

AIROD® Case Series: A New Bougie for Endotracheal Intubation

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Citation: Schmitz ED (2020) AIROD® Case Series: A New Bougie for Endotracheal Intubation. J Emerg Trauma Care. Vol.5 No.2:20

Abstract

Background: Trauma services are an important yet expensive facet of emergency. AIROD® is a single-use telescopic bougie that is small enough to fit into a pocket. AIROD® is sterile and can be expanded in haste when needed, saving precious seconds, while attempting to intubate a patient. The non-malleable bougie is able to overcome the compressive force of the oropharyngeal tissue improving the view of the vocal cords and facilitating advancement of an endotracheal tube into the trachea along with a laryngoscope.

Keywords: Endotracheal intubation; Telescopic bougie; AIROD

Received: April 04, 2020; **Accepted:** May 18, 2020; **Published:** May 25, 2020

Introduction

There are approximately 50 million intubations performed a year with 1/3 of those occurring in the USA. A multicenter registry of ED intubations, reporting data from 2002-2012, found that approximately 12% of intubations resulted in adverse intubation-related events such as death [1-3].

In order to reduce the likelihood of adverse events it is imperative that the first attempt at endotracheal intubation is successful [4,5]. Despite increasing adoption of expensive video laryngoscopy, first-attempt intubation success rates are only 85% [1]. BEAM trial reported a 96% success rate in first-attempt intubation of a difficult airway with bougie vs. only 82% with endotracheal tube + stylet [6-10].

AIROD® was designed to aid in the advancement of an endotracheal tube past the vocal cords with the use of a laryngoscope. AIROD® can also improve the view of the vocal cords during intubation by displacing oropharyngeal tissue. The following case series demonstrates the usefulness of the AIROD®: each of the 21 intubations was successful on the first-attempt and facilitated by the single-use telescopic bougie without causing any trauma. All intubations were performed by the author (**Figure 1**).

Case Series

Case 1

A 70-year-old female had >50 pyh current smoker with severe COPD not on home oxygen presented with an oxygen saturation of 70%. She was found to have multi-lobar pneumonia predominately in the right upper and middle lobes. Despite Bipap therapy her hypoxia worsened, and she required

intubation. Inspection of her oropharynx prior to intubation revealed very prominent 1st incisors as well as canines that were eroded at the roots left worse than right. Multiple black, necrotic molars right worse than left with a putrid odor. Her oxygen saturation, despite being on 15 L nasal cannula, hovered in the low 90s. In anticipation of a difficult airway the AIROD® was prepared by extending the rods and ensuring the rods were in the locked position. A Miller 4 blade was gently inserted past the teeth and into the oropharynx. A grade 2 view was obtained. This was immediately followed by gentle insertion of the AIROD® which was advanced just distal to the vocal cords. An 8.0 endotracheal tube was advanced down the AIROD® by the respiratory therapist while the AIROD® was held in position. As the endotracheal tube was advanced into the oropharynx, hand position was changed from holding the AIROD® to holding the tip of the endotracheal tube while the respiratory therapist held the distal end of the AIROD®. The endotracheal tube was then advanced past the vocal cords and into the trachea while the respiratory therapist removed the AIROD® with ease. No complications occurred. No trauma occurred to the oropharynx, vocal cords or trachea. The patient was successfully ventilated and oxygen saturations improved to high 90s.

Case 2

A 61-year-old male admitted with severe schizophrenia and acute delirium with a PaO2 of 61 mmHg despite Bipap 14/6 on 90% FiO2 with a minute ventilation of 18 L/min from multi-lobar pneumonia.



Figure 1 Single-use telescopic bougie in the closed (left) and extended (right) position with an endotracheal tube loaded at the distal end.

A Miller 4 blade was gently inserted past the teeth and into the oropharynx. A grade 1 view was obtained. The AIROD[®] was gently advanced 2 cm past the vocal cords followed by an assistant advancing a 7.5 endotracheal tube down the AIROD[®] until grasped, and then the endotracheal tube was slid into the trachea while the assistant held the distal end of the AIROD[®]. The AIROD[®] was then removed intact with no evidence of airway trauma.

