ORIGINAL ARTICLE

Efficacy and safety of endotracheal intubation performed in moving vs motionless environments

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Objective. To compare the efficacy and safety of endotracheal intubation (ETI) in a simulated clinical environment in motion vs a motionless one.

Method. Clinical simulation trial of ETI with 3 endotracheal tubes (Airtraq, Fast-trach, Macintosh laryngoscope) in mannequins with realistic physiological responses (MetiMan) in 2 scenarios: an environment in motion vs a motionless one. Thirty-six physicians expert in prehospital ETI participated. Outcome variables were successful intubation, effective intubation, number of attempts, maximum apnea time, and total maneuver time. The safety variables were the presence of bradycardia, tachycardia, or high or low systolic blood pressures (ie, 20% variation from baseline); hypoxemia (decrease in oxygen saturation to <90% or 10% below baseline), tube placement in the esophagus or main bronchus, and dental trauma.

Results. No statistically significant differences between the 2 scenarios were found in the numbers of successful ETI (motionless, 71 [65.7%]; in motion, 67 [62.0%]; *P*=.277) or effective ETI (motionless, 104 [96.3%]; in motion, 105 [97.2%]; *P*=.108). Likewise, the number of attempts were similar (motionless, 91 [84.2%]; in motion, 90 [83.3%]; *P*=.305). Nor did we see differences in the mean (SD) maximum apnea times (motionless, 14.0 [5.6] seconds; in motion, 14.9 [8.1] seconds; *P*=.570) or mean total maneuver times (motionless, 236.7 [73.4] seconds; in motion, 210.3 [77.9] seconds; *P*=.164). The prevalences of bradycardia, tachycardia, high or low systolic blood pressure, hypoxemia, placements in the esophagus or bronchus, and dental trauma also did not differ significantly between the 2 scenarios.

Conclusion. Neither efficacy nor safety variables differed significantly when ETI was performed in mannequins in a motionless environment vs one simulating ambulances in motion.

Keywords: Endotracheal intubation. Ambulance in motion. Medical devices. Prehospital emergencies.

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Estudio comparativo de la eficacia y seguridad de la intubación endotraqueal en movimiento y en estático

Objetivo. Evaluar la eficacia y seguridad de la intubación endotraqueal (IET) en movimiento en comparación con la realización en estático.

Método. Ensayo de simulación clínica con maniquíes con respuesta fisiológica MetiMan® que comparó la IET en dos escenarios, intubar en estático (IE) y en movimiento (IM), utilizando 3 dispositivos de IET (Airtraq®, Fast-trach® y Laringoscopio Macintosh®). Treinta y seis médicos expertos en intubación prehospitalaria fueron los intervinientes. Las variables de resultado fueron la intubación efectiva y exitosa, el número de intentos, el tiempo máximo de apnea (TMA) y el tiempo total de la técnica (TTT). Las variables de seguridad fueron la presencia de bradi- y taquicardia, hiper- e hipotensión, hipoxemia, tubo endotraqueal (TET) alojado en esófago o en bronquio y el traumatismo dental.

Resultados. No hubo diferencias estadísticamente significativas en el porcentaje de IET exitosa [IE: 71 (65,7%) *vs* IM: 67 (62,0%); p = 0,277] ni de efectividad (IE: 104 (96,3%) *vs* IM: 105 (97,2%); p = 0,108), en el número de intentos [IE: 91 (84,2%) *vs* IM: 90 (83,3%); p = 0,305], en la media de TMA [IE: 14,0 (DE 5,6) segundos *vs* IM: 14,9 (DE 8,1) segundos; p = 0,570], TTT [IE: 236,7 (DE 73,4) segundos *vs* IM: 210,9 (DE 77,9) segundos; p = 0,164]. Tampoco se demostró aumento o descenso de un 20% de las cifras iniciales de la frecuencia cardiaca o de la presión arterial sistólica, la saturación de oxígeno inferior a 90% o descenso de un 10% de la basal, intubación esofágica o bronquial ni trauma dental, entre ambos escenarios.

