



Effect of Single-Dose Preemptive Systemic Dexamethasone on Postoperative Dysphagia and Odynophagia Following Anterior Cervical Spine Surgery: A Double-Blinded, Prospective, Randomized Controlled Trial

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Background: The efficacy of preoperative dexamethasone in anterior cervical discectomy and fusion (ACDF) to reduce dysphagia and odynophagia remains controversial. This study evaluated the effect of a single dose of intravenous dexamethasone given as preemptive analgesia in the ACDF procedure.

Methods: A total of 64 patients aged 18 years or over were randomized into two groups. The experimental group received dexamethasone 10 mg intravenously before surgery for 60 minutes, and the control group received normal saline. One surgeon operated on all patients. The Bazaz score and visual analog scale (VAS) for odynophagia were measured at 0 hour, 24 hours, 48 hours, 72 hours, and 2 weeks postoperatively. Prevertebral soft-tissue swelling (PSTS) and the modified Japanese orthopedic association (mJOA) score were measured preoperatively and 2 weeks postoperatively.

Results: The Bazaz scores at 0, 24, 48, and 72 hours after operation were significantly lower in the dexamethasone group than in the placebo group ($p < 0.001$, $p < 0.001$, $p < 0.001$, and $p = 0.004$, respectively). The VAS scores of the dexamethasone group were significantly lower than those of the placebo group at 0, 24, 48, and 72 hours after surgery (all $p < 0.001$), but there was no significant reduction in the Bazaz score and VAS score at 2 weeks postoperatively. There was no difference in PSTS and mJOA preoperatively and 2 weeks postoperatively.

Conclusions: A single dose of intravenous dexamethasone used preoperatively in single-level and multilevel ACDF can significantly improve symptoms of dysphagia and odynophagia early on postoperatively.

Keywords: *Dexamethasone, Anterior cervical discectomy and fusion, Dysphagia, Odynophagia, Preemptive*

Anterior cervical discectomy and fusion (ACDF) is a very common surgical procedure for the treatment of cervical

spondylosis with myelopathy or radiculopathy. The most common complications observed postoperatively were dysphagia and odynophagia. Dysphagia could appear with or without odynophagia and/or respiratory complications after ACDF.

Generally, the Smith-Robinson approach is the technique used in ACDF. For the entire operation, the esophagus, trachea, and prevertebral tissue are retracted to the lateral side of the neck, which may consequently cause inflammation and edema of the surrounding tissues. Com-

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plications such as dysphagia, odynophagia, and airway obstruction can arise as a result of the surgical approach. However, postoperative dysphagia after ACDF could be from other causes, such as subcutaneous hematoma, prevertebral soft-tissue swelling (PSTS), muscular or mucosal injury, nerve injury, and mechanical compression caused by the implant.¹⁾

Many methods have been proposed to reduce postoperative dysphagia, such as preoperative tracheal and esophageal traction exercises, reduction of endotracheal tube cuff pressure, use of dynamic instead of static self-retracting retractors, use of low-profile implants, avoidance of prolonged surgical time, and use of corticosteroids.²⁾

Perioperative corticosteroids are known to be a safe and inexpensive pharmacological treatment. They have been shown to reduce pain and inflammation in a variety of surgical operations, including third molar extraction, laparoscopic procedures, and spine surgery in several studies. Corticosteroids inhibit the synthesis and release of pro-inflammatory and anti-inflammatory mediators, resulting in a strong anti-inflammatory response. Dexamethasone is a glucocorticoid that is synthesized. It is a powerful anti-inflammatory drug that can help with both acute and chronic pain. Dexamethasone suppresses the release of interleukins 1, 2, and 6, as well as the production of prostaglandins, and reduces impulse transmission in C-type fibers, among other things. With a half-life of 3 hours, it has a longer duration of action than other steroids.³⁾

The administration of corticosteroids to prevent dysphagia and odynophagia remains controversial. Many studies report the efficacy of intravenous corticosteroids in reducing dysphagia and odynophagia after ACDF. However, there is a lack of strong evidence in the literature supporting the efficacy, timing, and dosage of administration. A previous study by Jeyamohan et al.⁴⁾ has discovered that the effect of multiple doses of intravenous dexamethasone given intraoperatively and postoperatively can improve dysphagia. However, the results showed a significant effect on short-term fusion rates 6 months postoperatively after use of multiple doses of intravenous dexamethasone.

