WILDERNESS & ENVIRONMENTAL MEDICINE, **28,** S61–S68 (2017)

TACTICAL COMBAT CASUALTY CARE: TRANSITIONING BATTLEFIELD LESSONS LEARNED TO OTHER AUSTERE ENVIRONMENTS

Awake Cricothyrotomy: A Novel Approach to the Surgical Airway in the Tactical Setting

Robert L. Mabry, MD; Chetan U. Kharod, MD, MPH; Brad L. Bennett, PhD, EMT-P

From the Combat Casualty Care, Office of the Surgeon General (Army), Falls Church, VA (Dr Mabry); the Military EMS & Disaster Medicine Fellowship, JBSA-Fort Sam Houston, TX (Dr Kharod); and the Military & Emergency Medicine Department, F. Edward Hébert School of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD (Dr Bennett).

Airway obstruction on the battlefield is most often due to maxillofacial trauma, which may include bleeding and disrupted airway anatomy. In many of these cases, surgical cricothyrotomy (SC) is the preferred airway management procedure. SC is an emergency airway procedure performed when attempts to open an airway using nasal devices, oral devices, or tracheal intubation have failed, or when the risks from intubation are unacceptably high. The aim of this overview is to describe a novel approach to the inevitably surgical airway in which SC is the first and best procedure to manage the difficult or failed airway. The awake SC technique and supporting algorithm are presented along with the limitations and future directions. Awake SC, using local anesthetic with or without ketamine, will allow the knowledgeable provider to manage patients with a compromised airway across the continuum of emergency care ranging from remote/en route care, austere settings, and prehospital to the emergency department.

Keywords: airway, obstruction, cricothyrotomy, cricothyroidotomy, trauma

Introduction

Historically, airway management has had top priority for the civilian emergency medical services (EMS) and military combat medicine, as indicated by the acronyms ABC (airway, breathing, circulation) and MARCH (massive bleeding, airway, respiration, circulation, head/hypothermia), respectively.[1,2] The critical fundamentals of airway management are no different whether in the prehospital or hospital setting. However, the assessment techniques and airway devices vary based on the physical location of the trauma patient (eg, urban EMS, combat or tactical medicine, wilderness medicine, or hospital).

Norman McSwain, MD, developed the notion of *principles versus preferences* in medical care as a fundamental concept in critical thinking and decision making in prehospital trauma care.[3] This concept can be illustrated using surgical cricothyrotomy (SC) procedure as an example. The *principle* is to open the airway through the cricothyroid membrane with the understanding of 3 key priorities: 1) oxygenate, 2) ventilate, and 3) protect the airway. The *preference* is how the principle is realized using one of the many SC procedural steps, surgical tools selection, and airway tube of choice. Even though there are many commercial cricothyrotomy devices and surgical procedural steps to consider, not all are ideal for use based on the severity of patient trauma and physical location.[4] Thus, the aim of this overview is to provide a rationale for considering an SC procedure for a semiconscious or awake airway-obstructed patient as a rapid and simple technique easily performed in austere conditions. Henceforth, this procedure is identified as an awake SC.

Case vignettes

The following 3 cases present scenarios in both civilian and military austere environments where an awake SC procedure is rapidly needed to create a patent airway.

Corresponding author: Robert L. Mabry, MD, Chief, Combat Casualty Care, Office of the Surgeon General (Army), Falls Church, VA; e-mail: robert.l.mabry8.mil@mail.mil.

Presented at the Tactical Combat Casualty Care: Transitioning Battlefield Lessons Learned to Other Austere Environments Preconference to the Seventh World Congress of Mountain & Wilderness Medicine, Telluride, Colorado, July 30–31, 2016.

