# Blind bougie first pass success endotracheal intubation process: An out-of-hospital case report

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## ABSTRACT

The blind bougie technique is performed when the epiglottis is visible to the intubator, but the vocal cords cannot be seen (Grade III Cormack-Lehane view). The blind bougie technique for endotracheal intubation is not routinely performed by Critical Care Paramedics for a failed intubation in the pre-hospital setting. However, at Hamad Medical Corporation Ambulance Service in the State of Qatar, the blind bougie technique is included in their failed airway clinical practice guidelines. This case report aims to describe the rapid sequence induction for intubation process and endotracheal tube placement in an adult trauma patient, presenting with a difficult airway, using the blind bougie technique in the out-of-hospital setting. A 35-year-old male patient was ejected from an all-terrain vehicle following a high-speed accident in the desert. The patient sustained an isolated head injury. Based on the patient's clinical presentation, he required immediate endotracheal intubation for maintenance and protection of his airway prior to rapid transport to definitive care. Predictors of difficult airway were calculated. Using the blind bougie technique, endotracheal intubation was performed with first pass success. It is recommended that emergency medical services include the blind bougie technique of endotracheal intubation among their difficult airway procedures.

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## BACKGROUND

Annually more than 250 critically ill or injured patients undergo out-of-hospital rapid sequence induction for intubation (RSII) in the State of Qatar. Rapid sequence induction for intubation is the rapid administration of an anaesthetic and paralytic agent creating an optimal intubating condition to ensure a first pass endotracheal tube airway placement avoiding gastric aspiration.[1]

Avoiding the risk of aspiration has always been a goal of RSII with the clear understanding that tracheal intubation is a high-risk procedure in critical patients. The risk of aspiration and physiolog-

ical complications increases with repeated intubation attempts making first pass success a goal of advanced airway management.[1,2]

The importance of first pass success when performing tracheal intubation was studied by Sakles *et al*.[3] They aimed to determine the incidence of adverse events (AEs) associated with failed first pass endotracheal tube placement (ETT). Over the four-year study 1,828 orotracheal intubations were undertaken. If the intubation was successful on the first attempt, the incidence of one or more AEs was 14.2%, whereas in cases requiring two attempts, the incidence of AEs was 47.2%; in cases requiring three attempts, the incidence of one or more AEs was 63.6%. Ultimately, as the number of attempts increases the incidence of AEs increased substantially.[3]

Primarily at Hamad Medical Corporation Ambulance Service (HMCAS), RSII is performed on patients who fail to maintain and protect their airway, fail to effectively oxygenate and ventilate and may present with a deteriorating clinical condition.[4]

In the out-of-hospital setting, the procedure of RSII is a compilation of various individual procedures to improve first pass success of ETT placement including (but not limited to); pre-oxygenation, laryngoscopy, medication administration, patient monitoring, laryngeal tube airway (LTA) insertion, cricothyroidotomy kit insertion, mechanical ventilation. These procedures are dependent on effective communication, teamwork, knowledgeable, skilful, and experienced practitioners. However, equipment deficiencies and flaws in processes and systems can impair the effective execution of the RSII procedure.[5]

An assessment of predictors of a difficult airway during airway management are essential to minimize risks associated with first pass success of endotracheal intubation (ETI).[5] Predictors to difficult airway management may include an increased size of tongue in relation to pharyngeal size, airway oedema, airway and facial trauma, limited jaw opening, limited cervical mobility, airway obstruction (vomitus and blood), a hard collar, short or no neck scenario, and morbidly obese patients.[6,7]

Based on the frequency of the RSII procedure being performed by Critical Care Paramedics (CCP) at HMCAS, the organisation has included a Difficult Airway Procedure in their Clinical Practice Guidelines (CPG) (Figure 1).[4] A procedure for the blind bougie technique has been revised and included in their Clinical Procedure Manual. Annually, CCPs undergo training on emergency airway, oxygenation and ventilation management which includes the blind bougie technique performed on manikins.

