A Prospective Observational Study of Emergency Airway Management in Emergency Department

Winchana Srivilaithon MD*

** Department of Emergency Medicine, Thammasat University, Pathumthani, Thailand*

Background and Objective: *In the emergency department (ED), airway management by emergency physicians is becoming more common. The presented study described emergency intubation indications, methods, operator characteristics, success rates, and adverse event rates.*

Material and Method: *Prospective observational study using data collection form was done in the ED of Thammasat University Hospital from September 2012 to August 2015. Data were collected by each physician intubator at the time of each intubation.*

Results: *The author recorded 1,393 encounters underwent intubation in ED. Intubation was ultimately successful in 99.43%. Cardiac arrest (18.95%) and head injury (7.32%) were the most common indication for intubation in medical encounters and trauma encounters, respectively. The overall success rates on the first attempt were 74.66% (95% confidence interval (CI); 72.37-76.94%). Rapid sequence intubation (RSI) was used in 22.47% of all encounters, had success rates on the first attempt of intubation higher than sedation without paralysis (79.55% vs. 66.09%, risk difference 15.93%, 95% CI for difference [8.64-23.23%]; p<0.01). Senior physicians in emergency medicine had the highest rates of successful intubation on the first attempt (81.94%, 95% CI; 78.84-85.03%). The overall adverse event rates were 8.47%.*

Conclusion: *The presented study observed high overall intubation success rates in ED. RSI has the highest success rates in the first attempt of intubation. Resident and staff in emergency medicine take major role in airway management. Training in emergency medicine residency programs can improve airway management skill.*

Keywords: *Emergency airway management, Intubation, Emergency department, Rapid sequence intubation, Success rate*

J Med Assoc Thai 2016; 99 (Suppl. 4): S131-S137
Full text. e-Journal: *http://www.jmatonline.com*

In emergency departments, emergency airway management by emergency physicians is becoming more common. This specialty continues to grow yet little is known about intubation practices, whereas most of patients needed emergency airway management in emergency department and were in critical situation. Residents training in emergency medicine and emergency medicine staffs take a major role in airway management, including the use of rapid sequence intubation (RSI), defined as intubation after rapid induction and paralysis[1-3].

Many large multicenter studies outside Thailand had reported information on emergency airway management in emergency department[4-7]. Several previous small studies in Thailand had reported intubation methods and success rates within single institution, but had some limitations on data describing patients, techniques, providers and adverse events of emergency airway management in emergency department[8,9].

Our objectives were to describe emergency intubation indications, methods used for intubation, operator characteristics, success rates by method and operator, and adverse events.

Correspondence to:
Srivilaithon W, Department of Emergency Medicine, Faculty of Medicine, Thammasat University, 99 Phahonyothin Road, Khlong Luang, Pathumthani 12121, Thailand.
Phone: +66-86-3669260
E-mail: winchanas@gmail.com

Material and Method

Study design and setting

This was prospective observational study. The study took place in emergency department of Thammasat Hospital, Pathumthani, Thailand. Thammasat Hospital is a 600-bed university tertiary care center. Emergency department has 60,000 patient visits per year. The medical staffs were consisting of emergency attending physicians, emergency medicine residents, interns in general practices, and externs in their last year of medical training from Thammasat medical school. Only staffs worked in emergency department were participating in intubation process.

Patients were accessed and intubated according to their indication. Each patient was counted into an intubation encounter.

The Emergency Department of Thammasat Hospital is a training center for emergency medicine residency program, with a three-year training period. There were interns and externs rotating in the emergency department over a year. They were involved in the intubation process under the supervision of a senior emergency resident or emergency attending staff.

Study population and data collection

This study was approved by Human Research Ethics Committee of Thammasat University (Faculty of Medicine). Data were collected prospectively from first September 2012 to 31 August 2015. The author included all patients who presented to the emergency department and underwent emergency tracheal intubation. After each intubation, intubator completed the data collecting form developed for this study. Data included gender, age, weight, vital sign before start intubation (blood pressure, pulse rate, respiratory rate and oxygen saturation), Glasgow coma scale, duration of procedure, main indication for intubation, initial method of intubation, difficult airway indicator, operator level of training, number of attempts, success or failure, dosage and name of medication used, vital signs after intubation and adverse events.

