Is this patient hypovolemic?
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Authors' objectives
To systematically review the physical diagnosis of hypovolaemia in adults.

Searching
MEDLINE was searched from January 1966 to November 1997 for publications in the English language, using the search terms 'dehydration/di', 'hypotension', 'orthostatic' or 'tilt-table test'. A second search used 'exp dehydration', 'exp hypotension', 'orthostatic' or 'exp heart rate' and 'exp physical examination', 'exp medical history taking' or 'exp professional competence', or 'exp sensitivity and specificity', 'reproducibility of results', 'observer variation', 'diagnostic tests, routine', 'exp decision support techniques' or 'Bayes theorem'. A third textword search used the terms 'skin turgor', 'acute blood loss', 'orthostatic vital signs' or ('postural' and 'pulse').

One author also checked the bibliographies of retrieved articles and textbooks on physical diagnosis and personal files for additional relevant studies.

Study selection
Study designs of evaluations included in the review
No inclusion criteria relating to the study design were specified. The review included studies of diagnostic accuracy in clinical populations (diagnostic cohort). Also included were healthy volunteer studies in which the participants were tested before and after phlebotomy, (a form of diagnostic case-control study).

Specific interventions included in the review
No inclusion criteria relating to the index test were specified. The included studies investigated postural vital signs, capillary refill time, dry axilla, dry mucous membranes, dry tongue, tongue furrows, confusion, weakness, non-fluent speech and sunken eyes.

Reference standard test against which the new test was compared
No inclusion criteria relating to the reference standard were specified. The included clinical studies used a wide variety of reference standards, such as various biochemical parameters, hypotension, postural vital signs, and weight gain after rehydration.

Participants included in the review
The included studies were of adults, aged 16 years or older, who were healthy volunteers or patients presenting to an emergency department with suspected hypovolaemia. Studies of the physical diagnosis of hypovolaemia in infants and children were excluded from the review.

Outcomes assessed in the review
No inclusion criteria relating to the outcome measures were specified. The outcome measures used in the review were the sensitivity, specificity, and positive and negative likelihood ratios (LRs).

How were decisions on the relevance of primary studies made?
One author selected the studies for inclusion.

Assessment of study quality
The methodological quality of the included clinical studies was rated using a 3-level scale (A, B or C). Level A corresponded to an independent, blind comparison of a defined physical sign with an acceptable criterion standard of hypovolaemia in more than 50 consecutive patients suspected of having hypovolaemia. Level B was the same as A, but fewer than 50 consecutive patients were suspected of having volume depletion. Level C was all other studies, including...
those using a criterion standard of uncertain validity. Two authors independently graded the included studies as A, B or C according to a set of predetermined criteria. There was complete agreement on the classification.

**Data extraction**

The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. The data extracted from the healthy volunteer studies were study source, the number of patients, the amount of blood removed, change in pulse, and changes in systolic and diastolic blood-pressure (BP). The data extracted from the clinical studies were study source, grade of study, the number of patients, age, patient characteristics, index test and definition of abnormal finding, reference standard, reason why the study was not grade A, and results.

**Methods of synthesis**

How were the studies combined?
The pooled estimates of sensitivity, specificity, and positive and negative LRs were calculated, along with 95% confidence intervals (CIs), using a random-effects model.

How were differences between studies investigated?
The authors did not state how differences between the studies were investigated.

**Results of the review**

Ten phlebotomy studies (612 participants) and 4 clinical studies (179 participants) were included. In the phlebotomy studies, there were 504 participants in the moderate blood loss (450 to 630 mL) group and 108 participants in the large blood loss (630 to 1,150 mL) group.

Healthy volunteer studies.

Postural pulse increment (at least 30 beats/minute) or severe postural dizziness had a sensitivity of 22% (95% CI: 6, 48) for moderate blood loss (3 studies) and 97% (95% CI: 91, 100) for large blood loss (2 studies), with a corresponding specificity of 98% (95% CI: 97, 99). Postural hypotension (greater than 20 mmHg decrease in systolic BP) had a sensitivity of 9% (95% CI: 6, 12) for moderate blood loss (3 studies), with a specificity of 94% (95% CI: 84, 99). Supine tachycardia (pulse greater than 100 beats/minute) had a sensitivity of 0% (95% CI: 0, 42) for moderate blood loss (1 study) and 12% (95% CI: 5, 24) for large blood loss (4 studies), with a corresponding specificity of 96% (95% CI: 88, 99). Supine hypotension had a sensitivity of 13% (95% CI: 0, 50) for moderate blood loss (1 study) and 33% (95% CI: 21, 47) for large blood loss (4 studies), with a corresponding specificity of 97% (95% CI: 90, 100).

