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CASE REPORT

The King laryngeal tube: a mimic of esophageal intubation in the emergency department

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Abstract The King Airway is a temporary airway device used primarily in the pre-hospital setting and typically exchanged for an endotracheal tube upon arrival to the emergency department. Since this usually occurs before imaging, many radiologists are unfamiliar with the King Airway. This lack of familiarity can have important consequences for the patient and treating team. The purpose of this article is to raise awareness of the King Airway among radiologists, emphasize appropriate positioning, and review the imaging complications of incorrect positioning.

Keywords King laryngeal tube · Alternative airway devices · Emergency intubation

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Introduction

First described in 2000 [1] and approved for use in 2003, the King laryngeal tube (LT) and the modified version King LTS™ (King Systems, Noblesville, IN) are temporary airway devices that have been shown to be quicker and easier to insert than an endotracheal tube [2–5]. Mainly used in the pre-hospital setting, they allow paramedics to safely and efficiently secure an airway before emergency department (ED) personnel can establish a definitive airway.

Since this airway device exchange typically occurs prior to imaging, many radiologists have never seen a King Airway—or the similar Combitube™ (Mallinckrodt-Covidien; Boulder, CO)—and are unaware of its expected positioning. Unlike an endotracheal tube whose tip is designed to be in the lower trachea, the tip of a King Airway is intended for the upper esophagus. This may result in a radiologist mistaking a correctly positioned King Airway for the potentially devastating complication of a malpositioned endotracheal tube in the esophagus. The subsequent urgent phone call based on this assumption may distract the emergency team by unnecessarily increasing its cognitive load during the critical early moments of care.

The purpose of this case report is to raise awareness of the King Airway among radiologists, emphasize appropriate positioning, and review the complications of incorrect positioning.

Case

A 51 year-old man with unknown medical history was unresponsive in the field following a witnessed fall. Upon arrival of emergency medical services, he was found to be in cardiac arrest with pulseless electrical activity. Spontaneous

circulation returned during advanced cardiopulmonary life support; however, the patient again became pulseless shortly after. A King LTS was inserted during transport, and spontaneous circulation was again achieved by arrival at the ED.

An immediate portable chest radiograph demonstrated right upper lobe collapse and a distended stomach. A CT scan of the head then showed diffuse bilateral subarachnoid and intraventricular hemorrhage, presumed due to intracranial aneurysm rupture. A cervical spine CT scan was negative for trauma but showed the King LTS kinked in the esophagus.

Following these imaging examinations, the King LTS was exchanged for an endotracheal tube and the patient was stabilized. A repeat chest radiograph showed re-aeration of the right upper lobe without gastric distention. The patient remained unresponsive to all stimuli with absent reflexes, and brain death was declared the following day. As part of organ-transplant evaluation, a chest CT scan was obtained and showed multifocal ground-glass opacities and a right upper lobe consolidation.

Discussion

The King Airway is a blind intubation system intended for placement in the upper esophagus. The Combitube is a similar apparatus that is permitted to enter the trachea or esophagus but usually enters the esophagus. During placement, the King Airway is advanced until it meets resistance in the esophagus. The two cuffs are then inflated—the more proximal oropharyngeal cuff stabilizes the tube and seals the oropharynx, and the more distal esophageal cuff prevents gastric insufflation. The tube is then pulled back slightly to push the epiglottis upward and away from the trachea. The esophageal cuff also blocks aspiration of gastric contents into the airway. A ventilation orifice between the two cuffs faces the glottis and directs air towards the trachea (Fig. 1). To prevent the ventilation orifice from extending past the glottis and the oropharyngeal cuff from obstructing the trachea, the cuff should sit above the hyoid bone [6].

When a King Airway is identified on CT, the radiologist should ensure that the cuffs are inflated in the appropriate positions and that the epiglottis and oropharyngeal cuff do not block airflow to the trachea. While the King LT and endotracheal tube are both single lumen tubes with similar CT appearances, a specialized King LTS has a second lumen. In this model, the dorsal lumen is designed for gastric tube placement, and the ventral lumen is for ventilation (Fig. 2). The second lumen is an important feature distinguishing the King LTS and Combitube intended for the esophagus from an endotracheal tube intended for the trachea.

In the presented case, although the King LTS was appropriately placed into the esophagus, it was kinked distally. As a result, the esophageal cuff could not provide a seal, and gastric