Preemptive analgesia has been proven to be effective in reducing postoperative pain in many surgical procedures.⁵⁻⁸⁾ The incidence of dysphagia is high in the immediate postoperative period, gradually dropping to 12%–14% approximately 1 year after surgery, and there are concerns about the effects of multiple doses of steroids on spinal fusion.⁹⁾ This study is the first study to evaluate the effect of a single dose of intravenous dexamethasone given as a preemptive analgesic in the ACDF procedure. In this study, we aimed to analyze the clinical results and radio-

graphic imaging following single-dose preoperative intravenous dexamethasone use to investigate whether it could reduce dysphagia and dysphonia, as well as prevertebral soft-tissue edema, in patients who underwent ACDF surgery.

METHODS

This study is a prospective, double-blinded, randomized controlled trial. The study is registered at the Thai Clinical Trials Registry (TCTR20210716004). Approval was obtained from the Human Research Ethics Committee of Thammasat University (No. MTU-EC-OT-1-075/60). This study was performed during April 2016 to December 2017 at Thammasat Hospital. For patients to be included in the study, they had to be over 18 years old and have ACDF at 1–3 levels. Patients who underwent revision surgery, used steroids regularly, presented with allergies or contraindications to steroid use, were pregnant, had uncontrolled diabetes mellitus, or had cognitive impairment were excluded.

After giving written informed consent, patients were randomly allocated to an experimental group or a control group. Randomization was performed with the use of a computer spreadsheet random number generator. From the random number list, the pharmacist assigned a code determining which patient would receive dexamethasone or a placebo. The investigational pharmacist (SN) was the only individual who was unblinded in this study. The experimental group received dexamethasone 2.5 mL (10 mg) mixed with normal saline up to 7.5 mL contained in a syringe. The placebo group received 10 mL of saline contained in a similar syringe as the experimental group. The medication was mixed by the investigational pharmacy and delivered to the operating room with blinded content to the anesthesiologist, surgeon, and patient. Each patient received information on how to evaluate the symptoms of odynophagia using the visual analog scale (VAS) and dysphagia using the Bazaz dysphagia questionnaire.¹⁰⁾ Lateral C-spine radiographs were obtained from the patients before the surgery. A modified Japanese orthopedic association (mJOA) score was then utilized to assess disease severity for cervical spondylotic myelopathy (CSM) patients. An anesthesiologist (SS) who was not involved in data collection infused the patients with dexamethasone or a placebo 60 minutes before the surgical incision. Intubation and general anesthesia administration were performed according to standard guidelines by a specialized anesthesiologist (CS) with a cuff pressure set at 10–20 cm H₂O.

The single orthopedic spine surgeon (KS) at Thammasat University Hospital performed ACDF surgery using

the standard left-side anterior Smith-Robinson approach. A transverse incision was used in all cases. The platysma was split by electrocauterization. The esophagus and trachea were gently retracted medially. The prevertebral fascia was incised at the midline. The longus colli muscle was retracted laterally to the unciniate process. During the procedures, assistants used Army-Navy retractors for surgical exposure while performing surgery. The retractor was released and replaced to decrease the amount of static retraction time. Caspar distractor pins were used in every case to insert a cancellous bone graft retrieved from the pelvic bone or polyetheretherketone cages to encourage fusion. The upper and lower end vertebrae were fixed with anterior cervical plates (Mercury Orthopesia, Bangkok, Thailand), which had 2.5 mm in thickness. A draining tube was then placed before closing the incision. All patients received 500 mg of paracetamol as needed every 4 hours and 0.1 mg/kg of morphine as needed every 4 hours.

The primary outcome was change in swallowing, which was assessed by the Bazaz dysphagia questionnaire for dysphagia and the VAS for odynophagia. These data were collected preoperatively and data collection was repeated once the patients were transferred to the ward and at 24 hours, 48 hours, 72 hours, and 2 weeks after the operation.

Secondary outcomes were measured with the PSTS index and modified JOA scores. The average value of PSTS ratio (soft tissue [S]/vertebrae [V]) of C3–C5 was measured from lateral C-spine radiographs (Fig. 1). Lateral C-spine radiographs were obtained immediately and 2 weeks after

the operation to evaluate PSTS. Three orthopedic surgery residents (PM, PK, and RR), who were uninformed of the patients' group, collected the data from the radiographs and interobserver reliability was assessed during the following process. The assessment of disease severity was done by the attending surgeon (NT) using a modified JOA score for CSM patients at 2 weeks postoperatively. Blood volume collected from the draining tube was recorded and removed when the patient bled less than 30 mL per day. Also, the side effects of the drugs administered were recorded.

