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Clinical Study

Prophylactic perioperative dexamethasone decreases the incidence of postoperative C5 palsies after a posterior cervical laminectomy and fusion

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Abstract

BACKGROUND CONTEXT: Postoperative C5 palsy is a well-known complication of cervical decompression procedures. Studies have shown that posterior laminectomy and fusions confer the greatest risk of C5 palsy. Despite this, pharmacologic preventive measures remain unknown. We hypothesize that prophylactic perioperative dexamethasone (DEX) will decrease the rate of postoperative C5 palsy in patients undergoing a multilevel posterior cervical laminectomy and fusion.

PURPOSE: The purpose of this study was to assess the safety and efficacy of prophylactic perioperative DEX in decreasing the rate of postoperative C5 palsy.

DESIGN: This is a retrospective, single-institution clinical study.

PATIENT SAMPLE: The patient population included all patients undergoing multilevel posterior cervical laminectomy and instrumented fusion procedures for myeloradiculopathy or myelopathy, who also received a course of perioperative dexamethasone. Surgeries occurred between 2012 and 2017 at a single tertiary care center by a single surgeon with at least 1 year of follow-up. Patients who underwent decompression procedures other than multilevel posterior cervical laminectomy and instrumented fusions; had trauma, fracture; underwent decompression not including C5-level, insulin-dependent diabetes mellitus; and had documented adverse reactions to steroids were excluded.

OUTCOME MEASURES: Preoperative demographics and postoperative complications, including development of postoperative C5 palsy, were considered as outcome measures.

MATERIALS AND METHODS: A total of 189 consecutive patients who underwent multilevel posterior cervical laminectomy and instrumented fusion and received prophylactic perioperative DEX were reviewed. The rate of C5 palsy was investigated and compared with our historical control rate of C5 palsy before the institutional implementation of perioperative DEX. Demographics were reviewed, and risk factor stratification was analyzed. The safety of using DEX was investigated by examining postoperative complications. The clinical course of patients who developed C5 palsy was then reported.

RESULTS: Postoperative C5 palsy occurred in 5 of the 138 patients (3.6%) meeting the inclusion criteria. Patients receiving perioperative DEX had a significantly decreased rate of postoperative C5 palsy compared with those who did not (3.6% vs. 9.5%, p=.01). Age was the only risk factor that was significantly correlated with development of C5 palsy (72.71±7.76 vs. 61.07±10.59, p=.02). Infection, seroma, and wound complication rates were 2.8%, 2.17%, and 1.44%, respectively, in patients receiving prophylactic DEX. All five patients receiving DEX who developed C5 palsy recovered with no residual deficits at an average of 16.8 weeks postoperatively.

FDA device/drug status: Not applicable.

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CONCLUSIONS: Perioperative prophylactic DEX therapy is a safe and effective way to decrease the incidence of C5 palsies in patients who undergo multilevel posterior laminectomy and fusion for myeloradiculopathy or myelopathy.

Keywords: C5 palsy; Cervical decompression; Dexamethasone; Fusion; Laminectomy; Prophylaxis

Introduction

Posterior cervical laminectomy and fusion is a well-established decompression procedure for treating cervical myeloradiculopathy and is associated with relatively few complications [1]. However, one of the most widely reported and frequently discussed complications of cervical decompression surgery is postoperative palsy of the C5 nerve root [2], with a reported incidence of up to 30% [3,4]. A C5 palsy is defined as the unilateral or bilateral paresis of the deltoid and/or biceps brachii muscles, with or without pain or dermatomal sensory deficits that were not present preoperatively [5–7]. Although C5 palsies in the large majority of cases resolve spontaneously within the first 6 months of surgery, rare reports cite a delayed recovery of up to 2 years postoperatively [3,8,9]. Despite the overall good prognosis of this condition, individuals with postoperative C5 nerve palsies have a decreased quality of life and an increased cost of care, especially during the immediate postoperative period [10]. To date, research regarding C5 nerve palsy has largely centered around its incidence, risk factors, and potential pathogenesis. Relatively few studies address the prevention of what appears to be an iatrogenic disease, and to this point, the pharmacologic prevention of C5 palsy has not been evaluated.