Conclusiones. No se encontraron diferencias significativas en términos de eficacia ni seguridad entre la IET en movimiento y en dinámico en un escenario simulado.

Palabras clave: Intubación endotraqueal. Ambulancia en movimiento. Dispositivo. Emergencias prehospitalarias.

Introduction

The rapid and safe handling of the airway, through endotracheal intubation (ETI), is decisive in critical patient assistance in the prehospital environment[1,2]. Currently, there is controversy regarding if it should be carried out in this area, due to the delay in arriving at the hospital with increased prehospital assistance time, which may be crucial[3,4], especially in patients with chronic life-threatening conditions[5-7]. On the other hand, there are

other situations that would require assistance while moving, given the danger of stopping the vehicle, such as unsafe scenarios (e.g. fires, explosions) or violent scenarios (e.g. wars, terrorism) and unfavourable weather conditions (e.g., fog, rain). In Spain, road safety regulations prohibit stopping the vehicle on motorways (except in spaces enabled for it), roads without shoulder and all those points without visibility[8]. In addition, and paradoxically, it prohibits travelling on these same roads without a restraint system. This has led many authors to analyse different procedures performed during the transfer[9-13].

In a previous pilot study, we observed that the ETI was feasible in a moving ambulance[14] and Wong et al. documented that there were no differences in ETI during the transfer and in static[15]. Despite this, it is known that it is an invasive and risky technique and that manipulation with a laryngoscope stimulates the sympathetic and parasympathetic systems and its inadequate performance or after multiple attempts can lead to the onset of hypoxemia, bradycardia and hypotension[16,17]. Other elements that increase the risk in the ground transportation of critical patients are also present. Accelerations, at the physiological level, can produce hypotension and tachycardia, and decelerations, hypertension and bradycardia[18].

Considering the above written, the objective was to evaluate the efficacy and safety of the ETI in motion as opposed to static, carried out by a group of pre-hospital EIT experts.

Method

A clinical simulation trial was designed with pairs of participants considering age, sex and years of experience. The project was approved by the Vice-Rectorate for Research, Development and Innovation of the University of Alicante.

The group of participants were 36 volunteer professionals. The selection criteria were to be a physician with prior work experience in terrestrial units of advanced life support (ALS) of the Emergency Service of Alicante (Spain).

Two scenarios were simulated, one in motion and the other one in static. The first, in the clinical simulation laboratory of the Faculty of Health Sciences of the University of Alicante, where participants intubated in static (IS). The second, created in the ambulatory cabin of an ALS (advanced life support) ambulance, where the participants intubated in movement (IM). Two high-fidelity mannequins with a MetiMan® physiological response (CAE Inc.) were used to assess the patient's hemodynamic status during the procedure. The airway of the simulated patient was grade I according to the Cormack-Lehane scale[19]. The three ETI devices were Airtraq® (rigid optical laryngoscope designed to facilitate complete visualization of the airway throughout the ETI process), Fast-trach® (laryngeal mask for advanced airway optimization blindly) and Macintosh® Laryngoscope (device for the ETI that allows direct vision of the vocal cords). The medication prescribed for sedation and relaxation was protocolized and the rapid sequence of intubation was used[20]. Three different clinical cases (ASA-PS III)[21] were created with baseline hemodynamic constants in which the ETI[22] was indicated (Table 1). These cases were programmed in the software of both mannequins, adding to the ambulance mannequin the conditions of "acceleration" and "deceleration" according to the pathophysiology of the terrestrial transport[18]. To reduce variability, the vehicle, the driver and the circuit were always the same. The chosen route was the University of Alicante road, which is 2.9 km long and has traffic moderators (e.g. positive, negative, oblique road bumps, etc.). The maximum speed was 30 Km/h. The mean acceleration was ± 0.20 g, the maximum peak being ± 0.30 g as measured by an accelerometer from the GPS Status & Toolbox (MobiWIA, Inc.) installed on a mobile device. The 36 subjects intubated both in movement and in static in the three clinical cases and using the three devices. They were assigned in a simple random way; first, the scenario of initiation, secondly, in the order of use of the devices and, lastly, the clinical case to each device.

