Combitube™ rescue for Cesarean delivery followed by ninth and twelfth cranial nerve dysfunction

[Opération de sauvetage avec un Combitube™ lors d'un accouchement par césarienne suivi d'un dysfonctionnement au niveau des neuvième et douzième nerfs crâniens]

Jorge E. Zamora MD FRCPC, Tarit K. Saha MD

Purpose: The Combitube™ has been shown to be effective in many airway management scenarios. We describe its use as a rescue device in a "cannot intubate cannot ventilate" (CICV) situation that was encountered during a Cesarean delivery (CD) followed by transient cranial nerve dysfunction.

Clinical features: A 24-yr-old gravida 4 para 1 (weight 112 kg, body mass index 44 $kg \cdot m^{-2}$) at 34 weeks gestation, with pregnancy induced hypertension and a prior history of uneventful airway management, presented for urgent CD. She refused regional anesthesia and attempts at awake laryngoscopy and intubation. Following rapid sequence induction, attempts at direct laryngoscopy and intubation failed. Ventilation via facemask and laryngeal mask also failed. A Combitube was inserted and inflated according to manufacturer's instructions and resulted in successful ventilation of the patient. The Combitube was in place for approximately three hours and then removed uneventfully. The following day, the patient presented with signs and symptoms consistent with bilateral glossopharyngeal and unilateral hypoglossal nerve dysfunction. Three months later the patient's nerve dysfunction had completely resolved.

Conclusion: Although this patient's transient nerve dysfunction was most likely due to the Combitube, we believe its inclusion as part of any difficult airway armamentarium should be encouraged. Training in its use should be promoted. It has an important role in emergency airway management and can be effective when other non-surgical ventilation techniques fail. Despite this, clinicians must remain vigilant for complications following its use.

CAN J ANESTH 2008 / 55: 11 / pp 779–784

Objectif *: Il a été démontré que le Combitube™ peut être efficace dans de nombreux contextes de prise en charge des voies aériennes. Nous décrivons ici son utilisation comme appareil de sauvetage dans une situation où l'intubation et la ventilation sont impossibles (« cannot intubate cannot ventilate » - CICV) survenue pendant un accouchement par césarienne (AC) et suivie par un dysfonctionnement temporaire des nerfs crâniens.*

Éléments cliniques *: Une femme de 24 ans (G4, P1) (poids 112 kg, indice de masse corporelle 44 $kg \cdot m^{-2}$) à 34 semaines de grossesse, souffrant d'une hypertension provoquée par la grossesse et n'ayant pas d'antécédents de prise en charge des voies aériennes difficile, s'est présentée pour un AC urgent. Elle a refusé l'anesthésie régionale et les tentatives de laryngoscopie et d'intubation vigiles. À la suite de l'induction en séquence rapide, les tentatives de laryngoscopie et d'intubation ont échoué. La ventilation par masque facial et masque laryngé ont également échoué. Un Combitube a été inséré et gonflé selon les instructions du fabricant, résultant en une ventilation réussie de la patiente. Le Combitube est resté en place durant environ trois heures, puis a été retiré sans complication. Le jour suivant, la patiente a manifesté des signes et des symptômes compatibles avec une atteinte bilatérale des nerfs glossopharyngiens et unilatérale du grand hypoglosse. Trois mois plus tard, l'atteinte nerveuse de la patiente avait complètement disparu.*

Conclusion *: Bien que l'atteinte nerveuse temporaire de la patiente fut très probablement due au Combitube, nous pensons que l'inclusion de cet appareil dans l'arsenal thérapeutique de n'importe quelle prise en charge des voies aériennes difficile devrait être soutenu. La formation quant à son usage devrait être encouragée. Le Combitube joue un rôle important dans la prise en charge d'urgence*

From the Department of Anesthesiology, Queen's University, Kingston, Ontario, Canada.

Address correspondence to: Dr. Jorge E. Zamora, Assistant Professor, Department of Anesthesiology, Queen's University, Kingston, Ontario K7L 2V7, Canada. Phone: 613-549-6666, ext. 3468; Fax: 613-548-1375; E-mail: zamoraj@kgh.kari.net

No funding was received for this case report.

