



African Federation for Emergency Medicine
African Journal of Emergency Medicine

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ORIGINAL RESEARCH ARTICLES

The availability of alternative devices for the management of the difficult airway in public emergency centres in the Western Cape



La disponibilité de dispositifs alternatifs pour la gestion des voies respiratoires problématique dans des services des urgences publics dans la province du Cap Occidental

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Received 1 September 2014; revised 29 October 2014; accepted 12 November 2014; available online 7 January 2015

Introduction: The failed or difficult airway is a rare, but life-threatening situation. Alternative airway devices to direct laryngoscopy are essential aids to manage these scenarios successfully. The aim of this study was to determine which alternative airway devices are currently available in public emergency centres in the Western Cape Province, South Africa.

Methods: A cross sectional study was conducted in 15 emergency centres. Data regarding the availability of different classes of alternative airway devices were documented on a standardised data collection sheet by a single investigator via direct observation. Incomplete or non-functional equipment was classified as unavailable. Summary statistics were used to describe the data.

Results: Twenty-six different types of alternative airway devices were documented. Three centres (20%) had no alternative airway device. Five centres (33.3%) stocked only one device, three centres (20%) had two devices and four centres (26.7%) had more than two devices. Most centres ($n = 12$, 80%) stocked supraglottic airways (only one centre (6.7%) had paediatric sizes). Tracheal tube introducers were available in five centres (33.3%). Four centres (26.7%) had video-laryngoscopes, but none had optical laryngoscopes. Retroglottic devices and needle cricothyroidotomy equipment were available in two centres (13.3%). Although surgical cricothyroidotomy equipment was available, the equipment was widely dispersed and only three centres (20%) had pre-packed sets available. None of the specialised paediatric centres had needle cricothyroidotomy equipment readily available.

Discussion: The study demonstrated that Western Cape public emergency centres are currently inadequately stocked with regard to alternative airway devices. A guideline regarding the procurement and implementation of these devices is needed.

Introduction: Les voies respiratoires problématiques ou insuffisances respiratoires constituent une situation rare, mais potentiellement mortelle. Les dispositifs de gestion des voies respiratoires alternatifs destinés à guider les laryngoscopies sont des outils essentiels pour gérer ces scénarios avec succès. L'objectif de cette étude était de déterminer les dispositifs de gestion des voies respiratoires alternatifs actuellement disponibles dans des services des urgences publics dans la province du Cap Occidental, en Afrique du Sud.

Méthodes: Une étude transversale a été réalisée dans 15 services des urgences. Les données relatives à la disponibilité de différentes catégories de dispositifs de gestion des voies respiratoires alternatifs ont été documentées sur une fiche de collecte de données standardisées par un observateur unique, par observation directe. L'équipement incomplet ou qui ne fonctionnait pas a été classé comme non disponible. Des statistiques synthétiques ont été utilisées afin de décrire les données.

Résultats: Vingt-six types de dispositifs de gestion des voies respiratoires différents ont été rapportés. Trois services (20%) ne disposaient pas de dispositif de gestion des voies respiratoires alternatif. Cinq services (33, 3%) ne stockaient qu'un dispositif, trois services (20%) stockaient deux dispositifs et quatre services (26,7%) comptaient plus de deux dispositifs. La plupart des centres ($n = 12$, 80%) étaient dotés de dispositifs supraglottiques (seul un service (6, 7%) disposait de dispositifs en taille pédiatrique). Des aides à l'intubation étaient disponibles dans cinq services (33,3%). Quatre services (26, 7%) étaient dotés de vidéo-laryngoscopes, mais aucun ne disposait de laryngoscopes à fibre optique. Des dispositifs rétroglottiques et des aiguilles de cricothyroïdotomie étaient disponibles dans deux services (13, 3%). Bien que des dispositifs de cricothyroïdotomie chirurgicale étaient disponibles, ceux-ci n'étaient pas disponibles partout, et seuls trois services (20%) disposaient de kits préemballés à disposition. Aucun des services spécialisés en pédiatrie ne disposait de dispositif de cricothyroïdotomie facilement accessible.

