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Respiration and the Airway

RESPIRATION AND THE AIRWAY

Team-based model for non-operating room airway management: validation using a simulation-based study

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Abstract

Background: Non-operating room (non-OR) airway management has previously been identified as an area of concern because it carries a significant risk for complications. One reason for this could be attributed to the independent practice of residents in these situations. The aim of the present study was to ascertain whether differences in performance exist between residents working alone *vs* with a resident partner when encountering simulated non-OR airway management scenarios.
Methods: Thirty-six anaesthesia residents were randomized into two groups. Each group experienced three separate scenarios (two scenarios initially and then a third 6 weeks later). The scenarios consisted of one control scenario and two critical event scenarios [i.e. asystole during laryngoscopy and pulseless electrical activity (PEA) upon post-intubation institution of positive pressure ventilation]. One group experienced the simulated non-OR scenarios alone (Solo group). The other group consisted of resident pairs, participating in the same three scenarios (Team group).
Results: Although the time to intubation did not differ between the Solo and Team groups, there were several differences in performance. The Team group received better overall performance ratings for the asystole (8.5 *vs* 5.5 out of 10; $P<0.001$) and PEA (8.5 *vs* 5.8 out of 10; $P<0.001$) scenarios. The Team group was also able to recognize asystole and PEA conditions faster than the Solo group [10.1 *vs* 23.5 s ($P<0.001$) and 13.3 *vs* 36.0 s ($P<0.001$), respectively].
Conclusions: Residents who performed a simulated intubation with a second trained provider had better overall performance than those who practised independently. The residents who practised in a group were also faster to diagnose serious complications, including peri-intubation asystole and PEA. Given these data, it is reasonable that training programmes consider performing all non-OR airway management with a team-based method.

Key words: airway management; high-fidelity simulation; team-based anaesthesia

Although the majority of airway management performed by anaesthetists occurs in the operating room (OR), there are many instances where it takes place in settings such as medical wards, intensive care units (ICUs), emergency departments (EDs), and other procedural locations. Although OR intubations are performed in a relatively 'controlled' environment, non-OR intubations can be emergent in nature and performed in suboptimal conditions (e.g. missing or unfamiliar equipment, difficulties in patient positioning on patient beds, involvement from staff unfamiliar with airway management).[1] Not surprisingly, reported complications from non-OR intubations are numerous (e.g. failed intubation, aspiration, mainstem intubation, haemodynamic compromise),[2] and complication rates as high as 27% have been described.[3]

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Editor's key points

- It is not clear whether or not performance of a resident in cardiopulmonary resuscitation outside the operating theatre can be improved by the presence of another person.
- Residents were randomized to two groups, and residents performed cardiopulmonary resuscitation, with or without another person.
- Performance of cardiopulmonary resuscitation by a team was better than by one person.

Although the reasons for non-OR airway management-related complications are myriad, the emergent nature, a lack of expected resources, and superimposed patient co-morbidities are likely to be major contributors. It is perhaps not surprising that complications related to out-of-OR intubations make up a significant number of cases in the ASA closed claims database.[4] Most studies have determined that patients intubated in the presence of an attending physician were less likely to suffer complications,[1 5] although Schwartz and colleagues[6] found no such effect. Although it has been suspected that the presence of a second anaesthesia provider can have a positive effect on patient outcomes,[7] studying the performance of anaesthetists in non-OR scenarios has proved difficult.

The influence of a second anaesthesia resident on performance of non-OR intubations is not clear. This may be a lost opportunity, because a recent study at a tertiary care centre revealed that residents working alone managed 64% of non-OR intubations (i.e. without a second trained assistant or attending physician).[8] Although similar studies are lacking, this percentage is likely to be representative of the practice at other major academic medical centres. As there is an ethical dilemma in allowing trainees to engage in airway management on their own for the sole purpose of research, simulation affords an opportunity to study performance in an analogous environment. The aim of the present study was to ascertain whether differences in performance exist between residents working alone *vs* with a resident partner when encountering simulated non-OR airway management scenarios.

