Stenting of the Mainstem Bronchus in Children: A Word of Caution

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We present two patients with critical hemorrhage following expandable metallic stenting of the left mainstem bronchus in children. Stent migration with erosion into a bronchial artery leading to mycotic pseudoaneurysm formation and overwhelming pulmonary hemorrhage occurred in both patients. One patient died from uncontrollable hemoptysis. The second patient was salvaged by left pneumonectomy and patch repair at the site of mycotic aortic rupture. Stenting of a mainstem bronchus, particularly in cyanotic children must be approached with extreme caution.

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Airway obstruction from tracheo or bronchomalacia may pose life-threatening problems. When the etiology is aortic or great vessel compression, then aortopexy may relieve the problem [1]. In patients where this is not successful or feasible, placement of a metallic expandable stent has emerged as an alternative therapy [2–6]. Stents have most frequently been used for relief of tracheal obstruction, but occasionally they have been deployed in the mainstem bronchus. The potential for stent erosion through the thin bronchial wall has been discussed, but not well documented in the clinical setting. Our experience with two severe complications of mainstem bronchus stenting in cyanotic children is described and discussed below.

Case Reports

Patient 1

A 4-year-old girl with a dilated cardiomyopathy and documented severe pulmonary hypertension required a tracheostomy for respiratory failure. The patient had persisting collapse of the left lung and computed tomographic (CT) scan revealed left main bronchus narrowing. Bronchoscopy revealed severe left mainstem bronchomalacia 12-mm in length. A 2-cm Wallstent (Boston Scientific, Watertown, MA) was placed in the left mainstem bronchus and dilated to 7 mm.

One-month later the patient presented to the emergency department with copious bright red blood through tracheostomy. History was positive for cough and secretions, but negative for fever or other suggestion of upper respiratory infection. Chest roentgenogram was clear. Following immediate transfer to our institution repeat films revealed evidence of a left lower lobe infiltrate. While being prepared for bronchoscopy the patient had massive hemoptysis requiring transfusion and vasopressor support. Emergency arteriography illustrated a ruptured pseudoaneurysm adjacent to the stented left bronchus with active bleeding into the lung (Fig 1). Despite coil embolization of the involved bronchial artery, the patient had progressive desaturation and hemodynamic instability. She expired within hours of the embolization procedure.

Patient 2

Following late presentation with hypoxia and respiratory distress, an 18-month-old female with Down's syndrome, hypoplasia of the left heart, and severe coarctation of the aorta with ductal dependent systemic flow underwent a modified Norwood procedure. Postoperatively the patient had difficulty weaning from the ventilator because of persistent left lung collapse. Bronchoscopy revealed left mainstem bronchomalacia with near total obstruction. Attempts to reexpand the left lung failed and a Palmaz stent (Cordis Corporation, Miami Lakes, FL) 2-cm in length was positioned in the left mainstem bronchus and dilated to 6 mm. The left lung expanded and the patient was extubated within 1 week and discharged home on low flow nasal oxygen.

At 24 months the patient underwent a bidirectional Glenn with an additional 3-mm modified Blalock shunt to augment pulmonary flow. The left lung appeared normal on chest roentgenogram.

When she was 3 years old the patient had a cardiac catheterization in anticipation of a complete Fontan. Pulmonary artery mean pressure was 15 mm Hg and systemic saturation was in the high 70s. The left lung appeared normal and the patient was felt to be a Fontan candidate.

Three-days after the catheterization there was acute deterioration with respiratory distress and hypoxia. The left lung was opacified on chest roentgenogram. After

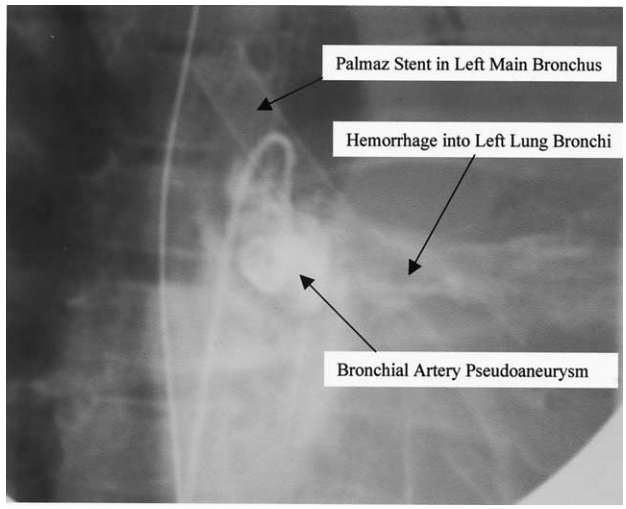

Fig 1. Angiogram of patient 1. The bronchial artery pseudoaneurysm is demonstrated with contrast injection, and constrast from the pseudoaneurysm is seen in the airways of the left lung.

