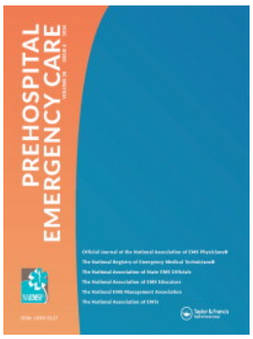

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TITLE PAGE

Prehospital SALAD Airway Technique in an Adolescent with Penetrating Trauma Case Report

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ABSTRACT

Prehospital SALAD Airway Technique in an Adolescent with Penetrating Trauma Case Report

We present a case of an adolescent patient with a penetrating gunshot wound to the mouth requiring endotracheal intubation via rapid sequence intubation in the prehospital setting. The team used video laryngoscopy (VL) to secure the airway; however, continuous bloody secretions increased the complexity of the procedure and required the application of the Suction-Assisted Laryngoscopy and Airway Decontamination (SALAD) method to facilitate intubation. By utilizing the SALAD procedure, the field of view on the VL camera remained unobscured, and the patient's airway remained clear, allowing for an uneventful intubation procedure. No episodes of hypoxia, hypotension, bradycardia, or obvious clinical signs of pulmonary aspiration occurred during the procedure. The patient was transported to a local Pediatric Level I trauma center, where he underwent emergent surgery to repair an esophageal laceration and was discharged to home 40 days later. This case highlights the importance of deliberate and proactive management of the contaminated airway in the prehospital setting. The SALAD technique replaces the Yankauer suction catheter with a larger bore suction catheter in conjunction with VL to perform gross decontamination of the mouth and airway before attempting intubation. This is followed by permanently placing the large bore suction catheter under constant suction in the posterior pharynx or esophagus to keep the VL camera unobscured by vomit or blood to facilitate intubation. After the intubation, the suction catheter may be removed unless ongoing suction is required. Keeping the VL camera unobscured during the procedure may improve first-pass intubation success rate.

WORD COUNT: 246

KEYWORDS: SALAD, intubation, adolescent, video laryngoscopy, prehospital, Case Report

MAIN DOCUMENT

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INTRODUCTION

Adolescent endotracheal intubation is a high-risk/low-frequency procedure performed by Emergency Medical Services (EMS) clinicians. Over the last decade, technological advances in video laryngoscopy (VL) have offered additional tools for intubating critically ill or injured patients. A barrier to using VL is the presence of blood, vomit, or other secretions that may obstruct the image on the video screen of the laryngoscope. A modification to the intubation procedure known as Suction-Assisted Laryngoscopy and Airway Decontamination (SALAD) allows the laryngoscopist to use VL in a patient with a heavily contaminated airway (1). This report discusses using the SALAD approach while managing the airway in an adolescent patient with penetrating trauma to the mouth. Participant data has been anonymized; however, these alterations have not distorted the scholarly meaning of the case.

CASE REPORT

Emergency Medical Services was dispatched to a local park for an adolescent patient with a gunshot wound. The calling party reported the patient was shot in the mouth but remained completely alert. The caller also stated the patient had heavy bleeding from the mouth and an injury to The patient's hand. An ambulance team with two Paramedics was dispatched to the scene along with Fire Department First Responders. A Paramedic supervisor who is also a board-certified Emergency Nurse Practitioner (ENP) was co-dispatched to the location. The ambulance

team was advised to stage pending law enforcement's arrival and clearance into the scene. Pre-arrival instructions were given to the caller while units were en route.

After the scene was secured by law enforcement, the team made contact with a 17 year-old-male patient with gunshot wounds to The patient's face and a secondary blast injury to the left hand. On exam, he was awake and alert with strong radial pulses. The patient did not exhibit any evidence of dyspnea, and auscultation revealed clear bilateral lung sounds. The patient was seated upright, leaning forward and spitting blood from his mouth to keep the airway clear. The patient complained of significant pain from the gunshot wounds. The patient's initial blood pressure was 121/66 mmHg (automated cuff), and his heart rate was 66 beats per minute. The patient's oxygen saturation on room air was 97%, and the respiratory rate was within normal limits. The patient was awake, and his movements were purposeful, but the patient could not speak clearly, secondary to his injury. However, The patient could answer "yes" and "no" questions. Given his communication difficulties, The patient had no known significant past medical history, but obtaining a health history was limited. After the initial rapid trauma assessment, The patient was loaded into the ambulance.

