ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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ENDOVASCULAR TREATMENT IN THE MANAGEMENT OF HEMOPTYSIS: SINGLE CENTER EXPERIENCE AND EARLY STAGE CLINICAL RESULTS

HEMOPTİZİ YÖNETİMİNDE ENDOVASKÜLER TEDAVİ: TEK MERKEZ DENEYİMİ VE ERKEN DÖNEM SONUÇLARI

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Öz

Amaç

Hemoptizide kanama kontrolü için endovasküler tedavi ilk kez 1970'lerde tarif edildi ve yapıldı. Günümüzde, benign ve malign patolojilerde her derecedeki hemoptizi için bronşiyal arter embolizasyonu yapılmaktadır. Endovasküler tedavi gerçekleştirilen hemoptizi hastalarında, hasta demografisi, anjiyografik bulgular, tedavinin teknik başarısı ve erken dönem klinik başarı değerlendirmesi için bu olgu serisi sunulmaktadır.

Gereç ve Yöntem

2007-2018 yılları arasında, Girişimsel Radyoloji Ünitemizde, embolizasyon amacıyla anjiografi yapılan hemoptizi hastaları çalışmaya dahil edildi. Hasta demografisi, anjiyografik bulgular, tedavinin teknik başarısı ve erken dönem klinik başarısı değerlendirildi.

Bulgular

Hemoptizisi olan 47 hastadan, anjiyografik bulguları olan 37 hastada, endovasküler embolizasyon gerçekleştirildi ve %91,8 teknik başarı elde edildi (n=34). Erken dönem klinik başarı, hastanede kalma süresi veya ilk bir aylık süre için, 31 hastada (%91) elde edildi. Başlıca anjiyografik anormallik, parankimal boyanma ve ilk tercih edilen embolizan ajan polivinil alkol (PVA) idi. İşlemle ilgili herhangi bir komplikasyon görülmedi.

Sonuç

Sonuçlar, hemoptizi hastalarında endovasküler tedavinin güncel literatürü destekleyen güvenli ve etkili bir tedavi yöntemi olduğunu göstermektedir.

Anahtar Kelimeler: Hemoptizi; embolizasyon; endovasküler tedavi

Abstract

Objective

Endovascular treatment for bleeding control in hemoptysis was first performed and described in the 1970s. Bronchial artery embolization is today performed for all degrees of hemoptysis in benign and malignant pathologies. Case series for evaluating patient demographics, angiographic findings, technical success of treatment, and early clinical success are presented in this study.

Material and Methods

Patients with hemoptysis undergoing angiographic evaluation in our Interventional Radiology Unit in 2007-2018 were included in the study. Patients' demographics, angiographic findings, technical success of treatment, and early clinical success were evaluated.

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Results
Endovascular embolization was performed on 37 patients with angiographic pathologic signs from 47 patients with hemoptysis, and 91.8% technical success was achieved (n=34). Early stage clinical success, during hospital stay or the first month, was achieved in 31 (91%) patients. The principal angiographic abnormality was parenchymal staining, and the first choice embolizing agent was polyvinyl alcohol (PVA). No complications related to the procedure were observed.

Conclusions
The results suggest that endovascular treatment in patients with hemoptysis is a safe and an effective approach that supports the current literature.

Keywords: Hemoptysis; embolization; endovascular treatment

Introduction

Endovascular treatment for bleeding control in hemoptysis was first performed by Remy et al. and described in 1974. Bronchial artery embolization is performed for all degrees of hemoptysis in benign and malignant pathologies (1). Generally, moderate and massive hemoptysis is challenging when not controlled using conservative methods. Surgical treatment has a high mortality rate of 18% in elective cases and of up to 40% in emergency cases (2). The underlying disease is usually tuberculosis, bronchiectasis, aspergilloma or malignancies. Technical success and early clinical success in the endovascular treatment of hemoptysis is high, but recurrence is a problem.

The aim of this retrospective study was to determine the demographics of patients presenting with hemoptysis for endovascular treatment, their angiographic findings, the technical success of treatment, and early clinical success.