Table 1. Standardized clinical cases in software for clinical simulation

		Drugs used according to RSI	
1 Craniocephalic injury			
GCS, initial (m/v/e)	< 8 (4/2/1)	Etomidate	0.3 mg
SpO_2, initial	93%	Midazolam	0.2 mg/kg
Respiratory rate, initial*	39	Roncuronium	0.6 mg/kg
Systolic blood pressure, initial	140 mmHg		
Initial heart rate**	90		
2 Asthmatic crisis			
GCS, initial (m/v/e)	10 (6/2/2)	Ketamine	2 mg/kg
SpO_2, initial	78%	Cisatracurium	0.15 mg/kg
Respiratory rate, initial	44		
Systolic blood pressure, initial	78 mmHg		
Initial Heart Rate**	30		
3 Septic shock			
GCS, initial (m/v/e)	< 12 (4/3/4)	Etomidate	0.3 mg
SpO_2, initial	< 90%	Fentanyl	0.10 mg/kg
Respiratory rate, initial	30	Cisatracurium	0.15 mg/kg
Initial systolic blood pressure	72 mmHg		
Initial heart rate**	144		

RSI: Rapid sequence intubation; GCS: Glasgow Coma Scale; SpO_2: Oxygen saturation.
* Breaths per minute. **Beats per minute.

The variables were collected by observers using a Ulstein-style consensus template for advanced management of the airway in the prehospital environment[23]. The outcome variables for efficacy were successful intubation, effective intubation, number of attempts, maximum apnea time (MAT) and total time spent in the technique (TTT). Regarding safety, variables were bradycardia, tachycardia, hypotension, hypertension, hypoxemia, oesophageal or bronchial intubation, and dental trauma.

Successful intubation was considered when an effective ventilation was performed after the swelling of the pneumo blockage of the endotracheal tube (ETT) with less than 45 s of apnea. Effective intubation, when the ETI was performed in 3 trials or less. The number of ETI

attempts was defined as the insertion of any device through the teeth[24]. The MAT was the one in which there was no ventilation with mask bag through intubation device. The TTT was the distance between the beginning of the technique, when the participant decided to proceed to intubate and remove the preoxygenation, and the adequate fixation of the ETT with the support of Thomas® after verification with stethoscope of its correct situation. In the case of Fast-trach®, it was necessary to remove the laryngeal mask leaving the ETT fixed.

Bradycardia was defined as a decrease in heart rate (HR) below 40 beats per minute (bpm) if the patient's baseline was reduced by 20%. Tachycardia, as the increase in HR above 100 bpm, if it increased the basal by 20%. Hypotension, such as systolic blood pressure (SBP) below 90 mmHg if it decreased by 20% of baseline. Hypertension, SBP above 160 mmHg if it increased by 20% of baseline. Hypoxemia, oxygen saturation ($SatO_2$) of the patient with values below 90%, when the initial situation was above this, or a decrease of 10% when the baseline was below 90%[16]. Oesophageal intubation was defined as the placement of the ETT in the oesophagus after the intubation manoeuvre and verification of the position of the tube with a stethoscope. Right bronchus intubation, such as ETT in right bronchus with selective ventilation. Dental trauma, such as the lesion on teeth attributed to the device.

The sample size (n = 40 observations) was calculated based on the difference of expected proportions with the success rate in the ETI performed by physicians with laryngoscope in a controlled environment, with a power of 95% and p value = 0.011.

Quantitative variables were expressed as mean and standard deviation (SD) and qualitative variables with their absolute and relative frequencies. Contrast hypothesis of discrete variables was performed with the chi-square test and the hypothesis test of the continuous variables with the Student t test for comparison of paired means (t). Statistically significant differences were considered when the p-value was less than 0.05. The analysis was performed using the statistical package SPSS Statistics (Version 22.0, Armonk, NY: IBM Corp.)