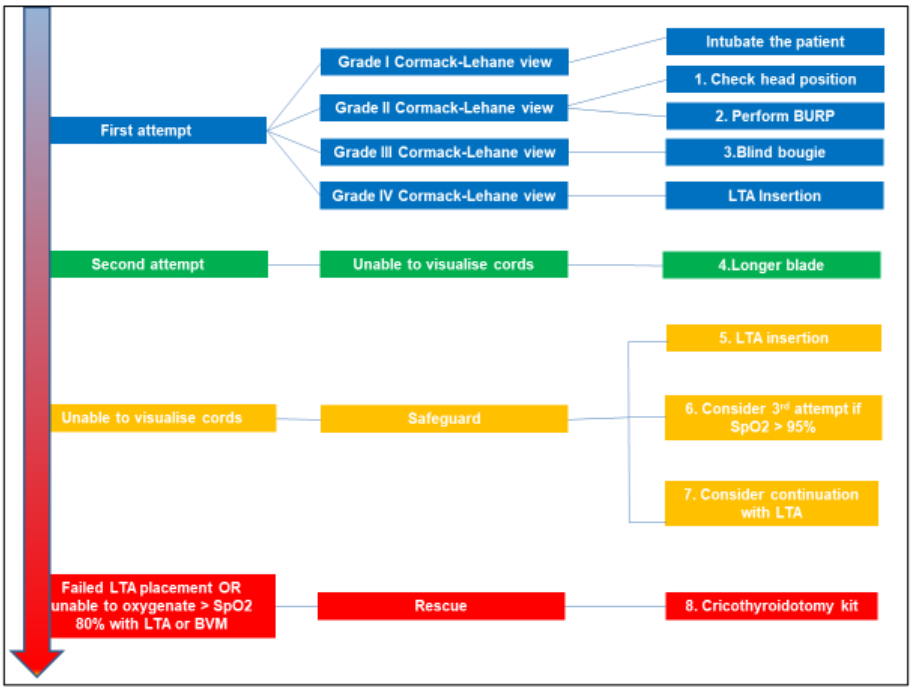


Figure 1: HMCAS Difficult Airway Procedure
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The blind bougie technique is performed when the epiglottis is visible to the intubator, but the vocal cords cannot be seen, depicting a Grade III Cormack-Lehane view.[5] By design the distal tip of the bougie has a 30° bend. This allows the intubator to pass the distal tip of the bougie underneath the epiglottis and through the vocal cords blindly. The 30° bend of the distal tip lifts the floppy epiglottis and facilitates the advancement of the bougie blindly.[8] The ETT is then passed blindly guided by the bougie.

### Blind bougie technique

1. With a Grade III Cormack-Lehane view, grasp the bougie in the right hand at the 20-25 cm mark and pass it alongside the laryngoscope with the 30° angled tip anteriorly.[9]
2. The tip of the bougie is then advanced underneath the epiglottis and passes the vocal cords blindly. The 30° bend of the distal tip lifts the floppy epiglottis and facilitates the advancement of the bougie blindly past the vocal cords.[9]
3. The intubator should feel the tip of the bougie rubbing along the tracheal rings. A "clicking" sound may be heard. The tip of the bougie must be passed anteriorly in order to feel the tracheal rings.[9]
4. Follow advancement into the trachea to a depth of approximately 30 cm in the average adult. At this point the tip of the bougie will make contact with the carina/main stem bronchus and stop advancing, commonly referred to as a "hang up".[9]
5. Maintain tongue displacement with laryngoscopy/hand grasp and pass the ETT over the bougie to a depth of 3 times its internal diameter (ID) (e.g. 7.0 ID = 21cm at the level of the teeth, but do not force the advancement. An assistant should grasp the proximal end of the bougie to stabilize it.[9]
6. Inflate ETT cuff inlet port with the appropriate amount air and validate with an ETT cuff manometer.[4]
7. Place bag-valve-mask (BVM) on ETT with end tidal carbon dioxide ($ETCO_2$) monitoring, ventilate while listening over epigastrium, left lung and then right lung to ensure proper placement.[4]
8. Confirm ETT placement with $ETCO_2$ waveform monitoring. After the ETT is confirmed to be in the trachea, secure the ETT with a standard commercial tube holder. Ensure that the ETT cuff is adequately inflated.[4] The bougie has been shown to effectively improve first pass success when managing a difficult airway.[5,10] However, the bougie has a potential to cause airway trauma.[5,11]

## CASE REPORT

A 35-year-old male patient was involved in an all-terrain vehicle (ATV) accident in the desert in the autumn of 2019. A request for HMCAS assistance was made to the National Command Centre (NCC) at 16h10. The Call-For-Service (CFS) was immediately dispatched to the closest Ambulance Paramedic (AP) team. HMCAS teams are strategically positioned throughout the country and in the popular desert areas during the camping season (October-April) to ensure rapid response times.[12] LifeFlight, the HMCAS helicopter service with a CCP was also dispatched simultaneously.

