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Post-extubation dysphagia in trauma patients: it's hard to swallow

Amy M. Kwok, M.D., M.P.H.*, James W. Davis, M.D., Kathleen M. Cagle, R.N., M.P.H., Lawrence P. Sue, M.D., Krista L. Kaups, M.D., M.Sc.

UCSF Fresno, Department of Surgery, 2823 Fresno Street, Fresno, CA 93721, USA

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BACKGROUND: There is a significant incidence of unrecognized postextubation dysphagia in trauma patients. The purpose of this study was to evaluate the incidence, ascertain the risk factors, and identify patients with postextubation dysphagia who will require clinical swallow evaluation.

METHODS: A prospective observational study was performed on 270 trauma patients. Bedside clinical swallow evaluation was done within 24 hours of extubation. Logistic regression analysis was used to adjust for confounding variables.

RESULTS: The incidence of oropharyngeal dysphagia (OD) in our study was 42%. Ventilator days was the strongest independent risk factor for OD (3.6 vs 8.0, $P < .001$). The odds ratio showed a 25% risk for OD for each additional ventilator day. Silent aspiration was found in 37% of patients with OD.

CONCLUSIONS: Trauma patients requiring mechanical ventilation for ≥ 2 days are at increased risk for dysphagia and should undergo routine swallow evaluations after extubation.
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Dysphagia is defined as difficulty or inability to swallow. In patients requiring endotracheal intubation for mechanical ventilation, swallowing function is often temporarily impaired after removal of the endotracheal tube. The described incidence of postextubation dysphagia (PED) in a mixed medical and surgical population ranges from 3% to 62%.[1] PED results from both mechanical and cognitive mechanisms. Mechanical causes are related to the endotracheal tube and include mucosal abrasion, laryngeal edema, and decrease in laryngeal sensation. Cognitive mechanisms include traumatic brain injury or critical illness, which can lead to decreased coordination of the swallowing reflex.[2] Consequences of PED include aspiration of oral secretions, food, and liquids, leading to pneumonia with resultant prolongation of hospital stay and increased mortality.[3] Martino et al[4] showed that the risk for developing pneumonia is 11 times greater in adult patients with stroke who aspirate compared with those with no aspiration, leading to increases in mortality and hospital cost. We hypothesized that there is a significant incidence of unrecognized PED in trauma patients. The purpose of this study was to evaluate the incidence of dysphagia in recently extubated trauma patients, to ascertain risk factors for dysphagia, and to identify trauma patients at high risk for PED, including those with silent aspiration, who will benefit from clinical swallow evaluation (CSE) and intervention.

Methods

A prospective observational study was performed, at an American College of Surgeons–verified level 1 trauma

* Corresponding author. Tel.: +1-559-459-4090; fax: +1-559-459-3719.
E-mail address: kwoka74@gmail.com
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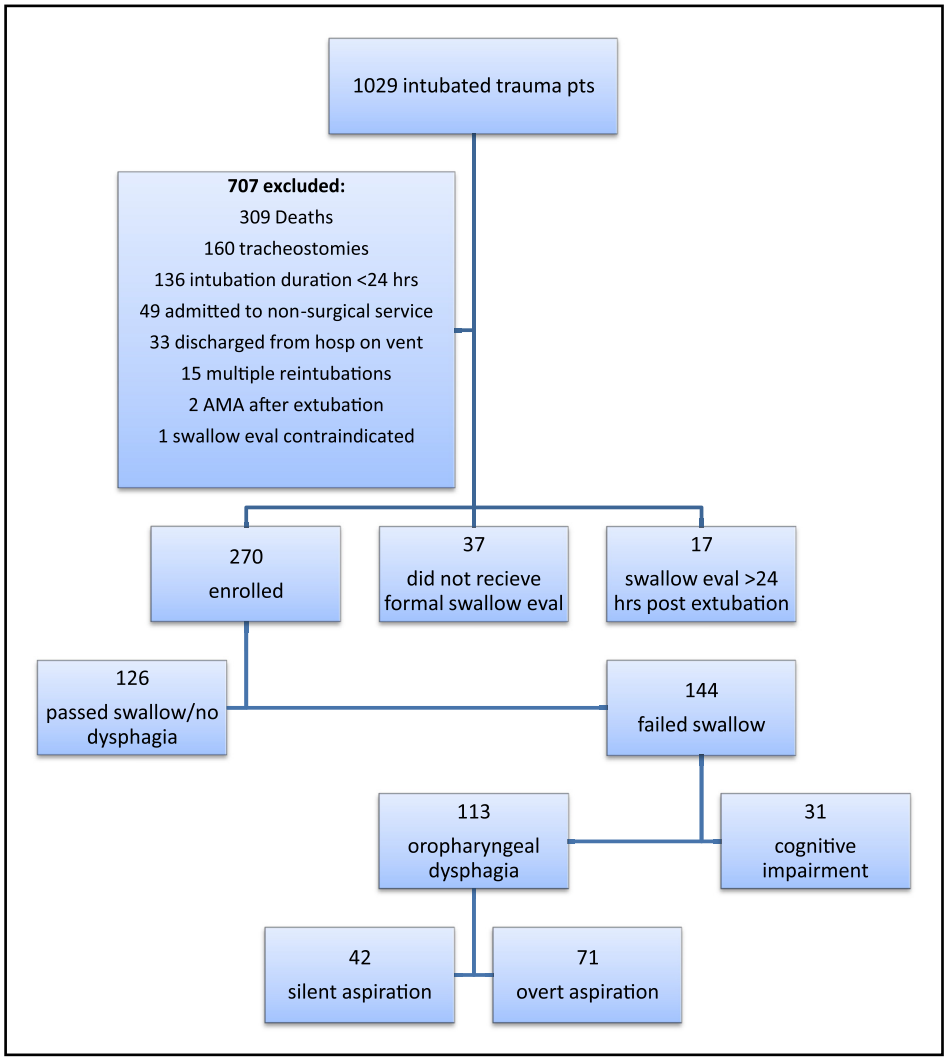