The present study was using protocol from National Emergency Airway Registry (NEAR). We describe each encounter by "method" and number of "attempts". We define a "method" as a single set of medication or devices, such as rapid sequence intubation with a Macintosh laryngoscope[4]. The present study defined an "attempt" as a single effort to place an airway. Each encounter could have one or more methods and each method could have one or more attempts.

The present study divided operator level of training into three groups; (i) last year medical students or an extern group, (ii) interns in general practice, first year residents were in junior physician group, and (iii) second year to third year residents and emergency attending staff were in senior physician group.

Measurements

The present study reported information about the distribution of (i) indication for intubation in emergency department, divided all encounters into medical encounter and trauma encounter, (ii) methods used for initial intubating in medical encounter and trauma encounter, (iii) success rates for each method according to type of encounters, (iv) first intubator and success rates for the first attempt, and (v) adverse event and rates.

Statistical analysis

The present study presented descriptive data as frequencies and percentages for categorical variables with 95% confidence intervals (95% CI), and mean with standard deviation (SD) or median with interquartile range (IQR) for continuous variable. All analysis was performed with STATA software (version 12.0, StataCorp, College Station, TX).

Results

The present study included 1,393 encounters. Table 1 shows patient characteristics and primary indication for intubation. Most encounters were adult, which 1,361 encounters (97.7%). The indications for intubation were medical emergency in 1,213 encounters (87.08%) and for trauma event in 180 encounters (12.92%). Most of medical emergency were cardiac arrest in 264 encounters (18.95%). The overall success intubation rates were 99.43%; of which 74.66% of the encounters were successful with the first attempt.

Table 2 shows method using in emergency airway management for each encounter. Oral tracheal intubation without any medication was used in 612 encounters (43.93%). Oral tracheal intubation with induction agents or sedatives without neuromuscular blockade, were used in 460 encounters (33.02%). Rapid sequence intubation was used in 313 encounters (22.47%).

For all encounters and methods (Table 3), 1,040 encounters (74.66%, 95% CI; 72.37-76.94%) were successful on the first attempt of intubation procedure and 1,347 encounters (96.7%, 95% CI; 95.75-97.63%) successful on $\leq$3 attempts. The success rates on the first attempt of rapid sequence intubation method were higher than sedation without paralysis method in all encounters (79.55% vs. 66.09%, risk difference 15.93%, 95% CI for difference; [8.64-23.23%]; $p<0.01$). Based on the indication for intubation, the success rates in $\leq$3 attempts were 97.03% (95% CI; 96.07-97.98%) for medical encounters and 94.44% (95% CI; 91.06-97.82%) for trauma encounters. Including all method, intubation was fully successful in 1,385 encounters (99.43%). As to failed intubation, two encounters (0.14%) received surgical cricothyrotomy for a rescue airway and six encounters (0.43%) were successful with fiberoptic assisted intubation.

Table 1. Patients' characteristics and principal indication for intubation

Characteristic	No. of patients (n = 1,393)	% of patients
Male	885	63.53
Age (year) mean (SD) 59.5 (21.1)		
Adult		
16-65	718	51.54
>65	643	46.16
Pediatric		
<1 (infant)	10	0.72
1-15	22	1.58
Medical encounter		
Cardiac arrest	264	18.95
Pneumonia	256	18.38
Altered mental status	159	11.41
Congestive heart failure	145	10.41
Stroke	106	7.61
Status epilepticus	67	4.81
Chronic obstructive pulmonary disease	52	3.73
Shock	28	2.01
Coma	36	2.58
Asthma	18	1.29
Myocardial infarction	10	0.72
Pulmonary embolus	9	0.65
Gastrointestinal bleeding	14	1.01
Airway obstruction	16	1.15
Overdose	7	0.50
Anaphylaxis	1	0.07
Uncategorized encounters	25	1.80
Subtotal	1,213	87.08
Trauma encounter		
Head injury	102	7.32
Traumatic arrest	39	2.80
Facial trauma	13	0.93
Traumatic shock	7	0.50
Burn/inhalation	4	0.29
General trauma	11	0.79
Trauma-combative	4	0.29
Subtotal	180	12.92
Duration (minute) median (IQR) 5 (2-7)		
Glottis exposure grade		
1	801	57.50
2	436	31.30
3	120	8.61
4	36	2.58
Need increase force	240	17.23
BURB	262	18.81
Cord closed	51	3.66
Sniff position	482	34.60
Cricoid pressure	346	24.84
Success rate		
Overall	1,385	99.43
Success in 1st attempt	1,040	74.66
Success in ≤3 attempt	1,347	96.70

