

A comparison of two techniques for inserting the Airtraq™ laryngoscope in morbidly obese patients

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Summary

We postulated that video-controlled tracheal intubation with the Airtraq™ laryngoscope using the reverse manoeuvre instead of the standard technique of insertion could facilitate the airway management of morbidly obese patients. For the reverse manoeuvre the laryngoscope is inserted 180° opposite to that recommended, and once in place rotated into the conventional pharyngeal position. Eighty (40 lean and 40 morbidly obese) ASA I–III adult patients were randomly allocated to four equal groups to compare the standard technique to the reverse manoeuvre for inserting the Airtraq laryngoscope. Video-controlled and clinical tracheal intubation characteristics were recorded. The reverse manoeuvre did not influence tracheal intubation characteristics in the group of lean patients. In the group of morbidly obese patients, the standard technique of insertion was not satisfactory in 20% of cases and the reverse manoeuvre facilitated, speeded and secured tracheal intubation.

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The Airtraq™ (Prodol Meditec S.A., Vizcaya, Spain) disposable laryngoscope was designed to provide a view of the glottis without altering the normal alignment of the oral and pharyngeal axes. The Airtraq laryngoscope has been used in normal airways [1] and under simulated difficult airway scenarios [2]. Four experienced anaesthetists in our department received training in the use of the Airtraq laryngoscope using a manikin and unfixed cadavers. Following 2 months of experience using the Airtraq laryngoscope in patients undergoing bariatric surgery, the major factor determining the time for tracheal intubation appeared to be difficulty in placing the laryngoscope in the pharynx of some obese patients. We postulated that tracheal intubation might be facilitated if the Airtraq laryngoscope was inserted 180° opposite to that recommended and, once in place, rotated into the conventional pharyngeal position (reverse manoeuvre). After testing the reverse manoeuvre in cadavers, we decided to compare its effectiveness with the standard technique of insertion in lean and morbidly obese patients undergoing elective surgery.

Methods

After Institutional Ethics Committee approval and written informed consent was obtained, 80 ASA I–III adult patients, 40 lean ($\text{BMI} \leq 25 \text{ kg.m}^{-2}$) and 40 morbidly obese ($\text{BMI} > 35 \text{ kg.m}^{-2}$) patients were enrolled in this prospective study. Randomisation of the technique for inserting the Airtraq laryngoscope was performed at the pre-operative anaesthetic visit. Patients were assigned to the standard technique or the reverse manoeuvre using sealed envelopes opened by the anaesthetist in the operating room. The four trained anaesthetists involved in the study were experienced in tracheal intubation using the Airtraq laryngoscope. They all performed the same number of tracheal intubations in lean and morbidly obese patients. Patients with limited mouth opening ($< 3 \text{ cm}$), suffering from symptomatic gastric reflex or hiatus hernia, and those in whom suxamethonium was contra-indicated, were not included.

Anaesthetic technique

After attaching monitors and following pre-oxygenation, anaesthesia was induced with sufentanil $0.2 \mu\text{g.kg}^{-1}$, propofol 2.5 mg.kg^{-1} and atracurium 0.5 mg.kg^{-1} in the group of lean patients, and propofol 250–300 mg and suxamethonium 1 mg.kg^{-1} in the group of obese patients. When there was no response at the adductor pollicis to single twitch stimulation of the ulnar nerve, video-controlled tracheal intubation with the Airtraq laryngoscope was attempted using the standard technique or the reverse manoeuvre for insertion. Once the view of the glottis was optimal with either technique, the tracheal tube was passed through the vocal cords, the Airtraq laryngoscope removed and general anaesthesia continued.

Airway management characteristics

Video-clips recorded from the built-in camera of the Airtraq laryngoscope were stored on a personal computer and retrospectively observed and timed by an investigator blinded to the patient's group. We determined the intubation times from the recordings. Intubation time (IT) was defined as the time from the start of oral insertion of the Airtraq laryngoscope to visualisation of the superior border of the tracheal tube cuff passing the vocal cords. We also subdivided IT into the time required to achieve a centred view of the glottis opening with the Airtraq laryngoscope (exposure time – ET), and the time required to manipulate the tube to insert it into the glottis (manipulation time – MT). We recorded oxygen saturation throughout the intubation period. We carefully examined the video-clips of the oral and pharyngeal cavity for injury as we slowly removed the Airtraq laryngoscope using the same technique chosen for insertion. After each tracheal intubation, the anaesthetist performing the procedure was asked to rate the ease of insertion of the Airtraq laryngoscope on a scale of 0–100 (VAS_{DIFF}: 0 = easy, 100 = impossible).