The AP team arrived on scene and were at the patient's side within five minutes of the CFS. It was reported that two ATVs had collided at high speed, frontal impact. Only two victims were reported on scene, both drivers. The first victim was ejected from the ATV. The second victim had a less traumatic impact, was assessed by the AP and did not require any urgent management. None of the drivers wore helmets.

The first victim was found lying supine and unresponsive on the ground with no catastrophic bleeding noted. The patient's airway was obstructed with vomitus which was cleared with suctioning. The patient had a pulse rate (PR) of 120 beats per minute (bpm), respiratory rate (RR) of 10 per minute, an oxygen saturation ($SpO_2$) of 96% on ambient air, a blood pressure (BP) of 175/99 and a Glasgow Coma Scale (GCS) of 5/15 (Eye = 1, Verbal = 1 and Motor = 3).

On assessment, the patient presented with rhinorrhoea and otorrhea, with multiple lacerations to the head. All bleeding was stopped and the head wounds were dressed. Crepitus was palpated at many places on the skull. The patient's pupils were unequal and sluggishly reactive to light (Left = 5mm and Right = 4mm). Following the rapid trauma survey, no other injuries were noted.

The patient was started on oxygen therapy via a non-rebreather mask. Bilateral intravenous (IV) access was established, and the patient was fully spinal motion restricted (SMR) on a scoop stretcher. The patient was then loaded into the modified all terrain ambulance and transported to the landing zone to rendezvous with the LifeFlight CCP.

The AP team rendezvoused with the LifeFlight CCP team at 16h45. The patient was handed over

to the CCP and on initial assessment, the patient was found to have an isolated head injury. At this stage the patient's PR = 113 bpm, RR remained at 10 breaths per minute, $SpO_2$ = 95% on non-rebreather (NRB), nasal $ETCO_2$ = 60 mmHg, BP = 143/117 mmHg and the GCS remained 5/15. On chest auscultation the right lower lung fields presented with adventitious sounds with a possibility of aspiration or pulmonary contusion. No fractured ribs were palpable. Prior to transportation, the CCP decided to perform RSII and ETI.[13] This decision was based on the patient's low GCS (<8/15)[14] and a failure to maintain and protect the airway from aspiration, the patient was experiencing some degree of ventilatory compromise (high $ETCO_2$) and a possibility that his condition may deteriorate during transit.[15]

The patient was then prepared for RSI. With full SMR, the scoop stretcher was elevated to 30° head-up (Reverse Trendelenburg position).[15] This position helps reduce further increases in intracranial pressure in a patient with traumatic brain injury, recruits alveoli and improves pre-oxygenation increasing safe apnoea time, minimizes the risk of passive regurgitation and aspiration during the apnoeic phase of RSI and achieves the ear to sternal notch position which improves visualization of the vocal cords hence enhancing first pass success of ETI.[14,16]

Pre-oxygenation had also commenced to denitrogenate and fill up the patient's alveoli with oxygen for five minutes.[15] Pre-oxygenation helps provide a safe apnoea time and reduces the risk of desaturation during ETT placement.[16] The patient was placed on nasal cannula oxygen (via the ETCO2 device) at a flow rate of 15 litres per minute (LPM). As the patient was taking adequate tidal volume breaths, oxygen delivery via the tightly fitting NRB mask was continued and the flowrate was increased to 15 LPM.[15] After assessing the IV lines for patency, the patient was pre-loaded with 500 millilitres (ml) of Normal Saline to help prevent a drop in BP once RSI medications were administered.[16] Patient monitoring of BP, RR, PR, $SpO_2$, $ETCO_2$, and electrocardiogram continued every 2 minutes. As the patient was classified as being critical, defibrillation pads were placed on his chest in anticipation for cardiac arrest.

Table 1: RSI Checklist

| *Acronym* | **Confirmation** |
|---|---|
| **S** | **Suction:** turned on and working, hard tip catheter placed under the right shoulder. Is there a need for a second suction unit? |
| **O** | **Oxygen:** patient has been pre-oxygenated. Apnoeic oxygenation provided via nasal cannula (NODESAT). Check backup supply of oxygen. Prepare BVM, OPA and inline $ETCO_2$. |
| **A** | **Airway equipment:** Check that the airway pack has been prepared including laryngoscopes, endotracheal tubes, bougie, LTAs and cricothyroidotomy kit. Set up video laryngoscope and test. |
| **P** | **Position:** Pre-oxygenation and patient intubation position optimized, intubator position optimized. |
| **P** | **Physiology optimization:** Ensure oxygenation and pre-oxygenation optimization. Also ensure hemodynamics is optimized. |
| **P** | **Pharmacy:** Ensure bilateral IV patency. Administer IV fluid preload, as required. Prepare pre-RSII medication. Also prepare phenylephrine and adrenaline push doses. |
| **M** | **Monitors:** ECG with audible HR tone, $SpO_2$, $ETCO_2$, NIBP every 2 minutes. Attach defibrillation pads. |
| **E** | **Emergency equipment:** Set-up the mechanical ventilator and conduct a circuit test. Pre-set ventilatory parameters which will be optimized post ETT placement. |