Discussion: L'étude a démontré que les services des urgences publics disposaient à l'heure actuelle de stocks inadéquats de dispositifs de gestion des voies aériennes alternatifs. Une directive concernant l'approvisionnement et la mise en service de ces dispositifs est nécessaire.

African relevance

- Managing a threatened airway is stressful without the necessary expertise.
- The availability of alternative ventilation and intubation devices are essential.
- Public Emergency centres often lack adequate alternative airway devices.

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Peer review under responsibility of African Federation for Emergency Medicine.



Introduction

Advanced airway management is indicated when a patient fails to protect his or her own airway. Failure to secure a threatened airway can have devastating consequences, leading to permanent neurological damage or even death. However, managing the threatened airway is not always a straightforward procedure and many factors come into play.

About 4% of patients will not be amenable to timely intubation via direct laryngoscopy due to the presence of a difficult airway, whilst 0.3% will have a failed airway.¹ Although a universal definition of the difficult airway is not used in published literature, it has been defined by the American Society of Anesthesiologists (ASA) as ‘the clinical situation in which a conventionally trained anaesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both’.² The concept of the failed airway is also included here and is defined by the ASA as the failure of endotracheal tube placement after multiple attempts.² In these situations, alternative devices to the endotracheal tube and laryngoscope to achieve intubation, as well as equipment other than the bag-valve-mask to ventilate the patient, become paramount in an attempt to avoid the dreaded ‘cannot ventilate, cannot intubate’ situation. A vast number of alternative devices, many in a plethora of subtly altered incarnations, are currently available. They act as facilitators of direct laryngoscopy, either as alternative ventilation devices or alternative intubation devices.

The NAP4 project, a prospective study that evaluated all major airway events that transpired in United Kingdom hospitals over a one year period, highlighted the concept that successful airway management in the emergency centre (EC) called for adequate training of staff (‘the right person’), an environment conducive to successful intubation (‘the right place’), adequate preparation as well as the right equipment.³ This equipment, including alternative airway equipment, should preferentially be standardised across a hospital, with a list of minimum equipment to be available in the EC to be standardised at a national level.³ In South Africa, the Emergency Medicine Society of South Africa (EMSSA) offers guidance to the management of the difficult airway through their published guidelines on rapid sequence intubation.⁴ According to these guidelines at least one alternative device for ventilation (Laryngeal Mask Airway (LMA) or Laryngeal Tube) should be available as a rescue airway device. Furthermore, equipment to establish a surgical airway (cricothyroidotomy set or percutaneous tracheostomy set) as definitive alternative intubation technique is mandatory equipment. Other alternative intubation techniques (video laryngoscopy, fibre-optic laryngoscopy, intubating LMAs and lighted stylets) are advocated if they are suited for the clinical scenario and if the expertise is available. The availability of such devices in a South African setting has not yet been studied. It is only through the establishment of the *status quo* that a potential shortage of alternative devices to aid in the management of the difficult airway can be illuminated. The need for intervention can subsequently be assessed and suitable recommendations can be made. This study aimed to determine the availability of alternative airway devices in public ECs in the Western Cape, South Africa.

Methods

A cross-sectional study was completed over a 12-day period (19 June to 30 June 2013). This study was approved by the Stellenbosch University Health Research Ethics Committee (S12/08/233).

