RESEARCH ARTICLE

Repeat High-Dose Dexamethasone May Improve Recovery 48 Hours after Total Hip Arthroplasty

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Abstract

Objectives: Perioperative dexamethasone is an effective anti-emetic and systemic analgesic in total hip arthroplasty (THA) that may reduce opioid consumption and enhance rapid recovery. However, there is no consensus on the optimal perioperative dosing that is safe and effective for faster rehabilitation and improved pain control while maintaining safe blood glucose levels.

Methods: A retrospective review of 101 primary THA patients at a single institution who received perioperative dexamethasone was conducted. Patients were stratified by dexamethasone induction dosage (10 mg as high, <6mg as low) and whether a repeat dose was given 16-24 hours postoperatively. Age, gender, BMI, diabetes status, and ASA were controlled between groups. The pain was evaluated with inpatient morphine milligram equivalents (MME) requirements and visual analog scale (VAS) at 8, 16, and 24 hours postoperatively. Mobility was assessed by inpatient ambulation distance, Boston AM-PAC mobility score, and percentage of gait assistance as determined by a physical therapist. Secondary outcomes included postoperative nausea and vomiting (PONV) limiting therapy sessions, PONV requiring breakthrough anti-emetics, glucose levels, surgical site infection, wound healing complications, and discharge destination.

Results: : Compared to patients receiving one dose of high or low dexamethasone, patients receiving two dosages of high-dose dexamethasone had significantly further ambulation distance and lower percentage of gait assistance on postoperative day 2. A generalized linear model also predicted that any repeat dexamethasone, regardless of dosage, significantly improved ambulation distance and gait assistance compared to the one-dose cohort. There was no statistically significant difference between VAS scores, MME requirements, PONV, postoperative glucose levels >200, discharge destination, or risk of infection between groups.

Conclusion: A repeat high-dose dexamethasone, the morning after surgery, may improve percentage of gait assistance and ambulation endurance on postoperative day two. There was no risk of uncontrolled glucose levels or infections compared to receiving one dose of dexamethasone at induction.

Level of evidence: III

Keywords: Dexamethasone, Peri-operative management, Pain control, Patient outcomes, Total hip arthroplasty

Introduction

By 2030, the domestic demand for primary total hip arthroplasty (THA) is expected to grow to nearly 650,000 procedures.[1] To mediate the increased costs of these procedures, post-surgical protocols must be adapted to shorten the length of hospital stay (LOS) and decrease postoperative pain and subsequent opioid consumption.[2] Enhanced recovery after surgery (ERAS) protocols have been implemented to improve the efficiency of postoperative care for various surgical procedures. Dexamethasone, a potent glucocorticoid, has proved to be efficacious as an analgesic when given at high doses perioperatively and

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postoperatively (24-48 hours) in patients undergoing joint arthroplasty.[3,4] Secondary to its analgesic effects, dexamethasone is an effective drug against anesthesia-induced postoperative nausea and vomiting (PONV). However, the adverse side effects of dexamethasone use in surgical patients are well documented and include wound infection, impaired wound healing, and variable glycemic response.[5]

Perioperative and postoperative pain management is a key factor in reducing opioid consumption-related nausea while enhancing rapid recovery and mobility.[6] PONV is often cited as the most common adverse event after surgery and can lead to significant discomfort and lower patient satisfaction.[7] With the trend towards earlier rehabilitation protocols and shorter length of stay, providers need to control for PONV as it can interfere with physical therapy sessions and return to functional independence. However, there has been no clear consensus on the optimal perioperative dosing of dexamethasone to promote faster rehabilitation while maintaining safe blood glucose levels.[8] Prior studies have demonstrated that the majority of severe postoperative pain occurs around 48 hours after total joint arthroplasty, and there is debate on the exact timing and dosing required to provide a better reduction in acute pain scores and enhance ambulation assessment.[9,10]

Inflammatory markers, such as CRP and IL-6 levels, have been previously investigated as biomarkers of inflammation and a source of inflammatory pain 48-72 hours after THA.[3] Decreased CRP and IL-6 levels after perioperative use of dexamethasone have been correlated with lower dynamic pain scores, better hip range of motion, and less opioid use.[3] However, it remains unclear as to the exact dosage and when during the postoperative period patients will benefit most from a repeat dose of steroids. In this retrospective review of THA patients, we aimed to evaluate the levels of postoperative VAS pain scores, mobility scores, and occurrence of debilitating PONV in patients stratified by dexamethasone induction dosage and timing of repeat dosage. We sought to determine the efficacy and safety of repeat dexamethasone in THA patients, and we predict that patients receiving repeat doses of dexamethasone 24 hours after induction dose would have improved mobility scores, less opioid requirements, and improved subjective VAS pain scores compared to the single dose group.