Accepted for publication July 25, 2008.

Revision accepted August 25, 2008.

des voies aériennes et peut être efficace lorsque les autres techniques de ventilation non chirurgicales échouent. Malgré son utilité, les cliniciens doivent demeurer vigilants et attentifs aux complications qui peuvent survenir à la suite de son utilisation.

THE Combitube™ (Tyco-Kendall Healthcare, Mansfield, MA, USA) has been shown to be effective in various airway management scenarios. Its elective use has been described for routine surgery [1] and for Cesarean delivery (CD) under general anesthesia.[2] It has also been shown to be useful as a rescue device for in-hospital airway management when the laryngeal mask airway (LMA) has failed.[3,4] Despite this, it is estimated that only 55% of Canadian hospitals,[5] and only 38% of Irish obstetric units,[6] have a Combitube available. We describe its use as a rescue device in a "cannot intubate cannot ventilate" (CICV) situation that was encountered during a CD followed by transient cranial nerve dysfunction. Written consent for publication was obtained by the patient described herein.

Case description

A 24-yr-old gravida 4 para 1 (weight 112 kg, body mass index 44 $kg \cdot m^{-2}$) at 34 weeks gestation presented for urgent CD for worsening pregnancy induced hypertension. Her medical history was significant for idiopathic intracranial hypertension, which presented as transient visual loss during her previous pregnancy. A lumboperitoneal shunt had been placed at the L3–L4 interspace. Two years previously, she had undergone CD for breech presentation under general anesthesia. A Cormack and Lehane (CL) grade 1 view was recorded at that time.

Airway examination revealed a Mallampati class 4 airway and full dentition. Her thyromental distance, temporomandibular joint mobility, and cervical spine mobility were normal. Despite an extensive explanation of the anesthetic risks, she insisted on general anesthesia for her procedure. She refused attempts at airway topical anesthesia, awake laryngoscopy, and awake intubation.

Given her prior history of uneventful airway management, we decided to proceed with general anesthesia. Emergency airway equipment was prepared and readily available. We proceeded with rapid sequence induction using fentanyl 150 μg, sodium thiopental 400 mg, and succinylcholine 120 mg *iv*. The first attempt at laryngoscopy with a size 3 Macintosh blade resulted in a CL grade 3 view. Her position was optimized, and a second attempt at laryngoscopy with external laryngeal pressure resulted in a CL grade 3 view. Attempted intubation with a size 7.0 styletted endotracheal tube (ETT) was unsuccessful. She was repositioned. Attempts at bag mask ventilation were unsuccessful, as assessed by absence of exhaled carbon dioxide on capnography. A third intubation attempt using a size 4 Macintosh blade with a size 6.5 ETT, a gum elastic bougie, external laryngeal pressure, and adjustment of cricoid pressure (CP) was unsuccessful. Efforts to ventilate the patient using a bag mask, an oropharyngeal airway, and a two handed mask grip, as well as optimizing the patient's position and adjusting CP were unsuccessful. We were unable to ventilate the patient despite insertion of a size 4 LMA and release of CP. Cricoid pressure was reapplied, and the LMA was reinserted. Suspecting laryngospasm, an additional dose of succinylcholine 20 mg *iv* was given, and CP was released. Ventilation attempts via bag mask and LMA were again unsuccessful. The lowest measured oxygen saturation during our attempts to secure the patient's airway was between 65 and 70%.

Using a blind technique, a 37 Fr Combitube SA™ was easily inserted on the first attempt. The cuffs were inflated according to the manufacturer's recommendations using 85 mL and 12 mL of air to inflate the pharyngeal cuff and the distal cuffs, respectively. Esophageal placement of the Combitube tip was confirmed. With the device in place, 100% oxygen, and 5 cm water positive end expiratory pressure, her oxygen saturation increased above 90%. The time lapse between induction of anesthesia and placement of the Combitube was approximately five minutes. Prior to, and during our attempts to secure the patient's airway, her blood pressure was between 180/120 mmHg and 150/105 mmHg, with a transient increase to 200/125 mmHg during our attempts at laryngoscopy. When we were confident that we had an acceptable airway, we allowed the CD to proceed. A female infant was delivered with initial Apgar score 5 improving to 9 after administration of naloxone. During the CD, the patient's blood pressure remained between 150/105 mmHg and 115/65 mmHg with a transient decrease to 90/55 mmHg, which was promptly treated with a bolus of phenylephrine 100 μg *iv*.

