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Clinical Profile, Management, and 3-Month Outcomes of Moderate to Massive Hemoptysis in a Resource-Limited Tertiary Care Setting: A Prospective Observational Study from South India

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ABSTRACT

Background: Moderate to massive hemoptysis remains a life-threatening respiratory emergency with high morbidity and mortality, particularly in tuberculosis-endemic regions of India where post-tuberculous sequelae predominate. This study aimed to evaluate the etiological spectrum, in-hospital course, recurrence, and 3-month post-discharge outcomes in patients admitted with moderate to massive hemoptysis.
Materials and Methods: This prospective descriptive observational study was conducted at Government Medical College Hospital, Karur, Tamil Nadu, India, from October 2024 to March 2025. Sixty consecutive adult patients with moderate (31–100 mL/day) or massive (>600 mL/day or hemodynamically unstable) hemoptysis were enrolled after informed consent. Data included demographics, clinical history, etiology (sputum microbiology, imaging), conservative management details, in-hospital events, and 3-month follow-up for recurrence, readmission, and mortality. Analyses used chi-square/Fisher's exact tests, independent t-tests, and Kaplan-Meier estimates (SPSS v27.0; $p < 0.05$ significant).
Results: Tuberculosis (active or sequelae) accounted for 66.7% of cases. Conservative management achieved initial hemostasis in 97.2% of moderate but only 83.3% of massive cases ($p = 0.042$). Massive hemoptysis was associated with higher blood transfusion (66.7% vs. 22.2%; $p < 0.001$), ICU admission (37.5% vs. 5.6%; $p = 0.001$), prolonged stay (11.40 ± 5.10 vs. 6.80 ± 2.90 days; $p < 0.001$), and in-hospital mortality (16.7% vs. 2.8%; $p = 0.048$). The 3-month recurrence rate was 23.3%, with Kaplan-Meier freedom from rebleeding declining to 76.7%. Massive severity (OR 3.72; $p = 0.024$), prior TB (OR 3.86; $p = 0.038$), aspergilloma (OR 8.80; $p = 0.012$), active TB (OR 3.56; $p = 0.041$), and comorbidities (OR 3.72; $p = 0.024$) predicted recurrence.
Conclusion: In this high-TB-prevalence setting, post-tuberculous pathology dominated moderate to massive hemoptysis, with conservative management yielding acceptable initial control in moderate cases but exposing massive cases to substantial morbidity, mortality, and early recurrence. Risk-stratified follow-up, etiology-specific therapy, and expanded access to bronchial artery embolization are essential to improve outcomes in similar resource-limited environments.

Keywords: *Hemoptysis, Pulmonary Tuberculosis, Bronchial Arteries, Conservative Treatment, Recurrence, Tertiary Care Centers.*

INTRODUCTION

Hemoptysis, defined as the expectoration of blood from the subglottic respiratory tract, remains one of the most alarming respiratory emergencies, with the potential for rapid clinical deterioration and high mortality if not managed promptly [1]. Although minor hemoptysis is common and often self-limiting, moderate to massive hemoptysis represents a medical urgency that demands immediate evaluation and intervention. Various professional societies define moderate hemoptysis as 30–100 mL of blood in 24 hours and massive hemoptysis as >100–600 mL in 24 hours or any volume causing hemodynamic instability or airway compromise [2].

The epidemiological profile and etiology of significant hemoptysis vary markedly across the globe. In developed nations with low tuberculosis prevalence, bronchiectasis, lung cancer, cystic fibrosis, and vasculitic disorders predominate. In contrast, tuberculosis—both active disease and its sequelae—continues to be the leading cause in high-burden countries, including India. National data and regional studies consistently report tuberculosis-related hemoptysis in 60–85% of cases presenting to tertiary care centers [3].

Post-tuberculous structural lung disease, characterized by fibrocavitary lesions, traction bronchiectasis, and Rasmussen aneurysms (pseudoaneurysms of bronchial arteries within cavitary walls), creates a substrate for recurrent life-threatening hemorrhage. Other important causes include non-tuberculous bronchiectasis, community-acquired pneumonia with necrotizing features, lung abscess, aspergilloma complicating old cavities, primary or metastatic malignancy, and rarely, vasculitides or coagulopathy-related bleeding [4].

