Original Article

Endotracheal Intubation on a Stationary vs. Moving Ambulance

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Background: Airway management plays an important role in emergency medical services (EMS). Paramedics or doctors are able to manage the airway by endotracheal intubation (ETI). However, there have yet been no studies conducted comparing ETI on stationary and moving ambulances in Thailand.

Objective: To compare time until the cuff inflation and time until first ventilation in stationary and moving ambulances.

Materials and Methods: This was a prospective crossover study consisting of 55 doctors on rotation in the emergency room (ER) and emergency medicine residency training from April to December 2019. Vehicles in the moving ambulance group traveled at a speed of 80 km/hr on real roads over a distance of 5 kilometers. Video was recorded of the procedure. A standard mannequin was used for airway simulation.

Results: In the majority of cases, ETI was successful on the first attempt in both groups (90.9% success in the stationary ambulance and 76.4% in the moving ambulance). The time until cuff inflation in the stationary and moving ambulance was 13.5±4.9 seconds and 20.6±4.6 seconds, respectively (p = 0.026). Time until the first ventilation in the stationary ambulance was 20.1±7.6 seconds and 28.4±5.6 seconds in the moving ambulance (p = 0.015).

Conclusion: Time until the cuff inflation and time until the first ventilation in the moving ambulance were longer than in the stationary ambulance. In addition, the rate of successful ETI on the first attempt was higher in the stationary ambulance than in the moving ambulance.

Keywords: Emergency medical services, Emergency care, Prehospital emergency care, Intubation, Ambulances

J Med Assoc Thai 2020;103(Suppl. 6): 18-21
Website: http://www.jmatonline.com

Airway management plays an important role in emergency medical services (EMS), as it can prevent obstruction of the airway and hypoxia, and delay management can lead to both more serious injuries and an increased mortality rate[1,2]. Basic airway management includes opening the airway and performing rescue breathing. However, there is still debate regarding the benefits to patients of advanced airway management[3]. Although considered the most educated, one of the top five studies involving EMS study[4], most of them have studied the success rates of endotracheal intubation (ETI) in various situations or the symptoms of the patients after airway management[5-13].

In Thailand, EMS paramedics or doctors are able to manage the airway by ETI, which is a skill that they practice during their emergency residency training. Generally, before initiating ETI, the ambulance must be stopped completely, which causes management to be delayed. If ETI is initiated while driving, the time until patients who are unable to breathe on their own undergo airway management will be reduced, possibly resulting in lower rates of death and disability. Previous studies of ETI in ambulances have found success rates ranging from 25.0 to 95.5%[14,15]. However, there have been no studies comparing ETI on stationary and moving ambulances in Thailand. The objective of the present study was thus to make this comparison in terms of both the success rate of and duration to ETI.

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Materials and Methods

This was a prospective crossover study. The sample consisted of 55 doctors on rotation in the emergency room (ER) and in emergency medicine residency training from April to December 2019. The exclusion criteria were inability to bend back for ETI and propensity for car sickness. Ethical approval was provided by the Khon Kaen University Ethics Committee for Human Research (HE621148).

The sample size was calculated based on the difference in mean outcome between the groups. In order to achieve a significance level of 5% and power of test of 0.8, we determined that a sample size of 55 would be required.

How to cite this article: Apiratwarakul K, Pumiyoch P, Ienghong K, Phungoen P, Gaysonsiri D, Bhudhisawasdi V. Endotracheal Intubation on a Stationary vs. Moving Ambulance. J Med Assoc Thai 2020;103(Suppl.6): 18-21.

Statistical analysis was performed using SPSS for Windows version 16.0 (SPSS Inc., Chicago, IL, USA). Categorical data were presented using percentages and continuous data using mean and standard deviation. Univariable analysis was performed using a two-sample t-test for numerical data and a Pearson's correlation for data relationship between the two groups.

The moving ambulance traveled at a speed of 80 km/hr on real roads on direct routes for a distance of 5 kilometers. The procedures were observed via video recordings taken inside the ambulance. A standard mannequin was used for airway simulation.

