First Attempt Success at Intubation is Associated with a Lower Odds of Adverse Events in the ICU

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Background

First attempt success (FAS) at endotracheal intubation has been associated with a reduced occurrence of adverse events (AEs) in both emergency department and anesthesia intubations, and as a result, has become the surrogate outcome of choice on studies on airway management across multiple disciplines. Despite this, there is limited evidence associating FAS with reduced rates of AEs in the intensive care unit (ICU).

Objective

To evaluate the association of FAS with odds of AEs during intubations performed by intensivists in the ICU

Methods

Prospective observational study of 809 consecutive patients intubated in the ICU of a university medical center from January 1, 2012 – December 31, 2014.

Data were collected through a continuous quality improvement program on all patients intubated in the ICU over the study period. Data relating to patient demographics, each intubation attempt and AEs were analyzed.

An adjusted multivariate regression analysis was used to determine the relationship between FAS and AEs.

Results

809 patient were intubated during the 36-month study period

Table 1:

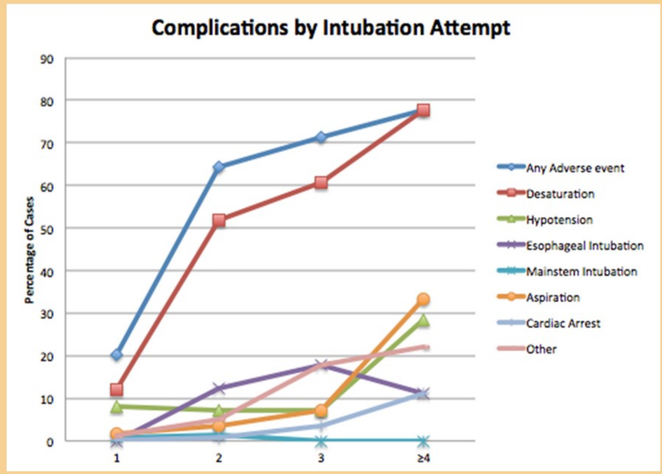
Patient Characteristics	
Characteristic	
Median age, yr	60 (53-73)
Male sex	44%
Reason for intubation	
Respiratory failure	44.6%
Airway protection	21.9%
Patient control	1.5%
Cardiac arrest	2.6%
Hypoxia	22.1%
Hemodynamic instability	3.5%
Severe metabolic acidosis	3.8%

Table 2:

Operator Characteristics	
Intubation Attempts	
FAS	78.5%
2nd Attempt	16.9%
3rd Attempt	3.5%
≥4 Attempts	1.1%
Operator Post Graduate Year	
PGY1	7.7%
PGY2	17.4%
PGY3	12.5%
PGY4	25.8%
PGY5	24.5%
PGY6	12.1%
Intubation Device	
DL	16.8%
VL	83.2%

FAS was associated with one or more AE in 20.2% while >1 attempt was associated with at least one AE in 66.1% ($p < 0.001$).

Figure 1:



Results (cont)

In logistic regression analysis, more than one intubation attempt was associated with 8.1 times the odds of an AE (95% CI 5.5-12.1), adjusting for method of intubation, use of video laryngoscopy, operator experience and prior non-invasive ventilation use.

Table 3:

Variable	Adjusted Odds Ratio (aOR)	95% CI	P value
Intubation attempts			
1	[Reference]		
2 or more	8.14	5.50 –12.06	<0.001
Method			
RSI	[Reference]		
Sedation only	0.98	0.65 – 1.48	0.914
No medication	0.76	0.24 – 2.37	0.635
Device			
DL	[Reference]		
VL	0.87	0.55 – 1.40	0.577
Operator PGY			
1	[Reference]		
2	0.48	0.23 – 1.00	0.052
3	0.75	0.36 – 1.59	0.452
4	0.80	0.41 – 1.58	0.525
5	0.99	0.51 – 1.95	0.985
6	1.20	0.57 – 2.53	0.632
NIV prior to intubation			
No	[Reference]		
Yes	1.76	1.24 – 2.51	0.002

Conclusion

In the ICU, a failed first attempt at endotracheal intubation is associated with a higher odds of AEs.

This data supports the notion that FAS is an appropriate outcome when studying airway management in the ICU.

Limitations

This was a single-institution observational study.

The Unanticipated Difficult Airway during Emergency Tracheal Intubation

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Background

The goal of tracheal intubation in the emergency department (ED) is to achieve first pass success without an adverse event (FPS-AE) and cases in which this is not achieved should be classified as difficult. Physicians are taught to anticipate cases of difficult intubation in order to make preparations to obviate or respond to the difficulty, however prediction methods to date remain imperfect.

Objective

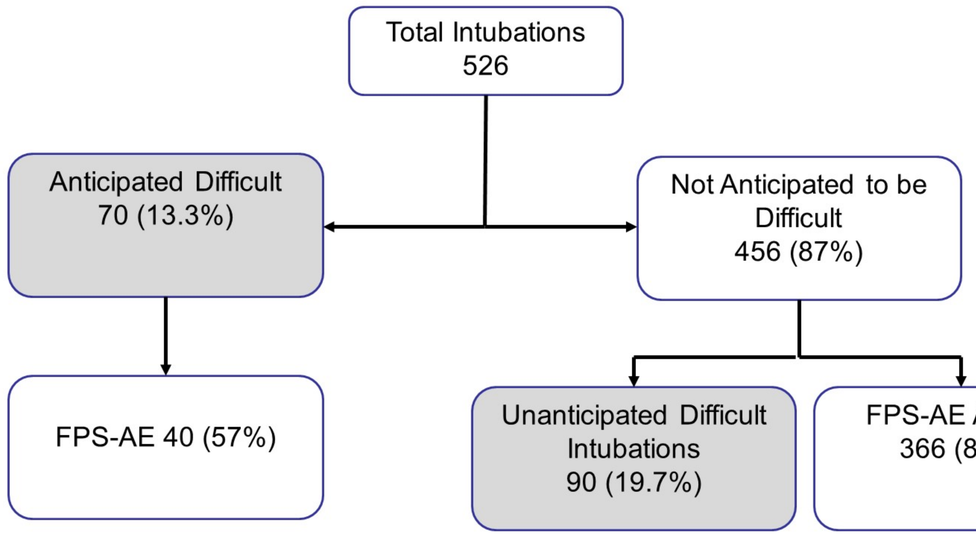
The objective of this study was to retrospectively evaluate the unanticipated difficult airway encountered during tracheal intubation.

Methods

Study Design: Retrospective Observational
Time Frame: July 1, 2015 to June 30, 2016
Setting: Academic Level 1 Trauma Center
Population Studied: All patients who underwent intubation in the emergency department.
Data Collection: Following each intubation, the operator completed a standardized CQI data form which included the information on patient, operator and procedural characteristics.

- Included an assessment of difficulty prior to the procedure
  - Routine
  - Challenging
  - Difficult

Results



Anticipated Difficult vs Unanticipated Difficult

	Unanticipated Difficult	Anticipated Difficult
RSI	68.5%	30.5%
Succinylcholine	73%	73%
Rocuronium	27%	27%
Method		
VL	84%	90%
DL	16%	4%
Other	0%	6%
Operator		
≤PGY 2	64.4%	14.3%
DAPs	2.3	3.6

VL = Video Laryngoscopy, DL = Direct Laryngoscopy, DAPs = Difficult Airway Predictors

Multivariable Logistic Regression Predicting Odds of Difficulty Among Those Not Anticipated to be Difficult

Variable	Odds Ratio	95% CI
Each Additional DAP	1.33	1.14-1.56
Lack of use of Apneic Oxygenation	2.21	1.14-4.31

*Adjusted for all other variables that met the p<0.2 criterion for inclusion in the model: reason for intubation, operator specialty.; Hosmer-Lemeshow goodness-of-fit p-value = 0.49; AUC = 0.70.

Disclosure: Dr. Sakles serves as an advisor to Verathon Medical

Methods Continued

FPS(-)AE Defined as successful intubation on a single laryngoscope insertion without the occurrence of an adverse event such as:
Desaturation, hypotension, aspiration

Difficult Airway Predictors

- Blood or vomit present
- Short neck
- Neck immobility or face/neck trauma
- Small mandible, large tongue, edema
- Obesity
- Restricted mouth opening

Groups Compared:
Anticipated to be difficult
Anticipated not difficult and was not
Anticipated not difficult but was difficult
Data Analysis: Multivariable Logistic Regression and Fisher's exact test.