Materials and Metods

This retrospective study was performed at a single academic orthopedic hospital and included patients receiving primary THA between 2020 and 2021 during the COVID pandemic. The study protocol was reviewed and approved by our affiliated Institutional Review Board. Given the retrospective nature of the study, informed consent was not obtained. During the collection period, a total of 101 primary THAs were available for analysis. Due to the COVID testing protocols, the number of elective THAs performed was limited compared to the pre-pandemic era to reduce the potential spread of the disease. Patients in this study received no dose, high (10 mg), or low (<6 mg) dose of dexamethasone at induction. Patients then received a second dose of dexamethasone 16-24 hours postoperatively. Whether or not patients received dexamethasone and dosing level was based upon surgeon preference and patient comorbidities.

All patients received standardized preoperative optimization, including weight control, glucose control, and medical co-management when indicated. Preoperative prophylaxis included weight-based antibiotic dosing of Ancef or Vancomycin and Gentamycin for those with penicillin allergies or those with a positive MRSA colonization. Postoperatively, patients received 24 hours of antibiotic prophylaxis with Ancef or Vancomycin and Gentamycin. All patients received a multilayered closure with dry dressings, not utilizing negative pressure therapy

Postoperatively, all patients were admitted to the medical/surgical floor. The standard postoperative pain regimen included Tylenol 650 mg every 6 hours and 5 or 10 mg of oxycodone as needed. For PONV, patients were given ondansetron, metoclopramide, or promethazine for a breakthrough.

Physical therapy included early ambulation with a walker either on the day of surgery or POD1, dependent on the start time of surgery. Patients were discharged from the hospital when all physical therapy needs were met, they were able to ambulate >150 feet, the pain was well controlled on an oral regimen, or it was deemed the patient required intensive rehabilitation services at a skilled nursing facility or acute rehabilitation facility.

Each patient's descriptive characteristics, including age, gender, race, BMI, diabetes status, and ASA classification, were collected. Pain level was evaluated by calculating total inpatient morphine milligram equivalents (MME) requirements and visual analog scale (VAS) at 8, 16, 24 hours postoperatively, and postoperative day 2. Mobility was assessed by inpatient ambulation distance, Boston AM-PAC mobility score, and percentage of gait assistance as determined by a physical therapist. Secondary outcomes evaluated include postoperative nausea and vomiting (PONV) limiting therapy sessions, PONV requiring breakthrough anti-emetics, surgical site infection, wound healing complications, periprosthetic joint infection within 90 days (PJI), and discharge destination. Surgical site infection was defined as a superficial infection of the incision requiring oral antibiotic administration for presumed cellulitis or suture abscess without a diagnosis of underlying periprosthetic joint infection and involvement of the capsule and prosthesis. PJI was determined using the updated 2018 criteria for periprosthetic infections, including the presence of a sinus tract or two positive cultures with the same pathogen comprising the major criteria, and elevated CRP, D-dimer, ESR, synovial WBC, Leukocyte esterase, alpha-defensin, synovial PMN, synovial CRP comprising minor criteria. All data was collected using the institution's electronic medical record system.

Statistical Analysis

Our data were analyzed using Stata 17 (StataCorp LLC, College Station, TX). Data were separated by dexamethasone dose levels. Continuous variables were described with mean ± standard deviation, with interquartile range (IQR) when appropriate, and categorical variables were described as absolute and relative frequency. Descriptive statistics were utilized for patient characteristics. Continuous variables were analyzed using Analysis of Variance (ANOVA) with the level of significance defined as $P < 0.05$.

A bivariate linear regression was performed to determine the relationship between the increasing dose of dexamethasone and its effects on outcomes and complications. The level of significance was defined as $P<0.05$.

