Awake light-aided blind nasal intubation: prototype device

O. Nofal*

Faculty of Medicine, Zagazig University, No. 269, Moallaemin Sector, Bahr Street, Zagazig City, Egypt
*E-mail: onofall@hotmail.com

Background. Limited mouth opening associated with unavailable or ineffective fibreoptic bronchoscope (FOB) is an intubation challenge. A light-aiding device may facilitate the blind nasal intubation.

Methods. Awake blind nasal intubation was planned for 16 elective patients with inaccessible oral route (three children and 13 adults, ASA I–II). Topical anaesthesia for the supraglottis, glottis, and upper trachea was performed using prototype supraglottic topical anaesthesia device and cricothyroid injection of local anaesthesia. Hand-made light-aiding intubation device was used to help blind nasal intubation. Three attempts of blind nasal intubation (60 s each) were allowed, otherwise failure and FOB intubation were considered. During the procedure, heart rate, mean arterial pressure, and arterial oxygen saturation (\(S_{\text{paO}}\)) were measured. Temperature created at the bulb surface of the device was measured for 4 min duration, with and without exposing the bulb to oxygen flow of 6 litre min\(^{-1}\).

Results. All the patients were successfully intubated except one child. Time to intubate in adults was mean (SD) 52.7 (8.6) s. \(S_{\text{paO}}\) showed significant difference between before and after procedural values. The maximum temperature recorded at the bulb surface was 46.8 (0.4)\({}^\circ\text{C}\) and 48.1 (0.8)\({}^\circ\text{C}\) with and without oxygen flow, respectively.

Conclusions. The device appeared to be a safe and cost-effective transillumination method for blind nasal intubation in difficult airways.

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Nasal intubation is required when there is poor mouth opening, the oral route is inaccessible, or when facial fractures involve the mandible or maxilla. Inability to use fibreoptic nasal intubation may not be limited to situations of unavailability (lack of equipment, expertise, or experience) but also when there is bleeding or secretions in the airway. While blind nasal intubation may be appropriate, it requires special skill\(^1\) and has been facilitated by the transillumination method first described in 1959.\(^2\) The objective of this study was to describe the performance of blind nasal intubation facilitated by transillumination using a novel prototype device.

Methods
The present study was performed at Zigzag University Hospital between January 2005 and June 2008. After obtaining Research and Ethics Board approval and informed patients’ (or parental) consent, a limited trial of this prototype device was first performed in patients with anticipated normal airway. The current study was performed with the back-up of different difficult airway management options including fibreoptic intubation and the possibility of performing an emergency tracheostomy.

A hand-made light-aiding intubation device (Fig. 1) was made of a small bulb (12 V, 5 W, Osram, Germany) which was connected to an electrical wire and tightly inserted into a refined cut end of a nasogastric tube (Kawamato Corporation, India) size 12 that measured 115 cm in length. The wire was connected to an electrical adaptor (MOHA ME-300 Multivoltage AC-DC Adaptor, China). The light bulb was transmitted forward and laterally. The flexibility of the light-aiding device is more or less similar to that of the used nasogastric tube. The
nasogastric tube with the bulb fixed at its end was inserted through the suction port of the swivel connector (SIMS Portex Limited, UK) into an endotracheal (ET) tube size 7 mm with the bulb within the ET tube just at its bevelled end. To measure the temperature created at the bulb surface, the temperature probe (Dragger Anesthesia Machine, Primus, Lubeck, Germany) was attached to the top of the bulb and its temperature was recorded every 30 s for 4 min period. The measurements were repeated with flow of oxygen (6 litre min$^{-1}$) passing through the tracheal tube that was connected to the anaesthesia machine. The bulb temperature measurements were repeated four times.

A prototype supraglottic topical anaesthesia (SGTA) device was used to anaesthetize mucosa of the nasal, nasopharyngeal, and oropharyngeal airway (Patency no. 23733, Academy of Scientific Research and Technology, ARST, Egypt). The device (Fig. 2) consisted of a gauze of cotton surrounding a punctured suction catheter (15–17 cm along its distal part in adult cases) with closed distal tip that allows irrigation of local anaesthetic (LA) into the surrounding cotton by injection through the proximal opening of the catheter. The size of the catheter (usually 14–16 G in adult) and the length surrounded by the cotton gauze would be dependent on patient’s age and body build. The lubricated device, after smooth and gradual nasal insertion through the wider nostril till the hypopharynx with the help of two nasal puffs of xylocaine spray at the start of nasal insertion, would ensure intimate contact between soaked cotton with LA lidocaine 1%/epinephrine 1/200 000 mixture and upper airway mucosal surface with capability to re-inject LA if needed to intensify the LA blockade. In, out, and rotator movements of the SGTA device (3–5 min after insertion) without patient discomfort proved the effectiveness of SGTA, otherwise 5 ml of xylocaine/epinephrine mixture would be injected through the catheter of the inserted SGTA device.

