



Ruth Bird, MBBCh

-Specialist Registrar:
Anaesthesia & Paediatric
Trauma Fellow

Daniel Nevin, MBBCh

-Consultant in Anaesthesia &
Pre-Hospital Care

The Royal London Hospital

London's Air Ambulance (HEMS)

London, E1 1BB

KEY POINTS

- Bougies are used as an adjunct for intubation, tracheostomy/endotracheal tube exchanges, rigid bronchoscopy, and double-lumen tracheal tubes.
- The use of bougie as part of an airway management bundle has been cited in the literature as improving first pass success rates.
- Hemorrhage, mucosal injury, and tracheal perforation leading to pneumothorax are all reported complications from bougie use.

Use of a bougie as a tracheal intubation aid was first described by Macintosh in 1949.¹ The bougie is a moderately flexible, stylet-type device which can be bent and manipulated into shape to facilitate a seldinger-like (tube-over-bougie) technique of endotracheal intubation.

Bougies are commonly 15 French Gauge in diameter and 70cm in length, though smaller sizes are available for use in paediatrics. The distal tip of the bougie is angled at 30 degrees and should be positioned to point anteriorly during intubation to facilitate navigation of the device towards an anteriorly-located larynx. The bougie is inserted into the airway beyond the vocal cords, after which an endotracheal tube (ETT) is passed over the bougie using a 90° anti-clockwise rotation to prevent the bevelled tube tip from getting held up at the level of the larynx. After tracheal tube placement beyond the vocal cords, the bougie is removed.

In patients with a low Cormack-Lehane view (grades 1 or 2) the bougie can be introduced directly into the trachea under direct or video laryngoscopy. If the vocal cords are not visible and the epiglottis is partially visible (Cormack-Lehane grade 3), it can be used to blindly locate the tracheal opening below the epiglottis. After placing the tip inside the trachea it should be introduced gently to avoid trauma. Upon feeding the bougie into the trachea the intubator should feel the characteristic clicks caused by sliding it over the tracheal rings.² Apart from use as an adjunct to intubation, bougies are also commonly used during ETT or tracheostomy exchange, to guide rigid bronchoscopy, insertion of double-lumen tracheal tubes and for use with intubating laryngeal mask devices (exchange for ETT).

Rapid sequence induction/intubation (RSI) of critically ill patients outside of the controlled environment of the operating theatre is associated with a higher risk of hypoxia, cardiovascular collapse and death.² Airway adverse events that result in death or neurological injury are 30 and 60-fold more likely to occur in the Emergency Department and Intensive Care Unit respectively.³ The pre-hospital trauma patient poses additional challenges in the form of cardiovascular

instability, and the requirement for cervical-spine immobilization and could be argued to be the least 'controlled environment' to perform airway intervention.⁴

While it is generally accepted that airway management may occasionally be problematic and that complications occur, it was not known how frequently these occurred or the nature of such events. The 4th National Audit Project (NAP4) of the Royal College of Anaesthetists of the United Kingdom (UK) in conjunction with the Difficult Airway Society set out to address this issue. It was designed to answer the following questions:

- What type of airway devices are used during anaesthesia and the frequency of their use?
- How often do major complications (leading to serious harm), occur in association with airway management for anaesthesia, the intensive care units and the emergency departments of the UK?
- What is the nature of these events and what can be learned in order to reduce their frequency and consequences?

NAP4 highlighted many potential issues with airway management including inexperienced operators, inadequate equipment availability, poor planning and limited non-technical skills.³

Intubation bundles have been shown to reduce immediate, and severe life-threatening complications associated with intubation.³ Intubation success rates and an effective failed-intubation rescue plan are both quality markers of an EMS system conducting rapid sequence induction/ intubation. A study by Lockey from London's Air Ambulance looked at physician success rates during pre-hospital intubation for over seven thousand patients (the largest study of intubation by pre-hospital physicians to date).⁵ They observed a high intubation success rate (99.3%) and rescue success rate (100%) with a low incidence of rescue intervention requirement (0.7%).⁵ This considerably increases the available evidence in this area of pre-hospital emergency medicine and suggests that high-quality, safe, airway intervention is routinely delivered.

It is worth appreciating the context of a system with such high airway success rates. London's Air Ambulance is an urban, physician-led, pre-hospital trauma service, serving a daytime population of up to 10 million people in an area approximately 5,000 square kilometres. The operational team (doctor and paramedic) is delivered to incidents by helicopter in the daytime and by fast response car at night. Tasking is only to trauma patients with severe injury. The service attends an average of 5-6 trauma patients per

day. Doctors are experienced anaesthetists or emergency physicians with a minimum of 6 months of in-hospital anaesthetic experience. Most doctors have some prior pre-hospital training and experience. Further, in-post training is provided in a 4-6 week induction period under the guidance and supervision of pre-hospital care consultants.