The crew considered all proximal trauma center destinations and transported by ground to a high-volume pediatric level I trauma center after a total scene time of 9 minutes. The pediatric trauma center was equidistant to the closest adult Level I Trauma Center but was considered for possible benefits for this adolescent patient in the post-acute period. A firefighter drove the ambulance to the hospital, which allowed both crewmembers and an EMS supervisor to manage care in the patient compartment. With adequate personnel on-board, all procedures were completed during transport, eliminating the need to pull to the side of the road for patient

management. The patient was seated in a high-fowler position with a nasal cannula and was comfortable suctioning his airway with a large bore suction catheter. Intravenous access was established, and a sub-dissociative dose of Ketamine (0.25 mg/kg) was given for pain control. Bleeding from the mouth was a challenge to control because of the location of the injury, but the airway remained patent as long as suction was continuously applied. During transport, the patient's mental status began to deteriorate. On physical exam, a pool of large blood was observed in the posterior pharynx, and the patient was no longer aware of the need to suction his secretions. The team took over oral suctioning, and equipment was set up for rapid sequence intubation while simultaneously prepping for a surgical airway. The patient remained in a high fowler position during the setup phase, with one team member assigned to oral suctioning.

The patient's airway remained patent, with EMS clinicians assisting with suction as needed. Simultaneously, medications (induction agent, skeletal muscle relaxant, & bolus dose vasopressors), intubation equipment, and adjuncts (Bag Valve Mask (BVM) + Positive End Expiratory Pressure (PEEP) valve, oropharyngeal and nasopharyngeal airways, Bougie, King LT airway, and the surgical airway kit) were prepared. All patient monitors, including SpO_2, End Tidal CO_2, automatic blood pressure, and electrocardiogram (ECG) leads were verified to be in place. The airway plan discussed was to intubate the patient via VL using the SALAD method. If unable to intubate via VL, the camera would remain in place, but the laryngoscopist would shift to direct laryngoscopy (DL)for intubation, provided oxygen saturation did not fall below 93%. This was possible because the team used VL with standard geometry blades. Simultaneously a second operator would prepare for surgical airway management by assembling equipment, identifying landmarks, and cleaning the neck to prepare for incision if unable to intubate. High-flow oxygen was delivered via two delivery devices simultaneously at max liter flow allowed by

the flowmeter (> 15 lpm). A nasal cannula, plus BVM + PEEP, was in place and allowed the patient to breathe 100% oxygen through the mask spontaneously. The mask seal would be broken as needed for airway suctioning.

While still in a high-fowler position, induction and paralysis were initiated. The patient was given Ketamine 70 mg IV push and Rocuronium 90 mg IV push. After 60 seconds, the head of the stretcher was dropped to approximately 30 degrees. After ensuring the patient was flaccid, the mask was removed, and suction was applied to clear bloody secretions. The VL was placed into the mouth, but the laryngoscopist noted bloody secretions continued actively from the esophagus and posterior hypopharynx. The large bore tonsil tip suction catheter was placed in the far-left side of the mouth and into the proximal esophagus, clearing the bloody secretions and allowing for an unobstructed view of the VL screen. The endotracheal tube was successfully placed in one attempt and without oxygen desaturation. Tube placement was verified by a 4-phase capnograph and bilateral breath sounds. The endotracheal tube was secured, and the patient received post-intubation care, which included the application of a mechanical transport ventilator, sedation, and orogastric tube placement, which returned several hundred milliliters of bloody emesis into the canister. The remainder of the case was uneventful, and the patient was delivered to the trauma center without complication. The patient was diagnosed with a laceration of the pharynx and cervical esophagus, tooth fracture, and handgun blast injuries to the patient's left hand. He underwent emergent surgery and was discharged home after a 40-day hospital stay. The patient was lost to follow-up after discharge.

In the days following the case, as a routine part of the quality improvement process, the cardiac monitor case file was analyzed which provides second-by-second data of all vital signs parameters and available waveforms including capnograph and pulse oximetry waveforms. This information was compared to the data entered into the patient care record to confirm number of attempts and vital signs trends. Figure 1 shows vital signs data over the course of the case displayed in one-minute snapshots.

DISCUSSION

This case highlights the importance of deliberate and proactive management of the contaminated airway in the prehospital setting. The contaminated airway is an airway in which visualization of anatomic landmarks and delivery of an endotracheal tube is complicated by the presence of bodily fluids such as blood, emesis, pulmonary edema, or other secretions. Airway contamination is frequently encountered in prehospital and emergency department settings (2-4).