CASE 1

A law enforcement (LE) tactical team assembles to perform forced-entry outside a suspected drug laboratory. As the team makes entry into the laboratory, a device detonates, causing injury to several team members. The on-scene emergency physician (EP) observes blast trauma to one officer's neck and recognizes a possible need for a surgical airway intervention. As the immediate tactical situation comes under control with LE reinforcements, the EP returns attention to the officer's airway. The patient is conscious, but confused and agitated. With the patient's disrupted airway anatomy, altered mental status, and ongoing facial bleeding, the EP rapidly prepares for an emergent surgical airway.

CASE 2

A dismounted patrol consisting of US and coalition soldiers is conducting operations in a remote Afghan village. One of the coalition soldiers steps on an improvised explosive device and is badly wounded. As the surrounding soldiers secure the scene and begin to assess him, a combat medic arrives on scene, responding to the call for "Medic!" Even from a distance, the medic can see the soldier's badly injured facial anatomy and hear the raspy sonorous breathing. There is no active firefight, and the patient has no exsanguinating hemorrhage. He remains unresponsive and has noisy, spontaneous breathing. Looking at his face, the medic cannot visualize where to begin to intubate and decides to prepare the soldier's neck for a surgical airway intervention.

CASE 3

A local county search and rescue team member fell from a significant height while rappelling during high angle technical rescue training in the mountains of northern California. The team member sustained severe facial and head trauma. The members of the small climbing team, including the team paramedic, witnessed the fall and were able to rappel down 50 m to provide assistance. The initial responding team members conducted a rapid ABC assessment and noted no severe bleeding, but they observed facial contusions, a compound mandibular fracture, fractured teeth, and bleeding in the mouth resulting in an obstructed airway. The arriving paramedic conducted a rapid trauma assessment and found the patient with sonorous breathing, but alert to all questions. The team paramedic made a rapid decision to conduct an SC.

Background

Over a decade of lessons learned in combat casualty airway management clearly highlights the concepts of principles vs preferences about how best to manage a difficult airway. In particular, there is substantial airway management experience during the 3 phases of care as described in Tactical Combat Casualty Care (TCCC) Guidelines: 1) Care Under Fire; 2) Tactical Field Care; and 3) Tactical Evacuation Care. Airway management in the TCCC training curriculum discusses the use of traditional basic and advanced airway support techniques (eg, body repositioning such as leaning forward, chin lift, or jaw thrust; use of nasopharyngeal airways; and SC as the advanced airway procedure).[2,5] See Table 1 for an overview of the TCCC guidelines for airway management in the Tactical Field Care phase.

During the Afghanistan and Iraq conflicts (2001–2011), traumatic airway obstruction was responsible for 8% of fatalities caused by penetrating injury to the face and neck anatomy and was the second leading cause of preventable mortality.[6] These findings are similar, but slightly greater than that previously reported for airway obstruction mortality (1%−2%). Airway obstruction is the third leading cause of preventable death on the battlefield.[7] SC incidence rates in the military out-of-hospital setting are double that of paramedics in the civilian EMS.[8] This is due to the high incidence of penetrating (fragments) trauma from improvised explosion devices and gunshot wounds. The face and anterior neck of combat personnel typically are not covered with protective armor, which increases the likelihood of upper airway structural injury and the need for rapid SC airway management.

The majority of US military combat medics are trained at the emergency medical technician (EMT)-basic level. Although outside the scope of US civilian EMT-basic training, SC is an essential battlefield medical skill. Although all combat medics learn standard open SC, the first opportunity to perform the procedure clinically is during austere combat conditions that often result in complications and failure to place the SC tube correctly in the trachea. The SC failure rate is reported to be 33% for ground-based combat medics[8] and 18% for medical evacuation helicopter medics[9] in the challenging combat environments of Iraq and Afghanistan. Reported complications include bleeding, incorrect anatomic placement, mainstem intubation, and damage to associated airway structures.[8,10]

In addition to the lack of clinical SC experience, a recent review of the SC training procedures and techniques have identified 5 specific gap areas that might explain, in part, the high SC failure rates for US military