UNIVERSITE DE LAUSANNE – FACULTE DE BIOLOGIE ET DE MEDECINE

DEPARTEMENT DES SERVICES DE CHIRURGIE ET D'ANESTHESIOLOGIE

Service d'anesthésiologie

Videolaryngoscopy improves intubation condition in morbidly obese patients

THESE

préparée sous la direction du Professeur Donat R. Spahn (2003-2006),
puis du Docteur Lennart Magnusson,
Privat Docent et Maître d'Enseignement et de Recherche,
et présentée à la Faculté de biologie et de médecine de
l'Université de Lausanne pour l'obtention du grade de

DOCTEUR EN MEDECINE

par

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Originaire de Yvonand (Vaud)

Lausanne

2008

Rapport de synthèse

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Contexte clinique et objectifs: l'intubation oro-trachéale peut être plus difficile chez les patients obèses morbides (index de masse corporelle BMI > 35 kg/m²) que chez les patients non-obèses. Récemment, de nouveaux instruments permettant une intubation assistée au moyen d'une caméra ont été développés. Notre expérience pratique avec la vidéolaryngoscopie nous a conduit à l'hypothèse que celle-ci pourrait améliorer la vision laryngoscopique chez cette population spécifique et de ce fait faciliter l'intubation. Le but de cette étude était donc d'évaluer le bénéfice du vidéolaryngoscope sur le grade de laryngoscopie chez le patient obèse morbide.

Résultats: le grade laryngoscopique fut abaissé de manière significative avec le vidéolaryngoscope comparé à la vision directe avec un laryngoscope standard. Lorsque le grade laryngoscopique était plus grand que 1 à la laryngoscopie directe, il fut dans la grande majorité des cas (93% des patients) abaissé avec le vidéolaryngoscope. Chez les 7 % restant, le grade laryngoscopique resta identique.

Conclusions: chez le patient obèse morbide, l'utilisation du vidéolaryngoscope améliore de manière significative la visualisation du larynx et de ce fait facilite l'intubation. Une application systématique de ce procédé pourrait donc permettre de réduire l'incidence d'une intubation difficile ainsi que ses conséquences chez cette population de patients.

European Journal of Anaesthesiology 2007; 24: 1045–1049

doi: 10.1017/S0265021507000889

Original Article

Videolaryngoscopy improves intubation condition in morbidly obese patients

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Summary

Background and objective: Tracheal intubation may be more difficult in morbidly obese patients (body mass index $>35\,kg\,m^{-2}$) than in the non-obese. Recently, new video-assisted intubation devices have been developed. After some experience with videolaryngoscopy, we hypothesized that it could improve the laryngoscopic view in this specific population and therefore facilitate intubation. The aim of this study was to assess the benefit of a videolaryngoscope on the grade of laryngoscopy in morbid obesity. *Methods:* We studied 80 morbidly obese patients undergoing bariatric surgery. They were randomly assigned to one of two groups. One group was intubated with the help of the videolaryngoscope and in the control group the screen of the videolaryngoscope was hidden to the intubating anaesthesiologist. The primary end-point of the study was to assess in both groups the Cormack and Lehane direct and indirect grades of laryngoscopy. The duration of intubation, the number of attempts needed as well as the minimal S_PO_2 reached during the intubation process were measured. *Results:* Grade of laryngoscopy was significantly lower with the videolaryngoscope compared with the direct vision ($P < 0.001$). When the grade of laryngoscopy was higher than one with the direct laryngoscopy ($n = 30$), it was lower in 28 cases with the videolaryngoscope and remained the same only in two cases ($P < 0.001$). The minimal S_PO_2 reached during the intubation was higher with the videolaryngoscope but it did not reach statistical significance. *Conclusions:* In morbidly obese patients, the use of the videolaryngoscope significantly improves the visualization of the larynx and thereby facilitates intubation.

Keywords: OBESITY MORBID; INTUBATION INTRATRACHEAL; LARYNGOSCOPY, videolaryngoscope.

Introduction

Morbidly obese patients represent a particular challenge for the anaesthesiologist [1,2]. It has been shown that oro-tracheal intubation may be more difficult in obese patients than in lean patients [3]. Debate is still ongoing as to whether all patients with morbid obesity should be treated as if they had a difficult airway. In addition, morbidly obese patients have a lower oxygen reserve and increased oxygen consumption. This may lead to a decreased duration of non-hypoxic apnoea (defined as the duration to reach an S_PO_2 of 90%) despite the application of manoeuvres preventing atelectasis formation during induction of anaesthesia [4,5].

