Protruding Aortic Atheroma: is there a Need for a New Imaging Modality?

Itzhak Kronzon MD

Department of Medicine, New York University School of Medicine, New York, NY, USA

Key words: atherosclerosis, embolism, stroke, transesophageal echocardiography

IMAJ 2000;2:54–55

Protruding aortic atheroma is one of the most common etiologies for stroke and peripheral embolic events. The association between protruding aortic atheroma, as visualized by transesophageal echocardiography, and embolic stroke was first described nearly 10 years ago [1]. Since then, some important aspects of aortic atheroma have been described [2]. The amount of protruding atheroma increases from the proximal to the distal aorta. Protruding atheroma in the ascending aorta and proximal arch are rare; from this site distally, their prevalence increases. Aortic atheroma is associated with embolic events, and both retrospective and prospective studies have established this association [3–6]. The incidence of stroke in patients with protruding atheroma (defined as protrusion of 4–5 mm or more and/or mobile component) is 12–15% per year, and the incidence of any vascular event is as high as 30%! [3]. Aortic ulceration is an independent risk factor [7]. Pathologic studies have shown that the mobile components seen on TEE are usually clots [8]. Not surprisingly, aortic atheroma is associated with coronary artery disease as well as carotid stenosis [9,10]. Carotid stenosis is frequently associated with arterioarterial embolization, and is therefore frequently treated with carotid endarterectomy in patients with emboli stroke. However, since 40% of the patients who have carotid stenosis have protruding aortic atheroma, it is quite possible that in some of them the embolization is from the proximal aorta (the ascending aorta or, more likely, the aortic arch), and not from the site of the carotid stenosis [9].

Protruding aortic atheromas are associated with embolic events during invasive arterial procedures. While embolic stroke during cardiac catheterization is quite rare, most of such strokes occur in patients who have protruding aortic atheromas [11]. More importantly, aortic atheroma as seen by TEE is associated with a poor outcome of open heart surgery [12,13]. Aortic atheroma can be found in nearly 20% of patients over 65 years old who undergo coronary bypass surgery [12]. The mortality and incidence of stroke is six times higher in patients who have protruding atheromas than in patients without them [13]. Thus, protruding atheroma is a marker of morbidity and mortality in patients who undergo cardiac surgery.

Identifying this condition has become even more important since reports began appearing of a decrease in both mortality and incidence of embolic events in patients with protruding atheroma following anticoagulation treatment [14,15]. It also appears that minimally invasive direct coronary bypass surgery (without cardiopulmonary bypass or aortic manipulation) prevents intra-operative strokes that may occur as complications of aortic atheroma [16].

TEE provides excellent imaging of the ascending aorta, most of the aortic arch and the descending thoracic aorta. There is, however, a small segment at the junction of the ascending aorta and the aortic arch that cannot be visualized by this modality. The reason for this is the tracheal air column located between the esophagus and the aorta, which prevents the visualization of that segment of the aorta when viewed from the esophagus. Ultrasound does not travel well through air. In addition, the origin of the innominate artery cannot be visualized. However, most of the arch, including the left carotid and left subclavian artery, can readily be visualized and identified [17]. Although rarely harmful, TEE is indeed a semi-invasive procedure. It occasionally requires sedation and almost always requires topical anesthesia. Many patients consider the examination unpleasant. Rare complications have been reported, including death in 1:10,000 examinations [18]. The procedure is contraindicated in patients with pharyngoesophageal pathology such as varices, tumors, strictures, and diverticuli. The procedure should always be performed by a trained physician.

