INTRAOPERATIVE DOSING OF DEXAMETHASONE IN TYPE II DIABETIC PATIENTS UNDERGOING ORTHOPEDIC PROCEDURES

by

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ABSTRACT

SARAH LYNN WALKER. Scholarly Paper: Intraoperative Dosing of Dexamethasone in Type II Diabetic Patients Undergoing Orthopedic Procedures.
Under the direction of DR. STEPHANIE WOODS, PH.D., RN

The purpose of this quality improvement (QI) project was to identify trends in the intraoperative dosing of dexamethasone in type II diabetic patients undergoing orthopedic procedures at a community hospital to determine impact of dosage level on postoperative glycemic response compared to preoperative levels and HgbA1C levels.

Dexamethasone is a corticosteroid and despite its many documented benefits when administered perioperatively to surgical patients, it is often withheld in the type II diabetic population out of concern for effects on postoperative glycemic control. For this QI project, charts of type II diabetics receiving dexamethasone undergoing orthopedic procedures were reviewed. Data inclusion criteria were type II diabetics, procedures <4 hours, patients with a HbA1C reading 6.5-8.9%, patients who are non-pregnant, patients with an ASA classification of I, II, or III, and those not taking steroidal medications.

Dexamethasone dosage had a significant effect on the change of blood glucose levels, ($t = 4.16$, $p < .001$), with a higher dose leading to a greater increase in blood glucose (BG). There was a positive correlation between postoperative BG and both surgery length and age, meaning that the longer the surgery and the older the patient the higher the postop BG. Change in BG postoperatively had a negative correlation with HgbA1C, meaning that patients with a lower HgbA1C preoperatively had a greater increase in BG postoperatively. There was no significant increase in BG in doses of 0, 4, or 8 mg; but there was a significant increase in BG with a dexamethasone dose of 10 mg.

Results of the chart reviews found that small doses of dexamethasone did not increase postoperative BG significantly in type II diabetics. Larger doses of 10 mg had a significant increase in BG readings. Project results suggest further study and improvement interventions in dexamethasone dosing in diabetics.

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DEDICATION

For my family, both past and present, who encouraged me every step of the way. To my parents, whose love and support has been a daily reminder that I am fearfully and wonderfully made. To my sisters, who bring me joy and friendship each day. And to my Aunt Ann for introducing me to the field of nursing. May the road rise up to meet you.

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LIST OF ABBREVIATIONS

ASA: American Society of Anesthesiologists

BG: blood glucose

HgbA1C: hemoglobin A1C

OR: operating room

PACU: post anesthesia care unit

PONV: post-operative nausea and vomiting

QI: quality improvement

CHAPTER 1: INTRODUCTION

Dexamethasone is a powerful corticosteroid that has become a commonly used medication administered by anesthesia providers intraoperatively to patients undergoing a multitude of surgical types. Utilized for its multimodal benefits for patients under surgery, its most popular indication for anesthesia providers is to prevent postoperative nausea and vomiting (PONV). Its other benefits include enhanced analgesia and anti-inflammatory properties that aid in the body's ability to cope with the stress response to surgery (Bonilla et al., 2022). However, when it comes to diabetic patients (particularly type II), many anesthesia providers seem to be hesitant to administer a single dose of dexamethasone, even in low doses of 4 mg, due to its potential for hyperglycemia 6-12 hours postoperatively in type II diabetics (Nagelhout & Elisha, 2018).

Problem Statement

Dexamethasone has a unique ability to be utilized in several different clinical scenarios and has earned its position as a common medication administered in the operating room. According to Corcoran et al. (2021a), up to 50% of surgical patients may receive intraoperative dexamethasone, thus emphasizing its increased usage in the intraoperative area. A known side effect of dexamethasone is the potential for postoperative hyperglycemia. However, in the type II diabetic population the true severity of this blood glucose increase that is related independently to dexamethasone and any subsequent adverse outcomes are topics that are only beginning to be studied. A lack of agreement on dosing with dexamethasone intraoperatively is made apparent in one of the most utilized textbooks for nurse anesthesia education: Nagelhout and Elisha (2018). These authors state, "a dose of 4 mg IV is recommended after anesthesia induction…some clinicians prefer a higher dose of 8 mg IV" (Nagelhout & Elisha, 2018, p. 195).

