Left Ventricular Assist Device-Related Systolic Aortic Regurgitation

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A 39-year-old woman underwent transesophageal echocardiography during heart transplantation after 2.5 years of support with a continuous-flow left ventricular assist device (cf-LVAD). The patient was admitted to the hospital when a donor heart became available, and did not present with any symptoms or signs of heart failure on cf-LVAD support. Color-flow imaging demonstrated pronounced systolic aortic regurgitation (AR) while the LVAD was providing full support. The development of this unusual LVAD-related systolic AR may involve dynamic changes in resistance to flow of the aortic valve of an unknown mechanism.

In most cases involving a combination of cf-LVAD support and aortic valve incompetence, AR would manifest as a mild-to-moderate diastolic or continuous valve regurgitation. Surprisingly, the patient demonstrated pronounced systolic AR (Figure 1 and Movie in the online-only Data Supplement) on support with a Heartmate II LVAD (Thoratec Corp, Pleasanton, CA). At that time, the electrocardiogram showed low voltage and widespread T-top abnormalities, but was not changed in comparison with previous registrations (Figure 2). Furthermore, the chest x-ray showed no signs of heart dilation and decompensation while on LVAD support (Figure 3). Mean arterial pressures were nonpulsatile (mean, 70 mm Hg) at a pump speed setting of 9400 rpm at the time of echocardiography assessment. It is suggested that the development of systolic AR might be related to dynamic changes in the resistance to flow of the aortic valve along with consistent aortic valve closure.

The mechanism allowing systolic AR to manifest has yet to be explained. Hence, when the aortic valve would be consistently closed and incompetent at the same time, aortic AR might occur throughout the entire cardiac cycle. It is possible that decrease in resistance to flow of the aortic valve during systole rather than diastole may have caused explicitly systolic AR in this patient to manifest. Accordingly, dynamic movements of the aortic valve annulus and valve leaflets during LVAD support may explain this phenomenon. Similarly, local pressure disturbances around the valve leaflets induced by turbulent flow patterns of the cf-LVAD may be a potential cause as well. Even so, we do not know whether this phenomenon is caused by purely physiological effects of the cf-LVAD, or it involves primarily anatomic factors. Perhaps in association with good-functioning cf-LVAD at the time of heart transplantation, no evidence was found that indicates that the systolic AR carried any hemodynamic significance in this patient. Thus, more detailed assessment strategies are...
necessary to determine the physiology associated with systolic AR.

Despite being considered as a diastolic phenomenon, systolic AR has been described during ventricular systole with some types of arrhythmias, and along with unusual circulatory physiology. Yet, there have been no reports regarding the presence of systolic AR during support with cf-LVADs. Importantly, the case presented here demonstrates that systolic AR should be regarded as an additional way aortic valve incompetence manifests in patients during cf-LVAD support. Meanwhile, AR during LVAD support still remains a critical issue, associated with LVAD-induced aortic valve insufficiency and suboptimal mechanical circulatory support. Therefore, consideration should be taken regarding long-term cf-LVAD efficiency and circulatory support in such patients.

Figure 3. A chest x-ray was made before the heart transplantation of a patient with systolic AR which showed no signs of heart dilation and decompensation. AR indicates aortic regurgitation.

References

Disclosures
None.
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