Clinical studies.

The following estimates of diagnostic performance were each derived from a single study.

Pulse increment greater than 30 beats/minute: the sensitivity was 43%, the specificity 75%, the positive LR 1.7 (95% CI: 0.7, 4.0) and the negative LR 0.8 (95% CI: 0.5, 1.3).

Postural hypotension (systolic BP decline of greater than 20mm Hg), the sensitivity was 29%, the specificity 81%, the positive LR 1.5 (95% CI: 0.5, 4.6) and the negative LR 0.9 (95% CI: 0.6, 1.3).

Dry axilla, the sensitivity was 50%, the specificity 82%, the positive LR 2.8 (95% CI: 1.4, 5.4) and the negative LR 0.6 (95% CI: 0.4, 1.0).

Mucous membranes of mouth and nose dry, the sensitivity was 85%, the specificity 58%, the positive LR 2.0 (95% CI: 1.0, 4.0) and the negative LR 0.3 (95% CI: 0.1, 0.6).

Tongue dry, the sensitivity was 59%, the specificity 73%, the positive LR 2.1 (95% CI: 0.8, 5.8) and the negative LR 0.6 (95% CI: 0.3, 1.0).
Longitudinal furrows on tongue, the sensitivity was 85%, the specificity 58%, the positive LR 2.0 (95% CI: 1.0, 4.0) and the negative LR 0.3 (95% CI: 0.1, 0.6).

Sunken eyes, the sensitivity was 62%, the specificity 82%, the positive LR 3.4 (95% CI: 1.0, 12.2) and the negative LR 0.5 (95% CI: 0.3, 0.7).

Confusion present, the sensitivity was 57%, the specificity 73%, the positive LR 2.1 (95% CI: 0.8, 5.7) and the negative LR 0.6 (95% CI: 0.4, 1.0).

Upper or lower extremity weakness present, the sensitivity was 43%, the specificity 82%, the positive LR 2.3 (95% CI: 0.6, 8.6) and the negative LR 0.7 (95% CI: 0.5, 1.0).

Speech not clear or expressive, the sensitivity was 56%, the specificity 82%, the positive LR 3.1 (95% CI: 0.9, 11.1) and the negative LR 0.5 (95% CI: 0.4, 0.8).

Abnormally high capillary refill time, the sensitivity was 34%, the specificity 95%, the positive LR 6.9 (95% CI: 3.2, 14.9) and the negative LR 0.7 (95% CI: 0.5, 0.9).

Authors’ conclusions
A large postural pulse change (greater than or equal to 30 beats/minute) or severe postural dizziness is required to clinically diagnose hypovolaemia due to blood loss, although these findings are often absent after moderate amounts of blood loss. In patients with vomiting, diarrhoea, or decreased oral intake, few findings have proven utility; clinicians should measure serum electrolytes, serum blood urea nitrogen, and creatinine levels when diagnostic certainty is required.

CRD commentary
The authors did not state a clear research question and the inclusion and exclusion criteria were very poorly defined. The limitations of the literature search (a single database and English language publications) make it likely that relevant publications were missed. There was no attempt to identify unpublished studies, and no assessment of publication bias was reported. The quality of the included studies was formally assessed using limited criteria. The reporting of the review methodology was otherwise vague.

The details of the primary studies were tabulated clearly. No tests for heterogeneity were conducted, but the pooling of healthy volunteer studies was reasonable given the restricted nature of the study populations and the clear definition of the tests and thresholds reported. Data from clinical studies were extremely limited, with the performance characteristics of each index test being derived from only a single study. In addition, the authors appeared to present data in the ‘Results’ section, which was not derived from any of the included studies described.

The authors’ conclusions concerning the diagnosis of hypovolaemia due to blood loss were reasonable for the data presented. However, considerable caution should be exercised when extrapolating data from healthy volunteer studies to clinical populations. The data presented for clinical studies of patients with vomiting, diarrhoea, or decreased oral intake were insufficient to support the drawing of any firm conclusions. The authors statement that, for this population, ‘clinicians should measure serum electrolytes, serum blood urea nitrogen, and creatinine levels when diagnostic certainty is required’ was not supported by any evidence, since these biochemical parameters were not the subject of the review.

Implications of the review for practice and research
Practice: The authors stated that when applying these findings to practice, until further data are available, clinicians should have a low threshold for ordering tests of serum electrolytes, serum blood urea nitrogen, and creatinine.

Research: The authors stated that further research is needed on the role of physical examination in the diagnosis of hypovolaemia.
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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.