When the diagnosis of diabetes is added, this topic becomes even more of a debate with anesthesia providers – evidenced by the current research being conducted to investigate the best practices. It is also important to recognize potential confounding variables and effects surgery can have physiologically on the body that increase serum blood glucose. These factors include other medications containing glucose-based solutions (i.e. dextrose), blood products, exogenous catecholamines, parenteral nutrition and the surgical sympathetic activation of the hypothalamo-pituitary-adrenocortical (HPA) axis. This HPA activation leads to an increase in the body's blood sugar level due to intrinsic cortisol release from the body's overall stress response to surgery (Nagelhout & Elisha, 2018).

In addition, dexamethasone is thought to work on inhibiting postoperative nausea and vomiting (PONV) via anti-inflammatory mechanisms. These anti-inflammatory effects are also believed to help mitigate the neurohumoral stressors that surgery places on the body by suppressing the release of neuropeptides after tissue injury, leading to effects such as decreases in postoperative pain and improved quality of recovery post-surgery (Myles and Corcoran, 2021). Regardless of the documented benefits that dexamethasone has to offer patients undergoing surgery, there is a wide variety in practice and a lack of clear guidance when it comes to dosing dexamethasone in these patients. To create a true guideline and define evidence-based practice to anesthesia providers, the impact of dexamethasone on type II diabetic glycemic levels perioperatively must be better understood.

Purpose of Project

The purpose of this quality improvement project is to identify trends in the intraoperative dosing of dexamethasone in type II diabetic patients undergoing genitourinary, orthopedic, or bariatric procedures. Specifically, this project, which is part of a larger QI project, strives to create a record of effects of dexamethasone on patient glycemic levels postoperatively based on the dose received and their initial level of glycemic control (HbA1C) in patients undergoing orthopedic procedures. Overall, the goal is to develop a foundation for the creation of a clinical practice guideline for anesthesia providers when choosing how to safely dose dexamethasone in their type II diabetic patients to optimize patient outcomes.

Clinical Question – PICOT

In type II diabetic patients, aged 35-75, undergoing orthopedic surgical procedures lasting less than 4 hours at a full-service community hospital, does the intraoperative administration of IV dexamethasone have an effect on postoperative blood glucose levels compared to preoperative blood glucose levels?

CHAPTER 2: LITERATURE REVIEW

Methods

This literature search was conducted using the databases PubMed, Web of Science, CINAHL, and ScienceDirect via the University of North Carolina Charlotte Library services. The literature search was conducted from January 15th, 2023, to February 10th, 2023, and a librarian specializing in Allied Health was consulted to assist with the search methodology. All searches were limited to a 10-year time frame in an organized effort to find more current practices and evidence.

Keywords were selected based off the PICO question "In type II diabetic patients, aged 35-75, undergoing procedures lasting less than 4 hours at a full-service community hospital, does the intraoperative administration of IV dexamethasone have an effect on postoperative blood glucose levels compared to preoperative blood glucose levels?" In each database, searches were completed utilizing a variety of different keywords in an attempt to curtail the results. Keywords utilized included: dexamethasone, blood glucose, surgery, diabetes, type II diabetes mellitus, blood glucose concentrations, anesthesia, intraoperative, renal, gynecologic, urologic, genitourinary, urogynecologic, orthopedic, gastrointestinal, and bariatric. Advanced search techniques in PubMed consisted of added queries and the usage of AND/OR term identifiers. Advanced search techniques in Web of Science utilized citation references to obtain like sources and cited references from prominent articles.

Literature Review: Orthopedic Procedures

Dexamethasone is a common drug utilized in the orthopedic surgical setting, as its corticosteroid traits are uniquely beneficial in treating orthopedic pain (Nurok et al., 2017). Dexamethasone is widely used intraoperatively, specifically in orthopedic procedures, because of its ability to decrease postoperative nausea and vomiting, improve outcomes, reduce hospital length of stay, and provide effective analgesia for patients (O'Connell et al., 2018; Volkmar et al., 2022). Because of these positive outcomes following dexamethasone dosing, current research is directed at how the use of dexamethasone intraoperatively might benefit patients, while also maintaining safe outcomes in the recovery period.

Dexamethasone is a potent anti-inflammatory due its success in reducing prostaglandin synthesis, which has been shown to expedite recovery after orthopedic surgeries (Arumugam et al., 2020). However, as a corticosteroid, dexamethasone is capable of detrimental side effects such as hyperglycemia which can potentially negatively impact postoperative outcomes. In conjunction with its steroidal makeup, dexamethasone can potentiate altered immune responses and delay wound healing. Much of the skepticism involved in dexamethasone dosing in diabetic surgical patients specifically involves the concern for delayed wound healing and infection (Arumugam et al., 2020). Arumugam et al. (2020) performed a retrospective study identifying over 700 patients undergoing total hip or knee arthroplasties from 2016-2017, of whom 465 were diabetic. They found that dexamethasone was safe to administer to diabetic patients without increasing the risk for post-joint infection (PJI) or hyperglycemia. Although diabetes mellitus and hyperglycemia are both risk factors for post-joint infection, the dexamethasone dosing for diabetics in this study did not influence the rate of post-joint infection (Arumugam et al., 2020). Evidence suggests that high glucose readings and infection rates postoperatively are not related to dexamethasone administration, but rather to the diabetes diagnosis itself (Allen, 2019). Other studies reveal post joint infection rates were significantly decreased in diabetics who received a dexamethasone dosing (Heckmann et al., 2022).