Sample Size Calculation and Statistical Analysis

The sample size was calculated using the STATA program (power = 80% [beta], alpha = 0.05). The sample size was 29 in each group. When calculated with a 10% drop-out rate estimation, the total sample size was 32 patients for each group. Continuous data (age, body weight, height, duration of surgery, and amount of drain output) were analyzed using the unpaired Student *t*-test for normal distribution data and the Mann-Whitney *U*-test for non-normal distribution data. Differences between two groups of continuous data were analyzed by analysis of variance. Categorical data (sex, fusion level, and adverse events) were analyzed using the chi-square test and Fisher's exact test. Results were expressed as mean \pm standard deviation for normal distribution data and median (range) for non-normal distribution data. A *p*-value of < 0.05 was considered statistically significant.

RESULTS

There were 70 patients assessed for eligibility from March 2016 to December 2017. Six patients were excluded because 4 of them had undergone previous cervical surgery and the other 2 regularly used steroids. Sixty-four patients underwent randomization into two groups. There was no patient drop-out from this study. Therefore, a total of 32 patients were analyzed in each group (Fig. 2). Demographic and baseline characteristics were similar in the 2 trial groups, as shown in Table 1.

The operating time in the dexamethasone group was 87.28 ± 23.58 minutes and 81.32 ± 19.27 minutes in the placebo group, which displayed no significant difference ($p = 0.29$). In terms of blood loss, there was no significant difference between the two groups. The volume of blood collected from the drain on day 1, 2, and 3 postoperatively in the dexamethasone group was not significantly different from that in the placebo group (Table 2).

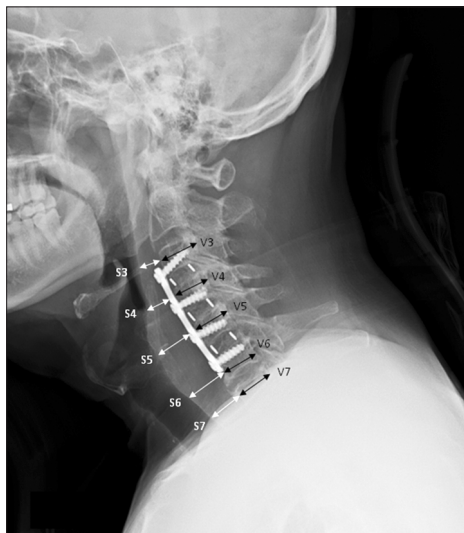


Fig. 1. Measurement of the prevertebral soft-tissue swelling ratio (soft tissue [S]/vertebrae [V]) on the 2 weeks postoperative radiograph.

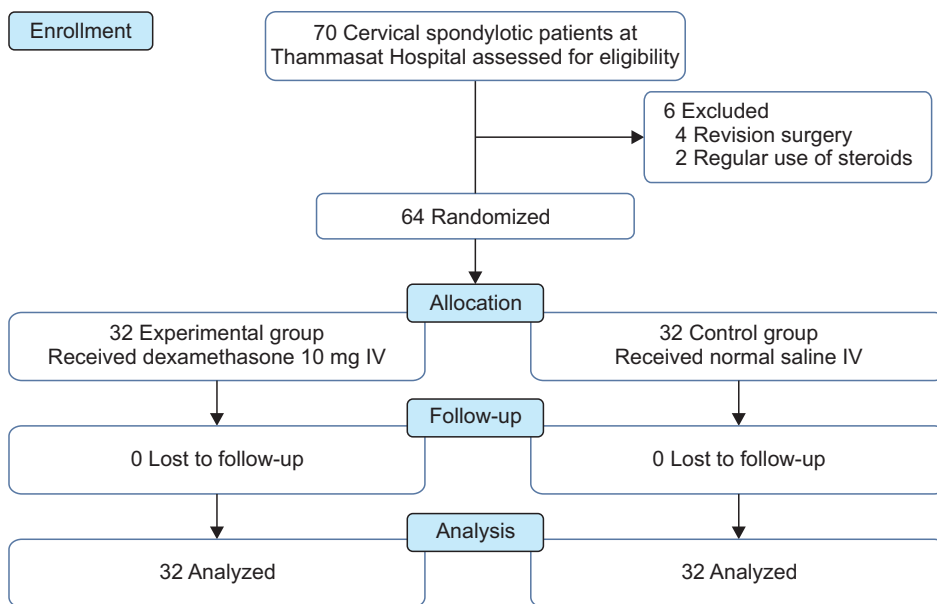


Fig. 2. Consolidated Standards of Reporting Trials (CONSORT) flow diagram. IV: intravenous.

Outcomes

VAS

The VAS score was utilized to assess the symptoms of odynophagia before the operation, at 0 hour, 24 hours, 48 hours, 72 hours, and 2 weeks after the operation. The results showed significant reduction of pain in the dexamethasone group at 0 hour, 24 hours, 48 hours, and 72 hours. In contrast, the VAS score recorded at 2 weeks postoperative was 0.16 ± 0.44 in the dexamethasone group and 0.41 ± 0.76 in the placebo group, demonstrating no significant difference ($p = 0.113$) (Table 3, Fig. 3).

