Dexamethasone Perioperative Coanalgesia in Lumbar Spine Fusion
A Controlled Cohort Study of Efficacy and Safety

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Purpose: A 48-hour trial of dexamethasone coanalgesia became our standard practice in May 2008. This is our research Ethics Board–approved review of this experience to date with attention to perioperative narcotics use and pain scores for the first 48 hours after surgery as well as length of stay (LOS), wound healing complications, and infections in the first 6 months, compared with the historical precedent control cohort.

Methods: Surgical case logs identified cases of 1- and 2-level elective lumbar decompression and fusion surgery performed since protocol initiation (cases) and for a like period beforehand (controls). Minimum of 6 months follow-up (sufficient to identify acute and subacute wound healing problems and perioperative infections) information was required. Hospital, Pain Service, and office records were reviewed for the extraction of outcomes data.

Results: We identified 132 cases and 146 controls. In 41 additional cases records were deficient. Baseline characteristics were equivalent. Cases included 70 males (53%) and 62 females (47%) of mean age 54 years (range, 18–84 y). Seventy-five (57%) cases were narcotics dependant (mean of 79.5 mg-morphine-equivalent daily). Controls included 78 males (53%) and 68 females (47%) of mean age 55 years (range, 27–85 y). Eighty-nine (61%) controls were narcotics dependant (mean 101.2 mg-morphine-equivalents daily). Mean morphine-equivalents narcotic consumption for 48 hours after surgery was 262.9 mg in cases and 280.7 mg in controls. VAS pain scores at 48 hours after surgery was 262.9 mg in cases and 280.7 mg in controls. VAS pain scores at 48 hours after surgery averaged 4.4 and 6.9 during rest and activity in the cases, and 3.7 and 6.3 during rest and activity in the controls. LOS averaged 3.9 days in cases and 5.2 days in controls. Delayed wound healing and surgical site infections were not observed in either group.

Conclusions: Systemic dexamethasone after 1- and 2-level lumbar fusion surgery demonstrated minimal impact on 48 hours perioperative narcotics use with no detriment to pain control, wound healing, or infections. LOS was shortened by 25%.

Key Words: lumbar fusion, steroids, pain control

Multimodality pain control is usual in modern surgical spine care.1 Narcotics are the mainstay in pain control after major surgery2 and can be administered orally, parenterally, or with patient control (PCA)3–6 and are commonly supplemented with acetaminophen,7 NSAIDs,8,9 and/or pregabaloid drugs.10–12 Local anesthetics and/or narcotics can be deposited at the surgical site preoperatively (preemptive analgesia), at wound closure, or postoperatively.13,14

Steroid infusions are commonly used for palliative pain control of the nonoperative patient15 (as epidural and caudal blocks, facet blocks, nerve root blocks, etc.) but are not a routine prescription in operative care as their use considered relatively contraindicated for perceived risk of potential steroid complications such as wound breakdown or infection.16

Steroids have a role in palliating spine pain and neurological symptoms from metastatic spinal cord compression17 and are anecdotally prescribed by some practitioners in the palliation of acute sciatica. Recently, TNF-α inhibitors have been demonstrated as effective for temporary relief of sciatica as well.18,19

Topical steroids have a role in managing postoperative pain after surgical decompression of sciatica.20,21

Parenteral dexamethasone is a common anesthetic prescription indicated to counteract perioperative nausea and vomiting in the spine and other operating rooms.22,23 The more extended use of parenterally administered dexamethasone has been explored as an adjunct in perioperative pain control after discectomy24–30 and in non–spine operations31,32 but not in spinal fusion surgery.

In May 2008, the senior author (D.A.B.) had occasion to provide lumbar fusion surgery to a patient with a long history of high-dose narcotic usage and treatment failure. When otherwise routine multimodality perioperative analgesia failed that patient we undertook a 48-hour trial of dexamethasone (4 mg IV q6h × 48 h) steroid coanalgesia that was spectacularly effective, so much so that the method was rapidly incorporated to our standard practice.
The current evidence is our research Ethics Board-approved (Hamilton Health Sciences study number 12-443-C) review of this experience with attention to perioperative narcotics use and pain scores for the first 48 hours after surgery, and also length of stay (LOS), wound healing complications, and infections in the first 6 months, as compared with the historical precedent control cohort. We have also reviewed the frequency of common narcotics complications such as pruritis, nausea, sedation, and gastrointestinal bleeding for potential benefit.