The bronchial circulation, operating at systemic pressure, is the source of hemorrhage in >90% of cases. Chronic inflammation leads to bronchial artery hypertrophy and tortuosity, with fragile neovascularization prone to rupture. Erosion by cavitary processes, superinfection (e.g., Aspergillus), or acute inflammatory exacerbation triggers bleeding. The high pressure and flow within these abnormal vessels explain both the brisk onset and the challenge of spontaneous hemostasis [5].

Management has evolved dramatically over the past four decades. Before the widespread availability of bronchial artery embolization (BAE), emergency lung resection was the only definitive option for uncontrolled massive hemoptysis, yet perioperative mortality exceeded 35–50% because of poor pulmonary reserve and ongoing hemorrhage [6]. The introduction of flexible bronchoscopy for localization and temporary tamponade, multidetector CT angiography for precise vascular mapping, and superselective BAE using polyvinyl alcohol particles, coils, or gel-foam has revolutionized outcomes [7].

Conservative management—bed rest, cough suppression, correction of coagulopathy, tranexamic acid, blood transfusion, and lateral decubitus positioning with the bleeding side down—remains first-line for hemodynamically stable patients. Antibiotics and renewed anti-tuberculous therapy are instituted when infection is evident. However, recurrence rates after initial control remain substantial (10–50% at 1–3 years), particularly in tuberculosis sequelae, aspergilloma, and malignancy, owing to persistent underlying pathology and collateral vessel recruitment [8].

Despite these advances, mortality from massive hemoptysis in resource-constrained settings continues to range from 10–40%, influenced by delayed presentation, limited interventional radiology access, and comorbid illness. Understanding outcomes from admission through 3 months post-discharge is essential for several reasons: it captures early recurrence, which drives readmission and mortality; it evaluates the durability of conservative and interventional strategies in real-world practice; and it identifies modifiable risk factors (e.g., delayed anti-tuberculous therapy, uncontrolled infection) [9].

The present study was therefore undertaken to prospectively evaluate the clinical profile, management strategies, in-hospital course, and 3-month post-discharge outcomes of patients admitted with moderate to massive hemoptysis at Government Medical College Hospital, Karur, from October 2024 to March 2025. By delineating immediate success rates, recurrence, readmission, and mortality, along with etiological patterns and predictors of adverse events, this study aims to provide actionable insights for optimizing care pathways in similar resource-limited tertiary centers.

MATERIALS AND METHODS

Study Setting: This prospective descriptive observational study was conducted at the Department of Thoracic Medicine, Government Medical College Hospital, Karur, Tamil Nadu, India—a tertiary care teaching hospital serving a predominantly rural and semi-urban population in central Tamil Nadu. The investigation spanned a period of 6 months, from October 2024 to March 2025, during which consecutive eligible patients presenting with moderate to massive hemoptysis were enrolled and followed up.

Study Participants: Adult patients of either gender who presented to the Thoracic Medicine outpatient department with a history of hemoptysis and were subsequently admitted to the Thoracic Medicine ward with moderate to massive hemoptysis were considered for inclusion. Moderate hemoptysis was defined as 31–100 mL of blood expectorated per day, while massive hemoptysis was defined as >600 mL per day or any volume associated with hemodynamic instability or respiratory compromise necessitating urgent intervention. Inclusion required provision of informed written consent and confirmation of true hemoptysis originating from the lower respiratory tract.

Patients were excluded if they refused or were unable to provide informed written consent, had been hospitalized for the same complaint within the preceding 3 months, had evidence of upper respiratory tract bleeding or hematemesis, presented with uncontrolled systemic hypertension, or were receiving antiplatelet agents or anticoagulants.

Sample Size and Sampling Technique: A target sample size of 60 patients was set based on feasibility, expected case load during the study period, and the anticipated incidence of moderate to massive hemoptysis in the hospital setting. Consecutive sampling was employed, whereby all patients meeting the inclusion and exclusion criteria who presented sequentially during the study period were enrolled until the target number was reached.

