Identifying the Risk of Swallowing-Related Pulmonary Complications in Older Patients With Hip Fracture

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abstract

To identify and potentially modify the risk of pulmonary complications in a group of older patients with hip fracture, the authors obtained speech and language pathology consultations for these patients. Then they performed a retrospective chart review of all patients 65 years and older who were admitted to their institution between June 2011 and July 2013 with acute hip fracture, were treated surgically, and had a speech and language pathology evaluation in the immediate perioperative period. The authors identified 52 patients who met the study criteria. According to the American Society of Anesthesiologists (ASA) classification system, at the time of surgery, 1 patient (2%) was classified as ASA I, 12 patients (23%) were ASA II, 26 (50%) were ASA III, and 12 (23%) were ASA IV. Based on a speech and language pathology evaluation, 22 patients (42%) were diagnosed with dysphagia. Statistical analysis showed that ASA III status and ASA IV status were meaningful predictors of dysphagia and that dysphagia itself was a strong risk factor for pulmonary aspiration, pneumonia, and aspiration pneumonitis. Evaluation by a speech and language pathologist, particularly of patients classified as ASA III or ASA IV, may be an efficient means of averting pulmonary morbidity that is common in older patients with hip fracture. [Orthopedics. 2016; 39(1):e93-e97.]

Hip fracture is a prominent and expanding public health problem. Fracture of the proximal femur does not directly cause death; it exacerbates comorbidities typical of the affected population, such as neurologic disease, congestive heart failure, deconditioning, and poor social functioning. Effective management of hip fracture requires a holistic approach. There is room for orthopedic surgeons and other health care providers to collaborate.

Pulmonary aspiration, pneumonia, and pneumonitis are major sources of morbidity and mortality after hip fracture, and swallowing pathology is among the root causes of these complications. Dysphagia often involves pulmonary aspiration of oral contents. In many cases, this aspiration is silent. In others, it leads to aspiration pneumonia and/or pneumonitis, and in certain circumstances, sudden massive aspiration is immediately lethal.

Dysphagia affects as many as 40% of older adults living independently, and among nursing home residents, the incidence is significantly higher. Both age and age-related neurologic diseases impair swallowing.

Dysphagia and pulmonary aspiration may be diagnosed by a speech and language pathologist who is trained to perform a bedside evaluation. Based on this
evaluation, radiographic assessment, dietary changes, special precautions, and/or referral to a subspecialty service may be recommended to avoid severe pulmonary complications.

Given the risk of pulmonary aspiration, pneumonia, and pneumonitis in patients with hip fracture and the potential for a speech and language pathology evaluation to avert these complications, the senior author’s department recommended the following policy change: speech and language pathology consultations were attempted for all patients 65 years and older who were admitted to the institution with acute hip fracture.11-13

This study reports the incidence of dysphagia, pulmonary aspiration, pneumonia, and pneumonitis in older patients with hip fracture treated at the study institution. The authors investigated the American Society of Anesthesiologists (ASA) classification, a widely used estimation of overall health, as a potential predictor of swallowing-related pathology (Table).

**Table**

| ASA I | Healthy |
| ASA II | Mild systemic disease |
| ASA III | Severe systemic disease that is not incapacitating |
| ASA IV | Severe, incapacitating disease that is a constant threat to life |
| ASA V | Moribund and not expected to live more than 24 hours or without surgery |
| ASA VI | Brain-dead organ donor |

Abbreviation: ASA, American Society of Anesthesiologists.

Based on the findings of speech and language pathology evaluation, 22 patients (42%) were diagnosed with dysphagia. In addition, 8 patients (15%) were diagnosed with pulmonary aspiration, either immediately by the speech and language pathologist or by an ensuing barium swallow study or upper endoscopy. One patient (2%) was deemed unsafe for any oral intake. Based on each evaluation, a speech and language pathologist recorded the presence of dysphagia and/or pulmonary aspiration and made 1 of the following recommendations: (1) maintain a normal diet without precautions; (2) modify the diet or follow restrictions/aspiration precautions (recommended for all patients with dysphagia/pulmonary aspiration); and/or (3) obtain either a barium swallow study or upper endoscopy to definitively rule in or rule out pulmonary aspiration.

