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The Effects of Dexamethasone in Diabetic Patients Undergoing Primary Total Joint Arthroplasty

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Dexamethasone reduces postoperative pain and nausea, with no evidence of increased rate of infection in total joint arthroplasty. However, the effects of dexamethasone on diabetic patients undergoing total joint arthroplasty remain relatively unexplored. The purpose of this study was to examine the effects of dexamethasone on postoperative blood glucose levels, prosthetic joint infections (PJIs), and 90-day hospital returns in diabetic patients following total joint arthroplasty. Retrospective analysis was performed on 228 adult patients with a diagnosis of diabetes who underwent primary total joint arthroplasty. Patients were stratified by intraoperative dexamethasone administration. In total, 173 (75.9%) patients received intraoperative dexamethasone, with no differences in demographic variables compared with patients who did not receive dexamethasone. There was no significant difference in PJIs or 90-day hospital returns. Patients who received dexamethasone had significantly increased blood glucose concentration on Postoperative Day 1 and were significantly more likely to have blood glucose levels exceeding 180 g/dl. Although postoperative blood glucose levels were significantly increased, it is unclear what effects, if any, transient hyperglycemia may have on outcomes. The outcomes of this study support perioperative administration of dexamethasone in diabetic patients.

Background

Total knee arthroplasty (TKA) and total hip arthroplasty (THA) are commonly performed orthopaedic procedures that restore function and quality of life for millions of patients every year. It is estimated that by 2030, approximately 4 million joint replacements will be performed each year in the United States alone (Kurtz et al., 2007). As total joint arthroplasty (TJA) indications continue to expand, there is added pressure to decrease the cost of care by reducing postoperative length of stay as well as unanticipated hospital returns (Molloy et al., 2017). In response to the recent shift toward outpatient TJA, efforts to optimize care by minimizing postoperative pain and nausea have intensified (Hoffmann et al., 2018; Rutherford et al., 2017).

One such effort has been the perioperative use of glucocorticoids, namely, dexamethasone, with the aim of decreasing postoperative pain, nausea, and vomiting. It is well established that the use of dexamethasone reduces postoperative pain and nausea after TJA (De Oliveria et al., 2013; Koh et al., 2013) and has even been shown to reduce length of hospital stay (Backes et al., 2013) and readmissions (Klement et al., 2018). Although the use of dexamethasone in TJA is a widely accepted practice, concerns have surfaced regarding its use in patients with diabetes.

Patients with diabetes have been shown to have a greater risk of many postoperative complications, including infection and wound complications (Lee et al., 2015; Moon et al., 2008). As the frequency of TJA is increasing, the number of patients with diabetes is also increasing. Diabetes is a pervasive disease, affecting 381.8 million people worldwide in 2013, with a projected surge to 591.9 million by 2035 (Guariguata et al., 2014). It has been estimated that between 8% and 22% of patients undergoing TJA have a diagnosis of diabetes (Chrastil et al., 2015). It stands to reason that a growing number of patients seeking TJA will have preexisting diabetes.

Dexamethasone use raises serum glucose levels, raising mean glucose plasma levels for 24 hours after administration (Waldron et al., 2013). This resultant hyperglycemia is concerning, considering the associated

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risk of postoperative surgical site infection and prosthetic joint infection (PJI; Stryker et al., 2013; Yang et al., 2017). The most common cause of readmission within 30 days following TJA is infection (Phruetthiphat et al., 2020). In the general population, dexamethasone has been shown to have no effect on the rate of PJIs (Klement et al., 2018; Richardson et al., 2016). However, the same cannot be assumed for the diabetic patient population.