Figure 1 Flow diagram of patient inclusion. AMA = against medical advice.

center, from January 1, 2011, to December 31, 2012. Adult trauma patients who were endotracheally intubated, were subsequently extubated, and had bedside CSE performed by a speech language pathologist within 24 hours after extubation were included. Patients were excluded if they were extubated within 24 hours of intubation, died before extubation, underwent tracheostomy, had multiple repeat intubations, or did not have swallow evaluations done within 24 hours of extubation.

The CSE included an oral peripheral exam, assessment of laryngeal function, upper airway assessment, and trials of different consistencies, starting with the thickest consistency and progressing to thin liquids. Failure was defined as coughing when drinking, laryngeal or pharyngeal residue, inability to clear the oropharynx, or multiple reswallows. Silent aspiration was suspected when airway wetness was heard when talking or by auscultation of the larynx, or delayed cough after swallowing was seen on exam. Reasons for swallow evaluation failure were further differentiated into cognitive impairment, defined as somnolence or sedation and/or decreased mental ability to coordinate swallowing, and oropharyngeal dysphagia (OD), a mechanical inability to swallow.

Patient variables included age, gender, Glasgow Coma Scale (GCS) score on arrival, Abbreviated Injury Score (AIS) by region, Injury Severity Score, endotracheal tube size, total ventilator days, and development of aspiration pneumonia after extubation. This study was approved by the institutional review board of UCSF Fresno.

Statistical analysis was performed using chi-square analysis and the Mann-Whitney U test for independent samples. Logistic regression analysis was used to adjust for confounding variables and to determine odds ratios. Significance was attributed to a P value $< .05$.

Results

During the 2-year study period, 1,029 trauma patients required endotracheal intubation. Of these patients, 136 patients were extubated within 24 hours of intubation, 309 died, 160 underwent tracheostomy, 49 were admitted to a

Table 1 Comparison of patients with and without OD

Variable	OD (n = 113)	No dysphagia (n = 126)	*P*
Men	84 (74%)	108 (86%)	.04
Women	29 (26%)	18 (14%)	
Age	44 ± 20	36 ± 15	.001
GCS score on arrival	9 ± 5	10 ± 5	NS
ISS	22 ± 11	19 ± 9	.02
Head/neck AIS	2.1 ± 1.7	1.7 ± 1.7	NS
Face AIS	.52 ± .97	.46 ± .84	NS
Ventilator days	8 ± 5.8	3.6 ± 3.3	<.001
Mortality	1 (<.01%)	0	NS
ETT size (mm)	7.5 ± .2	7.5 ± .2	NS

Data are expressed as number (percentage) or mean ± SD.
AIS = Abbreviated Injury Scale; ETT = endotracheal tube; GCS = Glasgow Coma Scale; ISS = Injury Severity Score; OD = oropharyngeal dysphagia.

nonsurgical service, 33 were discharged from the hospital on a ventilator, 15 had multiple repeat intubations, 2 left against medical advice after extubation, and 1 had a contraindication to a swallow evaluation, leaving a study cohort of 324 patients. Of these, 37 patients did not receive formal swallow evaluations, and 17 had CSEs done >24 hours from extubation leaving 270 patients in the study group. One hundred twenty-six of the 270 patients (46%) passed the initial swallow evaluation, and 144 of the 270 (54%) failed. In the group with PED, 31 patients had dysphagia secondary to cognitive impairment, and 113 had OD (Fig. 1).