Conclusion

In this observational study of the unanticipated difficult airway encountered during emergency tracheal intubation, the unanticipated difficult airway was reported with greater frequency than the anticipated difficult airway. Increasing numbers of difficult airway predictors and the absence of apneic oxygenation were associated with increased risk of unanticipated difficulty.

Limitations

- Observational, not randomized
- Single institution
- Operators reported data
- Retrospective

Reason For Failed Attempts At Laryngoscopy Differs Between Video And Direct Laryngoscopes

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BACKGROUND

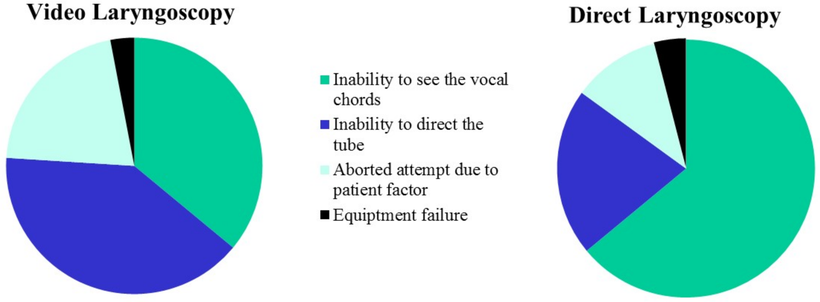
- First attempt success (FAS) has become a favored outcome in intubation-related research because of reduced odds of adverse events.
- Video Laryngoscopy (VL) has demonstrated increased FAS in recent observational and experimental studies when compared to direct laryngoscopy (DL).
- Despite improved FAS with VL, a substantial proportion of intubations with VL require > 1 attempt. To date we are unaware of any studies which have evaluated the reasons for failure between VL and DL.

MATERIALS AND METHODS

- Prospective observational study of all patients intubated using DL or VL in the intensive care unit (ICU) of a university medical center from January 1, 2012 to December 31, 2014.
- All intubations were performed under supervision by faculty skilled in airway management.
- Following each intubation, the operator completed a data collection form, which included information such as patient demographics, operator specialty, indication for intubation, paralytic agent, sedative agent, device(s) used, presence of certain difficult airway characteristics (DACs), pre-oxygenation methods, number of attempts at intubation and the outcome of each attempt, including complications.
- All patients who failed first attempt intubation were evaluated for the cause of failure.
- The primary outcome measured was reason for first attempt failure.

RESULTS

- Over the 36-month period, a total of 809 patients were intubated in the ICU.
- 673 were intubated with VL and 136 with DL. Of the first attempt failures (VL 132/673, 20% vs DL 47/136, 35%) reason for failure was reported in 131 and 47 cases, respectively.
- Reasons for failure included: inability to see the vocal cords (VL 47/131, 36%; DL 30/47, 64%, p=0.001), inability to direct the endotracheal tube (VL 52/131, 40%; DL 10/47, 21%, p-0.032), aborted attempt due to inadequate sedation, hypotension or hypoxemia (VL 28/131, 21%; DL 5/47, 11%, p=0.13) and equipment failure (VL 4/131, 3%; DL 2/47, 4%, p=0.65)
- Reason for failure did not differ with the level of operator experience or the laryngoscope blade design.



Reasons For First Attempt Failure	Video Laryngoscopy (132)	Direct Laryngoscopy (47)	P-Value
Inability to see vocal chords	47/131 (36%)	30/47 (64%)	0.001
Inability to direct endotracheal tube	52/131 (36%)	10/47 (21%)	0.032
Attempt aborted due to inadequate sedation, hypotension or hypoxemia	28/131 (21%)	5/47 (11%)	0.13
Equipment failure	4/131 (3%)	1/47 (4%)	0.65

Conclusion

First attempt failures with DL most commonly occur because of inability to see the vocal cords while a larger proportion of failures with VL occurred because of inability to direct the endotracheal tube. These data present targets for minimizing first attempt failures when performing tracheal intubation in the ICU

#672

Derivation of a Bundle to Improve First Attempt Success at Intubation in the Intensive Care Unit

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INTRODUCTION

A difficult intubation is defined as requiring >2 attempts or 10 minutes to perform. Prediction tools exist to anticipate the difficult intubation, yet two problems remain: 1. Performance of these tools is suboptimal and 2. Critically ill patients have limited tolerance for repeated or prolonged attempts at laryngoscopy. Thus, first attempt success (FAS) is the goal for intubations in the Intensive Care Unit (ICU) as adverse events (AEs) are more likely with each attempt. The goal of this study is to derive a bundle to improve the odds of FAS for ICU intubations.

MATERIALS AND METHODS

- This study was a retrospective analysis of prospectively collected continuous quality improvement data in all 809 patients intubated in the ICU of a university medical center from January 1, 2012 to January 1, 2014.
- Data relating to patient demographics, attempt(s), and complications were analyzed.
- A negative stepwise multivariable logistic regression analysis was performed to derive a three-item bundle to optimize the odds of FAS and reduce the odds of one or more AE when all three components were performed.
- Variables included items which the operator can control: sedative used, NMBA used, device used, method of preoxygenation, preoxygenation saturation. Confounders corrected for included variables that the operator cannot control, including operator specialty and post-graduate year.

RESULTS

- The elements with the highest odds of FAS were: preoxygenation to a saturation >93%, use of a neuromuscular blocking agent, and use of video laryngoscopy.
- 461 (57%) patients intubated had all components of the bundle performed and 348 (43%) patients had at least one component missing.
- **FAS was 84.2% when all bundle elements were performed and 69.5% when any component was missing (p < 0.001).**
- After controlling for operator experience and specialty, there were higher odds of FAS (aOR 2.61; 95% CI: 1.83–3.72) and reduced odds of an AE (aOR 0.70; 95% CI: 0.51–0.95) when all bundle elements were performed.

RESULTS (cont)

Any Complication	Odds ratio	Std Error	P > |z|	95% CI
Bundle	0.698	0.111	0.023	0.512 – 0.95
Operator Specialty				
Pulm/CCM	[Reference]			
CCM	1.81	0.55	0.053	0.99 – 3.28
EM	2.16	1.66	0.319	0.48 – 9.78
IM	3.19	2.35	0.115	0.75 – 13.5
FP	4.54	3.92	0.080	0.83 – 24.7
Anes	5.11	5.98	0.164	0.51 – 50.7
Operator PGY				
1	[Reference]			
2	0.498	0.23	0.135	0.2 – 1.24
3	0.63	0.22	0.185	0.32 – 1.25
4	1.41	1.02	0.634	0.34 – 5.79
5	1.62	1.17	0.500	0.4 – 6.65
6	2.38	1.77	0.242	0.56 – 10.18

RESULTS (cont)

First Attempt Success	Odds ratio	Std Error	P > |z|	95% CI
Bundle	2.61	0.47	0	1.83 – 3.72
Operator Specialty				
Pulm/CCM	[Reference]			
CCM	1.39	0.55	0.417	0.63 – 3.05
EM	1.83	1.38	0.425	0.42 – 8.05
IM	0.82	0.57	0.778	0.21 – 3.23
FP	0.63	0.53	0.588	0.12 – 3.29
Anes	1.48	1.92	0.761	0.12 – 18.7
Operator PGY				
1	[Reference]			
2	1.28	0.6	0.594	0.51 – 3.23
3	1.35	0.49	0.405	0.66 – 2.76
4	2.45	1.66	0.187	0.65 – 9.24
5	2.85	1.94	0.124	0.75 –10.85
6	2.26	1.61	0.25	0.56 – 9.11

CONCLUSIONS

These data suggest that a bundle including preoxygenation to a saturation >93%, neuromuscular blocking agent use, and video laryngoscopy improved odds of FAS and decreased odds of one or more AE for intubations performed in the ICU. Prospective studies are needed to validate these findings.