Material and Methods

Patients with hemoptysis undergoing angiographic evaluation in 2007-2018 were enrolled in this retrospective study. Approval was obtained from the ethics committee on 28.01.2019 (No. 24237859-86). Forty-seven patients presenting with hemoptysis and undergoing angiography for endovascular treatment at the Interventional Radiology Unit were included in the study.

Endovascular treatment was planned if the patient's symptoms did not regress despite standard medical treatment. Four patients were female and 43 were male, with a mean age of 58 years (range 31-82). Several definitions have been used to classify the degree of hemoptysis. Accordingly, mild hemoptysis is defined as bleeding of less than 100 mL / day or once less than 50 ml. Moderate hemoptysis is defined as bleeding of 100-300 mL a day or three times a week and more than 100 mL a day. Massive and life-threatening hemoptysis is defined as a) hemorrhage greater than 300 mL a day, b) hemoglobin (> 1 g / dL) or a decreased hematocrit count (> 5%) or respiratory failure (SPaO2, <60%) or hypotension (systolic blood pressure <90 mm Hg) (1). Patients presented with chronic recurrent, sudden onset mild to massive hemoptysis. Patients were evaluated in terms of hemoptysis grade in the light of this classification. The data were obtained from the registered documents and recorded images in the hospital system.

Bronchial Artery Embolization
Selective catheterization of the bronchial artery or suspicious vascular structure was performed after thoracic aortography intended to display the bronchial artery or other vascular structures (such as the intercostal arteries) in patients presenting with hemoptysis. Following the ultrasound-guided insertion of 4 or 5 French (F) introducers by the trans-femoral route, thoracic aortography was obtained with a diagnostic pigtail catheter. In case of doubt, both subclavian arteriographic images were obtained for imaging of the internal mammarian artery (IMA) or axillary artery branches, especially in lung apex lesions. The pathological vascular structures were next catheterized using diagnostic catheters (0.038 ") or, if necessary, diagnostic catheters were used as guiding catheters and catheterization was performed with microcatheters.

Different agents were used for embolization. Polyvinyl alcohol (PVA) particle, glue, coils and stent-graft, depending on angiographic pathology and interventional radiologist preference, was employed as an embolic agent. Angiographic pathologies such as enlarged vascular structures, hyper-vascularity, parenchymal staining, active contrast agent extravasation, arteriovenous shunt and aneurysm were determined.

All patients were evaluated in terms of cause of hemoptysis, angiographic imaging, vascular pathology, pathological vascular structures, parenchymal and vascular pathologies, number of embolized vessels, the embolic agent used, technical success, and early clinical success.

Results

Forty-seven patients with hemoptysis undergoing angiographic evaluation for endovascular treatment were enrolled in this retrospective study. Only 35 of these patients presenting with hemoptysis had undergone computed tomography. Examination of these 35 patients with computed tomography showed parenchymal hemorrhage in all, a diagnosis rate of 100%. The underlying etiologies causing hemoptysis were associated with tuberculosis, bronchiectasis, aspergilloma, malignancies, thoracic aortic aneurysm and other causes (alveolar hemorrhage, operative hydatid cyst), and comorbidity was present in some patients (Table 1). As shown in Table 1, the major etiological cause was tuberculosis. Five patients presented with chronic recurrent hemoptysis, 19 with mild hemoptysis and 23 with moderate / massive hemoptysis. The degree of hemoptysis was moderate/massive hemoptysis in approximately half (51%) of the patients in this case series.

Forty-seven patients undergoing angiographic examination due to hemoptysis were grouped as angiography-negative or -positive. No vascular pathology was detected at angiographic examination in 10 patients (angiography-negative), while vascular pathology was present in 37 (angiography-positive), most of whom had several comorbid pathologies. Vascular pathologies capable of causing hemoptysis in patients with positive angiography were enlarged vascular structures, hyper-vascularity, parenchymal staining, active contrast agent extravasation, arteriovenous shunt, and aneurysm. Parenchymal pathological staining was the most common cause, followed by enlarged vascular structures and hyper-vascularity (Figure 1). The patients' angiography findings are summarized in Table 2. Vascular structures causing angiographic pathology were predominantly the right and left bronchial arteries, intercostal arteries, the internal mammarian artery, the thoracic aorta, and axillary artery branches.

