Proximal (entry) tear of dissecting aortic aneurysm visualized by three-dimensional echocardiography

Yoshifumi Saijo, MD,[a,b] Hiroji Akimoto, MD,[b] Yoshikatsu Saiki, MD,[b] Koichi Tabayashi, MD,[b] Takashi Horinouchi, MD,[c] Takafumi Kobayashi, MD,[c] and Shin-ichi Nitta, MD,[a] Sendai, Japan

Location of the proximal (entry) tear of dissecting aortic aneurysm is important in determining the operative strategy. However, the morphologic characteristics of the tear have not been fully understood. Especially, in vivo characteristics of entry have not been visualized with conventional techniques. We present a case in which the morphologic characteristics and the blood flow through the entry were visualized with intraoperative 3-dimensional echocardiography.

From the Department of Medical Engineering and Cardiology, Institute of Development, Aging and Cancer,[a] Department of Cardiovascular Surgery, Graduate School of Medicine,[b] and the Department of Anesthesiology, Graduate School of Medicine,[c] Tohoku University, Sendai, Japan.

Received for publication April 8, 2002; accepted for publication April 19, 2002.

Address for reprints: Yoshifumi Saijo, MD, PhD, Department of Medical Engineering and Cardiology, Institute of Development, Aging and Cancer, Tohoku University, 4-1 Seiryomachi, Aoba-ku, Sendai 980-8575, Japan (E-mail: saijo@idac.tohoku.ac.jp).

J Thorac Cardiovasc Surg 2002;124:1245-6

0022-5223/2002 $35.00+0 **12/54/125639**

doi:10.1067/mtc.2002.125639

Clinical Summary

A 67-year-old woman with a long history of hypertension was admitted to our hospital for investigation of an enlarged aortic silhouette on her chest radiograph. Contrast-enhanced computed tomography (Figure 1, *A*) and digital subtraction angiography of the aorta (Figure 1, *B*) revealed a Stanford type A chronic aortic dissection and localized the proximal (entry) tear of the dissection to the proximal aortic arch. Surgical replacement of the aortic arch was indicated and subsequently performed. With the patient under stable general anesthesia, multiplanar transesophageal echocardiography (TEE) was initiated for intraoperative monitoring of the dissection along with cardiac function. Initial 2-dimensional TEE confirmed enlargement of the aortic arch and showed the intimal flap fluttering between the true and false lumens. Color Doppler mapping depicted the blood flow from the true lumen into the false lumen. The TEE transducer was fixed at the level where the tear was clearly observed, and the observation plane was rotated in 3° step with synchronization to electrocardiogram and respiration. Sixty-one planes of both 2-dimensional and color Doppler TEE images in one cardiac cycle were taken and reconstructed to 3-dimensional images with commercially available software (Echoview; TomTec Imaging Systems GmbH, Munich, Germany). Three-dimensional echocardiography vividly demonstrated the entire tear and the 3-dimensional nature of entry into the dissecting false lumen (Figure 2, *A*). More strikingly, the color Doppler mapping

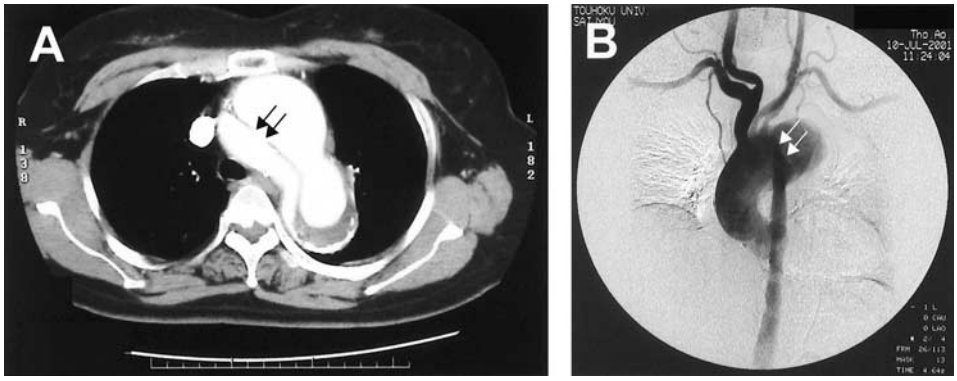

Figure 1. A, Contrast-enhanced computed tomography showing dissecting aortic aneurysm (DeBakey type I, Stanford type A). *Arrows* indicate proximal (entry) tear of dissection. B, Digital subtraction angiogram showing true and false lumens. *Arrows* indicate entry.