Case 3

A 54-year-old male with severe coronary artery disease on aspirin and Plavix with a history of a seizure disorder associated with alcohol withdrawal became unresponsive and a code blue was called. He was found to be apneic with oxygen saturation in the 50s. He was stimulated by the Hospitalist and woke up. He was transferred to the ICU where he became completely unresponsive again and stopped breathing. He was immediately ventilated with a bag-valve mask and oxygenation improved to 100%. He then bolted up out of bed and became very combative. Propofol was given and he was laid supine and ventilated with a bag-valve mask. Inspection of his oropharynx revealed a very large tongue, some missing and multiple sharp teeth with mouth opening of only 2 fingerbreadths. There was blood and emesis in his oropharynx that was suctioned. A Miller 4 blade was inserted into the oropharynx but only grade 4 views could be obtained. The AIROD[®] was inserted into the oropharynx in the fully extended and locked position and the proximal tip was used to gently lift the epiglottis exposing the vocal cords and improving the view to a grade 2. AIROD[®] was advanced 2 cm past the vocal cords and an assistant advanced an 8.0 endotracheal tube down the AIROD[®] until it was grasped, and the endotracheal tube was advanced successfully past the vocal cords while the assistant held the distal end of the AIROD[®]. The AIROD[®] was removed intact without any oropharyngeal or vocal cord trauma.

Case 4

A 48-year-old male obese alcoholic smoker who was critically ill with an admission albumin of 0.9 and lactic acid of 9 with multiorgan system failure from an intra-abdominal abscess with septic shock on 15 mcg/min of epinephrine and 25 mcg/min of Levophed was obtunded and in acute respiratory failure. The AIROD[®] was pre-loaded with an 8.0 endotracheal tube onto the distal end of the AIROD[®] prior to providing sedation with Etomidate and bag-valve mask ventilation in anticipation of a difficult airway: full beard, mouth opening 2 cm, large tongue, and collapse of the walls of the oropharynx as well as false cords.

Using a Miller 4 blade a grade 2 view was obtained and the AIROD[®] was advanced 1 cm past the vocal cords followed by the endotracheal tube while an assistant held the distal end. There was no significant desaturation or trauma to the vocal cords or oropharynx. Pre-loading the AIROD[®] with the endotracheal tube improved the speed and autonomy of the intubation.

Case 5

A 71-year-old female 5'3 70 kg with CKD 3 from NSAIDs and h/o MI admitted with septic shock from acute colitis on 10 levophed despite 6L fluids with renal failure, hyperkalemia, profound metabolic acidosis with a lactate >15 and a VBG pH 6.87 required emergent intubation. She was combative from acute encephalopathy, Mallampati IV, mouth opening was 3 cm after removal of dentures and she had a large tongue. The AIROD[®] was pre-loaded with a 7.0 endotracheal tube on the distal end. The proximal end of the AIROD[®] was kept clean by placing into the endotracheal tube packaging with the 20-degree tip pointing to the right and lying flat on the mattress. The AIROD[®] was then tucked underneath the patient's right shoulder at a 45-degree angle to the neck for quick access by the operator. The patient received a small dose of propofol and was immediately ventilated with a bag-valve mask. A MAC 3 blade was gently placed into the mouth and a grade 2 view was obtained. The pre-loaded AIROD[®] was grasped at the smallest proximal section with the operator's hand in the supine position while the operator's eyes were fixed on the vocal cords. The square AIROD[®] was then rotated one 90 degrees turn counterclockwise only by feel without looking at the AIROD[®]. The AIROD[®] was gently inserted into the mouth and advanced just past the vocal cords 2 cm. The respiratory therapist held the distal end while the 7.0 endotracheal tubes were advanced down the AIROD[®]. It only took 10 seconds to intubate from insertion of the MAC blade until removal of the AIROD[®] and inflation of the endotracheal tube.

Case 6

An 83-year-old male, 5'6 in height, 85 kg non-smoker with prior DVT/PE on Eliquis, hemolytic anemia, CLL on rituximab and previous histoplasmosis s/p partial lung resection developed acute respiratory failure despite broad spectrum antibiotics and steroids. CT chest revealed diffuse ground glass opacities throughout his LUL, RML and RLL. He was started on bipap 12/6 w/ FiO₂ 60% but hypoxia worsened despite a minute ventilation of 26 L/min. He was transferred to the ICU and immediately intubated. The AIROD[®] was pre-loaded with an 8.0 endotracheal tube at the distal end and tucked under the patient's right shoulder with the tip lying flat and pointing laterally protected in

its packaging. The AIROD® lay at a 45-degree angle to the neck. He was given propofol and immediately ventilated with a bag-valve mask. A Miller 4 blade was gently inserted into the mouth with a grade 1 view followed by grasping the AIROD® with the operator's hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was advanced into the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. The intubation took approximately 10 seconds. A diagnostic bronchoscopy was performed next and did not reveal any tracheobronchial trauma.

