Case Report

Embolisation of a Bronchial Artery of Anomalous Origin in Massive Haemoptysis

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Abstract

Massive haemoptysis is the most dreaded of all respiratory emergencies. Bronchial artery embolisation is known to be a safe and effective procedure in massive haemoptysis. Bronchial artery of anomalous origin presents a diagnostic challenge to interventional radiologists searching for the source of haemorrhage. Here, we report a case of massive haemoptysis secondary to a lung carcinoma with the bronchial artery originating directly from the right subclavian artery. This artery was not evident during the initial flush thoracic aortogram. The anomalous-origin bronchial artery was then embolised using 15% diluted glue with good results. An anomalous-origin bronchial artery should be suspected if the source of haemorrhage is not visualised in the normally expected bronchial artery location.

Keywords: *bronchial arteries, glues, haemoptysis, therapeutic embolisation, medical sciences*

Introduction

Massive haemoptysis, which is defined as a pulmonary haemorrhage of 500–600 ml in 24 hours, is the most dreaded of all respiratory emergencies (1,2). Bronchial artery embolisation (BAE) has become an established procedure in the management of massive and recurrent haemoptysis (2,3). BAE is effective in the immediate control of haemorrhage, with a success rate ranging 88%–100% (2–4).

Bronchial artery of anomalous origin (BAAO) is known as a source of non-evident haemorrhage and persistent haemoptysis post-embolisation (1,5). The normal bronchial arteries usually arise from the descending thoracic aorta at the level of the T5 to T6 vertebrae, with an intrapulmonary course along the major bronchi (1,6). BAAO is defined as bronchial arteries that arise outside of these areas (1,5). Here, we report a case of a BAAO that originated directly from the right subclavian artery in a patient with right lower lobe lung carcinoma and the role of BAE in its management.

Case Report

A 58-year-old female Malay non-smoker presented in October 2008 with intermittent mild haemoptysis associated with loss of weight and appetite for duration of 2 months. A chest radiograph showed a mass in the right lower zone. A computed tomography (CT) scan of the thorax revealed a soft tissue mass in the mediobasal segment of the right lower lobe with collapse of the posterobasal segment (Figure 1). Bronchoscopy revealed an endobronchial mass obstructing the right intermediate bronchus. An endobronchial ultrasound did not show any enlarged mediastinal lymph nodes. Percutaneous fine needle aspiration of the mass was done and confirmed a diagnosis of large cell carcinoma. Chemotherapy was initiated with cisplatin and gemcitabine. Unfortunately, the patient developed thrombosis of the left superficial femoral vein after 2 cycles of chemotherapy, upon which she was anticoagulated with warfarin. Three weeks later, she presented with massive haemoptysis that was complicated by Type 2 respiratory failure and haemodynamic instability. She was resuscitated, ventilated, and then managed in the Intensive Care Unit (ICU). Urgent rigid bronchoscopy revealed huge blood

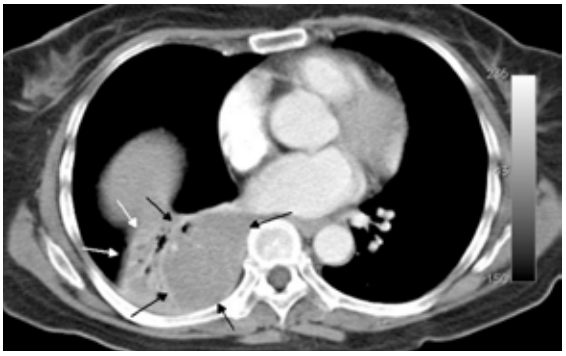

Figure 1: Axial-enhanced CT scan of the thorax showing the large mass in the mediobasal segment of the right lower lobe (black arrows). There is also an associated collapse of the posterobasal segment of the right lower lobe (white arrows).

