Egyptian Journal of Anaesthesia (2014) 30, 365–371

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Egyptian Journal of Anaesthesia

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Research Article

Comparative study between the trachlight and SensaScope intubation in normal patients scheduled for elective surgery

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Received 19 August 2013; revised 13 April 2014; accepted 31 May 2014
Available online 30 June 2014

KEYWORDS
Endotracheal intubation;
Trachlight;
SensaScope;
Normal patients

Abstract *Introduction:* Airway management is a core stone and remains a challenge of every anesthetist. Visual control may facilitate tracheal intubation. Rigid video-laryngoscopes are emerging among the devices suggested as alternatives to direct laryngoscopy. Among the many alternative devices to choose for tracheal intubation, semi-rigid fibrescopes and lighted stylets can alternate rigid laryngoscopy in endotracheal intubation.
Aim of the work: The aim of the study was to clarify the efficacy and hemodynamic responses associated with tracheal intubation using trachlight technique (blind object) compared to SensaScope technique in patients subjected to elective surgery.
Patients and methods: Thirty patients were randomly allocated to either the trachlight (TL) or SensaScope (SS) group, (15 patients in each group). All endotracheal intubations were performed after induction of general anesthesia. Evaluation of technique, performance, duration of intubation, number of attempts at intubation, success rate of intubation with each device, hemodynamic changes [heart rate (HR), mean arterial blood pressure (MAP)] and oxygen saturation (SpO_2) were recorded.
Results: The duration of the intubation procedures was shorter in the SS group (64.86 ± 54.166 s) than in the TL group (68.53 ± 50.89 s) but without statistical significance, while no significant difference in the numbers of intubation attempts between the two groups. HR and MAP showed transient increase without statistical significance between both groups.

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Peer review under responsibility of Egyptian Society of Anesthesiologists.

 http://dx.doi.org/10.1016/j.egja.2014.05.004

Conclusion: The endotracheal intubation was effectively using either trachlight or SensaScope, while the SensaScope (SS) group showed shorter time and attenuation of the hemodynamic changes produced by tracheal intubation without significant postoperative complications except 13% complaining of hoarseness of voice after extubation.

1. Introduction

Particularly, difficult tracheal intubation is a major cause of anesthesia-related morbidity and mortality. Although there are several definitions of difficult tracheal intubation, a difficult airway is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with face mask ventilation of the upper airway, difficulty with tracheal intubation, or both. The difficult airway represents a complex interaction between patient factors, the clinical setting, and the skills of the practitioner [1]. A little change in the incidence of complications caused by tracheal intubation had been improved in the recent years, in particular, due to the development of different intubation tools, use of pulse oximetry and capnometry [2]. Visual control may facilitate tracheal intubation, so, the rigid video-laryngoscopes are emerging among the devices suggested as alternatives to direct laryngoscopy [3]. In intubation that are anticipated to be difficult, video-laryngoscopes are allowed for better visualization of the larynx compared with direct laryngoscopy [4]. Aziz et al. showed that the Glidescope rescued 224 of 239 (94%) failed direct laryngoscopies [5], and Amathieu et al. successfully intubated 24 of 29 failed intubations with the airtraq optical laryngoscopy [6]. Another observational studies report successful intubation in 96.8–100% of difficult airway patients when lighted stylets or light wands were used [7]. Most of video-laryngoscopies have a shorter learning curve than those the Macintosh blade for inexperienced users [8].

A devices that contain fiberoptic bundles are alternative to blind techniques such as stylets and introducers because they provide a direct view of the airway from a viewpoint which is not available in standard direct laryngoscopy [9,10]. Reported complications from intubating stylets include mild mucosal bleeding and sore throat while lung laceration and gastric perforation can occur after the use of a tube-changer or airway exchange catheter [1].

The recently developed SensaScope has been designed and developed as a hybrid intubation endoscope according to clinical requirements as safe, easy to handle, and effective video-assisted intubation. It is combined by S-shaped rigid segment that enables a very intuitive handling by one hand only and flexible parts (3 cm long). It can be flexed in the sagittal plane for 75° in both directions (anteriorly and posteriorly) by a lever at the eye-piece as fiberoptic endoscope. Due to these attributes, the SensaScope became a very versatile and effective tool to master the unanticipated difficult intubation in anesthetized and paralyzed patients [11].