Assessment of Musculoskeletal Knowledge Among Emergency Medicine Physicians

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[2]Primary Care Sports Medicine Fellowship, University of Arizona College of Medicine, Tucson, AZ

Background

- Musculoskeletal competency is a consistently reported shortcoming in undergraduate and graduate medical education in many specialties.
- There have been no studies evaluating musculoskeletal knowledge of emergency physicians.

Purpose

- To assess musculoskeletal knowledge among emergency medicine junior residents, senior residents and attending physicians.

Methods

- A previously validated, open-ended, short answer exam with twenty-five questions based upon fundamental musculoskeletal knowledge was administered to emergency medicine junior residents, senior residents and attending emergency physicians.
- This examination was scored and converted to a percentage of the raw score
- Theses scores were then compared to previously established passing score for this exam.
- We tested for statistical significance using Student's t-test for independent samples.

Results

- 16 Attending respondents (29% response rate)
- 13 Resident respondents (25% response rate)

Figure 1. Mean Raw Scores

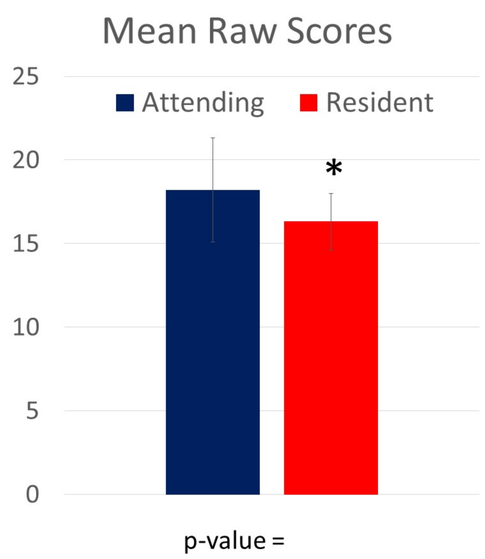
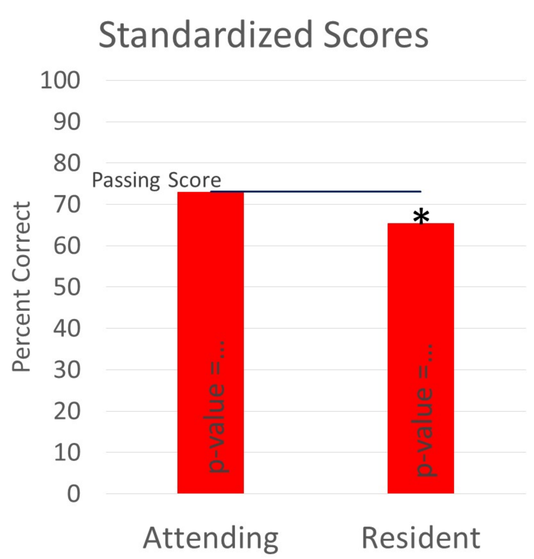


Figure 2. Standardized Scores



Conclusion

- Emergency medicine attending and resident physicians failed to demonstrate competency in musculoskeletal knowledge on a previously validated examination of fundamental musculoskeletal concepts.

Significance

- This study highlights the need for improvement in musculoskeletal education among emergency medicine physicians.

Acknowledgements

- Academy of Medical Education Scholars, Univ. of Arizona College of Medicine
- Department of Emergency Medicine, Univ. of Arizona College of Medicine
- Primary Care Sports Medicine Fellowship, Univ. of Arizona College of Medicine

DEVELOPMENT OF A NOVEL ULTRASOUND PERITONSILLAR ABSCESS MODEL FOR SIMULATION TRAINING

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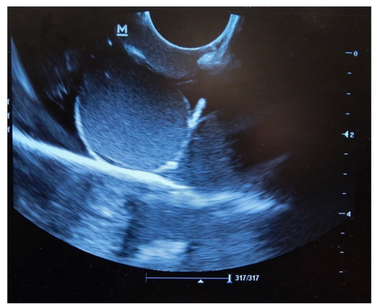
BACKGROUND

- Peritonsillar abscess (PTA) is a common presentation to the emergency department
- Residents often perform their first PTA need aspiration in the clinical setting
  - Nerve-racking
  - Multiple potential complications
- Few PTA task trainers described
  - None allow for ultrasound image acquisition, which improves procedural safety
- Simulating PTA needle aspirations under ultrasound guidance can build confidence and proficiency prior to actual clinical practice

OBJECTIVES

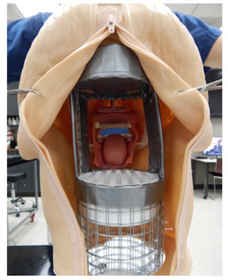
To create a realistic task trainer that allows emergency medicine residents to acquire ultrasound and needle aspiration skills when draining a peritonsillar abscess.

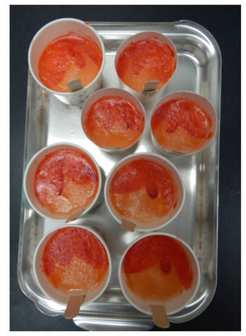


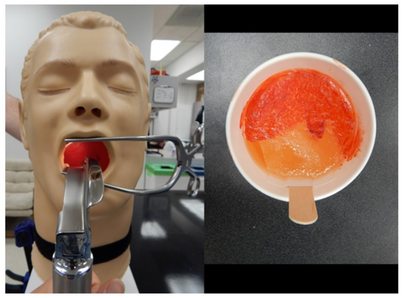
CURRICULAR DESIGN

The task trainer was build with low-cost, replaceable materials:

- An airway mannequin head, internally stripped aside from the tongue, was placed upright on a mesh wire cylinder attached to a wooden base.
- Water and barrier lotion were combined to simulation abscess material and injected into a small water balloon.
- The balloon was glued to the bottom of a paper cup with a tongue depressor taped inside, allowing insertion into a slit made at the base of the tongue.
- The slit ensured proper orientation of the abscess. The cup was filled with ballistic gelatin and layered with cotton to obscure the balloon.
- After setting, a uvula and two tonsils were painted on top. Cups were replaced after each needle aspiration.







CONCLUSIONS

This low-cost model
- Increased resident comfort in performing PTA needle aspiration
- Provided realistic ultrasound images
- Allows for repeated practice outside of the clinical setting

With the use of this model, residents
- Have the opportunity to learn appropriate procedural and ultrasound guidance technique
- Gain proficiency outside clinical practice

FUTURE DIRECTIONS

Further improvements to this model have already been made, including the addition of a carotid artery to increase anatomic fidelity and accuracy of ultrasound images.

ACKNOWLEDGEMENTS

Chris Hostetter
Arizona Simulation Technology and Education Center

RESULTS

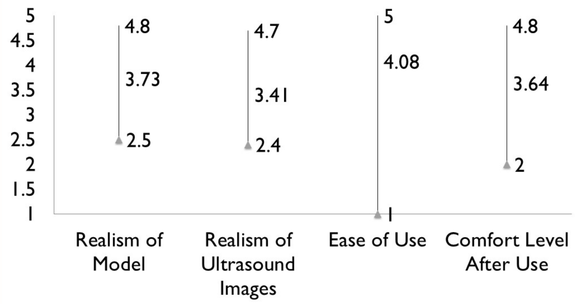
Residents were surveyed on their comfort performing PTA needle aspirations and on task trainer utility.

Eleven of 16 residents have previously drained one to three PTAs, with the rest having no prior experience.

On a 1-5 visual analog scale, residents
- Had increased comfort with needle aspiration of a PTA after practicing on the trainer
- Felt ultrasound images were representative of real PTAs
- Felt the model was realistic and easy to use

	Low	Mean	High	SD
Realism of Model	2.5	3.73	4.8	0.68
Realism of US images	2.4	3.41	4.7	0.61
Ease of Use	1.0	4.08	5.0	1.02
Comfort Level After Use	2.0	3.64	4.8	0.75

Visual Analog Scale Results



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Emergency Department Recognition of Critical Illness-Related Corticosteroid Insufficiency

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CIRCI BACKGROUND

Although controversial, corticosteroid administration has shown to decrease 28 day mortality, increase the occurrence of ventilator-free days and decrease vasopressor dependence. Experimental and clinical data suggest that the pathology is with glucocorticoid tissue resistance rather then suppression of the hypothalamic-pituitary-adrenal axis and adrenal failure. This complex syndrome is referred to as critical illness-related corticosteroid insufficiency (CIRCI). Presently, the Surviving Sepsis Campaign 2012 guidelines recommend corticosteroid administration to patients who remain hemodynamically unstable after adequate fluid and vasopressor therapy.