Bazaz score

The severity of dysphagia was assessed using the Bazaz score before surgery and 0 hour, 24 hours, 48 hours, 72 hours, and 2 weeks after surgery. The Bazaz scores in the dexamethasone group evaluated at 0 hour, at 24 hours, 48 hours, and 72 hours after the operation were 1.19 ± 0.59 , 0.69 ± 0.53 , 0.25 ± 0.44 , and 0.41 ± 0.50 , respectively, which were significantly lower than those in the placebo group having scores of 1.88 ± 0.55 , 1.56 ± 0.56 , 0.63 ± 0.55 , and 1.16 ± 1.13 , respectively ($p \leq 0.001$, $p < 0.001$, $p < 0.001$, and $p = 0.004$, respectively). However, there was no significant reduction in the score measured at 2 weeks postoperatively: the dexamethasone group had a score of 0.16 ± 0.37 while the placebo group had a score of 0.13 ± 0.34 ($p = 0.724$) (Table 3, Fig. 4). The number of ACDF levels was associated with the Bazaz score at 0 hour, 24 hours, 48 hours, 72 hours, and 2 weeks after surgery. Single-level ACDF had a significantly lower Bazaz score than multi-level (≥ 2 level) ACDF. In terms of operative time, a higher

Bazaz score was significantly associated with a longer operative time. Furthermore, the PSTS index at immediate postoperative was correlated with the Bazaz score at 0 hour. Likewise, the PSTS index at 2 weeks postoperative was correlated with the Bazaz score at 2 weeks (Table 4).

PSTS

The PSTS index (C3–C5) evaluated before, immediately after, and 2 weeks after the surgery demonstrated no significant difference between the dexamethasone group with indices of 0.469 ± 0.090 , 0.815 ± 0.116 , and 0.656 ± 0.127 , respectively, and the placebo group with indices of 0.453 ± 0.078 , 0.788 ± 0.128 , and 0.677 ± 0.133 , respectively ($p = 0.452$, $p = 0.371$, and $p = 0.528$).

Modified JOA score

Estimation of disease severity in CSM patients using the modified JOA score presented no significant difference between the two groups not only preoperatively but also at 2 weeks postoperatively. The dexamethasone group and placebo group had scores of 13.47 ± 0.92 and 13.81 ± 0.93 , respectively ($p = 0.141$).

DISCUSSION

ACDF is a very common surgical procedure for the treatment of cervical spondylosis with myelopathy or radiculopathy. Existing literature shows postoperative dysphagia after anterior cervical spine surgery ranges from 1% to 79%.¹¹ There are many causes of postoperative dysphagia after anterior cervical spine surgery, such as postsurgical

Table 1. Demographic Data

| Variable | Dexamethasone (n = 32) | Placebo (n = 32) | p-value |
|-----------------------|------------------------|------------------|--------------------|
| Age (yr) | 63.47 ± 7.14 | 63.69 ± 7.28 | 0.90* |
| Sex | | | 0.434 [†] |
| Male | 22 (68.8) | 19 (59.4) | |
| Female | 10 (31.3) | 13 (40.6) | |
| Underlying disease | | | 0.176* |
| No underlying disease | 16 (50.0) | 11 (34.4) | |
| DM | 4 (12.5) | 0 | |
| HTN | 4 (12.5) | 8 (25.0) | |
| DLP | 0 | 2 (6.3) | |
| DM with HTN | 3 (9.4) | 5 (15.6) | |
| HTN with DLP | 3 (9.4) | 3 (9.4) | |
| DM, HTN, DLP | 2 (6.3) | 3 (9.4) | |
| Weight (kg) | 68.19 ± 10.63 | 69.31 ± 10.60 | 0.673 [†] |
| Height (cm) | 164.81 ± 8.61 | 168.53 ± 6.81 | 0.060 [†] |
| Body mass index | 25.15 ± 3.90 | 24.42 ± 3.72 | 0.451 [†] |
| Level of CSM | 1.94 ± 0.91 | 2.03 ± 0.90 | 0.680 [†] |
| Level of ACDF | | | 0.998 [†] |
| C3–C4 | 3 (9.4) | 2 (6.3) | |
| C4–C5 | 5 (15.6) | 4 (12.5) | |
| C5–C6 | 6 (18.8) | 6 (18.9) | |
| C3–C5 | 1 (3.1) | 2 (6.3) | |
| C4–C6 | 3 (9.4) | 3 (9.4) | |
| C5–C7 | 2 (6.3) | 2 (6.3) | |
| C3–C6 | 10 (31.3) | 11 (34.4) | |
| C4–C7 | 2 (6.3) | 2 (6.3) | |
| Preoperative score | | | |
| VAS (odynophagia) | 0 | 0 | 0 [†] |
| Bazaz score | 0 | 0 | 0 [†] |
| PSTS index (C3–C5) | 0.469 ± 0.090 | 0.453 ± 0.078 | 0.452 [†] |
| mJOA score | 12.06 ± 1.19 | 12.13 ± 1.04 | 0.823 [†] |