Therefore, it is important to develop methods in order to facilitate intubation and decrease the duration of apnoea. The sniffing position is one option [6]. Recently, videolaryngoscopes have been developed [7,8], in particular for teaching oro-tracheal intubation [9,10]. These devices may also facilitate intubation in difficult airways. Therefore, the aim of our study was to evaluate clinically in morbidly obese patients if the use of the videolaryngoscope could improve the visualization

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Accepted for publication 14 May 2007 EJA 4412
First published online 4 July 2007

of the larynx in comparison with conventional laryngoscopy. Minor end-points were duration of intubation, number of attempts and lowest S_PO_2 during intubation with either of the techniques.

Methods

After approval by the local Ethics Committee and written informed consent, 80 morbidly obese patients, ASA II or III, aged 23–76 years and scheduled for bariatric surgery were enrolled in this prospective, randomized, single-blind study. Patients included in the study had a body mass index $>35\,kg\,m^{-2}$. Previous ENT surgery or radiotherapy or unstable cervical spine requiring stabilization before intubation were considered as exclusion criteria.

Patients were then randomly assigned to one of two groups. In both groups an assessment of the grade of laryngoscopy was performed by both direct visualization and indirectly using the view obtained by the video camera on the laryngoscope, and which was displayed on the 20 cm screen of a laptop computer. Then, in the video group, the videolaryngoscope was used for tracheal intubation. In the control group, the screen of the videolaryngoscope was hidden from the anaesthesiologist performing the intubation. The intubation was performed with the same blade for all the patients. The only difference was the use (or not) of the screen of the videolaryngoscope.

The videolaryngoscope used was a Rüsch videolaryngoscope (X-Lite Videolaryngoscope, Rüsch Medical, Germany) with the light source at the tip of the blade. The screen is mobile, as a laptop; therefore, it is always easy to have a good view on the screen, which is 20 cm in diameter.

Patients received no premedication. In the operating room, a special pillow was put under the patients' shoulders in order to ramp up the patient's shoulders, and the head and the neck was extended in a sniffing position. Five minutes preoxygenation with 100% oxygen with a tight facemask was performed. Anaesthesia was then induced with propofol ($1.5–2.5\,mg\,kg^{-1}$) followed by a continuous infusion of propofol at $4–6\,mg\,kg^{-1}\,h^{-1}$ and remifentanil at $0.25\,\mu g\,kg^{-1}\,min^{-1}$. Patients received cisatracurium $0.2\,mg\,kg^{-1}$ to facilitate intubation. Muscle relaxation was evaluated with a nerve stimulator placed on the ulnar nerve. When TOF response was 0, laryngoscopy was performed.

In the video group, tracheal intubation was performed with the help of the videolaryngoscope. In the control group, the screen of the videolaryngoscope was hidden for the intubating anaesthesiologist after he had assessed the indirect grade of laryngoscopy (on the screen) and intubation was performed conventionally with the same Macintosh 3 blade for all patients. Standard endotracheal tubes (8.0 mm inner diameter for male and 7.0 mm for female) were used. The same senior anaesthesiologist, with experience in the use of the videolaryngoscope and who was not involved in the study, always performed the intubation. If the patient was assigned to the control group, the screen of the video was hidden to this anaesthesiologist after he had assessed the grade. The intubating anaesthetist could not be blinded as he had to intubate either with the help of the video or without it. In case of difficult intubation, the standard difficult intubation algorithm of the Anaesthesiology Department was followed.

For each patient, the Mallampati score was measured as well as three variables that might predict a high grade of laryngoscopic view [11–14]: the neck circumference at the level of the thyroid cartilage, the width of maximum mouth opening (cm between the incisors) and the thyromental distance. Age, gender and a history of sleep apnoea were also recorded.

The view upon direct and indirect laryngoscopy was graded and assessed using the Cormack and Lehane scoring system in both groups [15]. The laryngoscopic grade was recorded as follows. With grade 1 view, the vocal cords could be seen; with grade 2 view, only the arytenoids were visible; with grade 3 view, only the epiglottis could be seen; and with grade 4 view, the epiglottis was not visible.

Duration of tracheal intubation and the number of attempts needed were measured. The timer was started when the intubating anaesthesiologist stopped manual ventilation to take the laryngoscope blade and stopped when the tube was confirmed as being intra-tracheal (end-tidal CO_2 ($ETCO_2$)). A new attempt was recorded each time the endotracheal tube had to be taken out of the mouth, for any reason. S_PO_2 was measured at three different times: while breathing room air, after 5 min of preoxygenation and the minimal S_PO_2 measured during the whole intubation process and before the mechanical ventilation was started.

Statistics

Values are expressed as mean±SD. For normally distributed values, between- and within-group comparisons were performed using unpaired and paired Student's *t*-test, respectively. For values not normally distributed, comparison between groups was performed with the Mann–Whitney test. The Bonferroni correction for multiple comparisons was applied. Comparison between direct and indirect laryngoscopic grade was performed with Fisher's

exact test. $P < 0.05$ was considered significant. Finally, a simple linear correlation of the morphologic and demographic criteria with the grade of laryngoscopy was performed followed by a stepwise regression test for the variables that were significant on the first test.

