

Factors predicting dysphagia after anterior cervical surgery

A multicenter retrospective study for 2 years of follow-up

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Abstract

A multicenter retrospective study.

The purpose of this study was to explore risk factors of dysphagia after anterior cervical surgery and factors affecting rehabilitation of dysphagia 2 years after surgery.

Patients who underwent anterior cervical surgery at 3 centers from January 2010 to January 2013 were included. The possible factors included 3 aspects: demographic variables—age, sex, body mass index (BMI): hypertension, diabetes, heart disease, smoking, alcohol use, diagnose (cervical spondylotic myelopathy or ossification of posterior longitudinal ligament), preoperative visual analogue scale (VAS), Oswestry Disability Index (ODI), Japanese Orthopaedic Association (JOA), surgical-related variables—surgical option (ACDF, ACCF, ACCDF, or Zero profile), operation time, blood loss, operative level, superior fusion segment, incision length, angle of C2 to C7, height of C2 to C7, cervical circumference, cervical circumference/height of C2 to C7.

The results of our study indicated that the rate of dysphagia at 0, 3, 6, 12, and 24 months after surgery was 20%, 5.4%, 2.4%, 1.1%, and 0.4%, respectively. Our results showed that age (58.8 years old), BMI (27.3 kg/m²), course of disease (11.6 months), operation time (103.2 min), blood loss (151.6 mL), incision length (9.1 cm), cervical circumference (46.8 cm), angle of C2 to C7 (15.3°), cervical circumference/height of C2 to C7 (4.8), preoperative VAS (7.5), and ODI (0.6) in dysphagia group were significantly higher than those (52.0, 24.6, 8.6, 88.2, 121.6, 8.6, 42.3, 12.6, 3.7, 5.6, and 0.4, respectively) in nondysphagia group; however, height of C2 to C7 (9.9 vs 11.7 cm) and preoperative JOA (8.3 vs 10.7) had opposite trend between 2 groups. We could also infer that female, smoking, diabetes, ossification of posterior longitudinal ligament, ACCDF, multilevel surgery, and superior fusion segment including C2 to C3 or C6 to C7 were the risk factors for dysphagia after surgery immediately. However, till 2 years after surgery, only 2 risk factors, smoking and diabetes, could slow rehabilitation of dysphagia.

Many factors could significantly increase rate of dysphagia after anterior cervical surgery. Operation time as a vital factor markedly increases immediate postoperative dysphagia and smoking, as the most important factor, lower recovery of dysphagia. Further study is needed to prove if these factors could influence dysphagia.

Abbreviations: ACDF = anterior cervical discectomy and fusion, ACCDF = anterior corpectomy combined with discectomy, ACCF = anterior cervical corpectomy and fusion, CSM = cervical spondylotic myelopathy, OPLL = ossification of posterior longitudinal ligament.

Keywords: anterior surgery, cervical, dysphagia, risk factors

Editor: Helen Gharaei.

Tao Wang, Lei Ma, Hui Wang, Da-Long Yang, Zhi-Long Bai, and Li-Jun Zhang equally contributed to this study.

Authors' contributions—DWY: conceived and designed the study; TW, HW, and DLY: collected data; TW, LQJ, and LJZ: analyzed the data; TW and LM: wrote the paper.

The authors have no funding and conflicts of interest to disclose.

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Medicine (2017) 96:34(e7916)

Received: 28 December 2016 / Received in final form: 1 August 2017 /

Accepted: 4 August 2017

<http://dx.doi.org/10.1097/MD.0000000000007916>

1. Introduction

Cervical spondylotic myelopathy (CSM) and ossification of posterior longitudinal ligament (OPLL) are common clinical degenerative diseases, seriously impacting quality of life and even causing disability for elderly population.^[1,2] Anterior approaches are widely applied in treatment for CSM and OPLL; however, it is difficult to avoid dysphagia.^[3,4] Some reported that the rate of dysphagia ranged from 2% to 60% according to different assessment.^[4–6] Bazaz^[7] reported a prospective study on the prevalence of dysphagia at 1, 2, 6, and 12 months in 249 patients who underwent anterior surgery and the incidence were 50.2%, 32.2%, 17.8%, and 12.5%, respectively.