INTRODUCTION

Sepsis is the 10th leading cause of death in the United States and results in 750,000 hospitalizations annually. Severe sepsis and septic shock carry a hospital mortality rate of 25-50%, and aggressive early care in the emergency department (ED) modifies mortality more than any other point in the hospital course. This study seeks to assess ED recognition of patients with possible CIRCI in the setting of severe sepsis and septic shock.

MATERIALS AND METHODS

- Single-center in a retrospective chart review over a one year period December 1, 2013 – December 1, 2014.
- Patients identified had an admission diagnosis of severe sepsis or septic shock at a university medical center with an academic ED with an annual census of > 75,000 patients.
- The medical record was reviewed for timing of corticosteroid administration for vasopressor refractory shock, and the incidence of testing cortisol levels.

RESULTS

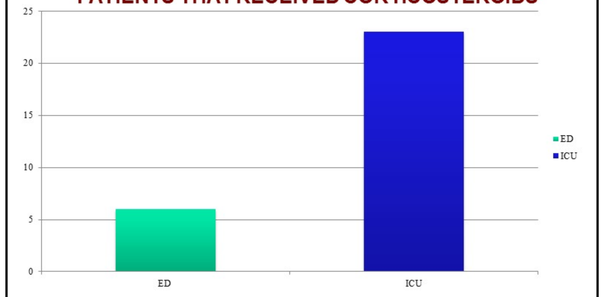
- Over the one-year period, 47 patients had an admission diagnosis of severe sepsis or septic shock.
- Of these 83% (39/47) received vasopressors in the ED, primarily norepinephrine (38/39, 97%).

PATIENT CHARACTERISTICS

		Corticosteroids		
Characteristic	All	Yes	No	
Age - yr		61		
Sex				
Men		21	10	11
Women		26	13	13
Prior or preexisting disease				
Hypertension		17		
Coronary artery disease		7		
Congestive heart failure		7		
Chronic pulmonary disease		4		
Cancer		5		
Diabetes		13		
Liver disease		2		
Admission Category				
Medical		42		
Emergency Surgery		5		

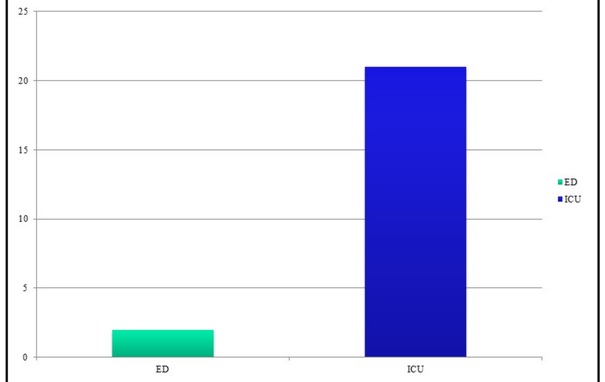
RESULTS

PATIENTS THAT RECEIVED CORTICOSTEROIDS



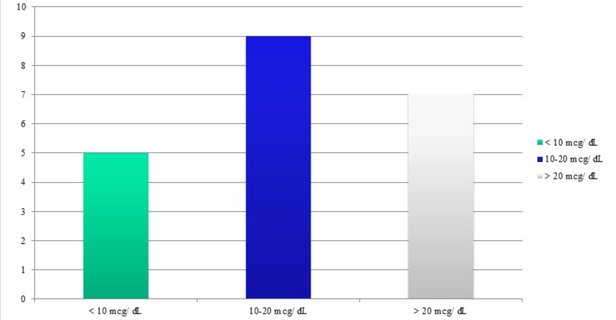
Only 13% (6/47) received corticosteroids in the ED while 49% (23/47) received corticosteroids in the intensive care unit (ICU).

EVALUATING THE RANDOM CORTISOL LEVEL



A random cortisol was drawn prior to admission to the ICU in 4% (2/47) of patients while 45% (21/47) had a random cortisol drawn once admitted to the ICU.

RISK BASED ON RANDOM CORTISOL



Of those with a random cortisol drawn, the results were as follows: 22% (5/23) had a level < 10 mcg/dL, 39% (9/23) 10-20 mcg/dL and 30% (7/23) > 20 mcg/dL.

CONCLUSIONS

These data suggest that CIRCI is under-recognized by emergency physicians in patients with an admission diagnosis of severe sepsis or septic shock at our institution. Of those patients where a cortisol level was checked, over 50% had values suggesting a moderate to high suspicion for CIRCI. Incidentally, we found that in a high volume ED, severe sepsis and septic shock is likely grossly under diagnosed. Further research is needed in this area to improve recognition and optimal treatment of CIRCI in this high-risk population.

Early Point-of-Care Ultrasound in Critical Care: Helpful, Critical, or Recreating the Swan Problem?

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Objective

Point-of-Care Ultrasound (POCUS) is commonly used to guide therapeutic decision and reduce diagnostic uncertainty amongst critically ill patients but patient-centered outcomes of POCUS use are lacking. The purpose of this study is to determine the association between POCUS and outcomes in patients admitted to the ICU from the ED with hemodynamic instability.

Methods

- Retrospective case-control study of all medical patients admitted to the ICU from two ED's at two academic hospitals from November 1, 2013 – October 31, 2016 with an initial shock index >0.6.
- Patients were divided into three groups: no POCUS, POCUS before intervention (vasopressor or fluid bolus) or POCUS after intervention.
- The primary outcome was in-hospital mortality.
- Secondary outcomes were time to fluids, vasopressors, and intubation.
- Outcomes were evaluated using appropriate tests for non-parametric distribution.

Results

During the study period, 5441 patients met inclusion criteria and were included in the analysis. Of these, 77% (4165) did not receive a POCUS, 11% (614) had a POCUS performed before intervention, and 12% (662) after intervention. Mortality was 22%, 29%, and 26%, respectively ($p < 0.001$).

Patients with POCUS prior to intervention also had a longer median time to fluids, median time to vasopressor initiation, and median time to intubation.

	No POCUS	POCUS before intervention	POCUS after intervention	
Cohort n	**4165**	**614**	**662**	
Mortality	**22%**	**29%**	**26%**	**p < 0.001**

Time (min) to intervention: Median (IQR)	No POCUS n=5729	POCUS before intervention n=831	POCUS after intervention n=738	p value
Fluids	**57 (27-146)**	**102 (43-271)**	**42 (22-78)**	**< 0.001**
Vasopressors	**262 (36-737)**	**323 (122-828)**	**275 (101-596)**	**0.0011**
Intubation	**93 (21-396)**	**230 (35-662)**	**162 (28-466)**	**< 0.001**

Conclusion

The data indicate that critically ill ED patients who had POCUS performed prior to an intervention had an increased mortality as well delay to administration of vasopressors, fluids, and intubation. The results suggest that POCUS use should be studied prospectively to understand its association with patient outcomes and timing of interventions.

Limitations

- Retrospective analysis with risk of unknown confounding variables
- No severity of illness scale in ED for regression model
- Possible that POCUS-first group is at higher mortality risk at baseline, prompting early POCUS.

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Predictors of Difficult Intubation When Using Video Laryngoscopy in the Intensive Care Unit

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THE UNIVERSITY OF ARIZONA

BACKGROUND

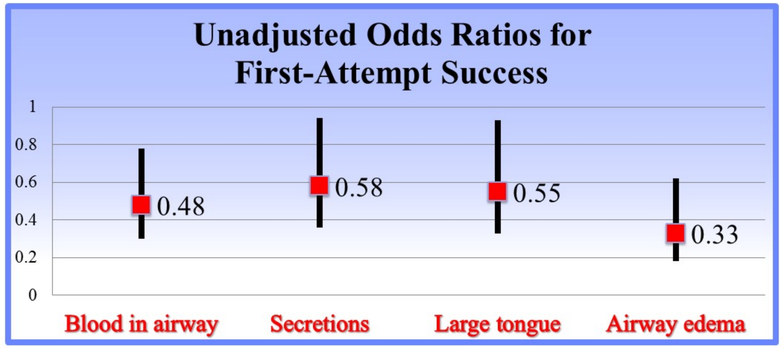
- Video laryngoscopy (VL) has been shown to improve first attempt success (FAS) and reduce adverse events (AEs) when compared to direct laryngoscopy (DL) in the ICU.
- Despite improved FAS, a significant proportion of intubations with VL require more than 1 attempt.
- The goal of this study is to identify anatomic characteristics that reduce the likelihood of FAS at intubation when using VL in the ICU.

