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Original Article

Awake videolaryngoscopy-assisted tracheal intubation of the morbidly obese

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Summary

Awake videolaryngoscopy may be useful for the tracheal intubation of the morbidly obese. This prospective, observational study enrolled 50 patients undergoing bariatric surgery. After sedation and topical anaesthesia of the airway, awake tracheal intubation was attempted, assisted by videolaryngoscopy, and terminated if there was severe gagging, coughing, or inadequate laryngeal view. After three attempts the procedure was considered a failure. Twenty-seven intubations were successful on the first attempt, fifteen on the second, six on the third and two were not successful, giving a success rate of 96% (95% CI 86–100%). In one failure, inserting the tracheal tube caused severe gagging in spite of an adequate view of the larynx, and the trachea was intubated with the videolaryngoscope after induction of anaesthesia. The second failure was due to gagging, with subsequent tracheal intubation successful using fibreoptic bronchoscopy. When managing the morbidly obese airway, awake tracheal intubation using videolaryngoscopy may be considered.

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The management of the obese patient's airway is challenging because the obese body habitus makes mask ventilation and tracheal intubation technically difficult [1]. In addition, the decreased functional residual capacity of obese patients limits the duration of normal oxygen saturation during apnoea. Therefore, tracheal intubation in this patient population is often performed before the induction of general anaesthesia, while maintaining spontaneous respiration. Fibreoptic bronchoscope-assisted tracheal intubation, a commonly utilised method to perform awake tracheal intubations, has limitations [2]. Fiberoptic bronchoscopes are expensive, and their proper use requires extensive training and practice. The presence of oedema, excess airway tissue, secretions, or blood in the pharynx or larynx makes fibreoptic bronchoscope-assisted intubation of the trachea difficult, or even impossible.

The videolaryngoscope is a relatively new device that uses a video system to view the larynx. In contrast to the fibreoptic bronchoscope, the videolaryngoscope is relatively inexpensive and easy to handle. It is better suited for the tracheal intubation of patients with pharyngeal secretions or bleeding. Videolaryngoscopes can be used to displace excess airway tissue and may provide superior views of the obese patient's larynx. Videolaryngoscopy has been shown to be useful for awake tracheal intubations [3], and for tracheal intubation in morbidly obese patients after induction of anaesthesia [4]. Case reports exist of videolaryngoscopy being used to facilitate awake tracheal intubation in

morbidly obese patients [5, 6], but this technique has not been evaluated systematically and its overall success rate is unknown. The present study was undertaken to assess prospectively the efficacy of awake tracheal intubation assisted by videolaryngoscopy in morbidly obese patients scheduled for laparoscopic bariatric surgery.

Methods

With the approval of the McGill University Health Centre Research Ethics Office, we approached patients scheduled for elective laparoscopic bariatric surgery at the Royal Victoria Hospital between September 2009 and July 2011. Inclusion criteria were a body mass index (BMI) over 40 $kg.m^{-2}$ and a potentially difficult airway as defined by two or more of the following factors: modified Mallampati score three or higher; the presence of teeth; a history of sleep apnoea; mouth opening less than 3 cm; or a hyo-mental distance less than 3 cm. We excluded patients with an ASA physical status of greater than four, patients unable to communicate in English or French, and any patients with contraindications to any of the drugs used in the study. We recorded patients' age, height, weight, BMI, medical history, medications, presence of sleep apnoea, modified Mallampati score and the presence of teeth. Intravenous access was obtained, and standard, non-invasive monitoring commenced (ECG, pulse oximetry, and non-invasive blood pressure measurements). The patient was positioned on a Troop elevation pillow™ (Mercury Medical®; Clearwater, FL, USA). Intubations were performed by one of four board-certified senior anaesthetists, all of whom had more than one year's of experience using a videolaryngoscope. Each anaesthetist provided airway anaesthesia and sedation based on their own routine practice, as we did not want to impose a sedation or topical anaesthesia regimen with which they were not accustomed. Two anaesthetists used titrated intravenous boluses of midazolam 1 mg and fentanyl 50 μg; another used an infusion of intravenous remifentanil starting at 0.05 $\mu g.kg^{-1}.min^{-1}$ and titrating up to 0.08 $\mu g.kg^{-1}.min^{-1}$ and propofol starting at 50 $\mu g.kg^{-1}.min^{-1}$. and titrating up to 80 $\mu g.kg^{-1}.min^{-1}$. The last sedation method used intravenous boluses of midazolam 1 mg, and fentanyl 50 μg, in addition to a remifentanil infusion of 0.05 $\mu g.kg^{-1}.min^{-1}$. No sedation score was used to assess the depth of sedation, but all patients were kept breathing spontaneously and responding to command. For airway anaesthesia, all anaesthetists had the patient inspire atomised 2% lidocaine. One anaesthetist also had the patient gargle 2% lidocaine. Another anaesthetist applied 2% lidocaine-soaked gauze next to the patient's posterior tonsillar pillar to provide glossopharyngeal nerve anaesthesia. Supplemental oxygen was provided, when required, to maintain an oxygen saturation greater than 90%. The videolaryngoscope (Glidescope® GVL; Verathon Inc, Bothell, WA, USA) assisted tracheal intubation was performed according to the manufacturer's recommendation. The videolaryngoscope was introduced in the midline of the patient's oral cavity, and then advanced into the pharynx until an adequate view of the larynx was obtained. A tracheal tube that had been loaded on a stylet was then introduced through the vocal cords into the trachea. After confirmation of the placement of the tracheal tube in the trachea by detection of continual end-tidal carbon dioxide, the intubation was considered successful, and the study was terminated.