Case 7

A 52-year-old male, 5'8 with alcoholic liver cirrhosis on lactulose with Guillain-Barre syndrome treated with mycophenolate mofetil fell a few weeks prior to this admission and suffered an unstable pelvic fracture along with a fractured right 9th rib had been convalescing in a nursing home when he developed flu like symptoms treated with Tamiflu. He was transferred to the hospital for worsening shortness of breath. Initial CXR showed ground glass opacities RUL, RLL and LLL with an abg of 7.38/28/51 on 4L FiO₂. Lactate 1.3. Procalcitonin elevated at 0.27. Hypoxia progressed over the ensuing evening requiring non-rebreather 15 L/min with O₂ saturation 95%. Repeat CXR revealed worsening ground glass opacities involving all lobes of the lung.

Airway assessment revealed Mallampati 4, stiff neck, missing left canine and only a 1 cm mouth opening. The AIROD® was pre-loaded with an 8.0 endotracheal tube at the distal end and tucked under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. The patient was laid flat and towels were placed under his head for optimal positioning. He was given propofol and succinylcholine. Bag-valve mask ventilation was not performed in order to minimize the chance of aerosolizing suspected COVID-19 virus. A narrow Miller 4 blade (only 1 cm wide – only Miller blade available) was gently inserted into the mouth with a grade 3b view. The AIROD® was grasped with the right hand while still looking at the epiglottis and the tip facing up was used to gently lift the epiglottis. The vocal cords were not visualized. The AIROD® was advanced a few centimeters past the epiglottis and an 8.0 ETT was advanced with resistance. The AIROD® was removed intact and the ambu-bag was connected to the ETT and bagging commenced for approximately 10 seconds. However, oxygen saturations fell below 90% so the ETT was immediately removed and ambu-bag was initiated for approximately 1 minute bringing the oxygen saturations up to 99%. Using cricoid pressure and a Mac 3 blade a 3b view was obtained and again the AIROD® was gently advanced and used to lift the epiglottis improving the view to a grade 2 view. The AIROD® was advanced 2 cm past the glottis then a pre-loaded 7.5 ETT was advanced down the bougie and into the trachea. The AIROD® was removed intact and the patient was ventilated effectively with good CO₂ exchange. MAP >65 at the end of the procedure with oxygen saturation 99%. Airway plateau pressure was 26. CXR confirmed good ETT placement

above the carina with no evidence of pneumothorax or significant oropharyngeal trauma.

Case 8

A 60-year-old female 5'3, 68 kg with a history of prior hepatic and renal transplant 2 years ago on cyclosporine and prednisone for rejection requiring dialysis for renal failure developed worsening fever and productive cough over the last 6 days and was admitted early this afternoon. She was placed in airborne isolation for suspected COVID-19 infection. Shortly after returning from dialysis this evening she developed acute bradycardia and a code blue was called as she was found pulseless and foaming at her mouth. I responded to the code blue. Upon arrival there were 3 nurses in the room performing CPR wearing CAPR protective personal equipment helmets. I put on my N95 mask and face shield and immediately proceeded to the head of the bed to where bag-valve mask ventilation was being performed to intubate. The bed was only off the floor 2 feet, so I had to get down on my knees. I pre-loaded the AIROD® with a 7.0 endotracheal tube at the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally. The AIROD® lay at a 45-degree angle to the neck. Without interrupting chest compressions, I inserted a Miller 4 blade; all I could see was white/tan pus. There was no suction available. I used the AIROD® to help clear the pus from the vocal cords and a grade 1 view was obtained. The AIROD® was advanced 2 cm past the glottis then a pre-loaded 7.0 ETT was slid down the AIROD® and into the trachea. The AIROD® was removed intact and the patient was ventilated effectively with good CO₂ exchange. The intubation took 12 seconds. Return of spontaneous circulation happened quickly. Later in the ICU bronchoscopy confirmed tracheal placement of the endotracheal tube without any oropharyngeal or tracheobronchial tree trauma.

