Causes for 30-Day Readmission following Transsphenoidal Surgery

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Abstract

Objective. The Affordable Care Act Readmissions Reduction Program introduced reimbursement policy changes resulting in penalties for hospitals with higher-than-average readmission rates among several categories, including elective surgical cases. We examined the rate of complications resulting in 30-day readmission following endoscopic transsphenoidal surgery.

Study Design. Case series with chart review.

Setting. Academic tertiary care center.

Methods. A database of 466 consecutive patients who underwent endoscopic transsphenoidal surgery at a tertiary care center between April 2006 and July 2014 was reviewed for 30-day causes for readmission, length of stay, level of care required, and average cost.

Results. Twenty-nine readmissions were identified within our study period, indicating a 30-day readmission rate of 6.2%. Among all patients, rates of 30-day readmission were 2.1% for epistaxis, 1.5% for hyponatremia, 0.9% for cerebrospinal fluid leak, and 1.7% for other medical conditions. Average cost per readmission ranged from $6011 for hyponatremia to $24,613 for cerebrospinal fluid leak.

Conclusion. Overall, the rate of 30-day readmission following endoscopic pituitary surgery is low. However, common causes of readmission do add significant cost to the overall care of this patient population. Special attention to surgical technique to prevent epistaxis and cerebrospinal fluid rhinorrhea, as well as multidisciplinary team management to avoid postoperative endocrine dysfunction, is critical to minimize these complications.

Keywords

readmission, transsphenoidal, pituitary, Readmissions Reduction Program

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Since the institution of the Affordable Care Act and its associated Readmissions Reduction Program (RRP), much focus within the medical and surgical community has been placed on identifying risk factors for 30-day readmission. The federal RRP focuses on reducing excess readmissions for patients with acute myocardial infarction, pneumonia, and congestive heart failure. More recently, the scope was expanded to include readmission for acute chronic obstructive pulmonary disease exacerbation and readmission after elective total hip or knee arthroplasty.1 Given that in 2009 the estimated cost to Medicare of all unplanned readmissions was $17.4 billion2 and that the Medicare savings from reduced reimbursements from 2010 to 2019 are estimated to total $7.1 billion,3 many clinicians anticipate that the RRP will soon expand to include additional diagnoses and procedures.

Some studies indicate that the metrics used by the RRP have little to no measurable association with overall quality of care but rather result in penalties to hospitals who provide care for the sickest of patients.4-7 However, a study by Tsai et al in 2013 shows that hospitals in the highest quartile of surgical volume also have the lowest rate of readmission,8 implying that some element of their surgical expertise and patient care experience may ultimately result in better care.

In addition to the impending expansion of the RRP to include more medical conditions and surgical procedures, provisions under the Hospital-Acquired Condition Reduction Program will result in a 1% reduction in payments to hospitals who rank in the upper quartile for conditions considered to be reasonably preventable.9 While the current surgical conditions focus on orthopedic and cardiac procedures,10 one could reasonably expect the application of standards regarding deep venous thrombosis, pulmonary embolism, and surgical site infections to expand to other specialties over the upcoming years.

With these issues in mind, we sought out to identify the most common reasons for 30-day readmission following endoscopic transsphenoidal resection of a pituitary tumor.

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Our aim was to estimate the associated costs of these readmissions at a single tertiary care center and consider approaches for lowering the rate of readmission.

Materials and Methods

For this study, a database was reviewed that included 466 consecutive patients who underwent endoscopic transsphenoidal resection of a pituitary tumor by a single otolaryngologist in combination with varied neurosurgeons at a tertiary care center between April 2006 and July 2014. Retrospective chart review was performed for all patients, including telephone, outpatient, and inpatient encounters that occurred within 30 days of the original date of surgery. For all patients who were readmitted within this period, the reason for readmission, the length of stay, and the required level of care were documented. This included any direct admissions as well as admissions through the emergency department. Data were also recorded for any patients who presented to the emergency department without subsequent hospital admission. Patients who presented more than once were counted for each hospital encounter. Those who initially presented to an outside hospital were transferred to the emergency department for otolaryngology and neurosurgical evaluation prior to admission. Reasons for readmission were divided into categories for epistaxis, hyponatremia, cerebrospinal fluid (CSF) leak, and all other medical conditions. This study was approved by the Institutional Review Board at the University of Cincinnati and thus did not include review of any outside hospital medical records for additional patient encounters.

