Korean Journal of Pediatrics Vol. 52, No. 1, 2009
DOI : 10.3345/kjp.2009.52.1.124
■ Case report ■

Pulmonary arteriovenous malformation manifesting with perioral cyanosis and dyspnea on exertion: A case report

Yu Kyung Kim, M.D., Jin Woo Kim, M.D., Gun Lee, M.D.* and Man Yong Han, M.D.

Department of Pediatrics, Department of Thoracic & Cardiovascular Surgery* Pochon CHA University, Seongnam, Korea

= Abstract =

Pulmonary arteriovenous malformations (PAVMs) are direct communications between pulmonary arteries and pulmonary veins, resulting in right-to-left shunts that may cause cyanosis, dyspnea, and digital clubbing. Neurological complications such as intracerebral hemorrhage or brain abscess may result from cerebral thrombosis or emboli. In most cases, they remain unrecognized until the late teenage years. Here, we report a case of a 6-year-old boy who presented with perioral cyanosis, digital clubbing, and dyspnea on exertion. A plain chest X-ray showed a focal nodular opacity in the right lower lobe (RLL), and a diagnosis of a large PAVM in the RLL was confirmed by chest computed tomography. A right lower lobectomy was successfully performed without any complications. Although their incidence in children is low, PAVMs should be suspected as a possible cause of cyanosis and dyspnea of non-cardiac origin, and should be treated promptly to prevent further neurological complications. (Korean J Pediatr 2009;52:124-128)

Key Words : Pulmonary arteriovenous malformations, Cyanosis, Dyspnea

Introduction

Pulmonary arteriovenous malformations (PAVMs) are direct communications between pulmonary arteries and pulmonary veins, resulting in anatomical right-to-left shunts that reduce arterial oxygen saturation (SaO_2)[1]. Patients with large shunts are hypoxemic and may experience dyspnea and clubbing, which may also be accompanied by polycythemia. In 1897, the first PAVM was found during the postmortem examination of a 12-year-old boy[2]. PAVMs may be present at birth, but in most cases, they remain unrecognized until the late teenage years[3]. We report a case of a 6-year-old boy with perioral cyanosis, digital clubbing, and dyspnea on exertion due to a large PAVM in the right lower lobe (RLL), for whom a right lower lobectomy resulted in complete disappearance of symptoms.

Received : 5 July 2008, Revised : 6 October 2008
Accepted : 16 October 2008
Address for correspondence : Manyong Han, M.D.
Department of Pediatrics, Hospital, Pochon CHA University School of Medicine
351 Yatap-dong, Bundang-gu, Seongnam, Gyonggi-do, 463-712, Korea
Tel : +82.31-780-6262, Fax : +82.31-780-5239
E-mail : drmesh@gmail.com
Man Yong Han has received grant support from Biorane Company. Yu Kyung Kim, Jin-Woo Kim, and Gun Lee have no relationships to declare.

Case report

A 6-year-old boy visited our outpatient clinic with primary complaints of perioral cyanosis and dyspnea on exertion (difficulty in ascending the stairs). The cyanosis began when he was a toddler and had become aggravated during recent months. He was born by cesarean section at 38 weeks of gestation weighing 2,990 g, after an in vitro fertilization pregnancy. He had no past medical history, and he did not have any history of epistaxis or neurological symptoms. In addition, there was no specific family history, except that his father had diabetes mellitus and hypertension.

His height and weight were 122 cm (75^{th} percentile) and 29 kg (97^{th} percentile). His blood pressure, pulse rate, respiratory rate, and body temperature were 103/69 mmHg, 90 bpm, 24 bpm, and 36.6℃, respectively. His O2 saturation by pulseoxymetry was 82-88% in room air. On physical examination, his general appearance was dusky, and he showed perioral and peripheral cyanosis (Fig. 1) and digital clubbing. There were no signs of telangiectasia or hemangiomas. His breathing sound was clear without any rales or wheezing. There were no audible murmur sounds.

