

Emergency Intubation of the Supine Patient on the Ground

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Abstract

This review article addresses the clinical problem encountered when a patient must be intubated while supine on the ground. In such situations the position from which the rescuer chooses to intubate may influence the likelihood of intubation success. Several studies have compared different rescuer positions including the prone, kneeling, sitting, straddling, left lateral decubitus and right lateral decubitus positions. Although further research is required to determine the definitively superior position, the straddling position may have numerous advantages. Unfortunately, the professionals required to intubate are generally unfamiliar with the straddling position. Consequently, it is recommended that the straddling position be integrated into formal airway management education.

Clinical Scenario

Emergency medical technicians (EMTs) and a cardiac arrest team are called to the service floor of a small local hospital. The power to a section of the hospital had gone out. On arrival, a 112 Kg, 35 year old electrician is found prone on the ground, unconscious and apneic, in a cramped 3 m x 4 m room containing switches and breakers for the electrical system of the hospital. His hard hat is upside-down in the corner of the room. A bracket holding one of the pipes is broken and a large steel pipe is dangling from the wall. Shards of glass and liquid from a smashed soft drink bottle are scattered on the floor. Outside the room are a small landing and a narrow staircase containing 2 sets of 8 iron-grid steps separated by a small landing. One of the two EMTs attending the victim informs the hospital's cardiac arrest team leader that the victim has a weak pulse and they are barely able to ventilate him by mask. She says that she can't seem to get behind the victim to intubate him. In addition, the victim is quite large and appears to be difficult to intubate. She thinks it might be easier to intubate him if she could get into a better position, but it would be very awkward for them to carry him down the stairs, even with help. Stabilizing his neck during the transfer would be very difficult. The team leader agrees with these findings. What advice could the team leader offer at this time?

Introduction

As with any emergency situation, the ABCs (airway, breathing and circulation) should be evaluated and managed in that order. In the apneic patient, the ability to rapidly secure the airway is the critical life-saving maneuver. Oral endotracheal intubation is the most reliable means of establishing control of the airway. During training, intubators stand at the head of a patient who is elevated on a stretcher or operating room table. However, reproducing this position may not be possible if the victim were to collapse unexpectedly to the ground. In such a situation the rescuer is required to assume unfamiliar and possibly awkward postures to intubate.

Rescuer Positions

The European Resuscitation Council (ERC) recommendation for the intubation of a supine patient on the ground is as follows: "If the patient is lying on the ground the rescuer should ideally also lie on the ground at the head of the patient with elbows placed at either side of the patient's head."¹ The basis for this recommendation is not stated. Several studies have therefore attempted to determine what in fact is the optimal rescuer position for intubating patients lying supine on the ground.

In 1997, Koetter et al. investigated whether the prone position (as recommended by the ERC) was superior to other positions for intubation on the ground.² In their study 24 EMTs intubated a mannequin placed on the ground from the following positions: prone (Figure 1), sitting (Figure 2), kneeling (Figure 3) and straddling (Figure 4). The rescuers took slightly longer to intubate from the straddling position than from the prone position (16.2 vs. 11.8 s), however, this small time difference was deemed clinically insignificant. There was no significant difference between the prone position and the other three positions in terms of speed, complication rate or rescuer preference. The authors concluded that the sitting, kneeling and straddling positions were viable alternatives to the prone position.

Shortly following Koetter *et al.*'s work, Adnet *et al.* published a study examining the efficacy of a new rescuer position, left lateral decubitus (LLD) (Figure 5).³ In their study, 30 physicians intubated a

mannequin on the ground in the LLD and kneeling positions. They found that the LLD position required significantly less time to intubate (14.6 vs 10.5 s), resulted in fewer complications and afforded significantly better glottic exposure. The authors concluded that the LLD position may greatly facilitate intubation of a patient on the ground. However, Koetter *et al* pointed out in a subsequent letter⁴ that the LLD position, like the prone position, requires that the rescuer lie down on the ground. This may be difficult or impossible in cramped conditions and may expose the rescuer to the risk of injury from substances or objects on the ground. In addition, these two positions may prove more difficult for shorter rescuers who would be unable to place their left elbow firmly on the ground.

Adnet followed up his study on mannequins by comparing the kneeling and LLD positions under field conditions.⁵ Over the course of the study, rescuers completed a questionnaire following any intubation in which the patient was intubated on the ground in either the LLD or kneeling position. Seventy-two patients were included in the LLD group and 271 in the kneeling group. The LLD position afforded significantly better glottic exposure, required significantly less use of external laryngeal pressure and significantly fewer attempts for successful intubation. The results of this study confirmed Adnet's earlier findings in the mannequin model, namely that the LLD position is associated with better glottic exposure and easier intubation.



Figure 1. Prone – intubator on stomach raised on elbows behind mannequin's head.