The local service airway bundle for RSI is robust and has been practiced for over 10 years. It aims to deliver a standardized and reproducible anaesthetic technique. The on-scene doctor has a limited number of treatment choices to make. Intubation is carried out by the doctor notably with the routine use of a bougie for every single intubation regardless of difficulty. Equipment for failed intubation includes a supraglottic airway device and equipment for surgical cricothyroidotomy. Correct tube placement is confirmed by the use of colorimetry and digital capnography. The pathway allows for a maximum of two initial attempts at intubation after drug administration. A set of operator drills to improve laryngoscopy when difficulty is encountered are followed if there is failure at the first attempt. Further failure to intubate leads the practitioner down a pathway to either placement of a supraglottic device (iGel) or a surgical airway. At least two good attempts at intubation must be performed. All members of the service are drilled in the procedure and regularly practice in a low fidelity simulation environment.

Apart from Lockey, multiple smaller studies have found similar first pass success rates when a bougie is part of the airway bundle used to facilitate intubation.⁶ Few studies other than the Lockey paper look specifically at bougie use in isolation or perform an assessment of a 'bougie-always' algorithm. Most of the research consists of small case series that hint the bougie is a useful adjunct. There are a few small 'bougie vs stylet' prospective studies where the bougie is considered slightly more favorable, but these are small in volume and lack power or statistical significance.

The Difficult Airway Society Guidelines recommend clinicians consider use of a bougie as part of the airway bundle if first look laryngoscopy/intubation is unsuccessful.⁷ This recommendation is also supported by the Association of Anaesthetists for Great Britain & Ireland Guidelines for pre-hospital anaesthesia.⁸ Many pre-hospital algorithms advocate routine use of a bougie to limit decision-making, streamline process and maximize 'bandwidth' during stressful tasks. There is a low rate of complications from using the device in this way.^{3,8}

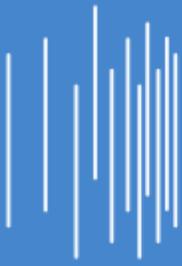
Bougie use however is not entirely benign. Minor airway injury resulting in blood on bronchial aspiration has been reported in 5% of bougie-assisted intubations.⁹ Major hemorrhage, mucosal injury, and tracheal perforation leading to pneumothorax have all been reported and were causes of serious

morbidity identified in the NAP 4 audit.^{3,9} It is recommended that a bougie be used with caution and the minimum force required be used to avoid injury.^{8,9}

The bougie is cheap, easy to use, and improves success rates for intubation when used in unexpected difficult airways. This simple tool should be readily available in all operating rooms or areas of the hospital where intubations take place. In emergency situations, it has been shown to be capable of helping achieve fast first-pass intubation with a smaller training curve than video laryngoscopes and fiberoptic bronchoscopes.¹⁰ Algorithms have successfully standardized advanced airway management and reduced failed intubation rates both in the emergency department and the pre-hospital setting. Adherence to structured protocols (that include bougie use), regular assessment and simulation training are likely to be of benefit to physicians-in-training particularly those from a non-anaesthetic background to maximize success.

References

1. Macintosh RR. An aid to oral intubation. *BMJ* 1949; 1: 28
2. Orebaugh SL. Difficult airway management in the emergency department. *J Emerg Med* 2002; 22(1): 31-48
3. Cook TM, Woodall N, Harper J et al. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments. *Br J Anaesth* 2011; 106(5): 632–42
4. Sherren PB, Tricklebank S, Glover G. Development of a standard operating procedure and checklist for rapid sequence induction in the critically ill. *Scand J of Trauma Resusc Emerg Med* 2014; 11:41
5. Lockey D, Crewdson K, Weaver A, et al. Observational study of the success rates of intubation and failed intubation airway rescue techniques in 7256 attempted intubations of trauma patients by pre-hospital physicians. *Br J Anaesth* 2014; 113(2): 220-25
6. Lossius H, Roislien J, Lockey D. Patient safety in pre-hospital emergency tracheal intubation: a comprehensive meta-analysis of the intubation success rates of EMS providers. *Crit Care* 2012; 16(1): R24
7. Henderson JJ, Popat MT, Latta IP et al. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004; 59: 675-94



8. Association of Anaesthetists of Great Britain and Ireland. Pre-hospital anaesthesia. London: AAGBI, 2009
9. Evans D, McGlashan J, Norris A. Iatrogenic airway injury. BJA Education 2015; 15(4): 184-9
10. Kovacs G, Law JA, McCrossin C, et al. A comparison of a fiberoptic stylet and a bougie as adjuncts to direct laryngoscopy in a manikin simulated difficult airway. Ann Emerg Med 2007; 50(6): 676-85