Values are presented as mean ± standard deviation or number (%).

DM: diabetes mellitus, HTN: hypertension, DLP: dyslipidemia, CSM: cervical spondylotic myelopathy, ACDF: anterior cervical discectomy and fusion, VAS: visual analog scale, PSTS: prevertebral soft-tissue swelling, mJOA: modified Japanese Orthopedic Association.

*Calculated with Pearson chi-square. [†]Calculated with independent samples *t*-test.

Table 2. Postoperative Evaluation

| Result | Dexamethasone (n = 32) | Placebo (n = 32) | p-value |
|----------------------|------------------------|------------------|-------------------|
| Operative time (min) | 87.28 ± 23.58 | 81.53 ± 19.27 | 0.29* |
| Blood loss (mL) | 18.75 ± 8.70 | 19.06 ± 8.18 | 0.88* |
| Drain (mL) | | | |
| Day 1 postoperative | 10.47 ± 4.08 | 14.06 ± 6.28 | 0.09 [†] |
| Day 2 postoperative | 6.56 ± 3.22 | 7.66 ± 3.59 | 0.20 [†] |
| Day 3 postoperative | 3.13 ± 2.46 | 2.34 ± 2.84 | 0.24 [†] |

Values are presented as mean ± standard deviation.

*Calculated with independent samples t-test. [†]Calculated with repeated analysis of variance.

Table 3. Outcomes

| Score | Dexamethasone (n = 32) | Placebo (n = 32) | p-value* |
|-------------------------|------------------------|------------------|----------|
| VAS (odynophagia) | | | |
| Preoperative | 0 | 0 | 0 |
| 0 hr postoperative | 4.28 ± 1.65 | 5.63 ± 1.45 | 0.001 |
| 24 hr postoperative | 2.16 ± 1.19 | 4.19 ± 1.44 | < 0.001 |
| 48 hr postoperative | 1.38 ± 1.10 | 3.00 ± 1.55 | < 0.001 |
| 72 hr postoperative | 0.63 ± 0.66 | 1.88 ± 0.83 | < 0.001 |
| 2 wk postoperative | 0.16 ± 0.44 | 0.41 ± 0.76 | 0.113 |
| Bazaz score | | | |
| Preoperative | 0 | 0 | 0 |
| 0 hr postoperative | 1.19 ± 0.59 | 1.88 ± 0.55 | < 0.001 |
| 24 hr postoperative | 0.69 ± 0.53 | 1.56 ± 0.56 | < 0.001 |
| 48 hr postoperative | 0.41 ± 0.50 | 1.16 ± 0.63 | < 0.001 |
| 72 hr postoperative | 0.25 ± 0.44 | 0.63 ± 0.55 | 0.004 |
| 2 wk postoperative | 0.16 ± 0.37 | 0.13 ± 0.34 | 0.724 |
| PSTS index (C3–C5) | | | |
| Preoperative | 0.47 ± 0.09 | 0.45 ± 0.08 | 0.452 |
| Immediate postoperative | 0.82 ± 0.12 | 0.79 ± 0.13 | 0.371 |
| 2 wk postoperative | 0.66 ± 0.13 | 0.68 ± 0.13 | 0.528 |
| mJOA score | | | |
| Preoperative | 12.06 ± 1.19 | 12.13 ± 1.04 | 0.823 |
| 2 wk postoperative | 13.47 ± 0.92 | 13.81 ± 0.93 | 0.141 |

Values are presented as mean ± standard deviation.

VAS: visual analog scale, PSTS: prevertebral soft-tissue swelling, mJOA: modified Japanese Orthopedic Association.

*Calculated with repeated analysis of variance.

