

Case Report

Mobile atheromatous plaque of the aortic arch diagnosed by transthoracic echocardiography prior to coronary artery bypass surgery

Which one would you choose: scepticism or wishful thinking?

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Abstract

A routine pre-operative chest X-ray of a patient admitted to our institution for an elective coronary artery bypass operation revealed a mildly dilated mediastinal silhouette, which led the cardiovascular surgery resident to schedule emergency transthoracic echocardiography (TTE), with a special note asking for detailed evaluation of the ascending aorta and aortic arch. TTE revealed a mobile atheroma at the aortic arch, which obliged the cardiac surgery team to modify their strategy to combined hemi-arcus aortae replacement and coronary artery bypass grafting (CABG). Although with transoesophageal echocardiography (TEE) a small portion of the ascending aorta may be obscured by the trachea, TEE provides higher resolution images than TTE. Therefore one can conclude that TEE is the imaging modality of choice for detecting aortic atheromatous plaques but in patients with low risk for stroke and aortic atheromas, a detailed TTE may be sufficient for the pre-operative assessment.

Keywords: aortic arch, atherosclerosis, aorta, echocardiography, circulatory arrest, coronary artery bypass grafts, CABG

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The aorta is an important source of athero-emboli, as recent studies have confirmed the strong correlation between severe aortic atheromatous plaques and stroke/death in the elderly.¹ The dimensions of the aortic arch atheroma (larger and thicker

than 4 mm) and the complexity of the plaque (ulcerative and/or mobile) are important risk factors for unexplained arterial embolic events such as stroke, transient ischaemic attack and peripheral emboli, together with multi-organ failure and death. Furthermore, mobile atheromas of the aortic arch are associated with increased peri-operative strokes in patients undergoing cardiac surgery.² Stroke incidence was found to be around 25% in patients with mobile plaques of the aortic arch, while it was only 2% in patients with quiescent non-mobile plaques.³

Potential aetiological risks independently associated with complex plaque formation are advanced age, history of hypertension, hypercholesterolaemia, increased body mass index, diabetes, and past or present tobacco use. Similarly, established risk for stroke occurrence are advanced age, male gender, previous stroke history, heredity, hypertension, smoking, diabetes mellitus, carotid artery disease, coronary artery disease and polycythaemia.^{4,5}

We can clearly conclude that risk factors for atherosclerosis and stroke overlap. In fact, in cardiac patients without clinical evidence of severe atherosclerotic disease, a high prevalence of combined aortic and carotid plaques was reported.⁴ Surgeons should consider these patients as strong candidates for pre-operative and postoperative athero-embolic complications.

Transoesophageal echocardiography (TEE), which is a safe and relatively less invasive procedure with a very low risk of complication is the modality of choice for the diagnosis of aortic atheromas, although CT, MRI and intra-operative epi-aortic ultrasonography are known to be complementary examination techniques.⁶ The progress in TEE technology has enabled surgeons to obtain a detailed view of the aorta pre- and peri-operatively, to quantify atheromatous plaques according to their thickness and the presence of mobile components, therefore classifying them as simple or complex. In one study, TEE was able to find aortic arch atheromatous disease in 55% of patients with a normal chest X-ray, and 91% of those had heavily calcified aortic knobs.⁷

We assumed that TEE evaluation of the aorta is useful in older patients with risk factors for stroke and those with radiographic evidence of aortic calcification, to determine the presence of severe atheromatous disease of the aortic arch pre-operatively. However, TEE is a semi-invasive procedure, which mostly requires sedation, is not always readily available, and may not be suitable for haemodynamically unstable patients. In this report, we highlight that in some patients such as ours but not in all, TTE may be used instead of TEE in this manner.

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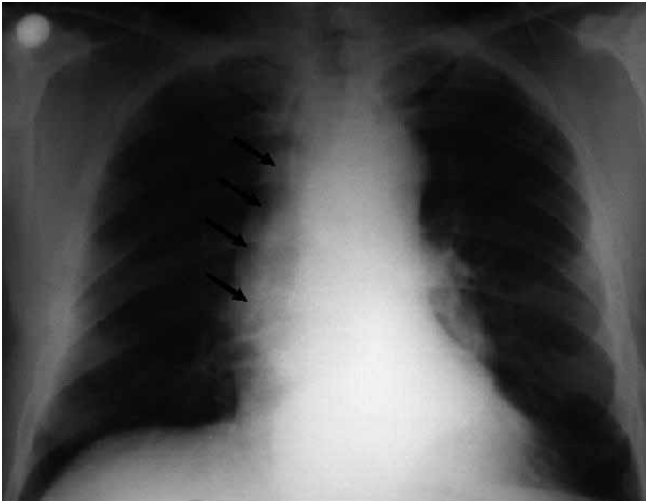


Fig. 1. Pre-operative chest X-ray showing a dilated and mildly calcified aortic arch (arrows).

Case report

A 65-year-old man with a history of stable angina was admitted to our institution for an elective CABG operation. He had hypertension, hypercholesterolaemia, diabetes mellitus controlled with oral medication and a smoking history of 50 years. The patient had no neurological complaints. The central nervous system and cardiovascular system were normal.