Results

Fifty-five subjects were examined, the characteristics of whom are shown in Table 1. The mean age of the subjects was 26.2±2.3 years. The majority of participants (63.6%; n = 35) were male and had <3 years of work experience (<1 year = 36.4%; 1 to 3 years = 36.4%; >3 years = 27.2%).

The first attempt at ETI was successful in the majority of cases in both groups (90.9% in the stationary ambulance and 76.4% in the moving ambulance). The average time until cuff inflation on the stationary and moving ambulance was 13.5±4.9 seconds and 20.6±4.6 seconds, respectively (p = 0.026; Table 2). The time until the first ventilation in the stationary ambulance was 20.1±7.6 seconds and 28.4±5.6 seconds in the moving ambulance (p = 0.015).

The majority of participants rated the difficulty of the procedure as 1 to 2 (1 being the easiest) in the stationary ambulance and 5 to 6 in the moving ambulance (58.2% and 54.6%, respectively) in Table 3.

Table 1. Characteristics of the subjects

	Number (%)
Age (years), mean ± SD	26.2±2.3
Gender: male	35 (63.6)
Work experience (years)	
<1	20 (36.4)
1 to 3	20 (36.4)
>3	15 (27.2)

Table 2. Comparison of success of and duration to endotracheal intubation

	Stationary ambulance (%)	Moving ambulance (%)	*p*-value
Successful attempt			0.032*
1	50 (90.9)	42 (76.4)	
2	3 (5.5)	10 (18.2)	
3	2 (3.6)	2 (3.6)	
>3	0	1 (1.8)	
Time until the cuff inflation (sec)	13.5±4.9	20.6±4.6	0.026*
Time until the first ventilation (sec)	20.1±7.6	28.4±5.6	0.015*

* Statistical significance

Table 3. Self-assessment of the difficulty of the procedure

Points#	Stationary ambulance (%)	Moving ambulance (%)
1 to 2	32 (58.2)	0
3 to 4	20 (36.4)	12 (21.8)
5 to 6	3 (5.4)	30 (54.6)
7 to 8	0	10 (18.2)
9 to 10	0	3 (5.4)

Scale of 1 to 10 (1: very easy procedure; 10: very difficult procedure)

Discussion

The present study compared physician's ETI skills in stationary and moving ambulances in real-world scenarios. The time until cuff inflation and the time until first ventilation in the moving ambulance were longer than in the stationary ambulance, which is consistent with the results of a previous study in paramedics[16]. The first attempt at ETI was successful more often in a stationary ambulance than in a moving ambulance, which is consistent with a study conducted by Karaca[16] in an ambulance simulator. This is likely due to the movement of the vehicle making the procedure more difficult to accomplish.

In addition, participants' assessed the procedure as being more difficult in the moving ambulance (using a 10-point scale). This contrasts with the results of a previous study conducted in Europe, in which paramedics rated the difficulty of ETI using an endotracheal tube with a classic stylet in a moving ambulance as being below 4. This may be due to paramedics playing a greater role in airway management than in Thailand, where only emergency physicians perform the procedure. The EMS in Thailand was established to provide prehospital care by medical staff. Emergency medical responders (EMRs), emergency medical technicians (EMTs), advanced emergency medical technicians (AEMTs), paramedics, nurses, and doctors are all deployed through this service[17-21].

The authors also found that the use of supraglottic airway devices (laryngeal mask airway: LMA) shortened the time to procedure when compared with ETI[22]. However, this study was limited in that the data were gathered from only one emergency medical services center. Moreover, the carryover effect couldn't be excluded due to the cross-over study design. Lastly, the short washout period might have affected the study outcome.

Conclusion

Times until the cuff inflation and first ventilation in the moving ambulance were longer than in the stationary

ambulance. The procedure was also successful on the first attempt in the stationary ambulance more often than in than the moving ambulance.

What is already known on this topic?

Airway management plays an important role in EMS in that it can prevent obstruction of the airway and hypoxia. Delayed management leads to more serious injuries and increased mortality rates.

What this study adds?