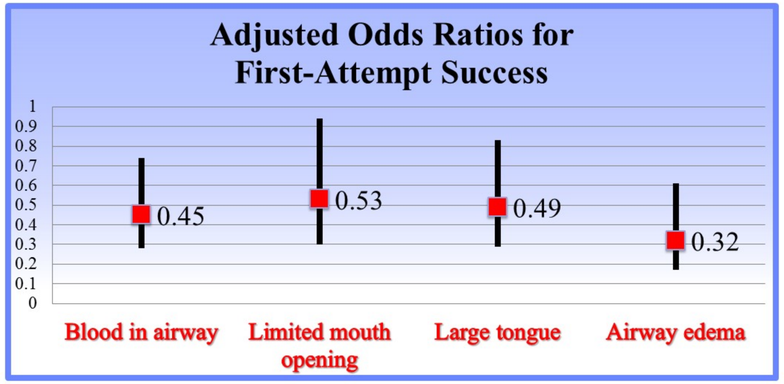
MATERIALS AND METHODS

- Prospective observational study of all patients intubated in the ICU of a university medical center from January 2012 to January 2014.
- Data relating to patient and operator demographics, device used, difficult airway characteristics (DACs), and outcome of each attempt were analyzed.
- DACs were analyzed using univariate and adjusted multivariate logistic regression analyses to control for potential confounders.

RESULTS

- 83% (673/809) of all patients were intubated using VL.
- Univariate analysis identified the following DACs were significant predictors of failed first attempt: blood in the airway (OR 0.48; 95% CI 0.30-0.78), secretions (OR 0.58; 95% CI 0.36-0.94), airway edema (OR 0.33; 95% CI 0.18-0.62), and large tongue (OR 0.55; 95% CI 0.33-0.93).
- Adjusting for operator specialty and experience, odds of FAS were significantly reduced in the presence of blood in the airway (aOR 0.45; 95% CI 0.28-0.74), limited mouth opening (aOR 0.53; 95% CI 0.30-0.94), large tongue (aOR 0.49; 95% CI 0.29-0.83), and airway edema (aOR 0.32; 95% CI 0.17-0.61).
- The DACs not found to be significant include:
  - obesity
  - small mandible
  - short neck, cervical immobility
  - face or neck trauma
  - presence of secretions
  - vomit in the airway





CONCLUSION

After controlling for operator specialty and experience, blood in the airway, limited mouth opening, large tongue, and airway edema were significant predictors of a failed first attempt at intubation using VL in the ICU. The physician should account for these DACs when preparing to intubate a patient in the ICU.

Razor Wire Mixup

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History

A 54 year-old right handed male who works as a prison guard presented with a right hand injury. He was at his post working when he extended his hand into the air to flag down a prison bus. He reported feeling a sudden pain after his hand contacted the overhead razor wire fence overhead. He noted that the index and ring fingers were impaled on the razor wire. Other prison guards responded to the injury but were unable to free the patient and ultimately they cut out a segment of the wire in order to free the patient for transport to the Emergency Department.

Physical Exam

Vital Signs: HR:90, BP:157/87, T:36.4 C, SpO2 100% on RA

HEENT, CV, Chest, Abdominal exams were unremarkable.

Right hand exam: Through and through impalement of the right index and ring finger distal phalanx volar pad as seen in the image. Intact distal sensation to light touch. Intact distal capillary refill.

The Problem

The offset razor blades are oriented in such a fashion that if the wire is pulled in the radial direction in an attempt to free the index and ring fingers the index finger will necessarily be punctured on the ulnar aspect by another razor.

Questions

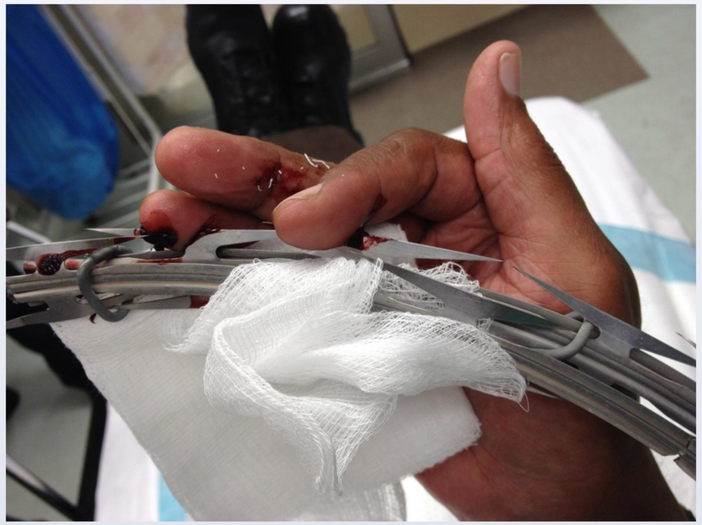
How do you remove the razor wire from the hand without creating another injury?

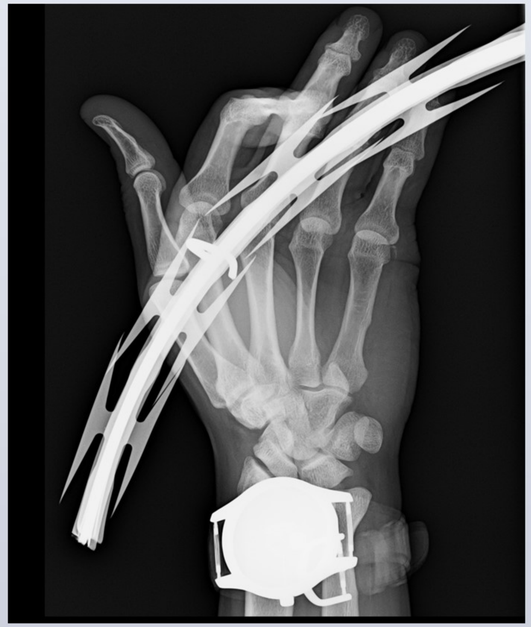
Which parts of the razor wire can you safely touch? Which parts are sharp? Will removal of the impaled blades cut the patient by slicing like a razor/blade?

Answers

1. The concertina wire coil is composed of three lengths of barbed tape with each tape supplying every third blade of the overall coil. The three lengths of barbed tape are attached by wire clasps spaced every few inches. When these claps are cut each length of barbed tape may be removed individually. This allowed for each finger to be freed one at a time without creating a second injury to the index finger.

2. While this type of barbed wire is often referred to as razor wire, unlike a razor its flat surfaces have not been sharpened and there is no cutting surface. Only the tapered point is designed to cut. It is best handled from the ends touching only the central shaft or with instruments.





Case Discussion

This is the case of a prison guard who impaled his own hand on the razor wire used to top prison fences. This injury presented a unique problem in that the fingers were impaled in such a way that directly attempting to pull out the wire altogether would only serve to puncture the index finger from the other side owing to the opposite facing and closely spaced spikes.

This style of razor wire, also known as concertina wire, is produced by laminating together three individual metal tapes each containing more widely spaced blades than the final product. By connecting these tapes a final product is produced with closely spaced blades facing in opposite directions and with a slight offset owing to the twist imparted to the wire. This creates the potential for the situation where removing the entire apparatus en bloc will result in a second injury to the opposite side of the impaled digit.

Patients can be safely liberated from the wire by separating the three individual metal tapes that compose it. This is accomplished by snipping the metal clasps that hold the three tapes together with wire cutters. Then the individual tapes, and thus the individual involved blades, can be removed one at a time without risk of causing a new puncture from the blade opposite the one being removed.

The blades themselves are not razors in that they are not sharpened on the flat surfaces and will not lacerate the patient like a knife during removal. However, they do taper to an exceptionally sharp point which must be avoided by the physician during removal. The best place to handle the fencing as well as the individual tapes is the central shaft and in the case of a cut piece of the fencing, the cut ends may also be handled.

