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# Hemoptysis: Etiology, Evaluation, and Outcome in a Tertiary Referral Hospital\*

Boaz Hirshberg, MD; Iftah Biran, MD; Mendel Glazer, MD; and Mordechai R. Kramer, MD, FCCP

**Objectives:** Hemoptysis, an important and alarming symptom, often indicates serious disease. This study was designed to assess the different causes of hemoptysis, the relative importance of the different diagnostic modalities employed, and the outcome in an Israeli population cohort.

**Design:** A retrospective analysis of 208 patients with hemoptysis at the Hadassah University Hospital, Jerusalem, Israel between January 1980 and August 1995.

**Results:** Bronchiectasis (20%), lung cancer (19%), bronchitis (18%), and pneumonia (16%) accounted for most causes of hemoptysis. In contrast to older studies, active tuberculosis was a rare finding (1.4%). Bronchiectasis and bleeding diathesis were major causes of moderate to severe hemoptysis while bronchitis and lung cancer were commonly associated with milder degrees of bleeding. CT scan was the most sensitive diagnostic test when employed alone, with a positive yield of 67%. However, it failed to locate at least three cases of lung cancer. When combining a CT study together with a bronchoscopy, the positive yield increased to 93%. The mortality rate for patients with mild to moderate hemoptysis was low (2.5% and 6%, respectively), while patients with massive hemoptysis had high mortality rates (38%). Patients with lung cancer or bleeding diathesis had higher mortality rates compared with the rest of the cohort.

**Conclusions:** Hemoptysis is a common symptom with a good prognosis in most cases. However, patients exhibiting massive bleeding or those with lung malignancy and patients with bleeding diathesis had a poorer prognosis. Patients older than 50 years with a positive smoking history need an extensive evaluation and follow-up to exclude lung carcinoma. The combined use of bronchoscopy and chest CT has the best yield in evaluating hemoptysis.

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**Key words:** bronchiectasis; bronchoscopy; chest CT; hemoptysis; lung cancer; tuberculosis

Hemoptysis is often an alarming presenting symptom. The etiology for hemoptysis varies among different series according to time of publication, the geographic location, and the diagnostic tests employed. The effective control of tuberculosis in Western countries has contributed to this change.<sup>1-10</sup> In these studies, the relation between the cause of the hemoptysis and the amount of bleeding is not well defined.

The common diagnostic evaluation usually consists of a plain chest radiograph, a CT of the chest, and a fiberoptic bronchoscopy. Bronchoscopy is also important for localizing the bleeding site, but a consen-

sus regarding the evaluation algorithm for these patients is still lacking.<sup>11-18</sup>

The purpose of this study was to evaluate the relative frequency of different causes of hemoptysis, specific risk factors, the value of the evaluation process, and the outcome in an Israeli cohort population.

## MATERIALS AND METHODS

We retrospectively reviewed the records of both inpatients and outpatients with hemoptysis at the Hadassah University Hospital, Jerusalem, Israel. Between January 1980 and August 1995, 249 inpatient and 50 outpatient files were identified. Ninety-one files were excluded owing to lack of adequate information or they were files of children younger than 13 years old. After exclusion, 208 files were evaluated.

Medical records with a hospital discharge diagnosis of hemoptysis were reviewed for the following information: age, sex, medical history, the amount of bleeding as determined by the admitting physician, the clinical course, evaluation, treatment, final diagnosis, and outcome. A diagnostic modality was considered positive if it led to the final diagnosis. We assessed whether the bronchoscopic evaluation was diagnostic, located the bleeding site, or was therapeutic.

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Hemoptysis was defined as bleeding originating from the lower respiratory tract.<sup>1</sup> We divided the patients into three groups based on the amount of bleeding: trivial (drops of blood, bloody sputum), moderate (<500 mL/24h, 1 to 2 cups), and massive (>500 mL/24 h, more than 2 cups).

## RESULTS

Of the 208 patients evaluated, 127 (61%) were male and 81 (39%) were female. The average age was 58±17 years with a range of 20 to 96 years of age. One hundred ten (53%) patients had a positive smoking history and most of them were male (90/110, 82%).