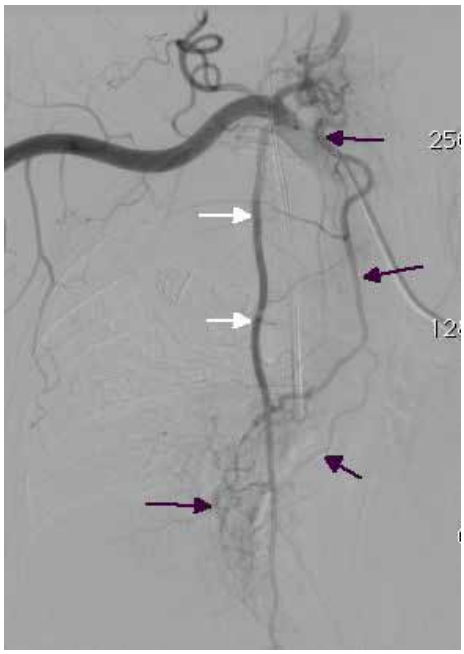

Figure 2: Selective right subclavian digital subtraction arteriogram. The right bronchial artery (purple arrows) originates directly from the right subclavian artery and is coursing inferiorly to supply the right lower lobe lung tumour. The right internal mammary artery (white arrows) is separate from the right bronchial artery.

clots occluding both the main bronchus and lower trachea. The blood clots were removed, and a double lumen endotracheal tube (ETT) was inserted to protect the left lung. The patient remained stable after the procedure. The double lumen ETT was later replaced with a single lumen ETT. The following day, fresh blood was noted from the ETT, causing intermittent desaturation. The patient was then referred to the interventional radiologist, where a thoracic angiogram was performed under general anaesthesia with the intention of transcatheter embolisation. A flush thoracic aortogram did not show any dilated or tortuous bronchial arteries supplying the right

lower lobe lung tumour. No evidence of contrast extravasation or pulmonary shunting was seen. Selective angiogram of the intercostal arteries was also performed with a 4F Cobra catheter, revealing similar results. A right subclavian arteriogram showed a dilated right bronchial artery supplying the tumour that originated directly from the right subclavian artery (Figure 2). The right bronchial artery was well-separated from the right internal mammary artery. A selective arteriogram of the right bronchial artery confirmed the initial finding (Figure 3a). A microcatheter (Miraflex, Cook) was introduced co-axially through the 4F Cobra catheter, with the tip of the microcatheter parked distally about 9.5 cm from the origin of the right bronchial artery. A superselective arteriogram was then performed pre-embolisation (Figure 3b). The decision to use 15% diluted glue (1.5 ml of Histoacryl Glue, B Braun diluted with 8.5 ml of Lipiodol, Guerbet) was made in view of the non-availability of other preferred embolic materials, such as polyvinyl alcohol (PVA). A total of 3 ml of 15% diluted glue was injected through the microcatheter until reflux was observed beyond the tip of the microcatheter under fluoroscopic guidance. The microcatheter was then pulled swiftly in one rapid motion and removed from the 4F Cobra catheter. An angiographic run post-embolisation revealed the complete obliteration of the right bronchial artery supplying the right lower lobe lung tumour (Figure 4).

The bleeding stopped after the embolisation. The patient was extubated 7 days later and remained stable. However, she developed persistent left hemiparesis, and CT scan of the brain showed a large left parietal lobe metastasis. She was then transferred to another tertiary centre for whole brain radiotherapy. Unfortunately, after completion of the radiotherapy, which took place about 2 weeks after the embolisation, she

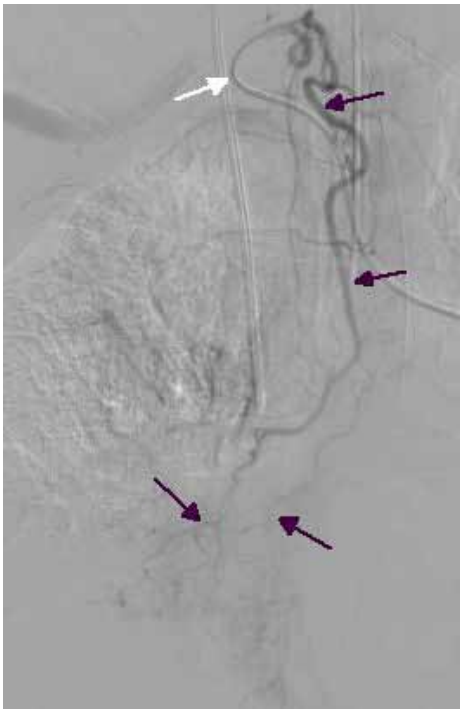

Figure 3a: Selective right bronchial digital subtraction arteriogram. The right bronchial artery was selectively cannulated with a 4F Cobra catheter (white arrow). The right bronchial artery (purple arrows) was seen dilated and tortuous while supplying the right lower lobe lung tumour.

