Implications of postoperative pulmonary aspiration following major urologic surgery

Eric J. Kirshenbaum, MD,[1,2] Robert H. Blackwell, MD,[1,2] Belinda Li, MD,[1] Anai N. Kothari, MD,[2,3] Paul C. Kuo, MD,[2,3] Robert C .Flanigan, MD,[1] Alex Gorbonos, MD,[1] Gopal N. Gupta, MD[1,2]

[1]Department of Urology, Loyola University Medical Center, Maywood, Illinois, USA
[2]One:MAP Division of Clinical Informatics and Analytics, Loyola University Medical Center, Maywood, Ilinois, USA
[3]Department of Surgery, Loyola University Medical Center, Maywood, Ilinois, USA

KIRSHENBAUM EJ, BLACKWELL RH, LI B, KOTHARI AN, KUO PC, FLANIGAN RC, GORBONOS A, GUPTA GN. Implications of postoperative pulmonary aspiration following major urologic surgery. *Can J Urol* 2018;25(1):9186-9192.

Introduction: *The purpose of this article is to assess the incidence of pulmonary aspiration following major urologic surgery, predictors of an aspiration event, and subsequent clinical outcomes.*

Materials and methods: *The Healthcare Cost and Utilization Project State Inpatient Database for California between 2007-2011 was used to identify cystectomy, prostatectomy, partial and radical nephrectomy patients. Aspiration events were identified within 30 days of surgery. The primary outcome was 30 day mortality and secondary outcomes included total length of stay, discharge location, and diagnoses of acute renal failure, pneumonia or sepsis. Descriptive statistics were performed. A multivariable logistic regression was performed to determine independent predictors of an aspiration event. A separate nonparsimonious logistic regression was fit to determine the independent effect of an aspiration event on 30 day mortality.*

Results: *Of 84,837 major urologic surgery patients 319 (0.4%) had an aspiration event. Risk factors for aspiration included ileus, congestive heart failure, paraplegia, chronic lung disease, and age ≥ 80 years (all $p < 0.01$). Aspiration patients had higher rates of renal failure (36.1% versus 2.5%), pneumonia (36.1% versus 2.5%), sepsis (35.7% versus 0.7%), a prolonged length of stay (17 days versus 3 days), and discharge to nursing facility(26.3% vs 2.3%) (all $p<0.001$). The 30 day mortality rate following aspiration was 20.7% compared to 0.8% ($p < 0.001$). Aspiration independently increases the risk of 30 day mortality (OR 3.1 (95%CI 2.2-4.5).*

Conclusions: *Postoperative aspiration following major urologic surgery is a devastating complication and precautions must be undertaken in high risk patient populations to avoid such an event.*

Key Words: aspiration, pneumonia, postoperative complications

Introduction

Complications after major urologic surgery pose challenges for patients and their families as well as the healthcare system. They can lead to prolonged lengths of stay, additional interventions, and premature mortality. In patients undergoing radical cystectomy, the rate of any postoperative complication may be as high as 56.3%.[1] Furthermore, patients with postoperative complications are 4.3 times as likely to be readmitted within 30 days, which has significant implications in the evolving landscape of hospital reimbursements.[2]

Among the most devastating of postoperative complications is a pulmonary aspiration event (pAE), defined as the inhalation of gastric or oropharyngeal contents into either the upper or lower respiratory tract.[3] Known risk factors for pulmonary aspiration are altered consciousness, gastrointestinal abnormalities, and advanced age,[4] making surgical patients especially vulnerable because of general anesthesia and delayed return of gastrointestinal motility after surgery. Historically, pulmonary aspiration was associated with mortality rates up to 40%-90%.[5,6] While these rates have improved over the past 3 decades, a pAE

Accepted for publication November 2017

Address correspondence to Dr. Eric J. Kirshenbaum, Dept. of Urology, Loyola University Medical Center, 2160 S. First Avenue, Fahey Center, Room 241, Maywood, IL 60153 USA

has remained a morbid complication within the non-urologic literature. While a rare occurrence, aspiration has been demonstrated to account for 10%-50% of all anesthesia-related deaths.[7-9] A United Kingdom-based database of anesthesia complications (NAP4) found aspiration to account for 17% of reported anesthesia events and 50% of anesthesia-related deaths.[7] Among the general surgery population, a pAE has been demonstrated to increase inpatient mortality risk by 7.6 times.[10] Similarly, Fineberg et al found that a pAE increased mortality 19 times among cervical spine surgery patients, as well as being associated with a significant increase in length of stay and cost utilization.[11]

