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Clinical Paper

Video laryngoscopy versus direct laryngoscopy for tracheal intubation during in-hospital cardiopulmonary resuscitation☆

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ABSTRACT

Aim: Tracheal intubation during cardiopulmonary resuscitation (CPR) is a high-risk procedure. Here, we investigated the efficacy of video laryngoscopy for tracheal intubation during CPR.

Methods: Data regarding tracheal intubation during CPR from in-hospital cardiac arrests occurring between January 2011 and December 2013 ($n = 229$) were prospectively collected and retrospectively analyzed.

Results: The initial laryngoscopy method was video laryngoscopy in 121 patients (52.8%) and direct laryngoscopy in 108 patients (47.2%). The rate of successful intubation at the first attempt was higher with video laryngoscopy (71.9%; 87/121) than with direct laryngoscopy (52.8%; 57/108; $p = 0.003$). The rate of success at the first attempt was higher for experienced (73.0%; 84/115) than inexperienced operators, including residents (52.6%; 60/114; $p = 0.001$). Mortality at day 28 after CPR was not significantly different between patients with successful tracheal intubation at the first attempt and without (68.1% [98/144] vs. 67.1% [57/85]; $p = 0.876$). In multivariate logistic regression analysis, a predicted difficult airway (odds ratio [95% confidence interval] = 0.22 [0.10–0.49]; $p < 0.001$), intubation by an experienced operator (2.63 [1.42–4.87]; $p = 0.002$), and use of video laryngoscopy rather than direct laryngoscopy (2.42 [1.30–4.45]; $p = 0.005$) were independently associated with a successful tracheal intubation at the first attempt.

Conclusion: Use of video laryngoscopy during CPR from in-hospital cardiac arrest is independently associated with successful tracheal intubation at the first attempt.

1. Introduction

Current guidelines for cardiopulmonary resuscitation (CPR) recommend that chest compressions be continued and interruptions be minimized during CPR.[1,2] Tracheal intubation (TI) during CPR should be performed quickly and efficiently by an experienced operator and interruption of chest compressions should be avoided where possible. Video laryngoscopy (VL) visualizes the epiglottic opening and surrounding structures. The superior efficacy and safety of VL compared with conventional direct laryngoscopy (DL) have been reported,[3,4] as well as a quicker TI with a higher rate of success at the first attempt of VL.[5,6] However, there have also been controversies in the role and usefulness of VL.[7,8]

If VL truly increases the success rate of TI and reduces the time required to perform this procedure, it would also be useful when rapid and efficient TI without interruption of chest compressions is required during CPR. However, clinical studies comparing VL and DL in CPR are lacking. Although the feasibility of VL in CPR has been reported, most of these studies have been performed in manikin models and did not directly compare DL and VL.[9,10] A recent prospective study reported a high success rate of TI with VL in an emergency department setting.[11] Although that study described a very high success rate of TI with VL, even for relatively inexperienced operators, VL was not compared with DL. To demonstrate the superiority of VL in CPR, it is necessary to directly perform this comparison. We thus investigated in our current study whether VL enabled faster TI with a higher success rate than DL during CPR to compare the efficiency, safety, and clinical outcomes of this approach.

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2. Methods

2.1. Study subjects and data collection

Since March 2008, the rapid response team at Asan Medical Center (referred to hereafter as the medical emergency team [MET]) have been providing medical support for patients in general wards with acute deterioration in clinical status or requiring CPR. The MET does not attend to patients in the intensive care unit, emergency department, or operating room. MET has been recording information for all cases of attending CPR and TI on specialized sheets as part of the electronic medical record. It has been mandatory at our institution to record the data of all patients with in-hospital cardiac arrest since January 2011. In our current analysis, the medical records of patients who were intubated during CPR from an in-hospital cardiac arrest between January 2011 and December 2013 were retrospectively reviewed based on their CPR and TI sheets. Baseline clinical characteristics (age, gender, and comorbid conditions) and clinical outcomes, including the return of spontaneous circulation (ROSC), alive hospital discharge, and mortality at day 28 after CPR, were assessed from the medical records. Approval for the present retrospective analysis was granted by the Institutional Review Board of Asan Medical Center who waived the requirement for informed consent.