Results

The 101 patients included in the study were separated into four different cohorts, including patients not receiving dexamethasone, patients receiving a single dose, patients receiving two low doses of dexamethasone, and patients receiving two high doses of dexamethasone. The mean age for the study population was 63 ± 13, with the two-high-dose dexamethasone cohort having a mildly decreased mean age of 58 ± 12.7; this difference was not considered statistically different. The mean BMI of the study was 29.4 ± 6.3, with the two-high-dose cohort having a mildly increased BMI of 31.2 ± 4.8, again noted not considered statistically different. Of the 101 patients, 12 were reported to have a past medical history of diabetes; none of these patients were included in the high-dose cohort and was considered statistically significant ($P<0.001$). There were otherwise no differences observed with regard to insulin dependence, HbA1c, smoking status, and ASA classification [Table 1].

Tables 1. Demographics

	0 Dose (n=8)	1 Dose (n=70)	2 Dose Low (n=14)	2 Dose High (n=9)	p
Demographics					
Age, mean ± SD	71.6 ± 7.7	63.1 ± 13.5	59.8 ± 14.3	58.1 ± 12.7	0.148
Sex, n (%)					0.225
Male	4 (50.0)	38 (54.3)	9 (64.3)	8 (88.9)	
Female	4 (50.0)	32 (45.7)	5 (35.7)	1 (11.1)	
Race, n (%)					0.179
White	3 (37.5)	56 (80.0)	11 (78.6)	8 (88.9)	
Black	1 (12.5)	2 (2.9)	2 (14.3)	1 (11.1)	
Asian	1 (12.5)	4 (5.7)	1 (7.1)	0 (0)	
Hispanic/Latino	2 (25.0)	7 (10.0)	0 (0)	0 (0)	
Native American	1 (12.5)	1 (1.4)	0 (0)	0 (0)	
Other Race					
BMI, mean ± SD	32.8 ± 5.1	29.3 ± 6.6	25.7 ± 4.6	31.2 ± 4.8	0.108
Past Medical History					
Diabetes, n (%)	5 (62.5)	5 (7.1)	2 (14.3)	0 (0)	**<0.001**
Recent Preoperative Blood Glucose, mean ± SD	125.6 ± 25.9	117.1 ± 23.8	114.1 ± 26.9	116.1 ± 25.0	0.757
Insulin Dependency, n (%)	1 (16.7)	0 (0)	0 (0)	0 (0)	0.078
HbA1c, mean ± SD	6.3 ± 0.8	4.6 ± 2.4	6.2 ± 1.4	--	0.158
Smoking History, n (%)					0.896
Never	4 (50.0)	50 (71.4)	10 (71.4)	6 (66.7)	
Current	0 (0)	1 (1.4)	0 (0)	0 (0)	
Former	4 (50.0)	19 (27.1)	4 (28.6)	3 (33.3)	
Steroid Use, n (%)	3 (37.5)	9 (12.9)	2 (14.3)	0 (0)	0.154
ASA Score, n (%)					0.532
1	1 (12.5)	2 (2.9)	0 (0)	1 (12.5)	
2	3 (37.5)	38 (55.1)	9 (64.3)	3 (37.5)	
3	4 (50.0)	29 (42.0)	5 (35.7)	4 (50.0)	
Operative Details					
Hip Laterality, n (%)					0.261
Right	4 (50.0)	38 (54.3)	4 (28.6)	3 (33.3)	
Left	4 (50.0)	32 (45.7)	10 (71.4)	6 (66.7)	
Surgical Approach, n (%)					**<0.001**
Anterior	7 (87.5)	51 (72.9)	2 (14.3)	1 (11.1)	
Posterior	1 (12.5)	19 (27.1)	12 (85.7)	8 (88.9)	
Cumulative Dexamethasone Dosage, mean ± SD	0 ± 0.0	8.3 ± 2.7	13.6 ± 2.8	20.0 ± 0.0	**<0.001**
Time of Second Dexamethasone Dosage, mean ± SD	--	--	21.1 ± 9.3	22.2 ± 2.7	0.722

Abbreviations: BMI, body mass index

Postoperative Functional Status

Patients receiving two doses of high-dose dexamethasone had statistically significant increased ambulation distance and decreased gait assistance percentage on POD2 as determined by physical therapy. Those in the single dose and low dose cohorts ambulated 95ft ± 86 and 185ft ± 66, respectively, while those are receiving 2 high doses of

dexamethasone ambulated 225ft ± 106 (P=0.01). An inverse trend was observed with regard to gait assistance; subjects in the single dose and low dose cohort required 27.9% ± 12.9 and 14.3% ± 13.4 assistance, respectively, while the two-dose group required 12.5% ± 14.4 assistance (P=0.025) [Table 2].