The pathogenesis of a postoperative C5 palsy has long been debated and remains poorly understood. Current theories include the stretching or the tethering of the C5 nerve root inside the neuroforamen [9,11], posterior spinal cord drift after the decompression, excessive intraoperative traction [12], spinal cord ischemia or reperfusion injury [13,14], inadvertent intraoperative injury to the nerve root [14], thermal nerve injury secondary to high-speed burring [15], or the existence of preoperative malrotation of the spinal cord [16]. C5 palsies have been reported after both anterior and posterior procedures [17]. However, it is thought that posterior procedures confer a greater risk of this complication. Of the posterior procedures, laminectomy and fusion procedures have the greatest risk of a C5 palsy, with rates of 11.0% and 12.2% reported by two meta-analyses [8,18]. In the largest case series to date, Bydon et al. observed a C5 palsy rate of 8.6% after 511 posterior cervical decompression and fusion procedures [19], whereas smaller studies cite rates of up to 24% [20]. Prior work at our institution examined the incidence of C5 palsies after different types of decompression procedures, and we also observed that the highest incidence rate (9.5%) of this complication was after a posterior laminectomy and fusion [21].

Prevention of C5 palsies has been less rigorously studied. Studies that assessed the prevention of C5 palsies have done so via intraoperative neurophysiological monitoring [22], preoperative electromyography testing [4], prophylactic bilateral foraminotomies [13,23], and the use of chilled irrigation water [24]. Results of the aforementioned studies have been inconsistent, and optimized therapy protocols are needed. The use of steroids after acute spinal cord injuries (SCIs) has been investigated extensively, with some studies showing beneficial neuroprotective effects if they are administered immediately after an SCI [25–27]. In addition to SCIs, dexamethasone (DEX) has been shown to reduce the incidence of cranial nerve palsies in a randomized prospective study of 1126 patients who have undergone a carotid endarterectomy with or without perioperative intravenous DEX [28]. Furthermore, both intravenous and local corticosteroids have been safely used in spine surgery to decrease airway edema when an anterior cervical approach is used [29,30]. However, to date, DEX has not been studied as a prophylactic measure to prevent a cervical nerve palsy, specifically of the C5 nerve root.

The aim of the present study was therefore to compare the incidence of a C5 palsy after a multilevel posterior cervical laminectomy and fusion in patients who were given prophylactic perioperative DEX therapy with that in patients who did not receive prophylactic steroids as previously reported by our institution [21]. The secondary aims of this work were to assess the safety of DEX by measuring the overall complication rate and to evaluate the length of stay and the readmission rate of those who underwent prophylactic therapy. Lastly, the risk factors for a postoperative C5 palsy in our cohort were identified. We hypothesized that prophylactic perioperative DEX administration prior to posterior cervical laminectomy and fusion would result in a decreased incidence of postoperative C5 palsy.

Materials and methods

Study design

This retrospective observational study included the prospectively collected data of 189 consecutive patients who had multilevel posterior laminectomy and fusion for myelopathy or myeloradiculopathy. These patients were administered prophylactic DEX via a standardized protocol during the perioperative period. Surgeries were performed by a single surgeon from January 2012 to January 2017 at a large academic tertiary referral center. All patients had at least 1 year of documented follow-up. The present study was approved by our institution's ethics review board, and data were

collected in a Health Insurance Portability and Accountability Act-compliant manner.

Inclusion and exclusion criteria

Patients were included in the present study if they underwent an isolated multilevel posterior laminectomy and fusion and received perioperative prophylactic DEX. All patients had multilevel stenosis with clinically disabling cervical radiculopathy, myelopathy, or myeloradiculopathy and failed extensive conservative treatments. Most patients had stenosis with a good sagittal lordotic alignment. All patients had at least two levels decompressed, all of which included the C5 level. Our inclusion criteria were similar to those of the previously published study from our institution [21].