Case 9

A 67-year-old female 5'7 91 kg with atrial fibrillation, diabetes, hypertension, gastric bypass with appendectomy and cholecystectomy developed acute nausea and abdominal pain 2 days prior to admission. She underwent a laparotomy the previous day to fix a small bowel obstruction. She was convalescing on surgical ward when she developed acute hypoxic respiratory failure. She was immediately transferred to the ICU. She had a complete collapse of her right lung with the entire right hemi-thorax opaque with tracheal deviation towards the right. Despite a non-rebreather mask her oxygen saturation was 78% and she was in shock with a BP of 50/30. She was positioned with a towel between her shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube at the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. She was given epinephrine along with propofol for sedation and immediately ventilated with a bag-valve mask. A Miller 4 blade was gently inserted into the mouth with a grade 1 view followed by grasping the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the

vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any evidence of oropharyngeal trauma. The intubation took 11 seconds. A therapeutic bronchoscopy was performed to decompress the right mainstem bronchus which was completely occluded by thick mucus. No oropharyngeal or tracheobronchial trauma occurred.

Case 10

An 83-year-old female 5'6. 144 kg with gram negative bacteremia from a UTI, septic shock with an LV EF 15-20%, AF w/ RVR, pulmonary artery 37 mm on CT chest, shock liver, ATN Cr 4.3 and lactate of 8.2 required intubation. Mallampati 4, large tongue, large neck, limited neck movement, dry oropharynx with thick mucus, missing upper teeth and a few lower teeth with necrotic base of lower incisors. She was positioned with a towel between her shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with a 7.5 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. She was given etomidate along with some propofol for sedation and immediately ventilated with a bag-valve mask. A Miller 4 blade was gently inserted into the mouth. Thick mucus enveloped the light of the laryngoscope limiting the view of the oropharynx. The AIROD® was inserted into the oropharynx and used to scrape away the mucus covering the light and a grade 1 view was obtained. The AIROD® was gently advanced 2 cm passed the vocal cords and the endotracheal tube was advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any damage to the oropharynx. The intubation took 18 seconds.

Case 11

A 73-year-old male 5'10 87 kg with hemorrhagic CVA unable to control his secretions required intubation. Mallampati 3, lower dentures and upper veneers. He was positioned with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 150 mg propofol for sedation and immediately ventilated with a bag-valve mask. A Miller 4 blade was gently inserted into the mouth revealing a grade 1 view followed by grasping the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 2 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any evidence of oropharyngeal trauma. A stopwatch was started upon initial airway inspection with insertion of the laryngoscope and stopped with inflation of the endotracheal tube cuff. The intubation procedure lasted 9 seconds.

Case 12

A 79-year-old male 5'6 43kg with DM II and hypothyroidism on Baclofen and Librium for anxiety fell at home and was admitted for a mild case of rhabdomyolysis two days prior. He was found hypoxic and obtunded in the early afternoon and a code blue was called. He was intubated on the floor for oxygen saturation in the 40s by anaesthesia. Despite full ventilatory support with Vt 500 PEEP 10 RR 25 and FiO₂ 100% his oxygenation remained in the 70s. He was transferred to the ICU where I immediately performed an ECHO while awaiting CXR: no evidence of RV strain or septal flattening to suggest a pulmonary embolism. CXR revealed a collapsed left lower lobe and lingual and tracheal deviation to the left. Immediately I inserted a bronchoscope into the 7.5 endotracheal tubes. After a few minutes I was able to make a small hole through the thick material blocking the left mainstem as well as the left upper and lower bronchi. Oxygenation improved to 100%. I was unable to clear the large pieces of material through the 7.5 endotracheal tubes, so it was removed. This was followed by placement of a Miller 4 blade gently into the patient's mouth revealing a grade 1 view. I then grasped the AIROD® which lay pre-loaded with an 8.5 endotracheal tube protected with an OR towel with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any evidence of oropharyngeal or tracheal trauma. Significant time was then spent utilizing biopsy forceps, rat tooth forceps and an electrocautery probe to remove all pieces of chicken and vegetables that he had accidentally aspirated into his lungs. He was extubated the next day with no evidence of hypoxic brain injury.