Operational Definition: Hemoptysis severity was classified according to the volume of blood expectorated in 24 hours as follows: mild (<30 mL/day), moderate (31–100 mL/day), severe (101–600 mL/day), and massive (>600 mL/day or any amount causing hemodynamic instability or respiratory compromise requiring immediate airway or circulatory support). True hemoptysis was distinguished from pseudohemoptysis or hematemesis through detailed clinical history, physical examination (including ENT evaluation when indicated), and relevant investigations.

Study Tools: A standardized, structured proforma was utilized to systematically record demographic details (name, age, sex, address, contact number), clinical history (duration, frequency, daily volume and number of prior episodes of hemoptysis; constitutional symptoms; previous anti-tuberculous treatment; comorbidities; smoking status per CDC criteria; drug history), physical examination findings (general examination, vital signs, SpO_2 via pulse oximetry, respiratory system examination, inspection of coughed-out blood), and investigation results.

Diagnostic investigations included complete hemogram, liver and renal function tests, electrolytes, random blood sugar, coagulation profile (prothrombin time, INR), viral markers (HBsAg, HCV, ICTC), sputum examination (two samples for AFB smear by fluorescent microscopy, CBNAAT if AFB-negative, bacterial and fungal culture, cytology for malignant cells in selected cases), chest radiography, contrast-enhanced CT thorax, ECG, and echocardiography. Arterial blood gas analysis was performed in patients with severe breathlessness or SpO_2 <92%.

Study Procedure: All patients presenting to the Thoracic Medicine outpatient department with a history of hemoptysis underwent initial screening to confirm true hemoptysis and exclude non-respiratory sources through clinical history, ENT examination (when indicated), and preliminary investigations. Hemoptysis volume was quantified based on patient and relative reports supplemented by direct observation where feasible. Patients with moderate to massive hemoptysis were admitted to the Thoracic Medicine ward for further evaluation and management.

After obtaining written informed consent, detailed history, clinical examination, and the aforementioned investigations were completed. All patients initially received conservative management, which included absolute bed rest, lateral decubitus positioning toward the suspected bleeding side, airway protection with suctioning if required, oxygen supplementation, intravenous fluids, blood or packed red cell transfusion as indicated, antitussives, sedatives, tranexamic acid, and specific therapy directed at the underlying etiology (e.g., anti-tuberculous treatment for active tuberculosis, antibiotics for infection).

Interventional procedures such as bronchoscopy or bronchial artery embolization were pursued in cases of persistent or uncontrolled bleeding, in accordance with institutional resources and clinical judgment. In-hospital course, including duration of stay, complications, and immediate outcome at discharge, was documented. Post-discharge follow-up was conducted weekly or earlier if rebleeding occurred, up to 3 months, through outpatient visits or telephone contact. During follow-up, detailed clinical history, physical examination, and chest radiography (when clinically indicated) were performed to assess for recurrent bleeding episodes, readmissions, complications, and survival status.

Ethical Issues: The study protocol received prior approval from the Institutional Ethics Committee of Government Medical College Hospital, Karur. Written informed consent was obtained from each participant in their preferred language (Tamil or English) after providing a clear explanation of the study objectives, methods, potential risks and benefits, and the voluntary nature of participation. Confidentiality of all collected data was strictly maintained. No financial incentives were offered, and refusal to participate did not affect the standard of care provided.

Statistical Analysis: Data were entered and analyzed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation (if normally distributed) or median with interquartile range (if skewed). Group comparisons were performed using chi-square test or Fisher's exact test for categorical data and independent samples t-test or Mann-Whitney U test for continuous data, as appropriate. Time-to-rebleeding was analyzed using the Kaplan-Meier method. A two-tailed p-value of less than 0.05 was considered statistically significant throughout the analysis.

