Screening for abdominal aortic aneurysm in coronary care unit patients with acute myocardial infarction using portable transthoracic echocardiography

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Aims
Patients with acute myocardial infarction (AMI) represent a high-risk population in which screening for abdominal aortic aneurysm (AAA) is recommended but only occasionally performed. Transthoracic echocardiography (TTE) may offer the unique opportunity to evaluate the cardiac function and to screen for AAA during the same examination. We aimed to evaluate the feasibility of AAA screening at bedside using a portable cardiac ultrasound (US) echo machine and to determine the prevalence of AAA in population with AMI.

Methods and results
The AA diameter was measured at bedside at the end of a regular TTE performed in consecutive patients admitted for AMI in the coronary care unit using a portable echo machine (Vivid i, General Electric). AAA was defined by a transverse diameter of ≥30 mm. We prospectively enrolled 193 patients (65 ± 11 years, 77% male). Measurement of the AA diameter was feasible in 93% and the duration was 3 ± 1 min. An AAA was observed in nine patients (4.7%) and the prevalence increased with age (7.7% after 60 years and 9.2% after 65 years). No AAA was observed in patients under 50 years old. Inter-observer variability between cardiologists using the portable US system was excellent (mean difference 1.8 ± 2.0 mm) as well as the accuracy compared with measurements performed by a radiologist using a dedicated vascular US system (mean difference 1.5 ± 1.3 mm).

Conclusion
Overall, the prevalence of AAA was 4.7%, increased with age, and seems higher than expected in the ‘same-aged population’. In regard to the simplicity, accuracy, and feasibility, screening for AAA during TTE (one cardiovascular shot) may be of value after AMI especially in elderly patients.

Keywords
Abdominal aortic aneurysm • Screening • Acute myocardial infarction • Echocardiography

Introduction
Abdominal aortic aneurysm (AAA) is the 14th leading cause of death almost from dramatic rupture. The overall mortality of ruptured AAA is 80–90% compared with a 30-day post-operative mortality of 3% after elective surgery. Considering the balance between incidence and cost-effectiveness, even if screening for AAA in asymptomatic patients combined with increased numbers of elective aneurysm surgery may reduce the mortality rate, the relatively low prevalence of AAA in the general population (5.5% of men over 65 years old) implies to target specific high-risk population. As AAA and coronary heart disease share common risks factors, patients with acute myocardial infarction (AMI) represent a high-risk population in which screening for another atherosclerotic location is recommended but often neglected. In addition, the prevalence of AAA in this population has never been properly evaluated.

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Ultrasound (US) scanning using a 3.5 MHz probe is a valid first-line method of screening. It is fast and safe with a sensitivity and specificity close to 100% with a low intra- and inter-observer variability. Previous studies have suggested that the 2.5 MHz probe used during routine transthoracic echocardiography (TTE) may be adequate for the detection of AAA with a sensitivity ranging from 91 to 94% using quick-screen programmes and the subcostal view. As most patients with AMI undergo a TTE when hospitalized in the cardiology coronary care unit (CCU), we aimed to evaluate the feasibility of AAA screening by the cardiologist at bedside during TTE using a portable cardiac echo machine and to determine the prevalence of AAA in this population.

Methods

Study design

Consecutive patients admitted for AMI in the CCU of Bichat Hospital, a large tertiary academic centre, were prospectively enrolled in the present study. Inclusion criteria were a clinical diagnosis of myocardial infarction using an elevation of biomarkers (troponin, CK) in the presence of chest pain and/or electrocardiographic changes in at least two derivations (persistent or transient ST-segment elevation or depression, T-waves inversion, flat T-waves, or pseudo-normalization of T-waves). There were no exclusion criteria. An oral informed consent was obtained in all patients.