Despite the significant morbidity and mortality demonstrated in the non-urologic literature associated with a pAE, no prior investigations have examined this outcome among urology patients undergoing major surgery. Our objective is to assess the incidence and clinical consequences of aspiration in urology patients in a population-wide database. We aim to identify predictors of aspiration to better understand this potentially fatal and avoidable complication.

Materials and methods

Data source

The Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID) for the state of California, including years 2007-2011 was used. The HCUP SID was sponsored by the Agency for Healthcare Research and Quality (AHRQ) to inform health-related decisions. The HCUP SID includes patient discharge records for all payers within an individual state. Patient data is de-identified and protected, and includes over 100 clinical and nonclinical variables. A benefit of this dataset is a unique linkage variable included in the database, allowing longitudinal follow-up of patients over time and across inpatient admissions.[12]

Patient selection

Using International Classification of Diseases, Ninth-Edition, Clinical Modification (ICD-9-CM) codes major urologic surgeries including nephrectomy (55.5x), partial nephrectomy (554), prostatectomy (60.3-60.5, 60.69, 60.62) and cystectomy (57.7, 57.71, 57.79, 68.8) in adults (age ≥ 18 years) were identified. A minimally invasive indicator, including both laparoscopic (54.21) and robotic procedures (17.4x), was assigned based on ICD-9-CM codes utilized in prior studies.[13] Patient comorbidity was assessed using the Elixhauser approach and severity of comorbid disease burden measured with the Charlson Comorbidity Index. Baseline patient characteristics were identified using ICD-9-CM codes with associated present on admission indicators.

Outcome measures

A pulmonary aspiration event within 30 days of the surgical admission was defined using ICD-9-CM diagnosis codes (507.0-507.9), based on methods used in prior study on the subject.[10] Patients were assessed for total length of stay, discharge location, 30 day mortality, as well as new diagnoses of ileus, acute renal failure, pneumonia or sepsis during their surgical admission.

Patient baseline characteristics and medical comorbidities were assessed, including age, race (Caucasian, African American, Hispanic, Asian, unknown/other), primary insurance provider (Medicare, Medicaid, private insurance, self-pay/other) type of procedure performed, as well as diagnoses of diabetes mellitus, hypertension, obesity, congestive heart failure, paraplegia, chronic renal insufficiency and chronic lung disease. Additionally, a Charlson Comorbidity Index was calculated.

Statistical analysis

Descriptive statistics were performed. Continuous variables were reported as medians and interquartile range (IQR), with Wilcoxon rank-sum test performed to assess significance. For categorical variables chi-squared tests were performed. A multivariable logistic regression model was fit to determine independent predictors of a pAE following major urologic surgery. To determine the independent effect a pAE has on 30 day mortality, a non-parsimonious multivariable logistic regression model was fit including all covariates, including postoperative complications of acute renal failure, sepsis, and pneumonia as they represent their own independent risk of mortality. Stata 13 (StataCorp, College Station, TX, USA) was used for all statistical analysis, with a p value of < 0.05 as the threshold for statistical significance.

Results

Between 2007 and 2011, 84,837 patients underwent major urologic surgery including radical cystectomy, radical prostatectomy, partial nephrectomy or radical nephrectomy. Table 1 describes the baseline characteristics and comorbidities of patients who underwent major urologic surgery, stratified by whether an aspiration event occurred. Patients in the aspiration group were older (72 years (60-79) versus 62 years (55-69), $p < 0.001$), primarily Caucasian (68%) or Hispanic (15.4%) and carried Medicare (68.4%)