2.2. TI during CPR

TI during CPR at our hospital was usually performed by the most experienced physician available at the time. Operators were classified as experienced if they were a licensed medical or surgical specialist who had actively cared for patients in a critical care unit for more than 1 year or as inexperienced if they did not fulfil these criteria. A MET nurse actively assisted the operator with the TI. Two types of VL were available, a Glide scope® (Verathon Medical Corporation, Bothell, WA, USA) and an Airway scope® (Pentax Corporation, Tokyo, Japan). The operator selected the DL or one of the available VL (Glide scope® or Airway scope®) as a tool for TI. However, only the type of laryngoscope (VL or DL) was recorded, not the precise equipment of VL. Because all the information was recorded only as a medical record and there was no plan of clinical study, the operators were not aware of future comparison between VL and DL at the time of TI. Although chest compressions were continued without interruption where possible during TI, they were interrupted in a limited number of cases at the operator's request. The following TI variables were recorded: success/failure at the first attempt, time to successful TI, and number of attempts until successful TI. TI success was usually assessed using a portable digital capnometer (EMMA®; Phasein AB, Danderyd, Sweden) and careful physical examination, including auscultation. The time to successful TI was calculated from the insertion of the laryngoscope to the confirmation of a successful TI. The number of TI attempts was counted using the number of laryngoscopy blade insertions into the oral cavity. A difficult airway was predicted based on physical examination including cervical motion, mouth opening, and mandibular size, which was recorded by MET nurse.[12] The results of the TI including the time and number of attempts before successful TI were not considered in the prediction of difficult airways.

2.3. Statistical analysis

Continuous variables are presented as mean ± standard deviation and categorical variables are presented as numbers with percentages. Data were compared between VL and DL and between experienced and inexperienced operators using independent Student's *t*-tests for continuous variables and chi-square tests for categorical variables. Univariate and multivariate logistic regression analyses were performed to identify the factors associated with a successful TI at the first attempt and mortality after 28 days. Variables with $p < 0.2$ in univariate analyses were included in the multivariate analysis. All statistical comparisons were two-sided and $p < 0.05$ was regarded as statistically significant. Statistical analyses were performed using the Statistical Package for Social Science 21.0 (IBM Corp., New York, NY, USA).

3. Results

3.1. Study population

During the study period, 332 CPRs were performed from in-hospital cardiac arrest at our hospital. Of these, 47 patients (14.2%) had a previously secured artificial airway, 26 patients (7.8%) achieved ROSC without TI, and 30 patients (9.0%) died without a TI attempt. TI was attempted during CPR in 229 patients (69.0%). Data on these patients were included in the present analysis. The flowchart of the overall study patient group is shown in Fig. 1. The mean patient age was 62.7 ± 15.9 years and 153 patients (66.6%) were male. TI during CPR was most frequently performed in a general ward ($n = 204$, 89.1%), followed by a study room such as an angiography, pulmonary, or exercise function test room or other diagnostic study room ($n = 15$, 6.6%), hemodialysis room ($n = 5$, 2.2%), out-patient department ($n = 2$, 0.9%), and other places, including the parking lot or hospital lobby ($n = 3$, 1.3%). Baseline clinical characteristics and comorbid conditions are shown in Table 1.

3.2. Tracheal intubation

TI was attempted by an inexperienced operator in 115 cases (50.2%) and an experienced operator in 114 patients (49.8%). The first operator used VL in 121 patients (52.8%) and DL in 108 patients (47.2%). TI was successful at the first attempt in 144 patients (62.9%) but was unsuccessful even after 10 min of repeated attempts in five patients (2.1%). The time to successful TI in the overall intubated patient group was 2.3 ± 2.8 min and 1.3 ± 0.9 min in patients successfully intubated at the first attempt. In the five patients with prolonged TI of 10 min or more, the lack of success was due to unexpected difficult airway in four patients. A laryngeal mask or tube with or without emergent tracheostomy or cricothyroidotomy was performed for the patient. In the other one patient with prolonged TI, the first and second TI attempts were failed by the first operator without acceptable cause and the second operator successfully intubated at a single attempt. Based on the unskilled tool management detailed on medical record, we regarded the operator inexperience as the cause of delay in one patient.

The rate of success at the first attempt was 71.9% with VL (87 successes at the first attempt in 121 patients) and 52.8% with DL (57 successes at the first attempt in 108 patients; $p = 0.003$; Table 2 and Fig. 2). The time to intubation was 2.1 ± 3.2 min with VL and 2.5 ± 2.4 min with DL ($p = 0.290$). In patients with successful TI at the first attempt, the time to intubation was also similar between VL (1.3 ± 0.9 min) and DL (1.4 ± 0.9 min; $p = 0.483$).

The rate of success at the first attempt was higher for experienced operators (73.0%; 84/115) than for inexperienced operators (52.6%; 60/114; $p = 0.001$; Table 3). However, experienced operators more frequently chose VL as the TI tool (64.3%; 74/115 vs. 41.2%; 47/114; $p < 0.001$). The time to intubation and incidence of related complications were similar for experienced and inexperienced operators. Multivariate logistic regression analysis revealed that a predicted difficult airway (odds ratio [95% confidence interval = 0.22 [0.10–0.49]; $p < 0.001$], VL rather than DL (2.42 [1.30–4.50]; $p = 0.005$), and TI by an experienced operator