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Indications and results of emergency surgical airways performed by a physician-staffed helicopter emergency service

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ABSTRACT

Background: Airway management is essential in critically ill or injured patients. In a "can't intubate, can't oxygenate" scenario, an emergency surgical airway (ESA), similar to a cricothyroidotomy, is the final step in airway management. This procedure is infrequently performed in the prehospital or clinical setting. The incidence of ESA may differ between physician- and non-physician-staffed emergency medical services (EMS). We examined the indications and results of ESA procedures among our physician-staffed EMS compared with non-physician-staffed services.
Methods: Data for all forms of airway management were obtained from our EMS providers and analyzed and compared with data from non-physician-staffed EMS found in the literature.
Results: Among 1871 patients requiring a secured airway, the incidence of a surgical airway was 1.6% ($n = 30$). Fourteen patients received a primary ESA. In 16 patients, a secondary ESA was required after failed endotracheal intubation. The total prehospital ESA tracheal access success rate was 96.7%.
Conclusion: The incidence of ESA in our patient population was low compared with those reported in the literature from non-physician-staffed EMS. Advanced intubation skills might be a contributing factor, thus reducing the number of ESAs required.

Background

In the Netherlands, four Helicopter Emergency Medical Services (HEMS) function as an adjunct to paramedical ambulance services. A Dutch HEMS team consists of a pilot, a flight nurse and a HEMS physician. This team is capable of delivering hospital-level medical care at a senior level (all HEMS physicians are consultants), including damage control resuscitation, general anaesthesia, advanced airway management and surgical interventions (amputations, thoracostomies, post-mortem caesarean sections), in the field.

HEMS are available 24/7 nationwide for acute critically ill or injured patients according to dispatch guidelines [1]. Similar to prehospital care systems in several European countries, our HEMS are physician staffed (pHEMS). These physicians are experienced trauma surgeons or anesthesiologists who are trained in emergency surgical procedures. Nijmegen pHEMS operate in a generally rural area in the south and eastern regions of the country on a 24/7 basis, serving approximately 4.5 million inhabitants. Regional ambulance services are dispatched according to uniform guidelines and work accordingly.

In airway management, adequate oxygenation and ventilation are essential to prevent poor outcome and death in trauma and cardiac arrest patients [2–4]. In a "can't intubate, can't oxygenate" (CICO) scenario, an emergency surgical airway (ESA) is the final step in difficult airway management [5]. An ESA is a potentially lifesaving procedure infrequently performed in prehospital or clinical settings. Dutch ambulance nurses are precluded from performing surgical airway procedures. In a CICO scenario, a percutaneous needle cricothyroidotomy is the last resort for airway management. Because of the small size of the patient groups, no statistically significant difference exists in the literature in favour of one specific emergency cricothyroidotomy method

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(needle or open) [6]. Dutch ambulance nurses are not legally allowed to use drugs to facilitate intubation. Therefore, all patients intubated by the ambulance service prior to HEMS arrival are intubated without sedatives or muscle relaxing drugs. Internationally, the incidence of prehospital emergency tracheal airways is as high as 10.9% [7]. Several factors influence this rate, including staff experience and training, confidence and proficiency in skills, the recognition of a possible difficult airway, the anticipation of airway-related complications and the clinical setting.

The incidence, indications and results of ESA performed by our pHEMS were studied. We hypothesized that the threshold for performing ESA by a pHEMS is lower compared with that for non-physician EMS. As a consequence, the incidence of ESAs performed by pHEMS is potentially increased. Our data were compared with international data from paramedic-staffed prehospital emergency services certified to perform invasive procedures.

Patients and methods

We studied the dispatch database from the Radboud University Medical Center, the Netherlands. Indications for airway management and vital parameters before and after treatment were noted.

After the endotracheal intubation (ETI) tube position was verified by capnography, thoracic movement and auscultation of breath sounds were assessed. All ESA were performed using the open surgical technique with a scalpel and an endotracheal tube.

All dispatches between January 2007 and December 2013 were analyzed. The cases of adults and children who underwent ESA by pHEMS were reviewed. The incidence and success rate of endotracheal intubations and ESA as well as survival in the first hours after the intervention were assessed.

Data were collected prospectively in the cohort database and retrospectively analyzed using SPSS (IBM, SPSS version 20).

