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Abstract

Background

Anterior cervical discectomy and fusion (ACDF) performed as an outpatient has become increasingly common for treating cervical spine pathology. Few reports have attempted to assess readmissions following outpatient ACDF. This study was performed to address this issue using population-based databases.

Methods

The State Ambulatory Services Database (SASD) for New Jersey (NJ) from 2003-2012 was used for analysis. Patients receiving ACDF (defined as anterior cervical fusion (ICD-0 code=81.02) + excision of intervertebral disc (80.51)) were extracted; those with three or more levels fused (ICD-9 codes 81.63-81.64), cancer (ICD-9 codes 140-239), or trauma (ICD-9 codes=805.0-806.9) were excluded. A series of perioperative complications including durotomy, red blood cell transfusion, acute posthemorrhagic anemia, paraplegia (weakness), and mortality were examined. Propensity score matching (PSM) was used to adjust the analysis for patient age, race, sex, primary payer for care, and number of diagnoses. The NJ SASD defined readmission as admission to the same facility within seven days of initial discharge.

Results

Two thousand sixteen (2,016) patients were found, 1,528 of whom had readmission data. Of these 1,528 patients, 83 (5.4%) required readmission. PSM was performed prior to comparing readmission versus non-readmission. While there was no difference in perioperative complications between the two groups, the small sample size of the readmission cohort prevented this analysis from having sufficient power. No patient requiring readmission had an initial length of stay greater than one day.

Conclusion

Based on a 10-year outpatient analysis, fewer than 6% of outpatient 1-2 level ACDFs require readmission. Future studies involving outpatients from several states will be necessary to determine whether these results of outpatient ACDF are applicable nationwide.

COMPLICATIONS
KEYWORDS: ANTERIOR CERVICAL DISCECTOMY AND FUSION, OUTPATIENT, READMISSION, NEW JERSEY STATE AMBULATORY AND SERVICES DATABASE
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Introduction

Anterior cervical discectomy and fusion (ACDF) performed as an outpatient has become increasingly common for treating cervical spine pathology. The typical patient receiving outpatient ACDF is a healthy male 43-50 years of age with a BMI of 27-29 and ≤ 2 medical co-morbidities (most likely hypertension, diabetes, hypercholesterolemia or depression) who has a cervical disc herniation and receives a single-level ACDF.[1-5] The relative good preoperative health of such patients has contributed greatly to the excellent reported outcomes of outpatient ACDF.[3,6] These outcomes, in combination with the potential savings in cost compared with inpatient ACDF have recently led to the rise of ACDF being performed on an outpatient basis.[3,6-8]

Few reports have attempted to assess readmissions following outpatient ACDF.[2,4-5] Of the limited previous reports, readmissions have typically resulted from postoperative neck swelling/hematoma, which has the potential to be life-threatening if not promptly evacuated.[4-5] This retrospective cohort study was performed to address readmissions following outpatient ACDF using the State Ambulatory Surgery and Services Database (SASD), a large multicenter population-based database which has been recently used in the peer-reviewed literature.[9-10]

For this study, the SASD for the state of New Jersey (overview available at https://www.hcup-us.ahrq.gov/sasdoverview.jsp) encompassing the years 2003 through 2012 was obtained from the Health Care Cost and Utilization Project, Agency for Healthcare Research and Quality (Rockville, MD).[11]

Methods

Data Source

The SASD includes encounter-level data for ambulatory surgery and other outpatient services from hospital-owned facilities, with the specific types of ambulatory surgery and outpatient services varying by state and data year. The SASD from each state includes encounter-level outpatient data that are translated into a uniform format to facilitate multistate comparisons and analyses, and contains a core set of uniform clinical and nonclinical information on all patients, regardless of payer, including those covered by Medicare, Medicaid, private insurance, and the uninsured. Some SASD states include additional patient demographic information such as race. Presently, 34 states participate in the SASD.

