

# ABCDE Approach for Massive Hemoptysis

## A Novel Cognitive Aid

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### ABSTRACT

Massive hemoptysis is a high-risk, low-frequency clinical scenario, and teaching the management of this emergency should extend beyond reliance on clinical exposure. Massive hemoptysis requires emergent intervention to avoid asphyxiation and death. Practitioners need both cognitive and procedural skills to intervene in a high-stress situation. Cognitive aids have demonstrated benefits in other emergency settings, but no such tool exists for massive hemoptysis. Using expert recommendations, we developed the ABCDE Approach for Massive Hemoptysis, a cognitively accessible, prioritized toolbox of interventions designed to assist learners in organizing an approach to these high-risk and time-sensitive patient cases. Herein we present the elements and use of the ABCDE approach. Providing a cognitive approach to massive hemoptysis is an important first step in improving education for this potentially fatal clinical scenario.

Massive hemoptysis is a rare occurrence; however, despite advanced therapies, it has a high associated mortality rate (1–3). The low frequency of these high-risk presentations makes the reliance on clinical

experience to learn management of massive hemoptysis inadequate (4). Most trainees, and even many experienced practitioners, do not encounter cases of massive hemoptysis frequently, and thus,

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in the absence of dedicated education, they may not be prepared to manage these cases when they arise.

Although the low incidence of massive hemoptysis makes scientific study of the optimal management difficult, experience and expert opinion lay the foundation for published recommendations for management. Many of these publications include complex flow diagrams to guide appropriate management. Current recommendations have tremendous benefit; however, challenges remain. One challenge is to ensure that while learning the nuances of management of massive hemoptysis, the priority of airway patency is not lost. Another challenge is to recall the learned approach during a high-stress episode, when practitioners must intervene quickly to avert asphyxiation. Cognitive aids provide a simplified framework and have been shown to be beneficial in other high-stress situations (5, 6). For massive hemoptysis, there has not been a cognitive aid or established education program.

We aspired to create a tool that incorporates the most crucial elements of massive hemoptysis management in a cognitively accessible format that would be straightforward to teach and easy to recall. We reviewed all relevant expert opinions published since 2000 regarding management of massive hemoptysis (7–14) and used these to create a prioritized approach that follows the A-B-C-D-E order for simplified cognitive retrieval (Table 1). Herein we describe the elements and recommended use of the ABCDE approach toolbox and discuss how this tool fills an educational gap.

## ELEMENTS OF THE ABCDE APPROACH

### Assess the Airway

The first priority is to maintain airway patency because clotting of the conducting

airways and subsequent asphyxiation are often the cause of death in cases of hemoptysis (7). This category includes “aspirate” to clear the airway (adequate suction is needed for fresh blood; a cryotherapy probe may be useful for established clot), “airway” to consider airway management, and “anesthesia” to consider early involvement for a difficult intubation. For “airway,” practitioners should assess whether an artificial airway needs to be established and, if so, what approach to take. When inserting an endotracheal tube (ETT), practitioners will determine which tube to choose and where it should be placed, thus selecting how many bronchi to intubate: “big 0,” 1, or 2. The “big” in big 0 helps learners remember to select a large ETT ( $\geq 8.5$ -mm internal diameter) to facilitate passing tools and suctioning when choosing to intubate the trachea. A “1” would be a mainstem bronchus intubation. Practitioners may choose to initially intubate the mainstem bronchus of the nonbleeding side to establish patency of this airway, later considering relocation of the ETT to the trachea. A “2” acknowledges the option of using a double-lumen ETT; however, this is discouraged in most cases of massive hemoptysis, given challenges with proper placement, inability to pass most tools through the narrow lumens, and the tendency of these narrower lumens to clot (7, 15).

### Block the Blood

The focus is on isolating the bleeding site to protect the remaining lung from filling with blood. This includes “bad side down” for lateral decubitus positioning and “bronch” to lateralize the source of bleeding, clear the airway, direct the ETT, and assist in placing an “endobronchial blocker.”

**Table 1.** ABCDE approach for massive hemoptysis

Toolbox Category	Components	Considerations
Assess the airway	Aspirate	Clear the airway
	Airway	Big 0: Large-bore endotracheal intubation 1: Mainstem bronchus intubation 2: Double lumen intubation*
	Anesthesia	
Block the blood	Bad side down	Lateral decubitus positioning
	Bronch	Lateralize the bleed Clear the airway Direct tube
	Endobronchial blocker	
Cause a clot	Compression	Direct tamponade Wedge
	Cold	Ice-cold saline irrigation
	Vasoconstriction	Epinephrine Vasopressin
	Coagulants	Thrombin with or without fibrin Tranexamic acid Oxidized regenerated cellulose
	Cautery	Electrocautery Argon plasma coagulation Laser
	Definitive therapy	IR consult Surgical consult Rigid bronchoscopy
Everything else	Eye on the patient	Vital signs Volume resuscitation
	Lab evaluation	ABG BUN CBC Coags Type and crossmatch

**Table 1. Continued.**

Toolbox Category	Components	Considerations
	Ensure coagulation	Medication review Correct coagulopathies

*Definition of abbreviations:* ABG = arterial blood gas; BUN = blood urea nitrogen; CBC = complete blood count; Coags = coagulation testing including prothrombin time, partial thromboplastin time, and international normalized ratio; ENT = ear, nose, and throat surgery; IP = interventional pulmonology; IR = interventional radiology.