TABLE 1. **Baseline patient characteristics by aspiration**

	Aspiration event		
	No	**Yes**	
	N (%)	**N (%)**	**p value**
Demographic characteristics			
Age (years), median (IQR)	62 (55-69)	72 (60-79)	< 0.001
Race			0.02
Caucasian	51,751 (61.2)	217 (68.0)	
Black	5,220 (6.2)	17 (5.3)	
Hispanic	12,987 (15.4)	49 (15.4)	
Asian	4,794 (5.7)	17 (5.3)	
Other/unknown	9,766 (11.5)	19 (6.0)	
Primary insurance provider			< 0.001
Private	44,074 (52.2)	69 (21.6)	
Medicare	32,078 (37.9)	218 (68.4)	
Medicaid	4,125 (4.9)	23 (7.2)	
Self-pay/uninsured	4,241 (5.0)	* (2.8)	
Medical comorbidities			
Obesity	8,024 (9.5)	33 (10.3)	0.6
Diabetes mellitus	10,719 (12.7)	54 (16.9)	0.02
Hypertension	38,220 (45.3)	150 (47.0)	0.5
Congestive heart failure	1,727 (2.1)	77 (24.1)	< 0.001
Paraplegia	492 (0.6)	20 (6.3)	< 0.001
Chronic lung disease	8,316 (9.9)	78 (24.5)	< 0.001
Chronic renal insufficiency	4,306 (5.1)	77 (24.1)	< 0.001
Charlson comorbidity, median (IQR)	2 (2-3)	3 (2-5)	< 0.001
Surgical characteristics			
Surgical procedure			< 0.001
Radical cystectomy	5,323 (98.6)	76 (1.4)	
Radical prostatectomy	44,579 (99.92)	31 (0.08)	
Partial nephrectomy	7,387 (99.5)	39 (0.5)	
Radical nephrectomy	27,229 (99.4)	173 (0.6)	
Postoperative ileus	5,047 (6.0)	93 (29.2)	< 0.001
Type of surgery			
Minimally invasive	25,053 (99.86)	36 (0.14)	< 0.001
Open	59,465 (99.53)	283 (0.47)	

*censored due to data usage restrictions

or private insurance (21.6%). The overall risk of aspiration following major urologic surgery was low, affecting 319 patients (0.4%). In terms of baseline medical comorbidities, patients who experienced a pAE had higher rates of congestive heart failure (24.1% versus 2.1%, $p < 0.001$), paraplegia (6.3% versus 0.6%, $p < 0.001$), chronic lung disease (24.5% versus 9.9%, $p < 0.001$), chronic renal insufficiency (24.1% versus 9.9%, $p < 0.001$), and a higher degree of medical comorbidity by Charlson Comorbidity Index (median 3 versus 2, $p < 0.001$). Radical cystectomy carried the highest rate of aspiration at 1.4% compared to 0.08% for prostatectomy, 0.5% for partial nephrectomy and 0.6% for radical nephrectomy ($p < 0.001$).

The clinical outcomes following an aspiration event were measured, Figure 1 and Table 2. In terms of 30 day mortality, patients who had a pAE had a mortality rate of 20.7% compared to 0.8% for those who had not ($p < 0.001$). The average length of stay in patients who had a pAE was 17 days compared to 3 days ($p < 0.001$). Additionally, a pAE carried a significantly increased rate of acute renal failure (36%