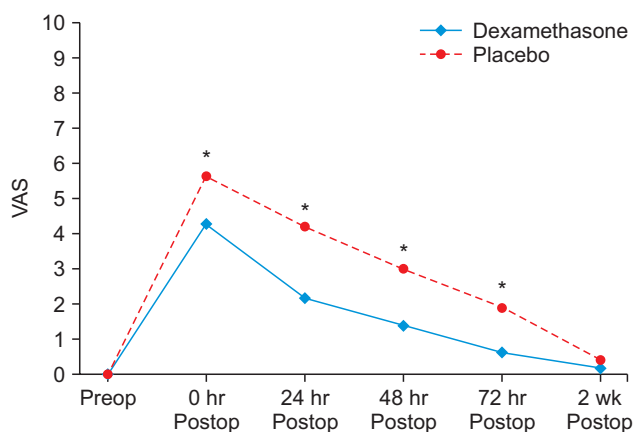


Fig. 3. Visual analog scale (VAS) graph used to assess symptoms of odynophagia. Preop: preoperative, Postop: postoperative. * $p < 0.05$.

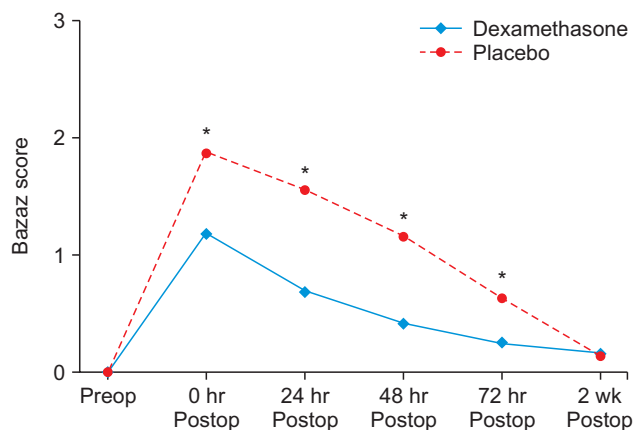


Fig. 4. Bazaz scores graph used to assess dysphagia. Preop: preoperative, Postop: postoperative. * $p < 0.05$.

edema. Edema following surgery is a natural physiological reaction to injury. The typical physiological response to tissue injury, regardless of the cause, is inflammation, which leads to edema. Because of its inhibitory effect on signal transduction through the interleukin-2 receptor, dexamethasone is widely utilized in many countries.¹² Preoperative dexamethasone has been shown to minimize postoperative edema and pain in a variety of operations, including oral and facial surgery.^{5,6} Similar to orthopedic surgery, studies on total joint arthroplasty and other spinal operations have found that preoperative dexamethasone had a beneficial effect.^{7,8} However, to our knowledge, there has been no article reporting the effect of single-dose preemptive dexamethasone focusing on dysphagia and odynophagia in anterior cervical spine surgery.

Our results demonstrated that preoperative intravenous dexamethasone 10 mg was better than the placebo for improving dysphagia and odynophagia in the first 72

Table 4. Bazaz Scores-Related Factors

| Bazaz score | Beta coefficient (95% CI) | p -value* |
|--------------------------------|---------------------------|-------------|
| ACDF single vs. multiple level | | |
| 0 hr postoperative | 0.66 (0.43–0.89) | < 0.001 |
| 24 hr postoperative | 0.67 (0.46–0.89) | < 0.001 |
| 48 hr postoperative | 0.43 (0.17–0.69) | 0.001 |
| 72 hr postoperative | 0.46 (0.24–0.67) | < 0.001 |
| 2 wk postoperative | 0.24 (0.08–0.40) | 0.004 |
| Operative time | | |
| 0 hr postoperative | 0.01 (0.01–0.02) | < 0.001 |
| 24 hr postoperative | 0.01 (0.01–0.02) | < 0.001 |
| 48 hr postoperative | 0.01 (0.01–0.02) | < 0.001 |
| 72 hr postoperative | 0.01 (0.01–0.02) | < 0.001 |
| 2 wk postoperative | 0.01 (0.00–0.01) | < 0.001 |
| PSTS index | | |
| 0 hr postoperative | 1.41 (0.31–2.50) | 0.012 |
| 2 wk postoperative | 0.89 (0.26–1.52) | 0.005 |

CI: confidence interval, ACDF: anterior cervical discectomy and fusion, PSTS: prevertebral soft-tissue swelling.