Airway management procedures

If we could not visualise the glottis within 30 s of Airtraq laryngoscope insertion (ET > 30 s) with either the standard technique or the reverse manoeuvre, our plan was to switch the insertion technique. If there was a failure to intubate the trachea with the Airtraq laryngoscope within 120 s, direct laryngoscopy was recommended. If ventilation proved impossible, placement of the LMA CTrach™ (SEBAC, Pantin, France) was recommended.

Statistics

We retrospectively measured exposure time in morbidly obese patients intubated with the Airtraq laryngoscope using the standard technique for insertion over the

2-month period preceding the present study. Exposure time as the study endpoint was chosen to determine sample size. We hypothesised that the reverse manoeuvre of insertion would reduce ET by 50% in the morbidly obese patients. A total of 40 patients randomly allocated to two groups was required to identify a significant difference with $\beta = 0.9$ and $\alpha = 0.05$ in a two-sided test. The Chi-squared test with Yates's correction for percentages, Fisher exact test for airway management continuous variables and nonparametric Mann–Whitney test for categorical data were applied. *p* values < 0.05 were considered statistically significant.

Results

No complications related to anaesthesia or airway management occurred. All patients had a tracheal tube placed within 120 s using the Airtraq laryngoscope. The two groups of lean and morbidly obese patients were comparable in terms of demographic and upper airway characteristics (Table 1). The lowest S_pO_2 was 88%, observed in one of the morbidly obese patients. In the group of lean patients, the reverse manoeuvre did not influence tracheal intubation times. In the group of morbidly obese patients, the reverse manoeuvre significantly shortened IT and ET (Table 2). Compared to the standard insertion technique, the reverse manoeuvre reduced mean (SD) ET two-fold: 24 (4) s vs 12 (3) s, *p* < 0.05, respectively. A switch from the standard technique to the reverse manoeuvre was necessary in four

Table 1 Patient details and pre-operative airway assessment characteristics. Values are mean [range] (SD) or number. No difference was observed between the two groups.

	Lean patients		Morbidly obese patients	
	<i>n</i> = 40		<i>n</i> = 40	
	Standard technique <i>n</i> = 20	Reverse manoeuvre <i>n</i> = 20	Standard technique <i>n</i> = 20	Reverse manoeuvre <i>n</i> = 20
Age; years	51 [31–69]	56 [38–74]	44 [24–66]	46 [21–69]
Gender; M/F	11/9	12/8	7/13	8/12
BMI; kg.m^{-2}	23 (2)	22 (3)	40 (4)	41 (7)
TDM; cm	6.9 (0.4)	7.1 (0.3)	6.4 (0.6)	6.2 (0.7)
IID; cm	4.3 (0.3)	4.1 (0.2)	3.7 (0.2)	3.9 (0.3)
Mallampati score, 1, 2, 3 4; no. of patients	14/6/0/0	13/6/1/0	5/9/6/0	5/8/6/1

Lean patients (BMI $\leq 25 \text{ kg.m}^{-2}$); morbidly obese patients (BMI $> 35 \text{ kg.m}^{-2}$).

TDM, thyromental distance; IID, interincisor distance; BMI, body mass index.

Table 2 Comparative tracheal intubation characteristics. Values are mean (SD) [Range] or number. * $p < 0.05$ standard vs. reverse.

	Lean patients		Morbidly obese patients	
	<i>n</i> = 40		<i>n</i> = 40	
	Standard technique <i>n</i> = 20	Reverse manoeuvre <i>n</i> = 20	Standard technique <i>n</i> = 20	Reverse manoeuvre <i>n</i> = 20
Intubation sequences duration; s				
ET	10 (3)	11 (2)	24 (7)	12 (3)*
MT	9 (3)	9 (3)	13 (3)	12 (4)
IT	19 (4)	20 (4)	37 (6)	25 (5)*
Switch of insertion technique	0	0	4	0
Upper airway injury; no. of patients				
Minor	1	1	5	3
Mild	0	0	2	0
Total	1	1	7	3
Lowest S_{pO_2}	99 (0)	99 (0)	96 (2)	95 (3)
VAS _{DIFF}	7 [5–15]	9 [5–20]	29 [15–100]	8 [5–15]*

Lean patients ($BMI \leq 25 \text{ kg.m}^{-2}$); morbidly obese patients ($BMI > 35 \text{ kg.m}^{-2}$).

IT – intubation time; ET – exposure time; MT – manipulation time. See text for details.

morbidly obese patients. In these patients, mean (SD) ET was reduced from > 30 s to 11 (5) s.