The 113 patients with OD were compared with the 126 patients without dysphagia. The groups with and without OD did not differ statistically with regard to head and neck AIS, face AIS, endotracheal tube size, or mortality. However, patients with OD were older (44 vs 36 years, $P = .001$), had more ventilator days (8 vs 3.6 days, $P < .001$), and a higher Injury Severity Score (22 vs 19, $P = .02$) (Table 1). Using binary logistic regression analysis to control for confounding variables, ventilator days and age remained significant independent risk factors for OD (Table 2). When modeled as a continuous variable, the odds ratio for ventilator days by logistic regression was 1.25 and for age was 1.03. The receiver operating characteristic curve for ventilator days had an area under the curve of .78 ($P < .001$), while that for age had an area under the curve of .62 ($P = .001$), indicating that ventilator days was the stronger predictor of OD rather than age.

Of importance, when looking at patients with OD, 42 of 113 patients (37%) were found to have silent aspiration upon examination, placing them at the highest risk for complications from dysphagia. After the diagnosis of dysphagia was made, interventions were undertaken ranging from keeping the patients on nil per os status to various dietary modifications (honey-thickened liquids, soft diet, etc). In the OD group, 62 of 113 patients (55%) were kept nil per os and required further evaluation before starting a diet, while the rest were started on a modified diet. Overall, all 113 patients resolved their dysphagia with ongoing treatment from speech therapy and were discharged on a diet. In contrast, 26 of 31 patients (84%) in the cognitive impairment group remained nil per os after initial swallow evaluation. However, 28 of the 31 patients (90%) were discharged on a diet, and only 3 of 31 (10%) were discharged on tube feeds (Table 3).

Comments

The average annual cost in the United States for critically ill patients with PED is estimated at >$500 million, primarily because of the occurrence of aspiration, leading to increases in pneumonia, hospital days, and mortality.[5] Endotracheal intubation has been associated with dysphagia, but few studies have examined the PED rate and risk factors for this in the trauma population. One study showed a correlation between admission GCS

Table 2 Independent predictors of OD

Predictor	OD (n = 113)	No dysphagia (n = 126)	Mann-Whitney *U* test *P* value	Logistic regression adjusted *P* value	OR (logistic regression exp [B])	95% CI
Ventilator days	8 ± 5.8	3.6 ± 3.3	<.001	<.001	1.25	1.15–1.36
Age (y)	44 ± 20	36 ± 15	.001	.003	1.03	1.01–1.04
ISS	22 ± 11	19 ± 9	.02	NA	NA	NA

Data are expressed as mean ± SD.
CI = confidence interval; ISS = Injury Severity Score; NA = not applicable; OD = oropharyngeal dysphagia; OR = odds ratio.

Table 3 Interventions for dysphagia

Intervention	OD (n = 113)	Cognitive impairment (n = 31)
NPO	62 (55%)	26 (84%)
Dietary modification	51 (45%)	5 (16%)
Discharged on diet	113 (100%)	28 (90%)

NPO = nil per os; OD = oropharyngeal dysphagia.

score and PED in trauma patients. In that study, patients with dysphagia had an admission GCS score of 9 compared with a GCS score of 14 in patients without dysphagia.[6] A more recent, retrospective study, looking at PED in the trauma population, found that age >55 years and number of ventilator days were predictive of dysphagia.[7] In our prospective observational study, we found ventilator days and age to be independent risk factors for OD. When looking at the area under the receiver-operating characteristic curve, ventilator days were a much stronger predictor of OD than age.

Laryngeal injury including edema, granuloma, and vocal cord paralysis is a known complication of prolonged endotracheal intubation. Santos et al[8] found that risk factors for postextubation laryngeal injury included duration of intubation and endotracheal tube size.[8] In this study, no difference was found in endotracheal tube size between the groups with and without dysphagia.

The length of time intubated was strongly associated with dysphagia. Each day after the initial 24 hours on mechanical ventilation increased the likelihood of dysphagia by 25%. After 2 days of mechanical ventilation, the risk for OD reached 50%. Of greater concern, 37% of the patients with dysphagia were found to have silent aspiration. A routine swallow evaluation after extubation for any trauma patient who has been on mechanical ventilation for ≥2 days will identify the group of the patients at risk for dysphagia (50%) and, more important, identify the high-risk group of silent aspirators. Outcomes in patients with dysphagia with speech therapy interventions were excellent. All patients with OD improved with dietary modifications and serial CSEs and were discharged on a regular diet. Furthermore, after implementing routine CSE at our institution for postextubation trauma patients, only 2 of the 144 patients with OD (.7%) were found to develop pneumonia related to aspiration after extubation during the hospital course.