Table 4 shows the first intubator depended on operator level of training. The group of senior physician (second year to third year residents and attending physicians) showed the highest successful on the first attempt rate in all encounters with 81.94% (95% CI; 78.84-85.03%). The successful rates on the first attempt in the junior physician group of all encounters were 72.48% (95% CI; 68.5-76.46%). However, externs for their first intubation had the lowest rate of success on the first attempt with 63.96% (95% CI; 58.56-69.35%).

Table 5 lists intubation-associated adverse events by type of encounter. The common adverse event by all encounters included hypotension-required intravenous fluid in 45 cases (3.23%). Major adverse events, defined as cardiac arrest, hypotension and pneumothorax, were identified in 67 cases (5.52%) with medical encounters and in five cases (2.78%) with trauma encounters.

Discussion

Successful emergency airway intubation is an important practical management in emergency department. This is observational study of emergency department intubation. The present study presented data describing 1,393 intubations in one emergency department. The observation showed 52.84% of first attempt were performed by emergency physicians or residents, whereas 47.16% by general practitioners or medical students under surveillance of emergency physician staff. In the present study, the overall success rate for airway managements were 99.43% of all encounters. In the present study, the observed success rates were consistent with the findings of other studies[4-8,10]. Almost all encounters were with adults with a relatively small number of pediatric intubations, consistent with the findings of other studies in Thailand[8].

The present study revealed cardiac arrest and head injury as the most common indication for emergency intubation in medical and traumatic cases, respectively. Considering that it is consistent with other studies, there were differences in other indications for intubation rates[4-6,8].

The author studied methods of emergency airway management. Rapid sequence intubation (RSI) as the first method chosen was successful on the first attempt of intubation in 81.55% of medical encounters, the highest rates than others method. This finding was consistent with many studies[4-6,11,12]. Many guidelines recommend using RSI as the initial intubation method

Table 2. Methods of airway management

Method	All encounters n (%)	Medical encounters n (%)	Trauma encounters n (%)
Oral without medication	612 (43.93)	521 (42.95)	91 (50.56)
Sedation without paralysis	460 (33.02)	414 (34.13)	46 (25.56)
Rapid sequence intubation	313 (22.47)	271 (22.34)	42 (23.33)
Surgical cricothyrotomy	2 (0.14)	2 (0.16)	0 (0)
Fiberoptic assist	6 (0.43)	5 (0.41)	1 (0.56)
Total	1,393 (100)	1,213 (100)	180 (100)

Table 3. Succession for methods of intubation

Method	All encounters		Medical encounters		Trauma encounters	
	Successful on 1st attempt n (%)	Successful in ≤3 attempts n (%)	Successful on 1st attempt n (%)	Successful in ≤3 attempts n (%)	Successful on 1st attempt n (%)	Successful in ≤3 attempts n (%)
Oral without medication	487 (79.58)	598 (97.71)	417 (80.04)	512 (98.27)	70 (76.92)	86 (94.51)
Sedation without paralysis	304 (66.09)	438 (95.22)	276 (66.67)	394 (95.17)	28 (60.87)	44 (95.65)
Rapid sequence intubation	249 (79.55)	309 (98.72)	221 (81.55)	269 (99.26)	28 (66.67)	40 (95.24)
Surgical cricothyrotomy	0	2 (100)	0	2 (100)	0	0
Total	1,040 (74.66)	1,347 (96.7)	914 (75.35)	1,177 (97.03)	126 (70)	170 (94.44)