This material is not at all intended to present the results of fusion surgery but only to investigate the issue of acute-phase pain control in these procedures.

METHODS

The senior author’s (D.A.B.) surgical case logs were reviewed so as to identify all cases of 1- and 2-level elective lumbar decompression and fusion surgery performed since our May 2008 regular prescription of dexamethasone infusion (4 mg IV q6h × 24 h) and with regard to which minimum of 6 months follow-up (deemed sufficient to identify acute and subacute wound healing problems and perioperative infections) information was available at the time of review. We then delved backward in time for a matching 4 years to retrieve a like volume of contiguous previous cases treated without the extended infusion. Hospital, Pain Service, and office records were then reviewed for the collection of outcomes data which were then analyzed for significance. Narcotics usage was converted to oral morphine equivalents for analysis.

All these operations included both decompression and stabilization of the operated motion segments. Indications included spinal stenosis with degenerative listhesis, recurrent disk herniation, and lytic spondylolisthesis but did not include nonspecific “back pain fusions.” Fusion was by an open posterolateral lumbar interbody fusion (PLIF) technique using only local bone and so with no iliac harvest, augmented with bilateral posterior pedicle screw instrumentation. The PLIF implant was Prospaze (Aesculap AG, Tuttinglen, Germany) and the pedicle screws were CD Horizon M-8 (Medtronic Sofamor Danek USA Inc., Memphis, TN).

To bring focus to the primary perioperative case experience, cases where LOS was extended by either extraordinary medical complications (myocardial infarction, DVT/PE) or marked preoperative debility requiring inpatient rehabilitation were excluded.

DESCRIPTION OF USUAL CARE AND DISCHARGE

The senior author’s (D.A.B.) regional spine care practice is mature and stable such that the balance of perioperative prescription and wound care are uniform. Practice is entirely based on the Spine care ward of our tertiary hospital which was dedicated in September 2004, approximately coincident to the earliest control cases reviewed here, and so there was uniformity of nursing care in all our cases. Postoperative orders are routinely handwritten by the senior author (D.A.B.) so as to avoid the inconsistencies of care that can follow prescriptions provided by irregular and rotating learners.

General anesthesia at our hospital is routinely provided using a mix of versed, propofol and fentanyl or remifentanyl with a single 8–10 mg dose of dexamethasone administered postinduction as propofol against postoperative nausea and vomiting.

Intraoperatively the wound area is preemptively infiltrated with xylocaine solution diluted to 0.33% concentration, immediately before incision. Wound irrigation is with bacitracin solution containing an emulsifier. At wound closure we again infiltrate with bupivacaine 0.5% solution.

Intraoperative bolus tranexamic acid (2 g) was given to control bleeding, and postoperative DVT prophylaxis with Lovenox (enoxaparin sodium; Sanofi-Aventis, Canada) 30 mg IV bid was administered until discharge. Standard postoperative analgesia is with a titrated (by ward nursing staff, against the patients’ analogue pain scores) mix of intravenous (morpine or hydromorphone) and oral (oxycodeone, hydromorphone, or codeine) narcotics in all cases. Any preoperative prescription of long-acting narcotics such as fentanyl patches or hydromorph contin is continued postoperatively. Diphenhydramine is provided as a routine antinauseant. In cases where patients were narcotics users preoperatively they were provided with intravenous patient-controlled parenteral narcotics (IV-PCA) for the first days after surgery. Gabapentinoids (gabapentin or lyrica) if used preoperatively are continued in-house, and incremental prescriptions for same are occasionally provided as indicated by the presentation of neuropathic pain. Acetaminophen is also routine. The senior author does not prescribe and in fact prohibits perioperative NSAIDs for concern to possible adverse impact on bone fusion biology. All these patients are seen daily in hospital by our Acute Pain Service (staffed by operating room anesthesiologists) for optimization of drug dosage and administration protocol, and pain scores data are recorded by that Service.