For the state of New Jersey, the SASD defines readmission as admission to the same facility from which the patient was discharged within the previous seven days. The SASD contains no information on the details of the readmission such as the reasons for the readmission or the length of stay in the second admission.

Inclusion and Exclusion Criteria

Using the International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis and treatment codes, discharges were identified for those patients undergoing ACDF (defined as anterior cervical fusion (ICD-0 code=81.02) + excision of intervertebral disc (80.51)). Patients with three or more levels fused (ICD-9 codes 81.63-81.64), cancer (ICD-9 codes 140-239), or trauma (ICD-9 codes=805.0-806.9) were excluded. Additionally, any patient with any missing data for age, sex, total hospital cost, in-hospital mortality, hospital length of stay, and number of diagnoses was excluded. Mortality data was reported using methodology consistent with the Health Care Cost and Utilization Project (HCUP) family of databases well-represented in the peer-reviewed literature, including the Nationwide Inpatient Sample, the Kids' Inpatient Database, and the State Inpatient Databases.[11]

Data Collection

Demographic data for age, race, gender, primary payer, hospital length of stay (LOS) and readmission were analyzed in this study (Table 1). A total of 14 postoperative variables were analyzed to compare readmissions versus non-readmissions for outpatient ACDF (Table 2). These variables were selected based on previous work involving population-based databases to conduct postoperative analyses and known perioperative ACDF complications (McGirt et al., 2015).

Statistical Analysis

Statistical analysis was performed using SPSS version 17 (IBM Corporation, Armonk, New York). The

Table 1. Demographics of outpatient ACDF patients examined in this study.

	No Readmission	Readmission	P Value
Age (years)	47.8	45.4	0.021
Female sex	47%	45%	0.660
Caucasian race	75%	80%	0.302
Medicaid as Primary Payer	0.01%	0%	0.351
Hospital Length of Stay (days)	0.17	0.11	0.114
Number of Diagnoses	2.82	2.22	0.006
Number of Procedures Performed	3.98	3.89	0.410
Plate Implanted with ACDF (percentage of patients)	63%	58%	0.374

characteristics of patients, providers and hospitals were summarized by descriptive statistics and analyzed using independent samples t-tests. Propensity score matching (PSM) was performed on all patients using R 3.2.3 (R Foundation for Statistical Computing, Vienna, Austria) assisted by MatchIt, rgenoud, and Matching packages to adjust for age, race, sex, primary payer of care, and number of diagnoses.[12-15] Following PSM, postoperative variables were analyzed using chi-square testing, with significance defined as a P value less than 0.05. Sample size calculations were performed using MapleTech online software (http://www.calculator.net/sample-size-calculator.html).

Results

From 2003 through 2012, the New Jersey SASD contained 4,194,207 outpatients, of whom 2,016 received ACDF. 1,528 of these 2,016 patients (75.8%) had readmission data. Demographics of readmission versus non-readmission patients are listed in Table 1. Differences between the two cohorts in age and number of diagnoses necessitated PSM (Table 1).

Table 2. Description of the 14 postoperative complications assessed in this NIS analysis to examine the impact of readmission on outpatient ACDF.

Postoperative Complication	Required Readmission	Did Not Require Readmission	P value	Odds Ratio
Durotomy	0/83	1/1,445	1.000	N/A
Arm Paralysis	0/83	0/1,445	N/A	N/A
Leg Paralysis	0/83	0/1,445	N/A	N/A
Paraplegia	0/83	0/1,445	N/A	N/A
Postoperative Infection	0/83	0/1,445	N/A	N/A
Hematoma/Seroma	0/83	1/1,445	1.000	N/A
Foreign Body Retainment	0/83	0/1,445	N/A	N/A
Acute Reaction to Foreign Body	0/83	0/1,445	N/A	N/A
Rh-Incompatible Reaction	0/83	0/1,445	N/A	N/A
Other Transfusion Reaction	0/83	0/1,445	N/A	N/A
Respiratory Complications	0/83	0/1,445	N/A	N/A
Acute Posthemorrhagic Anemia	0/83	0/1,445	N/A	N/A
Dysphonia	0/83	0/1,445	N/A	N/A
Red Blood Cell Transfusion	0/83	0/1,445	N/A	N/A