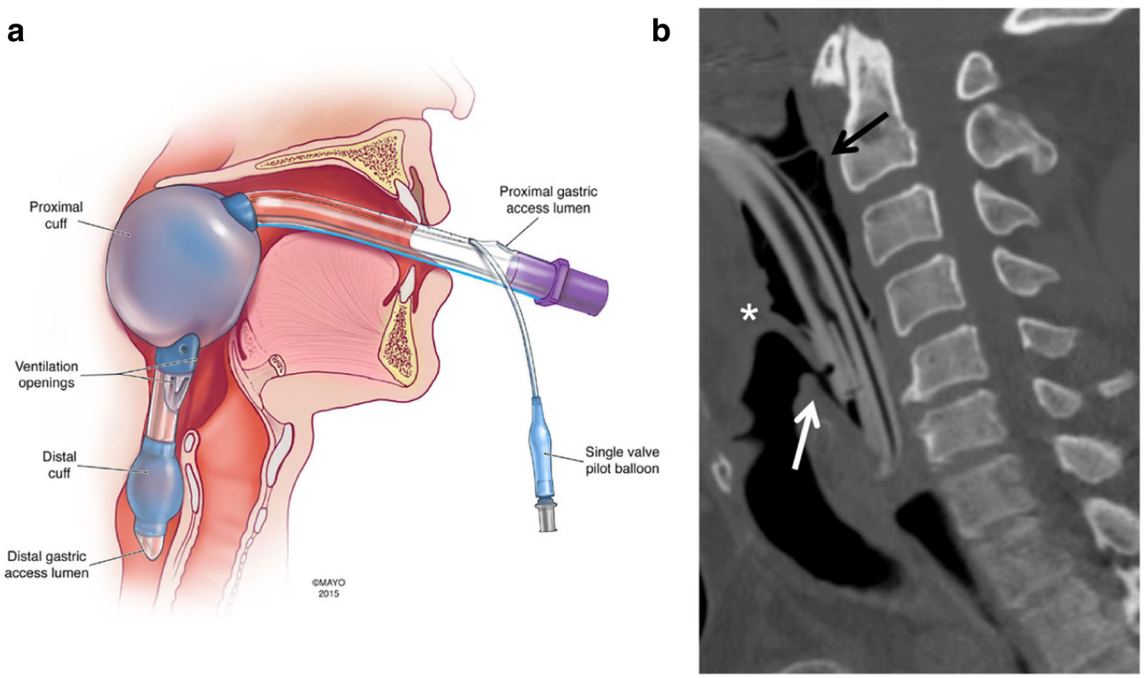

Fig. 1 Illustration (**a**) and sagittal CT image (**b**) of a King LTS. The proximal cuff is inflated in the oropharynx above the hyoid bone (*black arrow*), and the distal cuff is inflated in the esophagus. The ventilation orifice (*white arrow*) between the cuffs is directed towards the trachea. In **b**, the epiglottis is displaced downwards and partially covers the trachea (*star*), preventing adequate ventilation. The illustration is used with permission of Mayo Foundation for Medical Education and Research. All rights reserved

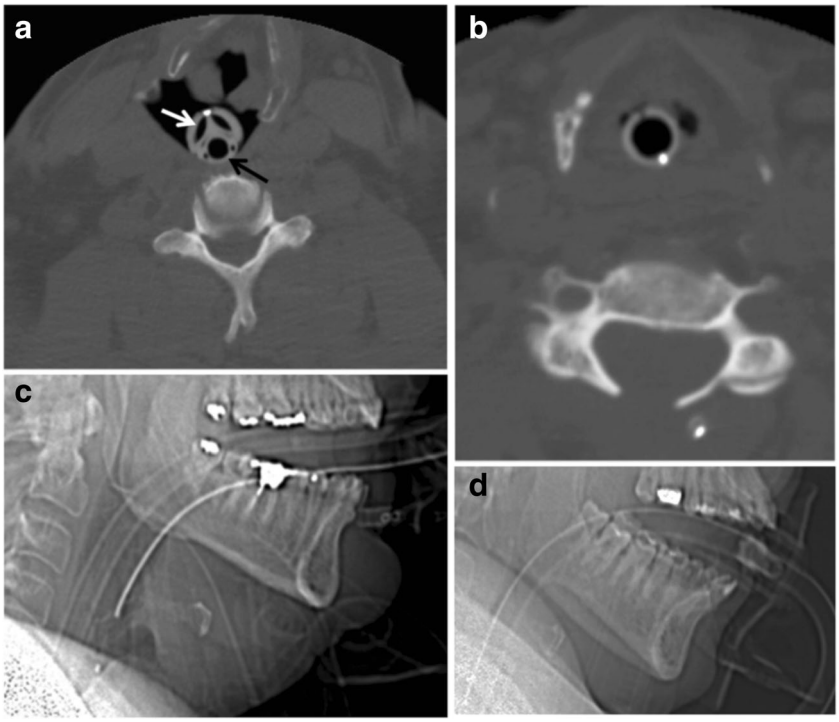

Fig. 2 Comparison of the dual-lumen King LTS with a single-lumen endotracheal tube. On axial CT, the dorsal lumen of the King LTS (**a**) is the gastric lumen (*black arrow*), and the ventral lumen is the ventilation lumen (*white arrow*). The endotracheal tube has one lumen (**b**). On lateral scout views, two lumens are evident in the King LTS (**c**) but not the endotracheal tube (**d**). Due to the coronal orientation of the septum dividing the two lumens, this difference is not appreciated on frontal radiographs or scout views of the neck

insufflation was apparent on chest radiography (Fig. 3). Aspiration presumably occurred at that time, as evidenced by the ground-glass opacities and right upper lobe consolidation seen on chest CT the following day (Fig. 4). Additionally, the epiglottis was displaced downwards by the oropharyngeal cuff and covered the trachea (Fig. 1). This probably prevented adequate ventilation, resulting in right upper lobe collapse. Following endotracheal intubation, the right upper lobe re-aerated and gastric distention resolved (Fig. 4).