Laboratory examinations showed a hemoglobin concentration of 18.3 g/dL, a hematocrit of 50.4%, a white blood cell

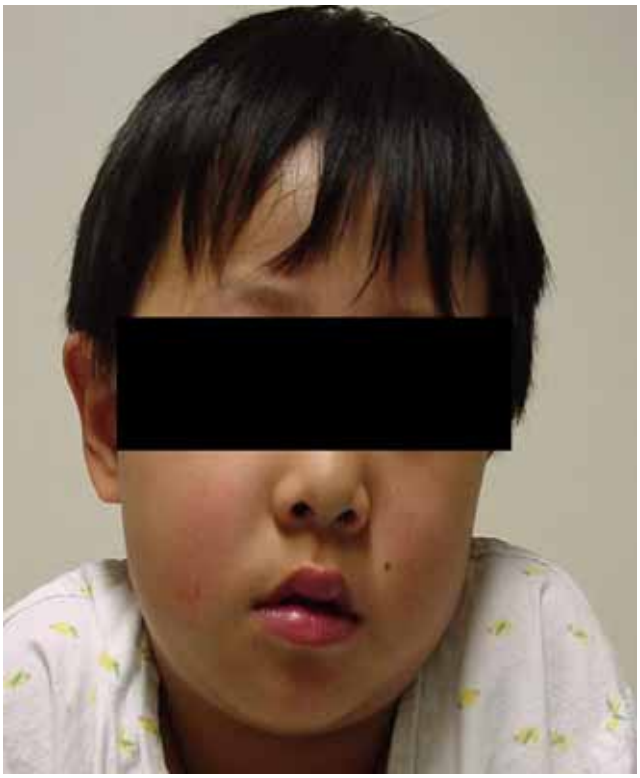

Fig. 1. Patient, showing perioral cyanosis.

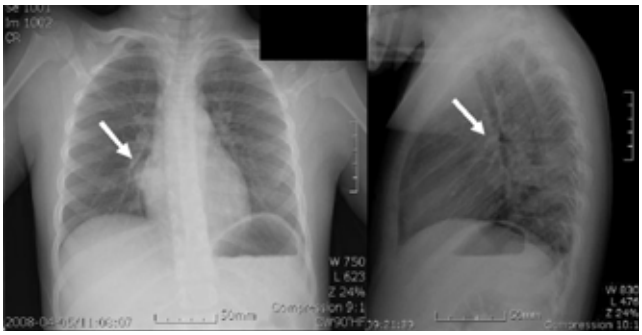

Fig. 2. Plain chest anteroposterior and right lateral view showing focal nodular opacity in the right lower lobe.

count of 5,890/mm^3 with a normal differential count and a platelet count of 264,000/mm^3. His prothrombin time was 11.6 sec, and the activated partial thromboplastin time was 30.3 sec. His methemoglobin level was 0.4% and routine blood chemistry showed normal results. Electrolytes and urinalysis were all within normal limits and C-reactive protein was negative. The results of arterial blood gas analysis were pH 7.423, pCO_2 30.5 mmHg, pO_2 50.6 mmHg, HCO_3 19.5 mmol/L, base excess 3.5 mmol/L, and O_2 saturation 87.2%, which suggested a hypoxic state. He required 5 liters of oxygen per

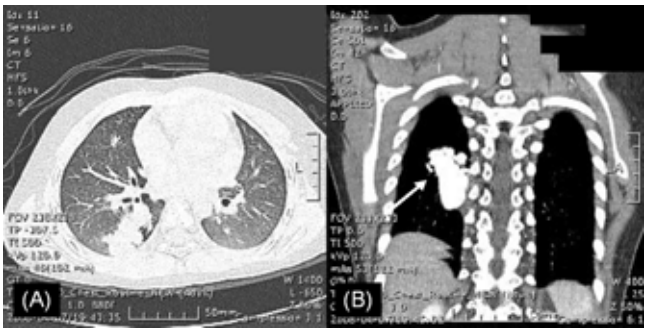

Fig. 3. Coronal (A) and sagittal view (B) of the chest CT with contrast enhancement demonstrates a highly enhanced conglomerated tortuous vascular mass, sized 3.1×2.7 cm, connecting the pulmonary artery and vein in the right lower lobe.

