Value of aortic arch analysis during routine transthoracic echocardiography in adults

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Aims

Despite the recommendations of the American Society of Echocardiography, the majority of clinicians and sonographers do not perform aortic arch analysis routinely during transthoracic echocardiography (TTE). The European guidelines remain unclear. The aim of our study is to evaluate the usefulness of aortic arch analysis during routine TTE in adults.

Methods and results

We performed aortic arch analysis on all 2000 adult patients (mean age 52, range 18–89) referred to our echocardiography lab for transthoracic echocardiograms between January and December 2007. Adequate study was obtained in 1826 patients (91% of cases). Suprasternal notch views and aortic arch analysis were normal in 1787 patients (98%) and abnormal in 39 patients (2%). Among patients with abnormal findings, 32 patients (82%) had aortic arch plaques, 24 of them (75%) had plaques ≥ 4 mm, and 8 patients (25%) had plaques ≤ 4 mm. Four patients (10%) had aortic arch aneurysms (diameter ≥ 4.5 cm). Other abnormal findings included one case of coarctation of the aorta, one case of a floating thrombus in a right pulmonary artery branch, one case of severe stenosis of the innominate artery, and one case of type A aortic dissection. Subsequently, 7 patients (18%) underwent surgery, 4 patients (10%) were started on oral anticoagulation therapy, and 28 patients (72%) treated with an antiplatelet and risk factors modification.

Conclusion

Aortic arch analysis showed significant pathology in 2% of the adult population undergoing routine TTE. This led to therapeutic interventions in all patients with abnormal findings, and to curative therapy in more than quarter of them. Aortic arch analysis should be mandatory during a routine exam and part of any standard digital acquisition protocol for TTE in adults.

KEYWORDS

Aortic arch; Transthoracic echocardiography

Introduction

During transthoracic echocardiography (TTE), the aortic arch is visualized in the suprasternal notch view. Other vessels can be also imaged from the suprasternal notch; these include the origins of the left common carotid, the innominate, and the left subclavian vessels.

Despite the recommendations of the American Society of Echocardiography, the majority of clinicians and sonographers do not obtain this view routinely during TTE. A recent report from the European Association of Echocardiography on standardization of performance, digital storage, and reporting of echocardiography studies considered that this view might not always be required in adults. In this study, our aim is to evaluate the usefulness of aortic arch analysis during routine TTE in adults.

Methods

Study population

We included in our study all patients referred to our echocardiography lab for transthoracic echocardiograms between January and December 2007. The study population consisted of 2000 consecutive adult patients. According to selection criteria and aiming to evaluate aortic arch analysis during routine TTE, no patients were excluded from the population referred.

Echocardiography protocol

All echocardiograms were performed by same operator (E.C.) using the same echocardiography machine, General Electric Vivid 7, with a probe M3S using a harmonic mode 1.7/3.4 MHz.

The echocardiography protocol recommended by the American and European Guidelines was applied to all patients.

A suprasternal long-axis view of the aortic arch was obtained at the end of every acquisition protocol, and Doppler studies with colour flow imaging were performed at the end of the grey scale (B-mode).
Results

Demographic data
The demographic results are summarized in the following table. Data are presented as mean ± SD or number (%).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No. of patients</td>
<td>2000 (100)</td>
</tr>
<tr>
<td>2 Men</td>
<td>1263 (63)</td>
</tr>
<tr>
<td>3 Women</td>
<td>737 (37)</td>
</tr>
<tr>
<td>4 Age (year)</td>
<td>52.45 ± 7.55</td>
</tr>
<tr>
<td>5 Age (min-max)</td>
<td>18—89</td>
</tr>
<tr>
<td>6 Cardiovascular risk factors</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>635 (32)</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>563 (28)</td>
</tr>
<tr>
<td>Family history</td>
<td>336 (17)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>447 (22)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>432 (22)</td>
</tr>
</tbody>
</table>

Echocardiography results
Adequate study, with complete visualization of the aortic arch by TTE, was obtained in 1826 patients (91% of cases). Suprasternal notch views and aortic arch analysis were normal in 1787 patients (98%) and abnormal in 39 patients (2%). Patients with abnormal findings included 32 patients (82%) with aortic arch plaques (Figure 1). These were classified based on the French Aortic Plaque Stroke study (FAPS) criteria as patients with protruding arch atheromas <4 mm and those with atheromas ≥4 mm. Among patients with aortic arch plaques, 24 patients (75%) had plaques <4 mm and 8 patients (25%) had plaques ≥4 mm. Four patients (10% of patients with abnormal findings) were found to have aortic arch aneurysms, with arch dilation and diameter ≥4.5 cm (Figure 2).