Table 4. Succession for first intubator

First intubator	No. of patients n (%)	Successful on 1st attempt n (%)		
		All encounters	Medical encounters	Trauma encounters
Extern	308 (22.11)	197 (63.96)	190 (64.85)	7 (46.67)
General practitioner	349 (25.05)	246 (70.51)	209 (70.46)	37 (64.8)
1st-year resident	138 (9.91)	107 (77.54)	91 (76.47)	16 (84.21)
2nd-year resident	331 (23.76)	272 (82.18)	241 (84.27)	31 (68.89)
3rd-year resident	230 (16.51)	187 (81.30)	159 (83.25)	28 (71.79)
Attending staff	37 (2.66)	31 (83.78)	24 (88.89)	7 (70)
Total	1,393 (100)	1,040 (74.66)	914 (75.35)	126 (70)

in patients who do not have contraindications[2,13-15].

The present study explored each group of intubator. Success on the first attempt of intubation rates depended on number of years after graduation. These findings were to be expected, given the increase in experience gained which helped with improvement during resident training[6]. There was no further improvement in success by the first intubator, and even a slight decline from second year residents to attending staff. These findings support the airway skill of residents in emergency medicine who are mature by the second year of training. However, early year residents in training were more likely to be allowed attempts on the anticipated easy airway cases. Thus, the third year resident and attending staff may be handling a select group of only the most difficult airway cases.

Limitation

The present study had several limitations.

Table 5. Adverse events by encounter type

Adverse event	Events in all methods n (%)	Events in medical encounters n (%)	Events trauma encounters n (%)
Hypotension-required IV fluid	45 (3.23)	44 (3.63)	1 (0.56)
Cardiac arrest	26 (1.87)	22 (1.81)	4 (2.22)
Esophageal intubation	17 (1.22)	9 (0.74)	8 (4.44)
Dental trauma	12 (0.86)	8 (0.66)	4 (2.22)
Direct airway injury	6 (0.43)	5 (0.41)	1 (0.56)
Main stem intubation	5 (0.36)	4 (0.33)	1 (0.56)
Laryngospasm	1 (0.07)	1 (0.08)	0
Pneumothorax	1 (0.07)	1 (0.08)	0
Total	118 (8.47)	99 (8.16)	19 (10.56)

First, the participated emergency department was the site of emergency medicine residency training programs; therefore, these results may not represent emergency airway management practices in non-academic hospitals due to possible variation in practices. These results may not be generalizable to community emergency departments.

Second, passive surveillance has intrinsic limitations; an under-estimation of the rate of failed intubations is thus possible. Self-reporting immediately after intubation can result in incomplete reporting of adverse events[16]. This study was not designed to measure patients' outcome after emergency airway management in emergency department. A more accurate analysis of adverse events and outcome requires follow-up of the patients.

Conclusion

The present study observed high overall intubation success rates but a low rate of serious adverse events in the emergency department. The RSI method has the highest success rates in the first attempt of intubation. However, still under used. Resident and staff in emergency medicine take a major role in emergency airway management. Training in emergency medicine residency programs can improve airway management skill.

What is already known on this topic?

In emergency departments, emergency airway management by emergency physicians is becoming more common. This specialty continues to grow yet little is known about intubation practices. Several previous small studies in Thailand had reported intubation methods and success rates within single institution, but had limitation on data describe patients, techniques, providers and adverse events of emergency airway management in emergency department.

What this study adds?

There were high overall emergency intubation success rates and a low rate of serious adverse event in emergency department. The RSI method has the highest success rates in the first attempt of intubation. However, still under used. Pre- and post-intubation review may increase its future use. Training in emergency medicine residency programs can improve airway management skill.