### Diagnosis

The causes of hemoptysis are listed in Table 1. Bronchiectasis, lung cancer, bronchitis, and pneumonia were the most common causes of hemoptysis in our population. Bronchitis was diagnosed when a patient had symptoms consistent with upper airway infection and normal chest radiographs. Pneumonia was bacterial in origin in most cases. Other causes were fungal in three patients and Echinococcus in two patients. Two patients had lung abscess. No diagnosis was reached in 17 (8%) patients, 14 of whom underwent bronchoscopy and 4 of whom had a CT. It should be noted that active tuberculosis was the cause of hemoptysis in only three patients (1.4%). Of the patients with lung cancer, 21 of 39 (54%) had a primary bronchogenic carcinoma and 18 of 39 (46%) had metastatic carcinoma with lung involvement. The types of lung malignancy are listed in Table 2. The most common primary lung cancer was small cell carcinoma (11/21, 52%) followed by squamous cell carcinoma (29%) and adenocarcinoma (19%). Metastases were commonly secondary to breast and larynx cancer (22% each), while melanoma accounted for 17%. The patients with primary bronchogenic carcinoma tended to be older (67±11

**Table 2—Type of Lung Malignancy**

Primary Cancer	No. (%)	Secondary Cancer	No. (%)
Small cell carcinoma	11 (52)	Breast	4 (22)
Squamous cell carcinoma	6 (29)	Larynx	4 (22)
Adenocarcinoma	4 (19)	Melanoma	3 (17)
		Lymphoma	2 (11)
		Other*	5 (28)
Total	21 (100)	Total	18 (100)

\*Other causes of metastatic cancer: spindle cell carcinoma, synovial sarcoma, thyroid carcinoma, colon carcinoma, renal cell carcinoma (one each).

years with a range of 46 to 82 years) with a positive smoking history (18 of the 21, 86%). Of the non-smokers with bronchogenic carcinoma, one was 53 years of age and the other two were older than 80 years.

Bleeding diathesis was iatrogenic in five patients (anticoagulant therapy) and secondary to thrombocytopenia in three patients with hematologic malignancies.

In two patients, systemic hypertension was the sole cause of hemoptysis. In these cases, bleeding from upper airways was excluded and was seen originating from the lower airways by bronchoscopy. The bleeding was closely associated with fluctuations in BP. The primary event was severe hypertension followed by hemoptysis. Only after lowering the BP did the bleeding stop.

### Severity of the Hemoptysis

Eighty (38%) patients had trivial bleeding, 99 (48%) had moderate bleeding, and 29 (14%) had massive bleeding. Lung cancer and bronchitis were associated with mild to moderate amounts of bleeding (90% and 95%, respectively), while patients with bleeding diathesis and bronchiectasis had moderate to severe hemoptysis (78% and 75%, respectively).

**Table 1—Cause of Hemoptysis**

Diagnosis	Trivial, No. (%)	Moderate, No. (%)	Severe, No. (%)	Total	Percent
Bronchiectasis	9 (22)	26 (63)	6 (15)	41	20
Lung cancer	15 (38)	20 (51)	4 (10)	39	19
Bronchitis	18 (49)	17 (46)	2 (5)	37	18
Infection, pneumonia	15 (45)	11 (33)	7 (21)	33	16
Unknown	8 (47)	9 (53)	0	17	8
Hemorrhagic diathesis	2 (25)	2 (25)	4 (50)	8	4
Congestive heart failure	6 (75)	2 (25)	0	8	4
Other*	7 (28)	12 (48)	6 (24)	25	11
All diseases	80 (38)	99 (48)	29 (14)	208	100

\*Pulmonary emboli, five (2%); bronchial adenoma, four (2%); mitral stenosis, 1%; tuberculosis, 1.4%; systemic hypertension, 1%; pulmonary hypertension, 1%; trauma, 1%; vasculitis, 1%; lipoid pneumonia, 1%; radiation pneumonitis, 1%.

Bronchoscopy was performed more often on the patients with moderate and severe hemoptysis (74% and 72%, respectively) compared with patients with mild hemoptysis (54%) (Table 3). Bronchoscopy was considered to be diagnostic in 57 of 137 (42%) patients. Positive results were found more often in the group with mild hemoptysis (54%) compared with the groups with moderate and severe hemoptysis (36% and 24%, respectively). However, bronchoscopy was more successful in locating the bleeding site in patients with moderate to severe hemoptysis (64% and 67%) than in those with mild hemoptysis in whom the bleeding site was located in 49% of cases. The bronchoscopy was considered therapeutic (when topical vasoconstriction, Fogarty balloon, or laser was applied to control the bleeding) in 10% of the patients (14/137).

The positive diagnostic yield of bronchoscopy was greater when the chest radiograph was abnormal (34/62, 55%) compared to the yield when the chest radiograph was normal (23/75, 31%). Twenty-two of 41 (54%) patients with an abnormal chest CT scan had a positive bronchoscopy, while only 7 of 18 (38%) patients with a normal CT scan had a positive bronchoscopy. Of the seven patients with a normal CT, three had lung cancer and four had infectious causes.

The chest CT had the best yield among the different diagnostic procedures employed. When both chest CT and bronchoscopy were employed, the positive yield increased to 93%.