Table 2. Outcomes

	0 Dose (n=8)	1 Dose (n=70)	2 Dose Low (n=14)	2 Dose High (n=9)	p
Hospitalization					
Tourniquet Time, mean ± SD	0.0 ± 0	1.1 ± 9.2	0.0 ± 0	0.0 ± 0	0.933
Morphine Equivalents, mean ± SD					
POD0	29.0 ± 23.6	23.6 ± 19.7	28.2 ± 20.7	26.8 ± 22.5	0.763
POD1	38.6 ± 25.7	28.2 ± 27.0	37.5 ± 36.1	36.1 ± 41.7	0.566
POD2	23.3 ± 31.0	27.6 ± 28.1	30.0 ± 21.2	46.5 ± 49.0	0.509
Discharge POD, mean ± SD	2.4 ± 1.3	1.8 ± 1.0	2.3 ± 1.0	1.8 ± 1.0	0.279
Discharge Destination, n (%)					0.679
Home	7 (87.5)	64 (91.4)	12 (85.7)	9 (100.0)	
SNF	1 (12.5)	6 (8.6)	2 (14.3)	0 (0)	
Complications					
Surgical Site Infection, n (%)	0 (0)	5 (7.1)	1 (7.1)	1 (11.1)	0.839
Wound Drainage, n (%)	0 (0)	4 (5.7)	0 (0)	1 (11.1)	0.581
DVT/PE, n (%)	0 (0)	1 (1.4)	0 (0)	0 (0)	0.930
Nausea/Vomiting, n (%)					
POD0	1 (20.0)	7 (11.7)	2 (15.4)	3 (37.5)	0.287
POD1	0 (0)	7 (10.6)	0 (0)	0 (0)	0.377
POD2	0 (0)	3 (9.4)	1 (14.3)	0 (0)	0.729
PT Stopped Due to Nausea/Vomiting POD0, n (%)	0 (0)	7 (17.5)	2 (15.4)	1 (12.5)	0.775
Zofran/Metoclopramide Requirement, n (%)					
POD0	2 (28.6)	30 (47.6)	3 (21.4)	3 (33.3)	0.259
POD1	0 (0)	12 (18.5)	1 (8.3)	0 (0)	0.283
Outcomes					
Distance, mean ± SD					
POD0	163.6 ± 246.8	49.0 ± 71.0	95.7 ± 167.5	123.3 ± 217.3	0.179
POD1	120.0 ± 95.7	182.2 ± 205.1	181.9 ± 134.5	244.7 ± 196.7	0.634
POD2	150.4 ± 144.0	94.6 ± 86.4	185.0 ± 65.5	225.0 ± 106.1	**0.010**
Gait Assistance %, mean ± SD					
POD0	25.0 ± 0.0	35.5 ± 22.0	28.8 ± 13.9	17.2 ± 14.8	0.083
POD1	29.2 ± 10.2	30.7 ± 18.3	29.2 ± 17.9	25.0 ± 21.7	0.857
POD2	31.3 ± 12.5	27.9 ± 12.9	14.3 ± 13.4	12.5 ± 14.4	**0.025**
Boston PAC Total Score, mean ± SD					
POD0	16.0 ± 1.9	14.5 ± 3.8	15.6 ± 2.2	15.7 ± 3.0	0.556
POD1	15.3 ± 3.0	17.8 ± 2.5	18.0 ± 1.7	16.8 ± 3.3	0.141
POD2	15.8 ± 2.5	16.6 ± 2.5	17.0 ± 0.0	17.0 ± 2.8	0.900
VAS, mean ± SD					
POD0	5.4 ± 3.4	3.8 ± 4.0	4.3 ± 3.1	4.5 ± 3.8	0.742
8 Hours	5.1 ± 3.1	4.4 ± 3.6	4.8 ± 2.9	6.2 ± 4.2	0.636
16 Hours	6.1 ± 3.0	4.3 ± 3.0	3.4 ± 3.4	4.8 ± 3.9	0.303
24 Hours	5.3 ± 3.6	4.3 ± 2.8	4.5 ± 3.3	5.7 ± 3.3	0.613
POD2	5.4 ± 3.1	4.0 ± 2.4	5.0 ± 2.8	5.0 ± 2.4	0.501