During completion of the CD, the otolaryngology service was contacted. With surgical support present and the patient positioned and prepared for emergency cricothyroidotomy, she was allowed to breathe spontaneously and awaken. When she was not exhibiting any respiratory difficulty and following commands, the Combitube cuffs were deflated and the device was removed. The time required for the CD to occur, for

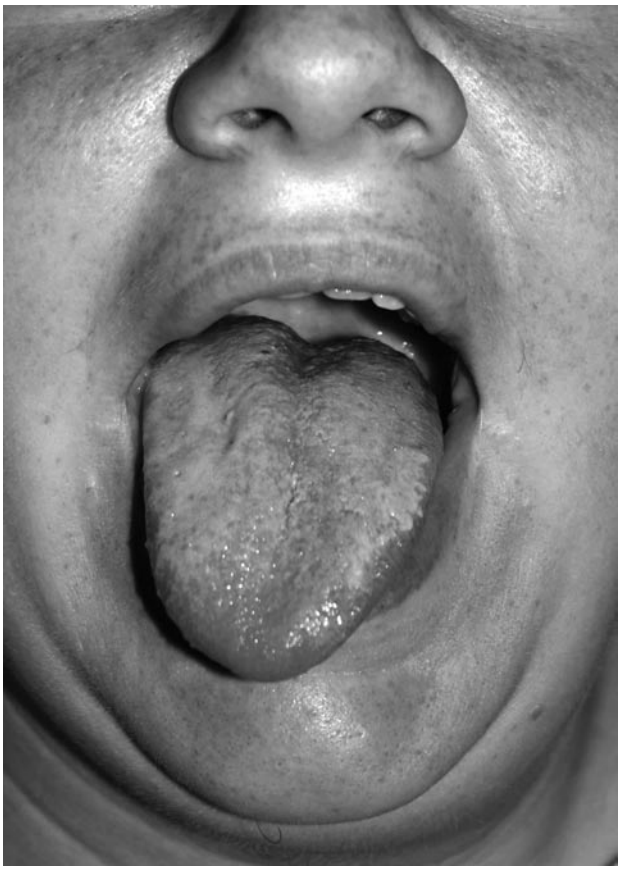

FIGURE 1 Photograph of patient on postoperative day two showing deviation of tongue to right on protrusion.

the mobilization of surgical personnel and resources, and to achieve a deliberate and controlled emergence resulted in the Combitube being in place for approximately three hours.

An in depth review of the patient's medical record was conducted specifically examining her condition at CD two years previously. At that time, physical examination revealed a Mallampati class 2 airway. We discovered that she had gained approximately ten more kilograms with her current pregnancy. Pregnancy induced hypertension was also not a feature of her previous pregnancy.

When the patient was seen the following day, she complained of a sore throat and difficulty swallowing. Her speech was slightly slurred. Examination showed her tongue deviating rightwards on protrusion (Figure 1). Light touch sensation to the posterior third of her tongue was absent bilaterally. There was no evidence of tongue swelling or hematoma. Gag reflex was intact, and uvula was midline during phonation. Computed tomography and magnetic resonance imaging (MRI) scans of her head and neck were unremarkable. She showed no evidence of aspiration pneumonitis, hypoxic encephalopathy, or intraoperative awareness. When she was assessed by a consultant otolaryngologist three months later, her symptoms had resolved and her examination was normal.

Discussion

In a recent survey of anesthesiologists practicing in the United States, 85% of respondents indicated that the LMA was their first choice device in a CICV situation.[7] A similar percentage stated that they were familiar or skilled with the device. Only 43% of respondents were familiar or skilled with the Combitube, and 48% chose it as a second choice device in a CICV situation. Although significantly more anesthesiologists are familiar with the LMA, the Combitube is still an accepted "non-invasive" airway device that must be considered in a CICV situation when the LMA fails.[8,9] The Combitube has been associated with pharyngeal and esophageal morbidity. Although other airway devices have been associated with nerve injury, a unique feature of our case is the transient glossopharyngeal (CN9) and hypoglossal (CN12) nerve dysfunction associated with Combitube use.