Some authors focused on risk factors of dysphagia after anterior cervical approaches. Bazaz^[7] found that female patients, ≥60 years old and multiple surgeries, were risk factors for dysphagia. Olsson^[8] found that patients with smoking were more likely to suffer from dysphagia. Brad^[9] explored to compare cervical arthroplasty and anterior cervical discectomy and fusion (ACDF) with rate of dysphagia and their results showed that no-profile cervical disc arthroplasty could significantly lower rate of dysphagia compared with ACDF. But as we know, the risk

factors for dysphagia after anterior cervical approaches remain debated.

This is the first multicenter retrospective study on dysphagia after anterior cervical approaches. The purpose of our study is to assess risk factors of dysphagia after anterior cervical approaches and perioperative factors predicting on rehabilitation of dysphagia.

2. Materials and methods

2.1. Subjects

The study was approved by the Institutional Review Board of the Third Hospital of Hebei Medical University, the First Hospital of HanDan, and the First Hospital of Shijiazhuang before data collection and analysis. The inclusion criteria included subjects who received anterior cervical surgery, >18 years old. The exclusion criteria include patients with cervical fracture, having history of any cervical surgery, having spinal deformities (including scoliosis, irregular endplate, sacralization, or lumbarization), and having cervical trauma or tumors. A total of 2827 patients who received anterior cervical surgery were included in our study from the Third Hospital of Hebei Medice University, the First Hospital of HanDan, and the First Hospital of Shijiazhuang, from January 2013 to September 2015.

2.2. Variables

Dysphagia was assessed by Bazaz-Yoo dysphagia questionnaire.^[7] The patients were graded as having none, mild, moderate, or severe dysphagia based on a telephone evaluation. The patients who experienced no episodes of swallowing difficulty were graded as “none.” Patients who experienced only rare episodes of dysphagia were graded as “mild.” These patients did not feel that their dysphagia was a significant problem. Moderate dysphagia was defined as occasional swallowing difficulty with very specific foods. “Severe” dysphagia was defined as frequent difficult swallowing with the majority of foods. We considered moderate and severe dysphagia as dysphagia patients in our study. We assessed demographic variables—age, sex, body mass index (BMI): divided weight (kg) by the square of height (m), hypertension, diabetes, heart disease, smoking, alcohol use, diagnose (CSM or OPLL), preoperative visual analogue scale (VAS), Oswestry Disability Index (ODI), Japanese Orthopaedic Association (JOA), surgical-related variables—surgical option (ACDF, ACCF, ACCDF, or Zero profile), operation time, blood loss, operative level, superior fusion segment, incision length, angle of C2 to C7: the angle between upper endplate of C2 and lower endplate of C7, height of C2-C7: distance between vertebral posterior vertex of C2 and posterior vertex of C7, cervical circumference: the largest diameter of the neck, cervical circumference/height of C2 to C7.

2.3. Statistical analysis

The methods were carried out in accordance with the approved guidelines. Two authors identified and collected all the data of patients according to inclusion and exclusion criteria. In addition, 2 authors were responsible for data analyses. All measurement data are presented as the mean \pm SD when data satisfied criteria for normality with $P > .05$. Otherwise, it should be presented as median (interquartile range, IQR). Age, BMI, preoperative VAS, ODI and JOA, operation time, blood loss, incision length, angle

of C2 to C7, height of C2 to C7, cervical circumference, cervical circumference/height of C2 to C7, satisfied criteria for normality and homogeneity of variance, statistical analysis between groups were performed using independent samples *t* test. And count data, like sex, hypertension, diabetes, heart disease, smoking, alcohol use, diagnose (CSM or OPLL), surgical-related variables—surgical option (ACDF, ACCF, ACCDF or Zero profile), operative level, superior fusion segment χ^2 test were used for data analysis. The Kolmogorov–Smirnov test was used to verify the normal data distribution. Statistical significance levels were considered to be $P < .05$. All statistical analyses were carried out using SPSS, version 21.0 (SPSS Inc., Chicago, IL).