Clinical investigation

Baseline characteristics were collected including age, gender, body mass index, history of atherothrombotic risk factors: smoking status (current or past smokers vs. non-smokers), diabetes mellitus (fasting glucose ≥7 mmol/L and/or the use of diet or oral hypoglycaemic agents or insulin treatment), hypertension (patients receiving antihypertensive medications or having known but untreated blood pressure ≥140/90 mmHg) and hypercholesterolaemia (fasting serum total cholesterol ≥220 mg/dL or treated hypercholesterolaemia). Physical examination consisted in measurement of bilateral brachial and ankle blood pressure to calculate the ankle–brachial index (ABI) and screen for peripheral arterial disease and abdominal examination (deep palpation in the left upper quadrant/epigastrium using the right hand). If the aorta was palpable, the examiner, using deep palpation with the left hand, attempted to ascertain whether the patients had AAA or simply a normal palpable aorta.

Echocardiography

Scanning of an AA was performed directly at bedside using a portable echocardiographic US system (Vivid I from General Electrics) and a 2.5 MHz cardiac probe. No abdominal preparation was required. Analysis of the aorta was made at the end of the regular TTE examination performed routinely in patients with AMI, using the subcostal view while the patient lying supine. The entire AA was first visualized in the transverse and longitudinal planes. Measurements were carried out in the transverse plane, antero-posterior outside-to-outside wall at both the suprarenal aorta level (next to the celiac vessel) and the infrarenal aorta level (just below the renal arteries) (Figure 1). External antero-posterior diameter was measured in each site three times and then averaged. Quality was defined as ‘good’ when the vessel was analysable easily, ‘correct’ when limits of the vessel were analysable but with less resolution, ‘average’ when limits were imprecise but distinguishable, and ‘poor’ when the vessel could not be seen. AAA was defined as an aortic external antero-posterior diameter of ≥30 mm. Patients with suspected AAA were referred to the vascular department to undergo a specific vascular Doppler echography using a dedicated US system and if needed were advised to consult a vascular surgeon.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables are expressed as absolute numbers and percentages. The prevalence of AAA was calculated as the number of AAA diagnosed divided by the number of patients included in the study. Feasibility was the percentage of patients in whom the aorta was analysable. Reproducibility was assessed as the difference between measurements performed at bedside by two cardiologists using the portable US system several days apart blinded of previous results. Accuracy was assessed as the difference between measurements performed at bedside by a cardiologist using the portable ultrasoundographic system and measurements performed blindly by a radiologist using a dedicated vascular US machine. Correlations between measurements were evaluated using linear regression. All tests were two-sided. A value of P < 0.05 was considered statistically significant.

Results

Population

One hundred and nineteen-three patients were consecutively and prospectively enrolled on two periods from February to October 2008 (9 months) and from June to September 2009 (4 months), including weekends, totaling 13 months. The mean age was 65 ± 11 years (27–98) and 150 (77%) were males. The mean
The feasibility of screening using the portable US system was 93%; 131 patients (7%) had a poor echocardiographic window. Quality of diameter.6 Screening programmes target the populations most likely to benefit of this strategy, maximize cost-effectiveness, and minimize inconvenience and risk to the healthy population. As the prevalence detected over 65-year-old patients (9.2%) is higher than that expected in the general ‘same-aged population’ (5.5%),2 screening of AAA may be recommended during TTE after AMI, as one ‘cardiovascular shot’, especially in the elderly population.

Rupture is a dreaded complication of AAA directly correlated to the antero-posterior diameter with an increasing risk over 50 mm.6 Patients hospitalized for AMI routinely undergo TTE. TTE may offer the unique opportunity to evaluate, during the same examination, the cardiac function and to screen for AAA. A cardiac probe offers the unique opportunity to evaluate, during the same examination, the cardiac function and to screen for AAA. A portable cardiac ultrasonography equipment at the bedside was highly feasible (93%), accurate, reproducible, and fast. As the prevalence of AAA increased with age, 5.5% after 50 years (n = 162), 7.7% after 60 years (n = 117), and 9.2% after 65 years (n = 97) (Figure 3). All aneurysms were located at the infrarenal level and were partially thrombosed. Clinical characteristics of the nine patients with AAA are presented in Table 1 (Right column). Our results did not change if we used the ratio of suprarenal/infrarenal aorta diameter ≥1.5 as a definition for AAA: the nine patients with a diameter of ≥30 mm were all identified as well as an additional patient with a 27 mm AA diameter.

