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The Spine Journal ■■ (2016) ■■–■■

THE SPINE JOURNAL

Review Article

Differences in the time of onset of postoperative upper limb palsy among surgical procedures: a meta-analysis

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Received 19 May 2016; revised 24 August 2016; accepted 12 September 2016

Abstract

BACKGROUND CONTEXT: The time of onset of postoperative upper limb palsy (ULP), also referred to as C5 palsy, varies among patients. Although some studies addressed the relationship between the time of onset of ULP and the potential etiologies, no meta-analysis has been conducted regarding the association between the time of onset of ULP and other factors such as surgical procedure type and treated diseases.

PURPOSE: This study aimed to elucidate differences in the time of onset of ULP among spinal surgical procedures and treated diseases to understand its etiology.

STUDY DESIGN: This is a meta-analysis.

OUTCOME MEASURES: The time of onset of ULP after cervical decompression surgery.

METHODS: We conducted a meta-analysis via searches of the PubMed, EMBASE, and Cochrane Library databases. Upper limb palsy within 2 days postoperatively or at 3 days or more postoperatively was defined as early- and late-onset, respectively. We calculated the pooled prevalence of early- and late-onset ULP with regard to surgical procedures and diseases using a random effects model. The proportion of early-onset ULP relative to all ULP was also determined. Surgical procedures were categorized into four procedures: (1) anterior cervical discectomy and fusion (ACDF); (2) anterior cervical corpectomy and fusion (ACCF); (3) laminoplasty or laminectomy (LPN); and (4) posterior spinal fusion with decompression (PSF). Treated diseases were classified as ossification of the posterior longitudinal ligament (OPLL) and non-OPLL.

RESULTS: The pooled prevalence of early-onset ULP was significantly stratified across three groups of surgical procedures (PSF [9.0%]>ACCF [3.7%] and LPN [2.5%]>ACDF [0.6%]). In the pooled analysis of late-onset ULP prevalence, three procedures (PSF [4.3%], ACCF [2.8%], and LPN [2.9%]) were similar, but ACDF (1.0%) was associated with a significantly lower prevalence than LPN. The prevalence of both early- and late-onset ULP was significantly higher with OPLL than without OPLL. However, the proportion of early-onset ULP relative to all ULP was similar between non-OPLL and OPLL (50.8% vs. 49.5%).

CONCLUSIONS: The high prevalence of early-onset ULP in PSF is attributable to a lag correction effect, which is triggered by posterior correction and fusion through comparison with LPN. The combination of our meta-analysis results and previous knowledge facilitates our understanding of the etiology of ULP.

Keywords: C5 palsy; Complication; Early-onset; Laminoplasty; Late-onset; Meta-analysis

FDA device/drug status: Not applicable.

Author disclosures: ***ST:*** Nothing to disclose. ***YN:*** Nothing to disclose. ***HA:*** Nothing to disclose. ***TK:*** Nothing to disclose. ***NH:*** Nothing to disclose.

There is a discrepancy between the affiliation where this study was conducted and the corresponding author's current affiliation. Dr. Takenaka was transferred from National Hospital Organization, Osaka Medical Center to Osaka University Graduate School of Medicine in April 2016.

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http://dx.doi.org/10.1016/j.spinee.2016.09.014
1529-9430/