3. Results

The rate of dysphagia after anterior cervical surgery immediately was 20% (566 of 2827). Our results showed that age (58.8 ± 9.7 years old), BMI (27.3 ± 4.6 kg/m²), course of disease (11.6 ± 3.8 months), operation time (103.2 ± 26.5 min), blood loss (151.6 ± 23.1 mL), incision length (9.1 ± 1.2 cm), cervical circumference (46.8 ± 9.2 cm), angle of C2 to C7 ($15.3 \pm 3.0^\circ$), cervical circumference/height of C2 to C7 (4.8 ± 1.3), preoperative VAS (7.5 ± 1.7), and ODI (0.6 ± 0.1) in dysphagia group were significantly higher than those (52.0 ± 11.1 , 24.6 ± 3.2 , 8.6 ± 3.3 , 88.2 ± 21.7 , 121.6 ± 20.4 , 8.6 ± 1.0 , 42.3 ± 8.3 , 12.6 ± 2.6 , 3.7 ± 1.0 , 5.6 ± 1.1 , 0.4 ± 0.08 , respectively) in nondysphagia group; however, height of C2 to C7 (9.9 ± 1.6 cm) and preoperative JOA (10.7 ± 1.8 vs 8.3 ± 1.5) had opposite trend between 2 groups. We could also infer that old subjects, female patients, individual with smoking, diabetes, OPLL, ACCDF, multilevel surgery, and superior fusion segment including C2 to C3 or C6 to C7 were the risk factors for dysphagia after surgery immediately, as shown in Table 1.

The rate of dysphagia after anterior cervical surgery 3 months after surgery was 5.4% (143 of 2827). Our results showed that age (64.4 ± 9.4 years old), operation time (111.0 ± 29.2 min), blood loss (160.5 ± 25.3 mL), preoperative VAS (7.9 ± 1.9), and ODI (0.64 ± 0.1) in dysphagia group were significantly higher than those (56.7 ± 9.0 , 101.8 ± 24.5 , 149.4 ± 23.8 , 7.3 ± 1.6 , 0.60 ± 0.1 , respectively) in nondysphagia group; however, preoperative JOA (8.5 ± 1.6 vs 7.7 ± 1.3) had opposite trend between 2 groups. We could also infer that old subjects, individual with smoking, diabetes, OPLL, multilevel surgery, and superior fusion segment (C2–C3 or C6–C7) were the risk factors for dysphagia after surgery immediately, as shown in Table 2.

The rate of dysphagia after anterior cervical surgery (6 months after surgery) was 2.4% (68 of 2827). Our results showed that age (67.6 ± 8.8), operation time (119.8 ± 25.7), blood loss (167.2 ± 24.0), preoperative VAS (8.5 ± 1.7), and ODI (0.66 ± 0.09) in dysphagia group were significantly higher than those (61.8 ± 9.0 , 104.1 ± 30.0 , 155.2 ± 25.2 , 7.3 ± 1.8 , 0.61 ± 0.10 , respectively) in nondysphagia group; however, preoperative JOA (7.3 ± 1.2 vs 8.0 ± 1.3) had opposite trend between 2 groups. We could also infer that old subjects, individual with smoking, diabetes, and OPLL were the risk factors for dysphagia after 6 months of surgery, as shown in Table 3.

The rate of dysphagia after anterior cervical surgery (1 year after surgery) was 1.1% (30 of 2827). Our results showed that age (70.0 ± 8.3), operation time (127.2 ± 21.2), and blood loss (176.3 ± 23.1) in dysphagia group were significantly higher than those (65.7 ± 8.9 , 113.3 ± 27.4 , 159.7 ± 22.1 , respectively) in nondysphagia group. We could also infer that individual with smoking and diabetes were the risk factors for dysphagia 1 year

Table 1**Comparison between nondysphagia group and dysphagia group after surgery immediately.**

