Pre-test probability risk scores and their use in contemporary management of patients with chest pain: One year stress echo cohort study

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Abstract
Objectives: To compare how patients with chest pain would be investigated, based on the two guidelines available for UK cardiologists, on the management of patients with stable chest pain. The UK National Institute of Clinical Excellence (NICE) guideline which was published in 2010 and the European society of cardiology (ESC) guideline published in 2013. Both guidelines utilise pre-test probability risk scores, to guide the choice of investigation.
Design: We undertook a large retrospective study to investigate the outcomes of stress echocardiography.
Setting: A large tertiary centre in the UK in a contemporary clinical practice.
Participants: Two thirds of the patients in the cohort were referred from our rapid access chest pain clinics.
Results: We found that the NICE risk score overestimates risk by 20% compared to the ESC Risk score. We also found that based on the NICE guidelines, 44% of the patients presenting with chest pain, in this cohort, would have been investigated invasively, with diagnostic coronary angiography. Using the ESC guidelines, only 0.3% of the patients would be investigated invasively.
Conclusion: The large discrepancy between the two guidelines can be easily reduced if NICE adopted the ESC risk score.

Keywords
pre-test probability, risk scores, guidelines, NICE, stress echocardiography

Introduction
National and international guidelines on the investigation of stable coronary artery disease have given increasing importance to the pre-test probability for the presence of coronary artery disease, provided risk scores and recommended the optimal investigation for the different risk score categories. The UK National Institute for Health and Clinical Excellence (NICE) guideline (2010) risk score is calculated based on the typicality of the symptoms, age, gender as well as the presence of a single cardiovascular-risk factor.¹ The European Society of Cardiology (ESC) guideline (2013) risk score is calculated based on the typicality of the symptoms, age and gender only.² Both guidelines suggest an escalating management based on the risk score: (1) No diagnostic test is needed if risk score is <10% based on NICE, and <15% based on the ESC guideline. (2) A non-invasive cardiac imaging test, such as cardiac CT or stress echocardiography, is recommended if the risk score is 10–60% based on NICE, or 15–85% based on ESC guideline. (3) Invasive coronary angiogram if the risk score is >61% based on NICE and >85% based on ESC guideline, for risk stratification. We compared the two risk score in a cohort of patients with stable chest pain who were investigated with stress echocardiography in a large tertiary centre in London, United Kingdom.

Methods
Data were collected from 908 consecutive patients who underwent stress echocardiography (dobutamine or exercise) between 1 January 2012 and 31 December 2012. All demographic data, cardiovascular risk factors, typicality of symptoms and the result of the stress echocardiography were collected from the hospital databases. For every patient the pre-test probability risk score, for both NICE and ESC, was calculated retrospectively and the recommended management recorded.¹,² Follow-up data for Major Adverse Cardiac Events were recorded for 12 months. major adverse cardiac events was defined as cardiac mortality, acute coronary syndrome and late revascularization.

All data were analysed with IBM SPSS version 20.0.0 (IBM Corporation Software Group Somers, NY). The normality of variables was tested using the Shapiro-Wilk test. For matched pairs and...
Results

From the 908 patients, 277 were known to have coronary artery disease, and further 25 had stress echocardiography for pre-op reasons and were excluded. 606 patients were included in the analysis. Mean age was 59.6 ± 12.2 years and 234 (38.6%) were male. Contrast was used in 53.6% of this cohort; 66 had moderate ischaemia (at least three segments), and 50 (75.8%) were investigated further with invasive coronary angiography and 15 (30%) were revascularised; 133 had either mild or limited apical ischaemia, 54 (40.6%) were investigated further with invasive coronary angiography and 5 (9.3%) were revascularised. During the follow-up period, 4 major adverse cardiac events were recorded, all had positive stress echocardiography, 3 had undergone invasive coronary angiography and none needed revascularisation. The fourth had moderate ischaemia on stress echocardiography but did not attend for invasive coronary angiography.

