

Tranexamic acid (TXA) can be administered via nebulization/aerosolization to treat acute hemoptysis and airway hemorrhage in anesthesia emergencies.

Study, Year	Design	Patient Population	Treatment Groups	Time Frame	Findings	Level of Evidence
Gopinath et al, ³ 2023	Open-label RCT, N = 110	Adult patients presenting to ED with active hemoptysis (blood in sputum in last 30 minutes)	Nebulized TXA (500 mg tid) vs IV TXA (500 mg tid)	30 minutes, 6/12/24 hours	- 30 min hemoptysis cessation signif. higher in nebulization patients - signif. lower amount of hemoptysis in nebulization patients - less bronchial artery embolization and higher discharge rate from ED (nebulized)	2
Wand et al, ⁴ 2018	Double blind RCT, N = 47	Adult patients admitted w/ hemoptysis of varying etiologies	Nebulized TXA 500 mg/5 mL vs normal saline inhalation 5 mL	5 days with follow up at 1 year	- TXA signif. reduced hemoptysis volume, more patients with resolution within 5 days, shorter LOS, fewer interventions	2
O'Neil et al, ⁵ 2020	Retrospective Observational study, N = 19	Pediatric patients age 0-18 yr, ICU	review of patients with hemoptysis who received at least one dose of inhaled or endotracheal instilled TXA	No set time frame, patient charts examined for entire LOS	- 18 of 19 patients achieved cessation of pulmonary hemorrhage w/ inhaled TXA - 8 patients had CHD, 4 had malignancy - lower Fio2 before TXA use associated with survival - no patient with cessation had repeat hemorrhage during admission - no major adverse events (seizure, DVT, renal failure)	4
Komura et al, ⁶ 2018	Case report, N = 1	69 year old female with stage IV lung adenocarcinoma and PE on rivaroxaban, acute hemoptysis; respiratory distress, 100% NRB	Given TXA 1000 mg in 20 mL normal saline, aerosolized	Results noted in 10 minutes, followed through discharge at 5 days	- hemoptysis resolved - respiratory distress improved - no subsequent hemoptysis, discharged 5 days later - No need to reverse systemic anticoagulation	4

Table 1: Appraisal of Literature Discussing Inhaled TXA for the Treatment of Hemoptysis and Airway Hemorrhage.³⁻⁶

Abbreviations: CHD, congenital heart defects; DVT, deep vein thrombosis; ED, emergency department; LOS, length of stay; NRB, nonrebreather; PE, pulmonary embolism; RCT, randomized controlled trial; tid, 3 times daily; TXA, tranexamic acid.



Use of Inhaled Tranexamic Acid to Treat Airway Bleeding in Anesthesia Emergencies

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INTRODUCTION

- Airway bleeding can arise from a multitude of etiologies and can range in severity from mild to life-threatening.¹
- Airway bleeding can have catastrophic consequences if it impairs the anesthesia provider's ability to establish an airway and ventilate the patient.¹
- Upper airway bleeding can obscure direct and video-assisted laryngoscopy.¹
- Lower respiratory bleeding can impair gas exchange even with successful intubation.¹
- TXA is an antifibrinolytic that inhibits plasminogen's lysine receptor to prevent conversion of plasminogen to plasmin and breakdown of fibrin clots.²
- IV TXA is readily available in many ORs.²
- PICOT: In patients experiencing acute hemoptysis and/or airway hemorrhage, does the administration of aerosolized TXA, compared to traditional treatments, produce hemostasis and resolution of hemoptysis immediately and over the course of several days?**

METHODS

- PubMed, Embase, Medline Ultimate, CINAHL Ultimate, and Cochrane Library were searched for the following key phrases: *aerosolized tranexamic acid/TXA, inhaled tranexamic acid/TXA, nebulized tranexamic acid/TXA, hemoptysis, and/or airway hemorrhage.*
- Limits included a date range of 2014-2024 and articles in English. No age limit was applied.
- 29 results from PubMed, 30 results from Embase, 24 results from Medline Ultimate, 21 results from CINAHL Ultimate, and 15 results from Cochrane Library.
- 2 randomized controlled trials (RCTs), a retrospective observational study, and a case report were chosen to address the topic. No systematic reviews currently exist on the topic.
- Integrative reviews: IRB/IACUC approval does not apply to this evidence-based project.

GAPS IN KNOWLEDGE

- No systematic reviews have been conducted on this topic, and only 2 RCTs exist at this time.
- No RCT has determined inhaled TXA's efficacy at sooner than 30 minutes after administration.
- RCTs excluded patients most likely to represent the anesthesia provider's experience: critically ill, hemodynamically unstable, respiratory distress, massive hemoptysis.³⁻⁵

REVIEW of LITERATURE/ CRITICAL APPRAISAL

- Gopinath et al found nebulized TXA to provide superior hemoptysis cessation at all measure time frames, lower hemoptysis volumes, fewer interventions, and faster discharge compared to IV TXA. Two patients who received nebulized TXA experienced bronchoconstriction responsive to short acting beta agonists (SABA).³
- Wand et al found nebulized TXA to provide significantly reduced hemoptysis volume, more hemoptysis resolution over 5 days, shorter LOS, and fewer interventions compared to placebo. No bronchospasms were noted.⁴
- Both RCTs excluded unstable patients and massive hemoptysis from the study.^{3,4}
- O'Neil et al found that approximately 95% of pediatric patients treated with inhaled TXA achieved cessation of pulmonary hemorrhage. Coagulation variables did not change significantly after TXA administration and no bronchospasms were identified. The authors were unable to identify nebulized TXA's impact on mortality rate in pediatric ICU patients.⁵
- Komura et al utilized aerosolized TXA in an anticoagulated cancer patient who had life-threatening hemoptysis and respiratory distress; cessation of hemoptysis and stabilization of vitals occurred within 10 minutes of administration with no adverse effects or need to reverse anticoagulants. The patient was discharged 5 days later with no further interventions and no more hemoptysis events.⁶
- Airway bleeding etiologies across all studies included malignancy, respiratory infection, tuberculosis, congenital defects, systemic anticoagulation, and iatrogenic injuries; aerosolized TXA appeared to be effective in all etiologies examined.³⁻⁶
- Synthesis:** all studies support the efficacy of inhaled TXA to treat hemoptysis across a variety of etiologies, but the time frame for cessation of hemoptysis has not yet been defined.

RECOMMENDATIONS for PRACTICE / CONCLUSIONS

- Aerosolized TXA can be administered to treat airway bleeding in anesthesia emergencies across a variety of etiologies including malignancy, infection, iatrogenic injury, impaired coagulation, and congenital defects.³⁻⁶
- Aerosolized TXA may be preferred over IV TXA to treat airway hemorrhage.³
- Adults should receive aerosolized TXA 500 to 1000 mg and pediatric patients should receive TXA 250 to 500 mg as deemed appropriate by the anesthesia provider. Suctioning prior to administration may improve efficacy.³⁻⁶
- Providers should monitor for bronchospasm after inhalation of TXA and treat with SABA.³
- Additional RCTs and systematic reviews are warranted to further define inhaled TXA's onset, efficacy, ideal dosing, and role in the management of airway hemorrhage.

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