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Research

Bronchial Artery Embolization Treatment During COVID-19 Pandemic: A Single-center Experience

COVİD-19 Pandemisi Sırasında Bronşiyal Arter Embolizasyon Tedavisi: Tek Merkez Deneyimi

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ABSTRACT

Objective: Bronchial artery embolization (BAE) now serves as the standard treatment for hemoptysis. The aim of this study was to determine the characteristics and outcomes of the patients who undergo BAE during the coronavirus disease-2019 pandemic period.

Methods: We retrospectively investigated patients that presented to the hospital with hemoptysis and received bronchial arterial embolization treatment during the pandemic period. Age, gender, history of previous diseases, and related data were collected.

Results: The study was conducted with 11 patients whose 18.18% (n=2) were female and 81.81% (n=9) were male. The mean age of the patients is 61.27±10.94 and they stayed in hospital 21.18±19.59 days on average. Infection and bronchiectasis were seen as the leading cause of hemorhagee. Also, alveolar hemorrhage seen 81.8% (n=9) of the patients. Dilated bronchial arteries were seen on 72.7% (n=8) of the patients. Although 54.5% (n=6) of the patients admitted to the intensive care unit after the procedure, no complication or mortality seen in any patient during the procedure.

Conclusion: Bronchial arterial embolization is an effective minimally invasive technique for treating hemoptysis. This invasive procedure could be applied safely during the pandemic period.

Keywords: Bronchial artery embolization, hemoptysis, COVID-19

ÖZ

Amaç: Bronşiyal arter embolizasyonu (BAE) artık hemoptizi için standart tedavi olarak kullanılmaktadır. Bu çalışmanın amacı, koronavirüs hastalığı-2019 pandemisi döneminde BAE uygulanan hastaların özelliklerini ve sonuçlarını tespit etmektir.

Gereç ve Yöntem: Pandemi döneminde hemoptizi ile hastaneye başvuran ve BAE tedavisi alan hastaları retrospektif olarak incelendi. Yaş, cinsiyet, geçirilmiş hastalık öyküsü ve ilgili verileri toplandı.

Bulgular: Çalışma %18,18 (n=2) kadın, %81,81 (n=9) erkek olan 11 hasta ile gerçekleştirildi. Hastaların yaş ortalaması 61,27±10,94 olup, ortalama 21,18±19,59 gün hastanede yatış süresi vardı. Enfeksiyon ve bronşektazi kanamanın önde gelen nedeni olarak görüldü. Ayrıca hastaların %81,8'inde (n=9) alveoler hemoraji görüldü. Hastaların %72,7'sinde (n=8) genişlemiş bronşiyal arterler görüldü. İşlem sonrası yoğun bakıma yatırılan hastaların %54,5'inde (n=6), işlem sırasında ise hiçbir hastada komplikasyon veya mortalite görülmedi.

Sonuç: BAE hemoptizi tedavisinde etkili minimal invaziv bir tekniktir. Bu invaziv prosedür pandemi döneminde güvenle uygulanabilir.

Anahtar Kelimeler: Bronşiyal arter embolizasyonu, hemoptizi, COVİD-19

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INTRODUCTION

Hemoptysis is the expectoration of bleeding originating from the tracheobronchial tree or lung parenchyma (1). The annual frequency of the diagnosis of hemoptysis is 10% in patients with chronic lung disease, with an incidence in any outpatient being reported as approximately 0.1% (1,2). Although more than 90% of hemoptysis cases are self-limiting, it is still a potentially life-threatening emergency (3). The manifestation of hemoptysis can vary from streaks of blood in the phlegm to massive bleeding that can be fatal. Therefore, hemoptysis requires a rapid diagnosis and treatment, but it is difficult to diagnose (4). Massive hemoptysis is defined as 200 mL or more blood expectoration at a time or more than 500 mL blood in 24 h (5). Of the blood supply to the lungs, 99% is provided by the pulmonary arteries, which are responsible for gas exchange, and the remaining 1% by the bronchial arteries.

Considering the causes of hemoptysis, half of the cases are due to unknown bleeding, but inflammatory lung diseases (25%), bronchial carcinoma and metastases (17%), bronchiectasis (7%), and less frequently cardiovascular diseases and anticoagulant use can also be effective factors (6). Bronchial artery angiography with bronchial artery embolization (BAE) is a minimal invasive technique that has emerged as a standard treatment for hemoptysis (7). It involves selective bronchial artery catheterization and angiography, followed by embolization of any aberrant blood vessels discovered to stop the bleeding. Patients with large and recurring hemoptysis have been treated with BAE (8). However, rebleeding can occur even after an apparently successful BAE (9,10).