After CN9 exits the skull through the jugular foramen, its main trunk travels anteriorly, inferiorly, and deep to the styloid process and the stylopharyngeus muscle. The pharyngeal branch of CN9 leaves the trunk by the time it has passed the stylopharyngeus muscle. It then travels around the lateral border of the stylopharyngeus muscle towards the base of the tongue and divides into its terminal tonsillar and lingual branches deep to the hyoglossus muscle (Figure 2).

CN12 exits from the skull through the hypoglossal canal. It then descends between the internal jugular vein and the internal carotid artery and lies anterior to the vagus nerve. At the angle of the mandible, CN12 becomes superficial and reaches the tongue slightly above the greater cornu of the hyoid bone. CN12 injury following oral intubation and LMA use has previously been reviewed.[10] Most cases of CN12 injury following intubation have been associated with other contributing or causative factors such as insertion of tonsil spatulae, other surgical instruments or throat packs, ETT cuff overinflation, suboptimal head positioning, unintentional extubation with an inflated ETT cuff, or hypotension. Except for the Combitube, no other instruments or devices remained in this patient's pharynx. Her head and neck were maintained in a sniffing position, except for a short period just prior to extubation when her head and neck were in an extended position.

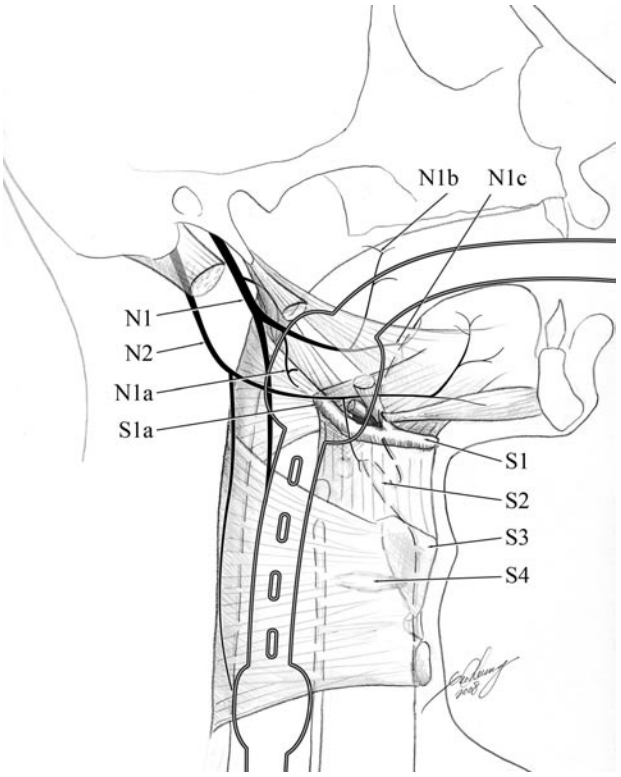

FIGURE 2 Illustration showing the relationship between the pharyngeal cuff of the Combitube and cranial nerves 9 and 12 (Courtesy Mr. Geoffrey Cheung).
N1 Glossopharyngeal nerve (CN 9)
a. Pharyngeal branch
b. Tonsillar branch
c. Lingual branch
N2 Hypoglossal nerve (CN 12)
S1 Hyoid bone
a. Greater cornu of hyoid bone
S2 Epiglottis
S3 Thyroid cartilage
S4 Glottis

Although laryngoscopy and intubation attempts might have caused our patient's CN12 dysfunction, this is unlikely. Where laryngoscopy and intubation were thought to be the primary cause of CN12 dysfunction, patients exhibited evidence of direct trauma to the tongue manifesting as either local swelling or hematoma, or both.[10–12] Three attempts at intubation did occur in this patient, but our patient did not exhibit any local swelling or hematoma. One case of CN12 dysfunction after routine intubation was thought to be secondary to a calcified stylohyoid ligament.[13] Computed tomography and MRI scans of our patient's head and neck revealed no evidence of calcified stylohyoid ligaments or muscles.