Table 2. Efficiency and safety depending on the scenario

	Static ETI n = 108	ETI in motion n = 108	p
Effectiveness			
Successful [n (%)]	71 (65.7)	67 (62.0)	0.197
Effective [n (%)]	104 (96.3)	105 (97.2)	0.102
No. ETI first attempt [n (%)]	90 (83.3)	91 (84.2)	0.305
MAT in seconds [mean (DE)]	14.0 (5.6)	14.9 (8.1)	0.570
TTT in seconds [average (DE)]	236.7 (73.4)	210.3 (77.9)	0.164
Security			
ETT in oesophagus [n (%)]	5 (13.9)	1 (2.8)	0.684
ETT in bronchus [n (%)]	26 (72.2)	9 (25)	0.667
Dental trauma [n (%)]	3 (8.3)	0 (0)	0.917
Other complications [n (%)]	5 (13.9)	5 (13.9)	0.333

ETI: endotracheal intubation; MAT: maxiun apnea time; TTT: time spent in the technique; ETT: endotrachal tuve

Results

The group of participants consisted of 23 males (63.9%) and 13 females (36.1%). All of them were prehospital physicians with a mean age of 44 years (SD 8.0) and mean previous intubation experience of 8 years (SD 5.1). A sample of 216 intubations was obtained, 108 in IS and 108 in IM.

Regarding the efficacy of the ETI, there was no statistically significant difference in the percentage of successful ETI (p = 0.197) or effectiveness (p = 0.102), number of ETIs in the first attempt (p = 0.305), in the mean MAT (p = 0.570) or TTT (p = 0.164) between the two scenarios (Table 2).

Regarding safety, adverse events such as oesophageal intubation, selective intubation, trauma to teeth and other complications did not show statistically significant differences between IS and IM (Table 2).

Table 3 shows the adverse events, considering the initial values of HR, SBP and $SatO_2$, according to the clinical case. The presence of brady- or tachycardia, hypo- and hypertension, and hypoxemia were not observed in any case. There were statistically significant differences regarding the mean of the HR in "Asthma" (p <0.001), mean SBP (p = 0.003 and p <0.001), "TBI"

Table 3. Adverse events after endotracheal intubation (ETI), depending on the clinical case and scenario

	Initial values according to clinical case*	ETI in movement n (%)	Static ETI n (%)	p
Bradi-/tachycardia, FC [mean (DE)]	TBI: 90 bpm	92.4 (14.2)	91.3 (14.5)	0.79
	Asthma: 30 bpm	89.3 (25.8)	44.5 (4.5)	< 0.001
	Shock: 144 bpm	44.4 (24.5)	97.4 (32.0)	0.001
Hypo-/hypertension. SBP [mean (SD)]	TBI: 140 mmHg	98.0 (24.8)	121.7 (14.0)	0.003
	Asthma: 78 mm Hg	99.9 (8.5)	82.6 (8.7)	< 0.001
	Shock: 72 mmHg	88.0 (12.1)	82.5 (10.4)	0.187
Hypoxemia. $SatO_2$ [mean (DE)]	TBI: 93% O_2	90.8 (12.8)	94.0 (4.1)	0.374
	Asthma: 78% O_2	79.8 (1.5)	77.4 (4.0)	0.032
	Shock: < 90% O_2	91.5 (2.4)	86.7 (3.7)	0.003

bpm: beats per minute; HR: heart rate; SBP: systolic blood pressure; $SatO_2$: oxygen saturation; TBI: cranioencephalic trauma.
* Baseline situation of the simulated patient according to clinical case.