Operative Technique

Pituitary tumors were removed with a binostril endoscopic endonasal transsphenoidal 2-surgeon technique as previously described. The LandmarX surgical navigation system (Medtronic Xomed, Inc, Jacksonville, Florida) was used for all cases. Otolaryngology performed wide sphenoidotomy and posterior septectomy via bilateral nasal cavities. Neurosurgery performed tumor resection and reconstruction of the sella with intradural, intracranial placement of abdominal fat, followed by an intradural, intracranial only sphenoid sinus to cover the sella. These steps were performed in all macroadenomas with or without an identifiable intraoperative leak, as well as in microadenomas with intraoperative leaks. NasoPore (Polyganics, Rozenburglaan, Netherlands) was then placed into the sphenoid sinus to cover the sella. These steps were performed in all macroadenomas with or without an identifiable intraoperative leak, as well as in microadenomas with intraoperative leaks. NasoPore (Polyganics, Rozenburglaan, Netherlands) was then placed into the posterior nasal cavity as a spacer to prevent scarring between the middle turbinate and septum. A lumbar drain was not routinely placed.

Postoperative Care

Patients were admitted to the neurosurgical service for observation. They were prescribed oxymetazoline nasal sprays twice daily for 3 days and instructed to apply sodium chloride nasal sprays every 2 hours while awake. An endocrine consultation was obtained by postoperative day 1 to manage postoperative endocrine dysfunction and provide discharge instructions for medical management of endocrine disorders such as diabetes insipidus. They were instructed to avoid any activities that may increase intracranial pressure and were monitored for nasal drainage. If an obvious CSF leak was observed, a lumbar drain was then placed by neurosurgery for a period of 3 to 5 days at a rate of 5 to 10 mL/h. If patients reported an unclear history of rhinorrhea, a mustard dressing was placed to monitor the amount of drainage. Provocative maneuvers, such as leaning forward and Valsalva, were not regularly attempted. Patients were generally discharged between postoperative days 1 and 3 and had follow-up arranged with otolaryngology at intervals of 1 and 4 weeks postoperatively for endonasal debridement. Patients followed up with neurosurgery during postoperative week 2 and with endocrinology within 1 to 2 weeks. With any concerns or complications, patients were encouraged to contact their surgeons to receive the most appropriate recommendations and clinical management.

Associated Cost

The hospital finance department assisted by providing the estimated costs associated with hospitalization. A separate average daily cost was calculated for the care of all neurosurgical patients residing in the hospital’s neuroscience intensive care unit (ICU) and the neurosurgical standard floor. As patients also incur a higher-than-average daily cost on an operative day as compared with nonoperative days, these differences were also accounted for in our calculations (Table 1). Separate calculations were performed for each reason for readmission, accounting for differences in ICU, floor, and operative costs during each readmission. Administrative restrictions prevented obtaining precise patient-specific costs for each readmission.

Results

Of the 466 consecutive transsphenoidal surgeries performed, a total number of 42 emergency department encounters were documented within a 30-day period. One patient was subsequently excluded from our study, as the reason for readmission was unrelated to surgery. This patient was readmitted due to a motor vehicle accident on postoperative day 29. By this report, the patient lost control of the vehicle after hitting any icy patch in the road. The patient denied any preceding symptoms or loss of consciousness, and further workup did not reveal any apparent surgical or endocrine complications.
The remaining 41 emergency department visits represented a total 30-day emergency department visit rate of 8.8%. Of these visits, there were 29 admissions representing a 30-day readmission rate of 6.2% (**Table 2**). These 29 admissions resulted in an additional 11 days of care in an ICU and 101 days of care on a medical-surgical floor, averaging 0.4 ICU days and 3.5 floor days per event (**Table 3**).

**Epistaxis**
There were 19 patient encounters for epistaxis, 10 of which resulted in readmission (2.1%). Five of these patients were admitted for operative exploration for hemostasis, while 1 was treated with embolization in interventional radiology. The other 4 patients were observed after nasal packing, including 1 patient with Von Willebrand disease. Patients readmitted for epistaxis accounted for a total of 18 days in hospital admission, with an average stay of 1.8 days. All of these cases were successfully managed on the surgical floor.

The average estimated cost of care for patients readmitted for epistaxis was $1847 for surgical floor expenses, in addition to an average of $9262 in operative day expenses. This resulted in an average total cost per readmission of $11,109 (**Table 4**).