Abbreviations: POD, postoperative day; SNF, skilled nursing facility; DVT/PE, deep vein thrombosis/pulmonary embolism; PT, physical therapy

Postoperative Pain

Postoperative pain levels were compared using VAS scores and calculated MME. Amongst the different dosage groups, no statistically significant differences were found on POD 0, 1, or 2. Conversely, we observed a phenomenon contradictory to our hypothesis. On POD 2, the VAS scores

for a single dose of dexamethasone was 4 ± 2 with MME 28 ± 28, IQR 1.88-45, while the VAS score for two high doses of dexamethasone was 5 ± 2 with MME 47 ± 49, IQR 5.63-84.4; however, these differences were not found to be statistically different (*P=0.501* and *P =0.509*, respectively) **[Table 2]**.

Complications

Among all patients, we observed one patient with DVT/PE, seven patients with surgical site infection, and five patients with postoperative wound drainage; no differences were found between the cohorts. Post-operatively, 38 patients required anti-emetic for nausea and vomiting, with 10 patients having their physical therapy deferred due to their symptoms.

Discharge Disposition

During the postoperative course, nine patients required discharge to a facility other than home with an average discharge date ranging from POD 1.8-2.4; there were no differences observed amongst the different cohorts regarding discharge destination (*P=0.679*) or length of stay (*P=0.279*) **[Table 2]**.

Table 3. Bivariate Linear Regression with Cumulative Dexamethasone Dose

		USC B	95% CI	p
Hospitalization				
Discharge POD		-0.026	(-0.065, 0.014)	0.203
Outcomes				
Distance				
	POD0	0.069	(-6.014, 6.152)	0.982
	POD1	2.756	(-4.781, 10.292)	0.469
	POD2	6.977	(2.295, 11.659)	**0.004**
Gait Assistance %				
	POD0	-0.981	(-1.827, -0.135)	**0.024**
	POD1	-0.528	(-1.263, 0.207)	0.157
	POD2	-0.883	(-1.612, -0.155)	**0.019**
Boston PAC Total Score				
	POD0	0.132	(-0.018, 0.283)	0.084
	POD1	0.063	(-0.067, 0.194)	0.336
	POD2	0.114	(-0.055, 0.283)	0.178
VAS				
	POD0	0.013	(-0.156, 0.182)	0.877
	8 Hours	0.044	(-0.110, 0.197)	0.573
	16 Hours	-0.007	(-0.145, 0.131)	0.916
	24 Hours	0.023	(-0.107, 0.152)	0.729
	POD2	0048	(-0.086, 0.181)	0.477

Abbreviations: POD, postoperative day

Discussion

With the new emphasis on enhanced recovery pathways and value-based health care models, providers need to optimize pain, improve return to functional recovery, reduce debilitating PONV, and decrease hospital length of stay. Although dexamethasone has previously been associated with wound healing complications, hyperglycemia, leukocytosis, and thromboembolism in the surgical literature, recent studies have demonstrated the safety and analgesic efficacy of systemic steroids in joint arthroplasty when administered within 24-48 hours after surgery.[8] Optimizing pain and PONV with

Cumulative Dexamethasone Dose

A bivariate linear regression was performed to assess the effect of increasing dexamethasone dose on outcomes. For a given increase in the dose of dexamethasone, there were statistically significant relationships between ambulation distance and gait assistance. Increasing doses of dexamethasone showed a statistically significant increase in ambulation distance on POD2 (*P=0.004*). There was an inverse relationship observed with regard to percentage of gait assistance or those receiving higher doses of dexamethasone, there was a decreased need for assistance on both POD0 and POD2 (*P=0.024* and *P=0.019*, respectively). There were no observable differences between increasing dexamethasone dose and Boston PAC scores and VAS scores postoperatively **[Table 3]**. A separate regression was performed to assess the effect of dexamethasone dose on complication rate. Again, there were no observed relationships between dexamethasone dose in relation to complication rate, including SSI, periprosthetic joint infections within 90 days, wound drainage, DVT/PE, nausea and vomiting, antiemetic usage, and inability to participate in physical therapy **[Table 4]**.