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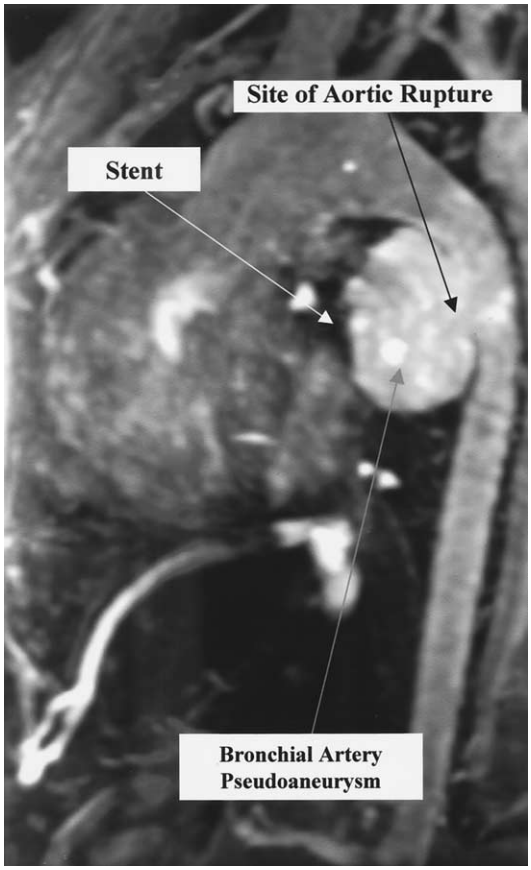

Fig 2. Contrast magnetic resonance imaging of patient 2 demonstrating the bronchial artery pseudoaneurysm and site of mycotic descending aorta rupture.

transfer to our facility bronchoscopy revealed a complete left mainstem bronchus obstruction due to organized thrombus. Magnetic resonance imaging (MRI) demonstrated a contained rupture of the proximal descending aorta with a large pseudoaneurysm (Fig 2). Major airways on the left side were obliterated.

At operation there was a large mediastinal pseudoaneurysm associated with a 1-cm defect of the medial descending aorta wall just below the isthmus. The left main bronchus was necrotic and disrupted with the stent visible in the mediastinum. The left lung was hemorrhagic and consolidated. Left pneumonectomy and patch repair of the aorta was carried out. Clot from the pseudoaneurym grew staphlococcus. After a protracted recovery the patient was discharged home with moderate cyanosis on nasal oxygen supplement.

Comment

Endoairway stenting has been used in difficult patients with malacia or other forms of central trachobronchial obstruction. Although recurrent stenosis due to granulation tissue has been the main complication of stents, erosion and migration of the metallic foreign body has also occurred. Autopsy studies have revealed full thickness stent erosion into the mediastinum [2]. Erosion and migration would be expected to be more common from the mainstem bronchus as opposed to the trachea because the airway wall is thinner and has less cartilage support.

The potential for stent erosion is of particular concern in the cyanotic patient who may have dilated bronchial collateral vessels in close proximity to the stent site. It appears that in both of our patients erosion into a bronchial vessel led to a pseudoanuurysm and airway hemorrhage. In patient 2, infection within the mediastinal pseudoaneurysm extended to the proximal descending aorta causing a mycotic rupture. The site of aortic disruption was well away from the stent itself.

In the acute setting, fluoroscopic, MRI, and CT angiography are all diagnostic. In the presence of active hemorrhage, interventional catheterization offers potential hemostasis through covered-stent or intravascular coil placement. However, in subacute or chronic presentation, three-dimensional reconstructions produced by MRI or CT better define bronchial-arterial relationships and surgical roadmaps. CT angiography is fast and simple, but poorly suited for serial evaluation because of nontrivial radiation exposure. Contrasted-enhanced magnetic resonance angiography offers outstanding anatomic detail, without ionizing radiation, making it the modality of choice for screening or serial examinations. Metal artifact from wall stents is minimal and presents no safety hazard to the patients.