The first prototype of the SensaScope (Acutronic MS, CH-8816 Hirzel, Switzerland) was released in 2006. It is a new semi-rigid video stylet designed to facilitate intubation under vision with the ease of handling [2]. Recently, a protective waterproof sleeve (SensaSleeeve TM, Acutronic Medical System AG, Hirzel, Switzerland) became available, which can be mounted on the SensaScope covering its entire shaft. With these recent developments, no need for immersion of the SensaScope into disinfectant for 45 min; after careful removal of the sleeve, a quick swabbing of the shaft with disinfectant-moistened gauze is sufficient [11]. The SensaScope, as any other endoscopic devices, has a limitation for intubation. It includes, the inability to elevate the tongue base, abundant secretions, bleeding, or vomiting precludes its use. Also, reduced mouth opening to less than 2 cm might be a hindrance [11].

Fiberoptic endotracheal intubation, which requires no elevation of the epiglottis requires skill in manipulation of the endoscope [12]. A first confirmation of this assumption has recently been found by Greif et al. who successfully have used the device in 13 cases of expected or even confirmed difficulty airway, while adopting an awake or slightly sedated approach [13].

A pilot prospective randomized controlled study was aimed to clarify the efficacy and hemodynamic responses associated with tracheal intubation by trachlight technique (blind object) compared to SensaScope technique in patients prepared for elective surgery.

2. Patients and methods

After approval of Al-azhar University Hospitals Ethical Committee and informed consent from each patient, thirty patients (ASA physical status I and II), all are underwent elective surgery under general anesthesia. All patients were investigated in this pilot prospective randomized controlled study. We excluded patients with pulmonary disease, hypertension, ischemic heart disease, cervical spine fracture, tumors, polyps in the upper airway, and patients with expected difficult airway or those with history of previous difficult endotracheal intubation. All patients were examined for difficult intubation according to the Wilson score, (the net summation of the score start by 0 which means easy endotracheal intubation, up to 10 that means very difficult endotracheal intubation), (Table 1).

The patients were randomly divided into two groups: Trachlight group (TL) (no. = 15) and SensaScope group (SS) (no. = 15). All patients were premedicated with an intramuscular (IM) injection of 0.5 mg atropine sulfate, 30 min before the induction of anesthesia. A total of 100 μg of fentanyl and 1 mg of midazolam were given intravenously as premedication. 100% oxygen for 3 min before intubation attempt was given. All patients were monitored by non-invasive blood pressure (NIBP), electrocardiography (ECG), pulse oximeter and capnography.

Induction of general anesthesia was done by intravenous 3–5 mg/kg thiopental sodium, 1 mg/kg succinylcholine followed by endotracheal intubation through one of the studied devices. Maintenance of anesthesia was done by inhalational of isoflurane (1.2%) and IV cisatracurium ($0.15\ mg\ kg^{-1}$) controlled intraoperatively by nerve stimulator.

Table 1 Wilson score for difficult intubation [14].

	Data	Problems	Score
1	Weight	< 90 kg	0
		90–110 kg	1
		> 110 kg	2
2	Head and neck movement	Above 90°	0
		About 90°	1
		Below 90°	2
3	Jaw movement	IG > 5 cm or slux > 0	0
		IG < 5 cm and slux = 0	1
		IG < 5 cm and slux < 0	2
4	Receding mandible	Normal	0
		Moderate	1
		Sever	2
5	Buck teeth	None	0
		Moderate	1
		Severe	2

IG = interincisor gap.
Slux = sublaxation (maximal forward protrusion of the lower incisors beyond the upper incisors).

The trachlight formed of a flexible and firm long lighted stylet at the distal end and connected to a battery at the proximal end (Fig. 1). In the TL group, the trachlight was lubricated and then introduced into an endotracheal tube, and the distal end of the stylet was bent to a 90° angle. The room lights were dimmed, and the device was introduced into the oral cavity and advanced until midline illumination was observed in the anterior neck (Fig. 2). The endotracheal tube was advanced until the glow disappeared behind the sternum and the stylet withdrawn from the endotracheal tube.

After removal of the trachlight, proper endotracheal tube placement was confirmed by auscultation of breath sounds on both sides of the chest and end-tidal carbon dioxide monitoring.

The SensaScope must be operated with the dominant hand, the thumb operating the lever which adjusts the angle of the flexible tip. All intubations were performed by the same investigators, who were familiar with both techniques. The assistant draws the tongue anteriorly to facilitate an excellent glottic view. Once the tip of the scope has passed the incisor teeth, the user watches the video-monitor or directly through the eye-piece. Once the distal flexible tip has passed the vocal cords, the SensaScope fiberoptic device was held firmly in position and the endotracheal tube (ETT) is railroaded carefully into the trachea with the left hand until it was seen on the screen to adjust the position under direct visual control. Finally, the SensaScope was removed while holding the ETT firmly in place with the left hand (Fig. 3).