Figure 4. Straddling – intubator's right knee between mannequin's left arm and torso, left foot planted above mannequin's right shoulder near head, laryngoscope in the right hand.



Figure 2. Sitting – intubator sitting behind mannequin with mannequin's head resting on one bent leg, other leg extended.



Figure 5. Left Lateral Decubitus (LLD) – intubator on the left side, left elbow posed on the ground, body perpendicular to the mannequin.



Figure 3. Kneeling – intubator behind mannequin's head on two knees.



Figure 6. Right Lateral Decubitus (RLD) – intubator on the right side, right elbow posed on the ground, body perpendicular to the mannequin.

A previously unstudied rescuer position was investigated by Birkinshaw *et al*⁶. Their mannequin study examined the five previously mentioned positions (prone, kneeling, sitting, straddling and LLD) as well as right lateral decubitus (RLD) (Figure 6). Their subjects consisted of 10 paramedics and 10 specialist registrars in accident and emergency medicine. The investigators found that none of the 6 intubator positions studied were statistically superior with respect to speed or ease of intubation and they also found no significant difference between the two subject groups. Although the results were not significant, the RLD position was found to be the most awkward position. This is likely because this position does not allow the rescuer to use the ground in order gain leverage for the arm during laryngoscopy.

The aforementioned studies evaluated rescuer positions by comparing time to intubate, subject preference or glottic exposure. However, none assessed the contribution of rescuer position to what we believe is the most important outcome: intubation success rate. In the above studies the mannequin or patient was always intubated successfully in a reasonable time regardless of the position used. Although the degree of airway difficulty in Adnet *et al*'s study on human patients is unknown, it can be concluded from the mannequin studies that when faced with an uncomplicated, familiar airway, rescuer position does not influence intubation success. It has been suggested that when faced with a difficult airway, the force that one is able to exert to align and visualize the soft tissues of the pharynx may determine the quality of access to the airway and hence the likelihood of successful intubation.⁷⁻¹⁰ Our lab recently conducted a mannequin study to investigate the maximum force (Pmax) that a rescuer can apply in each of the six previously mentioned positions.¹¹ This force was compared to the actual force required to align the soft tissues of the pharynx for endotracheal intubation (Pi) in each position. The ratio of these two forces, expressed as a percent (%max) was used as a measure of the 'reserve force' available to the rescuer should they be faced with a difficult intubation. The subjects consisted of 19 hospital staff, all with intubation experience. Intubating in the straddling position was found to require the lowest %max (68%). In practical terms, this means that if faced with a difficult intubation, there would be an additional 32% of Pmax available with which to align the soft tissues of the pharynx. The %max of the straddling position was significantly less than the prone (85%), right lateral decubitus (85%) and sitting positions (86%). Thus the straddling position may be an advantageous position for intubation on the ground especially when visualization of the glottis is difficult. The limitations of this study were that it was a simulation study in mannequins and that %max is only a putative predictor of intubation success and has not been validated in clinical trials.

In addition to a low %max, two further advantages of the straddling position is that, more than any other position, it protects the rescuer from hazards on the ground (e.g. blood and glass), and it is the only position that does not require any additional space above the patient's head. A potential drawback of the straddling position is that it reverses the rescuer's orientation to the patient's airway, which may make it difficult for the rescuer to recognize important anatomical landmarks. However, in our experiment, the time

required to intubate in the straddling position was not significantly different from all but one other position (LLD) (17.3 s vs 10.3 s) even though the subjects were previously unfamiliar with the straddling position. Nevertheless, specific training would likely be needed to familiarize rescuers with the reversed airway orientation.

Interestingly, paramedics in our city (Toronto) are taught to employ a two-person modification of the straddling position when attempting to intubate a very heavy patient on the ground.¹² For this procedure, one paramedic is instructed to perform two-handed laryngoscopy from the straddling position while a second paramedic intubates the patient from the prone position. This procedure takes advantage of the straddling position to allow the rescuer to exert a large force with the laryngoscope, while avoiding the need for the rescuer to intubate from an unfamiliar orientation. However, this maneuver does expose the intubating paramedic to ground hazards and requires space above the patient's head.

In the fictional case cited at the beginning of this article, the rescuer would try to avoid lying on the floor, and thus would not be able to assume the prone, LLD or RLD positions for intubation. More than any other position, the straddling position would protect the rescuer from harm due to substances or objects surrounding the victim. Furthermore, since all other positions require space to be available above the head of the patient, they may be difficult to perform in this cramped environment. In this scenario, it would be a reasonable option for the rescuer to attempt intubation from the straddling position.

Recommendations and Conclusion

The scenario provided at the beginning of this article was a composite of many real life situations faced by rescuers attending collapsed patients. The ability to intubate patients from a variety of positions, particularly straddling, should become a standard part of the skill set of all professional rescuers including doctors, respiratory therapists, EMTs and army medics.

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