Orthopedic Specific Findings

There are over 450-500,000 total hip arthroplasty procedures annually making it one of the most performed surgeries in the United States (Williams et al., 2023). To assess the effects dexamethasone has on orthopedic surgical patients, a retrospective study was done in 2016 comparing the effects of dexamethasone administration in diabetics receiving total hip or total knee arthroplasties (Nurok et al., 2017). This study sampled 625 patients aged 18-99 where fifty-nine of those orthopedic patients also had diabetes mellitus. Ultimately, Nurok et al. (2017) found no evidence of association between perioperative dexamethasone administration and the odds of glucose readings > 200 mg/dl following surgery.

To quantify any glycemic changes, it was necessary to have a preoperative blood sugar reading to monitor changes (Nurok et al., 2017). Preoperative glucose monitoring was done on all patients in the sample size by point of care testing. Inclusion and exclusion criteria were established to maintain validity of the sample size. Inclusion criteria for the chart review did not allow patients taking oral steroidal medications to be pooled in the sample, as these medications alter glucose readings (Low et al., 2015).

To identify trends following dexamethasone dosing in diabetics, research has included specific demographic information such as hemoglobin A1C (HbA1C), body mass index (BMI), medication regimen, and additional procedure information (O’Connell et al., 2018). These clinical characteristics were reviewed in samples of those receiving dexamethasone and those who did not. O’ Connell et al. (2018) found the blood glucose concentrations increased significantly over time and peaked at two hours after administration of any dose of dexamethasone, with “the maximum concentration of blood glucose higher in diabetic patients and was associated with increased BMI and HbA1C” (p. 6). O’ Connell et al. (2018) found that patients who received a 10 mg dose of dexamethasone had 3.52 higher odds of having elevated postoperative glucose readings than those who received no dexamethasone. Patients who received a dose less than 10 mg had a 1.75 higher odd of an elevated postoperative elevated BG reading than those who did not receive dexamethasone in any dose (O'Connell et al., 2018).

Though most studies recommend that the benefits of dexamethasone dosing in surgical diabetic patients outweigh the risks, there are certain patient characteristics that warrant special consideration prior to dosing. For example, diabetic patients with higher preoperative hemoglobin A1C are at higher risk for elevated blood glucose levels following intraoperative dexamethasone administration (Allen et al., 2019). Additional research again confirms that higher post joint infection rates are due not to the dexamethasone dosing itself, but due to the diabetes diagnosis (Godshaw et al., 2018). As can be expected, elevated HbA1C levels can contribute to higher postoperative glucose levels (Allen et al., 2019).

Additional Benefits to Dexamethasone in the Orthopedic Population

In their 2020 study, Arumugam et al. categorized their sample size into diabetic patients who received a 4 mg dose of dexamethasone and those that received an 8 mg dose prior to their joint arthroplasty surgery. While there is conflicting evidence regarding a dose dependent response to dexamethasone dosing and the elevation of blood glucose levels, Arumugam et al. (2020) found there were no significant differences in preoperative to postoperative blood glucose of patients receiving a 4 mg dose compared to an 8 mg dose; they both had a similar effect amongst diabetic surgical patients. Arumugam et al. (2020) reviewed 715 patients who underwent total joint arthroplasties, in which 20.7% received 4 mg dexamethasone and 79.3% received 8 mg dexamethasone and reported, "contrary to the belief that a larger dose of dexamethasone would lead to greater increases in post-op blood glucose, our study showed no significant difference between the two doses" (p. 5). Furthermore, the lack of major difference between preoperative and postoperative blood glucoses among diabetics and non-diabetics after dexamethasone dosing suggest "both 4mg and 8mg intraoperative dexamethasone have a similar effect on postoperative blood glucose" (Arumugam et al., 2020, p. 4). Godshaw et al. (2018) and Nurok et al. (2017) found similar results in their chart reviews of surgical joint procedures that identified there was no link of association between dexamethasone administration and postoperative blood glucose levels >200 mg/dL in diabetic or non-diabetic patients.