Table 4. Effectiveness and safety depending on the device of each scenario

	Airtraq® n = 36			Fast-trach® n = 36			Laryngoscope Macintosh® n = 36		
	IM	IS	p	IM	IS	p	IM	IS	p
Effectiveness									
Successful [n (%)]	20 (55.6)	24 (66.7)	0.236	18 (50)	21 (58.3)	0.735	29 (80.6)	26 (72.2)	0.958
Effective [n (%)]	34 (94.4)	33 (91.7)	0.028	35 (97.2)	36 (100)	0.972	36 (100)	35 (97.2)	0.972
ETI No. first attempt [n (%)]	29 (80.6)	28 (77.8)	0.273	28 (77.8)	32 (88.9)	0.864	33 (91.7)	31 (86.1)	0.971
MAT, in seconds [average (DE)]	8.6 (13.9)	17.9 (12.6)	0.797	10.2 (5.2)	10.0 (4.6)	0.89	15.7 (12.8)	13.9 (8.5)	0.486
TTT, in seconds [average (DE)]	184.3 (96.2)	216 (116.2)	0.143	293.5 (168.9)	289.7 (95.9)	0.915	153.1 (72.0)	204.4 (102.7)	0.023
Security									
ETT in oesophagus [n (%)]	0 (0)	3 (8.3)	–	1 (2.7)	0 (0)	–	1 (2.7)	2 (5.5)	0.659
ETT in bronchus [n (%)]	1 (2.7)	17 (47.2)	0.428	3 (8.3)	5 (13.8)	0.468	6 (16.6)	19 (52.7)	0.558
Dental trauma [n (%)]	0 (0)	1 (2.7)	–	0 (0)	0 (0)	–	0 (0)	3 (8.3)	–
Other complications [n (%)]	0 (0)	3 (8.3)	–	3 (8.3)	2 (5.5)	0.661	2 (5.5)	1 (2.7)	0.806

IM: endotracheal intubation in motion; IS: endotracheal intubation in static; MAT: maximum apnea time; TTT: total time of the technique; ETT: endotracheal tube.

and "Asthma", and the mean $SatO_2$ p = 0.032 and p = 0.003) in "Asthma" and "Shock", respectively.

As observed in Table 4, when comparing the three intubation devices, both moving and static, the difference in the percentage of effective ETT with the use of Airtraq was statistically significant (p = 0.028), in favour of movement. TTT was significantly lower when performed with the laryngoscope in IM (p = 0.023). There were no significant differences comparing the devices, in the two situations, for all other outcome variables, both efficacy and safety.

Regarding the adverse events depending on the device in IS and IM, considering the clinical case and the initial values of HR, SBP and $SatO_2$, no statistically significant differences were observed regarding the presence of brady- or tachycardia, Hypo and hypertension or hypoxemia. Table 5 shows that there were statistically significant differences with respect to the mean HR in "TBI", with Fast trach® (p = 0.012) and Laryngoscope (p = 0.013); And in "Asthma" with the three devices (Airtraq® p <0.001, Fast-trach® p <0.001 and Laryngoscope p = 0.004). Differences with the three devices (Airtraq® p = 0.028, Fast-trach® p <0.001 and Laryngoscope p = 0.004) were observed in "TBI"; And in "Asthma" with Airtraq® (p = 0.001) and Fast trach® (p = 0.001). In the case of $SatO_2$, there were statistically significant differences in "TBI" with Laryngoscope (p = 0.001), "Asthma" with Fast-trach® (p = 0.050) and Shock with Airtraq® (p = 0.006) And Laryngoscope (p = 0.004).

Discussion

The results of this study suggest that there are no significant differences in both efficacy and safety in the ETI carried out in an on-road ALS ground vehicle compared to static ETI in those clinical situations where it is indicated to intubate the patient, which has an easy airway (Cormack-Lehane Grade I), and provided, for the reasons described, the ambulance could not be stopped.

The efficiency of the ETI in motion was 97.2%, and did not differ between the two scenarios, which corroborates the data obtained by Wong et al.15, who succeeded in successfully intubating in 95.5% also in both scenarios in simulated patients with the same degree of difficulty.