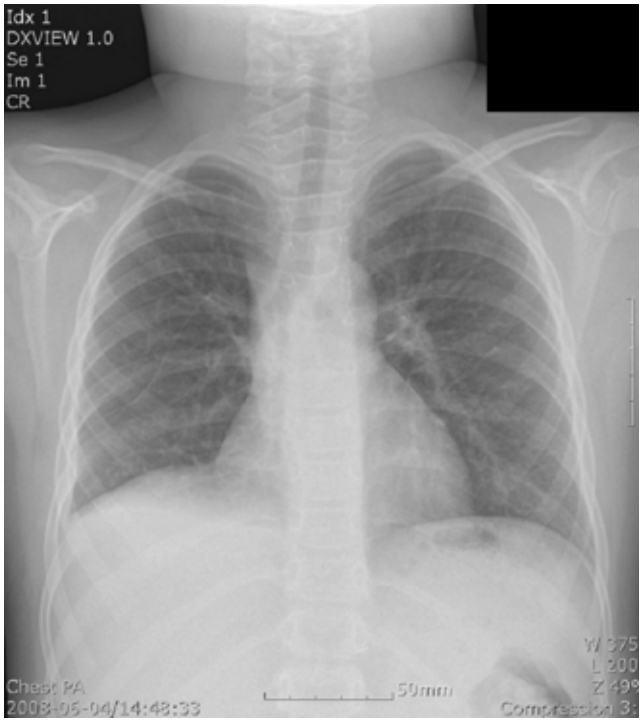

Fig. 4. Plain chest anteroposterior view taken after the right lower lobectomy showing the disappearance of the focal nodular opacity in the right lower lobe zone.

minute via mask to maintain O_2 saturation above 95%.

A chest X-ray showed focal nodular opacities in the RLL (Fig. 2). An electrocardiogram showed normal sinus rhythms with possible right ventricular hypertrophy. An echocardiogram showed moderate tricuspid regurgitation without any other abnormal findings. Chest computed tomography (CT) revealed a highly enhanced, conglomerated tortuous vascular mass sized 3.1 cm x 2.7 cm, connecting the pulmonary artery and vein in the RLL (Fig. 3).

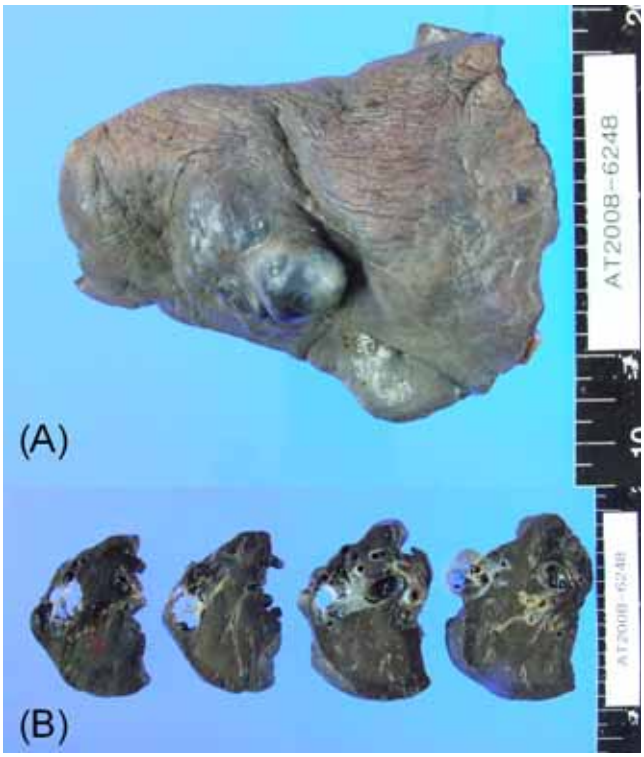

Fig. 5. The pathological examination of the external pleural surface shows a cystic lesion (A). The cut surface shows poorly-defined multiple cystic dilated vessels located at the periphery of the lobe. The diameter of the largest vessel was measured 2 cm (B).