A review of the literature revealed that the effects of dexamethasone in diabetic patients undergoing TJA remain relatively unexplored. There have been differing reports regarding whether perioperative dexamethasone use in diabetic patients undergoing TJA causes significant postoperative hyperglycemia. Two studies found that patients have increased hyperglycemia postoperatively but with no link to clinical significance (O'Connell et al., 2018; Wasfie et al., 2021). In contrast, two studies found that dexamethasone did not increase postoperative hyperglycemia (Allen et al., 2020; Godshaw et al., 2019). With limited and opposing evidence, further research was deemed necessary to inform best practice in caring for TJA patients with diabetes.

The aim of this study was to explore the effects of perioperative dexamethasone use in diabetic patients undergoing primary TJA. Specifically, postoperative blood glucose levels, PJIs, and 90-day hospital returns were examined.

Methods

Following approval from the institutional review board, we retrospectively reviewed all adult patients with a preexisting diagnosis of Type 1 or 2 diabetes mellitus who underwent hip or knee arthroplasty from 2013 to 2017 at a single tertiary referral center. The sample included 80 patients who underwent THA and 148 who underwent knee arthroplasty (of those 148 patients, 145 underwent TKA and three had other knee arthroplasty procedures). Patients were stratified on the basis of intraoperative dexamethasone administration, with doses ranging from 4 to 10 mg. Exclusion criteria included patients younger than 18 years, nondiabetic patients, and those undergoing revision arthroplasty.

Demographic variables including patient age, gender, and American Society of Anesthesiologists (ASA) score were evaluated. At the investigative institution, preoperative hemoglobin A_{1c} values are routinely obtained for all diabetic patients prior to elective TJA surgery to ensure appropriate optimization and to initiate endocrinology referral, if indicated. In addition to preoperative hemoglobin A_{1c}, postoperative blood glucose values from laboratory test results are obtained as part of routine patient care at 4 a.m. on Postoperative Day 1. Hospital returns, including emergency department visits and readmissions, as well as acute PJIs were evaluated within 90 days of surgery. All data were collected from electronic medical records.

Categorical data including gender, ASA score (categorized as ASA 1–2 vs. 3–4), and 90-day hospital returns were evaluated with a chi-squared test and are presented as count (percent). Continuous variables, which were nonparametric, including age, hemoglobin A_{1c}, and blood glucose, were evaluated with a Mann–Whitney test and are presented as median (lower quartile, upper quartile). Statistical analysis was performed using Wizard Pro for Mac (E. Millar, Chicago, IL), and a p value of less than .05 was considered statistically significant (see Table 1).

Results

From 2013 to 2017, a total of 228 patients with diabetes underwent TJA at our institution. Of those, 173 (75.9%) received intraoperative dexamethasone and 55 (24.1%) did not receive intraoperative dexamethasone. There were no significant differences in demographic variables of age, gender, or ASA score between groups. The median age for all patients was 66 years. There was also no significant difference in preoperative hemoglobin A_{1c} levels between groups. The median preoperative hemoglobin A_{1c} level was 6.4% and 6.5% for those who did and did not receive dexamethasone, respectively, indicating tight glycemic control was achieved prior to surgery in both groups.

Those patients who received dexamethasone intraoperatively had significantly higher blood glucose levels on Postoperative Day 1 (by mean 15.6 g/dl; $p = .011$). In addition, patients who received dexamethasone were significantly more likely to have blood glucose levels exceeding 180 g/dl ($p = .031$). Although there was no significant difference in PJIs or 90-day hospital returns between groups, 90-day hospital returns approached

Table 1. Patient Characteristics By Dexamethasone Administration

	Dexamethasone ($n = 173$)	No Dexamethasone ($n = 55$)	p
Age	66 (59, 71)	66 (60, 72)	.712
Gender (female)	85 (49.1%)	27 (49.1%)	.996
ASA score 1–2	43 (24.9%)	11 (20.0%)	.461
Preoperative hemoglobin A_{1c}	6.4 (6.0, 6.8)	6.5 (6.1, 7.1)	.225
POD1 blood glucose, g/dl	163 (139, 197)	147 (130, 172)	.011
90-day hospital returns	27 (15.6%)	4 (7.3%)	.116
Return for infection	5 (2.9%)	0 (0%)	.202