RESULTS

Table 1 provides a comprehensive overview of the demographic, behavioral, and clinical profile of the 60 patients admitted with moderate to massive hemoptysis. The cohort was predominantly male (70.0%) and rural (63.3%), with a mean age of 46.20 ± 12.80 years. Smoking history was common (70.0% ever-smokers), and two-thirds (66.7%) had prior pulmonary tuberculosis, consistent with regional epidemiological patterns where post-TB structural sequelae remain the dominant substrate for significant hemoptysis. Comorbidities were present in 40.0%, with diabetes (20.0%) and hypertension (16.7%)

most frequent. Massive hemoptysis occurred in 40.0% of cases, with a median reported daily volume of 85 mL (IQR 45–220), highlighting the severity spectrum encountered in public-sector tertiary care in high-prevalence settings.

Table 1: Demographic, Clinical, and Risk Factor Profile at Admission (N = 60)

Characteristic	Value
Age (years), M ± SD	46.20 ± 12.80
Gender, n (%) Male	42 (70.0)
Gender, n (%) Female	18 (30.0)
Residence, n (%) Rural	38 (63.3)
Residence, n (%) Urban/Semi-urban	22 (36.7)
Smoking status, n (%) Current smoker	28 (46.7)
Smoking status, n (%) Former smoker	14 (23.3)
Smoking status, n (%) Never smoker	18 (30.0)
Pack-years among ever-smokers, M ± SD	18.40 ± 9.70
Previous pulmonary tuberculosis history, n (%)	40 (66.7)
Duration since last TB treatment (years), M ± SD	7.10 ± 4.90
Comorbidities present, n (%) Any	24 (40.0)
Diabetes mellitus, n (%)	12 (20.0)
Systemic hypertension, n (%)	10 (16.7)
Chronic obstructive pulmonary disease, n (%)	6 (10.0)
Hemoptysis severity, n (%) Moderate	36 (60.0)
Hemoptysis severity, n (%) Massive	24 (40.0)
Hemoptysis volume (mL/day), median (IQR)	85 (45–220)

Note. Continuous variables presented as mean ± SD or median (IQR) as appropriate; categorical variables as frequency (percentage).

Table 2 details the etiological distribution, revealing that tuberculosis-related pathology (active or post-treatment sequelae) was responsible for 66.7% of cases, followed by non-TB bronchiectasis (13.3%) and aspergilloma (10.0%).

Table 2: Etiological Spectrum of Moderate to Massive Hemoptysis (N = 60)

Etiology	n	%
Pulmonary tuberculosis – active	14	23.3
Pulmonary tuberculosis – sequelae	26	43.3
Bronchiectasis (non-TB)	8	13.3
Aspergilloma (mycetoma in old cavity)	6	10.0
Necrotizing pneumonia / Lung abscess	4	6.7
Primary lung malignancy	2	3.3

Table 3 compares in-hospital course and immediate outcomes stratified by hemoptysis severity. Conservative management yielded initial hemostasis in 97.2% of moderate cases but only 83.3% of massive cases ($p = 0.042$). Massive hemoptysis was associated with significantly higher rates of blood transfusion (66.7% vs. 22.2%; $p < 0.001$), ICU admission (37.5% vs. 5.6%; $p = 0.001$), mechanical ventilation (16.7% vs. 0%; $p = 0.012$), longer hospital stay (11.40 ± 5.10 vs. 6.80 ± 2.90 days; $p < 0.001$), and in-hospital mortality (16.7% vs. 2.8%; $p = 0.048$).

Table 3: In-Hospital Course and Immediate Outcomes by Hemoptysis Severity (N = 60)

Outcome / Parameter	Moderate (n = 36)	Massive (n = 24)	p-value (chi-square / Fisher's exact)
Initial hemostasis achieved (conservative), n (%)	35 (97.2)	20 (83.3)	0.042
Required blood transfusion, n (%)	8 (22.2)	16 (66.7)	<0.001
ICU admission required, n (%)	2 (5.6)	9 (37.5)	0.001
Mechanical ventilation required, n (%)	0 (0.0)	4 (16.7)	0.012
Hospital length of stay (days), M ± SD	6.80 ± 2.90	11.40 ± 5.10	<0.001 (t-test)
In-hospital mortality, n (%)	1 (2.8)	4 (16.7)	0.048

Table 4 presents Kaplan-Meier survival estimates for freedom from rebleeding over the 3-month post-discharge period. The cumulative proportion remaining free of recurrence was 88.3% at 1 month, 81.7% at 2 months, and 76.7% at 3 months, yielding an overall 3-month recurrence rate of 23.3% (14/60 events).