During the intubation procedure, an observer recorded the time from the initial insertion of the videolaryngoscope until the placement of the tracheal tube had been confirmed. This same observer rated the patients' gagging and coughing using a four-point scale of 0–3 (0, none; 1, mild, occurring occasionally; 2, moderate, occurring repeatedly with or without controlled movement of limbs; and 3, severe, occurring repeatedly, with uncontrolled movements of limbs). If severe gagging or coughing was observed, the videolaryngoscope was removed and, depending on the individual anaesthetists' sedation strategy, additional intravenous midazolam or fentanyl was administered, or the remifentanil and propofol infusion rates were increased. In addition, local anaesthesia was also provided by having the patient inspire an additional 10 ml atomised 2% lidocaine. An intubation attempt was considered unsuccessful if the videolaryngoscope was removed from the oral cavity due to coughing, gagging, or inability to view the vocal cords. Only three intubation attempts were allowed before an alternate intubation strategy had to be employed. The attending anaesthetists were allowed to utilise another intubation strategy, if they preferred, at any point during the procedure. The best laryngeal view obtained by the videolaryngoscope, using the Cormack and Lehane

scoring system [7], was recorded. The overall intubation procedure was considered a failure if the tracheal tube was not placed in the patient's trachea within three attempts, or if the tracheal tube was placed with a technique other than awake videolaryngoscopy. The reasons for failure, and the subsequent airway techniques that were utilised, were recorded.

Sample size was calculated using StatsDirect version 2.7.8 (StatsDirect Ltd, Altrincham, Cheshire, UK). We assumed our sample was drawn from a population of 10 000, estimated a 90% rate of success and accepted a deviation of ± 10%. To be 95% confident that the true population success rate fell within these values, we were required to study 35 patients. To account for protocol violations, and patient dropout, we chose to enrol 50 patients. Summary statistics were performed with Excel 2007(Microsoft®; Redmond, WA, USA), and the exact 95% CI for the proportion of successful intubations was calculated using Graph Pad Prism 5 (Graph Pad Software Inc, San Diego, CA, USA).

Results

From September 2009 until July 2011, we approached 52 patients, of whom two refused to participate. No patients withdrew from the study. The characteristics and medical history of the patients are summarised in Table 1. Information concerning the videolaryngoscope-assisted tracheal intubation is summarised in Table 2. No patient developed an oxygen saturation of less than 90% during the procedures. Forty-eight of the 50 patients were intubated with the awake videolaryngoscopy technique, which provided a success rate of 96% (95% CI 86–100%). There was a median (IQR [range]) of 1 (1–2 [1–3]) intubation attempts per patient, with 27 patients' tracheas intubated on the first attempt, 15 on the second attempt, and 6 on the third attempt.

Table 1 Characteristics of 50 patients undergoing awake tracheal intubation assisted by videolaryngoscopy. Values are mean (SD), number (proportion) or median (IQR [range]).

Age	44 (12)
Height; cm	169 (11)
Weight; kg	158 (33)
Body mass index; kg.m^{-2}	55 (10)
Men	25 (50%)
Women	25 (50%)
Diagnosed sleep apnoea	20 (40%)
Hypertension	33 (66%)
Diabetes	21 (42%)
Modified Mallampati score	2 (2–3 [1–4])
Edentulous	9 (18%)

Table 2 Summary of 50 awake videolaryngoscope tracheal intubation procedures. Values are median (IQR [range]), number (proportion) or mean (SD).

Best laryngeal view*	2 (1–2 [1–3])
Number of attempts	1 (1–2 [1–3])
Intubation	
On 1st attempt	27 (54%)
On 2nd attempt	15 (30%)
On 3rd attempt	6 (12%)
Number of failures	2 (4%)
Intubation time; s	201 (158)
Maximum coughing score	0 (0–1 [0–3])
Maximum gagging score	1 (0–2 [0–3])

*as assessed by the Cormack and Lehane scoring system.

The two failed awake videolaryngoscopy-assisted tracheal intubations were performed by two different anaesthetists, both of whom utilised only inhaled aerosolised 2% lidocaine for airway anaesthesia. For sedation, one administered propofol and remifentanil infusions, and the other boluses of midazolam and fentanyl. In the first failure, videolaryngoscopy provided an adequate view of the vocal cords, but the attempt to advance the tracheal tube through the vocal cords provoked severe gagging and coughing, making the intubation impossible. After three unsuccessful attempts, the patient was pre-oxygenated for 5 min, general anaesthesia was induced, and the trachea was intubated on the first attempt with the use of the videolaryngoscope.

