Thromboembolism from the noncoronary cusp of a patient with a normal aortic valve and protein C deficiency

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Native aortic valve thrombi, especially when not associated with an abnormal aortic valve or infectious endocarditis, are rare. Here we report a case of acute lower-extremity thromboembolism caused by an aortic valve thrombus that was attached to the noncoronary cusp in the normal aortic valve. The thrombosis was presumably caused by protein C deficiency because preoperative laboratory examinations otherwise showed normal findings. Our review of the literature also suggests that the noncoronary cusp is at higher risk for thrombus formation in the structurally normal aortic valve.

Clinical Summary

A 61-year-old man with a 30-year history of hypertension visited our hospital, complaining of acute right lower extremity pain and coldness. Angiography revealed a right popliteal artery occlusion with embolic characteristics. Laboratory tests, electrocardiography, and transthoracic echocardiography showed normal findings except for a 30% decrease in protein C antigen and a 36% decrease in protein C activity. Thromboembolectomy was performed through the distal popliteal artery. An aortic valve mass, 1.5 cm in diameter and attached to the noncoronary cusp, was identified by means of intraoperative transesophageal echocardiography (Figure 1, A). Contrast-enhanced chest computed tomography confirmed the mass, which was associated with the native aortic valve (Figure 1, B). Because the thrombus was indistinguishable preoperatively from a tumor and repeated embolization seemed possible, urgent surgical intervention was performed to remove the aortic valve mass during cardiopulmonary bypass. An aortotomy was created for exploration of the noncoronary cusp mass, which revealed the presence of a thrombus. The thrombus was attached loosely to the cusp and was excised easily. The cusp surface site of attachment seemed to be slightly rough, but no abnormalities were observed in the native aortic valve; thus valve replacement was not required. Histologic examination revealed that the mass was thrombotic, as was the embolus retrieved from the popliteal artery. Postoperative transthoracic echocardiography

Figure 1. A, Intraoperative transesophageal echocardiography. A 1.5-cm mass is present on the noncoronary cusp of the aortic valve (arrow). B, Enhanced chest computed tomography was performed before cardiac surgery. A 1.5-cm low-density mass suspected to be thrombus was found at the level of the aortic valve (arrow).

revealed normal function of the aortic valve and normal movement of the cusps. The patient remained symptom free after 2 years, without recurrence of thrombosis.

Discussion

Native aortic valve thrombosis is rarely reported and usually occurs after valve injury after cardiac catheterization or surgery or after bacterial endocarditis. These cases are commonly associated with anomalies, such as bicuspid valves, calcifications, stenoses, or valve injury.^{1,2} Therefore aortic thrombosis with a normal aortic valve is extremely rare in the literature (Table 1). Interestingly, these reports indicate that thrombus on normal aortic valves occurred mostly on the noncoronary cusp.

Turbulence of blood flow, coagulopathy, and injury of the intima are essential factors in thrombus formation *in vivo*, as described previously. Abnormality of the aortic valve could explain thrombus formation at the sinus of Valsalva because intimal damage occurs at the cusp. However, coagulopathy does not predict the location of the thrombus, and most reports have focused on venous thrombosis. This seems reasonable because venous flow is slower and easily stagnated by compression or even respiration. Therefore flow disturbance is essential for creating a nidus for thrombus formation, irrespective of whether systemic coagulating disorders exist, if the intima is free from disease.

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TABLE 1. Reported cases of normal aortic valve thrombosis

Report	Age/sex	Location	Comorbidity
Schrem (1988) ⁶	23/F	Commissure (RCC-LCC, LCC-NCC)	SLE
Nakano (1990) ⁷	16/M	NCC	None
	56/M	NCC	None
Warner (1994) ⁸	44/M	RCC, NCC	Polycythemia
Chrstiaens (1996) ⁹	41/M	NCC	None
Yamaji (1997) ¹⁰	75/M	NCC	None
Jobic, 1999 ⁵	77/M	LCC	Protein S deficiency
Our case	61/M	NCC	Protein C deficiency

The blood flow at the sinus of Valsalva showed reverse flow at end systole. In diastole backward flow occurs into the coronary arteries. Therefore flow disturbance with vortices develops in every cardiac cycle at the aortic cusp.³ Examination of the endothelial cells at the valve cusp by means of scanning electron microscopy demonstrates polygonal and randomly shaped endothelial cells.⁴ This result also supports the motion of flow disturbance at the aortic valve. However, a predominance of thrombosis in the noncoronary cusp suggests that the blood flow in the noncoronary cusp is different from that in the right or left coronary cusp, although the flow pattern in each cusp has not been examined independently. The stagnation and vortices of the blood flow could occur in the noncoronary cusp during diastole because of the absence of the coronary arteries, increasing the tendency to form thrombus at this site. Coagulopathy might be essential in the formation of thrombus on healthy aortic valves. In 1999, Jobic and colleagues⁵ reported the first case of native aortic valve thrombosis

in a patient with protein S deficiency. We know of no similar cases involving protein C deficiency. Further identification of similar cases is required to determine whether thrombophilia might promote aortic valve thromboses, especially at the noncoronary cusp.

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