Pearls

Break down concertina wire into individual barbed tapes by cutting the connecting wire loops with wire snips to allow safe removal of individual barbs and reduced risk of creating an additional injury during removal.

Only the blade points themselves are sharp as the sides of each blade are not sharpened. Handle only the center connecting tape when possible or use instruments such as hemostats or pliers to handle the wire as the risk of injury to the removing physician is high.

Evaluation of the RESP Score for Survival Prediction in Venovenous Extracorporeal Membrane Oxygenation

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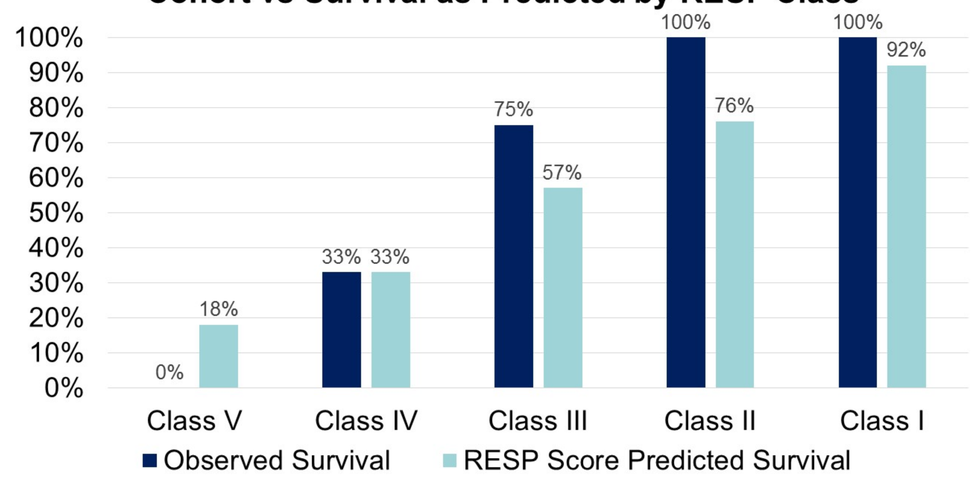
Background

Veno-venous (VV) extracorporeal membrane oxygenation (ECMO) has been used to support oxygenation and allow time for lung rest in individuals with acute respiratory distress syndrome (ARDS). As ECMO therapy has become more widely used, the body of research supporting which patients might benefit continues to develop and has produced different algorithms that can be used to help predict survival. The Respiratory Extracorporeal Membrane Oxygenation Prediction (RESP) score classifies patients based on pre-therapeutic markers into five groups with progressively decreasing probability of survival. We set out to compare survival as predicted by the RESP score group with actual observed survival in a VV-ECMO cohort.

Methods

A retrospective, observational study of adult patients admitted to the medical intensive care unit (MICU) at Banner University Medical Center Tucson (BUMCT) for VV-ECMO cannulation between January 1, 2015 and July 1, 2017. Pre-ECMO values including demographics, primary diagnosis, comorbidities, blood gas values, ventilator settings and duration of mechanical ventilation were abstracted from medical records and used to assign a RESP class for each patient (I-V). The RESP risk score classification was assigned (I-V) based on abstracted pre-ECMO variables and observed survival was compared with the predicted survival based on RESP class by two tailed-test of proportions.

Comparison of Observed Survival in a VV-ECMO Cohort vs Survival as Predicted by RESP Class



RESP Score Variable	VV-ECMO Cohort
Age	41.6 (23)
Immunocompromised	21.7% (5)
Mechanical ventilation duration prior to ECMO	
▪ **< 48 hours**	30.4% (7)
▪ **48 hours – 7 days**	34.8% (8)
▪ **> 7 days**	34.8% (8)
Acute respiratory diagnosis group	
▪ **Viral Pneumonia**	47.8% (11)
▪ **Bacterial Pneumonia**	30.4% (7)
▪ **Non-respiratory or chronic respiratory diagnosis**	21.7% (5)
CNS dysfunction	17.4% (4)
Neuromuscular blockade before ECMO	76.2% (16)
Nitric Oxide use before ECMO	55.0% (11)
Bicarbonate infusion before ECMO	35.0% (7)
Cardiac arrest before ECMO	17.4% (4)
$PaCO_2$ ≥75 mmHg/ 1-kpa	19.0% (4)
Peak inspiratory pressure ≥42cmH_20	7.7% (1)

Results

A total of 33 patients were admitted to the MICU for ECMO therapy, of which 23 received VV-ECMO of which 20 had complete data for calculation of the RESP score. When assessing RESP score risk classifications, we identified a total of 1, 6, 4, 6, and 3 patients in classes I-V, respectively. Observed survival was found to be: class I=100%, II=100%, III=75%, IV=33%, and V=0%. The observed values were compared to predicted survival for each RESP score class (I=92, II=76, III=57, IV=33, and V=18%) and found to exhibit no significant difference (p=0.32).

Conclusion

There was no significant difference in mean survival between patients who received VV-ECMO therapy and their predicted survival using the RESP score. This suggests that utilizing the RESP score for patients who may be candidates for VV ECMO could be an effective predictor of survival, and could be considered in deciding which patients may benefit from VV-ECMO.

Limitations

-Observational study, not randomized
-Single institution

*Disclosures: None

Predictors of complications of Intensive Care Unit airway management despite first attempt success using video laryngoscopy.

Navarro, Tomas MD[2]; Mosier, Jarrod MD[1,2]; Sakles, John MD[1]; Greenberg, Jeremy MD[1,2]; Natt, Bhupinder MD[1]; Chopra, Harsharon[2]; Hypes, Cameron, MD, MPH[1,2]
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THE UNIVERSITY OF ARIZONA.

INTRODUCTION

Limiting laryngoscopic attempts is the goal of airway management because of the association with reduced risk of complications. However, there are complications that occur despite first attempt success (FAS). The aim of this analysis was to identify difficult airway characteristics associated with at least one complication despite FAS achieved by video laryngoscopy.

METHODS

This is an observational study of consecutive patients intubated with video laryngoscopy at an academic ICU from January 1, 2012 to January 1, 2016 approved by the University of Arizona IRB. Intubation complications that occurred with FAS achieved by video laryngoscopy were identified and described. A multivariable logistic regression model was generated using backwards elimination predicting the occurrence of at least one complication despite FAS.

RESULTS

During the study period 1138 intubations were performed and 739 patients were intubated successfully on the first attempt using video laryngoscopy (Figure 1). Of these, 19.8% (146) experienced at least one complication. The following difficult airway characteristics were associated with at least one complication despite FAS: hypoxemia, (OR 2.0, 95% CI 1.3-3.2), vomit in the airway (OR 2.9, 95% CI 1.4-5.9), airway edema (OR 2.6, 95% CI 1.2-5.6), and hemodynamic instability (OR 1.7, 95% CI 1.1-2.6).

1138 Total Intubations

905 Video laryngoscopy Intubations*
GlideScope 23.2% (210)
C-MAC 74.5% (674)
McGrath MAC 1.9% (17)
KingVision 0.4% (4)

* Exclusions: 153 for DL, 58 for FFO, 17 for non-resident intubator, 1 missing data

166 First Attempt Failures

739 First Attempt Successes

At least one complication	19.8% (146)
Esophageal intubation	-
Desaturation >10%	11.5% (85)
Saturation Nadir Severity	
O2 saturation <80%	4.6% (34)
O2 saturation <70%	5.1% (38)
Aspiration	1.6% (12)
Hypotension	7.7% (57)
Airway Trauma	0.4% (3)
Mainstem intubation	0.8% (6)
Other	1.0% (7)
Cardiac Arrest	0.4% (3)
Bradycardia	0.4% (3)
Unspecified	0.1% (1)

Demographics

Characteristic	No Complications	≥ 1 Complication	p-value
Age (median, IQR)	59 (50-70)	60 (51-70)	0.26
Gender (male)	54.8%	56.9%	0.71
Method			0.82
RSI	80.9%	83.6%	
Sedation only	17.2%	15.1%	
No meds	1.9%	4.4%	
Operator PGY			0.35
1	6.8%	5.5%	
2	13.3%	13.0%	
3	10.8%	9.6%	
4	31.9%	25.3%	
5	24.5%	33.6%	
6+	12.8%	13.0%	

Multivariable Logistic Regression Model

At least one complication despite FAS	Unadjusted (Crude)		Adjusted*	
Variable	Odds Ratio	95% CI	Odds Ratio	95% CI
Hypoxia	2.4	1.6-3.6	2.0	1.3-3.2
Hemodynamic instability	1.7	1.2-2.6	1.7	1.1-2.6
Vomit present	2.4	1.2-4.6	2.9	1.4-5.9
Airway edema	3.0	1.5-6.2	2.6	1.2-5.6

*Adjusted for all other variables that met the p<0.2 criterion for inclusion in the model: method of intubation, short neck, large tongue, and cervical immobility.; Hosmer-Lemeshow goodness-of-fit p-value = 0.82; AUC = 0.68.
Abbreviations: CI, confidence interval; FAS, first attempt success; DACs, difficult airway characteristics.