Table 4. Bivariate Logistic Regression with Cumulative Dexamethasone Dose

	OR	95% CI	p
Hospitalization			
SNF Discharge	0.926	(0.804, 1.066)	0.285
Complications			
Surgical Site Infection	1.012	(0.872, 1.175)	0.873
Periprosthetic Joint Infection Within 90 Days	--	--	1.000
Wound Drainage	0.959	(0.801, 1.149)	0.649
DVT/PE	0.824	(0.527, 1.288)	0.396
Nausea/Vomiting			
POD0	1.027	(0.913, 1.155)	0.660
POD1	0.913	(0.775, 1.075)	0.274
POD2	1.019	(0.851, 1.219)	0.841
PT Stopped Due to Nausea/Vomiting POD0	0.986	(0.872, 1.114)	0.816
Zofran/Metoclopramide Requirement			
POD0	0.979	(0.903, 1.062)	0.613
POD1	0.941	(0.834, 1.063)	0.329
Glucose >200			
POD0	0.947	(0.729, 1.231)	0.685
POD1	1.251	(0.829, 1.888)	0.286
POD2	1.256	(0.888, 1.775)	0.197

Abbreviations: SNF, skilled nursing facility; DVT/PE, deep vein thrombosis/pulmonary embolism; POD, postoperative day; PT, physical therapy

perioperative dexamethasone may facilitate out of bed mobilization and reduce postoperative fatigue, a common symptom following post-surgical inflammatory stress reaction of decreased strength and feelings of exhaustion.[11] Since the biological half-life of dexamethasone is about 36 hours, and around 60% of arthroplasty patients present with severe pain 48 hours after surgery, a repeat second dose of dexamethasone 24 hours after initial induction dose may start to fully affect patients on postoperative day two when inflammatory pain is at the maximum and activity level increases.[12,13] While the optimal dosing and timing of dexamethasone for joint arthroplasty patients remains unclear, this study suggests a repeat dose of dexamethasone 24 hours post-surgery regardless of dosage, may enhance rehabilitation performance on a postoperative day two without increased risks of hyperglycemia or wound complications.

Compared to patients receiving one dose of high or low dexamethasone, patients receiving two dosages of high or low dose dexamethasone had statistically significant improved ambulation distance and lower percentage of gait assistance on postoperative day two. Prior studies have shown that compared to arthroplasty patients without dexamethasone, patients who received intraoperative dexamethasone improved time to ambulation compared to those without, but additional doses of dexamethasone had no further impact.[14,15] This finding may be correlated to our study in that repeat doses of dexamethasone had no impact on time to ambulate and distance walked during the early first <48 hours of surgery. However, during the peak inflammatory response after THA, which occurs around >48 hours postoperatively, our repeat dose dexamethasone patients were able to work more independently. They had better ambulation endurance during therapy sessions.

Postoperative fatigue is a multidimensional measure that considers feelings of fatigue and vigor that directly impact concentration, energy, mood, and ability to complete daily activities.[16] Steroids may attenuate fatigue after surgery, and in our patients, a repeat dose may not only help patients walk further and longer but also with less gait assistance and dependence. Prior studies have found that THA patients treated with repeat doses of 10mg dexamethasone had improved ambulation, hip flexion, and abduction on POD3 compared to patients without dexamethasone.[8,10] However, our study found that a repeat dose of dexamethasone, even if a low dose <6mg, was as effective as a repeat high dose of 10mg in ambulation distance and percentage of gait assistance. In patients who have diabetes or with borderline high blood glucose levels, where practitioners may be wary of repeating a high dose of POD1, our study suggests a low repeat dose of dexamethasone is as efficacious. Although the Boston AM-PAC scores, which evaluate the amount of dependence needed to complete activities of daily living, were not significantly improved between groups, the Boston AM-PAC scores evaluate tasks such as bed mobility and upper body grooming, which may not necessarily reflect functional recovery and improved endurance after THA.