However, O'Connell et al. (2018) and Low et al. (2015) found that a higher dose of intraoperative dexamethasone was associated with a higher postoperative blood glucose reading over 200 mg/dL in the first 72 hours after surgery, suggesting the 4 mg dose may be a more appropriate intraoperative dose for diabetic patients. Other reports observed that peak blood glucose levels occurred as early as 2-3 hours postoperatively and none of the hyperglycemic effects persisted beyond 24 hours (Allen et al., 2019; Bonilla et al., 2022; Park et al., 2021). In a recent analysis of perioperative use among diabetics undergoing total hip arthroplasty, Williams et al. (2023) concluded the adverse effects of dexamethasone and glycemic control in diabetics is limited to those who are treated with insulin prior to their procedure. They reported that the patients who did not receive dexamethasone had a higher mean blood glucose level than dexamethasone treated patients (William et al., 2023).

In summary, most of the retrospective research has surmised dexamethasone may transiently increase postoperative glucose levels in diabetics, but it has no effect beyond postoperative day 1 (Park et al., 202). Literature has found that the adverse effects of dexamethasone dosing in diabetics do not extend beyond what would be anticipated within its 24-hour duration of activity (William et al., 2023). Considering this evidence, type II diabetic patients that maintain a well-controlled glucose baseline may benefit from the safe administration of dexamethasone in the orthopedic setting (Nurok et al., 2017). Arumugam et al. (2020) suggested “perioperative dexamethasone should not be withheld from patients with diabetes for fear of hyperglycemia or risk of infection… as the benefits appear to outweigh the risks” (p. 6).

Conceptual Framework

This project utilized the SPO conceptual framework, alternatively known as the Donabedian model, named after Avedis Donabedian, who formulated this framework as a means for evaluating quality of medical care in the 1960s (Agency for Healthcare Research and Quality, 2015). The SPO model serves as a framework for examining and evaluating quality of health care, with the three steps being: S-structure, P-process, and O-outcome. Donabedian emphasized the importance of the connection between structures, processes, and outcomes; therefore, utilizing this model allows for relationships between the PICO, methodology, and outcomes to be identified. In this quality improvement project, the SPO model was utilized to evaluate the impact of dexamethasone dosing in type II diabetics. The structure (S) of this project included the full-service community hospital location and three different surgical patient populations being reviewed, consisting of type II diabetic patients undergoing either genitourinary, orthopedic, or bariatric procedures. The process (P) involved completing a literature review and subsequently a chart review to gain insight into the effects of dexamethasone dosing on blood glucose levels in the postoperative period. The outcome (O) of this QI project was to disseminate the findings on the effects of dexamethasone dosing in type II diabetic patients to anesthesia providers.

CHAPTER 3: METHODOLOGY

Project Design

This was a quality improvement project that served to provide updated information to anesthesia providers caring for type II diabetics undergoing orthopedic procedures receiving dexamethasone intraoperatively. This quality improvement was approved by Wake Forest School of Medicine and University of North Carolina Charlotte's IRBs. The PICOT question for this project read as follows: In type II diabetic patients, aged 35-75, undergoing orthopedic procedures lasting less than 4 hours at a full-service community hospital, does the intraoperative administration of IV dexamethasone have an effect on postoperative blood glucose levels compared to preoperative blood glucose levels?

Sample

The sample population included 70 chart reviews of patients with type II diabetes between the age of 35-75 that underwent any type of orthopedic procedure that lasted less than 4 hours. The sample included those who received a dexamethasone dose of 4 mg, 8 mg, 10 mg, or no dose during their orthopedic surgical procedure. Inclusion factors included patients with a type II diabetes diagnosis, aged 35-75, procedures less than four hours, patients with a documented HgbA1C reading within the last twelve months ranging from 6.5-8.9%, patients who are non-pregnant, and patients with an American Society of Anesthesiologists (ASA) classification of I, II, or III. To minimize confounding variables, exclusion criteria were also defined. This quality improvement project excluded patients with type I diabetes, patients on chronic steroid therapy, patients who take any prescribed antihyperglycemic medications the day of the procedure, patients older than 75 or younger than 35, any patient with significant comorbidities that qualify them as an ASA IV or V status, or any patient that did not undergo an orthopedic surgery. There was a total of 70 chart reviews with 35 receiving some dose of dexamethasone, either 4 mg, 8 mg, or 10 mg, and another 35 patients who received no dose of dexamethasone.