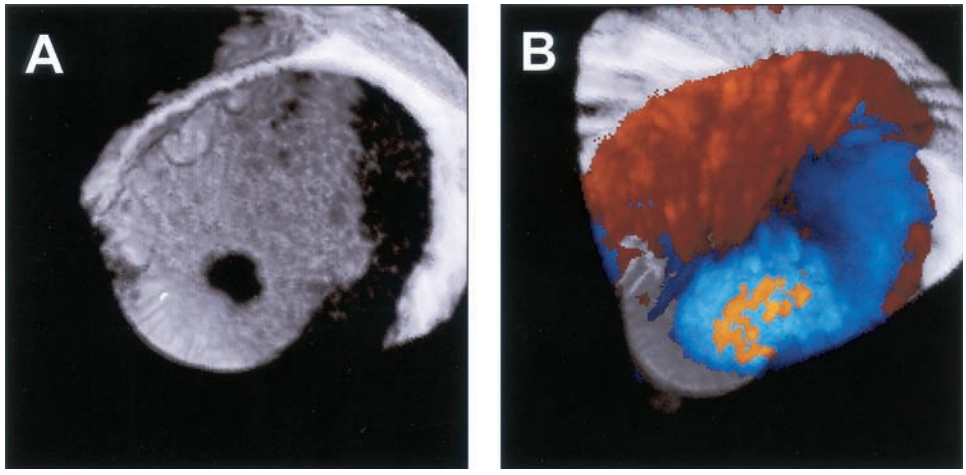

Figure 2. A, Three-dimensional echocardiogram demonstrating shape of entry. View is from false lumen. B, Tornado-like blood flow from true lumen to false lumen.

enabled us to detect the tornado-like blood flow from true to false lumen, along with its counterclockwise direction (Figure 2, *B*).

Discussion

TEE is now widely accepted as a diagnostic tool to detect the entrance point and to assess the blood flow distribution in dissecting aortic aneurysms.[1,2] To our knowledge, this is the first 3-dimensional image of an intimal tear in a chronic aortic dissection in vivo. Furthermore, the tornado-like blood flow was vividly shown by 3-dimensional color TEE. As an extension of this diagnostic modality, blood flow volume through the channel can be assessed by multiplying the area of the entry and the blood flow velocity. Hydrodynamic analysis of blood flow in the dissecting aneurysm[3,4] may also be enhanced with this 3-dimensional technology. Three-dimensional echocardiography applied to visualize the entry may provide new insights into the pathophysiologic process of a dissecting aortic aneurysm.

References

1. Armstrong WF, Bach DS, Carey L, Chen T, Donovan C, Falcone RA, et al. Spectrum of acute dissection of the ascending aorta: a transesophageal echocardiographic study. *J Am Soc Echocardiogr.* 1996;5:646-56.
2. Penco M, Paparoni S, Dagianti A, Fusilli C, Vitarelli A, De Remigis F, et al. Usefulness of transesophageal echocardiography in the assessment of aortic dissection. *Am J Cardiol.* 2000;86:53G-6G.
3. Chung JW, Elkins C, Sakai T, Kato N, Vestring T, Semba CP, et al. True-lumen collapse in aortic dissection: Part I. Evaluation of causative factors in phantoms with pulsatile flow. *Radiology.* 2000;214:87-98.
4. Hartmann T, Kolev N, Zimpfer M. A rare presentation of thoracic aortic dissection as detected by transoesophageal echocardiography. *Eur J Anaesthesiol.* 1997;14:655-8.