Since the King Airway terminates in the upper esophagus, it is not necessarily viewed on chest radiography. On our patient's initial chest radiograph, although the distal aspect of the tube can be seen in the neck to the right of midline due to kinking (Fig. 3), this modality is not reliable for evaluation of proper placement. The chest radiograph is better suited for indirect evidence of malpositioning, such as lung collapse and gastric insufflation. Subcutaneous emphysema in the neck and chest has also been reported as the result of inadvertent tube placement into the mediastinum [7]. If any of these findings are identified in the presence of a King Airway, the treating team should be informed of suspected malpositioning.

Other complications of the King Airway may occasionally occur with proper positioning but are unlikely to be recognized on imaging. These include tongue

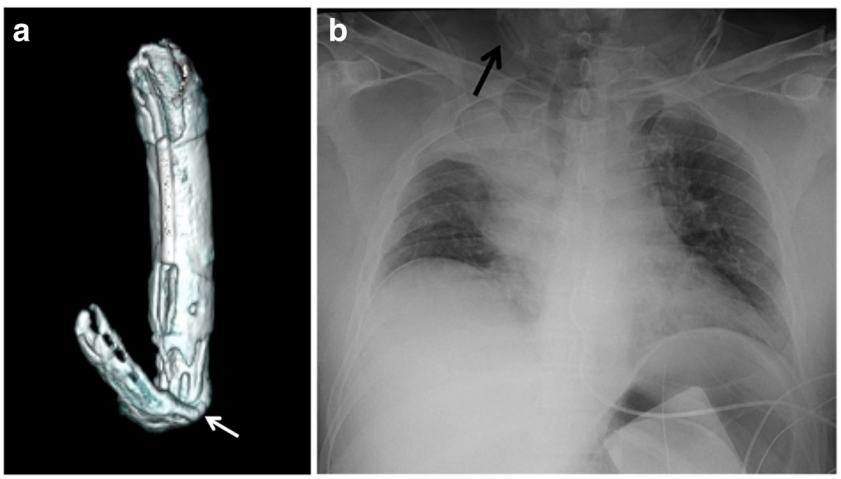

Fig. 3 Three-dimensional volume rendered image of the King LTS (**a**) with a kink distally (*arrow*) and subsequent chest radiograph (**b**) showing right upper lobe collapse and gastric insufflation. Upon close inspection, the kinked tube can be seen in the neck (*arrow*)

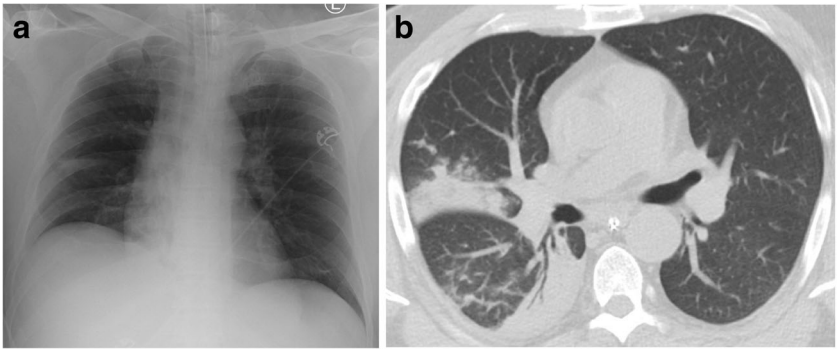

Fig. 4 Following endotracheal intubation, a chest radiograph shows the right upper lobe is aerated and the stomach is no longer distended (**a**). Chest CT shows right lower lobe ground glass and a right upper lobe consolidation, presumed due to aspiration (**b**)

engorgement, glottic edema, and esophageal edema. Tongue engorgement is most common, occurring in up to 15% of patients [8]. Usually due to an oversized device or vascular compression from overinflated cuffs, these complications may hinder subsequent endotracheal intubation.

Conclusion

Many radiologists are unfamiliar with alternative airways, such as the King Airway and Combitube. This can lead to incorrect assumptions about the type of device identified on imaging, proper positioning, and potential complications. These errors can have important downstream consequences for the patient.

Although these devices are usually replaced for an endotracheal tube immediately upon arrival to the ED, they may temporarily be left in place when other steps in resuscitation are considered higher priority. Recognition of incorrect placement can assist the emergency team by re-prioritizing the need for definitive endotracheal intubation. Conversely, these devices are easily mistaken for a misplaced endotracheal tube, and a radiologist's lack of familiarity can result in unnecessary and distracting phone calls to the treating team in the critical early moments of care.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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