The technique of Airtraq laryngoscope insertion did not influence tracheal intubation morbidity in the group of lean patients. Compared to the standard insertion technique, the reverse manoeuvre resulted in significantly fewer oropharyngeal lesions (10 vs 2, $p < 0.05$). Fewer morbidly obese patients suffered from mild velar mucous membrane injury after the reverse insertion manoeuvre. In four morbidly obese patients where the laryngoscope was inserted using the standard technique, localised and superficial mucous membrane bleeding was observed from cuts of 1–2 mm in length situated at the base of the pharyngopalatine arch. In four morbidly obese patients the posterior hard palate was observed to be reddened after the reverse manoeuvre of insertion. Among the four groups, perceived difficulty in insertion was significantly more common in the group of morbidly obese patients when the standard technique of insertion was used.

Discussion

We demonstrate that the reverse manoeuvre for insertion facilitated and secured tracheal intubation of morbidly obese patients, mainly by decreasing the time to obtain an optimal view of the glottis and by reducing the

occurrence of upper airway trauma during insertion of the Airtraq laryngoscope. We also show that the reverse manoeuvre of insertion did not affect tracheal intubation characteristics with lean patients.

In lean patients, correct placement of the Airtraq laryngoscope in the pharynx using the standard technique required very low pressure being applied to the device, whose dorsal face easily followed the anatomical contour of the hard palate during its descent into the pharynx. Similarly, the reverse manoeuvre in lean patients allowed the Airtraq laryngoscope blade to be easily inserted, probably because of the wide oral and pharyngeal space in these patients.

However, in the morbidly obese patients, although we applied the small amplitude crawling movements recommended by the inventor for the standard technique, considerable pressure was required to get the distal tip of the blade to pass the tongue, frequently resulting in an abrupt loss of resistance when the tip of the blade finally dived into the oropharyngeal space. Slow movements leading to correct placement of the tip of the blade in the vallecula were only possible in one-third of our morbidly obese patients, all of whom were scored as Mallampati 1 or 2. For all the other patients, placing the Airtraq laryngoscope required considerable pressure on the distal tip of the blade to overcome the narrowing of the junction between the oral and pharyngeal spaces. In four patients, one Mallampati grade 2 and three grade 3, the standard insertion technique failed satisfactorily to place the Airtraq laryngoscope in the pharynx. Investigators felt that the pressure applied to the Airtraq laryngoscope blade was unacceptable for clinical practice. The video clips showed that almost all the oropharyngeal injuries were related to difficult pharyngeal insertion of the Airtraq laryngoscope using the standard technique. In the four morbidly obese patients with localised and superficial mucous membrane abrasions, the laryngoscope blade descent in the pharynx was abrupt following initial tongue obstruction. Our data confirm that the Airtraq laryngoscope is correctly shaped for lean patients but its placement in some morbidly obese patients should be performed carefully.

Of interest, difficult Airtraq laryngoscope placement has already been described when tongue oedema was simulated in a manikin, resulting in a four-fold increased duration of tracheal intubation [2]. We assume that the reduced oropharyngeal space due to an enlarged tongue [3, 4] makes it more likely that the standard insertion technique will be difficult in morbidly obese patients. By using the reverse manoeuvre, the Airtraq laryngoscope was easily inserted into the pharynx. Our video recordings confirmed that the main reason why the reverse manoeuvre was effective was related to the initial depth

the laryngoscope was inserted into the oral cavity. By using the reverse manoeuvre, we increased the penetration of the Airtraq laryngoscope blade into the oral cavity, allowing the tip of the blade to be rotated around the posterior tongue directly into the pharynx. With the standard insertion technique the tip of the blade tended to push the downfolded anterior tongue into contact with the posterior pharyngeal wall, impeding descent of the Airtraq laryngoscope into the pharynx. The reverse manoeuvre mimicked the reverse method of inserting a Guedel airway with which anaesthetists are very familiar.

The reverse insertion manoeuvre was possible in all patients, probably because we selected those with an interincisor distance > 3 cm. However, this manoeuvre might not be applicable to all morbid obese patients. Because the Airtraq laryngoscope is only 1.8 cm thick but has a height of almost 2.8 cm, the reverse manoeuvre may make dental trauma more likely in patients with limited mouth opening. During preliminary evaluations we tested 45° and 90° rotations of the device but we selected a 180° rotation because it appeared to be the best compromise between easy oral placement, the initial depth of insertion and the risk of airway trauma of the hard or soft palate.

The reverse manoeuvre for insertion was performed without changing the position of the patient. Because the reverse manoeuvre was not affected by the short chin to sternum distance that some morbidly obese patients demonstrate, the Airtraq laryngoscope may have advantages over the Macintosh laryngoscope [5] when intubating the trachea morbidly obese patients [6].

In conclusion, we have demonstrated that the reverse manoeuvre of inserting the Airtraq laryngoscope was effective in facilitating tracheal intubation, shortening the duration of the procedure and reducing the risk of upper airway trauma in morbidly obese patients.

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