British Journal of Anaesthesia **100 (1):** 116–19 (2008)
doi:10.1093/bja/aem303 Advance Access publication October 23, 2007

Case report

Use of the McGrath® videolaryngoscope in the management of difficult and failed tracheal intubation

B. Shippey*†, D. Ray† and D. McKeown†

Department of Anaesthesia, Critical Care and Pain Medicine, Royal Infirmary of Edinburgh, 51 Little France Crescent, Edinburgh EH16 4SA, UK

**Corresponding author. Department of Anaesthesia, Queen Margaret Hospital, Dunfermline, Fife KY12 OSU, UK. E-mail: benshippey@mac.com*

Difficult laryngoscopy and failed tracheal intubation are associated with complications which can be serious, and on occasion, life-threatening. We report three cases of difficult and failed tracheal intubation using a conventional Macintosh laryngoscope in which tracheal intubation was accomplished swiftly and easily using a new design of videolaryngoscope, the McGrath®.

Br J Anaesth 2008; **100**: 116–19

Keywords: anaesthetic techniques, laryngoscopy; equipment, laryngoscopes

Accepted for publication: September 15, 2007

Adverse outcomes associated with respiratory events were found to constitute the largest class of injury in the American Society of Anesthesiologists Closed Claims Study.[1] Difficult tracheal intubation and oesophageal intubation accounted for more than one-third of these adverse events. Difficult laryngoscopy and failed tracheal intubation are associated with complications which can be serious, and on occasion, life-threatening.[2–5] Videolaryngoscopy, which can provide a good view of the larynx when conventional laryngoscopy has failed,[6–10] offers one possible solution to this problem.

We report three patients in whom tracheal intubation was not possible using a conventional Macintosh laryngoscope but was accomplished easily with the McGrath® videolaryngoscope (Fig. 1). All patients gave consent for inclusion in this report.

Case 1

A 62-yr-old female weighing 80 kg and 1.61 m tall (BMI 31 kg m^{-2}) was brought to the Accident and Emergency Department having been found unconscious at home. Her Glasgow Coma Scale score was 5 (E1, V1, M3). A drug overdose was suspected, but a computerized tomography brain scan was planned to exclude intracranial pathology. In view of her impaired ability to protect her airway, it was decided to undertake tracheal intubation before transfer to the radiology department. Assessment of the patient's airway identified a relatively short chin (thyromental distance <6.5 cm), reasonable mouth opening (>3 cm), normal dentition, and a short neck. The patient was positioned optimally with her head on a pillow. After preoxygenation, anaesthesia was induced with thiopentone 200 mg and suxamethonium 100 mg, and cricoid pressure applied. The emergency physician [year 1 specialist registrar (SpR) with limited experience of laryngoscopy] attempted laryngoscopy using a size 4 Macintosh blade but could not see the epiglottis (Cormack and Lehane[11] Grade 4). The supervising anaesthetist (a year 2 SpR) attempted laryngoscopy while the suxamethonium was still working, and also could not see the epiglottis. External laryngeal manipulation and backwards, upwards, rightwards pressure did not improve the view. An oropharyngeal airway was inserted, and oxygenation was maintained using bag-valve mask ventilation. A senior anaesthetist (a year 5 SpR, who was experienced in the use of the McGrath®) performed laryngoscopy with the McGrath®. The whole glottis was seen (Cormack and

†*Declaration of interest*. All three investigators have assisted Aircraft Medical in the development of the McGrath® videolaryngoscope. The employing authority of the investigators has received payment from Aircraft Medical for professional advice given by Drs McKeown and Ray on a consultative basis. Disposable laryngoscope blades were provided free of charge by Aircraft Medical for this clinical evaluation.

Fig 1 The McGrath® videolaryngoscope.

Lehane Grade 1), and after administration of a further 100 mg of suxamethonium, the trachea was intubated without difficulty with a size 8.5 mm Portex cuffed tracheal tube mounted onto a stylet ('Satin Slip', Mallinckrodt, Athlone, Ireland). Oxygen saturation was >94% at all times.