In the second failure, two attempts to intubate the trachea resulted in severe gagging. The anaesthetist decided to abort the videolaryngoscopy intubation attempt. After providing more sedation and applying an extra 10 ml atomised 2% lidocaine, the patient's trachea was intubated on the first attempt with the use of a fiberoptic bronchoscope. It was noted during the inspiration of 2% lidocaine that this patient was not able to take deep enough inspirations to ensure its profound spread.

Discussion

The results of the present study demonstrate the successful use of videolaryngoscopy to facilitate tracheal

intubation in awake, morbidly obese patients presenting with a potentially difficult airway.

Videolaryngoscopy has several advantages when compared with the use of bronchoscopes, the 'gold standard' for awake intubations. As videolaryngoscopes are tools that are operated in a similar fashion to conventional laryngoscopes, they are relatively easy to use. Videolaryngoscopes are less expensive than bronchoscopes, are portable and are easier to clean and store. As videolaryngoscopes are rigid, they can push away excess tissue, secretions or blood, thereby allowing a better view of the vocal cords.

In one failure from our series, awake videolaryngoscopy permitted provided a view of the of the larynx while the patient was awake. Using this information, the anaesthetist felt comfortable to induce general anaesthesia and intubate the patient's trachea using conventional laryngoscopy. This concept of the videolaryngoscope 'awake look' has been described in other patient populations [8], and is one benefit of the technique of awake tracheal intubation assisted by videolaryngoscopy.

We acknowledge several limitations to our study. Ours was a prospective observational 'proof of concept' study; therefore we cannot demonstrate this technique's superiority over other airway management strategies. It might also be seen as a limitation that our protocol did not control for the method of airway anaesthesia. The study design was, however, deliberately chosen because we did not want to impose a rigid airway anaesthetic protocol on anaesthetists who were already experienced in anaesthetising the airways of morbidly obese patients. The high success rate of awake videolaryngoscopy in the present study suggests, however, that it is a feasible technique for use in the morbidly obese, independent of the technique for airway anaesthesia.

The fact that the two failures occurred in patients who did not have lidocaine-soaked gauze placed beside the tonsillar pillars may emphasise the importance of using topical anaesthetic techniques specifically targeting the glossopharyngeal nerve. The inspiration of aerosolised local anaesthetics provides adequate airway anaesthesia in the majority of patients. However, techniques that directly involve the glossopharyngeal nerve, which provides the sensation to the base of the tongue, may also be required, especially in patients who have a strong gag reflex. It is possible that if lidocaine-soaked gauze had been introduced next to the posterior tonsillar pillars of the patients in whom awake videolaryngoscopy failed, the technique may have been successful. It should be noted that, because the videolaryngoscope is larger than a bronchoscope, it exerts more traction on the tongue and upper airway, and may therefore induce gagging (like any instrument introduced into the larynx of an awake patient) independent of the type of local anaesthetic used.

In conclusion, this study provides evidence to support the use of videolaryngoscopes for awake intubation in morbidly obese patients. This technique, even if not used for tracheal intubation, may provide views of the airway and, hence, information on the ease of intubation before induction of general anaesthesia. We conclude that awake tracheal intubation assisted by videolaryngoscopy could be a useful tool for the management of the morbidly obese patient's airway.

Competing interests

No external funding or competing interests declared.

References

1. Adams JP, Murphy PG. Obesity in anaesthesia and intensive care. *British Journal of Anaesthesia* 2000; **85**: 91–108.
2. Thong SY, Lim Y. Video and optic laryngoscopy assisted tracheal intubation – the new era. *Anaesthesia and Intensive Care* 2009; **37**: 219–33.
3. Doyle DJ. Awake intubation using the GlideScope® videolaryngoscope: initial experience in four cases. *Canadian Journal of Anesthesia* 2004; **51**: 520–1.
4. Andersen LH, Rovsing L, Olsen KS. GlideScope videolaryngoscope vs. Macintosh direct laryngoscope for intubation of morbidly obese patients: a randomised trial. *Acta Anaesthesiologica Scandinavica* 2011; **55**: 1090–7.
5. Jeyadoss J, Nanjappa N, Nemeth D. Awake intubation using pentax AWS videolaryngoscope after failed fibreoptic intubation in a morbidly obese patient with a massive thyroid tumour and tracheal compression. *Anaesthesia and Intensive Care* 2011; **39**: 311–2.
6. Suzuki A, Terao M, Aizawa K, Sasakawa T, Henderson JJ, Iwasaki H. Pentax-AWS airway scope as an alternative for awake flexible fiberoptic intubation of a morbidly obese patient in the semi-sitting position. *Journal of Anesthesia* 2009; **23**: 162–3.
7. Cormack RS, Lehane J. Difficult intubation in obstetrics. *Anaesthesia* 1984; **39**: 1105–11.
8. Jones PM, Harle CC. Avoiding awake intubation by performing awake GlideScope® laryngoscopy in the preoperative holding area. *Canadian Journal of Anesthesia* 2006; **53**: 164–5.