The ETI on the first attempt was equally possible, both in motion and in static. We would like to point out that in our study, 62% of the doctors were able to intubate in less than 45 seconds in the ambulance. According to Weingart[25], the decrease in $SatO_2$ in a patient undergoing RSI appears between 45 and 60 s after the administration of sedation. In fact, the AMT in our study was 14.9 s on average, in the case

Table 5. Adverse events after endotracheal intubation (IET), depending on the device, clinical case and scenario

Initial figures according to clinical case	Airtraq®			Fast-trach®			Laryngoscope Macintosh®		
	IM	IS	p	IM	IS	p	IM	IS	p
Bradi-/tachycardia FC [mean (DE)]									
TBI: 90 ppm	95.1 (11.8)	107.7 (9.6)	0.129	99.5 (8.4)	106.7 (3.7)	0.012	85.1 (14.9)	105.0 (3.7)	0.013
Asthma: 30 bpm	98.8 (25.5)	42.3 (3.8)	< 0.001	102.6 (23.4)	43.6 (2.3)	< 0.001	95.4 (21.6)	47.8 (15.8)	0.004
Shock: 144 bpm	30.0 (0.3)	91.6 (39.8)	< 0.001	30.2 (0.4)	94.7 (38.6)	0.005	35.4 (9.7)	103.3 (33.0)	< 0.001
Hipo/PAS [mean (DE)]									
TBI: 140 mmHg	102.6 (26.9)	130.2 (8.3)	0.028	96.6 (15.9)	130.8 (5.8)	< 0.001	85.0 (15.9)	126.8 (6.2)	< 0.001
Asthma: 78 mmHg	102.0 (12.0)	82.4 (10.4)	0.001	98.8 (11.6)	78.4 (2.0)	0.001	99.5 (12.8)	84.7 (12.8)	0.089
Shock: 72 mmHg	88.1 (10.8)	84.9 (16.3)	0.558	88.5 (15.0)	80.2 (6.8)	0.177	88.0 (16.1)	79.4 (6.8)	0.160
Hypoxemia $SatO_2$ [mean (DE)]									
TBI: 93% O_2	93.5 (4.0)	89.0 (13.1)	0.440	93.4 (1.6)	95.0 (4.2)	0.216	92.5 (2.9)	96.8 (3.3)	0.001
Asthma: 78% O_2	79.8 (4.1)	78.8 (4.7)	0.464	79.8 (1.9)	72.8 (9.5)	0.050	81.3 (2.2)	80.5 (1.8)	0.939
Shock: < 90% O_2	93.0 (2.4)	88.3 (5.3)	0.006	90.7 (1.6)	87.2 (4.2)	0.131	92.5 (2.4)	86.6 (4.3)	0.004

bpm: beats per minute; HR: heart rate; SBP: systolic blood pressure, $SatO_2$: Saturation of oxygen.
* Baseline situation of the simulated patient according to clinical case.

of moving intubation, less than the 21.2 s of Wong et al.[15] and did not differ from that measured by Gough et al.[26], in a care compartment of a stationary ambulance, which was 13.2 s. It is worth noting the number of successful ETIs in less than 45 s that were performed with the laryngoscope while moving, as well as that it took less time to perform the technique. These findings coincide with the bibliography consulted[27] in static intubation. This could be an acceptable limit in patients with good $SatO_2$ prior to intubation and adequate pulmonary preoxygenation. As in the study by Nakstad et al.[3], the initial $SatO_2$ in two of the cases was less than 90% so the risk of episodes of severe hypoxia was greater. According to Davis et al.[28], desaturation below 70% increases the risk of dysrhythmias, hemodynamic decompensation, brain damage due to hypoxia and even death. In the only case in which a CRP for ventricular fibrillation was present in our study, it was for this reason, i.e. a mannequin desaturation below 70% in an elongated ETI manoeuvre after several attempts in the ambulance.