Patients were excluded from the present study if they had a history of a trauma, tumor, any cervical fractures; reported a prior sensitivity or adverse reaction to steroids; had a concurrent anterior procedure; lacked adequate follow-up data; had an SCI that prevented pre- or postoperative motor testing, or had insulin-dependent diabetes mellitus.

Experimental protocol

All subjects received a 10-mg loading dose of intravenous DEX at the time of the initial incision, followed by 8 mg of DEX every 8 hours for 24 hours postoperatively. All patients received DEX unless allergies or an adverse reaction to steroids was documented, or the patient had insulin-dependent diabetes. Hard cervical collars were placed on all patients for 3 weeks postoperatively, followed by soft collars for an additional 3 weeks.

Hospital and intensive care unit lengths of stay were recorded. Complications were reported for the entire DEX group, which included infection, seroma, wound healing complications, epidural hematoma, pulmonary embolus, deep venous thrombosis, nerve complication other than C5 palsy, return to the operating room (OR), 90- and 365-day readmissions, and mortality.

C5 palsies were assessed clinically during the postoperative inpatient stay and during clinical follow-up. Age, time of onset, residual deficit, and time until maximal improvement were reported for those patients in whom postoperative C5 nerve palsy was present. The C5 palsy rates of those patients who were enrolled in our prophylactic steroid protocol were compared with those we previously reported of patients who did not receive steroids, hereafter referred to as our historical control group [21]. The surgical procedures and indications in the control group were identical to those used in our treatment group. The surgical technique for decompression in the historical control group was identical to that in the treatment group. Additionally, there was no change in intraoperative positioning, neuromonitoring, use of traction, or instrumentation between the two groups. Furthermore, there was no use of any other prophylactic measures for C5 palsy in both the historical control group and the treatment group (DEX only). Specifically, prophylactic foraminotomies, limited-width laminectomy, or the use of chilled irrigation water was not implemented in either the control or the treatment group.

Statistical analysis

Data were summarized as mean±standard deviation or frequency (percentage).

Risk factors were compared between those patients who received perioperative DEX and were diagnosed with a postoperative C5 palsy and those who did not. Risk factor analysis included age, gender, obesity, smoking status, diabetes status, Charlson Comorbidity Index (CCMI), preoperative sagittal alignment (measured by the C2–C7 Cobb angle on neutral lateral cervical radiographs), preoperative C5 radiculopathy, the presence of ossification of the posterior longitudinal ligament, the number of levels decompressed, revision surgery, prior anterior cervical decompression and fusion, and prior upper extremity surgery. A C2–C7 Cobb angle of <0° was considered kyphotic, 0–10° was considered neutral, and >10° was considered lordotic. Statistical analysis was performed via one-sample exact test of proportion, Student *t* test, Wilcoxon rank-sum test, and Fisher exact test. Statistical significance was placed at a p-value of <.05. All analyses were performed with SAS version 9.1.3 (SAS Institute Inc, Cary, NC, USA).

Results

Of the 189 initial patients collected during the study period, 51 were eliminated on the basis of the exclusion criteria: 10 (19.6%) for a trauma or fracture, 23 (45%) for decompressions at levels other than C5, and 18 (35%) who did not receive prophylactic perioperative DEX because of comorbidities or patient factors (Figure).

The 138 remaining patients all had follow-up data of at least 1 year and consisted of 55 women (39.9%) and 83 men (60.1%). The mean age of the patients was 61.49±10.71 years (range, 31–90), and their mean body mass index was 31.04 (±6.54). Three patients (2.2%) had previously undergone a posterior surgery and 25 (18.1%) had a prior anterior cervical decompression and fusion. The mean number of decompressed levels was 4.45±0.82. The mean sagittal alignment as measured by the C2–C7 Cobb angle was 10.96°±6.76 (−3° to 33°) for the entire group. Demographics were similar to those of our institution's previous analysis, which included a total of 116 patients who underwent a laminectomy and fusion. Data for the entire sample are summarized in Table 1.