*Calculated with mixed model analysis, adjusts for treatment.

hours after ACDF. The findings of the present study are consistent with those of prior studies of pre-, intra-, and postoperative IV dexamethasone (Table 5).¹¹ When compared to the placebo group, Jeyamohan et al.⁴ found that the group receiving intraoperative intravenous dexamethasone (0.2 mg/kg) followed by 4 postoperative doses of 0.06 mg/kg, administered every hour for the first 24 hours, had significantly improved swallowing function and airway edema.^{12,13} In any case, the patients who received steroids had significantly lower fusion rates at 6 months (steroid vs. placebo: 60% vs. 37.8%, $p = 0.046$), but the long-term fusion rates at 12 months and 24 months (80% vs. 75%; $p = 0.53$ and 95.2% vs. 92.7%; $p = 0.57$, respectively) remained unaffected.⁴ In our study, we only gave a single dose of intravenous dexamethasone. It may have an effect on fusion rates, but we are less concerned about this. Lee et al.¹⁴ showed that applying a mixture of triamcinolone 40 mg and morcellized collagen sponge to the retropharyngeal space reduced PSTS and odynophagia following ACDF when compared to a procedure without a steroid. In contrast, our study used a systemic single dose of dexamethasone, which did not significantly reduce PSTS, but

Table 5. Summarized Data of Previously Published Studies and This Study

| Author | Type of study | Patient | Surgery | Retractor | Exclusion criteria | Steroids protocol | Clinical scales for dysphagia | Effect |
|--------------------------------|---|---------|--|---|--|--|--|--|
| Jeyamohan et al. ⁴⁾ | Prospective, randomized, double-blinded, controlled | 112 | Underwent multilevel (≥ 2 motion segments) anterior cervical spine surgery | Thompson-Farley static (self-retaining) | Age < 18 yr, pregnancy, chronic preoperative steroid use, coma or incapacitation, unable to provide consent, allergy to dexamethasone or related drugs | Intravenous dexamethasone or saline every 6 hr for the first 24 hr | FOSS follow-up was performed at 1, 3, 6, 12, and 24 mo | Significantly improved swallowing function and airway edema and shortened length of stay/delays fusion |
| Lee et al. ¹⁴⁾ | Prospective, randomized | 50 | ACDF involving 1 or 2 segments | No reference | ≥ 3 Segments, revision surgery, corpectomy, trauma, infection, tumor, metabolic diseases | Triamcinolone 40 mg and morcellized collagen sponge to retropharyngeal space | VAS for odynophagia 1, 2 day postoperative, and 2 wk postoperative | Positive for the reduction of odynophagia and PSTE |
| Pedram et al. ¹⁵⁾ | Prospective randomized | 236 | Anterior cervical surgery | Cloward retractors | No reference | Methylprednisolone at 0, 12, and 24 hr postoperative | Fiberoptic ENT examination preoperative and 24–36 hr postoperative | Positive impact in dysphagia |
| Song et al. ¹⁶⁾ | Prospective randomized | 40 | ≥ 3 Levels ACDF | No reference | Trauma or any other situation that could cause soft-tissue swelling, gastrointestinal problems, diabetes mellitus, history of received steroids | Methylprednisolone intravenously every 6 hr for the first 24 hr | Bazaz scale daily until discharge (about 5 days) | Short-term effective in relieving dysphagia and decreasing PSTE |
| Jenkins et al. ¹⁷⁾ | Prospective, randomized, single-blinded, controlled | 75 | 1–3 Levels ACDF | Self-retaining retractors | Trauma, infection, tumor, revision procedure, general metabolic disease | Intravenous 10 mg of dexamethasone at time of closure, or 40 mg triamcinolone placed in the retropharyngeal space | Bazaz scale. EAT-10, VHI-10, VAS for neck pain, NDI at day 1, 2 wk, 6 wk, 3 mo, 6 mo, 1 yr postoperative | Both local and IV steroid yielded better PROMs for dysphagia |
| Cui et al. ¹⁸⁾ | Prospective, randomized, double-blinded, controlled | 64 | Multilevel anterior cervical spine surgery | No reference | Trauma, infection, tumor, requiring combined anterior-posterior procedures | Dexamethasone 0.3 mg/kg prior to incision, 0.15 mg/kg at 8 and 16 hr postoperative | Bazaz score, DSQ at day 1, 2, 1 wk, 2 wk, 1 mo, 3 mo, 6 mo, 1 yr postoperative | Can reduce dysphagia immediately and up to 6 mo postoperative |
| Nam et al. ¹⁹⁾ | Prospective randomized | 62 | One-level ACDF for cervical radiculopathy | No reference | ≥ 2 -Level ACDF, myelopathic disease, cervical trauma, corpectomy, traffic accidents, and workers' compensation | Dexamethasone intravenously: 0, 24, and 48 hr postoperative group 1, 10/5/5 mg; group 2, 20/10/10 mg; group 3, normal saline | VAS for dysphagia and for dyspnea follow-up: daily for 5 days after the procedure | Not effective in reducing postoperative prevertebral soft-tissue density or VAS for dysphagia |
| This study | Prospective, randomized, double-blinded, controlled | 64 | 1–3 Levels ACDF | Army Navy retractor, Caspar distractor pins | Revision surgery, regular usage of steroids, allergic or contraindicated to steroid use, pregnancy, uncontrolled diabetes mellitus, cognitive impairment | Intravenous 10 mg of dexamethasone 1 hr preoperative | VAS for odynophagia Bazaz score for dysphagia at 0, 24, 48, 72 hr and 2 wk postoperative | Significantly improved odynophagia and dysphagia in first 72 hr postoperative |

