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Hemoptysis recurrence after successful embolization of bronchial arteries

Nowotworowe krwawienia po embolizacji tętnic oskrzelowych

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S u m m a r y

Aim. The purpose of this study is evaluation of the occurence and causes of recurrent hemoptysis after its treatment with endovascular embolization.

Materials and methods. During the last decade 360 patients with severe hemoptysis were treated with embolization. Hemoptysis had many different underlying pathologies of which the most common were tuberculosis, bronchiectasis and aspergillosis. Embolization procedures were performed using different embolic materials like: absorbable haemostatic gelatin sponge (Spongostan), embolic particles (PVA – polyvinyl alcohol particles, Embospheres 350-900 μm), platinum coils and liquid materials (histoacrylate and Lipidol mixture).

Results. Control of hemoptysis was achieved in 92% of patients. Over 90% of patients suffered from postembolization syndrome. No severe complications were observed. Patients in whom more than 3 neighboring intercostal arteries were embolized had intercostal muscle pain for up to two weeks. Five patients suffered transient dysphagia and four had a hoarse throat. Bleeding recurrence was noted in 33% of cases within 12 months. The highest rate of recurrences occurred in patients with tuberculosis and aspergillosis and was due to revascularization by collaterals. Out of 99 patients with recurrent hemoptysis 72 underwent second embolization. Collaterals developed mainly from intercostal arteries.

Conclusions. Late recurrent bleeding after treatment of massive hemoptysis with embolization was observed in 33% of cases, most commonly in patients with tuberculosis and aspergillosis, as a result of revascularization of pathological lesions through local collateral circulation. To a lesser degree, recurrent bleedings were caused by incomplete occlusion of pathological vasculature.

Key words: hemoptysis, embolization, bronchial arteries

S t r e s z c z e n i e

Cel pracy. Celem badania jest ocena występowania i przyczyn nawrotów krwawień i krwotoków płucnych po ich leczeniu metodą embolizacji.

Materiał i metody. W ciągu ostatnich 10 lat, 360 chorych z krwotokami płucnymi było leczonych na drodze embolizacji. Przyczyny krwotoków były różne, najczęściej gruźlica, rozstrzenie oskrzeli, grzybica. Do embolizacji używano różnych materiałów embolizacyjnych: gąbki żelatynowej (Spongostan), cząstek alkoholu poliwinylowego PVA, Embosfer 350-900 μm, spiral platynowych oraz płynnych materiałów w postaci mieszaniny histoakrylu z Lipiodolem.

Wyniki. Zatrzymanie krwawienia uzyskano w 92% przypadków. U ponad 90% pacjentów wystąpił zespół poembolizacyjny. U części pacjentów odnotowano bóle mięśni międzyżebrowych. Pięciu chorych miało przejściowe zaburzenia połykania, a 4 chrypę. Nawroty krwawienia wystąpiły u 33% pacjentów w ciągu 12 miesięcy od embolizacji. Najwięcej nawrotów obserwowano u chorych na gruźlicę. Z 99 pacjentów z nawrotem krwawienia, 72 miało ponowną embolizację.

Wnioski. Ponowne krwawienie po embolizacji tętnic oskrzelowych wystąpiło w 33% przypadków. Najczęściej u pacjentów z gruźlicą i grzybniakami. Przyczyną była rewaskularyzacja zmian patologicznych, lub rzadziej, niekompletna embolizacja patologicznych naczyń.

Słowa kluczowe: krwawienie, embolizacja, tętnice oskrzelowe

INTRODUCTION

Hemoptysis is the spitting of blood that originated in the lungs or bronchial tree. The patient's history should help determine the amount of blood and differentiate between hemoptysis, pseudohemoptysis, and hematemesis. A focused physical examination can lead to the

diagnosis in most cases. In children, lower respiratory tract infection and foreign body aspiration are the most common causes of hemoptysis, whereas in adults, bronchitis, bronchogenic carcinoma, and pneumonia are the major causes. Chest radiographs often aid in the diagnosis and assist in using two complementary diagnostic procedures, fiberoptic bronchoscopy and high-resolution computed tomography, which are useful in difficult cases and when malignancy is suspected. The most common presentation is acute, mild hemoptysis caused by bronchitis. Low-risk patients with normal chest radiographs can be treated on an outpatient basis with close monitoring and appropriate oral antibiotics, if clinically indicated (1). If hemoptysis persists, consultation with a pulmonologist should be considered. In up to 34 percent of patients, no cause of hemoptysis can be found (1). The more dangerous presentation is the massive hemoptysis. It is a life-threatening clinical condition requiring urgent assessment and intervention. The mortality rate from massive hemoptysis depends on the bleeding rate and etiology. Hemoptysis greater than 1,000 mL per 24 hours in the presence of malignancy carries a mortality rate of 80 percent (2). Patients with massive hemoptysis need to undergo more aggressive, expedient approach. Diagnosis and therapy must occur simultaneously. Airway maintenance is vital because the primary mechanism of death is asphyxiation, not exsanguination (1). One of the treatment options that enables relatively quick access to the site of bleeding while being minimally invasive is the endovascular embolization performed by interventional radiologists. Since it's introduction in 1973 it became a well established, safe and effective treatment, in many clinical cases it has become the method of choice for massive hemoptysis (3). However, the problem with endovascular approach is that the long term results are hampered by recurrent bleedings. The purpose of this study is to present results of an analysis of hemoptysis recurrence after successful embolization and, if possible, identify the predisposing conditions.