Case 13

A 63-year-old female 5'5 110 kg with COPD, morbid obesity, OSA, AF, DM, and anxiety suffered a cardiac arrest and was successfully resuscitated with placement of a drug eluting stent into the RCA. One week later she required intubation for acute respiratory failure. Extubated the following day and developed stridor which resolved with pain medication and racemic epinephrine. After two days she developed acute respiratory failure again with stridor that resolved after receiving 4 mg IV versed. A diagnosis of paroxysmal vocal cord dysfunction was made. The following day she developed similar symptoms that responded to additional versed and Precedex. The next morning, she became anxious after Precedex was stopped and once again developed acute stridor with respiratory failure responding to Zyprexa and versed momentarily. She was comfortable throughout the day until her stridor resumed and despite Bipap she was unable to adequately ventilate. She became obtunded prompting intubation.

In addition to stridor her Mallampati was 4, she had sharp prominent full set of teeth, airway opening 1.5 cm, large tongue with excessive oropharyngeal tissue, false cords and vocal cord swelling. I pre-loaded the AIROD® with a 7.0 endotracheal tube

that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. She was given 20 mg of etomidate and immediately ventilated with a bag-valve mask. A Miller 4 blade was gently inserted into the mouth revealing a grade 4 view with purulent mucus in her oropharynx. I grasped the AIROD® with my hand supine and used it to manipulate the false cords and reveal the true vocal cords while cricoid pressure was being applied. A grade 2 view was obtained. The cords were adducted with a posterior glottal chink. The AIROD® was gently passed 2 cm through the tiny opening at the bottom of the vocal cords dilating the area with the smooth proximal tip. The endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any evidence of oropharyngeal trauma. It was a successful first attempt intubation without complications. Bronchoscopy confirmed no tracheobronchial tree trauma.

Case 14

A 19-year-old male 5'9 118 kg with autism spectrum disorder and influenza pneumonia intubated on arrival to the hospital for acute respiratory failure and possible overdose was extubated on day 4 and developed a complete occlusion of his right mainstem bronchus. He was positioned with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 200 mg propofol and rocuronium 50 mg. A Miller 4 blade was gently inserted into the mouth revealing a grade 2 view followed by grasping of the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 2 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The glottic opening was narrowed by vocal cords swelling so the endotracheal tube was twisted in order to pass it into the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. A stopwatch was started upon initial airway inspection with insertion of the laryngoscope and stopped with inflation of the endotracheal tube cuff. The intubation procedure lasted 13 seconds.

Case 15

A 72-year-old male 5'11 131 kg prior tobacco use with COPD on home oxygen, CKDz, diastolic dysfunction and paranoid schizophrenia developed acute shortness of breath over 24 hours. He arrived via ambulance to the ED on high flow oxygen. He had a fever of 102, a non-productive cough, lethargy and confusion. Procalcitonin 0.08 and wbc 9.5. CXR lobar consolidations involving the entire right lung with small LLL infiltrate. He arrived to the ICU and was placed in isolation for PUI for COVID-19. He was edentulous with a Mallampati score of 4. He was positioned

with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 200 mg propofol and rocuronium 50 mg. A Miller 4 blade was gently inserted into the mouth revealing a grade 1 view followed by grasping of the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was removed intact without any evidence of oropharyngeal trauma. A stopwatch was started upon initial airway inspection with insertion of the laryngoscope and stopped with inflation of the endotracheal tube cuff. The intubation procedure lasted 10 seconds.

Case 16

A 51-year-old 5'10 193 kg with cirrhosis, septic shock, coagulopathy, anemia with hemoglobin of 6.7 and thrombocytopenia with platelets of 16 actively bleeding from his dialysis catheter developed worsening metabolic encephalopathy and respiratory failure not responding to bipap 100% FiO₂ O₂ sats 94%. Morbidly obese, Mallampati 4, large tongue, large lips, missing and cracked sharp teeth, blood in oropharynx, mouth opening 2 cm. He was positioned with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 100 mg propofol. A Miller 4 blade was gently inserted into the mouth which was very dry. The tongue was lifted, and fresh blood visualized around the glottis. Cricoid pressure was applied revealing a grade 1 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. Cricoid pressure was released, The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. There was excessive oropharyngeal tissue surrounding the vocal cords requiring endotracheal tube twisting in order to pass the ETT into the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. Rocuronium 50 mg was then given.

He was ventilated adequately for 15 minutes; however, I could hear a tiny air leak so the ETT was removed after giving 100 mg of propofol. The AIROD® lay at a 45-degree angle to the neck tucked under the right shoulder with pre-loaded the AIROD® with a 7.5 ETT. A Miller 4 blade was gently inserted into the mouth revealing a small amount of fresh blood that was suctioned. A grade 1 view was obtained followed by grasping of the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 2 cm past the vocal cords and the endotracheal tube was then advanced into the trachea while the respiratory therapist held the distal end of the AIROD®. The AIROD® was

removed intact without any evidence of oropharyngeal trauma.