NODESAT = Nasal oxygen during efforts securing a tube; LTAs = Laryngeal tube airway; $SpO_2$ = Oxygen saturation, $ETCO_2$ = End tidal carbon dioxide; ECG = Electrocardiogram; HR = Heart rate; BP = Blood pressure; BVM = Bag-valve-mask; OPA = Oropharyngeal airway, IV = Intravenous

The equipment for RSI was also prepared (Table 2). The mechanical ventilator was tested and the circuit prepared for post RSI ventilation.[15] The suction was tested and prepared with a hard suction catheter.[14] The video laryngoscope was not available for the anticipated difficult airway. The adult intubation pack was assembled containing the 2 laryngoscope handles (long and short) and blades (size 3 and 4 Macintosh), size 8.0 mm ETT with spares size 7.0 mm and 9.0 mm. The supraglottic airway device (Laryngeal tube airway) was prepared for a failed intubation as a safeguard.[15] The cricothyroidotomy kit was also assembled in preparation for a can't intubate and can't ventilate

scenario.[14] The Magill forceps was placed close at hand and the BVM was assembled with an adult mask and an appropriately sized OPA. The inline $ETCO_2$ filter line was also placed in readiness for post ETT placement confirmation.[16]

The patient was estimated to weigh 100 kilograms. The RSI medication for analgesia, sedation and paralysis was prepared adhering to the anaesthetic triangle.[17] In pre-labelled syringes 300 micrograms (mcg) of Fentanyl, 200 milligrams (mg) of Ketamine and 100 mg of Rocuronium were prepared by the CCP.[17]

Once all preparation was undertaken (10 minutes), the pre-RSII "SOAPPPME" checklist was then completed (Table 1)[18] by the CCP to ensure everything was prepared for the RSII procedure. This is to mitigate risks and improve first pass success.

Table 2: Ps of the RSII Process

| *Listed Ps* | **Actions** |
|---|---|
| **P** | **Preparation:** Prepare equipment for ETI. ETT correct size and one size up and down. Two sets of laryngoscopes, video laryngoscope, suction unit, mechanical ventilator, BVM. The practitioner should also prepare themselves mentally. Prepare equipment for difficult/ failed intubation. |
| **P** | **Position:** Position the patient 20- 25º head up for optimal pre- oxygenation and laryngoscopy. Align the airway axes and place a pad under occiput. Trauma patients in the reverse Trendelenburg position and obese patients must be ramped to optimize ear to sternal notch position. |
| **P** | **Pre-oxygenation:** Pre-oxygenate the patient for 3-5 minutes to ensure adequate denitrogenation with nasal cannula at 15lpm, NRB at 15lpm or CPAP. |
| **P** | **Ponder:** Once the patient has been resuscitated, a decision should be taken if the patient still requires RSII. |
| **P** | **Pre-RSII briefing:** Brief the RSII team on the RSII procedure and their specific roles and responsibilities pre, per and post RSII. |
| **P** | **Paralysis:** Paralyze and induce the patient. Analgesia and sedation must be administered prior to the paralytic agent. Run in 500-1000ml NS (reduce in cardiac failure). For haemodynamically stable patients administer Fentanyl up to 3mcg/ kg PLUS Ketamine up to 2mg/ kg first, then Rocuronium 100mg [Rocuronium 150mg for patient greaterthaneqto100kg]. For haemodynamically unstable patients (severe hypotension) reduce to Fentanyl 1mcg/ kg PLUS Ketamine 1mg/ kg. Rocuronium dose remains the same. |
| **P** | **Pass the ETT:** Use a bougie or video laryngoscope for the primary attempt to improve first pass success. |
| **P** | **Proof of ETT:** Visualize the ETT go through the vocal cords. Auscultate EPIGASTRIUM/ LEFT LUNG/ RIGHT LUNG. Confirm capnography waveform. |
| **P** | **Post RSII management:** Secure ETT with commercial device and note the marking at the teeth level. Ensure that the ETT cuff is adequately inflated. Place the patient on a mechanical ventilator as soon as possible. Continuously monitor $ETCO_2$. Maintain sedation and paralysis. Ketamine 0.25 - 0.5mg/ kg every 15 - 20 min. as necessary and fentanyl 0.5mcg/ kg as necessary. Rocuronium 1mg/ kg every 25-30 min following 1st dose. |