Factors	Nondysphagia (n=2261)	Dysphagia (n=566)	P
Age (y)	52.0±11.1	58.8±9.7	<.001
20–30	34	2	<.001
30–40	176	6	
40–50	892	89	
50–60	912	186	
60–70	169	228	
>70	78	55	
Sex (male/female)	1198/1063	246/320	<.001
BMI (kg/m ²)	24.6±3.2	27.3±4.6	<.001
Smoking (yes/no)	463 (20.5%)/1798 (79.5%)	175 (30.9%)/391 (69.1%)	<.001
Alcohol use (yes/no)	931 (41.2%)/1330 (58.8%)	238 (42.0%)/328 (58.0%)	.505
Heart disease (yes/no)	487 (21.5%)/1774 (78.5%)	123 (21.7%)/443 (78.3%)	.780
Hypertension (yes/no)	820 (36.6%)/1441 (63.4%)	199 (35.2%)/367 (64.8%)	.812
Diabetes (yes/no)	767 (33.9%)/1494 (66.1%)	281 (49.6%)/285 (50.4%)	<.001
Diagnose			<.001
CSM	1781	306	
OPLL	480	260	
Course of disease (mo)	8.6±3.3	11.6±3.8	<.001
Surgical option			<.001
ACDF	998	89	
ACCF	621	76	
ACCDF	362	390	
Zero profile	280	11	
Surgical level			<.001
1	961	63	
2	889	142	
3	411	361	
Superior fusion segment			<.001
C2–C3	39	180	
C3–C4	138	69	
C4–C5	835	66	
C5–C6	926	78	
C6–C7	323	173	
Operation time (min)	88.2±21.7	103.2±26.5	<.001
Blood loss (mL)	121.6±20.4	151.6±23.1	<.001
Incision length (cm)	8.6±1.0	9.1±1.2	<.001
C2–C7 (°)	12.6±2.6	15.3±3.0	<.001
Height of C2–C7 (cm)	11.7±1.9	9.9±1.6	<.001
Cervical circumference (cm)	42.3±8.3	46.8±9.2	<.001
Cervical circumference/height of C2–C7	3.7±1.0	4.8±1.3	<.001
Preoperative VAS	5.6±1.1	7.5±1.7	<.001
Preoperative ODI	0.4±0.08	0.6±0.1	<.001
Preoperative JOA	10.7±1.8	8.3±1.5	<.001

after surgery, as shown in Table 4. The rate of dysphagia after anterior cervical surgery (2 years after surgery) was 0.4% (12 of 2827). Our results showed that smoking and diabetes in dysphagia group were significantly higher than those in nondysphagia group 2 years after surgery, as shown in Table 5.

4. Discussion

Dysphagia is a terrible complication after anterior cervical surgery, which can interfere daily and social life, and lower the satisfaction on surgery and quality of life if it continues for an extended period. We reviewed some related literature and concluded some points that may be the etiology of dysphagia, including pressure and long time of excessive retraction during operation for esophageal retraction, esophageal ischemia, irritation and inflammation caused by the height or the anterior profile of instrumentation. And other factors, like differences in the postoperative cervical kyphotic/clordotic deformity and soft

tissue edema and fibrosis due to postoperative granulation and fibrosis, also affect dysphagia after surgery.^[6–10] Postoperative dysphagia is caused by multiple factors, but the risk factors of it remain controversy.

Previous studies focused on single-center retrospective study, short follow-up, or small sample size. To our knowledge, this was the first multicenter retrospective study with large sample on this topic. The aim of our study was to explore risk factors of dysphagia after anterior cervical approaches and perioperative factors predicting on rehabilitation of dysphagia. The results of our study indicated that the rate of dysphagia at 0, 3, 6, 12, and 24 months after surgery were 20%, 5.4%, 2.4%, 1.1%, and 0.4%, respectively. Old subjects, female patients, patients with relatively higher BMI, smoking, diabetes, OPLL, longer course of disease, ACCDF, multilevel surgery, more operation time, more blood loss, longer incision length, more cervical circumference, larger angle of C2 to C7, higher preoperative VAS and ODI, lower JOA, shorter height of C2 to C7, and superior fusion

Table 2**Comparison between nondysphagia group and dysphagia group 3 months after surgery.**