Acknowledgement

The author would like to thank the emergency medicine staff, the emergency medicine resident and internists of emergency medicine department of Thammasat Hospital for helping in collecting intubation data.

Potential conflicts of interest

None.

References

1. Mace SE. Challenges and advances in intubation: airway evaluation and controversies with intubation. Emerg Med Clin North Am 2008; 26: 977-1000.
2. Mace SE. Challenges and advances in intubation: rapid sequence intubation.Emerg Med Clin North Am 2008; 26: 1043-68.
3. Sagarin MJ, Chiang V, Sakles JC, Barton ED, Wolfe RE, Vissers RJ, et al. Rapid sequence intubation

for pediatric emergency airway management. Pediatr Emerg Care 2002; 18: 417-23.
4. Walls RM, Brown CA 3rd, Bair AE, Pallin DJ. Emergency airway management: a multi-center report of 8937 emergency department intubations. J Emerg Med 2011; 41: 347-54.
5. Hasegawa K, Hagiwara Y, Chiba T, Watase H, Walls RM, Brown DF, et al. Emergency airway management in Japan: Interim analysis of a multi-center prospective observational study. Resuscitation 2012; 83: 428-33.
6. Sagarin MJ, Barton ED, Chng YM, Walls RM. Airway management by US and Canadian emergency medicine residents: a multicenter analysis of more than 6,000 endotracheal intubation attempts. Ann Emerg Med 2005; 46: 328-36.
7. Choi YF, Wong TW, Lau CC, Siu AYC, Lo CB, Yuen MC, et al. A Study of orotracheal intubation in emergency department of five district hospitals in Hong Kong. Hong Kong J Emerg Med 2003; 10: 138-45.
8. Wongyingsinn M, Songarj P, Assawinvinijkul T. A prospective observational study of tracheal intubation in an emergency department in a 2300-bed hospital of a developing country in a one-year period. Emerg Med J 2009; 26: 604-8.
9. Trakulsrichai S, Sundarathiti P, Chalermdamrichai P, Palasatien I, Rattanasiri S, Chatchaipun P, et al. An observation study of rapid sequence, awake and sedation-only intubations in an emergency department in Thai patients. J Med Assoc Thai 2009; 92: 1022-7.
10. Sakles JC, Laurin EG, Rantapaa AA, Panacek EA. Airway management in the emergency department: a one-year study of 610 tracheal intubations. Ann Emerg Med 1998; 31: 325-32.
11. Stevenson AG, Graham CA, Hall R, Korsah P, McGuffie AC. Tracheal intubation in the emergency department: the Scottish district hospital perspective. Emerg Med J 2007; 24: 394-7.
12. Butler JM, Clancy M, Robinson N, Driscoll P. An observational survey of emergency department rapid sequence intubation. Emerg Med J 2001; 18: 343-8.
13. Wang HE, Davis DP, Wayne MA, Delbridge T. Prehospital rapid-sequence intubation—what does the evidence show? Proceedings from the 2004 National Association of EMS Physicians annual meeting. PrehospEmerg Care 2004; 8: 366-77.
14. Kovacs G, Law JA, Ross J, Tallon J, MacQuarrie K, Petrie D, et al. Acute airway management in the emergency department by non-anesthesiologists. Can J Anaesth 2004; 51: 174-80.
15. American College of Emergency Physicians. Rapid-sequence Intubation [Internet]. Approved by ACEP Board of Directors, October 2006 [cited 2008 Feb 7]. Available from: https://www.acep.org/Clinical—Practice-Management/Rapid-Sequence-Intubation/
16. Wang HE, Domeier RM, Kupas DF, Greenwood MJ, O'Connor RE. Recommended guidelines for uniform reporting of data from out-of-hospital airway management: position statement of the National Association of EMS Physicians. PrehospEmerg Care 2004; 8: 58-72.