ETI = Endotracheal intubation; ETT = Endotracheal tube; $ETCO_2$ = End tidal carbon dioxide; BVM = Bag-valve-mask; NRB = Non-rebreather; CPAP = Continuous positive airway pressure; RSII = Rapid sequence induction for intubation; NS = Normal saline; Mg = Milligrams; Kg = Kilograms

The RSII team briefing was then conducted to distribute roles and responsibilities during the RSII process.[16] The briefing was conducted swiftly around the patient. This RSII team comprised of five practitioners. The Delta (supervisor), whose role is scene control and coordination was informed to update the family members of the process.[19] The Delta thus creates a clinical bubble for the primary RSII team. The two APs were also prebriefed on their roles and responsibilities. AP1 was placed in charge of IV fluid administration and vital signs monitoring. AP2 was the timekeeper and charted the events. The Critical Care Assistant (CCA) was responsible for medication administration, holding external laryngeal manipulation (ELM) (if required) and assisting the CCP with ETT placement using the bougie.

After the team briefing, a complete set of vital signs was recorded and trending evaluated. The

patient was clinically re-evaluated and RSII was still deemed as essential (Ponder, Table 2). Ambulance Paramedic 1 removed the cervical collar from the patient and maintained manual in-line stabilization of the cervical spine from the front, over the chest. Pre-RSII medication was administered sequentially intravenously; 1 = fentanyl, 2 = ketamine and 3 = rocuronium.[13] After the administration of rocuronium, AP2 started a 60-second countdown for paralysis. This is essential to ensure jaw flaccidity and paralysis prior to laryngoscopy. If laryngoscopy is performed prematurely, prior to complete paralysis has taken place, there is an increased risk of failed ETT placement.[4,15]

The CCP positioned at the patient's head then performed a jaw thrust feeling for jaw flaccidity and maintaining pharyngeal patency. This ensures the passive flow of oxygen into the airways during the apnoeic phase.[16] During the apnoeic phase vital signs trending is noted. The CCP observes for desaturation and hypotensive episodes post pre-RSII medication administration. No adverse events were noted at this stage.

After 60 seconds post Rocuronium administration, jaw flaccidity was felt by the CCP. The NRB mask was then removed, but the nasal cannula ($ETCO_2$) at a flowrate of 15 LPM was maintained to provide apnoeic oxygenation (NODESAT).[16] The size 4 Macintosh blade was utilized with the traditional laryngoscope. No vomitus, blood or deformity to the airways was noted. A Grade III Cormack-Lehane view with only parts of the epiglottis was visible to the CCP. The BURP (B = Backwards, U = Upwards, R = Rightwards, P = Positioning) manoeuvre was then performed by the CCP to help improve the view.[20] Unfortunately BURP did not bring the vocal cords into view of the laryngoscopist. Using the blind bougie technique, as highlighted above, the ETT was successfully placed on first attempt which was confirmed with continuous waveform $ETCO_2$. The patient did not undergo any desaturation or hypotensive events during the RSII procedure. After the ETT was secured at 24 cm between the teeth, the patient was placed on the mechanical ventilator; tidal volume 500mls, frequency 14 breaths per minute, I:E ratio 1:2, Pmax 40cm$H_2O$, $FiO_2$ 1.0 and PEEP of 5cm$H_2O$.

The post RSII checklist was then completed. Continuous waveform capnography was monitored. ETT cuff pressure was checked and set at 30cm$H_2O$. An orogastric tube was placed which drained minimal fluids. Vital signs post RSII remained stable and trended similarly to hospital admission. The patient was packaged and airlifted to the Trauma Centre. The patient was given two further doses of analgesia (50 mcg Fentanyl every 15-20 minutes) and sedation (50mg Ketamine every 15-20 minutes) and paralysis (100mg Rocuronium every 25-30 minutes) en-route to hospital.

The Clinical Command Desk (CCD) in the NCC was contacted and advised to pre-notify the Trauma Centre of the patient's arrival. The patient's vital signs on hospital admission were PR = 106 bpm, RR = 14 breaths per minute (mechanical ventilator), $SpO_2$ = 100%, $ETCO_2$ = 44 mmHg, BP = 163/100 mmHg.