Time to ETI was longer in a moving ambulance than in a stationary ambulance, and participants rated the procedure as being more difficult in the moving ambulance than in the stationary ambulance.

Acknowledgements

The present study received funding from the Khon Kaen University Faculty of Medicine (IN62228). The authors would like to thank Kaewjai Thepsuthammarat for her data analysis and statistical review and Dylan Southard for acting as English consultant.

Potential conflicts of interest

The authors declare no conflicts of interest.

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ทักษะการใส่ท่อช่วยหายใจในรถพยาบาลที่เคลื่อนที่และหยุดนิ่ง

กรกฎ อภิรัตน์วรากุล, ปรเมท ภูมิโยชน์, กมลวรรณ เอี้ยงฮง, ปริวัฒน์ ภู่เงิน, ดนุ เกษรศิริ, วัชรพงศ์ พุทธิสวัสดิ์

ภูมิหลัง: การจัดการทางเดินหายใจถือเป็นทักษะที่มีความสำคัญในระบบการแพทย์ฉุกเฉิน นักปฏิบัติการฉุกเฉินการแพทย์และแพทย์สามารถจัดการทางเดินหายใจด้วยการใส่ท่อช่วยหายใจได้ อย่างไรก็ตามยังไม่มีการศึกษาในประเทศไทยเกี่ยวกับการใส่ท่อช่วยหายใจในรถพยาบาลที่เคลื่อนที่และหยุดนิ่ง

วัตถุประสงค์: เพื่อเปรียบเทียบเวลาในการใส่ท่อช่วยหายใจและเวลาตั้งแต่ใส่ท่อช่วยหายใจจนเริ่มการช่วยหายใจในรถพยาบาลที่เคลื่อนที่และหยุดนิ่ง

วัสดุและวิธีการ: การศึกษาแบบไปข้างหน้าในแพทย์จำนวน 55 รายที่ปฏิบัติงาน ณ ห้องฉุกเฉินและแพทย์ประจำบ้านสาขาเวชศาสตร์ฉุกเฉิน ระหว่างเดือนเมษายน ถึงเดือนธันวาคม พ.ศ. 2562 โดยรถพยาบาลที่ทำการศึกษาใช้ความเร็วคงที่ 80 กิโลเมตร/ชั่วโมง บนถนนที่ใช้สัญจรปกติในระยะทาง 5 กิโลเมตร ใช้กล้องบันทึกภาพในการเก็บข้อมูลการใส่ท่อช่วยหายใจในรถพยาบาลด้วยหุ่นฝึกทักษะการใส่ท่อช่วยหายใจ

ผลการศึกษา: ทักษะในการใส่ท่อช่วยหายใจส่วนใหญ่สำเร็จในครั้งแรกของการปฏิบัติ (ร้อยละ 90.9 ในกลุ่มรถพยาบาลหยุดนิ่งและร้อยละ 76.4 ในกลุ่มรถพยาบาลเคลื่อนที่) ระยะเวลาในการใส่ท่อช่วยหายใจในกลุ่มรถพยาบาลหยุดนิ่ง 13.5±4.9 วินาที และ 20.6±4.6 วินาที ในกลุ่มรถพยาบาลเคลื่อนที่ ระยะเวลาตั้งแต่ใส่ท่อช่วยหายใจ จนเริ่มการช่วยหายใจในกลุ่มรถพยาบาลหยุดนิ่ง 20.1±7.6 วินาที และ 28.4±5.6 วินาทีในกลุ่มรถพยาบาลเคลื่อนที่

สรุป: ระยะเวลาในการใส่ท่อช่วยหายใจและระยะเวลาตั้งแต่ใส่ท่อช่วยหายใจจนเริ่มการช่วยหายใจในรถพยาบาลที่เคลื่อนที่ใช้เวลามากกว่ารถพยาบาลที่หยุดนิ่ง รวมทั้งอัตราการใส่ท่อช่วยสำเร็จในครั้งแรกในรถพยาบาลที่หยุดนิ่งมากกว่าในรถพยาบาลที่เคลื่อนที่