**Hyponatremia**
All 7 patients presenting with hyponatremia were admitted for medical management (1.5%). Four of these patients were admitted to the ICU, while 3 were admitted directly to the floor. This group accounted for a total of 8 days in the ICU and 14 days on the floor, resulting in an average of 1.1 ICU days and 2 floor days per readmission. This resulted in an average of $3078 in surgical floor expenses and $2934 in ICU expenses, for an average total of $6012 per readmission (**Table 4**).

**CSF Leak**
All 4 patients who presented with CSF rhinorrhea were admitted to the hospital (0.9%). One patient was successfully treated with a lumbar drain, while the other 3 required operative exploration and CSF leak repair. Two of these patients also had meningitis, with 1 requiring admission to the ICU for initial medical care. Patients readmitted with CSF leak accounted for a total of 2 days spent in the ICU and 32 days spent on the floor, resulting in an average of 0.5 ICU days and 8 floor days per readmission.

Patients readmitted for CSF leak had the highest rate of reoperation, the longest average hospital stay, and the highest total cost of readmission. The average estimated cost of care on an operative day was $12,404 per readmission. The average cost of care on the surgical floor was $11,543, while the ICU resulted in an average cost of $667. The average cost of CSF leak was $24,613 per readmission (**Table 4**).

**Other Medical Conditions**
A total of 11 separate patient encounters were recorded for other medical conditions, resulting in 8 readmissions (1.7%). Three patients were admitted for deep vein thrombosis. One patient also had a pulmonary embolism and was admitted to the ICU overnight before being transferred to the

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**Table 2. Patient Encounter Data, Sorted by Diagnosis.**

<table>
<thead>
<tr>
<th>Type of Hospital Event</th>
<th>ED Visit Only</th>
<th>Readmitted</th>
<th>Readmission Rate, %</th>
<th>Admit to Floor</th>
<th>Admit to ICU</th>
<th>OR / IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistaxis</td>
<td>9</td>
<td>10</td>
<td>2.1</td>
<td>10</td>
<td>0</td>
<td>5 OR, 1 IR</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>0</td>
<td>7</td>
<td>1.5</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>CSF leak</td>
<td>0</td>
<td>4</td>
<td>0.9</td>
<td>3</td>
<td>1</td>
<td>3 OR</td>
</tr>
<tr>
<td>Other medical conditions</td>
<td>3</td>
<td>8</td>
<td>1.7</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>All patients</td>
<td>12</td>
<td>29</td>
<td>6.2</td>
<td>23</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Abbreviations: CSF, cerebrospinal fluid; ED, emergency department; ICU, intensive care unit; IR, interventional radiology; OR, operating room.

*Values presented in number of patients, except for readmission rate.

**Table 3. Days Spent in Hospital, Sorted by Diagnosis.**

<table>
<thead>
<tr>
<th>Reason for Admission</th>
<th>Days on Floor</th>
<th>Days in Intensive Care Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Days</td>
<td>Average</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>18</td>
<td>1.8</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>CSF fluid leak</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Other medical conditions</td>
<td>37</td>
<td>4.6</td>
</tr>
<tr>
<td>All patients admitted</td>
<td>101</td>
<td>3.5</td>
</tr>
</tbody>
</table>

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Two patients were admitted with diagnoses of meningiitis without evidence of CSF leak. Two patients were admitted with acute renal failure and mild hypotension. One patient was admitted with intractable nausea and vomiting, which was attributed to mild adrenal insufficiency after he or she reported mistakenly stopping the outpatient regimen of steroids. As a group, all of these patients accounted for a total of 1 day in the ICU and 37 days on the floor, resulting in an average of 0.1 ICU days and 4.6 floor days per readmission.

Three of the patient encounters for other medical conditions resulted in nonadmission. One patient presented after a mechanical fall occurred several weeks postoperatively, which the patient reported was related to generalized weakness and orthostasis since surgery. Results of this patient’s emergency department workup and neurosurgical assessment were unremarkable, resulting in discharge to home without any further complications. Another patient presented with a chief complaint of diffuse back pain but also reported nasal congestion and anterior rhinorrhea consistent with a personal history of seasonal allergies. This patient had no objective clinical evidence of a CSF leak. Another patient presented to the emergency department for evaluation of subjective shortness of breath but was discharged home due to an unremarkable workup.

Patients in this group incurred an estimated average floor expense of $7126 and average ICU expense of $347 per readmission. This totaled an average overall expense of $7472 per readmission for other medical conditions (Table 4).

