



Clinical Study

Postoperative dysphagia correlates with increased morbidity, mortality, and costs in anterior cervical fusion



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ABSTRACT

Anterior cervical fusion (ACF) after discectomy and/or corpectomy is a common procedure with traditionally good patient outcomes. Though typically mild, postoperative dysphagia can result in significant patient morbidity. In this study, we examine the relationship between postoperative dysphagia and in-hospital outcomes, readmissions, and overall costs. The University HealthSystem Consortium (UHC) database was utilized to perform a retrospective cohort study of all adults who underwent a principal procedure of ACF of the anterior column (International Classification of Diseases, Ninth Revision [ICD-9] procedure code 81.02) between 2013 and 2015. Patients with a diagnosis of dysphagia (ICD-9 78720-78729) were compared to those without. Patient demographics, length of stay, in-hospital mortality, 30-day readmissions, and direct costs were recorded. A total of 49,300 patients who underwent ACF were identified. Mean age was 54.5 years and 50.2% were male. Dysphagia was documented in 3,137 patients (6.4%) during their hospital stay. Patients with dysphagia had an average 2.1 comorbidities, while patients without dysphagia had 1.5 ($p < 0.01$). Mean length of stay was 6.38 days in patients with dysphagia, and 2.13 days in those without ($p < 0.01$). In-hospital mortality was 0.10% in patients without dysphagia, and 0.61% in those with dysphagia ($p < 0.01$). Direct costs were \$13,099 in patients without dysphagia, and \$21,245 in those with dysphagia ($p < 0.01$). Thirty-day readmission rate was 2.9% in patients without dysphagia, and 5.3% in those with dysphagia ($p = 0.01$). In summary, dysphagia in patients who undergo ACF correlates with significantly increased length of stay, 30-day readmissions, and in-hospital mortality. Direct costs are similarly increased as a result.

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1. Introduction

Anterior cervical fusion (ACF) is a common neurosurgical procedure that includes anterior cervical discectomy and fusion, and anterior cervical corpectomy and fusion. ACF is generally well-tolerated with excellent clinical outcomes [1–3]. Furthermore, it has been shown to be cost-effective for treatment of cervical spondylotic myelopathy [4–6]. However, oropharyngeal dysphagia is one of the most common complications after ACF [7–9]. Reported incidences of postoperative dysphagia after ACF in the literature vary significantly, with some reports as high as 50.3% [10–13]. Occurrence of dysphagia is problematic, as it can result in prolonged hospitalization, need for further procedures, and increased costs. This study examines the impact of dysphagia on in-hospital

outcomes, 30-day readmissions, and direct costs after ACF using the University HealthSystem Consortium (UHC) database.

2. Methods

The UHC database was utilized to perform a retrospective cohort study of all adults with cervical degenerative disc disease who underwent a principal procedure of ACF of the anterior column (International Classification of Diseases, Ninth Revision [ICD-9] procedure code 81.02) between 2013 and 2015. Cervical degenerative disc disease was identified using ICD-9 diagnosis codes 721.0, 721.1, 722.0, 722.4, 722.6, 722.71, 722.81, 722.91, 723.0, 723.1, 723.2, 723.3, 723.4, 723.7, 723.9, 738.4, 738.5, or 756.12. Patients with a posterior cervical fusion (ICD-9 procedure code 81.03) were excluded, as were patients with a diagnosis of dysphagia (ICD-9 78720-78729) prior to admission.

The UHC is a collaborative database of 117 academic medical centers that provides clinical, financial, and administrative data.

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Costs were calculated by UHC using line item charges grouped by revenue code, and then multiplied by the ratio of cost-to-charge (calculated from the Medicare Cost Report). Costs are then adjusted for wage index and labor factors to obtain the observed direct cost in US dollars (<http://www.uhc.edu>).

Patients with a diagnosis of dysphagia (ICD-9 78720-78729) following ACF were compared to those without. Patient demographics, length of stay, in-hospital mortality, all-cause 30-day readmissions, and direct costs were recorded. Patients who underwent 1- or 2-level fusions were identified using ICD-9 procedure code 81.62 (fusion or re-fusion of 2–3 vertebrae). Similarly, patients who underwent 3 or more levels of fusion were identified using ICD-9 procedure code 81.63 (fusion or re-fusion of 4–8 vertebrae). A subgroup analysis comparing length of stay, in-hospital mortality, all-cause 30-day readmissions, and direct costs between 1- to 2-level fusions and 3 or more level fusions was also performed.

Principal diagnosis at readmission was recorded. Readmission diagnoses were classified as surgical-site infection, other infection, hematoma/seroma, pain, fracture/deformity, neurologic, hardware-related, medical complication, or pulmonary embolism/deep venous thrombosis. Readmission diagnoses related to dysphagia were also recorded. This was defined as a diagnosis on readmission of dysphagia, foreign body in larynx, upper respiratory infection, pneumonia, aspiration pneumonia, pneumonitis, esophageal complication, or gastrostomy complication.

Comorbidities were also evaluated, comparing patients with and without dysphagia after ACF. The UHC database utilized the Agency for Healthcare Research and Quality 29-Comorbidity Index [14]. Each of the 29 comorbidities was based on a set of ICD-9 codes.