Six patients (11%) showed evidence of pneumonia or aspiration pneumonitis during hospital admission. While hospitalized, 1 patient (2%) died after a suspected aspiration event.

**Analysis**

Associations between patient age, patient sex, and ASA classification and the outcomes dysphagia, pulmonary aspiration, and pneumonia/aspiration pneumonitis were assessed with the chi-square test and Fisher’s exact test. Pneumonia and aspiration pneumonitis are often superimposed and were grouped together for this reason. Because there were few occurrences of both pulmonary aspiration and pneumonia/aspiration pneumonitis, these outcomes were combined into 1 group of severe outcomes. The authors controlled for multiple testing for each predictor with a Bonferroni correction. Significance was set at \( P = .003 \), which approximated the Bonferroni correction at .05 of 20 for the number of tests.

Logistic regression was used to combine all predictors into a single model and evaluate their association with the outcomes after adjusting for other variables.

**Materials and Methods**

**Patient Selection Criteria**

Approval for this study was obtained from the institutional review board at the study institution. The authors performed a retrospective chart review of all patients who presented to the emergency department with acute hip fracture between June 2011 and July 2013, were treated operatively, and had a speech and language pathology evaluation in the perioperative period.

**Speech and Language Pathology Evaluation**

All of the study patients underwent a bedside swallow evaluation by 1 of several speech and language pathologists employed at the institution. This evaluation consisted of an assessment of the patient’s mental status, oxygen requirements, oral mucosa, swallowing, post-swallow events (eg, changes in vocal quality, coughing, burping, throat clearing), changes in vital signs, and subjective response to swallowing (eg, sensation of incomplete swallowing).

**Patient Characteristics**

The authors identified 52 patients who met the study criteria. This sample represented consecutive patients presenting to the institution with acute hip fracture in the given period except those who could not be evaluated for dysphagia, including patients with an endotracheal tube, patients who did not have a speech and language pathology evaluation, and patients who did not have an adequate record for retrospective review.

Mean patient age was 81 years (range, 65-98 years). The study included 36 women (69%) and 16 men (31%). At the time of surgery, 1 patient (2%) was classified as ASA I, 12 patients (23%) were ASA II, 26 patients (50%) were ASA III, and 12 patients (23%) were ASA IV.
Model selection was performed with Akaike’s information criterion to choose a final model that included only important variables. This multiple regression model was used to determine cutoff recommendations for speech and language pathology screening. Predictor cutoffs corresponded to the value at which the probability of an adverse outcome surpassed 0.5. This corresponded to an equal cost of false-positive and false-negative findings. Model assumptions were evaluated with residual plots. All analysis was performed with R statistical software (R Foundation for Statistical Computing, Vienna, Austria). For 1 patient, ASA classification was not available. Based on the patient’s age and the occurrence of dysphagia and pulmonary aspiration, this patient probably would have been classified as ASA III or ASA IV. However, in the interest of conservative analysis, the authors assigned the unknown value as ASA II. This decision did not qualitatively affect the results.

**RESULTS**

**Univariate Analysis**

The findings showed that ASA classification was clearly correlated with dysphagia. Incidence rates were 1 of 14 for ASA I and ASA II, 15 of 26 for ASA III, and 6 of 12 for ASA IV. Comparison of ASA I and ASA II vs ASA III (odds ratio [OR], 16.6; 95% confidence interval [CI], 1.95 to 800; P=.002) as well as ASA I and ASA II vs ASA III and ASA IV (OR, 15.3; 95% CI, 1.94 to 711; P=.002) showed significant differences. A strong relationship was found between age and dysphagia (OR [per year], 1.083; 95% CI, 1.018 to 1.158; P=.02), but the difference was not significant after correction for multiple testing.

The best predictor of combined severe outcomes (pulmonary aspiration and pneumonia/aspiration pneumonitis) was dysphagia. The incidence of severe outcomes showed a clear correlation with dysphagia: 0 of 30 vs 8 of 22 for pulmonary aspiration, 1 of 30 vs 5 of 22 for pneumonia, and 1 of 30 vs 12 of 22 for combined severe outcomes. Dysphagia was significantly associated with both pulmonary aspiration (OR, 16.11; 95% CI, 2.66 to infinity; P<.001) and combined severe outcomes (OR, 32.2; 95% CI, 3.92 to infinity; P<.001). No other predictor was significantly related.