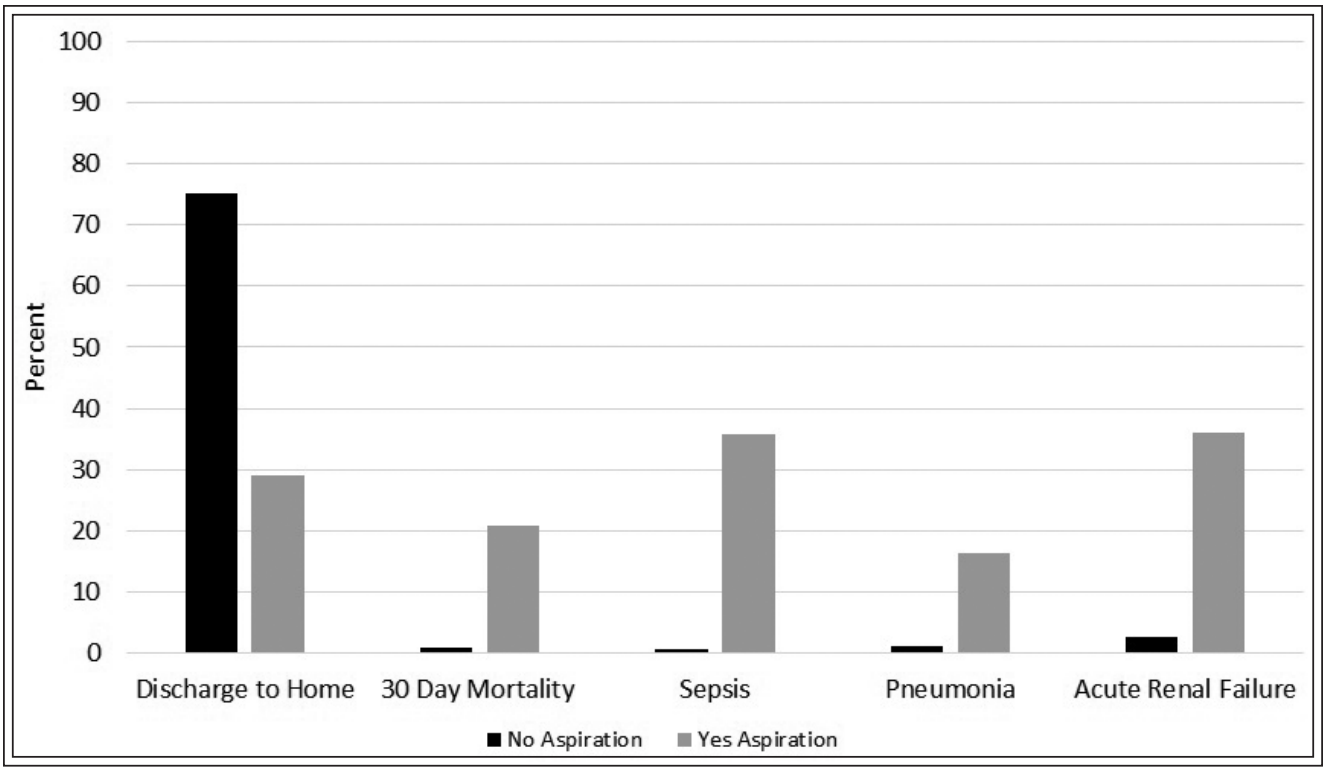

Figure 1. Rates of outcomes based on patient aspiration status. $p < 0.001$ for all variables.

versus 2.5%, $p < 0.001$), pneumonia (16% versus 1%, $p < 0.001$) and sepsis (35.7% versus 0.7%, $p < 0.001$). Patients who did not have an aspiration event were discharged to home in 82.2% of cases, compared to only 43.5% if an aspiration event occurred ($p < 0.001$). Alternate locations of discharge for aspiration cohort was nursing facilities (26.3% versus 2.3%), another facility (1.3% versus 0.2%), against medical advice (0.0% versus 0.04%), undocumented (13.2% versus 14.8%) or inpatient mortality (15.7% versus 0.8%).

TABLE 2. **Outcomes, stratified by aspiration**

	Aspiration event		
	No	**Yes**	
	N (%)	**N (%)**	**p value**
Length of stay (days), median (IQR)	3 (2-4)	17 (8-31)	< 0.001
Acute renal failure	2,146 (2.5)	115 (36.1)	< 0.001
Pneumonia	823 (1.0)	52 (16.3)	< 0.001
Sepsis	573 (0.7)	114 (35.7)	< 0.001
Discharge location			< 0.001
Home	63,523 (75.2)	93 (29.1)	
Home health	5,952 (7.0)	46 (14.4)	
Nursing facility	1,958 (2.3)	84 (26.3)	
Another facility	151 (0.2)	* (1.3)	
Against medical advice	31 (0.04)	0 (0)	
Not documented	12,460 (14.8)	42 (13.2)	
Inpatient mortality	443 (0.5)	50 (15.7)	
30 day mortality	637 (0.8)	66 (20.7)	< 0.001