Table 1 Etiologies of Hemoptysis

Disease	n	%
Tuberculosis	21	44.6
Bronchiectasis	13	27.6
Aspergilloma	2	4.2
Malignancy (Lung Ca.)	12	25.5
Thoracic aortic aneurysm	2	4.2
Other reasons	4	8.5

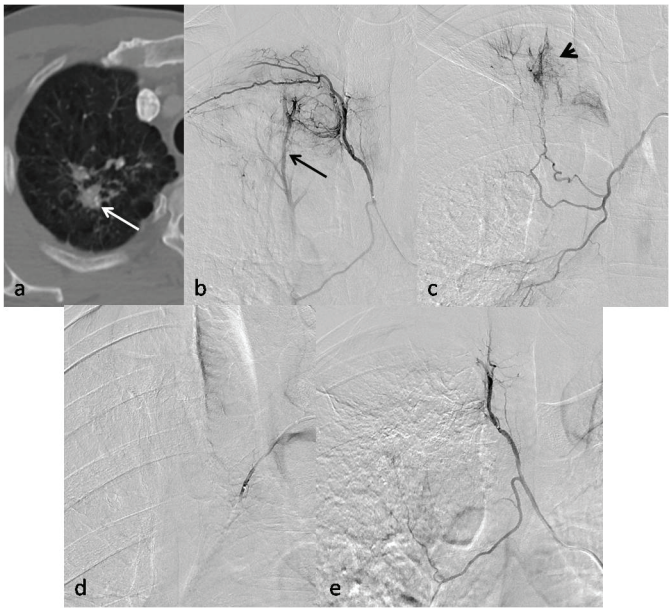

Figure 1
Fig. 1a) A 38-year-old male patient presented with mild hemoptysis. Thoracic CT revealed a tuberculosis sequel (white arrow) on the right upper lobe. b,c) Angiographic images revealed right upper intercostal artery and right bronchial artery dilatation and tortuosity, arteriovenous shunt (black arrow), right upper lobe hypervascularity and parenchymal staining (arrowhead). d,e) The right upper intercostal artery and right bronchial artery were selectively catheterized and embolized with 500-710 micron PVA particle and pathological staining, and the arteriovenous shunt resolved entirely on control angiograms.

Two patients had previously been described in case reports. Hemoptysis due to penetration of the aneurysms originating from the thoracic aortic proximal to the upper lobe of the left lung was present in both. Both were treated with thoracic endovascular aortic repair (TEVAR) using aortic stent-grafts (3). In three of the angiography positive patients, the vascular structure causing hemoptysis could not be catheterized, and the intervention failed in these. Of these two groups, 32 angiography-positive patients were catheterized with an average of 1.8 vessels, and embolization was performed. In one patient, both bronchial arteries causing hemoptysis in the first session could not be catheterized by femoral access. In the second session, after brachial access, both bronchial arteries were successfully catheterized and embolized. Three patients required second sessions because of recurrence in the first week.

The most commonly used agent for embolization was the PVA particle, and PVA, glue and coil agents were used together in some patients. The PVA particle size used in the procedures was between 355 and 1180 µm. The agents used are summarized in Table 3.

Technical success was achieved in 34 (91.8%) of the 37 patients with angiographic pathology. Final clinical success in these 34 patients undergoing technically successful embolization was 91% (31/34), considering hospital stay or the first one-month period. Although technically successful embolization was established in three patients, clinical success was not achieved in the early period. One patient died in the first month after embolization due to comorbid diseases. One of the other two patients in whom early clinical success was not achieved had undergone surgical lobectomy at the first week and first month post-embolization due to recurrence. None of the patients receiving endovascular treatment had any procedure-complications.