The patient subsequently underwent lobectomy of the RLL. Operative findings revealed a huge feeding artery (12 mm) and a draining vein (10 mm), and there were tortuous mixtures of vascular anomalies on the posterobasal segment area of the RLL (Fig. 5A,B).

A chest X-ray taken after the lobectomy showed the disappearance of the focal nodular opacity in the RLL (Fig 4). Arterial blood gas analysis on the second postoperative day showed pH 7.410, pCO_2 40.1 mmHg, pO_2 90.8 mmHg, HCO_3 24.8 mmol/L, base excess 0.3 mmol/L, and O_2 saturation 97% (in room air). The postoperative course was uneventful and he was discharged on the tenth postoperative day without any complications.

On follow up, his brain MRI revealed a normal finding and the dyspnea on exertion and cyanosis had completely disappeared.

Discussion

Cavernous hemangiomas belong to innate benign intracerebral vascular diseases and are characterized by the loss of muscular layer and elastic fibers within the lesion. Before the clinical application of CT, it was difficult to diagnose the disease because of negative angiography results. Scanning with high-field MRI shows that cavernous hemangiomas present specific images; there are reticulated, mixed signals from the hemorrhage with breakdown products in the center of the lesion, around which a signal loop is shown due to hemosiderin pigmentation[9]. The extensive application of MRI increases the diagnostic level, which makes it easy to diagnose more patients with cavernous hemangiomas[10]. Recently, due to extensive application of magnetic resonance imaging (MRI), an increasing number of patients with cavernous hemangiomas have been able to be determined[11].

In one study, a sharply demarcated spherical intracerebral hematoma or heterogeneous lesion should always make one consider the hypothesis of a cavernoma in pediatric age group[12].

Cavernous hemangiomas can affect patients of all ages. From newborns to people aged 84 years old, the incidence rate reaches its peak in patients about 30 years old. In 1995, Maraire and Awad confirm that one fourth of the patients in the various series are children[6].

There are slight male of female predominance, but majority of studies shows no differences in sex distribution[11]. The distribution of cavernous hemangiomas is related to the volume of nerve tissue. Although cavernous hemangiomas located in the cerebrum are frequent, their predilection site is not obvious. In children, supratentorial locations account for about 80%, while the other 20% are located in the posterior cerebral fossa[7, 8, 13]. In the pediatric age group, brainstem locations seem to be a little more frequent than in adults, and the pons (14.7%) is the most common site[8]. Cavernous hemangiomas in the cerebellum in pediatric age group like our case is uncommon.

Cerebral hemorrhage, epilepsy, headache, and neurological impairment are the main clinical manifestations. Some patients with cavernous hemangiomas, however, do not have any related symptoms or present several symptoms simultaneously with the slow progression of the disease[9]. Our patient presented posterior neck myalgia without neurological impairment as initial symptom, which is very unusual.

Since intracephalic cavernous hemangiomas are located deeply and even can be found in the brainstem and other important functional regions, it is not easy for a routine craniotomy to find the lesions accurately[14]. The natural history of brainstem cavernous hemangiomas indicates a higher mor-

bidity and mortality than cavernous hemangiomas in other locations. Radiosurgery appears to diminish the incidence of further hemorrhages but not remove the risk completely[15]. In patients with cavernous hemangiomas, moderately advanced or acute neurologic impairment is associated with hemorrhage of cavernous hemangiomas. Therefore, surgical treatment should be considered despite the certain risks of the operation[16]. Surgical treatment is suitable for patients with cavernous hemangiomas suffering from hemorrhage and neurological impairment; the disability rate of the resection operation is very low.