## Discussion

With the introduction of the Affordable Care Act, multiple changes in health care policy have been made that directly affect health care reimbursements. The RRP has the potential to significantly decrease government health care expenses over the upcoming years. If successful in reducing health care spending, these changes in Medicare reimbursements may ultimately exert a considerable influence on the policies of private insurers.

Over the coming years, hospitals that report a higher-than-average number of 30-day readmissions will likely find themselves under increasing pressure to meet these newly formed standards. Those hospitals that have been unable to reduce their rates of readmission for the currently affected diagnoses have been subjected to gradually increasing penalties. The current maximum reimbursement penalty incurred by hospitals that are above the acceptable rate of readmission has been expanded to 3% in 2015. While it is still uncertain whether this new metric has any correlation with other measures of quality of care, it is safe to anticipate expansion of this program to affect a broader range of patients and clinicians.

While prior studies within the otolaryngology and neurosurgical literature have looked at rates of complications or rates of readmission related to a specific complication, we believe that this is the first study to examine all encountered reasons for 30-day readmission in patients who have undergone endoscopic transphenoidal resection of pituitary tumors. Our data revealed 30-day rates of readmission of 2.1% for epistaxis, 1.5% for hyponatremia, 0.9% for CSF leak, and 1.7% for other medical conditions, resulting in an overall readmission rate of 6.2% (Table 2) and added cost of $672 to every case performed (Table 5). We found our rate of complications and rate of readmission to be comparable to the aggregate results of prior studies. Previously reported rates of readmission range from 0.7% to 1.8% for epistaxis, 2.9% to 6.4% for hyponatremia, and 0.6% to 4% for CSF leak. As clinical management of each complication varies among health care systems, it is difficult to extrapolate our 30-day readmission rate to estimate the associated costs at other institutions. Similarly, as surgical technique also varies among surgeons, it is difficult to estimate the overall average 30-day readmission rate among all hospitals based on this study alone.

Although 30-day readmission rates have been studied across most surgical specialties, the recent changes in reimbursement patterns have triggered renewed interest in the subject matter. Jencks et al reviewed Medicare claims data for 11.8 million patients and reported that 15.6% of patients who underwent 1 of 5 surgical procedures were readmitted within 30 days of discharge. Furthermore, >70% of these patients were hospitalized for a medical condition. In their study, half of all patients who were readmitted within 30 days did not have follow-up with their primary care physician prior to readmission. In 2009, Jack et al attempted to reduce medical service readmission rates by implementing a new hospital discharge system with

### Table 4. Average Costs Incurred per Readmission in US Dollars, Sorted by Diagnosis.

<table>
<thead>
<tr>
<th>Reason for Admission</th>
<th>Floor</th>
<th>ICU</th>
<th>OR/IR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistaxis</td>
<td>1847</td>
<td>0</td>
<td>9262</td>
<td>11,109</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>3078</td>
<td>2934</td>
<td>0</td>
<td>6012</td>
</tr>
<tr>
<td>CSF leak</td>
<td>11,543</td>
<td>667</td>
<td>12,404</td>
<td>24,613</td>
</tr>
<tr>
<td>Other medical conditions</td>
<td>7125</td>
<td>347</td>
<td>0</td>
<td>7472</td>
</tr>
<tr>
<td>All patients admitted</td>
<td>4935</td>
<td>920</td>
<td>4905</td>
<td>10,760</td>
</tr>
</tbody>
</table>

Abbreviations: CSF, cerebrospinal fluid; ICU, intensive care unit; IR, interventional radiology; OR, operating room.

*Estimated costs for patients undergoing OR/IR procedures were subtracted from costs for nonoperative floor and ICU hospital days. All 6 epistaxis patients and 2 CSF leak patients underwent interventions while residing on a standard floor, while 1 CSF leak patient was operated on while still receiving care in an ICU setting.
additional instruction and postdischarge telephone calls, which ultimately reduced the cost of care for patients within the experimental group when compared with controls.\textsuperscript{30} While the precise method of reducing costs in their study may not necessarily be adaptable to all surgical postoperative patients, it does underscore the potential to reduce costs associated with repeat hospital encounters by improving patient education. Our current protocol is such that each patient sees the otolaryngologist, neurosurgeon, and endocrinologist within 2 weeks postoperatively minimize medical complications and readmissions. We speculate that this close follow-up plan may play a role in this study’s relatively low incidence of 30-day readmission for endocrine and general medical complications.