**Regression Analysis**

**Dysphagia.** The results of logistic regression were consistent with the univariate results. Age and ASA classification remained correlated with dysphagia even after adjusting for the other variables [age (per year); OR, 1.06; 95% CI, 0.99 to 1.15; P=.08]; (ASA III vs ASA I and ASA II: OR, 13.93; 95% CI, 1.80 to infinity; P=.02); (ASA IV vs ASA I and ASA II: OR, 9.94; 95% CI, 0.91 to 109.0; P=.059]). The incidence in the ASA IV group was slightly but not significantly lower than that in the ASA III group. Therefore, because it was impossible to differentiate the risk of adverse outcomes between ASA III and ASA IV, it was reasonable to combine these groups into 1 predictor (ASA III and ASA IV vs ASA I and ASA II: OR, 12.6; 95% CI, 1.3 to infinity; P=.022). Sex was an unimportant variable (OR, 0.937; 95% CI, 0.24 to 3.99; P=.927).

To study the effect of age on dysphagia in the most at-risk ASA classes, Akaike’s information criterion was used to merge the ASA III and ASA IV groups and create a model without other variables. The authors determined the estimated 50% point for the combined ASA III and ASA IV groups (age, 80.2 years; 95% CI, 57 to 101). The confidence interval for the cutoff is large and reflects uncertainty about the effect of age. However, a clear difference was seen between the incidence of dysphagia in patients younger than 80 years in the combined ASA III and ASA IV group (3 of 11) (p1, 0.32; 95% CI, 0.10 to 0.61) compared with the incidence of dysphagia in patients older than 80 years (18 of 27) (p2, 0.66; 95% CI, 0.47 to 0.82; P=.036).

**Severe Outcome.** Dysphagia was a strong predictor of severe outcome, which was defined as pulmonary aspiration and pneumonia/aspiration pneumonitis, after adjusting for other covariates (OR, 32.3; 95% CI, 3.92 to infinity; P<.0001). More than half of the individuals who had dysphagia also experienced a severe outcome (P=.53; 95% CI, 0.32 to 0.72), whereas only 5% of the dysphagia-free group had a severe outcome (P=.05; 95% CI, 0.0 to 0.17).

**DISCUSSION**

Despite modern orthopedic protocols designed to allow near-immediate mobilization after a hip fracture, pain, recumbency, polypharmacy, disturbance of routine, and exposure to nosocomial pathogens are almost inevitable. These and other factors contribute to postfracture morbidity, including decubitus ulcers, delirium, wound or urinary tract infections, venous thromboembolic disease, congestive or ischemic heart disease, and pneumonia. Brown et al found that pneumonia, in particular, was a complication in the perioperative period in more than 8% of elderly patients with hip fracture. In a retrospective study of 467 patients with hip fracture, Khan et al found that 55 (11.8%) of patients were readmitted within 28 days of discharge. Pneumonia was the most common cause of readmission (15 of 55; 27.3%), and readmission alone was linked to higher 1-year mortality. Berry et al targeted pneumonia as a potentially modifiable complication of hip fracture that was associated with increased mortality in a cohort of patients in a nursing home.

Aspiration pneumonia results from an imbalance of oropharyngeal pathogens and host defenses. Healthy persons aspirate small quantities of oropharyngeal secretions while asleep. Presumably, ciliary action, coughing, and blood-mediated immune responses overcome this low-level inoculation. More virulent or voluminous pulmonary aspiration may result in pneumonia when these defenses are
impaired, for example, by neurologic disease that compromises the cough reflex or otherwise results in dysphagia. Chemical pneumonitis, simultaneously produced by aspiration of acidic gastric contents, may potentiate or compound microbial infection. Dysphagia may also result in sudden massive pulmonary aspiration and rapid death.