The first column contains the toolbox categories, the second column shows components to consider within each category, and the third column lists relevant data and diagnostic or therapeutic considerations for components.

\*Double-lumen intubation is not recommended for most cases of massive hemoptysis.

**Cause a Clot**

If the clinical scenario allows, practitioners may perform bronchoscopic interventions to “cause a clot.” This could include “compression” with direct tamponade or wedge positioning, “cold” with ice-cold saline irrigation, “vasoconstriction” with topical epinephrine or vasopressin, use of “coagulants” with thrombin with or without fibrin, tranexamic acid, or oxidized regenerated cellulose, or “cautery” with electrocautery, argon plasma coagulation, or laser.

**Definitive Therapy**

This addresses approaches to intervene more definitively, typically by procedural consultants rather than a general pulmonologist or intensivist. This may include contacting interventional radiology for bronchial artery embolization, surgery for resection, or a proceduralist with capability to perform rigid bronchoscopy if indicated by the clinical scenario. This step is especially important for patients who have had their airway secured and bleeding side blocked, because these are primarily temporizing measures, and management is not complete after those steps.

**Everything Else**

This final component acknowledges that general management of life-threatening

hemorrhage also applies to hemoptysis. This includes keeping an “eye on the patient,” specifically their vital signs and determining the need for volume resuscitation; sending a “lab evaluation” of relevant studies to guide resuscitation; and “ensuring coagulation” by reviewing the patient’s medications and using this information with laboratory results to correct coagulopathies.

**USE OF THE ABCDE APPROACH**

The ABCDE Approach for Massive Hemoptysis is intended to help learners approach management of these high-risk patients with a cognitively accessible toolbox that prioritizes airway protection and contains techniques relevant to pulmonologists and intensivists. It should be emphasized that this is a toolbox and not a stepwise approach to management of massive hemoptysis.

The priority is to maintain airway patency and protect the lungs from filling with blood; hence, the “airway” and “block” components are listed first. Some clinical scenarios would warrant bronchoscopic interventions to “cause a clot” first, one example being a significant postbiopsy bleed during bronchoscopy. The bronchoscopic interventions are grouped together in “cause a clot” for ease of recall and for practitioners to consider

bronchoscopic interventions in appropriately stable patients. In many scenarios, such as unstable patients or those for whom bronchoscopic intervention is not feasible, “definitive management” is more urgent. For example, a patient with a bleed requiring placement of an endobronchial blocker would not be appropriate for bronchoscopic interventions to “cause a clot,” both because they may be too unstable and because their bleeding site is blocked; they need emergent “definitive management.”

Several elements of this approach should be performed concurrently. A patient should be placed “bad side down” as soon as bleeding is first lateralized. Consultants may be called for “definitive management” while a patient is being intubated. Components of “everything else” should be performed concurrently with other management, not after other steps.

### LIMITATIONS OF THE ABCDE APPROACH

Although we attempted to create a comprehensive toolbox, the available interventions for massive hemoptysis may not be limited to what is included here, and additional interventions may be developed for future use. Favored interventions may vary by practitioner preference, and their selection may evolve over time as new evidence becomes available. An example is a move by some away from the use of topical epinephrine in favor of cold saline and topical coagulants, given the unfavorable side effect profile of epinephrine, while recognizing rigorous data are lacking (7, 16, 17). Our goal was not to be prescriptive about the use of interventions, but to provide a framework to consider

possible interventions and leave decisions to the practitioner.

Certain interventions may not be available at a facility or within the scope of training of all practitioners. There are a variety of endobronchial blockers, and available interventions to “cause a clot” may differ by institution. We recommend that practitioners familiarize themselves with the equipment and services available at their facility so they can easily be used in an emergency.

### ABCDE APPROACH FILLS AN EDUCATIONAL GAP

Recent literature shows we should not rely on clinical experience alone to teach trainees the skills they will need in clinical practice. This is particularly true for high-risk, low-frequency clinical scenarios (4, 18, 19). An internal survey of our pulmonary and critical care fellows demonstrated that they were not obtaining sufficient clinical experience to feel comfortable managing massive hemoptysis. They believed that management of massive hemoptysis is an important skill to have upon completion of fellowship and one that they wanted to improve upon.

The ABCDE Approach for Massive Hemoptysis provides a cognitive approach for management of these cases and importantly uses an accessible mnemonic to assist practitioners while in a high-stress clinical environment to organize and prioritize interventions. We presented the ABCDE Approach for Massive Hemoptysis to our pulmonary and critical care faculty, as well as in education sessions for our fellows. We received positive feedback from faculty and fellows regarding the usefulness of this tool, its comprehensive scope, and its ease of use.

Procedural practice and experience with the tools used to intervene for massive

hemoptysis are also critical skills. We agree with recommendations that simulation should be incorporated into training for bronchoscopic interventions (18, 20). With high-fidelity simulation, learners can apply a cognitive approach while practicing procedural skills. The ABCDE approach can be used to improve cognitive skills independent of teaching procedural skills. We have included both case-based learning and high-fidelity simulation in our massive hemoptysis curriculum and encourage educators to incorporate the ABCDE approach tool as it fits their education program.

With our focus on a simplified educational approach and cognitive recall, we expect that other pulmonary and critical care learners and practitioners would similarly benefit from use of the ABCDE Approach for Massive Hemoptysis cognitive toolbox. Establishing a cognitive approach to massive hemoptysis that is useful and applicable in a high-stress environment is a step toward improving education for and management of this high-fatality event.

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