TABLE 3. **Logistic regression**

	Univariate			Multivariate		
Demographic characteristics	**OR**	**95% CI**	**p value**	**OR**	**95% CI**	**p value**
Age (years)						
< 50	Referent			Referent		
50-60	0.8	0.5-1.3	0.5	1.3	0.8-2.2	0.3
60-70	0.9	0.6-1.4	0.8	1.1	0.8-1.7	0.8
70-80	2.8	1.8-4.1	< 0.001	1.4	0.8-2.4	0.2
>=80	7.5	4.9-11.5	< 0.001	2.1	1.2-3.7	0.01
Race						
Caucasian	Referent			Referent		
Black	0.8	0.5-1.3	0.3	0.9	0.5-1.5	0.7
Hispanic	0.9	0.7-1.2	0.5	0.8	0.6-1.2	0.3
Asian	0.8	0.5-1.4	0.5	0.7	0.4-1.3	0.3
Other/unknown	0.5	0.3-0.7	< 0.001	0.8	0.5-1.3	0.4
Primary insurance provider						
Private	Referent			Referent		
Medicare	4.3	3.3-5.7	< 0.001	1.7	1.2-2.4	0.006
Medicaid	3.6	2.2-5.7	< 0.001	1.1	0.6-1.9	0.8
Self-pay/uninsured	1.4	0.7-2.7	0.4	1.9	0.8	4.9
Medical comorbidities						
Obesity	1.1	0.8-1.6	0.6	0.8	0.6-1.3	0.4
Diabetes mellitus	1.4	1.0 - 1.9	0.02	1.1	0.8-1.5	0.6
Hypertension	1.1	0.9-1.3	0.5	1	0.8-1.3	0.9
Congestive heart failure	15.2	11.7-19.8	< 0.001	3.1	2.2-4.3	< 0.001
Paraplegia	11.4	7.2-18.1	< 0.001	3.8	2.2-6.5	< 0.001
Chronic lung disease	3	2.3-3.9	< 0.001	1.5	1.1-2.0	0.008
Chronic renal insufficiency	5.9	4.6-7.7	< 0.001	1.2	0.9-1.7	0.2
Charlson Comorbidity, median (IQR)	1.3	1.3-1.4	< 0.001	1	1.0-1.1	0.051
Surgical characteristics						
Surgical procedure						
Radical cystectomy	18.6	12.4-28	< 0.001	3.4	2.1-5.4	< 0.001
Radical prostatectomy	Referent			Referent		
Partial nephrectomy	6.9	4.4-11	< 0.001	4.3	2.6-6.7	< 0.001
Radical nephrectomy	8.3	5.8-12	< 0.001	2.9	1.9-4.3	<0.001
Types of surgery						
Minimally invasive	0.3	0.2-0.4	< 0.001	0.8	0.5-1.1	0.2
Postoperative ileus	6.5	5.1-8.3	< 0.001	1.8	1.3-2.4	< 0.001

On multivariate analysis, Table 3, the independent predictors of a pAE was determined adjusted for baseline demographics and medical comorbidities. Age ≥ 80 years (OR 2.1 (95% CI 1.2-3.7), p = 0.01) and primary insurance provider of Medicare (OR 1.7 (95% CI 1.2-2.4), p = 0.006) significantly increased the odds of a pAE. While other/unknown race significantly decreased the likelihood of an aspiration event on univariate analysis, the significance was not sustained on the multivariate logistic regression model (OR 0.8(0.5-1.3). In additional, chronic medical comorbidities of CHF (OR 3.1(95% CI 2.2-4.3), paraplegia (OR 3.8(95% CI 2.2-6.5), and chronic lung disease (OR 1.5(95% CI 1.1-2.0) all independently increased the risk of a pAE. Postoperative ileus was a strong independent predictor of an aspiration event (OR 1.8 (95% CI 1.3-2.4). Notably, diagnoses of obesity and diabetes mellitus did not increase the risk of a pAE, nor did surgical approach (minimally invasive versus open). Cystectomy (OR 3.4 (95% CI 2.1-5.4),

partial nephrectomy (OR 4.3 (95% CI 2.6-6.7) and radical nephrectomy (OR 2.9 (95% CI 1.9-4.3) all had an increased risk of a pAE compared to prostatectomy on multivariate analysis.

On the non-parsimonious model, a pAE event was determined to independently increase the risk of 30 day mortality (OR 3.1 (95% CI 2.1-4.5), adjusted for baseline demographics and medical comorbidities, as well as procedure type and postoperative complications of pneumonia, ileus, acute renal insufficiency, and sepsis.