Setting

This quality improvement project was conducted at a 196-bed, full-service community hospital located in a major metropolitan area in North Carolina. The hospital contains 16 operating rooms and provides surgical access for orthopedics, spine, electroconvulsive therapy, endoscopy, gastric bypass, general, vascular, total joint, urological, and women's pelvic health, using regional block modalities, monitored anesthesia care (MAC), and general anesthetic techniques. This institution serves a metropolitan community of over 800,000 people of adult and geriatric age groups (U.S. Census Bureau, 2021). It staffs approximately 30-40 certified registered nurse anesthetists (CRNAs) total and utilizes a care team model under anesthesiologist (MDA) supervision. The ORs run 45-50 cases daily on average, with an average of 9.4 orthopedic cases daily, 66 weekly, and 264 cases monthly, as of February 2023.

Intervention and Data Collection

This quality improvement project consisted of a chart review with the assistance of a data collection facilitator. As part of the chart review, charts were flagged of patients undergoing orthopedic surgical procedures at the full-service community hospital that were scheduled for a surgery lasting less than four hours and included all other inclusion criteria. This project had a comparative design that included patients' preoperative hemoglobin A1C (HbA1C) results in addition to all serum glucose levels during or following their surgical procedure.

The chart review included dexamethasone drug administration information including the dose and timing of administration. This information was compared to other patients undergoing the similar orthopedic surgical procedure to assess the trend of glucose fluctuation in type II diabetics who received a dose of dexamethasone intraoperatively. To stratify the data and assess trends, several chart reviews included patients with type II diabetes who did not receive a dose of dexamethasone to assess blood glucose alterations.

A data collection sheet was utilized that included all inclusion and exclusion criteria to maintain validity throughout the chart reviews. This data collection sheet was reviewed by the data collection facilitator who was able to provide comments for improvement to maintain consistency through the data collection. The chart review was conducted on the Reports tab on EPIC that allowed the criteria to be loaded such as patient age, surgical procedure and length of surgery, medical history and diagnoses, ASA status, patient home medication regimen, preoperative and postoperative labs, intraoperative anesthetic record, and dexamethasone dose. Once this report was gathered, additional filters were assigned to review each sample who received a dexamethasone dose of 4 mg, 8 mg, 10 mg, and no dose. Additional lab results were reviewed by pulling up each patient chart, reviewing their chart review tab, results tab, anesthesia record, and home medication list.

Efforts to maintain anonymity included de-identifying patient names, preventing any distribution of medical records beyond group members, and identifying data by their assigned numerical value to those who assisted with the data. All data was entered into a codebook to which only group members had access. The chart reviews of electronic medical records at the full-service community hospital were assigned appropriate confidential patient markers to maintain confidentiality, with only appropriate personal information able to be viewed.

Measurement Tools and Support

Statistical analysis was conducted with the assistance of Dr. Job Chen, an Associate Professor within the UNC-Charlotte School of Nursing who has a background in mathematics and applied quantitative methods. Dr. Chen served as a resource and assisted in obtaining statistical values from the data collection provided via the chart review. As previously mentioned, the data collection facilitator was a resource support person of paramount importance in assisting with the chart review/data collection portion of this project to successfully gain enough information from charts to meet the inclusion and exclusion criteria. The assistance of clinical expert Dr. Catherine Helms, a Clinical Pharmacist within the Atrium Health system, was employed to ensure that inclusion and exclusion criteria account for all potential factors that could affect blood glucose concentrations to ensure the most reliable results. This project was solely a chart review, with no additional ‘buy-in’ from staff members to complete. There were no additional costs that were utilized for the implementation of the project.

Timeline & Ethical Considerations

The first step in the timeline for data collection consisted of successfully defending the project proposal on April 18th, 2023. After a successful proposal defense, the process for filling out Institutional Review Board applications for the institution and UNC Charlotte began. IRB approval from the institution was granted on July 11th, 2023. IRB approval from UNC Charlotte was granted on August 4th, 2023. With the IRB approval secured for both Wake Forest and UNC-Charlotte, the data collection process and chart review commenced with an allotted 6-week timeframe for data collection. The data from the chart review will be fully collected by an estimated August 22nd, 2023 deadline. After a slight delay in getting access to begin the chart review due to extraneous circumstances, the review took place from September 15th-18th, 2023.

The statistical report from Dr. Chen was received on October 6, 2023, at which point the results were written for review.