Results

The two groups were similar regarding patient characteristics and the Mallampati score (Table 1). Laryngoscopic grades: out of the 80 patients, 30 had a laryngoscopic grade of 2 or 3 under direct vision (no patients in our study had a grade of 4). Out of these 30 patients, laryngoscopic grade was improved in the majority of patients (28 cases) or remained the same (two cases) with the videolaryngoscope ($P < 0.001$; Table 2). With indirect vision (video) there was no laryngoscopic grade of 3 or 4.

Table 1. Patient characteristics.

Variable	Video group ($n = 40$)	Control group ($n = 40$)
Age (yr)	45±13	45±12
Weight (kg)	118.6±27.7	122.3±22.8
Height (cm)	1.65±0.10	1.67±0.1
BMI (kg m^{-2})	42.8±6.9	43.5±5.4
Thyro-mental distance (cm)	6.3±0.9	6.1±1.3
Mouth opening (cm)	4.6±1.0	4.7±1.0
Neck circumference (cm)	46.2±5.4	47.3±5.0
Gender (M/F)	15/25	17/23
Sleep apnoea syndrome (n)	10	15
S_pO_2 room air (%)	96.4±2.4	96.2±2.9
S_pO_2 Preoxygenated (%)	98.9±0.5	98.9±0.4
Mallampati I/II/III/IV (n)	14/13/10/3	12/15/9/4

Data are mean±SD or numbers of patients.

Table 2. Comparison within subjects of the direct and the indirect grade of laryngoscopy for the whole cohort.

LG	*1*	*2*	*3*	*4*	*Total*
1	50	16	4	0	*70*
2	0	2	8	0	*10*
3	0	0	0	0	*0*
4	0	0	0	0	*0*
Total	*50*	18	12	0	

The columns represent the laryngoscopic grade with the direct vision (control) and the rows represent the laryngoscopic grade with the videolaryngoscope (indirect). In the table, the number of patients with the corresponding grades is shown. The grade of laryngoscopy was never higher with the videolaryngoscope than with the direct vision ($P < 0.001$). We had no direct grade of laryngoscopy higher than 3 and no grade of laryngoscopy higher than 2 with the videolaryngoscope.
LG: Laryngoscopic grade.

Table 3. Comparison between groups regarding the number of attempts needed for the intubation.

No. of attempts	Video group ($n = 40$)	Control group ($n = 40$)
1	38	32
2	2	6
3	0	1
>3	0	1

Although the number of attempts is slightly lower in the video group, it did not reach statistical significance ($P = 0.211$). There was no need for more than two attempts with the videolaryngoscope.

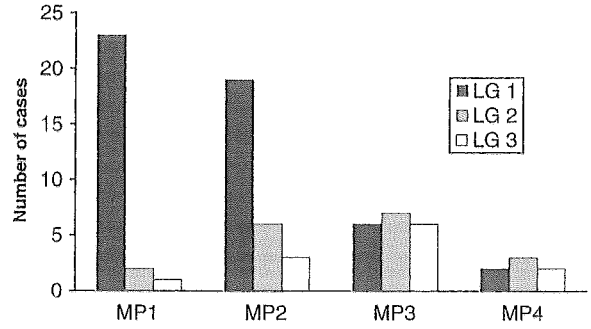

Figure 1.
The figure shows the different grades of laryngoscopy related to the Mallampati score of every patient. The grade of laryngoscopy is directly related to the Mallampati score ($P < 0.001$) *(LG: laryngoscopic grade; MP: Mallampati).*

The duration of intubation was significantly shorter with the videolaryngoscope than with direct view (59 ± 31 s (range: 30–208) vs. 93 ± 70 s (range: 40–450)) ($P = 0.006$). The minimal S_pO_2 was 98.2 ± 0.8% with the videolaryngoscope and 97.1 ± 3.8% with direct view ($P = 0.075$).

The oro-tracheal intubation was successful in all patients after one or more attempts. The number of attempts necessary was larger with the direct view than when the video was used but it did not reach statistical significance ($P = 0.21$; Table 3).

A univariate analysis was then performed to determine the predictive factors for a higher direct laryngoscopic grade. A multivariate analysis was then performed with the significant variables of the univariate analysis. The multivariate analysis demonstrated that the Mallampati score was the best independent risk factor for difficult visualization of the larynx ($P < 0.001$; Fig. 1). The width of mouth opening ($P = 0.001$) and the gender ($P = 0.004$) were also predictive (Table 4).

Table 4. Predictive factors for a difficult visualization of the larynx.