MATERIAL AND METHODS

In the series of 360 patients with massive hemoptysis treated with embolization during the last 10 years, there were 212 men and 148 women in the age of 29-80 years, mean 52.

Hemoptysis was considered to be massive if the blood loss was 300-600 ml per day in agreement with the most commonly used classification (4, 5, 6).

The underlying pathology in almost 80% was: tuberculosis (155 cases), bronchiectasis (98), aspergillosis (31). Remaining causes included cystic fibrosis (25), bronchogenic cancer (19), mucoviscidosis (6), vascular anomalies (2), and Rasmussen aneurysms (2).

In over 90% of patients the underlying pathology was diagnosed with computer tomography (CT). Before deciding to treat the patients with endovascular approach, all patients underwent digital subtraction angiography (DSA), to identify the source of bleeding. This diagnostic procedure consists of gaining percutaneous arterial access to the aorta through femoral artery. It was punctured in the groin, under local anesthesia (2% Lignocaine) and a 5F sheath was placed intraarterially. Using coaxial technique, arteries supplying the suspected region are selectively catheterized. In all cases bronchial arteries were supplying blood to the pathological lesions. In over 80% of patients intercostal arteries and in 24% branches of subclavian arteries were also involved. Contribution from phrenic arteries has been recognized in 7 patients. Catheterization of these arteries was often challenging therefore many different catheters were used. The most frequently used were 5F catheters Cobra, Simmonds, Headhunter and Yashiro. Should a smaller caliber or very tortuous vessel need selective catheterization, microcatheters were used. The most commonly used ProGreat 2,7F (Terumo) was adequate in the majority of difficult cases, however, sometimes special 1,5F microcatheters developed for catheterization of brain vessels need to be used.

In cases where the underlying pathology was identified the embolization procedure was carried out immediately. Angiographic findings included extravasation of contrast medium as well as other, indirect symptoms of bleeding like: tortuous arteries, neovascularity, staining, hypervascularity, shunting into pulmonary circulation and aneurysms. During angiography, active bleeding was recognized in 16% of cases. **The most common indirect signs were hypervascularization in 96%, contrast media staining in over 60%, tortuous vessels in 74%, arterio-venous shunts in nearly 70% and aneurysms in 4% of cases.**

After encountering any of these conditions, each identified pathology was embolized using absorbable haemostatic gelatin sponge (Spongostan), embolic particles (PVA – *polyvinyl alcohol particles*, Embospheres 350-900μm), platinum coils or liquid materials (histoacrylate and Lipidol mixture). It is essential to avoid the use of materials that can pass through the bronchopulmonary anastomosis.

After completing embolization control angiography was performed.

Out of 360 initially treated patients, 302 were followed for 12 months. Postprocedural clinical status, occurrence of complications or eventual recurrence of bleeding were all registered.

RESULTS

Control of hemoptysis was achieved in 92% of cases (fig. 1A, B; fig. 2A, B, C, D). Over 90% of patients suffered from postembolization syndrome manifested with fever, pain and nausea. These symptoms lasted for 2-3 days. No severe complications were observed. Patients in whom more than 3 neighboring intercostal arteries were embolized had intercostal muscle pain for up to two weeks. They required analgesic drugs during that period. Five patients suffered from dys-

phagia and four had a hoarse throat. These symptoms lasted for about a week and dissolved spontaneously. Bleeding recurrence was noted in 33% of cases within 12 months, most commonly in the second half of that period. The highest rate of recurrences occurred in patients with tuberculosis and aspergillosis and was due to revascularization by collaterals. Out of 99 patients with recurrent hemoptysis 72 underwent second, effective embolization. Collaterals were developing mainly from intercostal arteries.

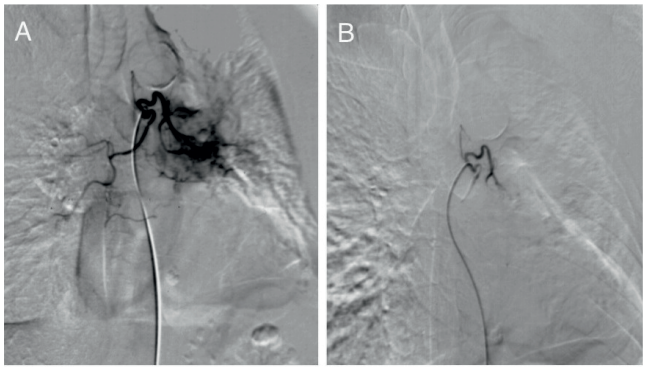

Fig. 1. Arteriography of the left bronchial artery shows pathological vasculature supplying the tumor (A). Pos-embolization control injection shows complete occlusion of pathological vessels (B).

