

Hemoptysis: Diagnosis and Treatment Strategies in a Tertiary Care Hospital

Hemoptisis: diagnóstico y estrategias de tratamiento en un hospital de tercer nivel

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ABSTRACT

Hemoptysis is defined as the expectoration of blood from the tracheobronchial tree, typically originating from bronchial arteries. Once the presence and bleeding site are confirmed, one must choose among different methods for managing hemoptysis, each with its own benefits and limitations. Bronchial artery embolization is a minimally invasive endovascular technique. It has become the method of choice for treating massive and recurrent hemoptysis. Its success rate in the first episode is over 80%. The recurrence rate after the procedure ranges from 10% to 55%, in which surgery may play an important role.

Objectives: To describe the demographic and clinical characteristics, the etiological diagnosis and treatment of patients with hemoptysis at a tertiary care level hospital in the City of Mexico.

Materials and methods: Retrospective study of patients diagnosed with hemoptysis during the period from January 2014 to December 2016. The data were obtained from the clinical records.

Results: A total of 34 patients with a mean age of 52 years were studied, with a predominance of males (52.9%). The etiology of hemoptysis was tuberculosis (45.5%), neoplasms (20.6%), bronchiectases (15.2%), and arteriovenous malformation (6.1%). The most frequent embolization site was the right upper bronchial artery (56.6%), followed by the left lower bronchial artery (23.3%); and a group of 6 patients (18.7%) required a second embolization procedure due to recurrence of bleeding.

Conclusion: The management of hemoptysis should be comprehensive. The main objective is to maintain airway permeability and evaluate each patient for optimal management based on the type and etiology of the hemoptysis.

Key words: Hemoptysis; Embolization; Treatment; Surgery

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RESUMEN

La hemoptisis se define como la expectoración de sangre del árbol traqueobronquial, por lo general se origina en las arterias bronquiales. Una vez confirmada la presencia y el sitio de sangrado se debe elegir entre los diferentes métodos de manejo de la hemoptisis, cada uno con sus beneficios y limitaciones. La embolización de arterias bronquiales es una técnica endovascular mínimamente invasiva. Se ha convertido en el método de elección para tratar hemoptisis masiva y recurrente. Tiene una tasa de éxito en el primer episodio superior al 80%. La tasa de recurrencia posterior al procedimiento va de un 10% a un 55%, en el cual la cirugía llega a tener un papel de importancia.

Objetivos: Describir las características demográficas, clínicas, diagnóstico etiológico y tratamiento de pacientes con hemoptisis en un hospital de tercer nivel de la Ciudad de México.

Material y métodos: Estudio retrospectivo de pacientes con diagnóstico de hemoptisis en el periodo comprendido entre enero de 2014 a diciembre de 2016. Los datos fueron obtenidos del expediente clínico.

Resultados: Se estudiaron 34 pacientes media de edad 52 años, con predominio en hombres (52,9%). La etiología de la hemoptisis fue tuberculosis (45,5%), neoplasias (20,6%), bronquiectasias (15,2%), malformación arteriovenosa (6,1%). El sitio de embolización más frecuente fue la arteria bronquial superior derecha (56,6%), seguido de la arteria bronquial inferior izquierda (23,3%) y un grupo de 6 pacientes (18,7%) requirieron un segundo evento de embolización por recurrencia del sangrado.

Conclusión: El manejo de la hemoptisis debe de ser integral. El objetivo principal es mantener una vía aérea permeable y evaluar cada paciente para un manejo óptimo de acuerdo al tipo y etiología de la hemoptisis.

Palabras clave: Hemoptisis; Embolización; Tratamiento; Cirugía

INTRODUCTION

Hemoptysis is defined as the expectoration of blood from the tracheobronchial tree, typically originating from bronchial arteries.¹⁻⁷

Its severity can vary and may require urgent in-hospital management. The prevalence varies depending on the region under study. When approaching a patient with hemoptysis, the first step is to confirm the presence of airway bleeding and then identify the precise site in order to establish the etiology and determine the most appropriate treatment.¹

Approximately 95% of hemoptysis cases are self-limiting, while the rest can be potentially fatal. Although there is no international consensus for its classification, it is generally accepted that massive hemoptysis is that which can lead to respiratory failure and patient's death. Regarding the volume of blood, it varies widely from 100 mL to 600 mL with no defined time frame.^{3, 5, 8, 9}