Aspiration events are rarely witnessed and may be clinically silent. Although it may be difficult to identify pulmonary aspiration as the cause of an individual case of pneumonia, the general etiologic link is accepted. Kikuchi et al found that 71% of patients with community-acquired pneumonia had low-level pulmonary aspiration compared with 10% of healthy, age-matched control subjects. The diagnosis of aspiration pneumonia is based on clinical findings, may be supported by a history of swallowing pathology, and is often confirmed by characteristic findings on imaging of the chest. Empiric or culture-driven antibiotic coverage of gram-negative bacilli and gram-positive cocci is often indicated, and supportive treatment is provided on a case-by-case basis.

Given the risk of swallowing-related morbidity and mortality in older patients with hip fracture and the potential for a speech and language pathology evaluation to avert these complications, the senior author’s department attempted to obtain speech and language pathology evaluations for all older patients admitted to the institution with hip fracture. Although high-quality evidence is available to guide many aspects of perioperative care in patients with hip fracture, the authors are unaware of previous studies addressing speech and language pathology evaluation and management of these patients.

The authors’ experience indicates that approximately 40% of older patients with hip fracture have dysphagia and that one-third of these [dysphagic] patients have frank pulmonary aspiration. Dysphagia conferred a 16-fold increase in the risk of pulmonary aspiration and pneumonia/pneumonitis, emphasizing the importance of intervention when dysphagia is identified. Preventive modalities recommended by the speech and language pathology service included dietary restrictions (eg, mechanical soft diet or thickened liquids) and aspiration precautions. Aspiration precautions are typically enforced by nursing staff or family members at the bedside and include monitoring at meal times, chin-down posturing, slow feeding, hand feeding, alternation of solids and liquids, and avoidance of straws. Feeding tubes, gastric acid–reducing agents, and psychoactive medications may be helpful in some cases, and these interventions were observed in the current series.

The importance of continued attention to swallowing pathology beyond the inpatient setting has been emphasized by Kind et al, who noted that nearly half of patients with hip fracture and stroke received no dysphagia-related instructions at discharge.

Statistical analysis showed a strong correlation between ASA III and ASA IV and dysphagia. Patients who were older than 80 years were at particular risk. Conversely, patients classified as ASA I or ASA II were unlikely to have dysphagia, pulmonary aspiration, or pneumonia/aspiration pneumonitis. The ASA classification was designed to quantify a patient’s overall health. It is typically estimated by an anesthesiologist before surgery and is part of preoperative risk assessment. Its widespread use has permitted standardization and epidemiologic study. A high ASA classification has been shown to be predictive of morbidity and death after hip fracture.

Donegan et al identified a strong association between ASA III and ASA IV and medical complications after hip fracture surgery in elderly patients. Brown et al described a specific link between the ASA classification of patients with hip fracture and pneumonia. Michel et al found that ASA III and ASA IV carried an almost 9-fold increased risk of death in the year after hip fracture.

The current findings are consistent with these reports and suggest a meaningful difference between patients classified as ASA I or ASA II and those classified as ASA III or ASA IV. In the current study, those classified as ASA III or ASA IV were nearly 8 times more likely to have dysphagia.

**Limitations**

This study had several limitations, including its retrospective design, relatively small size, lack of a control group, and reliance on a partially subjective evaluation performed by more than 1 speech and language pathologist. Although the authors’ department attempted to obtain speech and language pathology evaluations for all older patients with hip fracture, a number of patients who otherwise met the criteria were omitted from this analysis because a speech and language pathology evaluation was impossible, for example, because the patient was intubated. Therefore, this study ignored a meaningful cohort. Swallowing pathology certainly exists in patients who cannot undergo a bedside speech and language pathology evaluation, and this subpopulation warrants further study. Other patients who may have met the criteria were not included because a speech and language pathology evaluation was not performed or because an adequately detailed record could not be obtained. Finally, the study did not quantify a reduction in relative risk imparted by speech and language pathology intervention, and it suggests a role for systematic, prospective study in this area.

**Conclusion**

This study showed that dysphagia is common among older patients with hip fracture and confirmed that dysphagia is linked to significant pulmonary complications. A simple bedside dysphagia/aspiration evaluation, directed particu-
larly at older patients classified as ASA III or ASA IV, may be an efficient means of avoiding morbidity and even death in these patients.

References


