Complications of intraoperative epidural steroid use in lumbar discectomy: a systematic review and meta-analysis

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OBJECT The authors' aim in this paper was to review the intraoperative use of epidural steroids in lumbar discectomy surgery with a focus on surgical complications.

METHODS A comprehensive literature search was done using PubMed, MEDLINE, and the Cochrane Central Registry of Controlled Trials. Relevant papers were retrieved and analyzed. The authors performed a meta-analysis of all available data. Search terms included epidural, steroids, discectomy, lumbar disc surgery, herniated lumbar disc, methylprednisolone, and perioperative. The primary outcome was surgical complications such as wound infection or need for reoperation. Secondary outcomes were pain and postoperative narcotic usage.

RESULTS Sixteen trials and 1 retrospective study (a total of 1933 patients) were eligible for inclusion in this study. In all studies, steroids were added epidurally over the nerve root before closure in cases, and control patients underwent discectomy alone. The mean age (42.7 years vs 42.4 years; RR 0.30 [95% CI -0.30 to 0.90], $p = 0.32$), overall complication rates (2.69% vs 1.18%; RR 1.94 [95% CI 0.72-5.26], $p = 0.19$), and infectious complication rates (0.94% vs 0.08%; RR 4.58 [95% CI 0.75-27.95], $p = 0.10$) were similar between the steroid group and control group, respectively.

CONCLUSIONS There is good evidence that epidural steroids can decrease pain in the short term and decrease the usage of postoperative narcotics after lumbar spinal surgery for degenerative spinal disease. The authors' results demonstrate a trend toward increased infection with epidural steroid use, but there was not a statistically significant difference. More studies are needed to validate the long-term risk/benefit ratio of epidural steroids in lumbar discectomy.

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KEY WORDS epidural steroids; lumbar discectomy; complications

LUMBAR disc herniation can lead to debilitating pain and discomfort. The surgical treatment of choice for acute disc herniation without spondylolisthesis is lumbar discectomy. Approximately 2 of every 1000 Medicare patients will undergo lumbar laminectomy with or without discectomy.³⁵ Even after discectomy, some patients continue to experience radicular pain. Many surgeons administer epidural steroids intraoperatively over the exposed dura and/or nerve root after discectomy to decrease postoperative pain. There is considerable variability among surgeons in the use of intraoperative epidural steroids. In a Canadian study published in 2009, 49% of surgeons routinely used epidural steroids after surgery.⁶ With this widespread but nonstandardized use of epidural

steroids after lumbar discectomy, a better understanding of their associated risk is warranted.

Recently, 2 consecutive patients in our practice underwent an uncomplicated lumbar microdiscectomy and received 40 mg of triamcinolone acetonide epidurally on the nerve root. Both patients returned to the hospital with a symptomatic CSF leak within 2 weeks of surgery and needed revision surgery. In both of these cases, the CSF leak site was posteriorly on the dura/root (where the bulk of the steroid was placed) and was easily repaired. Considering that these leaks would have easily been seen intraoperatively, we contemplated whether steroids had any role in their creation. This experience prompted us to undertake this study.

There have been 2 reviews addressing the use of epidural steroids after lumbar discectomy and both focused on functional outcomes such as pain reduction and postoperative hospital stay.^{16,31} Neither directly addressed surgical complications. In 2010, Ranguis et al. published a systematic review of 12 trials published between 1992 and 2008 that examined whether epidural steroid usage after lumbar discectomy led to a decrease in postoperative pain.³¹ In 2014, Jamjoom and Jamjoom published a review that added trials published between 2009 and 2012.¹⁶ Since 2012 there has been 1 additional prospective randomized trial discussing epidural steroid use.² None of these reviews examined complications associated with epidural steroid use in a systematic fashion. This study analyzes all available data on complications associated with epidural steroid use. Complications addressed included infection, arachnoiditis, reherniation, durotomy, and CSF leak.