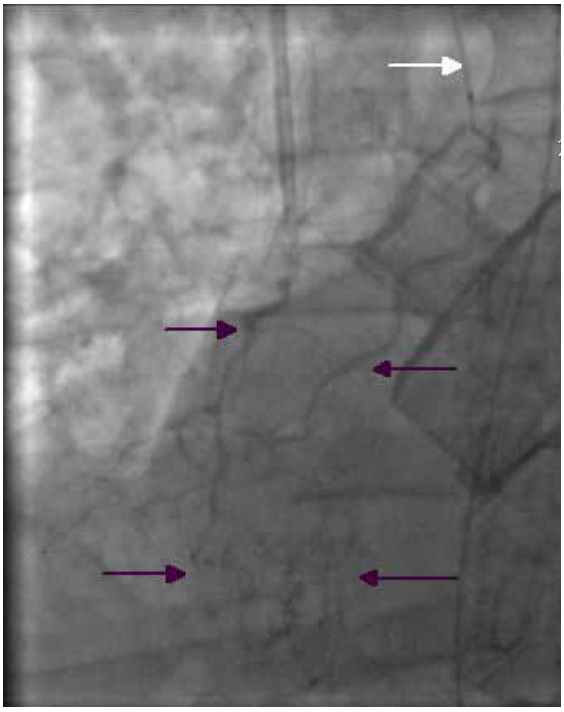

Figure 3b: Superselective arteriogram of the right bronchial artery with a microcatheter (white arrow) showing the terminal arteries supplying the right lower lobe lung tumour (purple arrows).

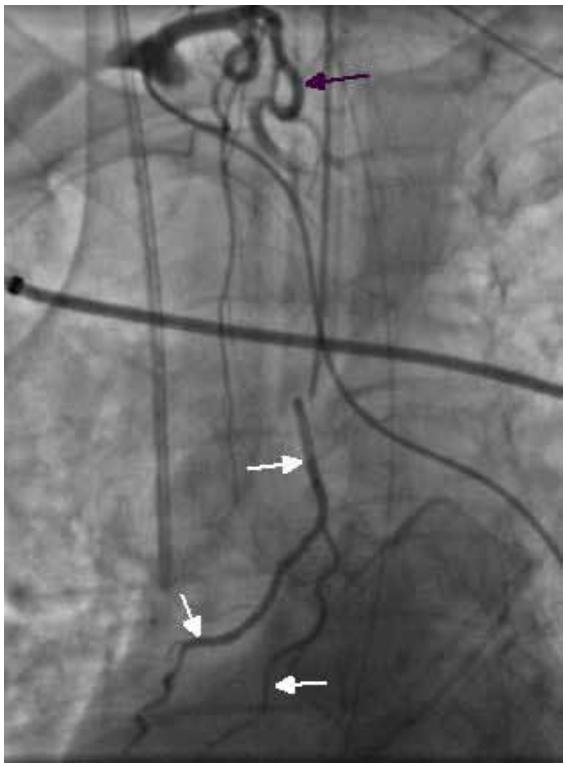

Figure 4: Selective subclavian arteriogram post-embolisation. The glue cast (white arrows) was within the distal branches of the right bronchial artery. Only the proximal right bronchial artery (purple arrow) became opaque post-embolisation.

developed another bout of massive haemoptysis and succumbed to it.

Discussion

A good and thorough knowledge of bronchial artery anatomy is essential to the interventional radiologist prior to a BAE, because 90% of the source of massive haemoptysis is from the bronchial circulation (1). The normal bronchial artery usually arises from the descending thoracic aorta between the T5 and T6 vertebral levels (1, 5). BAAO is defined as a bronchial artery that arises outside the region between the T5 and T6 vertebral levels (1,5). Sancho et al. reported that 8.3% of their patients had anomalous bronchial arteries (5). Out of the 27 anomalous bronchial arteries in their series, only 1 originated from the right subclavian artery. The rest originated from the aortic arch ($n = 24$), thyrocervical trunk ($n = 1$), and lower descending thoracic aorta ($n = 1$). Other sites of anomalous origin have been reported such as the costocervical trunk, brachiocephalic artery, pericardiophrenic artery, inferior phrenic artery, abdominal aorta, and coronary artery (1,7). These anomalous-origin bronchial arteries enter the pulmonary parenchyma through the pulmonary ligament or the adherent pleura, and their course is not parallel to the major bronchi (5).