Discussion

In this series of consecutive patients hospitalized for acute coronary syndrome in our CCU, the analysis of the AA by a cardiologist using a portable cardiac ultrasonography equipment at the bedside was highly feasible (93%), accurate, reproducible, and fast. As the prevalence of AAA in the general population is relatively low,2 the current guidelines recommend to screen specific population subsets: at least once men over 65 years old, women or men with familial history of AAA over 50 years old, and by extension patients with cardiovascular disease.3,4 Echography is the key exam using a vascular 3.5 MHz probe and has an excellent sensibility and specificity (close to 100%)5 including when ‘quick-screen analysis protocols’ are used.5

Patients hospitalized for AMI routinely undergo TTE. TTE may offer the unique opportunity to evaluate, during the same examination, the cardiac function and to screen for AAA. A cardiac probe has already been evaluated for AAA screening with a sensitivity between 91 and 96%.4 Our study was first performed using portable US systems directly at the patient bedside, at the end of a routine TTE (2.5 MHz probe). Feasibility was excellent (93%), independently of the time since the last meal, suggesting that no specific abdominal preparation is required. Inter-observer variability was 0.88, r = 0.98, P < 0.0001) (Figure 2). Using clinical palpation for screening, 31 patients (16%) had a palpable aorta of whom only 2 (6%) had an aneurysm confirmed using US.
was good and consistent with previous reports. Scan duration was short, 3 min in average to be added to the cardiac imaging time. No extra cost or additional equipment (same examinator, same material) was required. Our results suggest that US scanning is simple, quick, accurate, and reproducible when performed by a cardiologist using small portable systems. It is worth noting that abdominal palpation was neither sensitive nor specific for the diagnostic of AAA but remains essential in clinical practice to detect complications.

The prevalence of coronary artery disease in patients with AAA is well known and is one of the main causes of death.\(^9\) On the opposite, the prevalence of AAA in patients with coronary artery disease is less evaluated but seems higher and varies from 7 to 18% in patients with stable coronary artery disease. This large range may be due to differences in AAA definition and patient selection.\(^{10-12}\) Recently, Dupont et al.\(^{13}\) found a prevalence of AAA of 6.9% in patients undergoing coronary artery bypass surgery. In the present study, the prevalence was 4.7% in the overall population and increased with age, 9.2% after 65 years which is twice the expected prevalence for the age-adjusted.

The present study has several clinical implications. For the cardiologist, we suggest that at the end of the regular TTE, a quick analysis of the aorta by the subcostal view should be systematically performed. For the patient, they may benefit at least once of the screening, with respect to guidelines, especially in patients with risk factors. In the setting of an acute coronary syndrome, the diagnosis of large AAA before coronary angiography has implication for the treatment strategy (e.g. bare-metal stent vs. drug-eluting stent) and on the choice of the vascular access for angiography and percutaneous coronary intervention (radial vs. femoral). In addition, detection of small AAA is a strong incentive for intensive therapy.\(^{14}\)

Our study deserves several comments. First, quick-screen protocol and complete analysis of the aorta by the specialist should not be regarded as competitive but as complementary methods in order to optimize the screening programmes. Secondly, in the absence of control group, we cannot definitively establish the higher prevalence of AAA among AMI, compared with patients without AMI. Nevertheless, large previous studies suggested a lower prevalence in the general same-aged population. Finally, this was an observational study and was not intended nor powered to demonstrate the clinical impact of this screening programme.

**Conclusion**

This is the first study to highlight the interest of a systematic AAA screening by the cardiologist in patients admitted in the CCU for AMI using portable echocardiographic US systems during routine...
TTE at the bedside. In regard to the simplicity, accuracy, and feasibility of this screening of AAA, it may considered as a complement of the routine TTE examination as one cardiovascular shot screening strategy especially in the elderly population.

Conflict of interest: none declared.

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