Multiple studies have demonstrated the importance of first-pass success when intubating in both in-hospital and prehospital environments (5, 6, 7). Traditional airway management devices and adjuncts may be inadequate to prepare a clinician to manage the contaminated airway. The rigid Yankeuer suction catheter was developed initially by an otolaryngologist to delicately clear scant blood from the surgical field. Despite this intended use, it continues to be a first-line device for suctioning the airway in many emergency settings. Other commercially available large-bore suction catheters and even a few improvised devices are more effective at rapidly evacuating viscous fluids (8,9).

The SALAD technique is “an incremental, step-wise approach to managing a massively contaminated airway” (1). The technique involves the deliberate use of the larger bore suction catheter, a modern alternative to the Yankauer suction catheter, to open and continuously suction the airway during intubation. The large bore suction catheter is held overhand in the right hand and inserted into the mouth ahead of the laryngoscope in order to suction the oropharynx and distract the mandible to create space for the introduction of the laryngoscope. The oropharynx and hypopharynx are suctioned continuously as the laryngoscope is inserted into the appropriate depth. Once the laryngoscope is appropriately positioned in the vallecula, the catheter is withdrawn and reinserted in the left side of the patient’s mouth between the laryngoscope and the corner of the mouth. The catheter is then “parked” in the proximal esophagus just below the glottic opening to maintain continuous suction throughout the intubation. The patient can then be intubated in the typical fashion as the continuous suction maintains good visualization and mitigates any airway contaminants. Figure 2 demonstrates the steps of the SALAD procedure. The SALAD technique was initially developed in simulation by Dr. James DuCanto utilizing an airway manikin modified to simulate ongoing emesis. The literature describes the technique as a useful simulation exercise, improving learner confidence and speed at managed contaminated airways (10-14). Despite the growing body of evidence of the technique's advantages in simulation, there are few case reports describing the use of the technique in vivo to date (15). Maintenance of appropriate hemodynamics and oxygenation throughout laryngoscopy is critical to safe airway management (16). The use of the SALAD technique in this patient resulted in the rapid and successful first-pass intubation of a patient with a complex and difficult airway without any desaturation, bradycardia, or hemodynamic compromise. Figure 3 provides a timeline of events during the case.

CONCLUSION

This case highlights the importance of deliberate and thoughtful airway management in the prehospital setting. The EMS clinicians immediately recognized the complexity of this airway, developed thorough backup plans, and were prepared to proceed with an emergent surgical airway if necessary. There are two important lessons that were realized in the post-analysis phase of the case. First, the ability to record images or video would provide value for quality improvement efforts such as demonstrating the technique, verifying number of attempts, and giving the laryngoscopist direct feedback. Second, the SALAD procedure is different enough from traditional airway induction procedures that practicing the technique in a skills lab or cadaver lab is recommended before attempting on a real patient. The value of the SALAD procedure was demonstrated in this single case, by providing the laryngoscopist an unobscured view of the airway while utilizing VL during endotracheal intubation of the patient with penetrating trauma to the mouth.

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DECLARATION OF INTEREST STATEMENT: Dr. James DuCanto is the inventor of the DuCanto suction catheter which is sold by SSCOR.