Case 17

A 43-year-old male 5'10 87 kg male alcoholic with an acute subdural hematoma and delirium tremens was having hallucinations and developed intermittent apneic episodes with oxygen saturations in the 70s. He was positioned with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 200 mg propofol and rocuronium 50 mg. I inserted a Miller 4 blade gently into his mouth and had a grade 2 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced slowly into the trachea with no one holding the AIROD®. The AIROD® was not significantly advanced any further into the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. A timer was started upon initial airway inspection with insertion of the laryngoscope and stopped with inflation of the endotracheal tube cuff. The single-handed first-attempt intubation lasted 17 seconds.

Case 18

A 72-year-old male 5'9 88 kg non-smoker with no known medical problems admitted to the COVID-19 ward became more lethargic but not tachypneic or tachycardic despite being found in shock with an abg of 7.45/33/63 on a 100% NRB transferred to the ICU and placed in isolation for SARS-CoV-2. He was positioned with a towel between his shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with an 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 100 mg propofol and rocuronium 50 mg. I inserted a Miller 4 blade gently into his mouth revealing a grade 1 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced slowly into the trachea with no assistant holding the AIROD®. The AIROD® did not advance significantly down the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. The single-handed first-attempt intubation was performed quickly.

Case 19

A 60-year-old female 5'4 65 kg non-smoker DM II, HTN, OSA and adrenal insufficiency on hydrocortisone 30 mg tid was complaining of fever, chills and cough. She tested positive for COVID -19 and was hospitalized 5 days later for worsening shortness of breath. CXR on admission revealed small bilateral lower lobe infiltrates with oxygen saturation of 85%. Over the ensuing 13 days she developed SARS-CoV-2 with diffuse ground

glass opacities and despite Bipap at 100% FiO₂ her O₂ sats would not go above 84%. She was positioned with a towel between her shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with a 7.5 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. She was given 150 mg propofol and rocuronium 50 mg. I inserted a Miller 4 blade gently into her mouth revealing a grade 1 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced slowly into the trachea with no assistant holding the AIROD®. The AIROD® did not advance significantly down the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. The single-handed first-attempt intubation was performed very quickly.

Case 20

A 60-year-old female 4'10 72 kg non-smoker with non-insulin dependent DM II admitted 7 days ago for cough and worsening shortness of breath 3 days prior to admission. COVID-19 positive on admission, progressed to SARS-Cov-2. She was placed in the prone position while on 15 L NRB and 15L NC. Unable to keep oxygen saturations above 86% her PaO₂ was 62. CXR revealed a dramatic change from bilateral ground glass infiltrates to consolidations in all lobes. She was positioned with a towel between her shoulder blades to extend the neck into the sniffing position. I pre-loaded the AIROD® with a 7.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. She was given 100 mg propofol and rocuronium 50 mg. I inserted a Miller 4 blade gently into her mouth revealing a grade 1 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently passed 1 cm past the vocal cords and the endotracheal tube was then advanced slowly into the trachea with no assistant holding the AIROD®. The AIROD® did not advance significantly down the trachea. The AIROD® was removed intact without any evidence of oropharyngeal trauma. The single-handed first-attempt intubation was performed fast.

Case 21

A 54-year-old male 5'11 93kg with NIDDM, HTN and GERD admitted 5 days prior for worsening dyspnoea, cough and fever. He was diagnosed with COVID-19. He was progressed to severe ARDS secondary to SARS CoV-2. Despite 15L NRB, 15L NC and prone position O₂ sat 84%. ABG7.49/26/43, he was slightly confused and able to barely speak. I pre-loaded the AIROD® with a 8.0 endotracheal tube that had attached to it a 10 cc syringe onto the distal end and tucked it under the patient's right shoulder with the tip lying flat and pointing laterally protected with a sterile OR towel. The AIROD® lay at a 45-degree angle to the neck. He was given 200 mg propofol and rocuronium 50 mg without bag- valve-mask ventilation to

diminish exposure. I inserted a Miller 4 blade gently into his mouth revealing a grade 2 view. I grasped the AIROD® with my hand supine while still looking at the vocal cords. The AIROD® was gently inserted 2 cm past the vocal cords and the endotracheal tube was then advanced slowly into the trachea with no assistant holding the AIROD®. The AIROD® was pulled back as the endotracheal tube was advanced down the trachea. I inflated the endotracheal balloon then removed the AIROD® intact without any evidence of oropharyngeal trauma. The single-handed first-attempt intubation was performed successfully in approximately 10 seconds.