Of the 1,528 ACDF patients, 83 (5.4%) required readmission. Following PSM, comparisons between the readmission and non-readmission cohorts were made, which revealed no difference in perioperative complications (listed in Table 2). However, sample size calculations revealed that a minimum of 384 readmission patients would be required to provide sufficient power, which was significantly larger than the 83 patients in this study.

No patient who required readmission had an initial hospital length of stay longer than one day; only nine of the 83 patients who required readmission (10.8%) required hospital stay of a single day; the remaining 74 (89.2%) patients required no hospital stay. Overall, 99.8% of patients in our study (1,525 of 1,528) had hospital LOS of 0 or 1 days. There was no mortality among the 1,528 patients with readmission data.

Further examination revealed that 1,283 of the 1,528 patients (84%) had LOS of zero days (= same-day discharge), including 1,209 of the 1,445 patients who did not require readmission. For outpatient ACDFs who had same-day discharge, the readmission rate was 5.8% (74 of 1,283).

Discussion

The increasing popularity of outpatient ACDF as a means of cost savings compared with inpatient ACDF has resulted in increased interest in the safety of outpatient ACDF. One of the greatest threats to both the cost savings and safety associated with outpatient ACDF is the potential for an unacceptable rate of readmissions. This study was performed to assess readmissions in outpatient ACDF using a large 10-year ambulatory surgery database, comprising a total of 1,528 outpatient 1-2 level ACDF cases with known readmission data.

Our results indicate that the incidence of readmission following outpatient ACDF is 5.4%. Unfortunately, due to the definition of the NJ SASD of read-

mission, our results are an estimate of readmission within seven days of discharge, rather than the standard 30-day window used in most readmission analyses; this would most likely artificially lower our readmission rates in comparison. Further complicating our results is the inability of the NJ SASD to distinguish one-level from two-level operations, as the majority of previous studies have had a majority of one-level ACDFs, whereas our results may have involved significantly more two-level ACDFs.[1-2,4-5,16-19] The previous studies were single-center analyses which may have been subject to reporting bias in order to favor the safety of outpatient ACDF, whereas the present study used a state database with larger numbers from multiple centers and standardized reporting.

Noteworthy is the fact that the readmission rate in our study is by far the highest in the reported literature (Table 3). This may be due to the aforementioned mitigating factors, or it may be due to the fact that our sample size is at least 50% larger than any previous report examining outpatient ACDF readmissions and greater than the combined sample size of the next seven largest previous single-center reports that reported readmission data (Table 3). One alternative hypothesis is that the majority of the published literature may only define readmission as cases requiring actual hospital admission, as opposed to the SASD which documents Emergency Department visits regardless of whether they require hospital admission. This may actually result in our findings being more in line with the true rate of readmission than the published literature.

Another noteworthy finding is that no patient requiring readmission suffered any respiratory complications or hematoma/seroma (Table 2), given that postoperative airway issues (often secondary to an operative field hematoma) are a potentially life-threatening cause of readmission following ACDF, and have been a source of reluctance to performing ACDF on an outpatient basis.[6] A pertinent criticism of this study is that our definition of an outpatient (any patient recorded in the SASD) may be less strict than in previous reports, since almost none of those patients had any hospital LOS initially. To address this, we performed a subanalysis of New Jersey SASD ACDF patients with LOS of zero days, which comprised 84% of our overall population. This analysis revealed a readmission rate of 5.8%, which is nearly identical to the 5.4% readmission rate from our overall ACDF outpatient cohort. Furthermore, since the SASD definition of LOS is the date of discharge minus the date of admission, it is likely that outpatients in previously reported studies who underwent 23-hour observation would be included as a LOS = 1 in the SASD. In fact, 1,525 of the 1,528 patients in our study (99.8%) had LOS of 1 day or less.

