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Lower cervical levels: Increased risk of early dysphonia following anterior cervical spine surgery

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ABSTRACT

Objectives: The present study aimed to re-evaluate the incidence of early dysphonia after anterior cervical spine surgery (ACSS) and to determine the related risk factors.
Clinical materials and methods: Patients underwent ACSS between January 2011 and December 2013 at two sites were identified retrospectively from hospital's patient databases. A total of 233 cases were included in this study. Dysphonia developed 1 month postoperatively was recorded. Follow-up was conducted in all positive-response patients. Those reporting severe or persistent voice symptoms were referred to otolaryngologists for further assessments and (or) treatments. Pre and intraoperative factors were collected to determine their relationships with dysphonia one month postoperatively.
Results: 45 patients developed dysphonia at one month, including 23 males and 22 females, yielding to an incidence of 19.3%. 34 cases resolved themselves in 3 months, leaving the remaining 11 patients considered to be severe or persistent cases. However, 10 of them recovered spontaneously in the next 9 months, while the last case received vocal cord medialization and returned to almost normal speech function at 18 months. In univariate analysis, only approaching level involving C6-C7 or (and) C7-T1 was significantly associated with postoperative dysphonia ($P < 0.001$). This association was not weakened in multiple logistic regression analysis (OR 2.348, 95% CI 1.467–3.659, $P < 0.001$).
Conclusion: The incidence of early dysphonia following ACSS was relatively high and approaching at lower cervical levels was an independent predictive factor.

1. Introduction

Since firstly introduced by Smith and Robinson by in 1960s [1], anterior cervical spine surgery (ACSS) has been widely used in addressing the majority of cervical spine pathologies. Although clinical result of this procedure is generally good, there are complications that can be problematic and sometimes may be catastrophic. Several adverse events have been documented, including dysphagia, dysphonia, hematoma, Dural penetration, infection, airway obstruction, esophageal perforation, Horner's syndrome, instrumentation displacement [2]. When performing this approach, surgeons need to separate neurovascular structures from visceral structures for exposing anterior cervical spine, which may irritate the vocal related structures and result in voice problems [3]. As was reported in literature, dysphonia was the most common complication following ACSS [4–7]. However, this complication has been inadequately discussed. The reported incidence is highly varied, from 1% to 51% [8–14]. Most researchers believed postoperative dysphonia tends to resolve with time and was of minor significance [15]. In fact, it was proposed that even beyond 5 years after the surgeries, a marked proportion of 18.9% patients might still suffer from voice problems [8].

Recognition of predictive factors for postoperative dysphonia may allow for optimization and, in some instances, modification of perioperative condition to minimize the occurrence rate. To the best of our knowledge, among the seldom studies focused on postoperative dysphonia, only two discussed about risk factors [16–18]. Unfortunately, their findings might not be commonly applicable. In their studies, head and neck surgeons were routinely involved in the surgeries, which was a rare situation in most other spine centers. Besides, they only discussed about intraoperative factors.

In the present study, we aimed to re-evaluate the prevalence rate of dysphonia following ACSS based on a case series upon a 3 years' period. Since most dysphonia happened in early postoper-

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ative time and resolved with time [9], one month postoperatively was taken as indexed time point. To have a good understanding about how postoperative dysphonia evolved, all positive-response patients were carefully followed up. Specifically, we sought to assess both pre- and intraoperative factors about whether they increased postoperative dysphonia.

2. Clinical materials and methods

This study protocol was in accordance with guidelines set by the Research Ethics Board of our institutions. Between January 2011 and December 2013, 348 consecutive patients underwent ACSS at two institutes (Department of Orthopedics, Jiangxi Province People's Hospital and Departments of Spine surgery, Nanyang Hospital, Southern Medical University) for a range of different cervical pathologies. The medical charts of those patients were retrospectively identified. 115 patients were excluded for uncompleted medical records, preoperative existing voice problems, or failure to follow-up. Thus, 233 patients were finally involved in this study, which was consisted of 144 males and 89 females. The median age of this study group was 55 years, ranging from 21 to 82 years.

Since there were patients who had undergone two or more operations to their cervical spines during the study period, their first operation was taken as the indexed one. All surgeries were performed using standard Smith-Robinson right approach by 5 experienced senior surgeons. Simply, following a satisfactory general anesthesia and endotracheal intubation, the anterior cervical spine surgery was started with a right-sided incision. Deep retractors were used to provide a nice exposure of the surgical site. Different procedures, including anterior cervical discectomy and fusion (ACDF), anterior cervical discectomy, corpectomy and fusion (ACCF), total disc replacement, focal debridement, and dynamic cervical instrumenting (DCI) were performed as were indicated by patients' presentations and preoperative evaluations. Allografts or iliac crest autografts were chosen via surgeons' preference. Anterior instruments were performed in selective patients using different kinds of plating system, including Reflex Hybrid, Codman, Slimlock, Atlantis Vision, Stella or Trinica.