Failure to achieve intubation was defined as inability to intubate after a three attempts by the used device. So, three attempts of intubation, only, were allowed for both techniques. A classic conventional rigid laryngoscopy was introduced as an alternative technique in cases of failure of intubation. The time from intraoperative insertion of the device into the oral cavity until its removal, was recorded as the duration of each intubation attempt. The intubation time was defined as the sum of the durations of all intubation attempts with each technique.

Figure 1 Correct "hockey stick" configuration of the Trachlight™ together with the endotracheal tube prior to intubation.

Figure 2 Intubation procedure by light wand.

Mean arterial pressure (MAP), heart rate (HR), oxygen saturation (SpO_2) and end-tidal CO_2 were recorded at the following times:

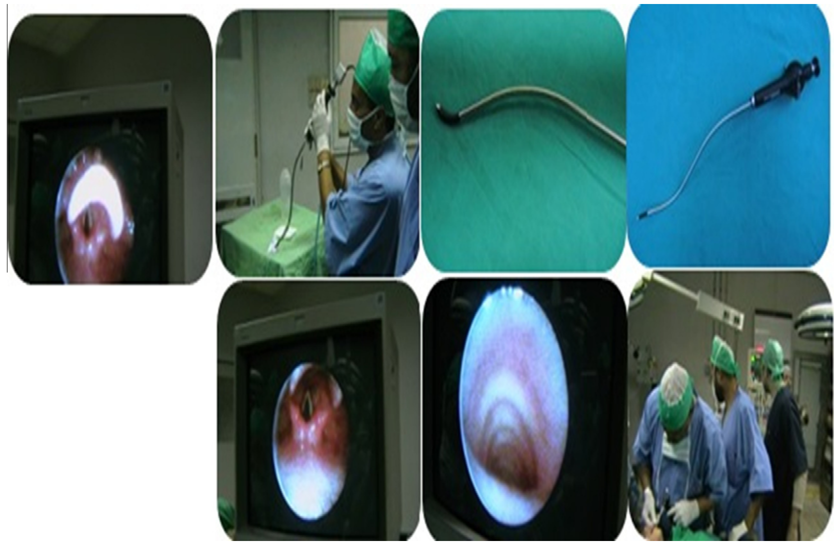

Figure 3 SensaScope intubation technique (video assisted).

(a) Before administration of midazolam or fentanyl (baseline).
(b) Immediately before the insertion of a device into the oral cavity (before intubation).
(c) Immediately after tracheal intubation.
(d) 10 min after successful tracheal intubation.

Baseline MAP and HR values were determined by averaging three independent measurements. Oxygen saturation (SpO_2) was continuously monitored during the intubation procedures to obtain the minimum saturation in each patient (do not allow (SpO_2) drop less than 90% to guard against patient's hypoxia). Changes from "before intubation" to "10 min after tracheal intubation" in MAP, HR, and SpO_2 were recorded.

At the conclusion of surgery and anesthesia, extubation was performed following confirmation of routine extubation criteria. After being transferred to the general ward, all patients were asked about complaints regarding sore throat and hoarseness of voice.

2.1. Statistics

Data are presented as means ± standard deviations (SDs). Statistical comparisons were performed by Chi-Square Test, followed by two sample test of mean. A probability value <0.05 was considered statistically significant.

3. Results

As regards the demographic data, there were no significant differences between the two groups regarding age, weight, and gender (Table 2).

Regarding preoperative airway assessment using Wilson score (Table 1), (the total summation of Wilson Score are 10) there were no significant differences between the two groups (Fig. 4). The duration of the intubation procedures was shorter in the SS groups (64.86 ± 54.166 s) than in the TL group (68.53 ± 50.89 s) but without statistical significance (*P value* 0.849) while no difference between the number of intubation attempts in both groups was observed (Fig. 5). Two patients in the TL group and three in the SS group were failed to be intubated after three attempts of intubation. All failed intubated patients were intubated using conventional laryngoscopy and replaced by new patients to complete the study. Two patients are complaining of hoarseness of voice but, sore throat or oropharyngeal laceration was not recorded as a complication in the SS group. On the other side, a 20% of patients are complaining of hoarseness of voice and sore throat, also, 26.67% of patients were complicated by oropharyngeal laceration in TL group, with statistical difference between the two groups (Table 3).