Discussion

Aspiration events affect 1 in 250 patients (0.4%) undergoing major urologic surgery. This complication is associated with longer lengths of stay, higher rates of acute renal insufficiency, pneumonia, sepsis, and 30 day mortality. Patients at the higher risk for this complication are elderly (≥ 80 years of age), develop postoperative ileus, and carry significant chronic medical comorbidities.

Aspiration following major urologic surgery is clearly a devastating complication. The implication of a pAE has been documented in the non-urologic literature in both surgical and non-surgical patients. Studer et al performed a retrospective analysis of 70 patients who underwent abdominal surgery and subsequently developed aspiration pneumonia. They found that 53% of patients required reintubation with an overall mortality rate of 27%.[14] Similarly, Kozlow et al retrospectively analyzed 318,880 surgical patients and found that an aspiration event increase mortality risk by a factor of 7.6(OR 7.6 (95% CI 6.5-8.9),[10] consistent with the increased risk demonstrated in the present study (OR 3.1 (95%CI 2.2-4.5). Our study is consistent with previous non-urologic literature as we found the incidence of 30 day mortality following a pAE to be 20.7% compared to 0.8% in the absence of such an event. The pathophysiology of respiratory compromise is threefold, with concern for particulate matter acutely obstructing the airway, bacterial seeding with oropharyngeal/gut flora, and acid-related injury this overwhelming pulmonary insult results in pulmonary edema, decreased lung compliance, and increased ventilation-perfusion mismatch.[15]

Several risk factors have been identified in the non-urologic and non-surgical literature that put patients at increased risk for a pAE. Advanced age, poor oral care, history of stroke and history of dysphagia have all been found to increase a patient's risk of aspiration.[3] Our study was the first to look specifically at urologic patients in order to identify patients at increased risk prior to surgery. We found on multivariable analysis that a advanced age (≥ 80 years), history of congestive heart failure, paraplegia, and chronic lung disease all placed patients at increased risk for a pAE. Interestingly, while minimally invasive surgery appeared to decrease the risk of pAE on univariate analysis, findings did not persist in our multivariate logistic regression model.

While aspiration following major urologic surgery is an uncommon complication, such an event is often catastrophic for patients. As such, everything must be done to identify those patients at increased risk and implement appropriate prevention measures. Starks and Harbert prospectively analyzed the rate of aspiration pneumonia following implementation of an aspiration prevention protocol in the cardiothoracic surgery population.[16] Included in the protocol was extension of NPO status from 2 hours to at least 6 following surgery, head of bed at 45 degrees, and implementation of routine bedside swallow evaluation by speech therapy prior to initiation of diet. In the 6 months prior to initiation of the protocol the postoperative aspiration rate was 11%, which improved to 0% following protocol initiation. Although there is unlikely a need to implement such a broad protocol in all patients undergoing urologic surgery as the overall rate is significantly lower in our surgical population, there may be a benefit in those deemed to be at increased risk as identified by this study. Additionally, there should be a low threshold for ordering a speech evaluation prior to initiating a diet if there is any concern for dysphagia.

In addition to aspiration protocols, the use of nasogastric tube has historically been used to prevent aspiration pneumonia especially in the cystectomy population. While no randomized control trials have been done specifically in the urologic population, we can extrapolate from the general surgery literature the utility of NG tube for prevention of aspiration pneumonia. A Cochrane review meta-analysis in 2007 looked at prospective studies that randomized patients to routine NG tube versus no NG tube. They demonstrated that those patients that did not have routine NG tube had earlier return of bowel function and decrease in pulmonary complication.[17] Similar results in the cystectomy population have demonstrated that NG tubes are ineffective in preventing pulmonary complications.[18,19] While routine use of NG tube has been shown to be ineffective at preventing pulmonary complications, it is widely accepted that they should be considered in those patients with abdominal distension, postoperative ileus and emesis.

Given the retrospective nature of this study, several limitations exist. As with all administrative database

studies, the validity of data relies on accurate coding and may be subject to discrepancies within various institutions. We used established codes utilized in previous studies for pAEs to improve the accuracy and reproducibility of our study population. Additionally, the incidence of a pAE may be underreported as the diagnosis is subjective and may be differ among clinicians. Further, there may be patients who had pulmonary complications associated with a silent pAE that were misdiagnosed as having atelectasis, hospital acquired pneumonia, anesthesia complication or pulmonary embolism, leading to an underestimation in the present study.