Standard wound care is both physical and parenteral. Initial skin prep was with chlorhexidine, and after fascial and subcutaneous closure the skin was reprepped with iodine solution before suturing. Skin closure was with interrupted 2-0 monofilament nylon suture (Ethilon; Ethicon Inc., Somerville, NJ). Small-diameter (1/4 inch) suction drains were used in all cases, drains removed when output decreased to <30 mL per 12-hour nursing ward shift.

We address the physical situation of the lumbar surgical wound (compressed firmly against often moist or even occasionally soiled bedsheets and subjected to shearing forces with all movements of the trunk) by routinely ordering that the patient be nursed in the decubitus position.

Preoperative antimyelocascular antibiotics (cephalexin, or vancomycin in cases with penicillin allergy) are first administered in the hour before incision and provided for an extended postoperative period in consideration of the known basic biology of wound
healing where basic science suggests a healing wound to be bacteriostatic only at 24–48 hours after closure.\textsuperscript{34–36} Despite the paucity of evidence in support.\textsuperscript{37} Routine prophylaxis is for 48 hours and this is extended to 72 hours for those patients presenting risk factors for infection (obesity, uncontrolled diabetes, immune compromise, severe debility).\textsuperscript{38,39} Intrawound antibiotics were not administered.\textsuperscript{40,41} Dressing changes are not routinely prescribed for that first 48–72 hours period so as to minimize potential acute-phase surgical site contamination from caregivers.

Management of serum glucose levels in diabetic patients (6 cases, 8 controls) included continuance inhospital of the patients’ baseline diabetes care prescription supplemented with short-acting insulin prescribed as a sliding scale titrated against capillary blood glucose levels measured qid. The sliding scale was discontinued either at discharge or when no supplementary insulin had been needed for 24 hours. No patient’s discharge was delayed by uncontrolled hyperglycemia.

Patients were discharged when independently able to mobilize and toilet, wound drainage < 30 mL/12-hour nursing ward shift, and when pain control was adequate without parenteral analgesia.

### CALCULATION OF ORAL MORPHINE EQUIVALENTS CONSUMPTION

The following conversion values, as provided online by McMaster University (http://nationalpaincentre.mcmaster.ca/opioid/), were used to calculate our patients’ Oral Morphine Equivalents (MEQ) consumption:

1. Oxycodeone (MEQ = 1.5), that is, oxycodeone 10 mg PO = morphine 15 mg PO.
2. Percocet (MEQ = 1.5 x 5), that is, 5 mg oxycodone per tablet therefore 5 x 1.5.
3. Dilaudid/Hydromorphone PO (MEQ = 2.5).
4. Dilaudid IV (MEQ = 5).
5. Hydromorphp Contin PO (MEQ = 5).
6. Codeine (MEQ = 0.15).
7. Tylenol #3 (MEQ = 4.5), 30 mg of codeine per tablet x MEQ of 0.15 for codeine.
8. Fentanyl nonpatch (MEQ = 100, in mcg), that is, Fentanyl 100 mcg = morphine 10,000 mcg = morphine 10 mg (parenteral) = 20 mg morphine PO.
9. Fentanyl patch (MEQ = patch strength x 24 h x 150). Patch strength was converted to total Fentanyl given over 24 hours, then multiplied by a conversion rate of 150, that is, Fentanyl patch 25 mcg/h x 24 hours = 600 mcg; Fentanyl over 24 hours — > 600 x 150 = 90,000 mcg morphine = 90 mg morphine PO.
10. Tramadol/Tramacet (MEQ = 0.2), that is, Tramadol 50 mg = 10 mg morphine PO.
11. Pethidine/Meperidone/Demerol (MEQ = 0.1), that is, Demerol 50 mg = 10 mg morphine PO.