On his chest X-ray, the aortic arch seemed dilated and mildly calcified (Fig. 1). Coronary angiography revealed triple-vessel disease with a left main coronary artery lesion of 60%. In our protocol, all patients scheduled for CABG operations are simultaneously scheduled for a pre-operative TTE examination for evaluation of their valvular and ventricular functions. In this patient with a mildly enlarged mediastinal silhouette on chest X-ray, the referring cardiovascular surgeon involved the echocardiography laboratory for a detailed evaluation of the ascending aorta and aortic arch. TTE performed at our institution showed minimal aortic regurgitation with an ejection fraction of 60% and a mobile atheroma at the aortic arch with minimal aortic dilatation (Fig. 2).

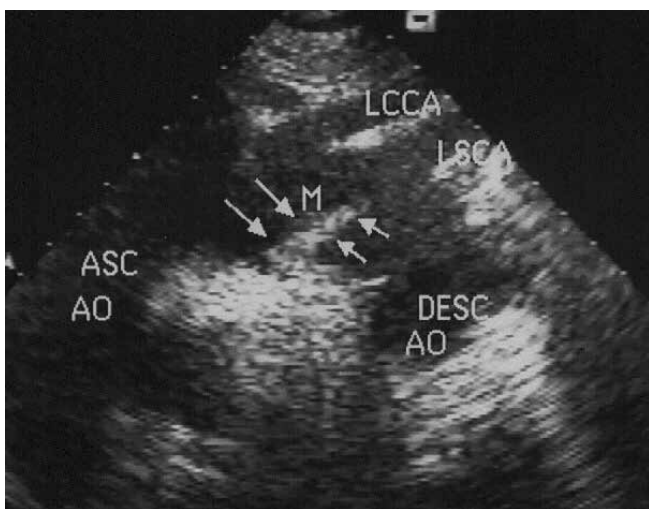


Fig. 2. Transthoracic echocardiographic examination revealing a mobile atheroma at the aortic arch with minimal aortic dilatation. Asc Ao: ascending aorta, LCCA: left common carotid artery, LSCA: left subclavian artery, Desc Ao: descending aorta, M: mobile atheroma.

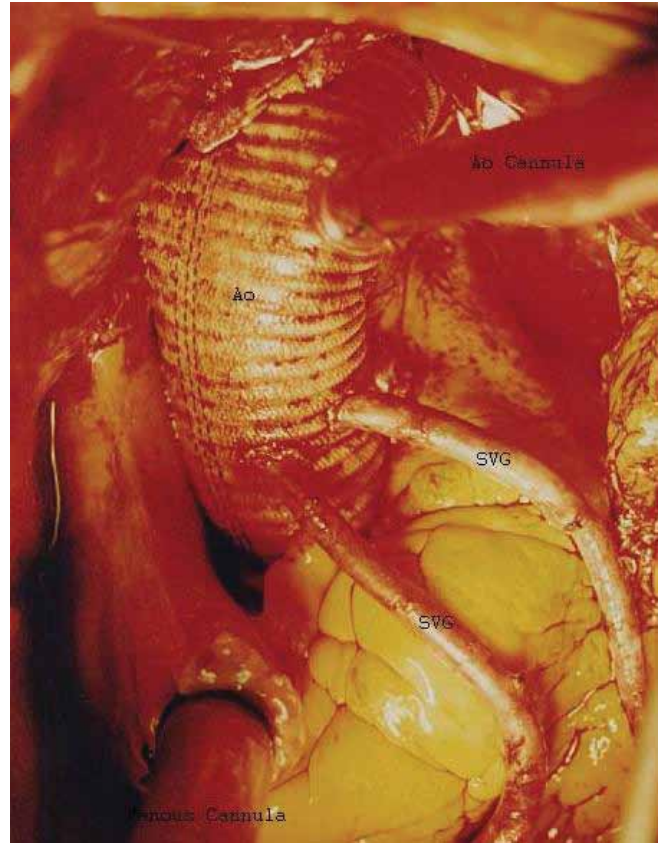


Fig. 3. Photograph taken at the end of the operation. Hemi-arcus replacement (no: 28 gel-coated dacron vascular graft) with proximal coronary anastomoses of the saphenous grafts constructed directly to the aortic graft. SVG: saphenous vein graft, Ao: dacron vascular graft.