Factors	Nondysphagia (n=413)	Dysphagia (n=153)	P
Age (y)	56.7±9.0	64.4±9.4	<.001
20–30	2	0	<.001
30–40	5	1	
40–50	77	12	
50–60	163	23	
60–70	153	75	
>70	13	42	
Sex (male/female)	237/329	67/86	.670
BMI (kg/m ²)	27.4±4.8	26.9±4.5	.235
Smoking (yes/no)	87 (21.1%)/324 (78.9%)	88 (57.5%)/65 (42.5%)	<.001
Alcohol use (yes/no)	177 (42.9%)/236 (57.1%)	61 (40.0%)/92 (60.0%)	.522
Heart disease (yes/no)	91 (22.0%)/312 (78.0%)	32 (20.9%)/121 (79.1%)	.673
Hypertension (yes/no)	143 (34.6%)/270 (65.4%)	56 (36.6%)/97 (63.4%)	.662
Diabetes (yes/no)	194 (47%)/219 (53%)	87 (56.9%)/66 (43.1%)	.037
Diagnose			.042
CSM	234	72	
OPLL	179	81	
Course of disease (mo)	11.5±4.0	11.6±3.5	.928
Surgical Option			.304
ACDF	66	23	
ACCF	62	18	
ACCDF	279	112	
Zero profile	6	0	
Surgical level			.044
1	53	10	
2	101	32	
3	259	111	
Superior fusion segment			<.001
C2–C3	117	63	
C3–C4	59	10	
C4–C5	57	9	
C5–C6	65	13	
C6–C7	115	58	
Operation time (min)	101.8±24.5	111.0±29.2	<.001
Blood loss (mL)	149.4±23.8	160.5±25.3	<.001
Incision length (cm)	9.1±1.2	9.4±1.4	.130
C2–C7 (°)	15.2±3.0	15.4±3.4	.450
Height of C2–C7 (cm)	9.9±1.6	10.1±1.7	.350
Cervical circumference (cm)	46.3±9.5	47.4±9.5	.245
Cervical circumference/height of C2–C7	4.8±1.3	4.8±1.2	.827
Preoperative VAS	7.3±1.6	7.9±1.9	<.001
Preoperative ODI	0.60±0.1	0.64±0.1	<.001
Preoperative JOA	8.5±1.6	7.7±1.3	<.001

segment including C2 to C3 or C6 to C7 were the risk factors for dysphagia after surgery immediately. However, 1 year after surgery, old people, more operation time and blood loss, and individual with smoking and diabetes were the risk factors. And 2 years after surgery smoking and diabetes were only 2 risk factors for rehabilitation of dysphagia.

As for immediate postoperative dysphagia, blood loss, incision length, course of disease, patients with OPLL, ACCDF and multilevel surgery, preoperative VAS and ODI, JOA, BMI, and cervical circumference were risk factors. We considered operation time as the most one. Higher preoperative VAS and ODI, lower JOA, longer course of disease implied that state of an illness was relatively serious, which was easy to understand that we need more time to decompress and restore alignment. Similarly, for patients with higher BMI, more cervical circumference, more time to be need to thoroughly expose and peel soft tissue clearly. It is well known that patients with

OPLL, ACCDF, superior fusion segment including C2 to C3 or C6 to C7 and multilevel surgery, which increase difficulty of surgery, we need more time to complete it perfectly. More operation time means excessive retraction, excessive duration and length of time of esophageal retraction, more serious esophageal ischemia, and easier to irritate soft tissue.^[10] More angle of C2 to C7 implied that anterior plates and instrumentation were more likely to irritate and surrounding soft tissue leading to inflammatory reaction. As the same with Bazaz,^[7] old patients and female patients were the risk factors for postoperative dysphagia.

Brad^[9] compared cervical arthroplasty and ACDF for dysphagia and found that no-profile cervical disc arthroplasty had a significantly lower rate of dysphagia. McAfee^[10] performed a prospective randomized on the same topic and draw the same conclusion. Xiao^[11] found that Zero profile could reduce the incidence of postoperative dysphagia compared with ACDF. We

Table 3**Comparison between nondysphagia group and dysphagia group 6 months after surgery.**