### STATISTICAL METHODS

For data analysis, descriptive statistics were performed for patients who received decadron and those who did not receive decadron. Categorical variables were reported as frequencies and relative frequencies and compared using the \( \chi^2 \) test or the Fisher exact test whenever appropriate. Continuous variables were reported as mean with SD or median and maximum when not normally distributed and compared using independent samples \( t \) test. Logistic regression analysis was used to explore the effect of using decadron adjusting for patient factors. Odds ratios (OR) with 95% confidence intervals were reported. A \( P \)-value of 0.05 was considered for statistical significance. SPSS version 20.0 (http://www.ibm.com) was used for this data analysis.

### RESULTS

The senior author performed 342 1- and 2-level PLIF fusions in the study period September 2004 to May 2012. In 41 otherwise qualifying cases the available records information was deficient. Twenty-three cases (3 cases and 18 controls) were either debilitated elderly (2 cases, 11 controls) or suffered unexpected major medical complications such as thrombosis (1 case, 4 controls) or myocardial infarction (no cases, 3 controls) requiring extended inpatient medical or rehabilitative care leading to extraordinary LOS > 10 days and were excluded. Debilitated elderly who in many cases were locomotor impaired either by their spine disease or for other medical reasons often required extended rehabilitation support as a function of their compromised baseline status rather than simply as a function of the surgery. We thus identified 132 qualifying cases who preoperatively received dexamethasone and 146 controls who did not receive the drug, all having adequate records information available.

Baseline (preoperative) characteristics of the groups were not statistically different (Table 1). The treated cohort consisted of 70 males (53%) and 62 females (47%) of mean age 54 years (range, 18–84 y). Seventy-five (57%) of the treated cohort were narcotics dependant at baseline, consuming a mean of 79.5 mg-morphine-equivalent daily. Controls included 78 males (53%) and 68 females (47%) of mean age 55 years (range, 27–85 y). Eighty-nine (61%) of the controls were narcotics dependant at baseline, consuming a mean of 101.2 mg-morphine-equivalents daily.

The mean oral morphine-equivalents narcotic consumption for the first 24 hours after surgery did not differ

<table>
<thead>
<tr>
<th>Table 1. Baseline Characteristic Comparison by Treatment</th>
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<td>Characteristic</td>
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<tr>
<td>Age, mean (SD)</td>
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<tr>
<td>Sex, n (%)</td>
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<tr>
<td>Female</td>
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<tr>
<td>Male</td>
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<tr>
<td>Number using narcotics at baseline (preoperative), n (%)</td>
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<tr>
<td>Oral morphine equivalents being used at baseline (preoperative), mean (SD)</td>
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</table>
(cases received a mean of 169.3 mg, controls 160.0 mg; \( P = 0.606 \)). Total mean oral morphine equivalents consumed at 48 hours were also not significantly different (cases 262.8 mg, controls 280.7 mg; \( P = 0.558 \)).

VAS pain scores (10-point scale), both at rest and with activity (ambulation), were also similar at both of the assessed 24- and 48-hour time points. At 24 hours the resting pain scores in the treated cohort averaged 4.8 and controls averaged 4.7 (\( P = 0.905 \)), and with activity pain scores averaged 7.2 in the treated group and 7.4 in controls (\( P = 0.371 \)). At 48 hours the resting pain scores in treated patients averaged 4.4 and controls averaged 3.7 (\( P = 0.041 \)), and with activity pain scores averaged 6.8 in cases and 6.3 in controls (\( P = 0.145 \)).

LOS was significantly decreased in the treated group (mean 4.0 d, median 3.0 d) as compared with controls (mean 5.0, median 4.0 d; \( P < 0.001 \)). The number of cases discharged at 48 hours was significantly higher for the treated group (80.4%) than for the controls (39.2%) with \( P \)-value of < 0.001.

The results were consistent after adjusting for patient factors. Using multivariable logistic regression analysis, the predictors of 48-hour discharge from hospital were dexamethasone use \( [\text{OR} = 6.2 \ (3.0-12.7)] \), narcotic use \( [\text{OR} = 2.3 \ (1.2-4.5, \ P < 0.001)] \), and younger age \( [\text{OR} = 0.97 \ (0.96-0.99)] \) (Table 2).

