Peri-operative Dexamethasone for Control of Pain After Total Knee Arthroplasty

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Abstract

Despite great advances made in TKA implant design and surgical technique, many patients still suffer from acute pain in the early postoperative period. This pilot study examined the administration intraoperative intravenous dexamethasone in combination with 3 days of postoperative oral dexamethasone for total knee arthroplasty (TKA) patients in order to reduce postoperative pain, prevent postoperative nausea and vomiting, and improve early post operative ambulation. We compared opioid use, numeric rating scale pain scores, and physical functioning in each group. Our results demonstrated a significant effect in PACU with less time for the dexamethasone group (97.9 minutes) versus the control (group 135.4 minutes) \((p = 0.009)\), lower reported pain scores in the dexamethasone group (2.61) than in the control group (4.33) \((p = 0.049)\), and less opioid usage with a dose equivalent of 0.419 for the dexamethasone group compared with 0.768 for the control group \((p = 0.041)\). Mean ambulation distance on the day of discharge was 280 feet in the dexamethasone group compared with 184 feet in the control group \((p = 0.074)\). From this retrospective pilot study, use of dexamethasone perioperatively for elective TKA appears to be beneficial without additional deep wound complications.
Background

Total knee arthroplasty (TKA) is a very successful procedure for the treatment of degenerative joint disease of the knee. Studies have predicted that the number of TKA’s performed in the United States will be approximately 3.5 million per year by the year 2030. Despite the great advances made in TKA implant design and surgical technique, many patients still suffer from acute pain in the early postoperative period. Many anesthesia modalities and medications have been used in numerous combinations in an attempt to reduce pain and limit side effects.

Standard treatment for pain relief after TKA includes opioid pain medication. Although opioid pain medication is effective in relieving pain, these medications can produce unwanted side effects, including postoperative nausea and vomiting (PONV), urinary retention, constipation, respiratory depression, confusion, and drowsiness. Identification of adjunctive treatments to reduce postoperative pain and the associated side effects from opioids may improve patient experience in the early postoperative recovery.

Corticosteroids are used to decrease pain and inflammation and to prevent PONV after surgery. Inflammation is one source of pain in TKA. The anti-inflammatory effects of corticosteroids have been known for decades. Corticosteroids are a subgroup of compounds known as adrenocorticoids that are naturally secreted by the adrenal gland. Synthetic agents, such as dexamethasone (Decadron, Merck Co., Whitehouse Station, NJ) are more potent, have longer duration of action, have increased anti-inflammatory properties, and generally reduce unwanted side effects of opioid consumption.
Corticosteroids may be given orally, intramuscularly, or intravenously. Factors which may influence both the therapeutic and adverse effects of corticosteroids include the pharmacokinetic properties of the steroid, daily dosage, timing of administration, and duration of treatment.\textsuperscript{4}

Dexamethasone, a corticosteroid, administered to TKA patients intraoperatively and during the early postoperative period may decrease postoperative pain, opioid consumption, and the associated side effects of opioid consumption. The addition of dexamethasone may increase well-being and improve rehabilitation after TKA.

The purpose of this pilot study was to determine whether administration of dexamethasone intravenously during total knee arthroplasty (TKA), and oral dexamethasone daily, for the first three postoperative days, would reduce postoperative pain, prevent nausea and vomiting, and increase early rehabilitation efforts.

**Materials and Methods**

We conducted a retrospective chart review of patients identified from our outcomes database who underwent total knee replacement and whose anesthesia included general with either femoral or femoral and sciatic nerve blocks. Patients who received spinal or intraarticular nerve blocks were excluded from the study. The groups were consecutive with the control group from 2005-2006 and the dexamethasone group from 2007 when we added dexamethasone to the pain treatment regime. Twenty-three patients (dexamethasone group) were identified who received dexamethasone 10 mg
intravenously during TKA surgery and dexamethasone 4mg orally daily for three days postoperatively and 23 patients (control group) who did not receive dexamethasone during TKA surgery or anytime postoperatively. This pilot study was approved by our institutional review board.

We compared the use of opioids for pain relief, postoperative nausea and vomiting, and physical functioning in each group. Each patient's opioid intake was monitored in the operating room, post-anesthesia care unit (PACU), day of surgery and each subsequent postoperative day for three days or until the day of discharge. Famotidine (Pepcid) 20 mg. was given orally twice a day until discharge for gastrointestinal prophylaxis in the dexamethasone group. Postoperative nausea and vomiting and respiratory depression were tracked. The patients were asked prior to surgery, after surgery, and each postoperative morning while in the hospital to provide their numerical (Numerical Rating Scale, NRS) verbal pain score.