HR showed transient increase, in both groups, following induction of anesthesia with statistical significant increase in TL group (P 0.025). HR decreased gradually toward the baseline within 10 min after intubation in both groups with statistically significant decrease in the SS group than the TL group ($P \leqslant 0.05$) (Fig. 6).

Mean arterial blood pressure in the TL group showed transient increase after intubation then return to near the base line reading within 10 min, compared to stationary course in the SS group through the interval between baseline and after intubation, then decreased more than the base line reading within 10 min with statistically significant decrease in SS group than TL group ($P < 0.05$) (Fig. 6).

4. Discussion

The difficult tracheal intubation is a major cause of anesthesia-related morbidity and mortality. Successful intubation reported in observational studies as (78–100%) of difficult

Table 2 Demographic data of the two groups.

	TL group (no = 15)	SS group (no = 15)	*P* value
Age	36.67 ± 14.05	30.27 ± 12.27	0.195
Weight	73.13 ± 17.63	69.46 ± 8.82	0.477
Sex (M/F)	3/12	7/8	

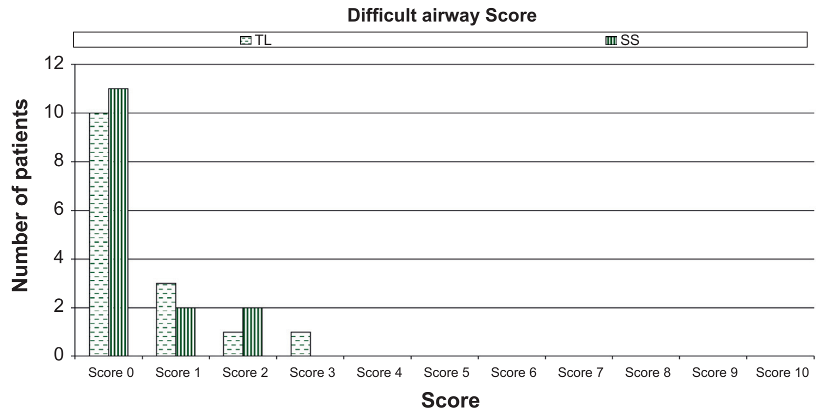

Figure 4 Airway assessment according to Wilson Score.

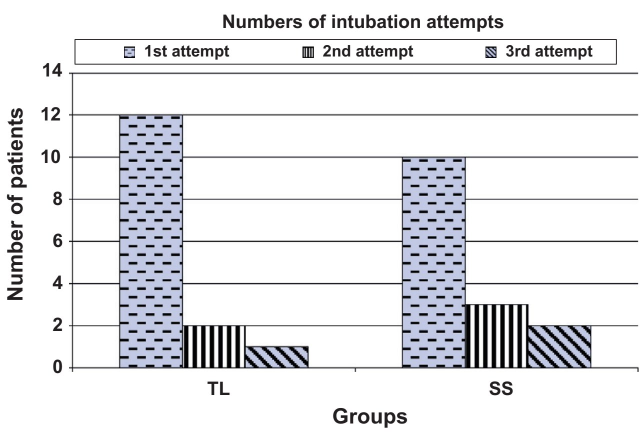

Figure 5 Number of intubation attempts.

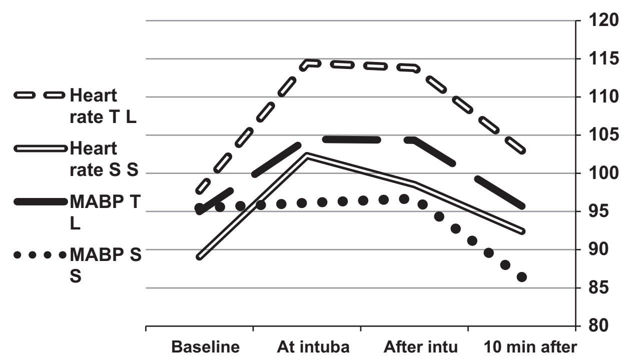

Figure 6 Hemodynamic changes in the two groups.

Table 3 Postoperative complications.

	TL group (no = 15)	SS group (no = 15)	*P* value
Hoarseness of voice	3	2	0.201
Sore throat	3	0	0.040
Oropharyngeal laceration	4	0	0.030

airway patients when intubating stylets were used. Intubating stylet complications include mild mucosal bleeding and sore throat [1]. Lung laceration and gastric perforation were reported complications after the use of a tube-changer or airway exchange catheter [15].