Case 2

A 71-yr-old female who had sustained multiple trauma required tracheal intubation as an emergency because of deteriorating oxygenation. Her cervical spine was immobilized in a semi-rigid collar and bolsters, and she was receiving infusion of blood and blood products. A rapid airway evaluation revealed prominent teeth and significant overbite, but no other factors associated with difficult laryngoscopy. Her weight was estimated to be approximately 70 kg. While maintaining manual in-line immobilization, the cervical collar was removed, anaesthesia was induced with ketamine 50 mg and suxamethonium 100 mg, cricoid pressure was applied, and after fasciculation ceased laryngoscopy was attempted by a year 3 SpR in anaesthesia. Mouth opening was a little limited, and the

epiglottis could not be seen. External laryngeal manipulation brought the epiglottis into view (Cormack and Lehane Grade 3), but passage of a single-use, coudé tip bougie into the trachea was unsuccessful. A size 4 classic laryngeal mask airway (LMA[†]) was inserted with a little difficulty for airway control. An Aintree catheter (Cook Europe, Limerick, Ireland) mounted over a fibreoptic laryngoscope was passed into the trachea, and the LMA was removed to allow passage of a 7.0 mm internal diameter Portex cuffed tracheal tube over the Aintree catheter into the trachea. After resuscitative surgery, she required a period of ventilatory support in the intensive care unit. The cervical spine was cleared after full radiological imaging, she was weaned from ventilation and the tracheal tube was removed. Later that day, however, she deteriorated with retention of pulmonary secretions and became confused. Propofol 50–70 mg h^{-1} was administered by infusion to control her agitation and bi-level positive pressure ventilation (BIPAP) was commenced by face-mask. Despite this, her respiratory condition continued to deteriorate; she became obviously tired and tachypnoeic (ventilatory frequency 39 breaths min^{-1}), although oxygenation was not grossly impaired (Sp_{O_2} 97%; Pa_{O_2} 9.4 kPa; $F_{I_{O_2}}$ 0.55). Eight hours after commencing the propofol infusion, a decision was made to re-intubate the trachea. Propofol 40 mg and alfentanil 1 mg were administered; no neuromuscular blocking agent was administered. Laryngoscopy with a size 4 Macintosh blade was attempted by a Consultant in Anaesthesia and Critical Care. Despite optimal positioning and external laryngeal manipulation, only the epiglottis was visible (Cormack and Lehane Grade 3). Laryngoscopy was repeated using the McGrath® videolaryngoscope. The whole glottis was easily visible (Cormack and Lehane Grade 1), and after administration of a further 30 mg of propofol, tracheal intubation was successful at the first attempt with a size 7.0 mm Portex tracheal tube mounted onto a stylet. Oxygen saturation was >96% throughout both attempts at laryngoscopy and tracheal intubation.

Case 3

A 46-yr-old female, weighing 100 kg and 1.75 m tall (BMI 33 kg m^{-2}), presented for emergency laparoscopic cholecystectomy. She had a full set of teeth, unrestricted neck movement, and good mouth opening; the Mallampati score was 3, but difficult tracheal intubation was not anticipated. The patient was placed in the 'sniffing' position with her head on a pillow. After preoxygenation, anaesthesia was induced with propofol 150 mg and fentanyl 200 μg, and atracurium 30 mg was administered. Manual ventilation with face-mask and anaesthetic breathing system was easy; anaesthesia was maintained with oxygen, air, and sevoflurane. Approximately 2.5 min after the administration of atracurium, laryngoscopy with a Macintosh size 4 blade revealed only the epiglottis (Cormack and Lehane Grade 3). This could not be improved by repositioning of the head or external laryngeal manipulation. When the McGrath® videolaryngoscope was used the whole glottis was visible (Cormack and Lehane Grade 1), and tracheal intubation with a size 8.0 mm Portex tracheal tube mounted onto a stylet was successful at the first attempt. Oxygen saturation was >97% throughout.

[†]LMA® is the property of Intavent Ltd.