Note. Continuous data are presented as median (lower quartile, upper quartile). Categorical data are presented as count (percent). ASA = American Society of Anesthesiologists; POD1 = Postoperative Day 1.

significance, with 7.3% occurrence in the group that did not receive dexamethasone and 15.6% in the group that did receive dexamethasone. This finding was not statistically significant; it was clinically significant. There was a wide range of chief complaints for 90-day hospital visits including pain, nausea, fever, falls, wound complications, infection, dislocation, fracture, atrial fibrillation, hyponatremia, and pneumonia. Of the patients who received dexamethasone, 27 returned to the hospital within 90 days, with nine returning for concerns of infection. In the group that did not receive dexamethasone, three patients returned to the hospital within 90 days, with two patients returning for concerns of infection.

Discussion

In this retrospective review, intraoperative dexamethasone administration significantly increased blood glucose levels in diabetic patients undergoing TJA. However, this transient increase in blood glucose was not associated with a significant increase in the incidence of PJIs or 90-day hospital returns in diabetic patients undergoing primary TJA. Although 90-day hospital returns did not reach statistical significance, it did appear to be clinically significant. However, a larger scale study is recommended for further exploration. There was a clear correlation between dexamethasone administration and postoperative hyperglycemia, but this did not impact clinical outcomes. The glycemic effects of dexamethasone seem to have little clinical significance in comparison with the established benefits of decreasing postoperative pain, nausea, and vomiting.

In concurrence with O'Connell et al. (2018) and Wasfie et al. (2021), these findings add support to the conflicting body of literature that dexamethasone does cause increased blood glucose levels in diabetic patients undergoing TJA. These findings also support the existing consensus in the literature that dexamethasone administration is not associated with increased incidence of PJIs in the general TJA population or in the diabetic patient population (Allen et al., 2020; Godshaw et al., 2019; Klement et al., 2018; O'Connell et al., 2018; Richardson et al., 2016; Wasfie et al., 2021).

The major limitations of this study include the retrospective design and the sample size. Retrospective reviews are prone to inherent bias. A larger sample size may have strengthened the findings, especially given that the outcome of 90-day hospital returns was relatively rare and approached significance in the sample. In addition, during the period of the study, there was little standardization in which diabetic patients received dexamethasone. As in a similar study by Allen et al. (2020), it is possible that anesthesia staff only administered dexamethasone to select diabetic patients. However, both groups had nearly equal preoperative hemoglobin A_{1c} percentages, meaning the groups were well matched in glycemic control. Finally, given the lack of standardization, the dosages of dexamethasone ranged from 4 to 10 mg, making comparison less congruent.

The implications of the findings of this study for nursing practice include advocacy for evidence-based clinical care and patient education. Nurses caring for diabetic patients in the perioperative setting should recognize the risks and benefits associated with dexamethasone administration. Understanding that although elevated blood glucose levels might result, the use of dexamethasone in the perioperative period has shown to improve pain and nausea and even reduce the length of hospital stays (Backes et al., 2013; De Oliveria et al., 2013; Koh et al., 2013). Patients should be educated on the likelihood of elevated blood glucose levels postoperatively but should be reassured of the transient nature of this change. This is particularly important as TJAs are increasingly being performed as outpatient procedures.

Recommendations for future research include further exploration of hospital returns, methods for standardization of dexamethasone administration protocols in TJA, and expansion into the use of dexamethasone in TJA revision procedures.

Conclusion

Administration of intraoperative dexamethasone to diabetic patients undergoing TJA was associated with an increase in postoperative blood glucose levels but was not associated with statistically significant increase in PJIs or 90-day hospital returns. The outcomes of this study would support the perioperative administration of dexamethasone in diabetic patients undergoing TJA, as the benefits seem to outweigh clinically significant risks.

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