CHAPTER 4: PROJECT FINDINGS & RESULTS

Data Analysis and Interpretation

There were 70 charts reviewed for this quality improvement project, 35 that received a dose of 4, 8, of 10 mg of intraoperative dexamethasone, and 35 that received no dose. The majority of charts reviewed underwent foot/ankle surgery (37.1%) and knee surgery (38.6%), with the remainder undergoing some sort of hip, shoulder, or elbow procedure. Ages ranged from 43 to 75 years (M = 63.19, SD = 7.77), with 87.1% of patients having an ASA 3 status and 12.9% an ASA 2 status. Surgical length times are listed in Table 1, with an overall average time of 90.79 minutes (SD = 49.77) and a range from 12 to 238 minutes.

Table 1 summarizes the pre- and post-operative blood glucose levels and the dexamethasone dose along with the sample size, surgery type, and length of surgery associated with the dose. A paired t-test was performed to find the difference between pre- and post-operative blood glucose readings in varied dexamethasone dosage groupings. Significant t-test values and p-values are included in Table 1.

Table 1. Pre-operative, post-operative, and change in blood glucose across different groups.

	Pre BG	Post BG	BG Change	*t*-value	*p*-value	Surgery Type	Sample Size (n=)	Surgery Length (avg)
Overall: BG *M* *Standard Deviation*	149.2 (53)	158.2 (49.5)	9.0 (45.6)	1.65	.104			
Dexamethasone Dose								
0 mg *Standard Deviation*	163.3 (64.5)	154.9 (51.7)	-8.4 (46.4)		.290	Foot/ankle (n=19) knee (n=11) shoulder (n=2) hip (n=1) wrist (n=1) hand (n=1)	35	78 min
4 mg *Standard Deviation*	136.3 (32.4)	136.5 (28.9)	0.2 (34.7)		.986	Foot/ankle (n=3) knee (n=3) shoulder (n=3) hip (n=1)	10	85 min
8 mg *Standard Deviation*	122.2 (44.0)	162.5 (50.3)	40.3 (38.9)		.052	Foot/ankle (n=4) spine (n=2)	6	110 min
10 mg *Standard Deviation*	138.6 (31.7)	174.4 (51.4)	35.7 (34.2)	4.55	<.001	Knee (13) hip (6)	19	103 min

Note. p-value tested the difference between pre and post BG and were based on paired t-tests.

The mean (M) dose of dexamethasone administered in the charts reviewed was 3.97 with a standard deviation (SD) of 4.41. Change in blood glucose readings was positively associated with surgery length ($t = 2.58$, $p =.012$), but surgery type had no effect ($F = 0.63$, $p = .537$). Receiving dexamethasone at any dose (compared to no dose) was also associated with greater increase in blood glucose ($t = 3.43$ $p = .001$).

Of note, there was a positive association between change in blood glucose and age with older people having a greater increase ($t =2.28$, $p = .026$). Changes in blood glucose were negatively associated with HgbA1C, indicating that people with a lower HgbA1C had a greater increase in postoperative blood glucose ($t = -2.76$, $p = .008$). Change in blood glucose was not associated with ASA status or surgery type.

Dexamethasone dosing had a significant effect on the change of blood glucose levels with a higher dose leading to a greater increase in blood glucose levels ($t =4.16$, $p <.001$). There was a significant increase in BG at a dose of 10 mg ($t = 4.55$, $p <.001$) but not a significant BG increase at 0 or 4 mg. Doses of 8 mg of dexamethasone approached significance in increasing blood glucose levels ($p = .052$). The finding indicates that higher doses of dexamethasone, that is 8 or 10 mg, is associated with a greater increase in blood glucose.

CHAPTER 5: SIGNIFICANCE AND IMPLICATIONS

Discussion of Results

This quality improvement project aimed to identify the trends of intraoperative dexamethasone dosing in type II diabetics undergoing orthopedic procedures. Dexamethasone dosing is often dosed differently based on the procedure and anesthesia provider preference and this chart review aimed to identify the effects of the dose in type II diabetics. There is no standard protocol for dexamethasone dosing in the reviewed hospital system, so this quality improvement aimed to disseminate chart review findings to anesthesia providers to aid them in future dosing among diabetics. This is important to improve the standard of care for type II diabetics undergoing orthopedic procedures and safely provide anesthetic care without increasing any additional risk.