In this issue of the Journal, Tenenbaum et al. [19] report on the use of spiral computerized tomography in patients with protruding atheroma. The results of SCT were compared with TEE, which served as a "gold standard." The authors were able to achieve a high specificity and sensitivity in the diagnosis of protruding aortic atheroma. In

TEE = transesophageal echocardiography

SCT = spiral computerized tomography

a smaller group of patients they used contrast injection that better evaluated the lumen of the aorta and obtained even more accurate information. More importantly, SCT was able to evaluate atheromas in the "blind spot" of the transesophageal echocardiogram — namely the distal ascending aorta and the proximal arch. The authors correctly state that in this blind area, the contrast-enhanced modality was superior to TEE. The major issue for the practitioner, therefore, is whether a "less invasive" modality such as SCT should replace the "semi-invasive" transesophageal echocardiogram in the evaluation of patients with embolic stroke.

One should take note that SCT is not a totally non-invasive procedure. The exposure to ionizing radiation has known hazards, and the injection of radiopaque contrast (usually an iodine compound) may, even in a small dose, induce an allergic reaction, exacerbate renal insufficiency, and precipitate congestive heart failure. While the images obtained by SCT demonstrate the entire aorta, they are less detailed than the images seen on TEE. In particular, they do not show the mobile components (clots), which are the most dangerous part of the protruding atherosclerotic plaque. The SCT equipment is heavy and immobile, and unlike transesophageal echocardiographic equipment, cannot be brought to the patient's bedside, the intensive care unit, or into the operating room. SCT equipment is much more expensive than the equipment needed for TEE, and thus, its use would increase the cost of medical care for patients with embolic stroke. In addition, unlike TEE, CT does not provide information about other possible cardiac sources of embolism, such as intracardiac masses and clots, vegetations, strands, intracardiac shunts, and valvular abnormalities. Finally, it is not yet clear what percentage of all patients with protruding aortic atheroma have disease that is limited to the "blind spot" of the transesophageal echocardiogram (i.e., distal ascending aorta and/or proximal arch). It appears that these are the only patients who will definitely benefit from an imaging modality other than TEE. Since aortic atherosclerosis is usually a diffuse disorder, and since it more frequently involves the more distal segments of the aorta, this exact anatomic distribution is rare.

Another promising non-invasive imaging modality for evaluating the entire aorta is magnetic resonance imaging. Here also, an MRI contrast agent (gadolinium) enhances image resolution. Unlike CT, MRI is not associated with ionizing radiation and the contrast used is less toxic. The images obtained are of high quality, and in selected cases can complement TEE [20]. However, like CT, the equipment is heavy, cumbersome and expensive and also cannot be used in the environment of feromagnetic materials. Such materials are found in monitors, electrodes, respirators, and many other devices associated with the modern care of patients with stroke.

It is now clear that protruding aortic atheroma is an important finding, and its correct diagnosis and treatment may influence patients' longevity and quality of life. It is also clear that no single modality used in the diagnosis of aortic atheroma is perfect. Thus, in selected cases, one modality can complement another.

