid preload and vasoconstrictors to decrease the incidence of spinal hypotension	90 patients of ASA grade I between the age of 18 and 45 years scheduled to undergo elective surgical procedures on the lower extremity or lower abdomen under spinal anesthesia	Randomized controlled trial Hypotension was defined as a decrease of MAP more than 20% of the baseline or less than 70 mmHg Bradycardia was defined as heart rate < 60	Independent: IV1: Group I patients (ondansetron group) received 4 mg ondansetron in 5 ml normal saline (IV) 15 minutes before induction of spinal anesthesia IV2: Group II patients (combination group) received preloading with 7.5 ml/kg/min of Ringer's lactate	The incidence of hypotension following the subarachnoid block in Group I (ondansetron group) was 17.6% versus group II (combination group) was 13.3%, while difference among the groups is statistically insignificant (P = 0.082)

Year	Citation: Author, Title, Country	Purpose of the Study	Sample Description	Design / Measures of Major Variables	Major Variables Being Measured	Findings
					over 10-minute period preceding the spinal block followed by intravenous bolus of 2.5 mg ephedrine in the first and second minute and 2.5 mg ephedrine every 5 minutes for the next 20 minutes after the injection of spinal anesthetic drug Dependent: DV1: non-invasive measurement of MAP DV2: heart rate DV3: Reactive hypertension	HR showed a significant increase in group II and a statistically insignificant change in group I with a statistically significant difference in the heart rate (HR) between both groups ($P < 0.05$) Ondansetron alone did not reduce hypotension, but it did decrease the amount of vasopressors needed. Ondansetron did reduce the incidence of bradycardia

Appendix B

Budget Plan Form and Justification

Budget Categories	Personal Funds	Organizational Contributions
ADMINISTRATIVE COSTS	$ 0	$ 0
Administrative Justification: Because this in-service detailed in this project will be conducted during a regularly scheduled monthly staff meeting within the anesthesia department at United Hospital Center and will not impact workflow or Operating Room productivity, there are no administrative costs associated with this project.		
MARKETING	$ 0	$ 0
Marketing Justification: There is no marketing plan associated with this project.		
EDUCATIONAL MATERIALS/ INCENTIVES	$ 5	$ 0
Educational Materials/Incentives Justification: This will cover the paper that the surveys will be printed on, as well as printing costs at the project designer's home.		
HOSPITALITY (food, room rentals, etc.)	$ 30	$ 0
Hospitality Justification: Breakfast will be provided for staff at the beginning of the in-service to increase anesthesia provider attendance.		
PROJECT SUPPLIES (office supplies, postage, printing, etc.)	$ 5	$ 0
Project Supplies Justification: Pens will be provided by the project designer at the in-service.		
TRAVEL EXPENSES	$ 0	$ 0
Travel Expenses Justification: There are no travel expenses related to this project.		
OTHER	$ 0	$ 0
Other Justification:		
TOTALS	$ 40	$ 0

Appendix C

WVUMedicine
UNITED HOSPITAL CENTER

June 27, 2020

To Whom It May Concern:

As the Chief CRNA at WVUMedicine's United Hospital Center, I am excited to lend my support to Kassidy Nutter, SRNA to implement her proposed Doctor of Nursing Practice Project. This letter serves as support for Kassidy's planned DNP Project proposal to deliver an educational in-service to the anesthesia staff at United Hospital Center regarding the usefulness of ondansetron in the mitigation of spinal anesthesia-induced hypotension. The organization and leadership at United Hospital Center fully support this Capstone project. We are excited for the opportunity to be included in this project and look forward to working with Kassidy on implementing this project at our facility.

Sincerely,

Matthew Camerlin, Chief CRNA
Department of Anesthesiology
WVUMedicine – United Hospital Center
681-342-2233
camerlinma@wvumedicine.org

Appendix D

Pre-Intervention Survey

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware that ondansetron is used to attenuate spinal anesthesia-induced hypotension.	**1**	**0**	**2**	**4**	**12**
I have a good understanding of ondansetron's mechanism of action in attenuating spinal anesthesia-induced hypotension.	**1**	**5**	**7**	**6**	**0**
I know the recommended optimal doses of ondansetron for obstetric and non-obstetric patients for the attenuation of spinal anesthesia-induced hypotension.	**1**	**4**	**8**	**4**	**2**
I routinely give ondansetron to patients undergoing spinal anesthesia prior to the establishment of the block, unless contraindicated.	**6**	**2**	**5**	**4**	**2**
I'm willing to make changes to my practice if evidence supports the change.	**0**	**0**	**0**	**5**	**12**

Appendix E

Post-Intervention Survey

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
This in-service increased my knowledge regarding the management of spinal anesthesia-induced hypotension.	**0**	**0**	**1**	**2**	**16**
This in-service increased my knowledge about the use of ondansetron in attenuating spinal anesthesia-induced hypotension.	**0**	**0**	**0**	**3**	**16**
I'm confident that I know the optimal dosages of ondansetron for obstetric and non-obstetric patients for the attenuation of spinal anesthesia-induced hypotension.	**0**	**0**	**0**	**3**	**16**
Based on what was learned in this survey, I intend to incorporate the proposed intervention into my future practice.	**0**	**0**	**0**	**4**	**15**
I believe this in-service provided sufficient evidence to influence a change in my anesthesia practice.	**0**	**0**	**0**	**3**	**16**

Appendix F

Statistical Results

Question 1

Test Statistics[a]

	LikertScore
Mann-Whitney U	64.000
Wilcoxon W	235.000
Z	-3.543
Asymp. Sig. (2-tailed)	<.001
Exact Sig. [2*(1-tailed Sig.)]	.001[b]

a. Grouping Variable: Question1

b. Not corrected for ties.

Question 2

Test Statistics[a]

	Responses
Mann-Whitney U	6.000
Wilcoxon W	177.000
Z	-5.222
Asymp. Sig. (2-tailed)	<.001
Exact Sig. [2*(1-tailed Sig.)]	<.001[b]

a. Grouping Variable: Question2

b. Not corrected for ties.

Question 3

Test Statistics[a]

	Responses
Mann-Whitney U	24.000
Wilcoxon W	195.000
Z	-4.702
Asymp. Sig. (2-tailed)	<.001
Exact Sig. [2*(1-tailed Sig.)]	<.001[b]

a. Grouping Variable: Question3

b. Not corrected for ties.

Question 4

Test Statistics[a]

	Responses
Mann-Whitney U	27.000
Wilcoxon W	198.000
Z	-4.548
Asymp. Sig. (2-tailed)	<.001
Exact Sig. [2*(1-tailed Sig.)]	<.001[b]

a. Grouping Variable: Question4

b. Not corrected for ties.