During the initial assessment, a chest X-ray is the first study to be performed.⁷ However, the absence of visible abnormalities does not rule out the presence of a lesion, neoplasm, or other pathology causing hemoptysis, as its sensitivity is only 50%.^{1, 5, 6}

Therefore, it is recommended that the evaluation should be complemented with a computed tomography (CT) scan, and if possible, a multi-detector computed tomography angiography (MDCT angiography). The MDCT angiography provides comprehensive anatomical coverage that reduces respiratory motion artifacts. It has almost 100% accuracy in identifying bleeding from bronchial arteries and also shows vascular anatomy, which is useful for therapeutic planning,^{1, 5, 9} whose primary objective is to control the bleeding.¹⁰

There is controversy about the use of the bronchoscopy in patients with bleeding. The rigid bronchoscopy offers good visibility and the possibility to aspirate clots and secretions, with the benefit of

being able to ventilate the patient simultaneously. However, various publications report only a 50% success rate in locating the bleeding site.^{3, 11}

Bronchial artery embolization (BAE) is a minimally invasive endovascular technique that has become the method of choice for treating massive and recurrent hemoptysis. It has a success rate of more than 80% in the first event.^{3, 5, 7} The recurrence rate of hemoptysis post-embolization ranges from 10% to 55%, so surgery plays a crucial role among therapeutic options through the resection of the affected lung tissue.^{8, 12}

The objective of this article is to describe the demographic and diagnostic characteristics and the therapeutic approaches used in patients with hemoptysis at a reference hospital.

MATERIALS AND METHODS

A retrospective study was conducted at the Instituto Nacional de Enfermedades Respiratorias Ismael Cosío Villegas during the period from January 2014 to December 2016. The study included patients older than 18 years diagnosed with hemoptysis who were treated in the Emergency Department and admitted to the hospital, and then underwent embolization at the Hemodynamics Service. Patients with incomplete medical records were excluded.

The clinical data collected included demographic information (age, gender), associated comorbidities (diabetes, hypertension, tuberculosis, smoking), etiology of hemoptysis, management of hemoptysis, bleeding time, length of hospital stay, characteristics of embolizations, and surgeries.

The bleeding time was measured from time of arrival in the Emergency Department until treatment. All patients underwent computed tomography angiography and bronchoscopy to confirm the bleeding and its etiology.

Ethical considerations

This study was conducted in accordance with the guidelines of the Ethics Committee of the Instituto Nacional de Enfermedades Respiratorias Ismael Cosío Villegas, following the protocol with the evaluation of medical records and in accordance with the Declaration of Helsinki (1964).

Statistical analysis

Categorical variables are presented as frequency and percentage. For quantitative variables, the Shapiro-Wilk test was conducted to determine the distribution of each variable. Variables with normal distribution are presented with mean and standard deviation, while variables without normal distribution are presented with median and percentiles (25th-75th). Statistical analysis was performed using the STATA program, version 14 (Stata Corporation, College Station, Texas, USA). A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 34 patients with hemoptysis who underwent embolization were included in the study. 52.9% were men, with a mean age of 52.4 ± 14.5 years. The volume of bleeding was 225 mL (ranging from 100 to 350 mL), and the mean evolution time before treatment was 3 days (Table 1).

The following comorbidities were found: diabetes mellitus (DM) in 38.2% of cases, systemic arterial hypertension (SAHT) in 20.5%, and pulmonary tuberculosis (PTB) in 38.2% (Table 1). Regarding the etiology of the bleeding, PTB was identified as the primary cause in 46.8% of cases, followed by neoplasms in 31.2%, bronchiectases in 15.6%, and arteriovenous malformation (AVM) in 6.2%. After confirming the bleeding and its origin through the CT angiography, the patients underwent embolization at the Hemodynamics Service (Table 1).