Dysphonia happened 1 month postoperatively was evaluated via outpatient visits, telephone surveys or letter contacts. Complaints of dysphonia include hoarseness, a breathy voice, a decrease of voice strength or a problem with singing. Symptoms due to postoperative pain or weakness were excluded. We used a method for determining dysphonia introduced by Mehra et al. [16]. Simply, Complaints of voice problems were firstly determined by asking "Did you have any voice problem following the surgery". If one responsed "yes", further 4 questions were given to figure out further detailed information. "Did you have hoarseness?", "did you have issues with voice pitch(reach high notes)?", "did you have issues with voice loudness?" and "did you have vocal cord paresis or paralysis?". To get a good knowledge of how the voice problems evolved, close contacts were kept with all positive response patients. A severe or persistent case was defined when one reported his or her symptoms significantly affected daily life or persist longer than 3 months. All severe or persistent cases were referred to otolaryngologists for further assessments and (or) treatments.

To find out possible risk factors for dysphonia, a set of preoperative and intraoperative characters were analyzed. The preoperative characters included diagnosis, gender, age, comorbidity, symptom duration, smoking status. Intraoperative characters included type of procedures, levels for surgery, approaching segment(s), plating status, plate type, length of incision, duration of surgery, estimated blood loss, primary surgery or revision. The variable "approaching segment(s)" was categorized as C2-C3 or(and) C3-C4, C4-C5 or(and) C5-C6, C6-C7 or(and) C7-T1. If ones' approaching segments overlapped in this category, he or she was distributed to both subgroups.

Statistics analyses were performed using the Statistical Packages for Social Sciences v13.0 (SPSS, Chicago, IL). Firstly, binomial univariate analyses were conducted to find out the potential risk factors tend to cause postoperative dysphagia. For quantitative variables, differences were tested using *t*-test for symmetrically distributed variables and nonparametric Wilcoxon test for those that were not. For categorical variables, contingency tables were used to assess the association by Fisher's exact test. All variables investigated were included for multiple logistic regressions using Stepwise forward method. A $P < 0.05$ was accepted as significant.

3. Results

3.1. Incidence of postoperative dysphonia and how they evolved

45 patients were considered developing dysphonia one month postoperatively, including 23 males and 22 females. So the incidence of dysphonia following ACSS yield to 19.3% in this study. All positive-response patients were followed up, with a median time of 4 months (ranged from 3 to 14 months). 34 (75.6%) of them recovered spontaneously within 3 months and they didn't think the voice problems negate their daily lives too much. However, the remaining 11 patients were referred to otolaryngologists because they claimed that their voice problems affected them significantly or their symptoms persist more than 3 months. Selective otolaryngologic evaluations, including indirect laryngoscopy, flexible laryngoscopy or laryngeal electromyography (EMG), were chosen to determine their etiologies. Vocal fold dysfunction was found in nine patients, 7 with impaired vocal fold motion (paresis) and 2 with complete vocal fold paralysis. Laryngeal EMG demonstrated that all the 9 patients had recurrent laryngeal nerve (RLN) palsies. The symptoms of 10 patients resolved gradually in next 10 months except one case with complete vocal fold paralysis. He received vocal fold medialization procedure at month 13 and returned to almost normal vocal fold mobility 5 months later.

3.2. Risk factor analysis

One main purpose of this study was to valuate a comprehensive set of potential pre and intraoperative risk factors, including pathologies, gender, age, comorbidity, symptoms duration, smoking status, type of procedure, levels for surgery, approaching segment(s), plating status, plate type, length of incision, duration of surgery, estimated blood loss, primary surgery or revision. In univariate analysis, only approaching at lower level(s), involving C6-C7 or (and) C7-T1, was significantly associated with postoperative dysphonia ($P < 0.001$) (Table 1, Table 2). This association was not weakened in multiple logistic regression analysis (OR 2.348, 95% CI 1.467–3.659, $P < 0.001$). (Table 3)

4. Discussion

It is well accepted that dysphonia is a common complication following ACSS [19]. Nevertheless, the reported incidence of this complication varied largely in literature. At which time period this problem was documented seemed to be a predominant reason for this variation, since in most time postoperative dysphonia tended to be transient. According to a research conducted by Tervonen et al., the occurrence rate of dysphonia was 60% at immediately postoperative period and it dropped to 7% in 9 months [9]. Other possible causes included study design manners, study series setting and how a dysphonia was determined. A prospective manner, a complicated cases cohort and a subjective way for determining