The most likely cause for this patient's CN9 and CN12 dysfunction appears to be due to the pressure exerted by the pharyngeal cuff of the Combitube. CN9 dysfunction has been reported following overinflation of a cuffed oropharyngeal airway.[14] The proposed mechanism was excessive pressure exerted on the pharyngeal mucosa. The most likely cause of our patient's signs was the pressure exerted on the pharyngeal mucosa that was transmitted to the lingual branch of CN9. Preservation of the gag reflex, in this case, can be explained by sparing of the pharyngeal and tonsillar branches of CN9. Unilateral CN12 dysfunction has been reported following the use of the LMA.[15–17] It was hypothesized that, as CN12 becomes superficial, it could become compressed between the LMA cuff and the greater cornu of the hyoid bone. Although the LMA was used during this patient's airway management, it was not effective and was in place for less than 60 seconds. The Combitube was in place for approximately three hours.

Pharyngeal mucosal pressures exerted by the LMA and Combitube pharyngeal cuff are similar when recommended inflation volumes are used.[18] At recommended inflation volumes, the Combitube SA pharyngeal cuff exerts direct mucosal pressure exceeding 100 cm H_2O.[19] Brimacombe *et al.*[20] have shown that pharyngeal mucosal paling and complete blood vessel collapse occur in 90% of patients when mucosal surfaces were exposed to pressures of 80 cm H_2O. Perfusion of nerves located in superficial locations could be compromised when pressures exerted by airway devices are transmitted directly via mucosal surfaces. With the Combitube, this might occur even when recommended inflation volumes are used.

Although this patient's transient nerve dysfunction was most likely due to the Combitube, we are not attempting to discourage its use, nor are we recommending that it, or any other airway adjunct, be regarded as a device that will be successful in all CICV situations. The safest way to manage a patient with an anticipated difficult airway is to secure the airway with the patient awake. In some instances, such as the one with which we were presented, this course of action cannot be used or clinicians may encounter unexpected difficulties. When presented with a CICV situation, many clinicians' non-surgical difficult ventilation management plans often end with use of the LMA or one of its variants.[21] In our case, the Combitube's success, relative to the LMA, might have been due to a number of factors. Even under optimal conditions, blind LMA insertion can lead to poor anatomical placement in a significant proportion of patients.[22] This can contribute to device failure. As has been pre-

viously reported, the natural curve and the increased rigidity of the Combitube might have resulted in better positioning compared to the LMA.[4] Features unique to the shape and position of the Combitube pharyngeal cuff might also have resulted in improved displacement of pharyngeal soft tissues, thus achieving enhanced patency of the patient's upper airway. The higher inflation pressures that can be delivered via a Combitube[23] might have helped overcome difficulties encountered in ventilating a morbidly obese parturient.

As previously described, the Combitube is not universally available in many centres or obstetric units. Its availability and our proficiency in its use allowed us to manage our patient's airway and to avoid the potential complications and morbidity associated with establishing an emergency surgical airway. Having a Combitube available allowed us to avert a potentially catastrophic outcome. Although all airway devices have intrinsic failure rates, we believe inclusion of the Combitube as part of any difficult airway armamentarium should be encouraged. Training in its use should be promoted. It has an important role in emergency airway management and can be effective when other non-surgical ventilation techniques fail. Despite this, clinicians must remain vigilant for complications following its use.

References

1 *Gaitini LA, Vaida SJ, Mostafa S, et al.* The Combitube in elective surgery: a report of 200 cases. Anesthesiology 2001; 94: 79–82.

2 *Urtubia RM, Medina JN, Alzamora R, et al.* Combitube for emergency cesarean section under general anesthesia. Case reports. Difficult Airway 2001; 4: 78–83.

3 *Mort TC.* Laryngeal mask airway and bougie intubation failures: the Combitube as a secondary rescue device for in-hospital emergency airway management. Anesth Analg 2006; 103: 1264–6.