Coronavirus disease-2019 (COVID-19) is caused by a new coronavirus known as severe acute respiratory syndrome coronavirus-2. The first case emerged in Wuhan, China in -November 2019, and the disease rapidly spread across the world. The most widely used method for the diagnosis of the disease is real-time reverse-transcriptase polymerase chain reaction test on a nasopharyngeal swab. Common symptoms include headache, loss of smell and taste, nasal congestion and runny nose, cough, muscle pain, sore throat, fever, and difficulty in breathing. There are only a few case reports detailing the BAE experience during the COVID-19 pandemic in the existing literature (11,12).

In this study, we retrospectively evaluated the relationship between COVID-19 infection, which causes lung infections, and hemoptysis that we treated with BAE.

METHODS

This study involved a retrospective analysis of 11 patients, two female and nine male, aged 39-80 years, who underwent bronchial arterial embolization at the University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital from June 2020, through June 2021. The University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital Instutional Review Board approved the study (decision no: 2022/514/238/9, date: 29/11/2022). All procedures involving human participants were approved in accordance with the ethical standards of the Institutional and/or National Research Committee, including the Helsinki Declaration of 1964 and its subsequent amendments or comparable ethical standards. Age, gender, previous disease history, and related data were collected from all patients. All patients who underwent the BAE procedure during the COVID-19 period were included in the study. Informed consent was obtained from all the patients before the procedure.

The sample consisted of cases that presented to the emergency department with the complaint of hemoptysis, in which upper airway bleeding was excluded by performing otolaryngology consultations following routine hemodynamic monitoring and laboratory tests. Routine cardiology consultations were made, and cardiac causes were also excluded. The follow-up of the patients was continued in the chest diseases department, and thoracic computed tomography and fiberoptic bronchoscopy procedures were also undertaken in the patients. Two patients required emergency BAE, whereas the rest patients underwent elective BAE. The patients were transferred to the interventional radiology unit, and the BAE procedures were performed. Patients' demographic information, vital signs (blood pressure, body temperature, pulsu, oxygen saturation), and blood parameters (hemoglobin, hematocrit, platelet count, and international normalized ratio) were included in the study's data form. Additionally, the hospital automation system was used to record the amount of hemoptysis, the number of embolized bronchial arteries, the length of hospital stay, the usage of anticoagulants, and the prevalence of chronic disease.

Statistical Analysis

The SPSS 25.0 package program was used for statistical analysis of the data. Categorical measures as numbers and percentages, and mean and standard deviation for continuous measurements (required summarized as median and minimum-maximum).

RESULTS

A total 11 patients were included to study. The patients 18.18% (n=2) were female and 81.81% (n=9) were male. The mean age of the patients was 61.27 years, and the mean length of hospital stay was approximately 21 days.

Tables 1 and 2 present the mean, standard deviation, minimum, and maximum values of continuous variables and the frequencies and percentages of discrete variables, respectively. In the duration of our research, the participants' blood pressure, pulse rates, and oxygen saturations were never measured to be lower than the standard ranges. Simultaneously, it was discovered that the patients' entrance hemoglobin and hematocrit values were not significantly below the baseline. All the patients who participated in the study were found to have a history of smoking. As can be seen in Table 1, neither thrombocytopenia nor an international normalized rate prolongation, which may be the cause of bleeding, were seen in any patient. In every patient, at least one and no more than two of the bronchial arteries were blocked with embolic material.

Alveolar bleeding occurred in 81.8% of patients, and dilated bronchial arteries occurred in 72.7% of patients. These were the two most prevalent findings (Table 2). Only two of the patients in our study had bronchiectasis, which is a significant contributor to the development of hemoptysis. However, nine of the patients did not have this condition. No complication occurred in any patient during the procedure, and general anesthesia was not applied to any patient.

DISCUSSION

BAE was first described in 1973 by Remy et al. (13) and is still a popular technique with its success for treating hemoptysis.

The most common symptoms of COVID-19, which emerged in 2019 and continues to affect the worldwide, include fever, dry cough, shortness of breath, widespread muscle aches, fatigue, and loss of taste and smell (14-16). Additionally, specific clinical results have also emerged, with the most prominent examples being vascular bed disorders. In addition to causing emboli-like diseases, such as stroke and myocardial infarction, COVID-19 can result in bleeding without disturbing the vascular structure (17).

In an autopsy study of seven patients that died due to COVID-19, it was reported not only vasculitis and microthrombus involving all the vessel segments but also severe endothelial damage and pathological angiogenesis on lung microangiopathy (18).

