Accuracy of electrocardiography in diagnosis of left ventricular hypertrophy in arterial hypertension: systematic review
Pewsner D, Juni P, Egger M, Battaglia M, Sandstrom J, Bachmann L M

CRD summary
This review assessed the accuracy of electrocardiography (ECG) in screening for left ventricular hypertrophy (LVH) in patients with hypertension in primary and secondary care settings. The more commonly used ECG indices are unsatisfactory for ruling out the diagnosis of LVH. This was a good review and the authors' conclusions are likely to be reliable.

Authors' objectives
To assess the accuracy of electrocardiography (ECG) in screening for left ventricular hypertrophy (LVH) in patients with hypertension.

Searching
MEDLINE, PREMEDLINE and EMBASE were searched from inception to December 2005 for articles published in English, German, Italian, Spanish, French and Portuguese (the search terms are available from the authors). The reference lists of relevant studies were checked and experts in the field were contacted.

Study selection
Study designs of evaluations included in the review
Observational studies were eligible for inclusion. Diagnostic case-control studies comparing patients with known LVH with healthy controls were excluded.

Specific interventions included in the review
Studies evaluating the accuracy of ECG indices for the diagnosis of LVH were eligible for inclusion. The review focused on the six most commonly used indices: the Sokolow-Lyon index, Cornell voltage index, Cornell product index, Gubner index, and Romhilt-Estes using a score of 4 or more points and 5 or more points as the diagnostic threshold. Details of each of the indices were provided in the original paper.

Reference standard test against which the new test was compared
Studies using echocardiography as the reference standard were eligible for inclusion, provided left ventricular mass was indexed for body surface area and not heart mass/body height.

Participants included in the review
Studies of asymptomatic patients with primary arterial hypertension in any health care setting were eligible for inclusion. Studies were excluded if the patients had concomitant left anterior fascicular block, left bundle branch block, or had known left ventricular hypertrophy. The included studies assessed men and women from primary and secondary care settings. The median prevalence of LVH was 33% (interquartile range: 23, 41) in primary care settings and 65% (interquartile range: 37, 81) in secondary care settings.

Outcomes assessed in the review
Studies reporting sufficient data to construct a 2x2 contingency table for the calculation of sensitivity and specificity were eligible for inclusion. The main interest was in the negative likelihood ratio (LR) as ECG would mainly be used to rule out the diagnosis of LVH.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed studies for relevance against the inclusion criteria.
Assessment of study quality
Studies were assessed as to whether they had consecutive enrolment, prospective design, clear description of technique, clear definition of cut-off threshold, blinded assessment of ECG and blinded assessment of echocardiography. Studies meeting all six criteria were defined as high quality; those meeting four to five criteria as intermediate quality; those meeting one to three criteria as low quality; and those meeting no criteria as very low quality. Two reviewers independently assessed quality.

Data extraction
Two reviewers independently extracted the data. The authors of the primary studies were contacted for missing data. Two by two contingency tables were constructed and sensitivities, specificities and LRs calculated, along with their 95% confidence intervals (CIs).

Methods of synthesis
How were the studies combined?
The studies were discussed in a narrative synthesis, grouped by index test. The median, range and interquartile range of the sensitivity, specificity and LRs were calculated. Sensitivities and specificities were plotted in the receiver operating characteristic (ROC) space and negative LRs were presented in forest plots.

How were differences between studies investigated?
Differences between the studies could be examined in tables of study characteristics and results, and in forest plots of the negative LRs.

Results of the review
Twenty-one observational studies (n=5,608) were included.

Three studies were classified as high quality, 11 as intermediate quality and 7 as low quality. The number of participants in the primary studies ranged from 30 to 947.

For each of the ECG indices most studies were located in the bottom left corner of the ROC space, indicating low sensitivity and high specificity. The median sensitivity ranged from 10.5% (range: 0 to 39) to 21% (range: 4 to 52) and the median specificity from 89% (range: 53 to 100) to 99% (range: 71 to 100). The median negative LR was fairly consistent across ECG indices: it ranged from 0.85 (range: 0.34 to 1.03) for the Romhilt-Estes score (4-point threshold) to 0.91 (range: 0.70 to 1.01) for the Gubner index. The median positive LR was more variable: it ranged from 1.90 (range: 0.16 to 25.9) for the Sokolow-Lyon index to 5.90 (range: 0.71 to 18.2) for the Romhilt-Estes score (4-point threshold).

Authors' conclusions
The more commonly used ECG indices are poor for ruling out the diagnosis of LVH in patients with hypertension.

CRD commentary
This review had a clearly defined review question. Articles written in a reasonable range of languages were included and relevant sources were searched for studies. Only limited attempts were made to locate unpublished studies so relevant studies might have been missed, though, as the authors pointed out, it is likely that such studies would have shown lower diagnostic accuracy and therefore not changed the conclusions. Appropriate methods were used to minimise error and bias in the review processes, and study quality was assessed and reported. Relevant details from the primary studies were provided and the approach to the analysis seems appropriate. The authors' conclusions are likely to be reliable.

Implications of the review for practice and research
Practice: ECG should not be done specifically to exclude LVH in patients with hypertension.

Research: Further investigation is required on the cost-effectiveness of diagnostic strategies in primary care settings. In addition, randomised controlled trials comparing diagnostic and treatment strategies and assessing clinical outcomes are required to inform the development of algorithms to identify which patients should be referred for echocardiography. New diagnostic technologies should be investigated, as well as outcomes in patients with LVH confirmed by echocardiography but with a negative electrocardiogram and those with positive ECG but a negative echocardiograph.

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