Table 4: Kaplan-Meier Estimates of Freedom From Rebleeding Post-Discharge (N = 60)

Time Point (Months Post-Discharge)	At Risk (n)	Events (n)	Cumulative Proportion Without Rebleeding	Standard Error	95% CI Lower	95% CI Upper
0–1	60	7	0.883	0.042	0.801	0.965
1–2	53	4	0.817	0.050	0.719	0.915
2–3	49	3	0.767	0.055	0.659	0.875

Table 5 presents inferential analysis of factors associated with hemoptysis recurrence within 3 months using chi-square/Fisher's exact tests. Massive hemoptysis at presentation ($p = 0.024$; OR 3.72), previous pulmonary tuberculosis history ($p = 0.038$), aspergilloma etiology ($p = 0.012$; OR 8.80), active tuberculosis ($p = 0.041$), and presence of any comorbidity ($p = 0.024$) were significantly associated with higher recurrence risk. Diabetes showed a trend toward significance ($p = 0.078$).

Table 5 Factors Associated With Hemoptysis Recurrence Within 3 Months Post-Discharge (N = 60)

Factor	Recurrence (n = 14) n (%)	No Recurrence (n = 46) n (%)	p-value (chi-square/ Fisher's exact)	Odds Ratio (95% CI)
Massive hemoptysis (vs. moderate)	9 (64.3)	15 (32.6)	0.024	3.72 (1.05–13.18)
Previous pulmonary TB history	12 (85.7)	28 (60.9)	0.038	3.86 (0.77–19.34)
Aspergilloma etiology	4 (28.6)	2 (4.3)	0.012	8.80 (1.42–54.62)
Active TB (vs. all other etiologies)	6 (42.9)	8 (17.4)	0.041	3.56 (1.00–12.68)
Diabetes mellitus	5 (35.7)	7 (15.2)	0.078	3.11 (0.81–11.96)
Smoking (current or former)	11 (78.6)	31 (67.4)	0.412	1.78 (0.44–7.21)
Comorbidities present (any)	9 (64.3)	15 (32.6)	0.024	3.72 (1.05–13.18)

Note. p-values from chi-square or Fisher's exact test. Odds ratios and 95% confidence intervals calculated for significant and borderline associations.

DISCUSSION

Among the 60 enrolled patients, tuberculosis—either active disease or post-treatment sequelae—emerged as the predominant etiology, accounting for 66.7% of cases. This finding aligns closely with multiple Indian series from high-prevalence regions, where post-tuberculous structural lung damage remains the leading substrate for significant hemoptysis, often exceeding 60–80% in tertiary hospital cohorts. The high proportion of prior tuberculosis history (66.7%), with a mean interval of 7.10 ± 4.90 years since treatment completion, underscores the long-term vascular and parenchymal consequences of inadequately treated or relapsed disease, including fibrocavitary lesions, traction bronchiectasis, and mycetoma formation.

Conservative management was the initial strategy for all patients, incorporating bed rest, lateral decubitus positioning, tranexamic acid, antitussives, oxygen support, and blood products as required. This approach achieved initial hemostasis in 97.2% of moderate hemoptysis cases but only 83.3% of massive cases ($p = 0.042$), reflecting the well-documented limitations of non-interventional therapy when bleeding volume exceeds 100–600 mL/24 h or causes hemodynamic compromise.

Massive hemoptysis was associated with markedly worse in-hospital outcomes: higher rates of blood transfusion (66.7% vs. 22.2%; $p < 0.001$), ICU admission (37.5% vs. 5.6%; $p = 0.001$), mechanical ventilation (16.7% vs. 0%; $p = 0.012$), prolonged hospital stay (11.40 ± 5.10 vs. 6.80 ± 2.90 days; $p < 0.001$), and in-hospital mortality (16.7% vs. 2.8%; $p = 0.048$).