Using the NICE and ESC guidelines the pre-test probability risk score were calculated. The NICE pre-test probability risk score were higher compared to ESC risk score (mean 54.7 ± 29.8% vs. 34.4% ± 19.7%). We found the same large difference when the data were reanalysed for females (mean 45.5% ± 29.2% vs. 24.6% ± 14.2%). In 478 cases the NICE pre-test probability risk score was higher, whereas in 126 cases it was lower, compared to ESC pre-test probability risk score ($P < 0.001$). The recommended management by NICE and ESC guidelines were categorized into the three groups (Table 1). For the no diagnostic test needed category, applying NICE risk score and guideline, 64 patients would not have been investigated compared with 103 patients if applying ESC risk score and guidelines (10.6% vs. 17.0%). None of the patients identified by NICE risk score as low risk needed revascularisation. Two patients identified by ESC risk score as low risk needed revascularisation. There was no major adverse cardiac events. For the non-invasive test category, applying NICE risk score and guideline, 273 patients would be investigated non-invasively compared to 501 patients if applying the ESC risk score and guideline (45.2% vs. 82.7%); 5 patients in this NICE guideline group were revascularised and there was one major adverse cardiac events; 17 patients in this ESC guideline group needed revascularisation and there were 4 major adverse cardiac events. For the invasive test category, NICE risk score and guideline would lead to 269 patients being investigated with invasive coronary angiography compared to only 2 patients based on ESC risk score and guideline (44.2% vs. 0.3%); 15 patients in this NICE guideline group were revascularised and there were three major adverse cardiac events. In the ESC guideline group, one patient required revascularization and there were no major adverse cardiac events.

Discussion

Our study demonstrates that the pre-test probability risk score Calculated using the NICE Guideline were significantly higher compared to the ESC pre-test probability risk score. This means that UK patients,

| Management according to NICE PTP Score | No test | Non-invasive test | Invasive test | Total | Revascularization | MACE |
|--------------------------------------|---------|------------------|---------------|-------|------------------|-------|
| No test                              | 44      | 59               | 0             | 103   | 2                | 0     |
| Non-invasive test                    | 20      | 215              | 266           | 501   | 17               | 4     |
| Invasive test                        | 0       | 0                | 2             | 2     | 1                | 0     |
| Total                                | 64      | 273              | 269           | 606   |                  |       |
| Revascularisation                    | 0       | 5                | 15            | 20    |                  |       |
| MACE                                 | 0       | 1                | 3             | 4     |                  |       |

PTP: pre-test probability; MACE: major adverse cardiac events.

Table 1. Patient management according to NICE and ESC pre-test probability scores for patients with chest pain and suspected stable coronary artery disease.
managed according to the NICE guidelines, are much more likely to be managed with invasive coronary angiography for two reasons: (1) the NICE guideline recommends that patients with pre-test probability risk score >61% should have invasive coronary angiography, (2) the NICE pre-test probability risk score significantly overestimates the pre-test probability, compared with that of the ESC. NICE based their risk score on the Duke Clinical Score. The ESC used an updated and extended version of the Diamond-Forrester model, by the European coronary artery disease consortium, which was published in 2011 and hence was not available to NICE. The original Duke Clinical score and Diamond and Forrester method were based on high risk populations undergoing invasive coronary angiography in the 1970s. The CONFIRM multinational Registry, of over 14,000 patients with suspected coronary artery disease who underwent CTCA, demonstrated that these risk score greatly overestimate the actual prevalence of disease in today’s populations. Finally, Demir et al. also demonstrated that the NICE risk score overestimates risk by 18%, compared to ESC risk score, on a cohort of 479 patients with chest pain, investigated with cardiac CT, stress echo and nuclear stress.

In our institution in 2012, the vast majority of our patients with stable chest pain were investigated non-invasively with stress echocardiography, which would be more in keeping with the ESC guideline. This is of lower cost, spares large number of patients, with relatively low prevalence of coronary artery disease, unnecessary invasive coronary angiography and frees up limited catheter lab space for interventional work. Our 12 month outcome data demonstrates that this approach is safe. NICE need to consider adopting the European coronary artery disease consortium risk score in their forthcoming update of their Guidelines. This would narrow the gap, on the recommended management strategies, between the two guidelines.

Declarations

Competing interests: None declared

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Ethical approval: This was an audit which was approved by the local audit department.

Contributorship: KA, JB and MM conceived the idea. DD, DR and IT extracted the data and calculated the risk scores. AP analysed the data. DD wrote the first draft. All authors contributed to writing the subsequent drafts of the manuscript.

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