Discussion

AIROD® is a single-use telescopic endotracheal intubation bougie. It is rigid, made of stainless steel and sterilized. It telescopes to two feet and has a specialized 20-degree angled tip. Once expanded it locks so it cannot be retracted. An endotracheal tube 7.0 or greater can be advanced over the telescoping bougie for smooth placement in the adult trachea. AIROD® is non-malleable and can gently displace oropharyngeal tissue, it does not sag and pull like plastic bougies, the unique locking mechanism prevents collapse and the square handle improves dexterity as well as spatial awareness of the proximal tip.

AIROD® telescopes open allowing for storage in small spaces such as a pocket or a crash cart without damaging its integrity like so many bougies that are ruined when bent for storage. Because of its small size, it can be stored in a myriad of places and easily accessed by emergency personnel in the field, emergency department, intensive care unit and operating room saving precious time and patient lives. AIROD® can be used with multiple different varieties of laryngoscopes. My preference is a Miller 4 laryngoscope because of the ability to lift the epiglottis and visualize the vocal cords especially in patients with a large tongue, limited mouth opening and decreased neck mobility.

The AIROD® can be slid along the length of the laryngoscope blade if needed to overcome the force of oropharyngeal tissue. Once the AIROD® is advanced a few centimeters past the vocal cords the rigidity of the AIROD® allows advancement of the endotracheal tube with ease because it can withstand the forces applied by the oropharyngeal tissue without significant bending. I have also used a Macintosh laryngoscope with the AIROD® which allows for displacement of the tongue and oropharyngeal tissue but placement into the vallecula above the epiglottis can limit exposure to the vocal cords. The AIROD® can overcome the limitation of the Macintosh laryngoscope by directly lifting the epiglottis and false vocal cords exposing the true vocal cords then the AIROD® can be gently slid along the posterior surface of the

epiglottis past the vocal cords followed by advancement of an endotracheal tube for successful intubation.

During the SARS-CoV-2 pandemic I used the AIROD® on every patient I intubated and found it to be an invaluable surgical instrument that increased my speed of endotracheal intubation remarkably. My average time of first-pass intubation no matter how difficult an airway has been less than half of the average time of emergency intubation of 38 seconds(3). The speed of intubation is more important than ever when a SARS-CoV-2 patient is intubated because of the risk of exposure to the staff during endotracheal intubation. Experts do not recommend bag-valve-mask ventilation at all either for pre-oxygenation or post-intubation which makes speed of endotracheal intubation of paramount importance.

Because the AIROD® is made of steel, similar to the Gliderite stylet used with the Glidescope as well as laryngoscopes and rigid bronchoscopes, it is possible that if used incorrectly trauma to the oropharynx as well as the trachea may occur, and caution is advised. To this date no oropharyngeal trauma has been reported during the use of the AIROD®. This is a small study performed by a single operator with inherent bias. A future multi-center multi-operator study comparing the AIROD® to the plastic bougie as well as stylet will allow for a much thorough statistical analysis.

The cost of the AIROD® is similar to the Glidescope's disposable covers that are used with each intubation. Because of the loss of direct sight and acute angles involved in the process of advancing an introducer during intubation with the Glidescope I do not recommend using the AIROD® with the Glidescope. The AIROD® was designed only to be used during adult endotracheal intubation.

Conclusion

AIROD® is a sterile single-use telescopic bougie that is used along with a laryngoscope when performing endotracheal intubation. Because of its small size it is easily stored in a pocket, helicopter, ambulance, crash cart, operating room, emergency department, intubation box and in the intensive care unit. Its rigidity helps displace oropharyngeal tissue improving the view of the vocal cords and it facilitates advancement of an endotracheal tube. When used appropriately with a laryngoscope the AIROD® increases the speed of first-pass intubation success saving precious seconds and avoiding life threatening hypoxia that can occur during endotracheal intubation.

Conflict of Interest

The author Evan Denis Schmitz, M.D. is the inventor of the AIROD® and can be contacted for any questions through airodmedical.com.

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