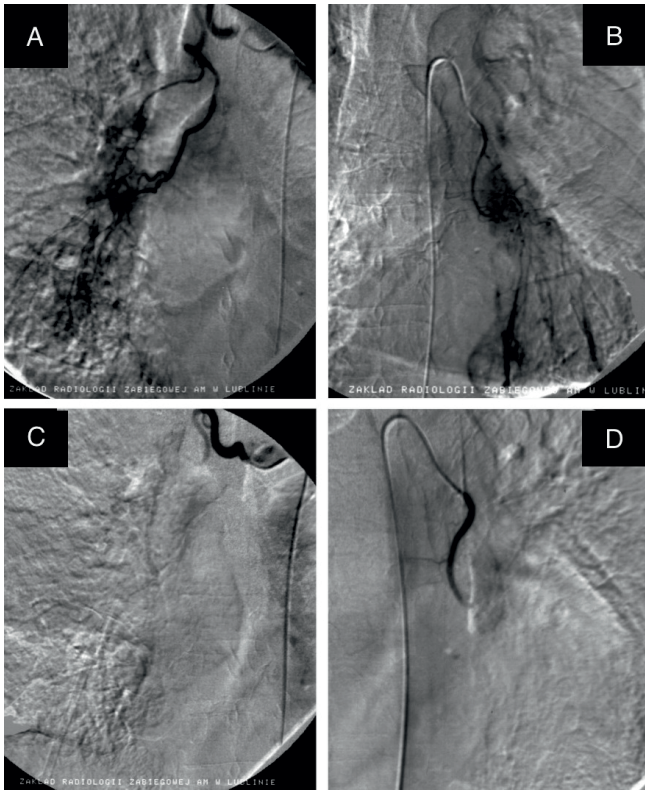

Fig. 2. Angiography presenting distal pathological branches of the right (A) and left (B) bronchial artery in bronchiectasis. Post-embolization control angiography shows complete occlusion of both right (C) and left (D) bronchial arteries.

DISCUSSION

Embolization of pathological vessels is a well established treatment method for patients with severe hemoptysis (7-15). Previous studies have also shown that embolization is very effective in controlling acute massive hemoptysis. The initial nonrecurrence rates for endovascular treatment have been reported to be 73-98%, with a mean follow-up period ranging from 1 day to 1 month (8,16-22). Immediate success rates have increased recently because of the introduction of superselective embolization and the refinement of embolic agents and techniques. However, the long- term success rate of bronchial artery embolization in hemoptysis is unfavorable. Long-term recurrence rates have been reported to be 10-52%, with a mean follow-up period ranging from 1 to 46 months (23-25). However, the long-term success rate can be improved with repeat procedure. Hemoptysis may recur after successful embolization if the disease process is not controlled with drug therapy or surgery because embolization does not address the underlying disease but rather treats the symptoms. In this sense, embolization is a palliative procedure that prepares the patient for elective surgery for localized disease or continued antimicrobial therapy (26).

Since the bronchial circulation is the major source of bronchial bleeding, and because bronchial arteries vary considerably in their numbers and sites of origin, knowledge of anatomical variations in bronchial arterial supply is crucial and it is the most important technical aspect of this endovascular procedure. Therefore a good deal of time should be spent on diagnostic evaluation of each patients systemic and pulmonary vasculature. Angiography of computed tomography and angiography of magnetic resonance imaging are both helpful in that respect. Interventional radiologists need to know the different possible origins of bronchial arteries in order to perform selective catheter angiography of these vessels. There is a wide variance of origins of the bronchial arteries coming from the aorta. In our experience, the right bronchial artery in about 80% of cases originated as a common intercostobronchial trunk from the right lateral or anterolateral surface of the aorta. Upper and lower left bronchial arteries most often originated from the anterior aspect of the thoracic aorta. Aortic arch origin of bronchial arteries made selective catheterization challenging. Sometimes there is a common trunk giving of the left and right bronchial artery. Most of the time the bronchial artery origin from aorta is located at the level T5 or T6. There are different classifications (Caldwell, Botenga, Uflacker) which describe up to 10 different types of bronchial arteries origins from aorta. Furthermore, the thyrocervical and brachiocephalic trunk, the subclavian, internal thoracic and phrenic artery can give rise to a bronchial artery.(28) However, the most dreaded consequence of a bronchial artery embolization is inadvertent occlusion of spinal arteries. It is extremely rare (5%) of patients, but it is very important to check if there are any connections to the spinal circulation, especially since they may not be visible on CT angiography in most cases (29, 30).

CONCLUSIONS

Late recurrent bleeding after treatment of massive hemoptysis with embolization was observed in 33% of cases, most commonly in patients with tuberculosis and aspergillosis, as a result of revascularization of pathological lesions through collateral circulation.

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