The outcomes of these patients are listed in Table 4. The patients with massive hemoptysis who survived had a longer hospital stay, needed surgery, and had a higher mortality rate. Higher mortality rate was also associated with bleeding diathesis (3/8 patients, 38%) and patients with lung cancer (8/39, 21%). The cause of death varied according to the amount of bleeding. In the group with trivial bleeding, both patients died due to infection. Infection (bacterial) was the main cause of death in the group

**Table 4—Outcome of Patients According to the Amount of Bleeding**

Hemoptysis	No. of		
	Hospitalization Days	Surgery (%)	Death (%)
Trivial	8.1±8	4/80 (5)	2/80 (2.5)
Moderate	9.5±7.7	9/99 (9)	6/99 (6)
Massive	19.3±21.1	5/29 (17)	11/29 (38)
Total	10.3±11.2	18/208 (8)	19/208 (9)

with moderate bleeding. In this group, none died because of the bleeding itself. However, bleeding was the direct cause of death in 8 of 11 patients with massive bleeding. The main reason for surgery in the group with massive bleeding was an attempt to control the bleeding. Surgery was performed for the underlying cause in the groups with trivial and moderate amounts of bleeding (eg, lung tumors). Surgery was an effective and safe method for control of bleeding. Only one patient died following a surgical procedure.

DISCUSSION

Bronchiectasis, lung cancer, bronchitis, and pneumonia are the leading causes of hemoptysis in the cohort studied. Most of the data regarding hemoptysis are based on retrospective studies published between 1930 and 1960, although new data have been gathered lately in studies that examined the utility of CT scan and fiberoptic bronchoscopy in the evaluation of hemoptysis. In most of the studies, one can find a bias secondary to patient selection or the diagnostic investigation employed. Table 5 shows the main causes of hemoptysis in different series in about 1,800 cases.

Tuberculosis was reported as an important cause of hemoptysis in older articles.<sup>5-8</sup> In the series of Abbot<sup>5</sup> from Atlanta, in the 1940s, the main diagnosis was active tuberculosis in 22% and bronchiectasis in 21% of the cases. Higher rates were reported by Heller<sup>8</sup> (39% of cases) and lower rates were reported by Moersch<sup>6</sup> in 1952 and Souders and Smith<sup>7</sup> in 1952 who thought that incidence of tuberculosis was underestimated because patients with known tuberculosis were not referred for bronchoscopic evaluation. Based on these studies, tuberculosis was considered a main cause of hemoptysis together with bronchiectasis and tumors.

In the last decade, tuberculosis is still an important cause of hemoptysis in areas with a high prevalence of the disease such as Africa<sup>3,9,10</sup> and inner-city New York.<sup>11</sup> Knott-Craig et al<sup>3</sup> from Tygerberg, South Africa, found tuberculosis as a cause of hemoptysis in

**Table 3—Evaluation of Patients With Hemoptysis**

Diagnostic Procedure	Performed (%)	Positive Results* (%)
Chest radiograph	208/208 (100)	104/208 (50)
CT scan	70/208 (34)	47/70 (67)
Ventilation perfusion scan	19/208 (9)	4/19 (21)
Angiography	4/208 (2)	1/4 (25)
Bronchoscopy	137/208 (66)	57/137 (42)
Bronchoscopy + CT	59/208 (28)	55/59 (93)

\*Positive result: any abnormal finding that contributed to the final diagnosis.

**Table 5—Main Causes of Hemoptysis in Different Series\***

	Abbott <sup>5</sup>	Souders and Smith <sup>7</sup>	Moersch <sup>6</sup>	Johnston and Reisz <sup>4</sup>	Alaoui et al <sup>10</sup>	Knott-Craig et al <sup>3</sup>	Santiago et al <sup>2</sup>	McGuinness et al <sup>11</sup>	Present Study
Year(s) of study	1940-47	1941-51	1950	1977-85	1985-90	1983-90	1974-81	1991-92	1980-95
Location	Atlanta	Lahey Clinic, Boston	Mayo Clinic	Kansas City	Casablanca, Morocco	South Africa	Los Angeles	New York	Jerusalem, Israel
No. of cases	497	105	200	148	291	120 (massive bleeding)	264	57	208
Bronchiectasis, %	21	<b>28.5</b>	26.5	1	15	51% (all had TB)	0.5	<b>25</b>	<b>20</b>
Carcinoma, %	21	3	<b>29.5</b>	19	<b>34</b>	5	<b>29</b>	12	19
Bronchitis, %	2	12.4	9	<b>37</b>	3.5	—	23	5	18
Pneumonia, %	2	1	8	5	7	4	11	12	16
Tuberculosis, %	<b>22</b>	1.9	5.5	7	19	<b>73</b>	6	16	1
Unknown, %	4	18	—	3	3	8	<b>22</b>	19	8
Others, %	28	35	21.5	28	18.5	10	9	5	18

\*Number in bold indicates highest figure. TB=tuberculosis.