Optimizing pain relief and reducing PONV may facilitate an earlier discharge, improve patient satisfaction, reduce hospital costs, and allow faster rehabilitation. Patients experiencing nausea and vomiting are four times more likely to be dissatisfied after surgery, and efficient management is critical for patient satisfaction and reduced costs.[17] Since the occurrence of PONV is usually reported within 24 hours after surgery, repeat doses of dexamethasone may not affect the occurrence of PONV beyond the first postoperative day.[10,18] In our study, we found no difference between the occurrence of PONV, use of breakthrough anti-emetic medications, and PONV interfering with physical therapy sessions, suggesting a single induction dose of dexamethasone is a sufficient lasting anti-emetic with ongoing effect.

Pain management is an important part of patient care and satisfaction, and previous studies have found dexamethasone to be effective in relieving pain and reducing postoperative opioid dependence.[14,15,19] Although we predicted a repeat dose of dexamethasone would reduce the inpatient opioid requirements and average pain scores, the required MME and VAS pain scores were not significantly different between groups. While Lei 2020 *et al.* found that multiple perioperative doses of dexamethasone significantly decreased dynamic VAS pain scores and inflammatory cytokine levels, there was no difference in VAS pain scores at rest and opioid consumption.[8] Perhaps the reason why our cohorts had no significant difference in average overall VAS pain scores and MME may be explained by the generally low pain scores at rest for all cohorts. The daily VAS score for each group was recorded as a daily average typically at rest, and all groups had daily averages of around 5/10. The baseline low VAS scores may explain why our groups had no significant difference in MME required, as increased MME would only be used for severe pain >7/10, and many of our patients generally had low VAS scores not requiring opioids.

Dexamethasone has been shown to increase perioperative blood glucose levels, leading to poor surgical outcomes, including infection, wound healing complications, and risks for revision surgery.[20] However, similar to other studies in the joint arthroplasty literature, repeat doses of high dose dexamethasone had no increased risk for surgical site infections, wound healing

complications, venous thromboembolic events, pruritus, or bleeding.[21,22] In fact, recent studies have suggested that perioperative systemic steroids may play a positive role in preventing venous thromboembolic events by suppressing thrombogenic markers thought to be responsible for the inflammatory reaction and coagulation cascade.[23,24] In line with recent studies, we found no significant association between the dosage of dexamethasone and the risk of perioperative blood glucose levels >200mg/dl between groups, as other studies have shown glucose levels >200 increases the risk for periprosthetic infections and complications.[15,25] While healthcare providers may be cautious in repeating high-dose steroids in susceptible diabetics with borderline glucose levels, this study suggests repeat high or low-dose dexamethasone 24 hours post initial induction dose is safe without increasing the risk for surgical site infections.

However, there are limitations to consider in this study, including its retrospective design, nonrandomized nature, and lack of blinding of patients, which may limit the generalizability of our results. Although we were able to compare doses of dexamethasone between patients, we did not involve a control group of THA patients without dexamethasone. However, due to previously established papers already highlighting the benefits of dexamethasone compared to controls, a missing control group in our study may not influence our conclusions as our study sought to compare the effects between the varying doses of dexamethasone rather than the utility of dexamethasone.[8] Also, due to the variability of the physical therapy staff present throughout the years, the Boston AM-PAC scores and mobility assessment scores were not performed by the same therapist, as scores may be subject to interobserver reliability. Furthermore, similar to other studies, our study was underpowered to detect many secondary outcomes, including complications of infection and PONV occurrence. Further direction into the efficacy of oral steroids may prove valuable in today's changing healthcare landscape of increasing frequency of outpatient same-day total joint arthroplasty as these patients may not be able to benefit from repeat dose of dexamethasone 24 hours after induction dose.

Conclusions

With the emphasis on enhanced recovery protocols and return to early functional recovery, a repeat perioperative dexamethasone may help facilitate out-of-bed mobilization and reduce postoperative fatigue. Although this study was underpowered and did not find outcome differences for same-day or postoperative day one discharges, patients receiving a repeat high or low dose dexamethasone the morning after surgery may have improved gait assistance and ambulation endurance on a postoperative day two compared to only one dose at induction. While dexamethasone should be carefully evaluated in high-risk diabetic patients with borderline blood glucose levels, there was no risk of hyperglycemia or periprosthetic joint infections in multiple doses of dexamethasone compared to receiving one dose at induction.

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Declaration of Informed Consent: N/A

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