Factors	Nondysphagia (n = 85)	Dysphagia (n = 68)	P
Age (y)	61.8±9.0	67.6±8.8	<.001
20–30	0	0	.042
30–40	1	0	
40–50	8	4	
50–60	14	9	
60–70	47	28	
>70	15	27	
Sex (male/female)	38/47	29/39	.799
BMI (kg/m ²)	26.9±4.6	26.8±4.4	.932
Smoking (yes/no)	42 (49.4%)/43 (50.6%)	46 (67.6%)/22 (32.4%)	.023
Alcohol use (yes/no)	35 (41.2%)/50 (58.8%)	26 (38.2%)/42 (61.8%)	.712
Heart disease (yes/no)	17 (20.0%)/68 (80.0%)	15 (22.1%)/53 (77.9%)	.756
Hypertension (yes/no)	33 (38.8%)/52 (61.2%)	23 (33.8%)/45 (66.2%)	.523
Diabetes (yes/no)	42 (49.4%)/43 (50.6%)	45 (66.2%)/23 (33.8%)	.037
Diagnose			.023
CSM	47	25	
OPLL	38	43	
Course of disease (mo)	11.3±3.7	12.0±3.2	.175
Surgical option			.880
ACDF	13	10	
ACCF	9	9	
ACCDF	63	49	
Zero profile	0	0	
Surgical level			.389
1	7	3	
2	15	17	
3	63	48	
Superior fusion segment			.470
C2–C3	39	24	
C3–C4	4	6	
C4–C5	5	4	
C5–C6	5	8	
C6–C7	32	26	
Operation time (min)	104.1±30.0	119.8±25.7	.001
Blood loss (mL)	155.2±25.2	167.2±24.0	.003
Incision length (cm)	9.4±1.3	9.1±1.5	.143
C2–C7 (°)	15.6±3.3	15.2±3.5	.417
Height of C2–C7 (cm)	10.0±1.6	10.2±1.7	.358
Cervical circumference (cm)	46.6±9.2	48.3±9.9	.269
Cervical circumference/height of C2–C7	4.8±1.3	4.8±1.2	.916
Preoperative VAS	7.3±1.8	8.5±1.7	<.001
Preoperative ODI	0.61±0.10	0.66±0.09	.001
Preoperative JOA	8.0±1.3	7.3±1.2	.001

also observed 4 anterior surgical plans, including ACDF, ACCF, ACCDF, and Zero profile. Only 5 of 285 (1.7%) patients receiving Zero profile had postoperative dysphagia, which had markedly lower incidence of dysphagia than other options. Patients with ACCDF had the highest rate (51.7%, 387 of 749). We used to choose ACCDF for these patients with multilevel CSM, indicating that we spend more operation time accomplishing it. Excessive retraction and serious esophageal ischemia caused postoperative dysphagia, which also needed more time to recover. Besides, we found that patients with superior fusion segment including C2 to C3 or C6 to C7 had a higher rate than other segments, which was opposite to Samuel Kalb.^[12] We believed that compared with superior fusion segment including C3 to C4, C4 to C5, or C5 to C6, more retraction was needed to complete exposure for surgical vision in patients with superior fusion segment including C2 to C3 or C6 to C7.

Few articles considered smoking as an important factor for dysphagia after anterior cervical surgery. Olsson^[8] compared smokers with nonsmokers in dysphagia and showed that smokers were more likely to have dysphagia, and their dysphagia scores were more severe than those in nonsmokers. We surprisingly found that patients with smoking were always the risk factor for dysphagia at 0, 3, 6, 12, and 24 months. In addition, the rate of dysphagia in patients with smoking immediately after surgery was 27.4% (175 of 566), but the rate kept approximately 50% from 3 to 24 months. What is more, the proportion of smoking in patients with dysphagia was increasing from 0 (30.9%, 175 of 566) to 24 months (100%, 12 of 12). As mentioned earlier, the smoking was a vital risk factor for dysphagia and recovery for dysphagia. Our results is consistent with Olsson's.^[8]

The present study has several limitations. First, it is a retrospective study; we need to conduct a prospective study to further explore the risk factors for dysphagia after anterior

Table 4**Comparison between nondysphagia group and dysphagia group 1 year after surgery.**

Factors	Nondysphagia (n=38)	Dysphagia (n=30)	P
Age (y)	65.7±8.9	70.0±8.3	.045
20–30	0	0	.852
30–40	0	0	
40–50	3	1	
50–60	5	4	
60–70	16	12	
>70	14	13	
Sex (male/female)	17/21	12/18	.695
BMI (kg/m ²)	26.5±4.4	27.2±4.4	.517
Smoking (yes/no)	21 (55.3%)/17 (44.7%)	25 (83.3%)/5 (16.7%)	.014
Alcohol use (yes/no)	16 (42.1%)/22 (57.9%)	10 (33.3%)/20 (66.7%)	.460
Heart disease (yes/no)	8 (21.1%)/30 (78.9%)	7 (23.3%)/23 (76.7%)	.822
Hypertension (yes/no)	12 (31.6%)/26 (68.4%)	11 (36.7%)/19 (63.3%)	.660
Diabetes (yes/no)	21 (55.3%)/17 (44.7%)	24 (80%)/6 (20%)	.032
Diagnose			.304
CSM	16	9	
OPLL	22	21	
Course of disease (mo)	12.2±3.7	11.8±2.5	.666
Surgical option			.722
ACDF	6	4	
ACCF	6	3	
ACCDF	26	23	
Zero profile	0	0	
Surgical level			.903
1	2	1	
2	9	8	
3	27	21	
Superior fusion segment			.454
C2–C3	15	9	
C3–C4	2	4	
C4–C5	1	3	
C5–C6	4	4	
C6–C7	16	10	
Operation time (min)	113.3±27.4	127.2±21.2	.018
Blood loss (mL)	159.7±22.1	176.3±23.1	.003
Incision length (cm)	9.2±1.6	8.9±1.4	.319
C2–C7 (°)	15.3±4.0	15.1±2.9	.824
Height of C2–C7 (cm)	10.0±1.7	10.5±1.8	.177
Cervical circumference (cm)	48.4±10.1	48.2±9.8	.943
Cervical circumference/height of C2–C7	5.0±1.3	4.6±1.0	.251
Preoperative VAS	8.5±1.7	8.5±1.7	.894
Preoperative ODI	0.68±0.09	0.65±0.08	.161
Preoperative JOA	7.3±1.3	7.4±1.1	.866