Discussion

Difficult laryngoscopy occurs in 2–8% of all general anaesthetic cases. Difficult intubation is less common, and failed intubation is rare.[1–4] Many techniques have been used to intubate the trachea when the opening of the glottis cannot be seen. The Difficult Airway Society suggests initially optimizing head and neck position, ensuring adequate muscle relaxation, changing to a different laryngoscope blade such as a straight or McCoy blade; if tracheal intubation is still not possible, then insertion of a classic LMA or intubating LMA and fibreoptic tracheal intubation through this is preferred.[12] The most common technique in North America is to choose another rigid laryngoscope such as the Bullard,[13] Upsher[14] or Wu,[15] or a fibreoptic laryngoscope;[16–18] use of the Airtraq® has also been described recently.[19 20] Other techniques involve trans-illumination of the anterior tissue of the neck, or blind passage of an armoured tracheal tube through the intubating LMA. The 'gold standard' method remains insertion of the tracheal tube under direct vision. This can be achieved using a flexible bronchoscope, but these are relatively expensive, and a sterile bronchoscope may not always be immediately available.[21]

Videolaryngoscopy is rapidly becoming an established technique that can provide a good view of the larynx when conventional laryngoscopy has failed.[6–10] The technique is relatively easily acquired,[22 23] and few complications are reported. Several videolaryngoscopes are commercially available, but have some limitations such as the requirement for a separate viewing screen, light source or power supply, and a need for the laryngoscope handle or blade to be sterilized between the patients. The McGrath® videolaryngoscope (Aircraft Medical, Edinburgh, UK) is a portable device which is powered by a single standard AA battery and features an on-board camera system and integral colour liquid crystal display mounted on the top of the laryngoscope handle. A sterile, transparent, acrylic single-use blade is used to reduce the risk of patient-to-patient contamination; the handle and the screen can be cleaned using alcohol-impregnated wipes. The McGrath® currently retails for £3950.

These three cases occurred between July and September 2006. The same McGrath® videolaryngoscope was used in all three patients. The design of the adjustable length

blade has since been modified to have fewer points of adjustment (from 9 to 3). No other modifications have been made to the version which is currently available commercially.

In the cases described here, we found that the use of the McGrath® videolaryngoscope resulted in a Grade 1 laryngoscopic view in patients who had Grade 3 or 4 views when a conventional Macintosh laryngoscope was used. In two of these cases, a poor view of the glottis using direct laryngoscopy was not anticipated. Tracheal intubation was completed quickly and without complication in all three patients using the McGrath®.

This mirrors our wider experience with the McGrath® videolaryngoscope. We have used the McGrath® to assist with tracheal intubation in more than 175 adult patients. In an initial clinical evaluation of the McGrath® in 150 unselected patients,[24] we successfully intubated 98% of patients using the McGrath®, and in two of the three 'failures', there was a technical problem with a pre-production version of the laryngoscope. We found a Grade 1 view of the larynx in 143 patients and a Grade 2 view in six patients. However, we found that insertion of a tube into the trachea was more awkward because of the more anterior view of the larynx obtained with the McGrath®. This potential difficulty can be overcome by a rigid stylet and shaping the tracheal tube before attempting insertion.[24] A similar solution has been proposed by users of the Glidescope® videolaryngoscope.[7]

During our initial experience with the McGrath®, we have encountered 70 patients who had one or more factors associated with difficult laryngoscopy (Mallampati score >2, mouth opening <3 cm, thyromental distance <6.5 cm, difficult dentition, BMI>35 kg m^{-2}, or previously recorded Cormack and Lehane Grade >2). Tracheal intubation was successful in all 70 patients, during the first laryngoscopy in 65 patients and during the second in the remaining five.

In conclusion, the McGrath® videolaryngoscope is a compact, portable, and easy to use alternative to direct laryngoscopy. We believe that it offers a valuable addition to the equipment currently available to rescue the difficult or failed tracheal intubation. A formal evaluation of the McGrath® in patients in whom tracheal intubation is expected to be difficult is necessary to fully establish its utility in such cases.