Topical anaesthesia for glottis and upper tracheal mucosa was achieved using the classic cricothyroid topical anaesthesia technique with injection of 4–5 ml of xylocaine 2%/epinephrine mixture at the end of deep breath and after positive air, negative blood aspiration test.$^{3,4}$

Sixteen patients, 13 adults and three children (8–11 yr), ASA I–II, were included in the study. The patients had limited or no ability to open the mouth due to locked jaw ($n=7$), intermaxillary fixation ($n=3$), previous faciomaxillary surgery ($n=3$), or recent history of difficult oral intubation ($n=3$).

All patients were undergoing elective surgery; awake blind nasal intubation was planned and explained to the patients (and care givers in paediatric cases) during the preoperative visit.

They were given atropine 20 $\mu$g kg$^{-1}$ i.m. 1 h before surgery. The adults were given morphine 10 mg i.m. 1 h before surgery and the three children were given a sedative dose of ketamine HCl 0.5 mg kg$^{-1}$ i.v. immediately before the procedure.$^{5,6}$

The patient was asked to rest his/her head in a slightly extended position during the procedure to allow maximal visualization of anterior neck of the patient during intubation.$^{7}$ Water-soluble lubricant was applied to the nostril to facilitate entry of the ET tube through the nose after confirming effective SGTA. Through the suction port of a swivel connector, the light-aiding intubation device was inserted into the ET tube to get the bulb just at the bevelled end of the ET tube. The tracheal tube was inserted into the selected anaesthetized nasal cavity and advanced gradually into the nasopharynx and then into the oropharynx as demonstrated by a sudden decrease in resistance to the inserted ET tube.$^{7,8}$ With the bulb in the nasopharynx, the central room light was put off leaving only the peripheral light on to keep the theatre light dimmed. The bulb was switched on, and the ET tube containing the bulb was
advanced gently towards the trachea using the light glow as a guide. Oxygen was administered during the whole time of the procedure by connecting the anesthesia machine circuit to the swivel connector with oxygen supply of 6 litre min\(^{-1}\). Feeling resistance with the glow seen at the lateral side of the neck beside the laryngeal prominence indicated that the light-aided ET unit was directed laterally to the lateral pharyngeal wall (pyriform fossa) and stacked there (Fig. 3). The light-aided ET unit was slightly withdrawn and redirected medially to direct the glow towards the thyroid prominence. The operator manipulated the unit, the larynx, or both externally to get a well-defined glow seen in the middle of the anterior neck passing below the thyroid prominence till the glow began to disappear below the cricothyroid membrane (Fig. 4), ensuring that the tip of the ET tube was in the trachea (and not oesophagus) approximately half way between vocal cords and carina. The position was confirmed by means of inflation and deflation of the reservoir bag with patient respiration, by chest auscultation, and \(T_{\text{CO}_2}\) detection.

A faint glow seen above the thyroid prominence would indicate that the tip of the ET tube was located in the vallecula and to be slightly withdrawn and slowly re-advanced more posterior with the patient’s neck flexed to direct the glow below the thyroid prominence. Three intubation attempts limited to 60 s each (after light bulb on) were allowed for tracheal intubation. If it was impossible to intubate the trachea within these attempts, failure was considered and fibreoptic intubation was performed.

During the procedure, the time to insert the light-aided ET unit endotracheally after switching the bulb on, number of attempts to intubate, success and failure rate, pre- and post-procedural heart rate (HR), mean arterial pressure (MAP), and \(S_p\text{O}_2\) were measured. Nasal bleeding was considered present when blood could be seen collected at the nose. At the end of surgery and after reversal of neuromuscular blocking agents, all patients were extubated awake using the light-aiding device as tube expander if re-intubation was to be required. The data were analysed using paired Student’s t-test considering \(P<0.05\) as significant (Minitab Statistical Software, Minitab Inc., USA).

**Results**

The age and body weight of the adult patients (seven males and six females), time to intubate, pre and post-procedural HR, MAP, and \(S_p\text{O}_2\) are shown in Table 1.

No nasal bleeding had been reported. However, 12 of 16 SGTAs devices were found to be tinged with blood after its extraction from the nose.

Of adults, 11 patients were intubated at the first and two patients at the second attempt; one child was successfully intubated after two attempts and another after three attempts. The third child was intubated using a fibreoptic bronchoscope (FOB) after failure of the allowed three attempts to intubate in spite of getting well-circumscribed anterior neck glow, but from oesophageal placement of the device (Fig. 5). The time required for intubation in the

![Fig 3](image1.png) ET light-aiding unit shows a circumscribed glow at the lateral side of the neck (1) at the level of thyroid prominence (pyriform fossa) that cannot be pushed more against the lateral pharyngeal wall. The arrow 2 points to the cannula used for cricothyroid topical anaesthesia.