Methods

Literature Search

A systematic search of the PubMed, MEDLINE, and the Cochrane Central Registry of Controlled Trials databases was done following the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The search was done using different combinations of the following terms: epidural, steroids, discectomy, lumbar disc surgery, herniated lumbar disc, methylprednisolone, and perioperative. The full texts of the appropriate studies were retrieved and analyzed by 2 authors. The date of the last search for this review was December 4, 2014. Duplicates were eliminated, and the remaining titles/abstracts were screened.

Eligibility Criteria

To be included in our analysis, the articles had to be randomized controlled trials, cohort studies, or retrospective studies of patients who underwent lumbar discectomy and had steroids applied onto the exposed nerve root or dura during the operation. Excluded from this analysis were articles in which patients had steroids administered intravenously^{3,20,21} or intramuscularly.¹⁰ Also excluded were studies in which the patients were treated with epidural nonsteroidal analgesics.^{26,34} However, we did include trials in which a combination of steroids and local anesthetics was used, as the focus of our review was complications from epidural steroids.^{5,9,15,17,28} We did not include trials in which the full text was not available^{14,23,27,30} or those not written in the English language.^{4,19}

Primary Outcome

The primary outcome for this study was surgical complications. This includes reherniation, hematoma formation, CSF leak, infection, repeat surgery, persistent radicular pain or new neurological deficit, and arachnoiditis. Secondary analysis for infectious complications was performed. Systemic complications such as abdominal distention, urinary retention, or pulmonary embolism were not analyzed.

Statistical Analysis

Continuous variables are reported as mean $\pm$ SD. Categorical variables are reported as proportions. Dichotomous outcomes were analyzed using the number of events in each group and the total number of participants to calculate the risk ratio. For continuous variables, the means and SDs from each study were used to calculate the mean difference. A random-effects model was used; 95% confidence intervals were calculated. Statistical analyses were performed using Review Manager (RevMan version 5.3, Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014); *p* values < 0.05 were considered statistically significant.

Results

Sixteen trials and 1 retrospective study fit the criteria for inclusion as outlined in the PRISMA flow diagram in Fig. 1. All 17 of these studies included patients who had undergone lumbar discectomy. This analysis included a total of 1933 patients, with 742 patients who received steroids and 1191 patients who did not receive steroids (Table 1). The dosage and type of steroid used varied between studies. The steroids used were methylprednisolone acetate 80 mg,^{2,7–9,15,25} methylprednisolone 40 mg,^{1,22,24,28,29,32} methylprednisolone sodium succinate 80 mg,^{12,17} dexamethasone,¹¹ hydrocortisone,¹⁸ and triamcinolone acetonide⁵ (Table 1). The average age, number of patients, type of steroid used, assessment method for pain, and overall complications for each study are summarized in Table 1. The mean age was similar between the 2 groups (42.7 vs 42.4 years; RR 0.30 [95% CI –0.30 to 0.90], *p* = 0.32).

Analyses of risk ratios and 95% CI with forest plots of the overall and infectious complications occurring in the included studies are displayed in Figs. 2 and 3. The overall complication rates (2.69% vs 1.18%; RR 1.94 [95% CI 0.72–5.26], *p* = 0.19) and infectious complication rates (0.94% vs 0.08%; RR 4.58 [95% CI 0.75–27.95], *p* = 0.10) were similar between the steroid group and the control group, respectively.

Analysis of studies reporting significant and nonsignificant reduction in the consumption of postoperative narcotics, postoperative hospital stay, pain reduction, and reduction in use of narcotics is summarized in Table 2. Five of the 7 studies that reported on changes in neurological status found a significant improvement after use of steroids. Seven of the 14 studies found a reduction in hospital stay with use of steroids. Similarly, most of the studies reported pain reduction (8 of 12) and reduction in narcotics use (10 of 11 studies) after use of steroids (Table 2). There were 5 reported cases of CSF leak in 2 studies,^{7,17} 3 in the steroid group and 2 in the control group. These did not reach statistical significance due to small numbers (*p* > 0.05).