CONCLUSIONS

Procedurally related complications of airway management occurred commonly in the ICU despite FAS. These results suggest that physiologic optimization of oxygenation and hemodynamic status may help to reduce complications during emergency intubation.

Failure to achieve first attempt success is associated with a higher odds of adverse events during intubation in the Intensive Care Unit using a video laryngoscope

Hypes, Cameron, MD, MPH[1,2]; Sakles, John MD[1]; Navarro, Tomas MD[2]; Greenberg, Jeremy MD[1,2]; Natt, Bhupinder MD[1]; Chopra, Harsharon[2]; ; Mosier, Jarrod MD[1,2]
[1]Section of Pulmonary, Allergy, Critical Care, and Sleep, Department of Medicine, University of Arizona, Tucson AZ [2]Department of Emergency Medicine, University of Arizona, Tucson AZ

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INTRODUCTION

The aim of this analysis was to determine if the association of first attempt success (FAS) with a reduction in adverse events (AE) holds true in the ICU and still persists after the widespread adoption of video laryngoscopy (VL).

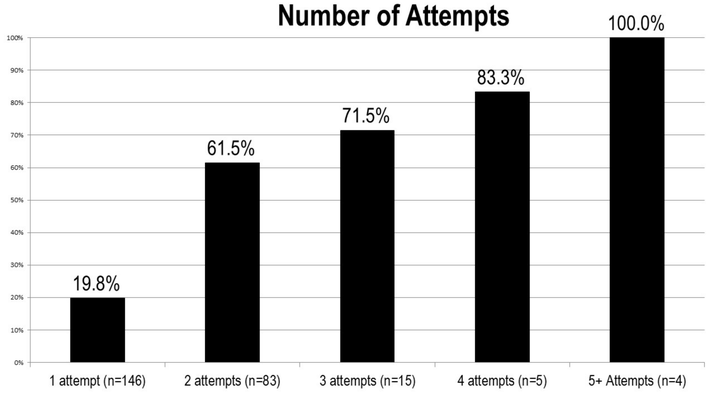
METHODS

Approval of this work was granted by the University of Arizona IRB. Observational study of consecutive patients intubated with VL in the ICU of a university medical center from January 1, 2012 – January 1, 2016. Patient demographics, intubation technique, number of attempts, and AEs were collected as part of a continuous quality improvement program. The primary outcome was the odds of an AE. A multivariable regression was performed via backwards elimination to examine the relationship between first attempt failure and complications.

RESULTS

A total of 905 patients were intubated using a VL. Of these FAS occurred in 739 (82%) which was associated with at least one AE in 146 (20%) whereas >1 attempt was needed in 166 (18%) with an adverse event occurring in 107 (65%, p<0.01). In logistic regression analysis >1 attempt was associated with 6.4 times the odds of at least one AE (95% CI 4.4 to 9.3) adjusting for potential confounders (Table 1).

Proportion of Patients with ≥ 1 Complication by Number of Attempts



1138 Total Intubations

905 Video laryngoscopy Intubations*
GlideScope 23.2% (210)
C-MAC 74.5% (674)
McGrath MAC 1.9% (17)
KingVision 0.4% (4)

* Exclusions: 153 for DL, 58 for FFO, 17 for non-resident intubator, 1 missing data

166 First Attempt Failures

739 First Attempt Successes

Adverse Event	First Attempt Failures	First Attempt Success	P-value
At least one complication	64.5% (107)	19.8% (146)	<0.001
Esophageal intubation	10.2% (17)	-	-
Desaturation >10%	53.0% (88)	11.5% (85)	<0.001
Oxygen saturation nadir			<0.001
O2 saturation ≤ 80%	12.1% (20)	4.6% (34)	
O2 saturation ≤ 70%	23.5% (39)	5.1% (38)	
Aspiration	7.8% (13)	1.6% (12)	<0.001
Hypotension	7.8% (13)	7.7% (57)	1.00
Airway Trauma	5.4% (9)	0.4% (3)	<0.001
Mainstem intubation	1.2% (2)	0.8% (6)	0.64
Other	6.0% (10)	1.0% (7)	<0.001
Cardiac Arrest	1.8% (3)	0.4% (3)	
Bradycardia	2.4% (4)	0.4% (3)	
Laryngospasm	1.8% (3)	0% (0)	
Not Documented	0% (0)	0.1% (1)	

Demographics

Characteristic	First Attempt Failures	First Attempt Success	p-value
Age (median, IQR)	57 (48-68)	59 (50-70)	0.13
Gender (male)	51%	55%	0.39
Method			**<0.001**
RSI	**65.6%**	**81.5%**	
Sedation only	**33.7%**	**16.7%**	
No meds	**0.6%**	**1.7%**	
Operator PGY			**0<0.001**
1	**12%**	**6.5%**	
2	**14.5%**	**13.3%**	
3	**22.3%**	**10.6%**	
4	**24.7%**	**30.6%**	
5	**16.3%**	**26.3%**	
6+	**10.2%**	**12.9%**	

Multivariable Logistic Regression Model

	Unadjusted (Crude)		Adjusted*	
Variable	Odds Ratio	95% CI	Odds Ratio	95% CI
>1 Attempt at laryngoscopy	**7.4**	**5.1-10.6**	**6.4**	**4.4-9.3**
Total number of DACs				
0	**[Reference]**		**[Reference]**	
1	**1.9**	**1.2-3.2**	**1.8**	**1.04-3.0**
2	**3.2**	**1.9-5.3**	**2.9**	**1.7-4.9**
3	**3.9**	**2.2-6.7**	**3.3**	**1.8-6.0**
4	**3.7**	**1.9-6.9**	**3.3**	**1.6-6.4**
5+	**10.4**	**5.2-20.6**	**6.8**	**3.2-14.3**
Reason for intubation				
Cardiac arrest	[Reference]		[Reference]	
Respiratory failure	5.1	0.7-40	5.8	0.7-49
Airway protection	2.7	0.3-21	3.4	0.4-30
Patient control	3.3	0.3-37	5.3	0.43-67
Hemodynamic instability	4.4	0.5-37	4.6	0.49-43
Severe acidosis	3.4	0.4-30	4.4	0.44-44

*Adjusted for all other variables shown; Hosmer-Lemeshow goodness-of-fit p-value = 0.38; AUC =0.76. Threshold for retention in the model p=0.20.

CONCLUSIONS

Despite the use of VL, a failed first attempt at intubation is associated with higher odds of AEs in the ICU. FAS should be the goal of emergency airway management, irrespective of location or device used.

Duration of Mechanical Ventilation and Patient Outcomes for Extracorporeal Membrane Oxygenation

Stephen Crabbe, MPH,[1] Josh Malo, MD,[2] Bhupinder Natt, MD,[2] Toshinobu Kazui, MD,[3] Zain Khalpey, MD,[3] Akshay Roy-Chaudhury, BS,[1] Jarrod Mosier, MD,[2,4] Cameron Hypes, MD[2,4]

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Background

For patients with severe acute respiratory distress syndrome (ARDS), veno-venous extracorporeal membrane oxygenation (VV-ECMO) is sometimes used to support oxygenation and allow time for lung rest. However, duration of pre-ECMO mechanical ventilation has been associated with increased mortality for patients who receive VV-ECMO and as such, prolonged mechanical ventilation has been suggested as a relative contraindication for VV-ECMO support.