Zimmerman et al.[17] thought that if repeating hemorrhages of the brainstem and the progressive aggravation of symptoms of the nervous system were confirmed through MRI, patients with cavernous hemangiomas located in superficial positions that offend the surface of the pia mater and whose surrounding tissue can be separated should consider surgical treatment. Patients with cavernous hemangiomas that do not reach the surface of the pia mater and that do not display symptoms of the nervous system may be monitored without specific management. Samii et al.[18] have made their opinions even clearer and go further in their recommendations. On the one hand, they recommend intervention in the case of superficial cavernous hemangiomas if the patient is young, even though it might be a serendipitous finding without hemorrhage. On the other, they recommend operation in case of progressive deterioration, with further hemorrhage, even though the cavernous hemangioma may not be superficial. The possibility of reaching deeply located cavernous hemangiomas and removing them with a very low morbidity have already been referred to by Mathiesen et al.[19]. Children and females of reproductive age should actively adopt surgical treatment since there is more of an opportunity for occurrence of the lesions and hemorrhage in these patients[20].

The prospective annual rate of hemorrhage from cavernous malformation is 4.5% in patients with previous hemorrhagic episodes, but only 0.6% in those without previous bleeding[21]. Early recurrent hemorrhage is thought to be unusual, but successive hemorrhage may occur at shorter time intervals. The interval from the initial symptomatic hemorrhage to the first recurrent hemorrhage ranged from 1 to 60 months and the second rebleeding occurred earlier; one patient experienced recurrent hemorrhages less than 1 week after the previous episode[22]. Some malformations which became hemorrhagic may continue to bleed intermittently [23].

The indication and timing for surgery of cavernous malformations is still unclear. The risk of significant hemorrhage from the malformation is relatively low, so prevention of hemorrhage should not be an absolute surgical indication[21]. However, some patients certainly should undergo surgery to improve or halt neurological aggravation. Hemorrhage in the posterior fossa is more likely to manifest clinically than that occurring above the tentorium.

Cavernous malformations located within the brainstem are known to have an aggressive clinical course, but can sometimes be removed without serious surgical morbidity. In contrast, conservatively managed patients within the brainstem lesion may die from a subsequent hemorrhage[17]. The limited space of the posterior fossa cannot tolerate mass expansion, so the damage to the surrounding brain tissues will be irreversible. Therefore, we did not have any reason to delay the surgical operation in our patient.

Sandalcioglu et al.[24], reported five cases whose cavernous hemangiomas were located in the cerebellum had favorable outcomes after surgery. Patients with cavernous hemangiomas accompanied by progressive neurological impairment or a recurrence should be treated through surgical means. If lesions are close to the brain surface, cutting open the pia mater should be avoided and therefore, the surgical risk is very low. If cavernous hemangiomas located within the brainstem are large in size but not accompanied by hemorrhage or extensive calcification, it is more difficult for surgeons to remove the lesions and therefore, there is a greater surgical risk[24].

Our patient presented with symptoms of posterior neck myalgia not with neurologic symptoms, which may be due to recurrent heamorrahages from this cerebellar lesion. Because his neurologic signs were not obvious, we misunderstood his pain was originating from the cervical spine. Hence, his cerebellar lesion was found accidentally during the cervical spinal MRI imaging. After the successful surgical removal of cerebellar cavernous hemangiomas, he is in good condition without any complications after 14 months of follow-up.

한 글 요 약

청색증과 호흡곤란을 동반한 폐동정맥루의 1예

포천중문의과대학 흉부외과학교실, *소아청소년과학교실*

김유경 · 김진우 · 이 건* · 한만용

폐동정맥루는 폐동맥과 폐정맥이 모세혈관 없이 바로 연결된 것으로서 우좌 단락을 형성하여 청색증, 호흡곤란과 곤봉지를 일

으키는 질환이다. 또한 뇌혈전에 의하여 뇌출혈이나 뇌농양 등의 신경학적인 합병증을 일으킬 수 있다. 대부분의 경우 청소년기 후기까지 증상이 나타나지 않는 경우가 많다. 본 증례는 입주위의 청색증과 곤봉지 및 호흡곤란을 보인 6세된 남아였다. 흉부 엑스레이에서 우측하엽에 국소적인 결절의 음영이 발견되었고 흉부 단층촬영을 통해 우측 하엽의 큰 폐동정맥루를 확진하였다. 우측 하엽의 폐절제술로 합병증 없이 성공적으로 치료하였다. 영유아시기에 폐동정맥루의 발생 빈도는 드물긴 하지만, 심혈관계 질환 없이 청색증과 호흡곤란을 보이는 드문 원인으로 폐동정맥루의 가능성을 염두에 두고 일찍 진단하고 치료함으로써 신경학적인 합병증의 발생을 예방하여야 한다.