73% of patients and Domoua et al<sup>9</sup> from Abidjan, Ivory Coast, reported 49.5% of hemoptysis cases. Alaoui et al<sup>10</sup> from Casablanca, Morocco, reported that carcinoma, tuberculosis, and bronchiectasis were the most common findings (34.4%, 18.9%, 15.1%, respectively). McGuinness et al<sup>11</sup> prospectively studied hemoptysis at Bellevue Hospital, New York, and found that bronchiectasis accounted for 25% of cases and tuberculosis for 16%. In our cohort, active tuberculosis was a rare finding, a fact reflecting the low incidence of tuberculosis in Israel.

The finding of bronchiectasis as a main cause of hemoptysis in our cohort differs from recently published articles.<sup>2,4</sup> Johnston and Reisz<sup>4</sup> reported that bronchiectasis caused only 1% of cases in Kansas City between 1977 and 1985. The authors believe that they underdiagnosed this entity because bronchography was rarely used. They did not state whether they utilized CT studies in the evaluation of their patients. Santiago et al<sup>2</sup> in west Los Angeles reported the incidence of bronchiectasis (0.5%). Bronchiectasis was probably underdiagnosed in this study due to the lack of utilization of bronchography and high-resolution CT scan (unavailable then). The finding of bronchiectasis as a main cause for hemoptysis in our study is probably secondary to remote nonactive infection by tuberculosis or other infections. A substantive number of the older Israeli population may have been exposed to tuberculosis during the Holocaust era in Europe or have come from countries with high prevalence of tuberculosis such as Iraq and Morocco. It should be expected that owing to the decreased incidence of tuberculosis in our area and effective antibiotic therapy, we will see a decline in bronchiectasis as a cause of hemoptysis.

The findings of lung cancer and bronchitis as other

main causes reflect the predominantly male cigarette smoking cohort. These findings are similar to those of most of the studies cited in this article.

Most patients underwent a thorough investigation to find the cause of the hemoptysis. We found that CT had the best yield in the search for a cause but, more importantly, the combined use of both high-resolution CT scan and bronchoscopy increased the positive yield to 93%. McGuinness et al<sup>11</sup> and Set et al<sup>14</sup> demonstrated similar findings. They have shown that bronchoscopy was unreliable in detecting peripheral lesions while CT was insensitive to early mucosal abnormalities. In our cohort, CT alone failed to locate three cases of lung cancer that were successfully diagnosed with bronchoscopy. Based on these findings, we conclude that CT scan and fiberoptic bronchoscopy are complementary modalities.

Bronchoscopy performed in patients with massive hemoptysis had a low yield of positive diagnostic value (24%). However, bronchoscopy located the bleeding site in up to 67% of the patients. This is of value early in the course of the illness, especially if surgery, such as lobectomy, is indicated due to life-threatening bleeding.

Patients with primary lung carcinoma were older, mostly male, and had a positive smoking history. Similar results have been described elsewhere.<sup>11,18</sup> Based on these results, we believe that patients older than 50 years of age with a positive smoking history should undergo a combined diagnostic procedure of bronchoscopy and CT scan to locate a possible malignancy.

The amount of bleeding usually correlated well with the length of hospital stay and the outcome of the patients. While patients with minimal hemoptysis had a shorter stay and generally had a good progno-

sis, patients with massive hemoptysis required a longer hospital stay, more surgical intervention, and had a graver prognosis.

The outcome of hemoptysis is generally good, with most patients surviving and released home. We identified two groups with increased risk. One included patients with bleeding diathesis who usually had a greater amount of bleeding with a high mortality rate, probably reflecting the difficulty in controlling the bleeding. The other group included patients with lung malignancy, mostly bronchogenic carcinoma. Infection was the main cause of death in the groups with trivial to moderate bleeding. In those groups, none died because of the bleeding itself.

Although this study gives a good idea of the etiology of hemoptysis in our cohort, it is limited by its retrospective nature. Furthermore, the evaluation and therapeutic decisions were not based on a preset protocol but rather on the clinical experience of each attending physician.

In conclusion, mild or moderate hemoptysis has a generally good prognosis. Patients exhibiting massive bleeding or patients with lung carcinoma or with bleeding diathesis have a poor outcome, although death is not always related to the bleeding itself. Patients older than 50 years with a positive smoking history are at increased risk for primary lung carcinoma and therefore need an extensive evaluation and follow-up. The combined use of bronchoscopy and chest CT probably gives the best diagnostic yield. Although active tuberculosis was a rare cause of hemoptysis, bronchiectasis from a remote infection is still a major cause for hemoptysis in our area.

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