FOSS: functional outcome swallowing scale, ACDF: anterior cervical discectomy and fusion, VAS: visual analog scale, PSTE: prevertebral soft-tissue edema, ENT: ear nose throat, EAT-10: Eating Assessment Tool, VHI-10: Voice Handicap Index, IV: intravenous, PROM: patient-reported outcome measure, DSQ: Dysphagia Short Questionnaire.

significantly reduced odynophagia and dysphagia. Pedram et al.¹⁵⁾ found that patients who received 1 mg/kg of methylprednisolone at 0 hour, 12 hours, and 24 hours postoperatively after anterior cervical spine surgery had significantly lower dysphagia and all other pharyngo-laryngeal complications compared to the control group. Similarly, Song et al.¹⁶⁾ performed multilevel (more than three levels) ACDF and gave 250 mg of methylprednisolone IV every 6 hours for the first 24 hours following surgery, which was beneficial in alleviating dysphagia and lowering PSTS. Tyler et al.¹⁷⁾ randomized patients undergoing ACDF into three groups: control (no steroid), IV steroid (single dose of 10 mg IV dexamethasone at the time of closure), or local steroid (40 mg of triamcinolone placed in the retropharyngeal space). When compared to the control group, both local and IV steroids dramatically reduced dysphagia symptoms. In a study by Cui et al.,¹⁸⁾ 33 patients undergoing multilevel anterior cervical spine surgery were given three doses of dexamethasone (0.3 mg/kg before incision and 0.15 mg/kg at 8 and 16 hours postoperatively) and reported less dysphagia than a group of 31 patients who received a placebo. Benefits were noticed right away and for up to 6 months after surgery. On subgroup analysis, patients with multilevel (≥ 2 level) fusion showed significantly lower Bazaz dysphagia and Dysphagia Short Questionnaire scales from dexamethasone, whereas there was no effect on single-level procedures. Many studies showed the risk factors associated with dysphagia following anterior cervical surgery, such as increased age (± 60 years), preoperative dysphagia, increased operative time, female sex, prominent implant and level of fusion,^{11,20,21)} which are comparable to our findings of the current study, in which dysphagia was related to multiple levels of ACDF and a longer operative time. However, these risk factors were well controlled equally between the two groups by the process of randomization. Postoperative measurement of PSTS from lateral C-spine radiographs resulted in no significant difference between the dexamethasone group and the placebo group. Kepler et al.²²⁾ showed no association between PSTS and the symptoms of dysphagia or odynophagia following ACDF surgery. In contrast, Kang et al.²³⁾ summarized that patients with dysphagia demonstrated higher differences in PSTS within 48 hours of surgery than those without dysphagia, but the differences were not significant. These findings agree with those of our study. Nam et al.¹⁹⁾ also reported giving multiple doses of dexamethasone after single-level ACDF was not effective in reducing postoperative prevertebral soft-tissue density, evaluated by using PSTS. However, multiple doses of dexamethasone led to a significant reduction in VAS score for dyspnea.

In this study, a single dose of IV dexamethasone as a preemptive analgesic was proven beneficial in improving odynophagia and dysphagia early postoperatively. Although dexamethasone has displayed its advantages towards the postoperative symptoms, its complications, including fusion rate, were not investigated in this study.

Our study has some limitations. First, this is a short-term result associated with postoperative dysphagia and odynophagia. However, these problems usually happen early postoperatively and spontaneously recover with time.⁹⁾ Difficulty of swallowing and pain threshold are different from patient to patient and the Bazaz dysphagia questionnaire and VAS are considered as subjective estimations. More accurate or multiple assessment tools might be better to evaluate patients' dysphagia and odynophagia. Although multilevel surgery is a documented risk factor for dysphagia, the incidence of dysphagia and odynophagia after single-level surgery is not zero.²⁴⁾ However, in our study, the distribution of multilevel procedures in both groups was not different.

According to this study, a single dose of IV dexamethasone used preoperatively in single-level and multilevel ACDF could significantly improve the symptoms of dysphagia and odynophagia early on postoperatively. While the effect of fusion rate was not introduced in the study, previous research exhibited no sequela following different fusion rates.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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