References

1) Guttmacher AE, Marchuk DA, White RI. Hereditary hemorrhagic telangiectasia. N Engl J Med 1995;333:918-24.
2) Churton T. Multiple aneurysms of pulmonary artery. BMJ 1897;1:1223.
3) Dines DE, Seward JB, Bernatz PE. Pulmonary arteriovenous fistulas. Mayo Clin Proc 1983;58:176-81.
4) Gossage JR, Kanj G. Pulmonary arteriovenous malformations. A state of the art review. Am J Respir Crit Care Med 1998;158:643-61.
5) Walder LA, Anastasia LF, Spodick DH. Pulmonary arteriovenous malformations with brain abscess. Am Heart J 1994; 127:227-32.
6) Kang SM, Kim MK, Chi JG. Pulmonary arteriovenous fistula in childhood: report of a case. Korean J Pathol 1992; 26:201-3.
7) Plauchu H, de Chadarevian JP, Bideau A, Robert JM. Age-related clinical profile of hereditary haemorrhagic telangiectasia in an epidemiological recruited population. Ann J Med Genet 1989;8:345-51.
8) Shovlin CL, Guttmacher AE, Buscarini E, Faughnan ME, Hyland RH, Westermann CJ, et al. Diagnostic criteria for hereditary hemorrhagic telangiectasia (Rendu-Osler-Weber syndrome). Am J Med Genet 2000;91:66-7.
9) Kuwon ES, Park WK, Ryu JS, Kwak SM, Lee HL, Jo CH, et al. A case of pulmonary arteriovenous fistula with a family history. Tuberc Respir Dis 1998;45:649-53.
10) Brydon HL, Akinwunmi J, Selway R, UI-Haq I. Brain abscesses associated with pulmonary arteriovenous malformations. Br J Neurosurg 1999;13:265-9.
11) Chang UG, Kim DG, Yang HJ, Lee HK, Choi KS, Han DH. Brain abscess associated with pulmonary arteriovenous malformation. J Korean Neurosurg Soc 1992;21:895-8.
12) Hall WA. Hereditary hemorrhagic telangiectasia (Rendu-Osler-Weber disease) presenting with polymicrobial brain abscess. J Neurosurg 1994;81:294-6.
13) Hewes RC, Auster M, White RI Jr. Cerebral embolism: first manifestation of pulmonary arteriovenous malformation in patients with hereditary hemorrhagic telangiectasia. Cardiovasc Intervent Radiol 1985;8:151-5.
14) White RI Jr, Pollak JS, Wirth JA. Pulmonary arteriovenous malformations: diagnosis and transcatheter embolotherapy. J Vasc Inter Radiol 1996;7:787-804.
15) Thompson RD, Jackson J, Peters M. Doré CJ, Hughes JM. Sensitivity and specificity of radioisotope right-left shunt measurements and pulse oximetry for the early detection of pulmonary arteriovenous malformations. Chest 1999;115: 109-13.
16) Cottin V, Plauchu H, Dupuis-Girod S, Cordier JF. Pulmonary arteriovenous malformations in patients with hereditary hemorrhagic telangiectasia: follow-up and pathophysiologic considerations. J Vasc Interv Radiol 2007;18:938-9.
17) Lee HK, Han GS. A case of transcatheter coil embolization of diffuse pulmonary arteriovenous malformation. J Korean Pediatr Soc 2001;44:1036-40.
18) Temes RT, Parasothy P, Endara SA, Wernly JA. Sensitivity and specificity of radioisotope right-left shunt measurements and pulse oximetry for the early detection of pulmonary arteriovenous malformation by video-assisted thoracic surgery. J Thorac Cardiovasc Surg 1998;116:878-9.