References

1. Tunick PA, Kronzon I. Protruding atherosclerotic plaque in the aortic arch of patients with systemic embolization: a new finding seen by transesophageal echocardiography. *Am Heart J* 1990;120:658–60.
2. Kronzon I, Tunick PA. Atheromatous disease of the thoracic aorta: pathologic and clinical implication. *Ann Intern Med* 1997;126:629–37.
3. Tunick PA, Perez JL, Kronzon I. Protruding atheromas in the thoracic aorta and system embolization. *Ann Intern Med* 1991;11:423–7.
4. Simons AJ, Carlson R, Hare Cl, Obeid AI, Simulyan H. The use of transesophageal echocardiography in detecting aortic atherosclerosis in patients with embolic disorders. *Am Heart J* 1992;123:224–6.
5. Tunick PA, Rosenzweig BP, Katz ES, Freedberg RS, Perez JL, Kronzon I. High risk for vascular events in patients with protruding aortic atheromas: a prospective study. *J Am Coll Cardiol* 1994;23:1085–90.
6. Atherosclerotic disease of the aortic arch as a risk factor for recurrent ischemic stroke. The French Study of Aortic Plaques in Stroke Group. *N Engl J Med* 1996;334:1216–21.
7. Amarenco P, Duyckaerts C, Tzourio C, Henin D, Bousser MG, Hauw JJ. Prevalence of ulcerated plaques in the aortic arch in patients with stroke. *N Engl J Med* 1994;331:1474–9.
8. Khatibzadeh M, Mitusch R, Stierle U, Gromoll B, Sheikhzdeb A. Aortic atherosclerotic plaque as a source of systemic embolism. *J Am Coll Cardiol* 1996;27:664–9.
9. Fazio GP, Redberg RF, Winsow T, Schiller NB. Transesophageal echocardiographically detected atherosclerotic aortic plaque is a marker for artery disease. *J Am Coll Cardiol* 1993;21:144–50.
10. Demopolous LA, Tunick PA, Bernstein NE, Perez JL, Kronzon I. Protruding atheromas of the aortic arch in symptomatic patients with carotid artery disease. *Am Heart J* 1995; 129:40–4.
11. Karalis DG, Quinn V, Victor MF, Ross JJ, Polansky M, Spratt KA, Chanrasekauan K. Risk of catheter related emboli in patients with atherosclerotic debris in the thoracic aorta. *Am Heart J* 1996;131:1149–55.
12. Katz ES, Tunick PA, Rusinek H, Ribakove G, Spencer FC, Kronzon I. Protruding aortic atheromas predict stroke in elderly patients undergoing cardiopulmonary bypass: experience with intraoperative transesophageal echocardiography. *J Am Coll Cardiol* 1992;20:70–7.
13. Stern A, Tunick PA, Culliford AT, Lachmann J, Baumann FG, Kanchuger MS, Marschall K, Shah A, Grossi E, Kronzon I. Protruding aortic arch atheromas: risk of stroke during heart surgery with and without aortic arch endarterectomy. *Am Heart J* 1999;138:746–52.
14. Ferrari E, Vidal R, Chevallier T, Baudouy M. Atherosclerosis of the thoracic aorta and aortic debris as a marker of poor prognosis: benefit of oral anticoagulants. *J Am Coll Cardiol* 1999;33:1317–22.
15. Dressler FA, Craig WR, Castello R, Labovitz A. Mobile aortic atheroma: efficacy of anticoagulation and influence of plaque morphology on recurrent stroke. *J Am Coll Cardiol* 1998;31:134–8.
16. Trehan N, Mishra M, Kasliwal R, Tunick PA, Kronzon I. Prevention of stroke during coronary bypass surgery in patients with protruding aortic atheromas identified by transesophageal echocardiography. *J Am Soc Echocardiogr* 1999;12(5):413.
17. Katz ES, Konecky N, Tunick PA, Rosenzweig BP, Freedberg RS, Kronzon I. Visualization and identification of the left common carotid and left subclavian arteries: a transesophageal approach. *J Am Soc Echocardiogr* 1996;9(1):58–61.
18. Daniel WG, Erbel R, Kasper W. Safety of transesophageal echocardiography: a multicenter study of 10419 examinations. *Circulation* 1991;83:817–21.
19. Tenenbaum A, Garniek A, Shemesh J, Stroh CI, Itzchak Y, Vered Z, Motro M, Fisman EZ. Spiral computerized tomography (dual helical mode) as a detector of aortic atheromas in patients with stroke and systemic emboli: additional benefit of the contrast-enhanced technique. *IMAJ* 2000;2:1–5
20. Kutz SM, Lee VS, Tunick PA, Krinsky GA, Kronzon I. Atheromas of the thoracic aorta: a comparison of transesophageal echocardiography and breath-hold gadolinium-enhanced 3D magnetic resonance angiography. *J Am Soc Echocardiogr* 1999;12:853–8.

Correspondence: Dr. I. Kronzon, NYU Medical Center, 560 First Avenue — HW 228, New York, NY 10016, USA. Tel: (1-212) 263 5665; Fax: (1-212) 263 8461; email: Itzhak.Kronzon@med.nyu.edu