Discussion

Hemoptysis is a life-threatening condition requiring immediate intervention. In addition to medical treatment, surgery is a rapid and effective method of controlling bleeding. However, determining the patient's physical condition and optimal surgical approach requires serious preoperative preparation, such as pulmonary function tests and bronchoscopy, and such prepara-

Table 2 Angiographic findings of patients

Findings	n	%
Angiography negative	10	21.2
Angiography positive	37	78.8
Enlarged vascular structures	19	51.3
Hyper-vascularity	19	51.3
Parenchymal staining	37	100
Active contrast agent extravasation	2	5.4
Arteriovenous shunt	4	10.8
Aneurysm	3	8.1

Table 3 Agents used for embolization

Agents	n	%
Polyvinyl alcohol (PVA) particle	29	85
Glue	1	2
Coil	8	23
Stent-graft	2	5

tions may not be possible in emergency situations (4). Bronchial artery embolization (BAE) has been an accepted treatment modality for the management of hemoptysis since it was first introduced in 1974 (1, 5). BAE has also been widely used for patients who cannot be operated (for palliation) and to stabilize patients before surgery (6).

In clinical practice, patient preparation for endovascular treatment can be completed in approximately an hour, and the patient's physical requirements are lower than those for surgery. With the adoption of the BAE, surgery has been gradually abandoned and is currently only indicated in certain cases (such as technical failure in endovascular therapy or early recurrence despite treatment).

In this retrospective case series, endovascular treatment for hemoptysis control was performed safely and with high efficacy. Diagnostic angiographic examination and embolization were performed on all patients with no adverse events. In 37 patients with angiographic positive, Technical success was achieved in 34 (91.8%) of the 37 angiography-positive patients. Technical success (catheterization and embolization of pathological vascular structures) in this series was consistent with the reported rates in current retrospective case series (90-98.5%) (7-10). In addition, bleeding control and early clinical success was achieved in 31 (91%) of the 34 patients undergoing embolization. The early clinical success rate was similar to that in previous studies (70-99%) (1, 7-9). Recurrence of hemoptysis despite successful embolization has been reported at rates as high as 9.8-57.8% (1). Since ours was a retrospective study, it was not possible to establish recurrence rates since patient follow-up was limited. Secondary embolization was required in three patients in the early period.

Hemoptysis was moderate or massive in approximately half (51%) of the patients in this case series. The most common etiologies reported to cause hemoptysis in the literature are tuberculosis, bronchiectasis and malignancies (7, 9, 11, and 12). Shao et al. (7) reported tuberculosis as the most common cause of hemoptysis in their large series of 344 cases (55.2%), followed by bronchiectasis (28.8) and malignancies (5.8%). In this case series, tuberculosis, bronchiectasis and malignancies were again common etiological factors. In addition, massive hemoptysis was present in two cases as a result of invasion of the thoracic aortic aneurysm into the lung parenchyma. The previous literature is limited to case reports of massive hemoptysis due to thoracic aortic aneurysms (13, 14).

Various embolic agents such as PVA, coil, gelfoam, and glue have been used for selective bronchial and non-bronchial artery embolization in patients with hemoptysis. Each embolic agent has its own characteristics, advantages and disadvantages. PVA was the most commonly used (85%) embolic agent in this study (Table 3), either alone or in combination with other embolization agents. PVA is a permanent embolic agent that cannot be resorbed and is also available in a variety of sizes. The most commonly preferred embolization agent size in the previous literature is 300-500 µm PVA, (total range from 150 to 1200 µm) (1). However, the use of PVA particles below 300 µm is not recommended due to the potential for pulmonary and systemic infarct with the passage of bronchopulmonary anastomosis with an average diameter of 325 µm (15). A minimum size of 355 µm was used in our case series. No undesirable organ embolization was encountered in cases in which embolization was performed.

There are a number of limitations to this study, particularly its retrospective nature. Other major limitations include the limited number of patients, lack of long-term follow-up, and the inability to detect recurrent hemoptysis.

Conclusion

In conclusion, tuberculosis, bronchiectasis and malignancy are the main causes of hemoptysis. An endovascular embolization technique was performed in this case series, and high early clinical success was achieved. The minimally invasive endovascular approach provides safe and effective treatment.

Ethics approval and consent to participate
The study was approved by the KTU Faculty of Medicine Ethics Committee. Written informed consent was provided by all patients.

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