Although hemoptysis is a rare finding in patients with COVID-19, studies have shown that it may also be the first sign (16,19). In a cohort study, it was reported the coexistence of COVID-19 and hemoptysis at a rate of 0.9%, and that of severe COVID-19 cases and hemoptysis at 2.3% (20). In another cohort study, 3% of the patients were found

Table 1. Basic statistics of continuous variables

Variables	n	Mean	Minimum	Maximum	Standard deviation
Age (year)	11	61.27	39.00	80.00	10.94
SAP (mmHg)	11	108.82	96.00	126.00	8.94
DAP (mmHg)	11	67.09	55.00	90.00	10.34
Body temperature (°C)	11	36.37	36.00	36.90	0.36
Pulse (/dk)	11	84.00	65.00	110.00	13.71
SpO_2 (%)	11	95.00	88.00	98.00	3.46
Hemoglobulin (g/dL)	11	12.40	9.00	17.00	2.42
Hematocrit (%)	11	35.80	29.10	44.70	4.65
Platelet count (per/mL)	11	251.36	161.00	472.00	103.67
INR	11	1.12	0.91	1.47	0.18
Smoking (number of packs per year)	11	26.09	0.00	50.00	20.94
EF (%)	11	57.22	50.00	65.00	5.07
Hemoptysis quantity	11	277.27	150.00	350.00	68.42
Number of bronchial arteries embolized	11	1.36	1.00	2.00	0.50
Length of stay in hospital (days)	11	21.18	5.00	53.00	19.59

SAP: Systolic arterial pressure, DAP: Diastolic arterial pressure, INR: International normalized rate, EF: Ejection fraction SpO_2: Peripheral oxygen saturation

to have COVID-19 and hemoptysis (21). In our study, two of the 11 patients that underwent BAE due to hemoptysis had a history of bronchiectasis and six had a history of malignancy.

Table 2. Frequency and percentages of discrete variables

Variables	Group	Frequency	Percentage
Anticoagulant use	Absent	6	54.5
	Present	5	45.5
Bronchiectasis	Absent	9	81.8
	Present	2	18.2
Infection	Absent	7	63.6
	Present	4	36.4
Tuberculosis	Absent	10	90.9
	Present	1	9.1
Others	Absent	5	45.5
	Present	6	54.5
Alveolar hemorrhage	Absent	2	18.2
	Present	9	81.8
Condensation	Absent	6	54.5
	Present	5	45.5
Dilated bronchial arteries	Absent	3	27.3
	Present	8	72.7
Pulmonary artery lesion	Absent	11	100.0
Emergency intervention	Absent	8	72.7
	Present	3	27.3
Complication during procedure	Absent	11	100.0
Malignancy	Absent	6	54.5
Complication during procedure	Present	5	45.5
Coronary heart disease	Absent	5	45.5
	Present	6	54.5
Hypertension	Absent	6	54.5
	Present	5	45.5
Chronic renal insufficiency	Absent	10	90.9
	Present	1	9.1
Pulmonary shunt	Absent	6	54.5
	Present	5	45.5
Mortality	Absent	11	100.0
ICU admission	Absent	5	45.5
	Present	6	54.5

ICU: Intensive care unit

In a study from China evaluating 1,099 patients, it was reported that 56% of the patients had a radiological ground-glass appearance, but no radiological finding was present in 18% of the cases (20). The imaging features of COVID-19 are similar to those of alveolar hemorrhage, and therefore they can be misinterpreted. As a result, thoracic tomography may not be sufficient to determine the location of the bleeding.

Although BAE emerged as a treatment option for dilated bronchial artery structures, it also started to be used for treating advanced hemoptysis cases without non-dilated bronchial arteries or structural problems in the lung during the COVID-19 pandemic. Many studies have shown that BAE is a safe and effective treatment option in cases of emergency and/or recurrent hemoptysis (22-24). This is also supported by our findings.

Even though BAE is a complex interventional procedure, the success it has produced in therapy should be more widely incorporated into medical practice because it has saved lives. Endovascular treatment alternatives should be administered by more physicians and in more facilities. To lower mortality rates during a pandemic and to arrange the treatment of non-pandemic emergencies, such advanced interventional therapy procedures should continue to be made available. This study also shown these good outcomes.

CONCLUSION

In conclusion, we consider that BAE is an effective treatment in cases of hemoptysis, which is frequently encountered during the COVID-19 pandemic.

ETHICS

Ethics Committee Approval: The study was carried out with the permission of University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (decision no: 2022/514/238/9, date: 29/11/2022).

Informed Consent: Written informed consent was taken from all patients due to nature of procedure.

Authorship Contributions

Surgical and Medical Practices: Ö.A., Concept: Ö.A., J.S.K., Design: Ö.A., Data Collection or Processing: Ö.A., Analysis or Interpretation: J.S.K., Literature Search: J.S.K., Writing: Ö.A., J.S.K.

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