### Patient follow-up

Following Medical Research Centre (MRC) approval, the patient's records were reviewed. On admission computerised tomography (CT) scans of the neck and abdomen showed no abnormalities. However, CT scans of the head showed multiple skull fractures; right base of skull fracture extending to involve the right occipital bone, left sphenoid sinus lateral wall fracture and a right temporal bone transverse fracture. The patient also sustained a diffuse subarachnoid haemorrhage with multiple intra parenchymal haemorrhagic contusions to the brain with no midline shift noted. The chest CT showed no haemo/pneumothorax or rib fractures but showed basilar lung infiltrates possibly from aspiration on the left lung and right lung contusions.

On admission at the Trauma Intensive Care Unit (TICU) the patient presented with atrial fibrillation. He was administered antiarrhythmics and beta blockers. At the ninety day follow up post injury, the patient's PR stabilized at 68. The patient's GCS was 10/15 (Eyes = 4, Motor = 5, Verbal = 1) with movements of the left side of his body noted. The patient was still admitted in hospital.

## DISCUSSION

A middle aged patient presented with an isolated head injury following a high speed ATV accident in the desert. The patient was extracted from the dunes by first responders who initiated basic life support management. Upon initial assessment by the CCP, a decision was taken to RSII the patient primarily for airway maintenance and protection.

An airway assessment was conducted on this patient and a difficult airway was predicted. These predictors included restricted neck movement, short neck and a large tongue. Rich summarised the six-Ds of airway assessment for predicting difficult airways (Disproportion, Distortion, Decreased thyromental distance, Decreased interincisor gap, Decreased range of motion and Dental

overbite).[6] Identifying and planning for a difficult airway in the pre-hospital setting encourages first pass success of ETT placement. This minimises the risks of airway trauma from repeated attempts, aspiration from passive regurgitation and desaturation.

First pass success is further advocated by a sequential process of RSII. The plethora of research on RSII identifies a compilation of 'P's as a tool to facilitate adherence to the process. HMCAS has designed its RSII CPG on the nine Ps of Preparation, Positioning, Pre-oxygenation, Ponder, Pre-RSII briefing, Paralysis after analgesia and sedation administration, Pass the ETT, Proof of ETT placement and Post RSII management.[4] As part of the RSII process, preparation, patient positioning and pre-oxygenation are undertaken simultaneously. However, the remaining process is completed sequentially.

The preparation phase of RSII is essential and predicated on "planning for the worst but expecting the best". The CCP has to prepare themselves mentally for the anticipated difficult airway, prepare their team and the patient. Further, the bougie and video laryngoscope (if available) has to be prepared in advance for a difficult airway. In this instance the blind bougie technique was performed as the primary procedure due to the anticipated difficult airway with successful placement of the ETT on first attempt.

Once the ETT is placed, verifying correct placement by visualization, auscultation and ETCO2 monitoring is essential. However, the CCP was unable to visualize the ETT pass the vocal cords in this patient due to airway difficulties. ETT placement could not be verified by auscultation either due to surrounding noise. The use of waveform capnography as proof of placement of the ETT was gold standard.[16] After 2-3 ventilations post RSII, with the BVM, waveform capnography was verified.

The blind bougie technique, like all emergency skill sets should be practiced regularly in a simulated environment enhancing first pass success when the skill set is required.[21] In the absence of the blind bougie technique multiple attempts of laryngoscopy may be performed by the practitioner to obtain an optimised view of the vocal cords to pass the ETT. As highlighted by Sakles *et al.*, multiple attempts of laryngoscopy increase the risk of airway trauma, passive regurgitation, aspiration and hypoxia.[3] Hence the primary goal of performing the blind bougie technique is to mitigate against patient safety risks and reduce mortality and morbidity.

## CONCLUSION

Regular training on emergency airway, oxygenation and ventilation management of the critically injured patient with the inclusion of the blind bougie technique contributed to first pass success in a patient with a difficult airway. The availability of a Failed Intubation Procedure and visual aids further supported the practitioner in a difficult airway scenario. It is recommended that ambulance services include the blind bougie technique in their Failed Intubation Procedure for the predicted difficult airway.

## CONFLICTS OF INTEREST

The authors report no conflicts of interest.

## AUTHOR CONTRIBUTIONS

PG and RB conceptualised the case report, YP and PG did the case follow-up, PG and GA did the ethics application and patient permission. All authors drafted and approved the final manuscript.

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