The overall incidence of a C5 nerve palsy in patients who received prophylactic perioperative DEX was 5 of 138 (3.6%). This rate was significantly less (p=**.01**, confidence interval: 0.01–0.08) than that of the historical controls (9.5%, 11 of

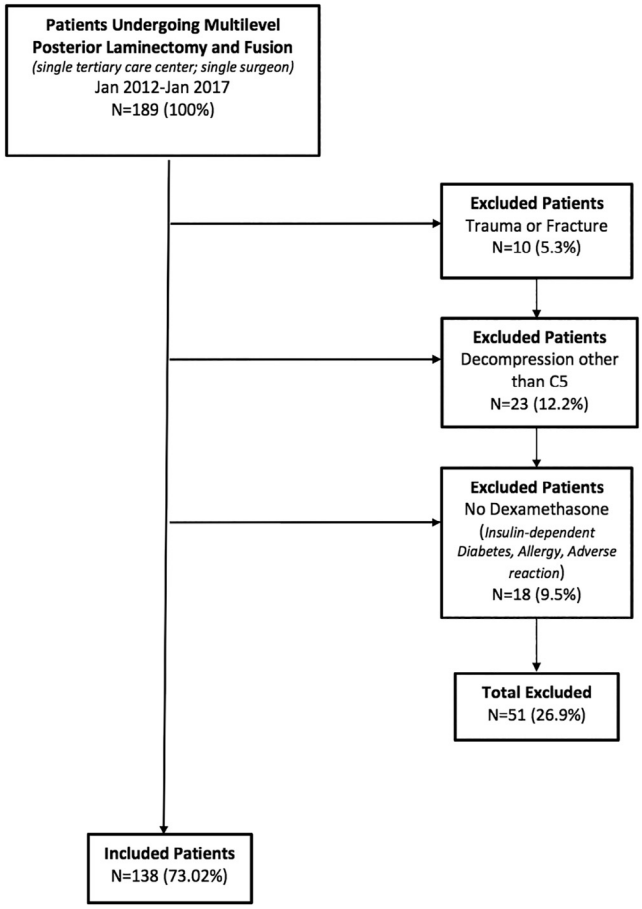

Figure. Flow diagram of the patients included in the study.

Table 1
Total demographic data and results

Total (N)	138
Age at OR, mean±SD	61.49±10.71
Gender, n (%)	Female, 55 (39.9)
	Male, 83 (60.1)
BMI, mean±SD	31.04±6.54
Smoker, n (%)	49 (35.5)
Diabetes status, n (%)	No diabetes, 102 (73.9)
	Diabetes, 26 (18.8)
	With organ damage, 10 (7.3)
CCMI, mean±SD	1.14±1.61
Preop C2–C7 Cobb angle, mean±SD (range)	Overall: 10.96°±6.76° (–3° to 33°)
Preop sagittal alignment, n (%)	Lordotic (>10°), 81 (58.7)
	Neutral (0–10°), 52 (37.6)
	Kyphotic (<0°), 5 (3.62)
PSF levels, n (%)	C2–T1, 9 (6.5)
	C2–T2, 3 (2.2)
	C3–C6, 4 (2.9)
	C3–C7, 92 (66.6)
	C3–T1, 15 (10.9)
	C3–T2, 2 (1.4)
	C4–C7, 2 (1.4)
	C4–T1, 2 (1.4)
	C5–C7, 1 (0.7)
	C5–T1, 1 (0.7)
Laminectomy levels, n (%)	C2–C6, 2 (1.4)
	C2–C7, 9 (6.5)
	C3–C5, 6 (4.3)
	C3–C6, 31 (22.4)
	C3–C7, 58 (42.1)
	C4–C5, 3 (2.2)
	C4–C6, 10 (7.2)
	C4–C7, 7 (5.1)
	C5–C7, 6 (4.3)
Revision posterior surgery, n (%)	3 (2.2)
Prior ACDF, n (%)	25 (18.1)
Prior upper extremity surgery, n (%)	22 (15.9)
ICU stay, n (%)	4 (2.9)
Days in ICU, mean	4.75
Hospital stay, mean±SD	4.05±2.37

OR, operating room; SD, standard deviation; BMI, body mass index; CCMI, Charlson Comorbidity Index; PSF, posterior spinal fusion; ACDF, anterior cervical decompression and fusion; ICU, intensive care unit; preop, preoperative.