Conclusion

Aspiration events affect 1 in 250 patients undergoing major urologic surgery, and are associated with increased postoperative complications, discharge to locations other than home, and 30 day mortality. Using the known risk factors for aspiration, targeted use of preventative measures may decrease the rate and impact of aspiration in the urologic population. □

References

1. Patel HD, Ball MW, Cohen JE, Kates M, Pierorazio PM, Allaf ME. Morbidity of urologic surgical procedures: an analysis of rates, risk factors, and outcomes. *Urology* 2015;85(3):552–560.
2. Lawson EH, Hall BL, Louie R et al. Association between occurrence of a postoperative complication and readmission. *Ann Surg* 2013;258(1):10-18.
3. Marik PE. Aspiration pneumonitis and aspiration pneumonia. *N Engl J Med* 2001;344(9):665-671.
4. Raghavendran K, Nemzek J, Napolitano LM, Knight PR. Aspiration-induced lung injury. *Crit Care Med* 2011;39(4):818-826.
5. Cameron JL, Mitchell WH, Zuidema GD. Aspiration pneumonia. Clinical outcome following documented aspiration. *Arch Surg* 1973;106(1):49-52.
6. Lewis RT, Burgess JH, Hampson LG. Cardiorespiratory studies in critical illness. Changes in aspiration pneumonitis. *Arch Surg* 1971;103(2):335-340.
7. Robinson M, Davidson A. Aspiration under anaesthesia: risk assessment and decision-making. *Continuing Education in Anaesthesia, Critical Care & Pain* 2013;14(4):171-175.
8. Warner MA, Warner ME, Weber JG. Clinical significance of pulmonary aspiration during the perioperative period. *Anesthesiology* 1993;78(1):56-62.
9. Olsson GL, Hallen B, Hambraeus-Jonzon K. Aspiration during anaesthesia: a computer-aided study of 185,358 anaesthetics. *Acta Anaesthesiol Scand* 1986;30(1):84-92.
10. Kozlow JH, Berenholtz SM, Garrett E, Dorman T, Pronovost PJ. Epidemiology and impact of aspiration pneumonia in patients undergoing surgery in Maryland, 1999–2000. *Crit Care Med* 2003;31(7):1930-1937.
11. Fineberg SJ, Oglesby M, Patel AA, Singh K. Incidence, risk factors, and mortality associated with aspiration in cervical spine surgery. *Spine* 2013;38(19):E1189-E1195.
12. Anon: HCUP State Inpatient Databases (SID). Healthcare Cost and Utilization Project (HCUP). Available at: www.hcup-us.ahrq.gov/sidoverview.jsp, accessed 09/2017.
13. Trinh Q-D, Sammon J, Sun M et al. Perioperative outcomes of robot-assisted radical prostatectomy compared with open radical prostatectomy: results from the nationwide inpatient sample. *Eur Urol* 2012;61(4):679-685.
14. Studer P, Räber G, Ott D, Candinas D, Schuriger B. Risk factors for fatal outcome in surgical patients with postoperative aspiration pneumonia. *Int J Surg* 2016;27:21-25.
15. Engelhardt T, Webster NR. Pulmonary aspiration of gastric contents in anaesthesia. *Br J Anaesth* 1999;83(3):453-460.
16. Starks B, Harbert C. Aspiration prevention protocol: decreasing postoperative pneumonia in heart surgery patients. *Crit Care Nurse* 2011;31(5):38-45.
17. Verma R, Nelson RL. Prophylactic nasogastric decompression after abdominal surgery. In: Cochrane Database of Systematic Reviews. 2007.
18. Inman BA, Harel F, Tiguert R, Lacombe L, Fradet Y. Routine nasogastric tubes are not required following cystectomy with urinary diversion: a comparative analysis of 430 patients. *J Urol* 2003;170(5):1888-1891.
19. Pruthi RS, Nielsen M, Smith A, Nix J, Schultz H, Wallen EM. Fast track program in patients undergoing radical cystectomy: results in 362 consecutive patients. *J Am Coll Surg* 2010(1);210:93-99.