2.1. Statistical analysis

Statistical analysis was performed utilizing IBM SPSS Statistics 23.0 software (IBM, Armonk, NY, USA). Two-tailed *t*-tests were used to evaluate statistically significant differences in mean numerical values for hospital length of stay and direct costs between dysphagia and non-dysphagia populations. Proportions of levels fused, in-hospital mortality, comorbidities, and reasons for readmission were analyzed for statistically significant differences in dysphagia and non-dysphagia populations utilizing 2-tailed *z*-tests. A statistical significance level of $p < 0.05$ was set for this analysis.

3. Results

A total of 49,300 patients who underwent ACF were identified. Mean age was 54.5 years and 50.2% were male. During admission for ACF, 3,137 patients (6.4%) had documented dysphagia. Length of stay was 6.38 ± 10.47 (mean \pm SD) days in patients with dysphagia, and 2.13 ± 3.11 days in those without ($p < 0.01$). Direct costs were $\$13,099 \pm \$7,963$ in patients without dysphagia, and $\$21,245 \pm \$18,399$ in those with dysphagia ($p < 0.01$). There were 47 (0.10%) deaths in patients without dysphagia, and 19 (0.61%) deaths in patients with dysphagia ($p < 0.01$) (Table 1).

Subgroup analysis revealed that of 41,672 patients with 1- to 2-level fusions, 2,373 (5.7%) had dysphagia. Patients with dysphagia had an average 4.11 more days in the hospital ($p < 0.01$). Mortality, cost, and readmission rates were significantly higher in the dysphagia group (Table 2). In 7,368 patients with 3- or more level fusions, 761 (10.3%) had dysphagia. Patients with dysphagia had an average 4.55 more days in the hospital ($p < 0.01$). Mortality, cost, and readmission rate were again significantly higher in the dysphagia group (Table 3).

Table 1
Analysis of dysphagia following anterior cervical fusion (N = 49,300)

	Dysphagia	No Dysphagia	<i>p</i> value
Cases (%)	3,137 (6.4)	46,163 (93.6)	NA
1- to 2-level fusion (%)	2,373 (5.7)	39,299 (94.3)	<0.01*
3+ level fusion (%)	761 (10.3)	6,607 (89.7)	<0.01*
Length of stay, days (mean \pm SD)	6.38 ± 10.47	2.13 ± 3.11	<0.01*
Deaths	20	47	<0.01*
Mortality percentage	0.61	0.10	NA
Direct costs (mean \pm SD)	$\$21,245 \pm \$18,399$	$\$13,099 \pm \$7,963$	<0.01*
30-day readmissions	166	1,332	<0.01*
30-day readmission percentage	5.3	2.9	NA

* $p < 0.05$ was considered statistically significant.
NA = Not applicable, SD = standard deviation.

Table 2
Analysis of dysphagia following 1- to 2-level anterior cervical fusion (N = 41,672)

	Dysphagia	No Dysphagia	<i>p</i> value
Cases (%)	2,373 (5.7)	39,299 (94.3)	NA
Length of stay, days (mean \pm SD)	6.16 ± 10.57	2.05 ± 3.06	<0.01*
Deaths	14	38	<0.01*
Mortality percentage	0.61	0.10	NA
Direct costs (mean \pm SD)	$\$19,832 \pm \$17,666$	$\$12,337 \pm \$7,208$	<0.01*
30-day readmissions	119	1,056	<0.01*
30-day readmission percentage	5.0	2.7	NA

* $p < 0.05$ was considered statistically significant.
NA = Not applicable, SD = standard deviation.

Table 3
Analysis of dysphagia following 3- or more level anterior cervical fusion (N = 7,368)

	Dysphagia	No Dysphagia	<i>p</i> value
Cases (%)	761 (10.3)	6,607 (89.7)	NA
Length of stay, days (mean \pm SD)	7.15 ± 10.21	2.60 ± 3.32	<0.01*
Deaths	6	9	<0.01*
Mortality percentage	0.61	0.10	NA
Direct costs (mean \pm SD)	$\$25,965 \pm \$20,265$	$\$17,606 \pm \$10,395$	<0.01*
30-day readmissions	45	269	0.02*
30-day readmission percentage	5.9	4.1	NA

* $p < 0.05$ was considered statistically significant.
NA = Not applicable, SD = standard deviation.

All-cause 30-day readmission rate was 5.3% in patients with dysphagia, and 2.9% in those without dysphagia ($p = 0.01$). Of the patients with dysphagia at initial hospitalization who were subsequently readmitted, 28 (16.9%) were due to dysphagia-related issues. Of the patients without dysphagia at initial hospitalization, 136 (10.2%) were readmitted due to dysphagia-related issues, including 70 patients (5.3%) who were readmitted with a new diagnosis of dysphagia. Patients with dysphagia at initial hospitalization also had increased rates of non-surgical site infections ($p < 0.01$). However, readmissions for surgical site infections were similar between both groups, as were readmissions due to pain, hardware-related complications, pulmonary embolism/deep venous thrombosis, or medical complications. Readmissions for neurologic deficit ($p = 0.04$) or hematoma/seroma ($p = 0.01$) were more common in patients without dysphagia at initial hospitalization (Table 4).

Patients with dysphagia had more total comorbidities with a mean 2.1 comorbidities per patient, while patients without

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