Predictive factors of a higher LG	Simple linear correlation	Stepwise regression test
Mallampati score	<0.001	<0.001
Mouth opening	0.001	0.001
Gender	0.004	0.004
Sleep apnoea syndrome	0.057	0.246
Age	0.007	0.268
Neck circumference	<0.001	0.308
Height	0.381	
Thyro-mental distance	0.508	
Weight	0.636	
BMI	0.864	

The Mallampati score, the mouth opening and the gender can be considered as independent predictors of a higher grade of laryngoscopy, which is related to a possible difficult intubation. All the other parameters could not be linked with a higher grade of laryngoscopy.
LG: Laryngoscopic grade.

Discussion

This study has shown that the use of a videolaryngoscope for the intubation in morbidly obese patients significantly improves the laryngoscopic grade. In the control group, these patients with a grade 2 or greater view (30 patients), the use of the videolaryngoscope lowered this score in 28 cases. The other two cases remained the same.

Our results can be compared to the study of Sun and colleagues [8] using the GlideScope. In their study, the duration of intubation was significantly increased with the GlideScope. In contrast, we found a significantly shorter intubation duration with the videolaryngoscope. This may be explained by two reasons: first, the videolaryngoscope uses a conventional Macintosh size 3 blade, which may in part explain the ease of its use. Moreover, all intubations were performed by the same senior anaesthesiologist who was an expert in the technique and had been using the device for more than six months before the beginning of the study. The results on the duration of the intubation as well as on the number of attempts needed may then have been positively influenced by the experience of the intubator and are not to be generalized without taking this into account.

Cooper and colleagues [7] could also demonstrate a benefit of using a GlideScope on the grade of laryngoscopy, but admitted that in 3.7% of the cases the intubation failed despite a good or excellent glottic view. They attributed these failures to limited prior experience or difficulty in manipulating the endotracheal tube while viewing a monitor. From our experience, it seems that less than 20 intubations are necessary in order to correctly use this device.

In a previous study, it has been demonstrated that difficult intubation had an incidence of 15.5% in morbidly obese patients [2]. The incidence of a direct laryngoscopic grade higher than 1 was 38% in our study. In more than 93% of these cases, the grade was lowered with the videolaryngoscope. In our study, only 16% of the patients had a laryngoscopic grade of 2 with the videolaryngoscope and none had a laryngoscopic grade of 3. As no patients had a laryngoscopic grade of 4 and only one needed more than three attempts for the intubation, further studies should be performed in order to show the usefulness of this device in cases of very difficult intubation.

As this device improves the laryngoscopic grade and probably shortens the duration of intubation, it may also decrease the incidence of severe desaturation during the intubation procedure in morbidly obese patients. Nevertheless, our study failed to demonstrate any benefit of using this device on oxygen saturation ($P = 0.076$), but this is probably due to a lack of power of our study. Indeed, desaturation during laryngoscopy was not the main outcome of the study.

There are however some restrictions to the use of the videolaryngoscope. A training period for its handling is necessary in order to use it correctly and to obtain its full benefit. The blade is the same as a normal Macintosh blade, but the wire with the light source comes out of the handle. Therefore, it may be difficult to introduce the blade in the mouth in patients with large breasts, which is nearly always the case in these patients. For this reason, it is imperative to position the patient on a pillow in order to extend the neck. Some training is necessary for the correct handling of the oro-tracheal tube while looking at a screen instead of looking directly at the larynx.

There are some limitations in our study, and the major one is that it could not be double-blind. In an attempt to perform a double-blind study, we tried to take pictures of the best vision obtained either directly through the mouth as well as on the screen of the video. Then an anaesthesiologist should have scored the laryngoscopic grade on these pictures. Unfortunately, it became rapidly evident that even on pictures it is easy to recognize if it has been taken through the mouth or directly on a screen. It was then not possible to assess objectively the laryngoscopic grade (on the video as well as in the throat), as the intubator could not be blinded. This introduces a possible source of bias. Another limitation is

that the senior anaesthesiologist performing the intubation was always the same and that he is an expert in the use of the videolaryngoscope. But since the end of our study, the videolaryngoscope has been widely used in our institution, and we have seen that the learning curve is very short.

In conclusion, for morbidly obese patients with a laryngoscopic grade of 2 or more, the videolaryngoscope nearly always allows a better visualization of the glottic anatomy, thereby improving the intubation conditions. It also probably facilitates faster endotracheal intubation. It is therefore a useful device to minimize the incidence of difficult intubation in morbidly obese patients. Therefore, in our institution, all morbidly obese patients are now intubated with this videolaryngoscope.

Acknowledgement

The study was entirely sponsored with funds from the Anaesthesiology Department of Lausanne. There was no external sponsorship.

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