The Western Cape Province covers an area of 129,370 km² and is home to approximately 5.3 million people; 78% relying on state health services.⁵ The City of Cape Town houses the biggest proportion of these inhabitants with an approximate citizenship of 3.5 million people.⁵ Health services in the public domain are provided by the Western Cape Provincial Department of Health and include 41 provincially aided or district hospitals, 5 regional hospitals and 3 tertiary hospitals.⁶ The tertiary hospitals (Groote Schuur Hospital, Tygerberg Hospital and Red Cross War Memorial Children’s Hospital) offer general as well as highly specialised services, the regional hospitals render services at a general specialist level, whilst the district hospitals function as specialist supported entities.⁵ Fifteen ECs in 11 hospitals in the Western Cape Province were sampled. The study included all three tertiary hospitals, four regional hospitals and four district hospitals (Table 1). One regional hospital (Mowbray Maternity Hospital) was excluded as it is a specialised Maternity and Neonatal hospital and does not have a general EC. The four district hospitals were included as these centres evaluate a high percentage of relatively ill patients and subsequently perform more endotracheal intubations compared to smaller district hospitals. Khayelitsha District Hospital, as well as Mitchell’s Plain District Hospital, opened after the study was commenced and were not included. The tertiary hospitals have separate ECs handling paediatric, surgical and medical emergencies. One of the tertiary hospitals (Red Cross War Memorial Children’s Hospital) is a paediatrics only facility, with separate medical and surgical ECs. The centres were all analysed individually.

A single data collector with knowledge regarding alternative airway devices collected all the data on a standardised data collection sheet (web appendix). Devices were categorised into: (1) Adjuncts to difficult intubation; (2) Alternative ventilation equipment; and (3) Alternative intubation equipment. Equipment that was not in a working condition or had missing parts was categorised as ‘unavailable’. Equipment that was used inappropriately, for example disposable tracheal tube introducers that were reused, were also classified as ‘unavailable’. Data were transferred to a password protected electronic spreadsheet (Microsoft Excel®, Microsoft Corporation, Redmond, WA).

Data were analysed using Microsoft Excel® (Microsoft Corporation, Redmond, WA) and summary statistics are presented.

Results

Twenty-six different types of alternative airway devices were documented. Five ECs (19.2%) had one type of alternative airway device available, seven (26.9%) stocked at least two devices, whilst four ECs (26.7%) had more than two devices available. Three centres (20%), all situated in tertiary hospitals, had no alternative airway device available, whilst the best stocked EC (a regional hospital) had five different types of

Table 1 Study hospitals.

Hospital	Location	Hospital level
Groote Schuur Hospital	Observatory, Cape town	Tertiary
Red Cross War Memorial Children's Hospital	Rondebosch, Cape Town	Tertiary
Tygerberg Hospital	Bellville, Cape Town	Tertiary
George Hospital	George, Eden	Regional
Paarl Hospital	Paarl, Winelands	Regional
New Somerset Hospital	Green Point, Cape Town	Regional
Worcester Hospital	Worcester, Breede Valley	Regional
G.F. Jooste Hospital	Manenberg, Cape Town	District
Helderberg Hospital	Somerset West, Overberg	District
Karl Bremer Hospital	Bellville, Cape Town	District
Victoria Hospital	Wynberg, Cape Town	District

devices. The availability of the different types of alternative airway devices is depicted in Table 2.

Tracheal tube introducers were available in 33% ($n = 5$) of the studied ECs. District hospitals had the highest percentage (75%, $n = 3$); whilst two of the tertiary hospitals' units did have introducers, they were of the disposable type and not meant for reuse. Eighty percent ($n = 12$) had at least one alternative ventilation device. Twenty percent of the centres ($n = 3$) had a second or third alternative ventilation device available. Supraglottic airways were the most frequently available device (80%, $n = 12$). Paediatric supraglottic airways were only available in one of the dedicated paediatric units (6.67%). Retroglottic airways and needle cricothyroidotomy equipment were rare (both 13%, $n = 2$). Needle cricothyroidotomy equipment was not available in any of the dedicated paediatric units.

Alternative intubation devices (not taking surgical airways into account), were available in 27% ($n = 4$) of the ECs and 13.3% ($n = 2$) had a second device available. Video laryngoscopes were most frequently available (overall 27%, $n = 4$; regional hospitals 75%, $n = 3$; tertiary hospitals 14%, $n = 1$). Intubating LMAs were available in 13% ($n = 2$) of the centres; both in regional hospitals. Lighted stylets/wands and fibre-optic endoscopic aids were not found in any of the centres. Complete surgical cricothyroidotomy sets were

available in 20%, ($n = 3$) of ECs. Two of these were regional hospitals and the other was accessible in a district hospital. No complete sets were readily available in tertiary hospitals.