Table 5**Comparison between nondysphagia group and dysphagia group 2 years after surgery.**

Factors	Nondysphagia (n=18)	Dysphagia (n=12)	P
Age (y)	69.3±8.8	71.1±7.5	.567
20–30	0	0	.738
30–40	0	0	
40–50	1	0	
50–60	2	2	
60–70	8	4	
>70	7	6	
Sex (male/female)	9/9	3/9	.171
BMI (kg/m ²)	27.0±4.6	27.7±4.3	.881
Smoking (yes/no)	13 (72.2%)/5 (17.8%)	12 (100%)/0 (0%)	.046
Alcohol use (yes/no)	7 (38.9%)/11 (61.1%)	3 (25%)/9 (75%)	.481
Heart disease (yes/no)	5 (27.8%)/13 (72.2%)	2 (16.7%)/10 (83.3%)	.279
Hypertension (Yes/No)	8 (44.4%)/10 (55.6%)	3 (25%)/9 (75%)	.745
Diabetes (Yes/No)	12 (66.7%)/6 (33.3%)	12 (100%)/0 (0%)	.025
Diagnose			
CSM	5	4	
OPLL	13	8	
Course of disease (mo)	11.7±2.7	12.1±2.2	.695
Surgical option			.761
ACDF	3	1	
ACCF	2	1	
ACCDF	13	10	
Zero profile	0	0	
Surgical level			.684
1	1	0	
2	5	3	
3	12	9	
Superior fusion segment			.552
C2–C3	5	4	
C3–C4	2	2	
C4–C5	3	0	
C5–C6	3	1	
C6–C7	5	5	
Operation time (min)	128.0±22.0	±20.9	.998
Blood loss (mL)	182.1±25.2	±17.5	.122
Incision length (cm)	8.5±1.5	9.4±1.1	.117
C2–C7 (°)	15.4±3.1	14.5±2.8	.406
Height of C2–C7 (cm)	10.6±2.2	10.4±1.3	.818
Cervical circumference (cm)	49.5±8.9	46.3±11.0	.385
Cervical circumference/height of C2–C7	4.7±1.0	4.5±1.1	.690
Preoperative VAS	8.4±1.7	8.6±1.6	.894
Preoperative ODI	0.65±0.09	0.64±0.07	.161
Preoperative JOA	7.4±1.3	7.3±0.7	.866

cervical surgery; second, some factors could not be observed due to retrospective study, for example, whether VAS, ODI, and JOA at time of 3, 6, 12, and 24 months after surgery could increase risk of SSI or not; whether reducing retraction properly during operation could lower risk of dysphagia or not, and so on. However, even though it has these limitations, it is valuable for surgeons to notice some variables leading to dysphagia before surgery.

We performed a multicenter retrospective study with large sample on dysphagia after anterior cervical surgery for 2 years of follow-up. The rate at 0, 3, 6, 12, and 24 months after surgery was 20%, 5.4%, 2.4%, 1.1%, and 0.4%, respectively. Many factors could increase risk of dysphagia after anterior cervical surgery, but we regarded operation time as the most important factor for immediate postoperative dysphagia and smoking as the most important factor for recovery of dysphagia. A prospective study is needed to assess factors for dysphagia after anterior cervical surgery.

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