BAE is currently an established procedure in the management of massive and recurrent haemoptysis, with success rates ranging 88%–100% (2–4). It has the advantage over surgery, especially in patients with poor pulmonary reserve, poor co-morbid conditions or massive haemoptysis (2). In surgical candidates, BAE has a role in controlling the haemorrhage while preparing the patient for an elective surgery (2).

Several types of embolic materials have been used for BAE, such as coils, gel foam, PVA, and glue (2–5,7). Among all of these, PVA with a diameter of 350–500 μm is the recommended embolic material because, in the process of BAE, the embolic materials should not be allowed to pass through the largest bronchopulmonary anastomosis, which measures 325 μm (1). However, the usage of a large-sized PVA has its

own problems. The delivery of large-sized PVA through a microcatheter is difficult since it can form a plug within the lumen (4). Because PVA is also mixed with water-soluble contrast materials that have higher viscosities than the iodised oil contrast material (Lipiodol, Guerbet) used to mix the glue, there will be a high risk of reflux during the later phase of embolisation as pressure within the distal vascular bed increased (4). Considering all of these potential problems, diluted glue was then used in this situation.

Since the 1990s, glue was exclusively used in the treatment of cerebral and spinal arteriovenous malformations, which led to the increased experience of interventional radiologists (IRs) in the control of its behaviour (8). The usage of glue is not without its own risk. The most important factor in controlling the risk in glue embolisation lies with a well-trained IR. The IR needs to mix an optimal glue concentration to enable the control of the time needed for glue polymerisation, and it also must perform a slow but continuous pace of injection to allow cast formation within the arterial lumen and tumour bed.

The technique of bronchial artery embolisation with glue in massive haemoptysis has been described by Razavi and Murphy (9). The usage of a microcatheter through a 5 or 6F guiding catheter is recommended for more secure catheter positioning. An optimal glue concentration is essential for preventing early polymerisation. The field of injection, microcatheter hub and gloves must be rinsed with a 5% dextrose solution to prevent glue from sticking to it. The microcatheter is then flushed with the 5% dextrose solution to prevent early polymerisation of glue within the microcatheter. The injection of the glue mixture can be done by either a single embolisation technique or a sandwich technique (9). During the glue injection, the IR needs to closely observe the occurrence of reflux to prevent the microcatheter from being embedded within the glue cast (4). Upon completion of embolisation, the syringe is aspirated and the microcatheter is rapidly removed. Baltacıoğlu et al. obtained an immediate success rate of 100% in controlling haemoptysis using 12.5% diluted glue in their series (4). Using glue, Razavi and Murphy had lower rebleeding rates (16.6%) as compared with the use of PVA (33%) in patients with massive haemoptysis (9).

In our patient, the flush thoracic aortogram failed to identify the source of pulmonary haemorrhage. Selective arteriograms of all of the visualised intercostal arteries also failed to identify the source of haemorrhage. Only a selective arteriogram of the right subclavian artery managed to identify the right bronchial artery supplying the right lower lobe tumour originating from the right subclavian artery. Embolisation of the right bronchial artery with a total of 3 ml of 15% diluted glue (1.5 ml of Histoacryl Glue, B Braun diluted with 8.5 ml of Lipiodol, Guerbet) produced an immediate control of the haemorrhage.

However, upon completion of radiotherapy, the patient developed a second bout of massive haemoptysis in another centre exactly 2 weeks after the embolisation. This recurrent massive haemoptysis commonly occurs in 20% to 30% of patients due to several factors (1,9), which include incomplete initial embolisation, recanalisation of embolised vessels, progression of disease, non-bronchial systemic arterial supply, or revascularisation by collateral circulation. In view of these problems, many centres have used multidetector CT (MDCT) angiography of the thorax to depict the bronchial or non-bronchial systemic arteries in patients with massive haemoptysis prior to BAE (6,10). Hartman et al. was able to depict ectopic (anomalous origin) bronchial arteries in 36% of their studied population using MDCT angiography (10). MDCT angiography of the thorax gives important anatomical information to the IR prior to a BAE.

In conclusion, a bronchial artery of anomalous origin must be suspected in patients in whom the source of haemorrhage is not evident and who have persistent haemoptysis post-embolisation.

Authors' Contributions

Conception and design: ARMR
Provision of study materials or patients, collection and assembly of data: ARMR, NTH, HSH
Drafting of article, final approval of article: ARMR, NTH, HSH, ASM
Critical revision of article: ARMR, ASM

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