Annex 1. Template agreed with the Ulstein style[23] with the standardized variables for clinical simulation study

- **Common system variables:**
  - 1 Level of toilet training at the scene
    - Physiotherapists
  - 2 Intubation devices available in the scene
    - Supraglottics
    - ETT
  - 3 Drugs for airway management available at the scene
    - Sedation
    - Muscle relaxants
    - Analgesics/opioids
  - 4 Main means of transport
    - Ground ambulance
- **Common patient variables:**
  - 6 morbidity
    - ASA-PS * 3 (Critical Patient)
  - 10 Indication of airway management
    - 1 = Descent of the level of consciousness or unconscious
    - 2 = Hypoxemia
    - 3 = Ineffective ventilation
  - 11 11 Respiratory frequency, initial
  - 12a Initial systolic blood pressure
  - 13a Heart rate, initial
  - 14 Glasgow Coma Scale, initial (m/v/e)
  - 15a SpO_2, initial; Basal: no O_2 supplementary
- **Post-intervention common variables:**
  - 16 Post-intervention ventilation
    - Controlled
  - 12b Post-intervention systolic pressure (Response variable)
  - 15b SpO_2 post-intervention (response variable)
  - 13b Post-intervention heart rate (response variable)
  - 19 19 Number of tries (Variable response)
    - 1 = An attempt
    - 2 = Multiple attempts by the same person
  - 20 Complications (Response variable)
    - 1 = ETT placed in the oesophagus
    - 2 = ETT placed in right bronchus
    - 3 = Tooth trauma
    - 5 = Hypoxia
    - 6 = Bradycardia
    - 7 = Hypotension
    - 8 = Other, define
  - 21 Drugs used to facilitate intubation
    - 1 = Sedation
    - 2 = Muscle relaxants
  - 3 = Analgesics/opioids
  - 22 Success in intubation (Response variable)
    - 1 = Success on a first try
    - 2 = Success after several attempts or more than one intervener
    - 3 = Not successful
  - 23 Device used for the management of the airway
    - 2 = Supraglottic
    - 3 = ETT

*APA-PS: American Society of Anesthesiologist Physical Satus Classification. ETT: endotracheal tube.

Of the major adverse events described in the literature, HR and SBP are the most sensitive hemodynamic variables at the time after ETI. If, in addition, we add the conditioner of the movement, with its corresponding pathophysiology, which also affects these two variables, it seems that the consequences can be harmful to the patient. In no case, the ETI caused bradycardia or extreme tachycardia. We would like to emphasize that our simulated patient was not hyperventilated after the ETI, which is a frequent cause of hypotension after the prehospital ETI[29]. Oesophageal ETIs are more numerous in static, with Airtraq®, although what is really important is to detect them quickly, since they are associated with high mortality rates. Oesophageal ETI devices or capnography monitoring should be used for this purpose, which can be used in the laboratory and ambulance[30]. As for minor complications (intubation in right bronchus, trauma to teeth and other complications such as ETT pneumo rupture and laryngeal mask neural rupture, etc.), they were presented in very low numbers and more usually with the Fast-trach®.

In the present study, there are several limitations, such as those inherent in the design of the study. In addition, it has not been contemplated the approach of the difficult airway, nor other sources of difficulty as the presence of vomits, secretions or blood. Nor could it be possible to study events such as regurgitation, aspiration, mucosal lesions or trauma in the trachea. Finally, the heart rate in "septic shock", after the "acceleration/deceleration" conditions, the software of the mannequin was 30 bpm in a constant way, and therefore this data could not be analysed in depth for not being consistent with reality.

In conclusion, no significant differences were found when performing intubation, in motion or in static, with clinical simulation, not observing an increase of adverse incidents added to those potentially present in static, even considering the variables associated with the pathophysiology of terrestrial transport. We believe that it is necessary to go deeper into this hypothesis, proposing new studies in real patients and increasing the variability in the airway.

Conflicting interests

The authors declare no conflict of interest reated to this article.

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The authors declare the non-existence of external financing of this article.

Ethical Responsibilities

The study was approved by the Vice-Rectorate for Research, Development and Innovation at the University of Alicante.

Informed consent was obtained from participants.

All authors have confirmed the maintenance of confidentiality and respect for patients' rights in the author's responsibilities document, publication agreement and assignment of rights to EMERGENCIAS.

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