References

1 Caplan RA, Posner KL, Ward RJ, Cheney FW. Adverse respiratory events in anesthesia: a closed claims analysis. *Anesthesiology* 1990; **72**: 828–33

2 Cattano D, Panicucci E, Paolicchi A, Forfori F, Giunta F, Hagberg C. Risk factors assessment of the difficult airway: an Italian survey of 1956 patients. *Anesth Analg* 2004; **99**: 1774–93

3 Rose DK, Cohen MM. The airway: problems and predictions in 18,500 patients. *Can J Anaesth* 1994; **41**: 372–83

4 Combes X, Le Roux B, Suen P, *et al*. Unanticipated difficult airway in anesthetized patients: prospective validation of a management algorithm. *Anesthesiology* 2004; **100**: 1146–50

5 Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Management of the difficult airway: a closed claims analysis. *Anesthesiology* 2005; **103**: 33–9

6 Cooper RM. Use of a new videolaryngoscope (GlideScope) in the management of a difficult airway. *Can J Anaesth* 2003; **50**: 611–3

7 Cooper RM, Pacey JA, Bishop MJ, McCluskey SA. Early clinical experience with a new videolaryngoscope (GlideScope) in 728 patients. *Can J Anaesth* 2005; **52**: 191–8

8 Lai HY, Chen IH, Chen A, Hwang FY, Lee Y. The use of the GlideScope® for tracheal intubation in patients with ankylosing spondylitis. *Br J Anaesth* 2006; **97**: 419–22

9 Kaplan MB, Hagberg CS, Ward DS, *et al*. Comparison of direct and video-assisted views of the larynx during routine intubation. *J Clin Anesth* 2006; **18**: 357–62

10 Asai T, Shingu K. Use of the videolaryngoscope (letter). *Anaesthesia* 2004; **59**: 513–4

11 Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984; **39**: 1105–11

12 Difficult Airway Society. Strategy for intubation by direct laryngoscopy, no predicted airway problem, no risk of regurgitation. Available from www.das.uk.com/guidelines/ddl.html (accessed 21 March 2007)

13 Bjoraker DG. The Bullard intubating laryngoscope. *Anesth Rev* 1990; **17**: 64–70

14 Pearce AC, Shaw S, Macklin S. Evaluation of the Upsherscope. *Anaesthesia* 1996; **51**: 561–4

15 Wu T, Chou H. A new laryngoscope: the combination intubating device. *Anesthesiology* 1994; **81**: 1085–6

16 Connelly NR, Ghandour K, Robbins L, Dunn S, Gibson C. Management of unexpected difficult airway at a teaching institution over a 7-year period. *J Clin Anesth* 2006; **18**: 198–204

17 Rosenblatt WH, Wagner PJ, Ovassapian A, Kain ZN. Practice patterns in managing the difficult airway by anesthesiologists in the United States. *Anesth Analg* 1998; **87**: 153–7

18 Jenkins K, Wong DT, Correa R. Management choices for the difficult airway by anesthesiologists in Canada. *Can J Anaesth* 2002; **49**: 850–6

19 Maharaj CH, Costello JF, McDonnell JG, Harte BH, Laffey JG. The Airtraq® as a rescue device following failed direct laryngoscopy—a case series. *Anaesthesia* 2007; **62**: 598–601

20 Dhonneur G, Ndoko S, Amathieu R, Housseini L, Poncelet C, Tual L. Tracheal intubation using the Airtraq® in morbid obese patients undergoing emergency cesarean delivery. *Anesthesiology* 2007; **106**: 629–30

21 Kristensen MS, Moller J. Airway management behaviour, experience and knowledge among Danish anaesthesiologists—room for improvement. *Acta Anaesthesiol Scand* 2001; **45**: 1181–5

22 Lim Y, Lim TJ, Liu EH. Ease of intubation with the GlideScope or Macintosh laryngoscope by inexperienced operators in simulated difficult airways. *Can J Anaesth* 2004; **51**: 641–2

23 Lim TJ, Lim Y, Liu EH. Evaluation of ease of intubation with the GlideScope or Macintosh laryngoscope by anaesthetists in simulated easy and difficult laryngoscopy. *Anaesthesia* 2005; **60**: 180–3

24 Shippey B, Ray D, McKeown D. Case series: The McGrath® videolaryngoscope—an initial clinical evaluation. *Can J Anaesth* 2007; **54**: 304–13