116) [21]. Age was found to be the only independent predictor of a C5 nerve palsy. Patients who developed a palsy were 10 years older on average (72.71±7.76 vs. 61.07±10.59, p=**.02**). Body mass index (32.88±4.58 vs. 30.97±6.60, p=.40), gender (p=.65), preoperative sagittal alignment (p=.75), presence of preoperative C5 radiculopathy (p=.90), and all other outcomes or patient factors were equivocal (Table 2).

The infection, seroma, and wound complication rates were 2.89% (4), 2.17% (3), and 1.44% (2), respectively, for patients who received prophylactic DEX. No complications occurred in a patient who developed a C5 nerve palsy. Nerve complications other than a C5 palsy occurred in 3 subjects (2.17%). These included a 37-year-old man who sustained a traumatic disc rupture after a ground-level fall 1 month postoperatively, and the other two had adjacent segment radiculopathy at the C8 level more than 1 year postoperatively. Fourteen patients (10.8%) were readmitted within a year of surgery. Five (3.62%) were readmitted within 90 days for a trauma (2), infection (1), or a pulmonary embolus (2). Seven patients went back to the OR within the first year, one for perioperative epidural hematoma, one secondary to postoperative cervical trauma, one for an asymptomatic nonunion, one for adjacent segment disease, one for irrigation and debridement of a surgical site infection, and two for lumbar surgery unrelated to their cervical spine. Only one patient with C5 nerve palsy was readmitted and went back to the OR, although this readmission was for lumbar surgery. The 1-year mortality rate was 0.72% (1/138), which occurred secondary to complications of late undiagnosed metastatic lung cancer unrelated to the patients' cervical spine. Complications are listed in Tables 3–5.

The time of the initial onset of C5 palsy symptoms ranged from immediately postoperatively to 2 weeks after surgery. Two of five patients (40%) had bilateral C5 palsies. None of the patients with postoperative C5 palsy had any neuromonitoring alerts intraoperatively. All C5 palsies completely resolved without any residual pain or motor or sensory deficit at the final follow-up. The time until maximal recovery ranged from 2 to 10 months postoperatively, with a mean

Table 2
Risk factor analysis for development of C5 palsy

Risk factor	C5 palsy n=5	No C5 palsy n=133	p-Value, test
Age, mean±SD	72.71±7.76	61.07±10.59	**.02**, *t* test
BMI, mean±SD	32.88±4.58	30.97±6.60	.40, Wilcoxon rank-sum test
Women, n (%)	1 (20.0)	54 (40.6)	.65, Fisher exact test
Revision posterior surgery, n (%)	0 (0.0)	3 (2.3)	1.00, Fisher exact test
Smoker, n (%)	1 (20.0)	48 (36.1)	.66, Fisher exact test
Diabetes status, n (%)			.05, Fisher exact test
No diabetes	3 (60.0)	99 (74.4)	
Diabetes	0 (0.0)	26 (19.6)	
Diabetes with organ damage	2 (40.0)	8 (6.0)	
Preop sagittal alignment	11.6°±4.45	10.94°±6.85	.75, Wilcoxon rank-sum test
Preop C5 radiculopathy, n (%)	2 (40)	49 (36.8)	.90, *t* test
Presence of OPLL, n (%)	0 (0)	1 (0.75)	N/A
CCMI, mean±SD	2.60±2.07	1.08±1.58	.06, Wilcoxon rank-sum test
Prior ACDF, n (%)	1 (20.0)	24 (18.1)	1.00, Fisher exact test
Number of laminectomy levels, mean±SD	4.80±1.10	4.44±0.86	.29, Wilcoxon-rank sum test
Length of stay, mean±SD	5.00±2.00	4.02±2.39	.13, Wilcoxon-rank sum test

SD, standard deviation; BMI, body mass index; OPLL, ossification of the posterior longitudinal ligament; ACDF, anterior cervical decompression and fusion; CCMI, Charlson Comorbidity Index; N/A, not applicable; preop, preoperative.