This QI project resulted in an increase in post-operative BG readings in patients with older ages, longer surgical times, and those who received any dose of dexamethasone. The overall change in postoperative blood glucose readings was 9.0 points across all groups ($p = .104$). Overall, there was not a significant change in blood glucose readings postoperatively ($t = 1.65$, $p = .104$), and there was not a significant increase in dexamethasone doses of 0, 4, or 8 mg ($p > .052$). O' Connell et al. (2018) found a positive correlation between a higher dose of dexamethasone and postoperative blood glucose readings, which was a similar find in the QI project data review. Nurok et al. (2017) reported those who received the intraoperative dose of 4mg of dexamethasone showed no evidence of experiencing elevated blood glucose readings postoperatively (> 200 mg/dl). Conversely, Bonilla et al. (2022) found that patients with diabetes who received a dose of dexamethasone during surgery were more likely to develop postoperative hyperglycemia. The literature reviewed consistently reported that glycemic elevations following surgery, if any, were transient and did not persist beyond 24 hours (Allen et al., 2020).

The chart reviews for this quality improvement project revealed a negative association with HgbA1C and diabetic patients' postoperative BG readings ($t = -2.76$, $p = .008$). Patients with a lower HgbA1C had a greater increase in postoperative BG. These findings directly contradict Allen et. al (2019) and Godshaw et. al's (2018) findings that elevated HgbA1C, not dexamethasone administration, was most predictive of maximum BG levels. Review of the literature also found that blood glucose readings were higher in patient with an increased BMI and HgbA1C, contradicting the results of this QI project (O'Connell et al., 2018; Godshaw et al., 2018). The data of this project showed a negative association between change in BG and HgbA1C ($t= -2.76$, $p = .008$). Patients who had a lower HgbA1C had a greater increase in blood glucose readings following a dose of dexamethasone.

Surgical length was positively associated with changes in blood glucose readings ($t = 2.58$, $p = .012$). There was no effect on glucose change and surgery type ($F = 0.63$, $p = .537$). Williams et al. (2023) found diabetic patients who received intraoperative dexamethasone had a shorter hospital stay on average than those who did not receive the steroid, all while maintaining similar glycemic control. Nurok et al. (2017) found no evidence of difference in length of stay between groups of patients who received a dose of dexamethasone and those who did not. Bonilla et al. (2022) reported blood glucose levels began to rise three hours following dexamethasone administration, possibly linking the surgery length with rises in BG readings.

Limitations

There were several limitations of this quality improvement project. There were time constraints obtaining IRB approval and teammate commitments. Because of the limited scope of the quality improvement project, only a small number of charts were reviewed. This limited the validity of results due to the limited timeline for chart review. Additional retrospective review of the effects of dexamethasone administration on blood glucose in Type II diabetics is needed. Post-joint infection rates greatly impacted dexamethasone dosing in the literature review and affected the dosing and administration in diabetics, but examining post-joint infections was beyond the scope of this QI project.

Anesthesia providers are unique in their practice of dexamethasone dosing for diabetics, and as a result, many different dosages are seen throughout practice. This quality improvement project consisted of a retrospective chart review of selected patients who were dosed differently among age groups, surgery types and lengths, A1C readings, etc. As a result, there was no way to identify the reasoning behind each dexamethasone administration. This project limitation prevented provider engagement to further enhance understanding of dose preferences and considerations in the diabetic population. The limited scope of this quality improvement project prevented the use of a survey to providers (in addition to a chart review) to engage in their reasoning behind dosing of dexamethasone in orthopedic procedures in the diabetic population. This subjective data could be trended alongside chart review material to give a comprehensive report of dexamethasone use in diabetics and its postsurgical effects.

Additionally, a limitation of this QI project involved the limited representativeness of type II diabetics undergoing orthopedic procedures. Because of time limitations, a large pool of charts could not be compiled for review. In an effort to minimize limited representatives, an additional 35 charts were reviewed that specifically had no dose of dexamethasone. Though limitations were present in this quality improvement project, they did not affect the interpretation or applicability of results.

Implications for Nursing Practice

Future projects could involve a more expansive chart review of type II diabetics undergoing orthopedic procedures. Additional review of postoperative effects of dexamethasone administration would aid in defining the appropriate use of dexamethasone in diabetics. Advanced study could suggest a protocol for diabetic patients undergoing orthopedic procedures to aid in recovery time while also minimizing negative side effects. Future review of glucose readings throughout the hospital stays for diabetic patients receiving large doses of dexamethasone (i.e., 10 mg) could further demonstrate the effects and correlation between dexamethasone dose and BG findings.

Recommendations

There is no standard protocol for dexamethasone dosing in the reviewed hospital system, so this quality improvement aimed to disseminate chart review findings to anesthesia providers to aid them in future dosing among diabetics. This is important to improve the standard of care for type II diabetics undergoing orthopedic procedures and safely provide anesthetic care without increasing any additional risk. This chart review found many different doses administered in the orthopedic population with only a small sample size represented from each dosage group. After completion of the QI project and chart reviews, it is recommended to disseminate results of chart reviews to anesthesia providers giving care to the orthopedic population to improve diabetic patient care during surgery. Disseminating findings to provide the most up to date information of dexamethasone dosing would aid in future dosing considerations for anesthesia providers in type II diabetics.