Unfortunately, despite the relatively large sample size, the number of readmissions (83) remained too small to adequately power this study to detect significant differences involving the 14 perioperative complications examined (Table 2). It is possible that there exist differences between outpatient ACDF readmission and nonreadmission patients with regard to these complications; however this study was simply not powered to detect any such difference.

The most prominent limitations of this study are its retrospective nature and reliance on a single state.

Table 3. Comparison of readmission rates from this study with that of the peer-reviewed literature on outpatient ACDF.

	Number of outpatient ACDF patients	Readmission rate
Silvers et al., 1996	50	NR
Stieber et al., 2005	30	0%
Villavicencio et al., 2007	103	1.9%
Erickson et al., 2007	58	0%
Liu et al., 2009	45	0%
Garringer et al., 2010	645	NR
Trahan et al., 2011	59	1.7%
Lied et al., 2013	96	1.0%
Tally et al., 2013	119	0%
McGirt et al., 2015	1,168	NR*
Adamson et al., 2016	1,000	2.2%
Present study	1,528	5.4%

NR = Not reported. * = Did not specifically report readmission rate; rate of "major morbidity" (surgical site infection, new neurological deficit, stroke, reintubation, deep vein thrombosis/pulmonary embolism, myocardial infarction, postoperative hematoma, return to operating room within 30 days) was 0.94%.

Utilization of the SASD allows for potential uncertainty regarding the accuracy of case assignment for the database, given the reliance of the database on ICD-9 rather than current procedural terminology (CPT) coding; the SASD is unable to assess the specific reasoning behind a patient seeking readmission beyond ICD-9 coding data. This reliance on ICD-9 coding also prohibits the differentiation between one-level and two-level fusions (respectively two vertebrae and three vertebrae fusions), since they both share the same ICD-9 procedure code of 81.62. Furthermore, the SASD does not allow for determination of the chronological relation between the ICD-9 codes and the surgical procedure, which eliminates the possibility of performing analysis involving temporal association. Another important limitation is the lack of granularity in the SASD to perform an analysis of comorbidities and other factors previously shown to be associated with longer LOS in ACDF.[20] A sixth limitation is the fact that more than 24% of patients who received outpatient ACDF did not have readmission data; it is possible that these patients may have suffered more severe postoperative complications than the 76% of patients who did have readmission data. A seventh limitation is that given the outpatient nature of this database, potential complications which occurred following discharge that did not involve a patient being readmitted may have not been included; for instance, a patient discharged from an ambulatory center who subsequently died at home without having been readmitted may not have been included as a mortality in the SASD. However, the SASD "contains hospital identifiers that permit linkage to inpatient hospital databases, such as the Agency for Healthcare Research and Quality-sponsored State Inpatient Databases and the American Hospital Association Annual Survey File"; therefore the likelihood of not capturing mortality in the SASD remains extremely low, even beyond 90 days following discharge.[11] The nature of the HCUP database family collection of data prohibits determination of 30-day mortality rates, which is certainly a limitation compared with other population-based databases. Finally, because the SASD readmission data for New Jersey only involves the first seven postoperative days, any subsequent complications would not have been captured by the New Jersey SASD, even if they occurred within the first 30 days postoperatively. Of the 34 states that currently participate in the SASD, New Jersey is one of only three that contains any readmission data, with the other two being Maryland and Vermont.

Conclusions

Accepting the limitations of the SASD, these findings from a population-based database of 1,528 outpatient 1-2 level ACDF cases comprising a 10-year period indicate that more than 5% of outpatient ACDFs require readmission within the first seven days following discharge. Future studies involving outpatients from several states will be necessary to determine whether this study's results are applicable nationwide.

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Disclosures & COI

The authors declare no relevant disclosures.

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