![Fig 4](image2.png) ET light-aiding unit had entered the glottic opening, showing a well-circumscribed glow (1) in the anterior neck below the thyroid prominence (2) and begins to disappear below the sternal notch. The arrow 3 points to the cannula used for cricothyroid topical anaesthesia.

**Table 1** The range, mean (so), and confidence interval (CI) of the patients’ data including age, body weight (BW), time to intubate, pre- and post-procedural HR, MAP, and \(S_p\text{O}_2\). *\(P<0.01\)

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two children was 140 and 70 s. None of the patients required re-intubation.

The mean (sd) temperatures generated by the light bulb were 37.4 (0.4)°C and 48.1 (0.8)°C after 30 and 240 s, respectively. The corresponding values were 36.5 (0.5)°C and 46.8 (0.4)°C with the light-aiding device fixed at the tip of the ET tube size 7 mm with oxygen flow of 6 litre min⁻¹ passing through. The recorded temperatures showed strong positive correlation with time (an r value of 0.984 and 0.988, respectively) (Fig. 6).

**Discussion**

The studied cases were either with limited ability (or inability) to open their mouth or recently postponed cases because of failed oral intubation by senior anaesthetist (≥10 yr experience). With unavailable or available but ineffective (presence of upper airway bleeding or secretions) FOB service, awake light-aided blind nasal intubation was considered the most appropriate way to intubate such patients. The author tried to achieve it with the use of a hand-made simple flexible light device.

The highest temperature recorded after 4 min with this hand-made device with O₂ flow (6 litre min⁻¹) passing through the connected anaesthetic circuit was 49°C and 48.1°C as the highest reading and highest mean, respectively, which was less than that reported with the trachlight that reaches 55 (6°C at the first blink (30 s) and 103 (10)°C after 250 s. The higher temperature with trachlight is related to its brighter bulb that can be used with theatre light in contrast to the present device that requires dim theatre lights, representing a potential disadvantage when dealing with patients with thick neck, and critical patients where low ambient light may not be desirable or not easily achieved. For more safety, the bulb was kept inside the tube just within its bevelled end to avoid direct contact with the mucosa while it is illuminated. Also the light was kept off until the tracheal tube was introduced into the pharynx. The actual contact time between the moving bulb and mucosa, even if it was to occur, would still be <4 min, which adds to the safety of its use. The flow of oxygen (6 litre min⁻¹) passing through the ET, in addition to keeping the patient well oxygenated, helps in keeping the light bulb less warm.

The hand-made light-aiding device used in the study to achieve awake nasal intubation was flexible enough to follow easily the curvature of the nasopharyngeal airway without trauma as that reported with other commercial lightwand devices with stiff stylet. Davis and colleagues recommended that the tip of loaded stylet should remain just inside the tracheal tube and to use a rubber stopper to prevent the tube’s riding up the stylet and exposing the potentially damaging rigid stylet tip to oropharyngeal, laryngeal, or tracheal structures. Favaro and colleagues reported nasal bleeding in 4.35% and 5.3% of their patients (two groups) that could be explained by using the trachlight that has a retractable traumatic stiff stylet for nasotracheal intubation in their study in contrast to the flexible device used in the present study with no reported nasal bleeding. Also there have been two case reports of arytenoid dislocation after lightwand use.

The device used in this study is characteristically long enough (116 cm) to be advanced alone into the trachea and then to thread the ET tube over it, avoiding the hang up of the ET tube at the glottis inlet as reported with the flexible wand of the trachlight after retraction of its stiff stylet. Hung and colleagues reported that after retraction of the internal stiff stylet of the trachlight, the tip of the ET tube occasionally seems to get ‘hung up’ and cannot be readily advanced into the tracheal inlet as reported with the flexible wand of the trachlight after retraction of its stiff stylet. The lengthy device used in the present study allows the anaesthetist to use it as tube exchanger as well during extubation for rapid easy re-intubation if needed as recommended in such difficult intubation cases.

Passing through a swivel connector, the hand-made light-aiding device allows the anaesthetist to oxygenate the patient all the time during the procedure, one of the
In the future, being a non-controlled study, a comparative study with one of the available light-aiding devices, for example, trachlight, is warranted for both nasal and oral use. Also, design modification with more light bulb brightness and still limited heat production is required.

In conclusion, the hand-made light-aiding intubation device has proved to be an effective and safe aid for blind nasotracheal intubation in patients with difficult airways. Its use in children may be associated with a false-positive impression of proper tracheal placement, a limitation to be kept in mind.

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