Discussion

The study indicated that the majority of the bigger ECs in the Western Cape had at least one alternative form of equipment available to manage a difficult airway. This is similar to a previous international study where 89% of the ECs held some form of alternative airway equipment.⁷ However, effective management of a difficult airway dictates that alternative modes for ventilation as well as intubation should be readily available. It is thus of vital importance to assess the availability of aids to intubation, alternative ventilation devices and alternative intubation devices separately.

Aids to intubation

Tracheal tube introducers (also commonly referred to as "bougies" or gum elastic bougies) were not found in large numbers (33%). This stands in stark comparison to tracheal tube introducers being available in 99% of English ECs studied earlier.⁸

Table 2 The availability of alternative airway devices in Western Cape emergency centres.

	All (n , %)	Tertiary hospitals* (n , %)	Regional hospitals† (n , %)	District hospitals‡ (n , %)
<i>Adjuncts to difficult intubation</i>				
Tracheal Tube Introducers	5 (33%)	0 (0%)	2 (50%)	3 (75%)
<i>Alternative ventilation devices</i>				
Supraglottic airways	12 (80%)	5 (71.4%)	3 (75%)	4 (100%)
Retroglottic airways	2 (13%)	0 (0%)	1 (25%)	1 (25%)
Needle cricothyroidotomy equipment§	2 (13%)	0 (0%)	2 (50%)	0 (0%)
<i>Alternative intubation devices</i>				
Video laryngoscope	4 (27%)	1 (14.2%)	3 (75%)	0 (0%)
Surgical cricothyroidotomy equipment§	3 (20%)	0 (0%)	2 (50%)	1 (25%)
Intubating LMA	2 (13%)	0 (0%)	2 (50%)	0 (0%)
Optical laryngoscopy	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lighted stylets/wands	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Fibre-optic endoscopic aids	0 (0%)	0 (0%)	0 (0%)	0 (0%)

* $N = 7$.

† $N = 4$.

‡ $N = 4$.

§ Only complete, pre-assembled sets included.

Directly comparing styletted endotracheal tubes to assisted intubation with tracheal tube introducers, the latter has been shown to have significantly higher success rates (94% vs. 77%).¹⁰ In EMSSA's rapid sequence intubation guidelines, tracheal tube introducers play a critical role - not only is its use indicated during a second attempt, but emphasis is also placed on it being an optional adjunct during the first attempt at intubation.⁴ This recommendation is echoed by the South African Society of Anaesthesiologists through their official guidelines on airway management resources in operating theatres.⁹ Their recommendation is that tracheal tube introducers form part of the standard equipment for endotracheal intubation.⁹

Alternative ventilation devices

Supraglottic airways (e.g. LMAs) have a substantial body of evidence to back their use in the EC. They form an integral part of the difficult airway management protocols proposed by the recently updated ASA guidelines for difficult airway management as well as the local EMSSA guideline.^{2,4} Furthermore it is specifically advocated by the South African Society of Anaesthesiologists that LMAs form part of an emergency airway kit that should be available in all health care facilities, whether intubations are routinely performed or not.³ Using the LMA as back-up device, successful ventilation can be achieved in up to 94% of patients.⁹ The relatively high availability of LMAs (80%) is thus reassuring. Of concern is that paediatric-sized supraglottic airways were only found in one of the dedicated paediatric ECs, whilst eight of the sampled ECs treat paediatric emergency cases (two centres being exclusive specialist paediatric ECs). Failed intubation via direct laryngoscopy and failed face-mask ventilation are very rare in the paediatric population (0.42% and <0.02%, respectively).¹¹ However, failure of both is a devastating situation that has been addressed by the Difficult Airway Society in their management of the difficult paediatric airway guidelines, in which they advocate for the use of LMAs as rescue device if oxygenation via bag-valve mask ventilation fails.¹¹

Retroglottic airways (e.g. the oesophageal-tracheal combitube) are alternatives to supraglottic airways. The retroglottic airway devices available in the study sample included the Laryngeal Tube (VBM Medizintechnik, Sulz, Germany) and the Rüschi Easytube (Teleflex Medical (Reusch), Kernen, Germany.) The Laryngeal Tube is a single lumen device whilst the Rüschi Easytube has a double lumen, similar to the oesophageal-tracheal combitube (Tyco-Healthcare-Nellcor, Pleasanton, California). Although a number of cases have been reported of these devices being successfully used in the management of the difficult airway and in the emergency situation, in-depth studies are lacking and their definite role in emergency intubation has not been clarified.^{12,13} Wide implementation of its use cannot be advocated at this moment.