One shortcoming of this study is the lack of data regarding any patient care encounters that may have occurred at other hospitals. In 2006, Halfon et al\textsuperscript{31} reviewed patient data from 49 hospitals and discovered that approximately 17% of 30-day secondary admissions occurred at a hospital different from the place of original admission. We believe that these data may differ between medical and surgical patients due to the emphasis placed upon involving the operating surgeon in most perioperative patient care. Anecdotally, the senior author who saw all patients at follow-up intervals of 1 and 4 weeks postoperatively reports no known outside admissions during this 30-day period. However, it would be naïve to expect that all perioperative medical and surgical complications either presented to or were known to our hospital. While our data may accurately reflect estimated rates of complications more obviously related to the recent procedure, patients may not always report more minor perioperative complications. Additionally, there is certainly a potential recall bias when one attempts to reflect on past complications.

Another limitation of this study included the administrative restrictions that resulted in an inability to retrospectively review patient-specific costs for each hospital stay. As estimated daily costs included all neurosurgical patients within either the neuroscience ICU or the neurosurgical standard floor, the actual costs for our patient population may differ.

Patients who experienced a complication during their initial surgical admission but did not have a 30-day readmission were not included in this study, nor were patients who had concerns that were successfully managed via an outpatient clinic visit.

As our primary goal was to identify those patients who required readmission for complications that were not present, not recognized, or not appropriately addressed during their initial stay, we did not feel that this imposed any significant limitations on our study.

Within this study, each readmission category identified a unique added burden to our hospital system. Epistaxis accounted for the highest overall rates of readmission and reoperation (Table 2). Patients with hyponatremia spent the highest number of days in an ICU setting during readmission. CSF leak resulted in the longest average additional stay per readmission, and all other medical conditions were responsible for the largest total number of days readmitted (Table 3). CSF leaks also resulted in the highest cost per individual readmission, although this was similar in average cost added to all patients when compared with epistaxis (Table 5).

Given the variety of complications resulting in readmission in this study, it seems likely that reducing readmission rates will require a multifaceted approach. Study of our own institution’s reasons for readmission has prompted increasing standardization of postoperative endocrinology evaluation. Additionally, we have modified our surgical technique during the dissection of the mucosa overlying the anterior wall of the sphenoid sinus to preserve the posterior nasal artery, as has been previously described.\textsuperscript{32} Further investigation to identify risk factors for readmission is needed so that we may better understand how to best avoid unnecessary health care costs and their associated penalties. Proper patient selection, operative technique, perioperative care, patient education, and appropriate follow-up should all be optimized to achieve the best possible outcomes.

**Conclusion**

In this developing era of concern regarding patient readmission metrics and changes in reimbursement, it is important to begin to examine postoperative complications and common causes for readmission. Given that many of the primary causes for readmission following transsphenoidal surgery may be preventable, proper attention to patient care and education may allow us to provide higher-quality care at an overall lower cost. Those who are unable to critically analyze and improve on these complications will likely suffer increasing reimbursement penalties over the coming years.

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**Table 5. Average Cost Added per Patient Undergoing Transsphenoidal Pituitary Surgery in US Dollars, Sorted by Diagnosis.**

<table>
<thead>
<tr>
<th>Reason for Admission</th>
<th>Readmit Rate, %</th>
<th>Cost Per Readmission, $</th>
<th>Average Cost Added per Patient, All Patients, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistaxis</td>
<td>2.1</td>
<td>11,109</td>
<td>233</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>1.5</td>
<td>6012</td>
<td>90</td>
</tr>
<tr>
<td>Cerebrospinal fluid leak</td>
<td>0.9</td>
<td>24,613</td>
<td>222</td>
</tr>
<tr>
<td>Other medical conditions</td>
<td>1.7</td>
<td>7472</td>
<td>127</td>
</tr>
<tr>
<td>All patients admitted</td>
<td>6.2</td>
<td>10,760</td>
<td>672</td>
</tr>
</tbody>
</table>
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Author Contributions

Brian L. Hendricks, acquisition, analysis and interpretation of data and literature; drafting of original article; final approval of article for submission; agreement to accountability for all aspects of the work; Tasneem A. Shikary, acquisition, analysis and interpretation of data; critical review and revisions to article; final approval of article for submission; agreement to accountability for all aspects of the work; Lee A. Zimmer, acquisition, analysis and interpretation of data; critical review and revisions to article; final approval of article for submission; agreement to accountability for all aspects of the work.

Disclosures

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