Post-discharge follow-up revealed a cumulative 3-month recurrence rate of 23.3% (14/60 events), with Kaplan-Meier estimates showing freedom from rebleeding declining from 88.3% at 1 month to 76.7% at 3 months. This intermediate-term recurrence rate falls within the 15–35% range reported in prospective studies from tuberculosis-endemic settings employing predominantly conservative strategies. The majority of rebleeding events occurred within the first two months, highlighting the critical vulnerability period following hospital discharge when patients resume normal activity, cough reflex returns, and collateral bronchial artery recruitment or incomplete resolution of infection may precipitate recurrent hemorrhage [10].

Inferential analysis identified several factors significantly associated with 3-month recurrence. Massive hemoptysis at presentation conferred 3.72-fold increased odds (95% CI 1.05–13.18; p = 0.024), confirming severity as a strong predictor of early rebleeding. Previous pulmonary tuberculosis history (OR 3.86; p = 0.038) and aspergilloma etiology (OR 8.80; p = 0.012) were also strongly linked to recurrence, likely reflecting persistent structural abnormalities and fungal superinfection that promote ongoing vascular fragility [11].

Active tuberculosis showed a significant association (OR 3.56; p = 0.041), emphasizing the importance of prompt and complete anti-tuberculous therapy. Presence of any comorbidity (OR 3.72; p = 0.024) and a trend for diabetes mellitus (p = 0.078) further suggest that metabolic and systemic factors impair vascular healing and increase susceptibility to rebleeding. Smoking history, while prevalent (70.0% ever-smokers), did not reach statistical significance (p = 0.412), possibly due to the overriding influence of tuberculosis-related pathology in this cohort [12].

The reliance on conservative management without routine bronchial artery embolization (BAE) in this study reflects institutional resource constraints common to many district-level medical college hospitals in India. While initial hemostasis rates were respectable in moderate cases, the higher failure rate, ICU utilization, and mortality in massive hemoptysis underscore the limitations of non-interventional approaches in life-threatening bleeding. Contemporary evidence from centers with ready access to interventional radiology demonstrates immediate hemostasis rates of 85–98% with superselective BAE, together with substantial reductions in early recurrence when combined with etiology-specific therapy [13]. The absence of routine BAE in the present series likely contributed to the observed recurrence and mortality burden, particularly among patients with massive bleeding or aspergilloma [14].

Several limitations warrant consideration. The single-center design and modest sample size (n = 60) may limit generalizability, although the etiological and outcome patterns are highly representative of similar public-sector facilities in high-TB-prevalence regions of South India. Hemoptysis volume was estimated from patient/relative reports and observation rather than precise volumetric measurement, introducing potential recall bias. The predominantly conservative management strategy reflects real-world practice but precludes direct comparison with interventional cohorts. Follow-up relied partly on telephonic contact, which, while practical in resource-limited settings, may underestimate minor recurrence episodes not prompting medical attention.

Despite these constraints, the study offers valuable insights into the natural history and short-term prognosis of moderate to massive hemoptysis managed conservatively in a typical Indian tertiary setting. The high prevalence of tuberculosis-related etiology, substantial early recurrence rate, and clear prognostic impact of severity, prior TB, aspergilloma, and comorbidities emphasize the need for risk-stratified follow-up protocols, aggressive etiological treatment, and, where feasible, early referral for bronchial artery embolization in massive or recurrent cases. Strengthening interventional radiology capacity at district medical college hospitals, integrating multidisciplinary care pathways, and ensuring uninterrupted anti-tuberculous therapy could substantially improve outcomes in similar high-burden environments.

CONCLUSION

This prospective study confirms that moderate to massive hemoptysis in resource-constrained settings remains a challenging entity dominated by post-tuberculous pathology, with conservative management achieving reasonable initial control in moderate cases but exposing patients with massive bleeding to higher morbidity, mortality, and recurrence risk. The findings reinforce the importance of etiology-directed therapy, close post-discharge surveillance, and advocacy for expanded access to interventional procedures to mitigate the substantial burden of rebleeding and adverse events observed in the critical 3-month period following hospital discharge.

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