

Rationale:

Massive hemoptysis requires providers to intervene quickly, but given its rare occurrence, fellows may not obtain enough clinical experience to feel equipped to manage this life-threatening presentation. Managing massive hemoptysis requires both a cognitive framework for choosing appropriate interventions, as well as facility with procedural skills to intervene. Cognitive tools can help providers in emergency clinical scenarios to retrieve information and decide steps to take, but no such tool exists for management of massive hemoptysis. For teaching high-risk, low-volume clinical scenarios, simulation-based training is optimal, but no simulator to teach management of massive hemoptysis exists commercially to allow for practice of cognitive and procedural skills. We sought to develop a cognitive tool and high-fidelity simulator to train fellows how to intervene in cases of massive hemoptysis.

Methods:

To develop a cognitive tool to assist in the approach to management of massive hemoptysis, we reviewed all recently published expert opinions on this topic. Using these we developed a prioritized, cognitively accessible “ABCDE Approach for Massive Hemoptysis” tool (Table 1). To develop a simulator, we used computed tomography images to develop an anatomically correct 3D-printed airway model that was made of material that was sturdy but somewhat compliant to distending forces. This airway model was inserted into a decommissioned Laerdal SimMan 3G manikin, connecting the airway model to the manikin at the level of the cricoid cartilage; the model was able to “bleed” from one of 3 sources during case-based simulation (Figure 1). During simulations, fellows were provided a case and asked to intervene as they felt appropriate. This model allowed for intubation, bronchoscopy, and placement of an endobronchial blocker, among other interventions. The cognitive material and simulation experience were delivered to Pulmonary/Critical Care fellows in educational workshops. Fellows completed pre- and post-session self-assessments and were surveyed regarding the cognitive tool and simulator following the session; all assessments used a 4- or 5-point Likert scale.

Results:

Nineteen fellows from the University of Colorado Pulmonary Critical Care Fellowship program participated in the workshop, which included learning the “ABCDE Approach for Massive Hemoptysis” and subsequently practicing management on the massive hemoptysis simulator. Prior to the session, fewer than half (47%) of the fellows agreed that they could manage massive hemoptysis, with only 21% reporting confidence in their skill; only 5% knew how to place an endobronchial blocker. Following the session there was a statistically significant increase in the percentage of fellows reporting they could perform relevant skills, with 100% of fellows reporting knowledge and confidence in cognitive and procedural skills to manage massive hemoptysis. Survey questions assessing the utility of the cognitive “ABCDE Approach” and of the hemoptysis simulator were overwhelmingly positive, with 94-100% of respondents agreeing that these were beneficial and should be used for teaching in the future. Comments from participants regarding the materials and training session were positive.

Conclusions:

We successfully created and implemented a workshop to teach the cognitive and procedural skills needed for management of massive hemoptysis. The “ABCDE Approach for Massive Hemoptysis” is a useful and relevant tool to teach the cognitive component of management of massive hemoptysis. We developed a novel high-fidelity massive hemoptysis simulator which was successful in teaching fellows important procedural skills for intervening in massive hemoptysis. Teaching the “ABCDE Approach” and providing training with a hands-on simulator provided a comprehensive educational experience for fellows that can be replicated by other training programs.