Our study had several limitations. The gold standard for evaluation of dysphagia is a video fluoroscopic swallow study or a fiber-optic endoscopic evaluation of swallowing. Although there has been no comparison between fiber-optic endoscopic evaluation of swallowing and CSE, it is possible that a higher percentage of patients with dysphagia were not accounted for with only a bedside CSE, because we did not confirm our CSE with any fluoroscopic imaging. Last, 54 patients were excluded because they were not evaluated with CSE or underwent evaluation >24 hours after extubation.

Conclusions

To our knowledge, this study is the largest and only prospective trial of PED in the trauma population. The incidence of OD in our study was 42%. The single independent risk factor was the number of ventilator days. The risk for dysphagia increased to 50% after 2 days of intubation. Risk factors that were not associated with OD included gender, Injury Severity Score, AIS by region, GCS score on admission, and endotracheal tube size. Of importance, 37% of the patients with OD were found to have silent aspiration, placing them at the highest risk for complications from dysphagia. However, with dietary modifications and serial CSEs, all OD resolved by day of discharge. We recommend that all patients requiring mechanical ventilation for ≥2 days have a beside CSE after extubation. Early identification and intervention in this high-risk group can lead to reductions in complications associated with aspiration.

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Discussion

Michael Truitt, M.D. (Dallas, TX): I'd like to congratulate Dr Kwok on an excellent presentation.

This is another in a long line of provocative and well executed projects from the Fresno group. This particular project included 680 trauma patients followed prospectively of which 127 ultimately met study criteria. Ultimately they found an approximately 50% incidence of dysphagia. They further characterized these patients into 2 categories based on etiology. These categories were broadly defined as cognitive impairment and oropharyngeal dysfunction. Of those patients in the oropharyngeal dysfunction group, 42% had evidence of silent aspiration. That number surprised me and it is important as it could have a significant impact on patient outcomes. As a result, I have 3 questions:

1. What was the indication for a swallow postextubation? Was it protocolized or was this at attending discretion? If it was at the discretion of the attending, could this have led to a selection bias?

2. Did you consider elective versus emergent/difficult intubations as a risk factor? Ventilator days in that setting could simply be a surrogate for patients who had a difficult intubation or were more acutely ill.

3. Finally, have you been able to demonstrate improved outcomes as a result of early diagnosis and treatment of patients with postextubation dysphagia? I haven't seen this clinically as frequently as you and others describe it. What is the clinical significance of these findings?

Thank you again for the opportunity to discuss this paper.

Amy Kwok, M.D. (Fresno, CA): We did not. We had about 135 patients that did not get a swallow evaluation. Most of the reason for that was that they had a swallow evaluation greater than 24 hrs or they were moved out of the ICU. We did not look at that population to compare it to our study group population.

For Dr Truitt, thank you for your questions. What was the indication for swallow post extubation? We did actually have a protocol in place. All the patients that were in the ICU that were intubated and extubated received a swallow evaluation within 24 hours of extubation. For your next question, for the elective vs emergent extubation, all of our patients were trauma patient and were intubated emergently. We therefore did not look at elective vs emergent intubation in this population. But it will be something that we will looking for in the future. For outcomes, we did not specifically address this topic in our study. This was a prospective observational study. We do know that 2 of the 156 patients in our study did have documented aspiration pneumonia prior to discharge. But we did not look specifically at the outcomes in our study.

Randall Friese, M.D. (Tucson, AZ): I just want to say that was an outstanding study, well organized, well designed, very focused, well analyzed. I want to ask you. Did you have enough data to do a receiver operating curve analysis to see exactly where the cutoff is? I know you are saying somewhere between 3 and 8? And you went with 3 in your recommendations, but maybe it is 5? And maybe we can do a few of these studies. I think we are getting down to the point where we are trying to improve trauma care at this tiny little level and these tiny little changes do make differences in the long run. Thank you.

Dr Kwok: What we found was that the odds ratio was 1.22, gives us 22% risk per day. Our cutoff was at 3 days which would allow us to find and treat 66% of the patients with dysphagia. We did not however look at each specific day to see what day would be the best.

Christine Cocanour, M.D. (Sacramento, CA): Very nicely presented. Question: As for those patients that did have difficulty with swallowing, how long did it take for them to be able to regain their ability to swallow? I know you had said that by the time they were discharged, but since discharge can take place over many, many days to months, what was the average?

Dr Kwok: The majority actually regained normal function, oral swallowing function within 5 days. There were a couple outliers that were up to about a week to 2, but I would say that the majority did regain function within 5 days.