Note: Bold indicates significance.

recovery of 16.8 weeks. Four of five C5 palsies recovered within 3 months, and all were treated with physical therapy. Residual deficits were defined as the failure of either the deltoid or the biceps brachii muscles to return to their full motor strength, a sensory deficit in the C5 distribution, or increased pain in the C5 distribution compared with the patient's preoperative status (Table 6).

Table 3
Complication rate for patients receiving DEX

Complication, n (%)	Total, N=138
Infection	4 (2.89)
Seroma	3 (2.17)
Epidural hematoma	1 (0.72)
Wound complication	2 (1.44)
Other nerve complications	3 (2.17)
Readmission	14 (10.14)
Return to OR	7 (5.07)
1-y mortality	1 (0.72)
ICU admission, n (range) (%)	4 (1–11 d) (2.89)
Pulmonary embolus	2 (1.44)
Mortality	1 (0.72)

DEX, dexamethasone; OR, operating room; ICU, intensive care unit.

Table 4
Return to OR within 1 year post operation

Return to OR, n (%)	Reason
7 (5.07)	Epidural hematoma
	Cervical trauma after GLF
	Non-union of PSF
	Adjacent segment disease (2)
	Infection
	Lumbar surgery (2)*

GLF, ground-level fall; PSF, posterior spinal fusion.

* Indicates patients with C5 palsy.

Discussion

C5 palsies after a cervical decompression have been widely documented in the literature, although their pathogenesis continues to be debated. Until this point, studies have mainly focused on the incidence, predisposing factors, clinical outcomes, and potential pathogenesis of C5 palsies [2,3,8,9,18,31–34]. However, despite the known risk of a C5 palsy, studies that evaluate the prevention of this complication have been far less robust. The present study is the first to our knowledge to comparatively assess the effectiveness of a perioperative prophylactic course of DEX therapy on the prevention of a postoperative C5 palsy. We showed that a prophylactic course of perioperative DEX was both safe and effective at significantly decreasing the rate of C5 nerve palsies after a multilevel posterior laminectomy and fusion compared with our institution's historical controls (9.5% vs. 3.6%, p=.02).

Beyond its clinical benefits, the present study suggests that the use of prophylactic steroids is safe. In our work, rates of infection (2.89%), epidural hematoma (0.72%), wound

Table 5
Ninety- and 365-day readmissions to the hospital

90-d readmissions (N=5)	365-d readmissions (N=8)
Ground-level fall (2)	Symptomatic non-union (1)
SSI infection (1)	Respiratory failure (1)
Pulmonary embolus (2)	Adjacent segment disease (1)
	Pneumonia (1)
	Lumbar surgery (1)
	MI (1)
	General surgery (1)
	Drug overdose (1)

SSI, surgical site infection; MI, myocardial infarction.

Table 6
Clinical course of patients with postoperative C5 palsy

Age	Gender	BMI	CCMI	Preop sagittal alignment (°)	Preop weakness	Preop C5 radic.	Intraop NM Alert	Laterality	Onset	Lowest MMT	Time to maximal recovery (wk)	Lami levels	Residual deficit
70	F	40.6	3	11	No	Yes	None	Right	POD1	3/5	8	C4–C6	None
75	M	29.0	4	9	No	No	None	Bilateral	POD1	3/5	12	C3–C7	None
61	M	32.8	0	15	No	No	None	Left	POD14	2/5	12	C3–C7	None
80	M	30.0	1	6	No	Yes	None	Left	POD1	3/5	40	C3–C7	None
77	M	32.0	5	17	No	No	None	Bilateral	POD5	2/5	12	C2–C7	None