The surgical strategy was modified due to these findings and the arterial cannulation site was moved to the innominate artery with a regular two-staged venous cannulation, followed by a hemi-arcus aorta replacement with a quadruple CABG (left

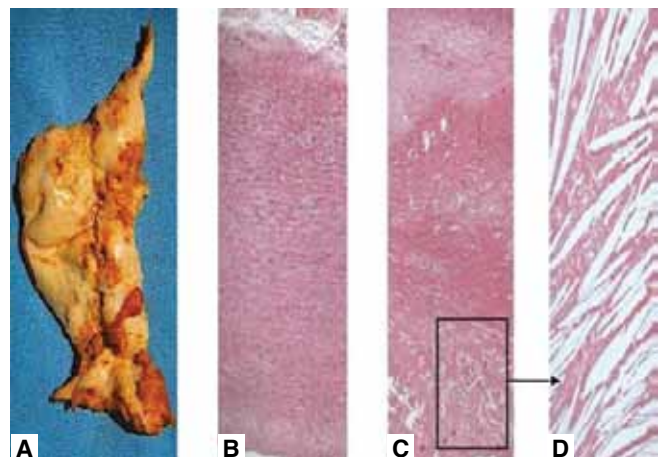


Fig. 4. Macroscopic and histopathological view of the aortic arch specimen. A. Excisional aortic specimen with the mobile atheroma in the aortic arch (arrow) showing rupture of the tunica intima, atheromas with ulceration, and a pedunculated thrombus formation attached to the arterial wall. B, C and D. Histopathological examination of the specimen showing atherosclerotic intimal changes, chronic fibrosis and full-thickness degeneration of the artery.

internal thoracic artery–left anterior descending artery bypass graft, aorta–diagonal artery–obtuse marginal branch of the circumflex artery bypass with saphenous vein graft, aorta–right coronary artery bypass with saphenous vein graft) (cardiopulmonary bypass time: 123 min, total circulatory arrest time at 18°C: 25 min, cross-clamp time: 81 min).

After distal coronary anastomoses, a segment from the supra-coronary aorta to the left subclavian artery ostium was excised and the hemi-arcus was replaced with a number 28 gel-coated dacron vascular graft. Lastly, proximal coronary anastomoses of the saphenous grafts were performed directly to the aortic graft (Fig. 3). No operative/postoperative embolic or other complications were experienced following the successful operation.

Pathological examination of the specimen revealed macroscopically: rupture of the tunica intima, an atheromatous plaque with ulceration, and a pedunculated thrombus formation attached to the arterial wall, and microscopically: atherosclerotic intimal changes, chronic fibrosis, and full-thickness degeneration of the artery (Fig. 4). The patient was discharged from the ICU on the third postoperative day and from hospital on the 15th postoperative day. The patient presented for routine cardiology and cardiovascular surgery follow up without any complaints.

Discussion

Although several variables were identified as risk factors for peri-operative stroke, the majority of strokes occur in patients where no definitive aetiological factors can be identified. All patients undergoing cardiac surgery may have atherosclerotic aortic plaques with no clinical evidence, and these are a potential source of serious peri-operative or postoperative athero-embolic complications. Thorough pre-operative echocardiographic evaluation of the patient, and particularly of the elderly, is crucial for an uneventful surgical outcome.

TTE compares favourably with TEE in the identification of atheromatous plaques of the aortic arch and distal ascending aorta, although it is less effective in identifying simple plaques of the proximal ascending aorta. The demonstration of aortic plaque with TEE has a sensitivity of 91%, specificity of 82%, and positive and negative predictive values of 72 and 95%, respectively.⁸ However, TEE, which is a sensitive technique to determine protruding aortic atheromas with or without a mobile component, cannot always visualise plaques located in the distal ascending aorta and proximal aortic arch.⁹

Weinberger *et al.* reported that TTE could be used to visualise plaques in the distal ascending aorta and aortic arch, and particularly plaques at the junction of the ascending aorta and aortic arch that could be obscured by the bronchi and may be missed by TEE.⁹ TTE was able to detect simple plaques undetected with TEE, particularly in the proximal ascending aorta. Konstadt *et al.* reported that up to 42% of the ascending aorta cannot be visualised by TEE, so potential embolic plaques can be missed by that modality.¹⁰ All complex plaques, morphologically similar and visualised with TEE were also demonstrated with TTE. Both techniques are able to identify the plaques as pedunculated or proliferative and to picture their mobility.

To our knowledge, there is no study comparing TTE with TEE in detecting mobile atheromatous plaques. Most echocardiographers feel that TEE is more accurate than TTE for the critical measurement of plaque thickness and for the diagnosis of mobile

thrombi (high resolution and proximity to the aorta). The small portion of the ascending aorta that is masked by the trachea near the origin of the innominate artery may not be seen on TEE and only 2% of the plaques may be missed with this modality.¹¹

As a significant proportion of aortic plaques of stroke patients can be demonstrated with TTE, the necessity for a TEE evaluation, which is a relatively invasive procedure, will automatically diminish. Unfortunately, combined TEE and TTE examinations of the aortic arch may still be mandatory in a subgroup of patients, to rule out the presence of atherosclerotic plaque. TTE imaging of the aortic arch is also useful for sequential evaluation of the plaques already identified with TEE, and therefore helps physicians to omit repetitive TEE examinations.

Conclusion

Routine TTE evaluation is a valuable modality, particularly for elderly candidates, for aortic cannulation in open-heart surgery. In our case, the pre-operative TTE examination of the patient enabled the surgeon to make the correct and custom-designed operative decision, which assured a safe procedure and better surgical outcome.

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