Despite the risks, metallic stenting may be the only alternative in patients with complex airway obstruction. Once vascular compression has been minimized, stenting may be the only option to avoid the complications of ongoing mechanical ventilation. Without positive pressure ventilation these patients have persisting pulmonary collapse, consolidation, and problems with infection. In some patients, including both patients described in this report, it may be difficult to keep the lung up even with assisted ventilation. Stents are highly effective in correcting airway obstruction and allowing patients to come off the ventilator. However, as noted by Jacobs and coworkers [7], wire stents, particularly in the bronchus, are almost always nonremovable and they present an ongoing risk of erosion. Given the experience noted in this report we are avoiding expandable metallic stents in the mainstem bronchus in cyanotic children where the likelihood of large bronchial collateral vessels is high.

Nicolai and colleagues [8] has recently reported an experience with 13 bronchial stenting events in 6 children using a soft mesh stent (SS34 to 90; Boston Scientific) or nitinol (Nitinol briliary or Ultraflex bronchial; Boston Scientific). These devices were not subject to the erosion and migration problems that have been associated with the Palmaz stent, and have also been successfully removed on several occasions. The authors have concluded that nitinol stents are probably the best choice for the pediatric airway.

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CASE REPORTS

Complete Tracheal Rupture After a Failed Suicide Attempt

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Tracheal rupture is life-threatening and its management poses a considerable challenge to both anesthesiologists and surgeons. We report the case of a 44-year-old patient with a complete tracheal rupture after a failed suicide attempt by hanging. A rare bilateral injury of the laryngeal nerves was associated. An original tracheal intubation was performed using the video unit for thoracoscopy. The severity of the lesions required the placement of a tracheostomy cannula after the tracheal repair. The postoperative course was uneventful. The patient was discharged on the 12th day, with a remaining moderate dysphonia.

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Ruptures of the tracheobronchial tree are common after blunt trauma, penetrating or gunshot wounds, explosion injuries, hanging, and iatrogenic injuries. They often present as a life-threatening situation with the development of tension pneumothorax, mediastinal and cervical emphysema, stridor, and respiratory distress. Management is usually difficult and involves emergency physicians, anesthesiologists, and surgeons.

Hanging as a method of attempting suicide is increasing in incidence. Most of the victims are males younger than 40 years old with a history of suicide attempts. Unlike judicial hanging, where the body falls from a great height resulting in certain death, suicide hanging has a rather optimistic survival prognosis, as the fatal spinal cord and skeletal injuries are rare with a favorable neurologic outcome. Patients with spontaneous circulation on scene usually survive; therefore, aggressive resuscitation and management of hanging victims are justified.

We report the case of a 44-year-old patient with a history of a depressive disorder and a previous failed suicide attempt who was brought to our service a few hours after a suicide attempt by hanging. Paramedics found the patient prone within minutes after his relatives cut down the rope. On examination at the scene the patient's airway was partially occluded by his tongue; however, he was ventilating normally and he presented an obvious strangulation mark. Neurologic examination was unremarkable. He complained of progressive discomfort in the neck, and developed progressive subcutaneous emphysema of the face and neck, accompanied by stridor and hoarseness.

On arrival at the hospital he was stable, with pulse 76 beats/minute, blood pressure 120/70 mm Hg, respiratory rate 18 breaths/minute, and oxygen saturation 97% on 2 L/minute oxygen. A cervical x-ray revealed prevertebral air, massive cervical and upper thoracic surgical emphysema, and no other abnormality. Cervical and thoracic computed tomography (CT) revealed a complete tracheal rupture starting from the 3rd cervical vertebrae up to the 5th cervical vertebrae (Fig 1).

The patient was taken to the operating room for surgical repair of his tracheal rupture 10 hours after his suicide attempt. We performed intubation with a small-caliber No. 7F-gauge Mallinckrodt endotracheal catheter under direct videothoracoscopic control, while the patient was under general anesthesia without curarization. The cuff was carefully placed and inflated under the tracheal rupture. The patient was placed under controlled ventilation. Because the lesion was in the upper third of the trachea, we approached it through a large transcervical incision; the infrahyoid muscles were separated along the midline down to the sternum and the pretracheal fascia was opened longitudinally.

We found a complete tracheal section between the cricoid bone and the first tracheal ring associated with a bilateral injury of the superior laryngeal nerves. On the left side the nerve was completely ruptured with the

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