การศึกษาแบบสังเกตไปข้างหน้าของการดูแลฉุกเฉินระบบทางเดินหายใจในห้องฉุกเฉิน

วินชนะ ศรีวิไลทนต์

วัตถุประสงค์: ในห้องฉุกเฉิน การดูแลทางเดินหายใจฉุกเฉินโดยแพทย์เวชศาสตร์ฉุกเฉินเป็นสิ่งที่พบได้มากขึ้น งานวิจัยนี้มีวัตถุประสงค์ในการให้ข้อมูลของข้อบ่งชี้ในการใส่ท่อช่วยหายใจฉุกเฉิน วิธีการใส่ท่อช่วยหายใจ ลักษณะของผู้ใส่ท่อช่วยหายใจ อัตราความสำเร็จของการใส่ท่อช่วยหายใจ และภาวะแทรกซ้อนที่เกิดขึ้น

วัสดุและวิธีการ: เก็บข้อมูลแบบสังเกตไปข้างหน้าในผู้ที่ได้รับการใส่ท่อช่วยหายใจในห้องฉุกเฉินของโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ โดยใช้แบบเก็บข้อมูล ระหว่างเดือนกันยายน พ.ศ. 2555 ถึงเดือนสิงหาคม พ.ศ. 2558 ข้อมูลในการใส่ท่อช่วยหายใจแต่ละครั้งจะถูกบันทึกโดยผู้ที่ทำการใส่ท่อช่วยหายใจเอง

ผลการศึกษา: เก็บข้อมูลในผู้ป่วยที่ถูกใส่ท่อช่วยหายใจที่ห้องฉุกเฉินทั้งหมด 1,393 ราย สามารถใส่ท่อช่วยหายใจได้สำเร็จร้อยละ 99.43 ภาวะหัวใจหยุดเต้น (ร้อยละ 18.95) และการบาดเจ็บที่ศีรษะ (ร้อยละ 7.32) พบเป็นข้อบ่งชี้ในการใส่ท่อช่วยหายใจมากที่สุดในกลุ่มผู้ป่วยอายุรกรรมและผู้บาดเจ็บตามลำดับ อัตราความสำเร็จตั้งแต่ครั้งแรกของการใส่ท่อช่วยหายใจโดยรวมอยู่ที่ร้อยละ 74.66 (95% confidence interval (CI); 72.37-76.94%) การใส่ท่อช่วยหายใจด้วยวิธี rapid sequence intubation มีจำนวนร้อยละ 22.47 ของการใส่ท่อช่วยหายใจทั้งหมด พบว่ามีอัตราความสำเร็จตั้งแต่ครั้งแรกของการใส่ท่อช่วยหายใจสูงกว่าผู้ที่ใส่ท่อช่วยหายใจด้วยการใช้ยาทำให้สลบแต่ไม่ใช้ยาคลายกล้ามเนื้อ (ร้อยละ 79.55 เทียบกับร้อยละ 66.09, risk difference 15.93%, 95% CI for difference [8.64-23.23%]; p<0.01) ผู้ที่มีประสบการณ์สูงในสาขาเวชศาสตร์ฉุกเฉินมีอัตราความสำเร็จตั้งแต่ครั้งแรกของการใส่ท่อช่วยหายใจสูงที่สุด (ร้อยละ 81.93, 95% CI; 78.84-85.03%) อัตราการเกิดภาวะแทรกซ้อนอยู่ที่ร้อยละ 8.47

สรุป: การใส่ท่อช่วยหายใจฉุกเฉินที่ห้องฉุกเฉินมีอัตราการสำเร็จที่สูง การใส่ท่อช่วยหายใจด้วยวิธี rapid sequence intubation มีอัตราความสำเร็จตั้งแต่ครั้งแรกของการใส่ท่อช่วยหายใจสูงที่สุด แพทย์ประจำบ้านและอาจารย์สาขาเวชศาสตร์ฉุกเฉินเป็นผู้ที่มีหน้าที่สำคัญในการดูแลทางเดินหายใจของผู้ป่วย การฝึกฝนแพทย์ประจำบ้านสาขาเวชศาสตร์ฉุกเฉินสามารถเพิ่มความสามารถในการดูแลทางเดินหายใจในผู้ป่วยฉุกเฉินได้