Discussion

Many patients will continue to have back and leg pain following lumbar discectomy. This has been attributed to several causes, including insufficient discectomy, insufficient rehabilitation, incorrect diagnosis, or complications such as recurrent disc herniation, arachnoiditis, epidural

FIG. 1. Flow diagram illustrating systematic review of published literature evaluating epidural steroid usage in lumbar discectomy. IM = intramuscular; IV = intravenous.

fibrosis, or infection. Epidural steroids are often used as an adjunct to improve preoperative pain or reduce acute postoperative pain. Steroids may work by suppression of inflammatory mediators such as prostaglandins, bradykinins, and histamines.¹³ It has been shown that inflammation is an important mediator of pain in the interactions between injured disc tissue and the surrounding neural tissue.¹³

Infection after lumbar discectomy has been reported to occur at a rate of 0.2% with the use of prophylactic antibiotics, which are the standard of care.³³ It was not explicitly stated whether prophylactic antibiotics were used in the trial by Foulkes and Robinson that reported an infection in the control group.¹¹ Lowell et al. reported an increased rate of infection in patients receiving epidural steroids after

discectomy, with 3 cases of epidural abscess in the steroid group.²⁴ The operating surgeon in this trial reported that there were no cases of infection in the next 439 discectomies he performed after he abandoned the use of epidural steroids. In all other trials that reported complications, no direct correlation was found between epidural steroid usage and complications reported. The only exception to this was in a trial by Jones and Barnett in which 1 case of epidural hematoma was attributed to steroid usage.¹⁸

Only 2 papers in our review commented on the CSF leakage rate, with no significant impact from the use of steroids.^{7,17} While there are no data on this, in our practice we do not use steroids in cases of intentional or unintentional durotomy.

Based on our analysis, the use of epidural steroids after lumbar discectomy is linked with a higher infection rate but this increased rate does not reach statistical significance. The overall rate of complications after microdiscectomy is low, especially infectious complications, making it difficult to draw conclusions from a single study, but pooling patients from all eligible studies increases the statistical power. In the combined trials there were 20 total complications in the steroid groups (20/742 [2.69%]) 14 in the control groups (14/1191 [1.18%]). In the combined trials there were 7 infections in patients who received epidural steroids (7/742 [0.94%]) and 1 infection in the control groups (1/1191 [0.08%]). The rate of complications does not show a significant difference between the steroid and control groups when comparing total complications ($p = 0.19$) or when comparing infection rate alone ($p = 0.10$).

It has been hypothesized that the use of steroids as an adjunct postdiscectomy will decrease pain by prevention of epidural fibrosis and limiting the degree of scar formation.¹⁴ Häckel et al. published a study that found a statistically significant correlation between the degree of fibrosis and pain, but reported that the application of epidural steroids was not associated with a lower incidence of scar formation or failed back surgery syndrome.¹⁴ Theoretically, the antiinflammatory effect of epidural steroids could delay healing of the disc space and decrease fibrous tissue formation, hence decreasing the likelihood of reherniation. There were 3 cases of reherniation in the steroid groups (3/742 [0.4%]) versus 5 cases in all of the control groups (5/1191 [0.42%]), with no significant difference ($p = 1.000$).

There is good evidence that epidural steroid usage decreases short-term pain, but it may not be effective for prevention of long-term pain. Four studies found there to be no significant pain reduction;^{9,17,25,28} 8 studies reported significant pain reduction,^{1,2,8,12,15,29,32} but none of these studies except 1 reported there to be any difference between placebo and treatment groups for any period longer than 6 weeks.³² Five of the 7 studies that commented on neurological impairment found impairment to be significantly reduced in the patient population that received epidural steroids.^{2,9,12,18,32} The other 2 found there to be no association.^{8,29} Rasmussen et al. published a study that demonstrated a 24% reduction in neurological impairment in the steroid group compared with the control group, in addition to a slight reduction in reoperation after a 2-year follow-up.³² Debi et al. found no difference in neurological

TABLE 1. Analysis of series regarding age of patients, number of patients, method for pain assessment, type of steroid used, and total complications