TABLE 1. Basal characteristics

Variable n (%)	All n = 34
Gender (masculine)	18 (52.9)
Age (years)	52.4± 14.5
Days of hospital stay (n = 33)	18 (9-27)
Volume of bleeding (n = 30)	225 (100-350)
Bleeding time * (days)	3± 2.25
Smoking	13 (38.2)
Smoking (pack/years) (n = 12)	10.1 (6.3-23.5)
Biomass	6 (18.2)
Exposure to wood smoke	15 (44.1)
WSEI (n= 20)	50 (8-144)
Diabetes	13 (38.2)
Hypertension	7 (20.6)
Tuberculosis	14 (41.2)
Etiology	
Tuberculosis	15 (45.5)
Neoplasm	7 (20.6)
Aspergilloma	1 (3.1)
Bronchiectases	5 (15.2)
Arteriovenous malformation	2 (6.1)
Undiagnosed	4 (9.5)

Categorical variables are expressed as n (%). Continuous variables are shown as mean ± SD or median (p 25-75). SI: smoking index; WSEI: wood smoke exposure index, HS: hospital stay

TABLE 2. Arteries involved in the management of embolizations and surgeries

Total number of embolizations	n (%)
1	n (%)
2	26 (81.25)
Embolized artery	6 (18.75)
Upper bronchial artery	
Right	17 (56.6)
Left	6 (20)
Upper bronchial artery	
Right	7 (23.3)
Left	3 (10)
Mammary arteries	
Right	2 (6.7)
Left	6 (20)
Phrenic arteries	
Right	1 (3.3)
Left	2 (6.7)
Intercostal arteries	
Right	0
Left	2 (6.5)
Arteriovenous malformations	2 (6.5)
Embolization material	
COIL	2 (6.3)
Alcohol microspheres* (PVA)	30 (93.7)
<i>Surgical interventions</i>	
Bronchoscopy	13 (39.4)
Surgery	9 (27.3)
Lobectomy	5 (15.6)
Middle lobectomy	1 (20)
Right lower lobectomy	3 (60)
Left upper lobectomy	1 (20)
Pneumonectomy	1 (11.1)
Segmentectomy	2 (22.2)
Tumor/lesion resection	1 (3.2)
Surgical complications	
Post-surgical bleeding	2 (22.2)

*PVA: polyvinyl alcohol. Categorical variables are presented as n and percentage [n (%)]

The bleeding was successfully controlled in the first procedure for 81.2% of the patients, while 18.7% of the individuals required a second embolization due to recurrence. In 93.7% of the cases, microspheres of alcohol were used, and 6.4% were treated with coils. The most commonly embolized arteries were bronchial arteries (n = 10), mam-

mary arteries (n = 8), and the phrenic artery (n=3) (Table 2).

Surgery was necessary for 9 patients, 5 of which required lobectomy: 3 in the right lower lobe, 1 in the left upper lobe, and 1 in the middle lobe. One patient had bleeding from a left cavitated lesion that required pneumonectomy due to extensive parenchymal damage, and one underwent non-anatomical pulmonary resection of the bleeding-causing lesion (Table 2).

DISCUSSION

A total of 34 patients who underwent embolization due to hemoptysis were evaluated, and a 81.2% success rate was found in the first event. 7 patients underwent surgery as definitive treatment. Six patients required a second embolization due to recurrent bleeding. Fructer et al reported that BAE is highly effective for hemoptysis control and has adequate long-term efficacy, except when the bleeding is secondary to lung cancer or bronchiectasis, where embolization is a temporary measure prior to surgery.¹³

While most cases of hemoptysis are self-limiting, the presence of massive bleeding can lead to a mortality rate ranging from 10% to 60%.¹³ In the same series by Furcher et al, the recurrence of bleeding within the first 30 days after embolization was reported at 31.2%, and 22.9% for the period of more than 30 days after embolization. Long-term recurrence following embolization ranges from 10% to 60% and is attributed to occluded vessel recanalization or neovascularization when the etiology has not been treated, such as in cases of aspergilloma and cancer.^{13, 14} 4 patients of our group experienced a new bleeding episode within one month of the initial embolization and required re-intervention, while in another patient, bleeding recurred at 93 days. Two patients (33.3%) of the group who experienced hemoptysis recurrence eventually underwent surgery as definitive treatment.