Suprasternal notch view and arch analysis also detected other abnormalities including the following: one patient was found to have coarctation of the aorta, one patient had a floating thrombus in a right pulmonary artery branch (Figure 3), one patient had severe stenosis of the innominate artery, and one patient had a type A aortic dissection with extension to the aortic arch (Figure 4).

Discussion
Aortic arch disease
Aortic atherosclerosis is the most common disease of the aortic arch. Plaques of atherosclerosis are usually visualized as regions of intimal thickening or protrusion. They may be calcified, ulcerated, or seen with superimposed thrombi. These plaques and other aortic plaques are considered a marker of vascular disease and a risk factor for cerebrovascular events. In fact, patients with severe high-risk aortic plaques were found to have the highest-risk carotid lesions. It is therefore important to consider evaluation of the aortic arch in stroke patients with cerebrovascular events and findings of severe carotid disease.

Findings from the FAPS group supported causality concerning aortic arch plaques and stroke, rather than simple association. In this study, for patients with aortic arch plaques ≥4 mm, the odds ratio for stroke was very high when compared with plaques <4 mm. Causality is suggested by the fact that the odds ratio for stroke in patients with plaques ≥4 mm in the arch was 13.8, compared with an odds ratio of 1.5 for plaques of the same size but located in the descending aorta (hence, less likely to send emboli upstream to the brain).

Furthermore, the FAPS showed that the 1-year risk of stroke in patients with severe aortic arch plaque is high. Similar observations were noted by the SPAF investigators (Stroke Prevention in Atrial Fibrillation). Diseases of the aortic arch also include aneurysmal dilation, dissection, and coarctation of the aorta.

Echocardiographic evaluation of aortic arch: the suprasternal notch view
The aortic arch can be seen from the suprasternal notch view during TTE. Aortic arch atheromas can be assessed using echocardiography. Transthoracic echocardiography has been proved a useful tool for evaluation of these atheromas.

In a study by Weinberger et al., transthoracic B-mode ultrasonography was performed to image the aortic arch. The results were compared with those of transoesophageal echocardiography (TEE) performed on same patients. In this study, B-mode imaging compared favourably with TEE in identification of plaques in the aortic arch. Furthermore, plaques of distal ascending aorta were visualized by B-mode and were not seen by TEE. The accuracy of this technique may be enhanced by the use of harmonic imaging. Schwammenthal et al. performed transcutaneous echocardiographic evaluation of aortic arch atheromas in a series of 354 patients who underwent TEE. In their study, adequate transcutaneous image quality could be achieved in 84% of patients. Positive and negative predictive values for large protruding aortic arch atheromas on TEE were 91% and 98%, respectively. They concluded that suprasternal harmonic imaging reliably predicted or excluded the presence of protruding aortic arch atheromas. It also provided complementary views of regions that may be blind spots for TEE.

Transthoracic echocardiography is also useful for evaluation of aneurysmal dilation of the ascending aorta and aortic arch. The 2003 ACC/AHA guidelines for echocardiography recommend echocardiography for evaluation of suspected aortic aneurysm, with TTE being the first choice for this indication. Transthoracic measurements and computed tomography measurements of these dilations correlate very well.

Evaluation of the aortic arch and suprasternal view are of particular importance in patients with bicuspid aortic valve, for the association of this condition with aneurysmal dilation. This condition is also frequently associated with coarctation of the aorta.

Suprasternal notch view can also be used for detection of coarctation of the aorta. In this view, colour and spectral Doppler evaluation of the proximal descending aorta may detect accelerated flow characteristic of coarctation. Coarctation should be suspected if forward velocity in the descending aorta by continuous-wave Doppler exceeds 2 m/s.
For patients with thoracic aortic dissection, TTE can visualize the dissection. However, it is less sensitive and less specific than TEE, computed tomography, and magnetic resonance imaging for evaluation of aortic dissection.16

Clinical implications
In our study, aortic arch analysis was evaluated as screening tool during TTE. Findings had major clinical impact on management of patients with abnormal findings. Seven patients (18%) underwent surgery, 4 patients (10%) were started on oral anticoagulation therapy, and 28 patients (72%) treated with an antiplatelet and considered for risk factors modification.

Conclusion
Aortic arch disease is associated with high incidence of vascular events.5–8,17,18 Aortic arch analysis showed significant pathology in 2% of the adult population undergoing TTE. This led to therapeutic interventions in all patients with abnormal findings, and to curative therapy in more than quarter of them. Aortic arch analysis should therefore be mandatory during a routine exam and part of any standard digital acquisition protocol for TTE in adults. In the presence of aortic arch abnormalities by TTE, a TEE may be indicated in specific cases for a better visualization and analysis of the lesions and better prognosis outcome.
Conflict of interest: none declared.

References


Figure 3  Aortic arch aneurysm.

Figure 4  Dissection of the aortic arch.