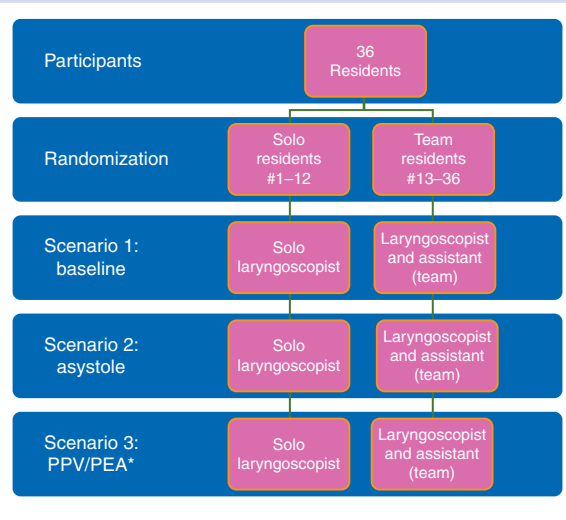

Fig 1 Randomization scheme and study time line. PEA, pulseless electrical activity; PPV, positive pressure ventilation; *Scenario 3 occurred 6 weeks after Scenarios 1 and 2.

Table 1 Simulation scenarios

Scenarios
Scenario 1: standard, uncomplicated floor intubation proceeding uneventfully
Scenario 2: floor intubation complicated by asystole during laryngoscopy because of intense vagal stimulus of laryngoscopy (simulated airway made 'difficult' via tongue swelling feature)
Scenario 3: intensive care unit intubation complicated by pulseless electrical activity cardiac arrest with initiation of positive pressure ventilation

Methods

A waiver of written consent was granted for this study by the Mount Sinai Hospital Program for the Protection of Human Subjects. Thirty-six resident physicians from the Department of Anesthesiology, encompassing clinical anaesthesia years 1, 2, and 3 (CA-1, CA-2, and CA-3) were voluntarily enrolled (out of 60 available at the time of study offering). Participants were assigned unique identifiers and randomized to groups based on random integer generator data in Microsoft Excel (Microsoft Corp., Redmond, WA, USA; Fig. 1). One group performed all intubations without an assistant ('Solo' cohort), whereas the other group worked in pairs and had predefined roles as laryngoscopist or assistant ('Team' cohort), with the pre-assigned laryngoscopist maintaining that role throughout the simulation scenarios (Table 1).

Baseline participant characteristics were obtained from a survey given at the beginning of the experiment. For our purposes, a resident was defined as a senior resident if they had completed 1 yr of anaesthesia training [e.g. CA-2/postgraduate year (PGY)3 or CA-3/PGY4]. All junior residents (i.e. CA-1/PGY2) enrolled in the study had completed at least 6 months of anaesthesia training and were credentialled by the department to respond independently to airway management consultations outside of the OR at the time of the study. Blinding was not feasible for this study, because both participants and observers would easily be able to distinguish who was working solo *vs* those working as a member of a team. However, participants did not know what sort of scenarios they would be encountering or what sort of performance ratings would be collected.

Once assigned to their respective groups, residents participated in three simulated scenarios. We used a high-fidelity human patient simulator (CAE HPS; CAE, Gainesville, FL, USA) with predetermined clinical scenarios to test residents in simulated 'floor intubations'. In each scenario, the anaesthesia resident (or team) was called to intubate a patient located on an inpatient ward or ICU.

Although all residents at Mount Sinai are familiar with the simulator and the simulated environment, each underwent a 30 min group orientation on the equipment and the simulator's capabilities before the study, for purposes of standardization. The simulation laboratory was designed to resemble a standard inpatient hospital ward or unit bed. A five-lead ECG, automatic non-invasive blood pressure cuff, and pulse oximeter were