Chart review results indicated a significant increase in postoperative BG readings only in patients who received a dose of 10 mg. Because of these results, it is recommended to use caution in administering high doses of dexamethasone in diabetics intraoperatively. As anesthesia providers dose dexamethasone with many considerations in mind, additional consideration of diabetic patients will improve patient outcomes while ensuring safe dosing of intraoperative dexamethasone. Additionally, as previously mentioned, subjective data from anesthesia providers administering dexamethasone was not available for review in this QI project. It is recommended to involve surveys to providers to provide reasoning behind intraoperative dosing of dexamethasone. This information compiled alongside chart reviews could establish a more thorough review of dosing and effects in diabetics.

Summary

This QI project demonstrated a comprehensive review in dexamethasone dosing among type II diabetics undergoing orthopedic procedures. While many doses of dexamethasone are used intraoperatively, chart review found that a dose of 4-8 mg is effectively benign regarding postoperative blood glucose readings. Larger doses of 10 mg have a positive correlation with increases in blood glucose following surgery in diabetics. With these results in mind, anesthesia providers can safely use their clinical judgment while dosing dexamethasone in diabetic patients undergoing orthopedic surgeries.

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APPENDIX A: UNIVERSITY OF NORTH CAROLINA CHARLOTTE IRB APPROVAL

CHARLOTTE
DIVISION OF RESEARCH

To:	Natalie Gabhart University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Approval Date:	04-Aug-2023
RE:	Notice of Determination of Exemption
Exemption Category:	4
Study #:	IRB-24-0031
Study Title:	Intraoperative Dosing of Dexamethasone in Type II Diabetic Patients

This submission has been reviewed by the Office of Research Protections and Integrity (ORPI) and was determined to meet the Exempt category cited above under 45 CFR 46.104(d). This determination has no expiration or end date and is not subject to an annual continuing review. However, you are required to obtain approval for all changes to any aspect of this study before they can be implemented and to comply with the Investigator Responsibilities detailed below.

Your approved consent forms (if applicable) and other documents are available online at Submission Page.

Investigator's Responsibilities:

1. Amendments **must** be submitted for review and the amendment approved before implementing the amendment. This includes changes to study procedures, study materials, personnel, etc.
2. Researchers must adhere to all site-specific requirements mandated by the study site (e.g., face mask, access requirements and/or restrictions, etc.).
3. Data security procedures must follow procedures as described in the protocol and in accordance with OneIT Guidelines for Data Handling.
4. Promptly notify the IRB office (uncc-irb@charlotte.edu) of any adverse events or unanticipated risks to participants or others.
5. Five years (5) following this approval/determination, you must complete the Admin-Check In form via Niner Research to provide a study status update.
6. Be aware that this study is included in the Office of Research Protections and Integrity (ORPI) Post-Approval Monitoring program and may be selected for post-review monitoring at some point in the future.
7. Reply to the ORPI post-review monitoring and administrative check-ins that will be conducted periodically to update ORPI as to the status of the study.
8. Complete the Closure eform via Niner Research once the study is complete.

Please be aware that approval may still be required from other relevant authorities or "gatekeepers" (e.g., school principals, facility directors, custodians of records).

APPENDIX B: WAKE FOREST HEALTH BAPTIST IRB APPROVAL

WAKE FOREST
UNIVERSITY
HEALTH SCIENCES

Office of Research
INSTITUTIONAL REVIEW BOARD

MEMORANDUM

To: Danielle Brown
Atrium/Carolinas Healthcare System

From: Jeannie Sekits, Senior Protocol Analyst
Institutional Review Board

Date: 7/11/2023

Subject: Exempt Protocol: IRB00098449
Intraoperative Dosing of Dexamethasone in Type II Diabetic Patients

No protected health information will be used or disclosed in this research proposal; therefore the requirement for individual Authorization does not apply.

This research meets the criteria for a waiver of HIPAA authorization according to 45 CFR 164.512.

Exemption Category 4 - Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. null (Category null).

Note that only the Wake Forest University School of Medicine IRB can make the determination for its investigators that a research study is exempt. Investigators do not have the authority to make an independent determination that research involving human subjects is exempt. Each project requires a separate review and approval or exemption. The Board must be informed of any changes to this project, so that the Board can determine whether it continues to meet the requirements for exemption.

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