BMI, body mass index; CCMI, Charlson Comorbidity Index; POD, postoperative day; MMT, Manual Muscle Test; radic., radiculopathy; NM, neuromonitoring; F, female; M, male; preop, preoperative; intraop, intraoperative.

complication (1.44%), and pulmonary embolus (1.44%) were similar to those of prior literature [35–37]. The length of stay for the entire cohort was a mean of 4 days, 2.89% required an intensive care unit admission during their stay, and there was a 90-day readmission rate of 3.6% (a total of five, two of which were secondary to a low energy trauma unrelated to their cervical surgery). The return to OR rate was only 5.07% (a total of seven). These findings demonstrate that a prophylactic dose of DEX has a safety profile that is consistent with current rates in the literature for patients undergoing posterior laminectomy and fusion [35,38].

Despite the use of DEX, 5 of the 138 patients still developed a postoperative C5 palsy. However, all recovered without a residual deficit, and 80% (4/5) recovered within the first 3 months after surgery. Only age was a significant predictor of a C5 palsy (p=.02).

A strength of the present study was its strict inclusion criteria, as we addressed only the procedure most commonly associated with a C5 palsy [8,18–21,39]. This led to a homogenous dataset and the greatest potential for observing true differences in the rates of a C5 palsy. Furthermore, our inclusion and exclusion criteria were identical to those of our historical controls, and all procedures were performed at the same institution. A potential confounder is that a different single surgeon performed every procedure in each cohort. However, we believe that the consistent surgical technique and patient base between the historical control and treatment groups and the profound significance observed in the present study suggest that our findings are reliable.

Current strategies to prevent a C5 palsy currently rely on either continuous neurophysiological monitoring with continuous electromyography, transcranial electrical stimulation-induced intraoperative MEPs [40,41], or a prophylactic bilateral microforaminotomy [13,23]. However, the sensitivity and efficacy of the aforementioned techniques remain a subject of debate in the literature [6,13,42,43]. Newer studies that demonstrate the potential for therapeutic C5 palsy prevention have done so with either chilled irrigation, which is meant to reduce the risk of a thermal injury to the nerve roots [24], or a limited-width laminectomy to prevent the dorsal drift of the spinal cord [44]. All of the current C5 palsy prevention strategies take into account some form of nerve injury via traction, compression, thermal injury, or perioperative inflammation related to the trauma caused by surgery [28]. Similar to theories espoused by vascular and neurosurgery work [25,26,28,30,45,46], we hypothesized that iatrogenic trauma and inflammation may play a role in the development of a perioperative C5 palsy. In combination with the effectiveness of DEX at improving acute spinal cord and cranial nerve injuries in carotid endarterectomy, we hypothesized that administering DEX during a multilevel posterior laminectomy and fusion procedure will prevent postoperative C5 palsy.

There are several limitations to the present study, the most prominent of which is the lack of a true concurrent control. We minimized this bias by strictly adhering to the same inclusion criteria that were used in the previous study and by choosing the surgical approach most associated with a C5 palsy. Our definition of a C5 palsy was also the same between cohorts, circumventing any diagnostic differences. Our historical controls were from a time period before the institutional implementation of steroid prophylaxis, which we believe serves as an unbiased control. However, this made the direct comparison of complications between the two cohorts difficult. Further limitations include the retrospective nature of the present study, with the inherent bias thereof. Despite these limitations, we feel that these data may serve as the basis for future large multi-institutional validation studies for this novel preventative measure.

Conclusions

Perioperative prophylactic DEX therapy is a safe and effective way to decrease the incidence of C5 palsies in patients who undergo a multilevel posterior laminectomy and fusion for myeloradiculopathy or myelopathy. The efficacy of DEX highlights the potential role of perioperative inflammation, in addition to a direct injury as the potential pathogenesis of a C5 palsy. We therefore recommend that surgeons consider using DEX prophylaxis in isolation or in combination with current strategies to prevent a C5 palsy. We believe that the data represented in the present study can act as the basis for larger randomized trials.

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