In the treated group fully 11 cases, 6 of whom were preoperative narcotics users, were discharged on the first morning after surgery (8.3%) as compared with only 1 patient (no baseline narcotics) from the controls (0.7%; \( P = 0.002 \)).

Delayed wound healing and surgical site infections were not observed in either group. No patient suffered gastrointestinal bleeding.

Twenty-two of 132 cases (17%) and 26 of 146 (18%) delayed wound healing and surgical site infections.42 Twenty of 132 cases (15%) and 51 of 146 (35%) controls reported symptoms of nausea, but this difference was not significant (\( P = 0.008 \)).

Twelve of 132 cases (9%) and 22 of 146 (15%) controls reported symptoms of pruritis, but this difference was not significant (\( P = 0.569 \)).

Twenty-two of 132 cases (17%) and 26 of 146 (18%) controls were reported as sedated. This difference was not significant (\( P = 0.008 \)).

**DISCUSSION**

This chart review found that the routine parenteral administration of dexamethasone for 48 hours after single and 2-level lumbar fusions was safe when administered in the environment of standardized care and wound management described. Neither superficial nor deep wound infections were observed in the study.

To the authors’ knowledge only 1 infection presented in all these 342 fusions, this being a case from that group of 41 incremental cases where acute-care hospital records were incomplete and so the case was not included in this formal review. This was 44-year-old woman who underwent 1-level PLIF for recurrent lumbosacral disk prolapse with spondylolisthesis. She was prescribed perioperative dexamethasone and discharged to her home at 48 hours. She presented emergently 1 week later with increasing surgical site pain, swelling, and fever and was reexplored by an independent surgeon in the senior author’s absence with evacuation of a seemingly subcutaneous MRSA abscess, fascia was intact, and deep tissues were not purulent. Only short-term perioperative antibiotics were prescribed at the time. She was thereafter managed at her local hospital and did not return to our center until almost a year later when her local hospital’s Infectious Diseases Service referred her for multiply-recurrent MRSA(+) surgical site infection. She was treated with curative implant removal.

This report’s required minimum 6 months follow-up was chosen so that any similar cases of deep wound infection in the reviewed patients would be detected. Primary deep surgical site infection presenting later than 6 months after operation is unlikely.

We did not show any significant decrease in acute perioperative narcotics usage, any decrease in VAS pain scores, nor any significant decrease in narcotic side effects.

We did observe both a significant decrease in the mean LOS and the number of patients who were comfortable enough to be discharged home the morning after their operations. In the absence of any decrease in apparent pain (VAS score) or narcotics usage this is unexplained and may warrant further investigation. One possibility is that of simply decreased perioperative fatigue as has been observed with steroid coanalgesia after total knee replacement.

The findings from this chart review should be interpreted with caution due to the certain limitations inherent to study design. It is a retrospective review and prone to missing data. Patients are not included consecutively due to the exclusion of the patients with insufficient data. There was no a priori sample size calculation and the study may be underpowered for some calculations. Despite these limitations, the trend in early discharge from hospital in patients treated with decadron cannot be overlooked.

**TABLE 2.** Multivariable Analysis of Predictors of Discharge at 48 hours

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI of OR</th>
<th>( P )</th>
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<tbody>
<tr>
<td>Age</td>
<td>0.97</td>
<td>0.96-0.99</td>
<td>0.048</td>
</tr>
<tr>
<td>Decadron use</td>
<td>6.2</td>
<td>3.0-12.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Narcotic use</td>
<td>2.3</td>
<td>1.2-4.5</td>
<td>&lt; 0.001</td>
</tr>
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\( P \)-value for Hosmer-Lemeshow of goodness-of-fit = 0.521.

CI indicates confidence interval; OR, odds ratio.

**CONCLUSIONS**

The administration of systemic dexamethasone for 48 hours after 1- and 2-level lumbar decompression and fusion surgery seems to be safe. It effectively decreases LOS without significant impact on postoperative narcotics use within the first 48 hours of operation, detriment...
to pain control or increased frequency of common narcotic side effects. There is a need for a methodologically sound randomized controlled trial to determine the benefits of using perioperative dexamethasone in this patient population.

REFERENCES