Objective

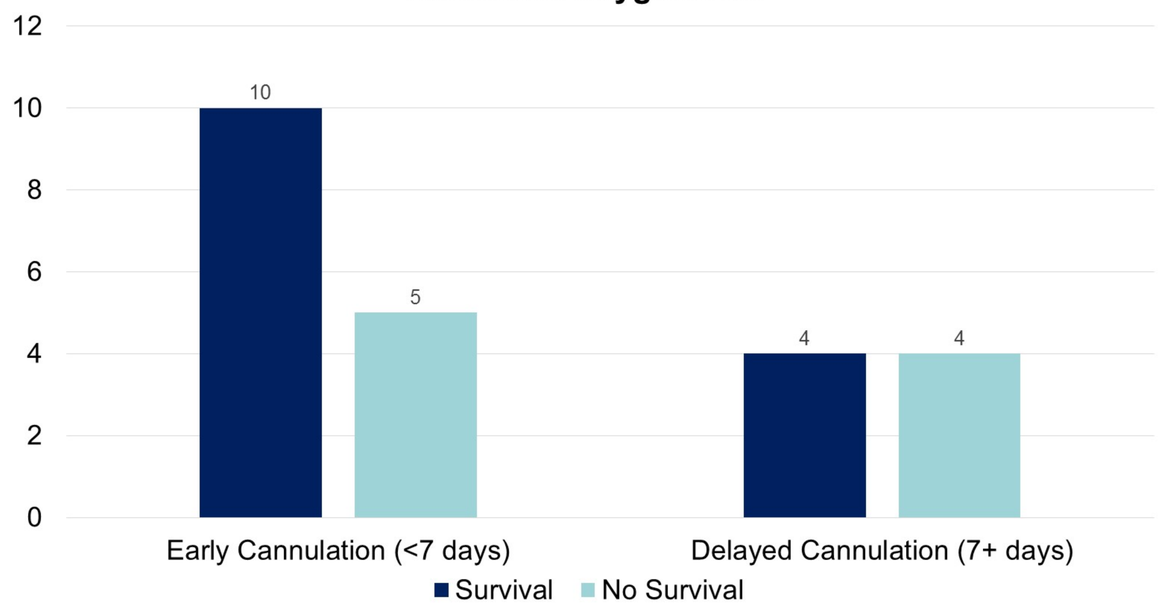
This study was conducted to examine the relationship between duration of pre-ECMO mechanical ventilation and mortality for patients who received VV-ECMO therapy for ARDS.

Methods

A retrospective, observational study of adult patients admitted to the ICU at an academic medical center for VV-ECMO between January 01, 2015 and July 1, 2017. Demographics, comorbidities, lab values and ventilator settings were extracted from the medical record along with outcomes such as length of stay and in-hospital mortality. Patients cannulated for ECMO more than 7 days after the initiation of mechanical ventilation were classified as the late initiation group.

	Early Cannulation	Delayed Cannulation	
Age	41.3	42.1	T= -0.1364
Male	53.3%	62.5%	FE = 1.000
Immunocompromised	26.7%	34.8%	FE = 0.621
Transport	60.0%	87.5%	FE = 0.345
Total Ventilator Days	20 days (IQR = 6.0-27.0)	58.5 days (IQR = 53.5-72.0)	P<0.01
ECMO Duration	9 days (IQR 4.0-12.0)	40.5 days (IQR 15.5-55.5)	P<0.01

Duration of Mechanical Ventilation and Survival to Discharge for Patients Receiving Veno-Venous Extracorporeal Membrane Oxygenation



Results

A total of 23 patients were treated with VV-ECMO therapy during the study period. Of these, eight underwent late initiation (median ventilator days 14.5 days, IQR 10-20.5), and 15 were early initiation (median 2.0 days, IQR 0-4.0, p<0.01). There was no difference between groups in survival to discharge (50% vs 67%, p=0.66) however cases in which ECMO was initiated later were associated with longer duration of ECMO (median 40.5 (IQR 15.5-55.5) vs 9 days (IQR 4.0-12.0), p<0.01), total duration of mechanical ventilation (median 58.5 (IQR 53.5-72.0) vs 20 days (IQR 6.0-27.0), p<0.01), and hospital length of stay (61.5 (IQR 55.0-74.5) vs 35 days (IQR 30.0-46.0), p<0.01).

Conclusion

These data suggest that late initiation of VV-ECMO for ARDS is associated with longer duration of recovery but a similar mortality as patients initiated early. Thus the relative contraindication should be reconsidered, and a prospective study is needed to delineate which patients stand to benefit from VV-ECMO therapy for ARDS.

Limitations

-Observational study, not randomized
-Single institution

*Disclosures: None

Comparison of Manual Vs. Mechanical Chest Compression Quality During Prehospital Cardiac Resuscitation

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Background

Cardiopulmonary resuscitation (CPR) quality is strongly linked to outcomes following out-of-hospital cardiac arrest (OHCA). However, manual CPR quality varies and, if preformed during prehospital transport, there is additional risk to providers.

Hypothesis

We hypothesized that use of a mechanical CPR device would provide higher quality CPR than manual CPR during the technically challenging periods of OHCA resuscitation such as packaging, loading, and transporting patients.

Methods

Cases of OHCA at a single site from 10/2008-10/2016 were identified. Two CPR quality metrics, chest compression fraction (CCfr) and CC rate (CCra), measured using accelerometer-based technology (E & X-Series), were compared between 3 time points: packaging (terminal 5 minutes on scene), loading (terminal 3 minutes on scene), and transport. Mechanical CPR was preformed using (AutoPulse®, ZOLL Medical) while most cases of manual CPR were performed with real-time audiovisual chest compression feedback enabled (Real CPR Help®).

Statistical Methods

To compare manual CPR [metronome rate of 100 beats per minutes (bmp)] and mechanical CPR (set CCra of 80 bpm) the median proportion of time in which CCra was within +/-5 bmp of the target range (pCCra) and the mean CCfr is reported using the Wilcoxon rank-sum test and Inter-Quartile ranges (IQR).

Results

357 cases were reviewed and 239 excluded: no age or age <18 years (6), medical or unknown location (31), non-cardiac etiology (87), data unavailable (115), leaving 118 included. CCfr was higher during packaging and loading periods in the mechanical group and CCra was more frequently within the target range in the mechanical group during all study periods

	All	Manual#	AutoPulse#	P-value*
Total subjects	N =118	N=93	N=25	
CCfr - packaging	76 (66, 86.7)	74.5 (64.5,82.7)	85 (80, 90.3)	0.0043
CCfr – loading	77.5 (62.3, 86.3)	72.2 (59.3, 84.7)	86 (82.1, 91.2)	0.001
CCfr - Transport	87.3 (77.3, 91.7)	88.1 (76.6, 92.5)	85.8 (82, 89.1)	0.4799
pCCra - Packaging	0.4 (0.2, 0.8)	0.4 (0.2, 0.6)	0.8 (0.6, 1)	0.001
pCCr - Loading	0.6 (0, 0.7)	0.3 (0, 0.7)	1 (0.5, 1)	0.0021
pCCra - Transport	0.7 (0.2, 0.9)	0.5 (0.1, 0.8)	0.8 (0.7, 1)	0.0002

median (IQR) for the patient-level mean/proportion of each CPR variable
* Wilcoxon rank-sum test

Limitations

- Selection Bias: Providers could have selected patients that were easy to package and transport with the AutoPulse resulting in better than expected CPR quality in the mechanical CPR group.
- Ascertainment Bias: Measurement of CC rate/frequency using accelerometer based technology could lead to errors. However, manual data review was preformed, minimizing the likelihood of this type of error.
- The single EMS agency from which cases were obtained utilizes an audio visual feedback system to improve CPR quality. Use of this technology has previously been shown to improve manual CPR quality resulting in higher than expected CRP quality in the manual group.
- This study was not powered to detect a change in outcomes following OHCA.

Summary and Conclusions

In adults with OHCA use of mechanical CPR may improve CPR quality without exposing providers to the risks of performing manual CPR during the packaging, loading, and transport of OHCA patients.

Disclosures

Annemarie Silver, PhD is an employee of Zoll Medical Corporation.