Visual control may facilitate tracheal intubation, so, the rigid video-laryngoscopes are emerging among the devices suggested as alternatives to direct laryngoscopy [3]. In intubation that are anticipated to be difficult, video-laryngoscopes allow for better visualization of the larynx compared with direct laryngoscopy [4]. Most of video-laryngoscopies have a shorter learning curve than the Macintosh blade for inexperienced users [8]. A devices that contain fiberoptic bundles are alternative to blind techniques (stylets and introducers) because they provide a direct view of the airway from a view-point which is not available in standard direct laryngoscopy [9,10]. The current study investigated thirty patients for tracheal intubation using the trachlight device compared to the fiberoptic technique (SensaScope). Biro et al. [2], investigated 32 cases with different degrees of visibility of the glottis with conventional direct laryngoscopy. Recently, confirmation of this assumption has been confirmed by Greif et al. who successfully have used the device in 13 cases of expected or even confirmed difficult airway, while adopting an awake or slightly sedated approach [13].

The most common cause of failure of fiberoptic intubation is a lack of experience under well-controlled conditions because, fiberoptic procedures require a high level of skill in manipulation of the endoscope [12]. The combination of a rigid shaft with a steerable tip in SensaScope provides easy rotating the advancing scope and railroading the endotracheal tube [11].

As with any intubation technique, regular use of and practice with the trachlight make it easy, improve performance and may also reduce the likelihood of complications [16].

The transillumination of the soft tissues of the anterior neck did not appear to be affected by the presence of secretions and blood in the oropharynx following multiple intubating attempts using a laryngoscope [17].

Saha et al. [18] found that the lighted intubating stylet technique has to be significantly faster than the fiberoptic technique for performing tracheal intubation in awake patients. The present study was also found that, the intubation times in the SensaScope group were insignificantly shorter than those in the trachlight group.

Rapidity of intubation may have been one of the main reasons for the increase in MAP after intubation in the SensaScope group. In addition, Hirabayashi et al. [19] reported that, grasping the jaw and lifting it upward by using the thumb and index finger to make a clear passage for the tracheal tube in the trachlight technique produced the same hemodynamic changes as those due to laryngoscopy induced stimulation. In the case of anesthetized and paralyzed patients, fiberoptic intubation requires maintenance of a patent airway during viewing of the vocal cords and passage of a tracheal tube.

The results of the current study indicate that SensaScope tracheal intubation group was associated with insignificant changes in mean arterial blood pressure just after intubation than trachlight intubation group, but, increased significantly in trachlight group as regards the heart rate.

The results showed differences between it and the Kohki et al.'s [20] study that indicated the tracheal intubation using the lightwand device was associated with less hemodynamic changes after intubation than was fiberoptic intubation in normotensive elderly patients, while did not differ significantly in hypertensive elderly patients. Takahashi et al. [21] concluded that, no differences between the lightwand technique and direct vision laryngoscopy in changes in arterial pressure and HR, during and after endotracheal intubation. Also, light-guided intubation using the trachlight is a safe and gentle technique for both oral and nasal ETT placement and positioning. The current study compared a less invasive video-assisted intubating device (SensaScope) with a blind intubating lighted stylet (trachlight), which may discuss the attenuation of in hemodynamics in patients using the SensaScope intubating device.

On the other side, Nishikawa et al. [22] found that the lightwand technique significantly attenuated hemodynamic changes to intubation in comparison with the laryngoscopic technique in normotensive patients; however, in hypertensive patients there were no differences in hemodynamic changes between the two techniques.

Félix et al. [23], concluded that, the lightwand intubation technique in patients with coronary artery disease does not modify the hemodynamic response associated with endotracheal intubation as compared with standard direct vision laryngoscopy.

Other anesthesia-related factors, such as premedication, general anesthetics, and drugs used during induction, are also known to affect the hemodynamic response to tracheal intubation [24–26]. The use of $5\ \mu g\ kg^{-1}$ of fentanyl together with inhalational anesthesia can blunt the cardiovascular responses to intubation [27,28].

The gentleness of the technique is demonstrated by the low incidence of mucosal injury and the absence of dental trauma compared to laryngoscopy [17].

In conclusion, both devices are effective in endotracheal intubation with short time of intubation in SS group. Also, hemodynamic attenuation was observed during endotracheal intubation using the SensaScope device. The postoperative complications were observed more with trachlight device than SensaScope device.

Conflict of interest

None declared.

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