Authors & Year	Steroid/Control Mean Patient Age in Yrs	No. of Patients (steroid, control)	Pain Outcome Assessment Method	Type of Op	Type of Steroid Used	Total Complications	
						Steroid Group (742 total)	Control Group (1191 total)
Abrihamkar et al., 2011	35.3, 36.6	66 (22, 44)	VAS	Laminectomy	MP 40 mg	None	None
Aljabi et al., 2014	45, 42	150 (75, 75)	VAS, PSLRT, ODI	Microdiscectomy	MP 80 mg	None	None
Bahari et al., 2010	41, 40.5	100 (50, 50)	VAS	Discectomy	TAC 10 mg	1 deep tissue infection	None
Davis et al., 1990	42.5, 44.4	86 (43, 43)	None	Hemilaminectomy/discectomy	MP 80 mg	2 unintentional durotomies w/ CSF leakage	None
Debi et al., 2002	42, 40	61 (26, 35)	VAS	Discectomy	MP 80 mg	None	None
Diaz et al., 2012	51.5, 53	201 (99, 102)	MPQ, modified ASIA score, SF-36, ABPI	Microdiscectomy, laminectomy	MP 80 mg	1 superficial infection	None
Foulkes & Robinson, 1990	44.3, 43.4	45 (22, 23)	Not available	Microdiscectomy	DM 16 mg	None	1 superficial infection, 1 reherniation
Glasser et al., 1993	45.4, 46.5	32 (12, 20)	Questionnaire	Microdiscectomy	MS 80 mg	None	None
Hurlbert et al., 1999	53, 50	60 (30, 30)	MPQ, SF-36, ABPI	Discectomy, laminectomy	MP 80 mg	2 superficial infections, 1 reherniation	1 reherniation
Jirattanaphochai et al., 2007	53, 51	103 (51, 52)	Verbal Numerical Rating Scale, ODI, SF-36	Posterior discectomy, decompressive laminectomy	MS 80 mg	1 unintended durotomy	2 unintended durotomies
Jones & Barnett, 1955	38.5, 36.7	100 (50, 50)	Postop opioid usage, time until ambulation	Discectomy	HC 25–50 mg	2 hematoma	1 hematoma
Lavyne & Blisky, 1992	38.8, 42	78 (42, 36)	Questionnaire	Discectomy	MP 40 mg	None	None
Lowell et al., 2000	Not available	470 (31, 439)	None	Discectomy	MP 40 mg	3 epidural abscesses	None
Lundin et al., 2003	40.1, 42.1	80 (38, 42)	VAS & DRI	Discectomy	MP 80 mg	None	None
Mirzai et al., 2002	39.1, 39.5	44 (22, 22)	VAS	Open discectomy/hemipartial laminectomy	MP 40 mg	None	None
Modi et al., 2009	29.8, 30.1	57 (29, 28)	VAS	Discectomy	MP 40 mg	None	None
Rasmussen et al., 2008	44, 40.9	200 (100, 100)	0–30 pain scale, PSLRT	Discectomy, medial partial laminectomy	MP 40 mg	2 reherniations, 5 fusions*	3 reherniations, 4 fusions*, 1 disc arthroplasty*

ABPI = Association of the British Pharmaceutical Industry; ASIA = American Spinal Injury Association; DM = dexamethasone; DRI = Disability Rating Index; HC = hydrocortisone; MP = methylprednisolone acetate; MPQ = McGill Pain Questionnaire; MS = methylprednisolone sodium succinate; ODI = Oswestry Disability Index; PSLRT = passive straight leg-raising test; SF-36 = 36-item Short-Form Health Survey; TAC = triamcinolone acetate; VAS = visual analog scale.

* Repeated surgery done for reasons other than reherniation.