On postoperative day one, and on the day of discharge, knee flexion and distance ambulated were measured. Our data analysis included demographics, anesthesia type, dexamethasone dose, surgical data, NRS, total opioid dose equivalents (DE, 1 DE = 10 mg morphine sulfate intravenously), PONV, physical functioning, and 3 month wound infection evaluation.

Data were analyzed using SPSS (DEFINE) version 13.0 (Chicago, IL). After checking for normal distribution of the data, independent t-tests were used to analyze the differences in NRS pain scores, opioid DEs, and physical functioning data between groups. Demographic and baseline data were analyzed using independent t-tests for
continuous data and chi-square tests for categorical data to determine if there were any differences between groups. All statistical tests were two-tailed and the alpha level was set at 5%.

Results

No significant differences were noted between groups with regard to age, gender, weight, height, or anesthesia. (Table 1) Our results demonstrated that patients given dexamethasone spent less time in PACU, 97.87 minutes versus 135.35 minutes in the control group ($p = 0.009$). Postoperative NRS pain scores in the PACU were less for the dexamethasone group (2.61) than in the control group (4.33) ($p = 0.049$) (Figure 1). PACU opioid DE of 0.419 were significantly less in the dexamethasone group compared to the DE of 0.768 in the control group ($p = 0.041$) (Figure 2). The NRS pain rating and opioid DE use at all other time points were similar.

Physical functioning findings included a mean ambulation distance on the day of discharge of 279.6 feet in the dexamethasone group compared with a mean of 184.1 feet in the control group ($p = 0.074$) (Figure 3). Flexion on the day of discharge was 84° in the dexamethasone group and 81° in the control group. Nausea was 13% and 8% lower in the dexamethasone group on the day of surgery and on postoperative day 1. Incidence of vomiting did not differ between groups. No wound infections were reported at three months, though one patient in the control group received antibiotics for a superficial infection.

Discussion.
We evaluated dexamethasone as a way to decrease pain, PONV, and increase physical functioning following TKA. In our pilot study we saw lower NRS pain scores ($p=0.049$) and lower DE usage ($p=0.041$) in the PACU for the dexamethasone group. We also saw a shorter time spent in the PACU for the dexamethasone group ($p=0.009$).

Previous authors have found that using corticosteroids can reduce pain and inflammation.$^{1, 3, 5, 6}$ Decreasing pain with dexamethasone may allow for less opioid use and potentially a better rehabilitation effort.

PONV can prolong hospitalizations and delay recovery. Movafegh found that using IV dexamethasone reduced PONV in their patients undergoing inguinal herniorrhaphy. Though the nausea was lower in the dexamethasone group, we did not see a statistical difference in PONV between groups in our study. The opioid usage of the dexamethasone group in the PACU was significantly less and this could reduce PONV in some patients. Holte and Kehlet concluded in their study that the positive effects of corticosteroids on PONV could improve recovery.$^7$

We observed an improvement in the ambulation distance on the day of discharge in the dexamethasone group, which could be due to decreased pain and/or inflammation. Vargas and Ross studied ACL reconstruction patients and saw a 38% reduction in time to ambulation in patients receiving dexamethasone intraoperatively and postoperatively.$^5$

A concern of using steroids around the time of joint replacement is a risk of infection. Vargas and Ross found no difference between groups of ACL patients with regard to infection or wound healing.$^5$ In our study no deep infections occurred in either group.
One patient in the control group was treated with oral antibiotics for a suspected early superficial infection.

This study is limited by its retrospective nature and the small numbers of patients. The patients were not matched during the selection process, though the groups were similar in demographics. The majority of the patients in the dexamethasone group were operated on in 2007, whereas the majority of the control group were operated on in 2005 and 2006. Though treatments other than dexamethasone did not change during this period, other factors in time may have had an effect on the groups. The time in PACU may have been influenced by the variation in the number of blocks that included sciatic nerve and femoral nerve in the dexamethasone group compared with the control group.

Based on this pilot study perioperative dexamethasone appears to be a safe modality in patients undergoing TKA. Dexamethasone does not appear to increase the risk of infection. The patients who received dexamethasone did show shorter stays, lower opioid usage and lower NRS pain scores in the PACU. Although no difference in PONV was noted in our study, dexamethasone is known to reduce the risk of PONV. The dexamethasone group also demonstrated an improved walking distance on the day of discharge. Dexamethasone appears to be a safe modality to use to control pain in patients undergoing TKA but further study with a prospective, randomized, larger population would be more definitive.
References