The most common embolization agents are polyvinyl alcohol (PVA), ranging from 150 μm to 1200 μm (with 300 μm to 500 μm being the most common size). PVA is non-absorbable and has a permanent occlusive effect. The use of microspheres of less than 300 μm is not recommended, as they could cross bronchopulmonary anastomoses of 325 μm and cause microinfarctions.^{9, 15}

In existing reports, the predominant causes of hemoptysis are pulmonary tuberculosis, bronchiectases, mycetomas, and cancer. Clearly, the source of the bleeding can be in the airway, the pulmonary parenchyma, or even the large-caliber vessels. It is important to consider that regardless of the cause, bleeding can occur in a volume significant enough to obstruct the airway and impede gas exchange. In our review, we found that nearly 45.5% of hemoptysis cases were caused by pulmonary tuberculosis, while cancer accounted for 20.6%, followed by bronchiectasis with 15.2%. The etiology of hemoptysis varies significantly according to the different reports due to the timing of the study and sociodemographic factors. Our data align with countries like China, Hong Kong, and India, where tuberculosis is the leading cause.^{1, 16, 17}

None of the patients we treated with embolization experienced bleeding of more than 350 mL, resulting in a stable evolution. Surgical resection is not recommended as the initial treatment for hemoptysis, though surgery has proven to be useful, particularly in cases of massive bleeding recurring within 72 hours or when an endovascular technique is not anatomically feasible. Surgery is also considered for lesions such as tumors or cavitations

with a risk of rebleeding. Among patients who underwent surgery, mortality rates ranging from 2% to 18% have been reported, but in emergency surgeries, the mortality rate rises to 50%.^{1, 16, 18}

Hemoptysis requires a well-organized multidisciplinary approach. Its presence has been associated with mortality rates between 25% and 50%. It can be classified based on its origin, the volume of the bleeding, or the etiology inducing it.¹⁹

This study provides an overview of the embolization treatment and offers insights into existing literature. Finally, it shows the management option suggested by a tertiary care institution. This study paves the way for a prospective evaluation to implement a management and treatment protocol for patient evolution (Figure 1).

Limitations

The main limitation of the study is the fact that the results are derived from a retrospective analysis and a single center. We believe that the obtained results are adequate for patients with hemoptysis undergoing embolization and are consistent with the existing literature. We propose conducting a prospective study and setting a unified care protocol to achieve better control over patient outcomes and evolution.

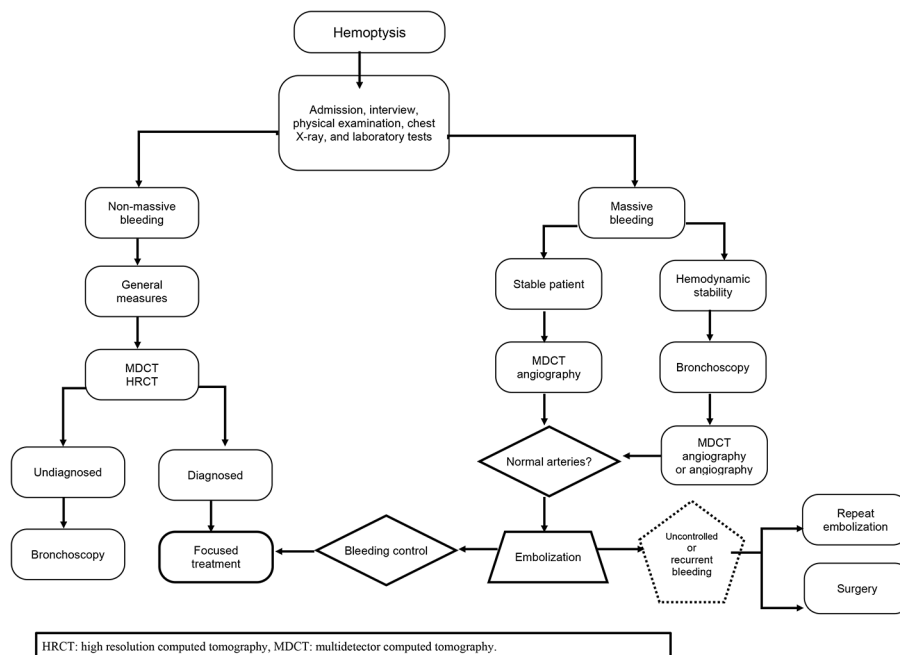


Figure 1. Algorithm for Diagnosis and Treatment

CONCLUSIONS

Patients with hemoptysis should be evaluated in units equipped with both human and material resources specialized in respiratory emergencies. Stabilizing a patient by securing the airway is of utmost importance; subsequently, the bleeding site should be identified, and as the first therapeutic option, embolization with polyvinyl alcohol microspheres or coils should be performed, with surgery as a last resort.

Conflict of interest

The authors of this article have no conflicts of interest among themselves or with any institution.

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