Percutaneous Transtracheal Jet Ventilation (PTJV) is the preferred mode of surgical airway rescue in the paediatric population.¹¹ It is thus of grave concern that needle cricothyroidotomy equipment was not freely available in the specialist paediatric units. Needle cricothyroidotomy sets were available in only two ECs, both as self-assembled kits. Although most of the needed equipment is freely available in most ECs, the assembly of kits should be done in advance. The last thing a

physician needs is to waste precious time in the event of an emergency.

Alternative intubation devices

Alternative intubation devices are generally advised on a case-by-case basis and familiarity with its use.⁴ Four of the studied centres had video laryngoscopes available, mostly in centres run by emergency physicians. During EC usage, the superiority that the video laryngoscopy has over direct laryngoscopy for first attempt success rate (68 vs. 78%, $p = 0.007$), as well as overall success rate (97.3% vs. 84.4%), has been shown.^{14,15} Video laryngoscopy is also advantageous in the management of the difficult airway with better laryngeal views obtained more often (93% vs. 80%).^{14,15} Due to the devices having an external display they also have the added benefit of a teaching aid. Compared to other alternative devices, video laryngoscopy is still relatively new and expensive. However, it is mentioned in the ASA guidelines as an alternative device for intubation, but advocating for more wide-spread use and implementation of the device would not be prudent. It might play a bigger part in the near future.

The EMSSA as well as the ASA guidelines both mandate the use of surgical cricothyroidotomy as the last option in the case of a failed airway; it is also found on EMSSA's mandatory equipment list.^{2,4} The South African Society of Anaesthesiologists also specifically calls for the inclusion of cricothyroidotomy equipment in an emergency airway kit.⁹ Despite this, only 20% of the ECs had formal surgical airway kits available. This situation is worrying, as a surgical airway might be the only option left in some circumstances.

Limitations

The study only evaluated ECs in the Western Cape, therefore the findings might not be generalizable to the rest of South Africa or other countries. The study only included relatively large ECs and the findings can thus not be taken as to represent smaller centres that might also have equipment needs. The exclusion of the Khayelitsha District Hospital and the Mitchell's Plain District Hospital is unfortunate, as the inclusion of their ECs could have served to paint a clearer picture of the current situation. Being new units one could expect that newer trends in equipment acquisition could have been followed and a better-equipped centre might have ensued. The study only assessed the availability of devices and did not address the clinical utilisation of these devices; the actual practical skills and knowledge that health care workers need to use the alternative airway devices would have to be assessed in future studies.

Conclusion

Airway management is a vital component in the care of the critically ill patient, but at the time of the study the included ECs did not have all the devices available to aid in the optimal management of the difficult/failed airway. Such a situation can lead to unnecessary morbidity and mortality and should be addressed as soon as possible. We recommend that guidelines should be implemented that include tracheal tube introducers

as aid to intubation as well as supraglottic airways as rescue ventilation devices. Pre-prepared surgical airway equipment sets as definitive alternative intubation route should be available in all centres where adult airway emergencies could arise. Other alternative methods of intubation should be available where the necessary expertise to utilise them is available. In ECs managing paediatric patients it is paramount that needle cricothyroidotomy sets as well as paediatric supraglottic airways should be available.

Conflict of interest

This work was supported by a research grant from the Harry Crossley Foundation. DJvH serves on the African Journal of Emergency Medicine's editorial board. He was in no way involved in the peer review process of this paper or the subsequent decision to publish the work. The authors declare no other conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.afjem.2014.11.001>.

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