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TABLE AND FIGURE CAPTIONS

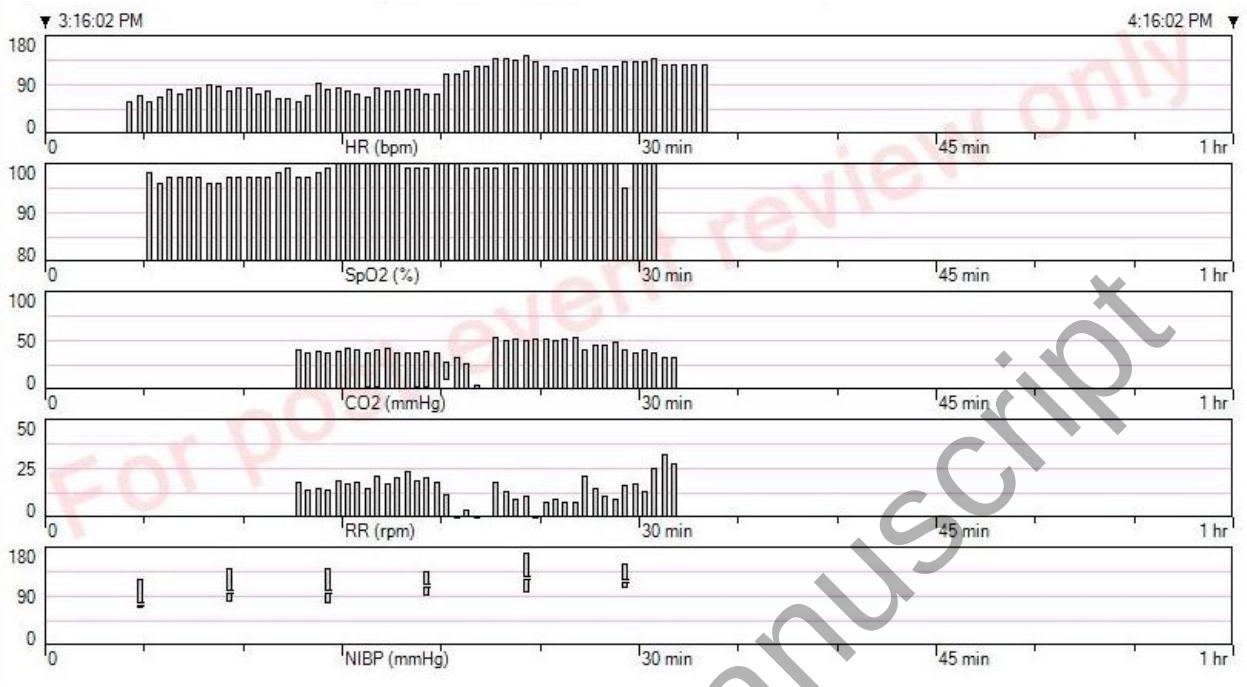

Figure 1 caption Vital signs trends

Figure 2 caption SSCOR DuCanto Catheter

Figure 2a caption Hold the large bore suction catheter overhand in the right hand, suction the oropharynx, and distract the mandible to create room for the laryngoscope.

Figure 2b caption Continuously suction the oropharynx and hypopharynx as the laryngoscope is inserted.

Figure 2c caption Position the laryngoscope into the vallecula and decontaminate the airway with suction.

Figure 2d caption The catheter is withdrawn and then reinserted to the left side of the patient's mouth and parked in the proximal esophagus just below the glottic opening on continuous suction.

Figure 2e caption Proceed to intubate and maintain a continuous suction to mitigate airway contaminants.

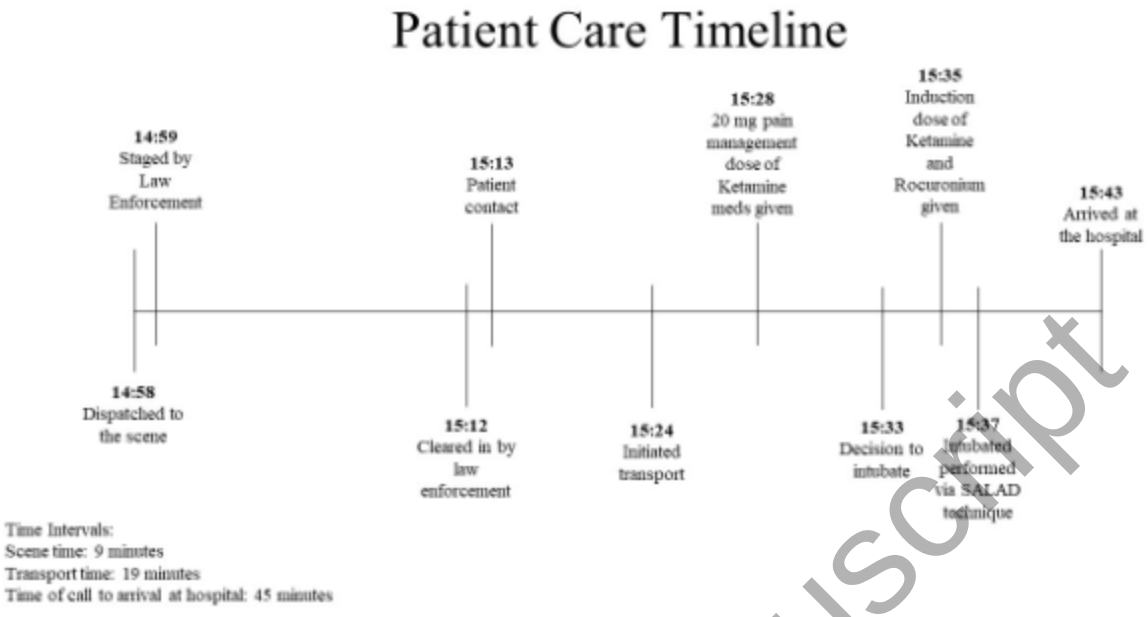

Figure 3 caption Timeline of events