Results

In the period from January 2007 to December 2013, a total of 1871 patients required a secured airway. This group consisted of 1382 (73.9%) males and 489 (26.1%) females between the ages of 0 and 93.1 years (median 37.5). Of all the patients requiring a secure airway, 493 received an endotracheal tube by ambulance nurses prior to pHEMS arrival. In 42 cases (8.5%), these tubes were repositioned by pHEMS because of esophageal intubation. The total number of pHEMS intubation patients in this study group was 1406.

The overall HEMS ETI success rate was 98.4%, and the overall median number of intubation attempts was 1, including ambulance attempts when applicable (range 1–6). Additional information regarding the first intubation success ratio of our pHEMS was presented in a separate article [8].

In seven cases, ETI was not successful, and no surgical airway was attempted or created. Alternative (non-surgical) airway methods were performed in four patients, including bag-valve mask ventilation ($n = 2$) and supraglottic airway device (SAD) ($n = 2$; 1 laryngeal mask, 1 laryngeal tube). In three cases, treatment was discontinued due to non-survivable injuries before a secured airway was obtained (Fig. 1).

A total of 30 ESAs were performed (28 cricothyroidotomies and 2 tracheotomies) in 24 males (80%) and 6 females (20%). The median age of these patients was 43.6 years (0.8–79.4). Nineteen ESAs (63%) were performed by HEMS physicians with an anesthesiological background, and the other 11 were performed by a surgeon on HEMS duty. Approximately 70% of the HEMS shifts were staffed by anesthesiologists.

Fourteen patients received a primary ESA without a prior pHEMS endotracheal intubation attempt (0.7%). These patients had

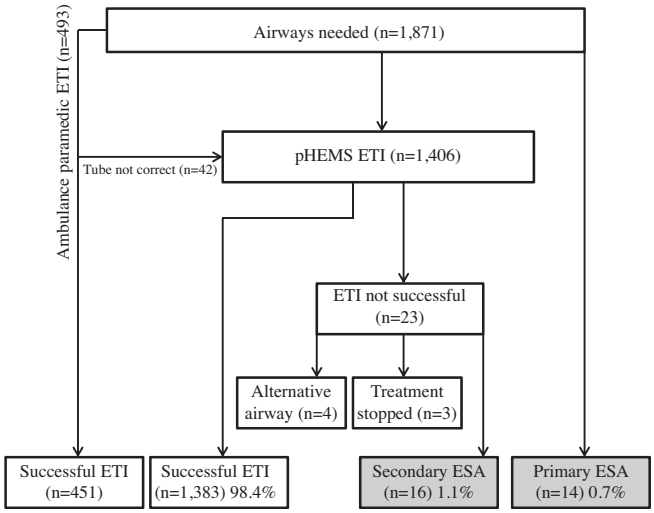

Fig. 1. Prehospital airways and management.

perforating airway lesions, extensive facial damage or upper airway swelling/obstruction. In those cases, the HEMS physician determined that an ETI was not possible. Another 16 patients received an ESA after failed ETI, representing 1.1% of pHEMS intubations (secondary ESA). The indications for ESA are listed in Table 1.

Three patients could not be ventilated after an ESA was created. The first patient was an 8-month-old infant with circulatory arrest, and no access to the airway could be created after tracheotomy due to an obstructing airway tumour. The second patient was a blunt trauma patient who could not be ventilated through ESA because of a proximal leakage of air after cuff insufflation. No return of spontaneous circulation was observed after bilateral thoracostomy. This patient was suspected to have a tracheal rupture without ventilation options, and treatment was ceased. The third patient was an elderly patient with an airway obstruction distal to the incision because of ingested food, making ventilation impossible. In summary, in these last two cases, the upper airway was accessible and an ESA was created, but ventilation was not possible.

Twenty-eight cricothyroidotomies and two tracheotomies were performed. Tracheotomies were performed in the 8-month-old child described above and an adult patient with a traumatic tracheal lesion facilitating tube insertion due to a knife cut.

In 14 patients, an ESA was created while cardiopulmonary resuscitation (CPR) was performed at HEMS arrival. Only one of these patients regained spontaneous circulation after cricothyroidotomy and ventilation; the others died at the scene.

In our total group of 30 ESAs, six patients survived hospital admission (20%). All survivors displayed spontaneous circulation prior to intervention. Eight patients died in the emergency department or intensive care unit, all after discontinuation of treatment due to extensive non-airway-related injuries.

Table 1
Indications for emergency surgical airway.

Indication	Number of patients	Percentage
Facial trauma	17	56.7%
Upper airway obstruction	6	20.0%
Facial/airway burns	2	6.7%
Carcinoma obstruction	1	3.3%
Penetrating airway trauma	4	13.3%
Total	30	100%