4 *Mercer M.* Respiratory failure after tracheal extubation in a patient with halo frame cervical spine immobilization--rescue therapy using the Combitube airway. Br J Anaesth 2001; 86: 886–91.

5 *Jenkins K, Wong DT, Correa R.* Management choices for the difficult airway by anesthesiologists in Canada. Can J Anesth 2002; 49: 850–6.

6 *Niazi A, Cummins E, Walsh K.* Difficult airway equipment in obstetric units in the republic of Ireland: results of a national survey. Eur J Anaesthesiol 2004; 21: 861–3.

7 *Ezri T, Szmuk P, Warters RD, Katz J, Hagberg CA.* Difficult airway management practice patterns among anesthesiologists practicing in the United States: have we made any progress? J Clin Anesth 2003; 15: 418–22.

8. *American Society of Anesthesiologists Task Force on Management of the Difficult Airway.* Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2003; 98: 1269–77.

9 *Crosby ET, Cooper RM, Douglas MJ, et al.* The unanticipated difficult airway with recommendations for management. Can J Anaesth 1998, 45: 757–76.

10 *Dziewas R, Ludemann P.* Hypoglossal nerve palsy as complication of oral intubation, bronchoscopy and use of the laryngeal mask airway. Eur Neurol 2002; 47: 239–43.

11 *Evers K, Eindhoven GB, Wierda JM.* Transient nerve damage following intubation for trans-sphenoidal hypophysectomy. Can J Anesth 1999; 46: 1143–5.

12 *Baumgarten V, Jalinski W, Bohm S, Galle E.* Hypoglossal paralysis after septum correction with intubation anesthesia (German). Anaesthesist 1997; 46: 34–7.

13 *Streppel M, Bachmann G, Stennert E.* Hypoglossal nerve palsy as a complication of transoral intubation for general anesthesia. Anesthesiology 1997; 86: 1007.

14 *Laffon M, Ferrandière M, Mercier C, Fusciardi J.* Transient lingual and glossopharyngeal nerve injury: a complication of cuffed oropharyngeal airway. Anesthesiology 2001; 94: 719–20.

15 *Nagai K, Sakuramoto C, Goto F.* Unilateral hypoglossal nerve paralysis following the use of the laryngeal mask airway. Anaesthesia 1994; 49: 603–4.

16 *King C, Street MK.* Twelfth cranial nerve paralysis following the use of a laryngeal mask airway. Anaesthesia 1994; 49: 786–7.

17 *Trumpelmann P, Cook T.* Unilateral hypoglossal nerve injury following the use of a ProSeal laryngeal mask. Anaesthesia 2005; 60: 101–2.

18 *Ulrich-Pur H, Hrska F, Krafft P, et al.* Comparison of mucosal pressures induced by cuffs of different airway devices. Anesthesiology 2006; 104: 933–8.

19 *Keller C, Brimacombe J, Boehler M, Loeckinger A, Puehringer F.* The influence of cuff volume and anatomic location on pharyngeal, esophageal, and tracheal mucosal pressures with the esophageal tracheal Combitube. Anesthesiology 2002; 96: 1074–7.

20 *Brimacombe J, Keller C, Puhringer F.* Pharyngeal mucosal pressure and perfusion: a fiberoptic evaluation of the posterior pharynx in anesthetized adult patients with a modified cuffed oropharyngeal airway. Anesthesiology 1999; 91: 1661–5.

21 *Keller C, Brimacombe J, Lirk P, Puhringer F.* Failed

obstetric tracheal intubation and postoperative respiratory support with the ProSeal laryngeal mask airway. Anesth Analg 2004; 98: 1467–70.

22 *Campbell RL, Biddle C, Assudmi N, Campbell JR, Hotchkiss M.* Fiberoptic assessment of laryngeal mask airway placement: blind insertion versus direct visual epiglottoscopy. J Oral Maxillofac Surg 2004; 62: 1108–13.

23 *Bein B, Carstensen S, Gleim M, et al.* A comparison of the Proseal laryngeal mask airway, the laryngeal tube S and the oesophageal–tracheal Combitube during routine surgical procedures. Eur J Anaesthesiol 2005; 22: 341–6.