Table 1
Full description of the search strings

Data base	
PubMed	((cervical spine OR cervical spine surgery) AND (surgery[MeSH Terms] OR operation[MeSH Terms] OR spinal decompression OR spinal fusion OR laminoplasty OR laminectomy)) AND (C5 palsy OR C5 palsies OR C-5 palsy OR C5 paresis OR upper limb palsy OR postoperative motor weakness OR upper extremity palsy OR segmental motor paralysis OR neurologic complication OR neurological complication OR spinal cord shift)
EMBASE	(cervical AND ("spine"/exp OR spine)) AND (surgery OR operation OR (spinal AND decompression) OR (spinal AND fusion) OR laminoplasty OR laminectomy) AND (c5 AND palsy OR (c5 AND palsies) OR ("c 5" AND palsy) OR (c5 AND paresis) OR (upper AND limb AND palsy) OR (postoperative AND motor AND weakness) OR (upper AND extremity AND palsy) OR (segmental AND motor AND paralysis) OR "neurologic complication" OR "neurological complication" OR (spinal AND cord AND shift))
The Cochrane Library	((cervical spine OR cervical spine surgery) AND (surgery OR operation OR spinal decompression OR spinal fusion OR laminoplasty OR laminectomy)) AND (C5 palsy OR C5 palsies OR C-5 palsy OR C5 paresis OR upper limb palsy OR postoperative motor weakness OR upper extremity palsy OR segmental motor paralysis OR neurologic complication OR neurological complication OR spinal cord shift)

Introduction

Cervical decompression surgery with or without fusion has been widely accepted for the treatment of myelopathy, regardless of an anterior or a posterior approach [1,2]. Among the various complications related to cervical decompression surgery, postoperative upper limb palsy (ULP), also termed C5 palsy, is one of the deleterious and frequent complications, which can result from these surgical procedures, although the prognosis is generally good. A recent meta-analysis determined an overall ULP prevalence of 5.3%, although this varied among cervical surgical procedures [3]. The study also reported a high prevalence of ULP among patients with ossification of the posterior longitudinal ligament (OPLL), compared with those without OPLL. However, the study did not investigate the differences in the time of onset of ULP among surgical procedures and between diseases.

Although most researchers would agree that the causes of ULP are multifactorial [3–8] and the time of onset ranges from immediately after surgery to several weeks, many studies have focused on a single etiology or surgical procedure and have attempted to understand how to prevent it [7,9–11]. These approaches have limitations for the apparently multifactorial etiology, and the association between the time of onset of ULP and other factors such as surgical procedures and treated diseases has not been consistently analyzed. As a consequence, the etiologies of ULP were not completely elucidated. In the present meta-analysis, we aimed to clarify differences in the time of onset of ULP among surgical procedures and between diseases to facilitate a comprehensive understanding of the multifactorial etiology of this condition.

Materials and methods

Search strategy

According to the Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines [12], we conducted a comprehensive search without language or publication date restrictions of PubMed, EMBASE, and the Cochrane Library databases up to October 2015. We used combinations of the following phrases to describe lesions (eg "cervical spine"), spinal interventions (eg "laminoplasty"), and so-called C5 palsy (eg "segmental motor paralysis"; Table 1).

Inclusion criteria

We applied the following inclusion criteria: (1) studies of cervical decompression surgery and (2) studies including information about the time of onset of ULP. We additionally applied the following exclusion criteria: (1) irrelevant subjects (eg animals); (2) irrelevant article types (eg reviews); (3) studies involving only foraminotomy, or combined anterior and posterior fusion; (4) unrelated topics (eg tumors); and (5) no or insufficient description of the time of onset of ULP or surgical procedures. If more than one study involving the same cohort from the same institution met our criteria, the study published most recently or with the largest population was chosen. After removing duplicate articles, two authors (ST and YN) independently screened the titles and abstracts. The authors then independently performed full-text reviews of the remaining studies to determine the final eligible studies. Kappa statistic was used to test the agreement between the authors who assessed the study's eligibility. Disagreement in the authors' decisions was resolved by a third reviewer (HA).

Data extraction

The following information was extracted from all eligible studies: first author, publication year, study type, sample size, average age, gender proportion, surgical procedure, disease, definition of ULP, accessed muscle, and time of onset of ULP. We defined ULP occurring within 2 days and ≥3 days postoperatively as early- and late-onset, respectively [13]. Upper limb palsy onset was defined as postoperative development of muscle weakness in the upper extremity. Preceding arm pain or numbness was not considered ULP onset. Some variations were included in previous descriptions of "C5 palsy," including segment motor paralysis [14], upper extremity palsy [9], and postoperative ULP [13]. We unified these terms under