FIG. 2. Risk ratio with 95% confidence intervals and forest plot for total complications in studies reporting on epidural steroid usage in lumbar discectomy. M-H = Mantel-Haenszel.

impairment between steroid and control groups, but the study was not designed to properly compare the groups.⁸

The reduction in use of opioid analgesics could potentially reduce the overall incidence of oversedation, respiratory depression, dizziness, mental disturbances, constipation, ileus, and other adverse effects associated with narcotics. Ten of the 12 studies that commented on postoperative opioid usage found there to be significantly reduced usage in patients receiving epidural steroids postoperatively.^{2,5,7,9,11,12,15,17,18,28} There is good evidence that the use of epidural steroids after lumbar discectomy decreases opioid analgesic use and pain in the short term. The hospital stay after an uncomplicated discectomy is typically less than 24–48 hours. The trial by Davis and Emmons reported a 37% reduction in postoperative hospital stay in the steroid group.⁷ Fourteen of the trials commented on

postoperative hospital stay and 7 found a significant reduction in the steroid group.^{2,7,11,12,25,29,32}

There are several limitations to this study. Most papers reviewed were not designed to analyze complications; therefore, the details of the patients who experienced complications were sometimes not available. Considering the small number of events, it is possible that with a larger sample size, the infectious complications could be more common in the steroid group, and therefore further studies are necessary. The follow-up time may not have been adequate to effectively assess complication rate in all of the studies. An example of this is the study by Abrishamkar et al. that stated no complications were detected during 14 days of follow-up.¹ Also, trials may have excluded some patients with complications. For example, Diaz et al. excluded patients with CSF leaks.⁹ While it is difficult to

FIG. 3. Risk ratio with 95% confidence intervals and forest plot for infectious complications in studies reporting on epidural steroid usage in lumbar discectomy.

TABLE 2. Results of studies examining reduction in neurological impairment, reduction in postoperative hospital stay, pain reduction, and reduction in narcotic use

Authors & Year	Reduction in Neurological Impairment	Reduction in Postop Hospital Stay	Pain Reduction	Reduction in Narcotic Use
Abrishamkar et al., 2011	Not available	Not significant	Significant (BP: 12 hrs)	Not available
Aljabi et al., 2014	Significant	Significant	Significant (BP: 1 mo)	Significant
Bahari et al., 2010	Not available	Not significant	Significant (BP: 1 day)	Significant
Davis & Emmons, 1990	Not available	Significant	Not available	Significant
Debi et al., 2002	No association	Not significant	Significant (BP: 14 days)	Not available
Diaz et al., 2012	Significant	Not significant	Not significant	Significant
Foulkes & Robinson, 1990	Not available	Significant	Not available	Significant
Glasser et al., 1993	Significant	Significant	Significant (BP/LP: 1 day)	Significant
Hurlbert et al., 1999	Not available	Not significant	Significant (BP/LP: 6 wks)	Significant
Jirattananaphochai et al., 2007	Not available	Not significant	Not significant	Significant
Jones & Barnett, 1955	Significant	Not available	Not available	Significant
Lavyne & Bilsky, 1992	Not available	Not significant	Not available	Not significant
Lowell et al., 2000	Not available	Not available	Not available	Not available
Lundin et al., 2003	Not available	Significant	Not significant	Not available
Mirzai et al., 2002	Not available	Not available	Not significant	Significant
Modi et al., 2009	No association	Significant	Significant (BP: 4 wks)	Used NSAIDs
Rasmussen et al., 2008	Significant	Significant	Significant (LP: 1 yr)	Not available

BP = back pain; LP = leg pain; NSAID = nonsteroidal antiinflammatory.

draw definitive conclusions due to the heterogeneity of the studies, our data certainly raise the possibility that routine use of epidural steroids may not be without complications.

Conclusions

Based on the analysis of 17 studies assessing the use of epidural steroids after lumbar discectomy, there is some evidence that steroids may not significantly increase the rate of complications. Our data demonstrated a trend toward more infectious complications in the steroid group, but not to a level of statistical significance. There is, however, good evidence that steroids reduce short-term pain and narcotic requirements after surgery. Surgeons who use epidural steroids should be aware of this trend and future studies of epidural steroid efficacy should diligently analyze complications.

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Disclosure

Dr. Ahmad is a consultant for DePuy Synthes.

Author Contributions

Conception and design: Ahmad. Acquisition of data: Akinduro. Analysis and interpretation of data: Akinduro, Haussen. Drafting the article: Akinduro, Miller. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Ahmad. Statistical analysis: Akinduro, Haussen. Study supervision: Ahmad.

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