Predictive value of normal sperm morphology: a structured literature review
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Authors' objectives
To establish the universal predictive value of normal sperm morphology in the in-vitro fertilisation (IVF) situation.

Searching
MEDLINE was searched using the keywords 'IVF', 'pregnancy' and 'normal sperm morphology'. Only studies performed in humans and published in the English language between 1978 and 1996 were included. The Unit's data bank of articles was also searched using the same criteria. The references of the articles obtained were crosschecked.

Study selection
Study designs of evaluations included in the review
The authors did not specify any inclusion criteria with respect to study design.

Specific interventions included in the review
Only studies of sperm morphology where abnormal/normal morphology fertility thresholds were identified were eligible for inclusion in the review.

A variety of classification systems were used in included studies to classify normality; these were Eliasson, the World Health Organization (1980, 1987, and 1992) and Tygerberg strict criteria. In addition, a variety of staining procedures were employed: papanicolaou; eosin yellow; Diff-Quik; Shorr; formalin and haematoxylin; deoxycycline and metronidazole; eosin-nigrosin; Testsimplet; haematoxylin and brilliant green; and Spermac.

Reference standard test against which the new test was compared
The authors did not specify any inclusion or exclusion criteria in relation to a reference standard test.

Participants included in the review
The authors did not specify any inclusion or exclusion criteria in relation to the participant characteristics. The population studied appears to have been infertile couples undergoing IVF.

Outcomes assessed in the review
The included studies had to provide descriptive data (per oocyte fertilisation, per cycle/transfer pregnancy rates and pregnancy outcome).

The outcomes assessed included the fertilisation rate (the number of oocytes fertilised), and the number of pregnancies obtained per cycle within the specified normal sperm morphology classification.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
The authors do not state that they assessed validity.

Data extraction
The data were independently analysed by two of the authors and the results tabulated by consensus. It is not stated how the data were extracted. Data were extracted on: the study authors; morphology classification method; stain method; outcomes. Where possible odds ratios (OR) and 95% confidence intervals (CIs) were estimated using the number of
oocytes fertilised and the number of pregnancies obtained per cycle. Studies with 0 counts (fertilisation or pregnancy rate) were given the value of 0.5 to enable the OR to be estimated.

**Methods of synthesis**

How were the studies combined?
The studies were, for the most part, combined using a narrative synthesis. The overall fertilisation rates and pregnancy rates were calculated. The outcomes were calculated according to the 5% strict threshold, the 14% strict threshold, and the 'other' criteria threshold.

How were differences between studies investigated?
Heterogeneity was demonstrated using plots of the OR and 95% CIs of predictive values of normal sperm morphology for the fertilisation and pregnancy rates, and was discussed in the text. However, no formal investigation of heterogeneity was undertaken.

**Results of the review**

A total of 49 studies were included in the review. The statistical analysis was conducted only on those 18 studies that provided adequate data. The number of samples/participants was not stated.

Use of a 5% threshold normal sperm morphology: 10 studies provided data that could be analysed for the prediction of fertilisation, whilst 11 studies provided data that could be used for the prediction of pregnancy. In the less than 5% group, the number of oocytes was 3,337 and the number of cycles was 396; in the 5% group, the number of oocytes was 13,327 oocytes and the number of cycles was 1,368.

Use of a 14% strict criteria threshold: 5 studies provided data that could be analysed for the prediction of fertilisation and 8 studies provided data that could be used for the prediction of pregnancy. In the less than 14% group, the number of oocytes was 6,209 and the number of cycles was 534 cycles; in the greater than 14% group, the number of oocytes was 3,325 and the number of cycles was 651.

Use of 'other' criteria: 3 studies provided data to evaluate the predictive value (fertilisation and pregnancy) of normal sperm morphology.

Statistical analysis could only be performed on 18 studies due to a lack of adequate descriptive data. Of the 18 studies presenting sufficient data for analysis, 15 studies used the strict criteria to evaluate sperm morphology, 2 used the World Health Organization guidelines and one used both of these criteria systems.

Use of a 5% threshold normal sperm morphology: all 10 studies showed a positive predictive value for normal sperm morphology in fertilisation, with 9 studies reaching significance; 9 of the 11 studies produced positive predictive values for prediction of pregnancy, with 2 reaching significance. The overall fertilisation rate per oocyte was 59.3% (1,979 out of 3,337) for the less than 5% group, and 77.6% (10,345 out of 13,327) for the 5% group. The overall pregnancy rate per cycle was 15.2% (60 out of 395) for the less than 5% group, and 26% (355 out of 1,368) for the 5% group.

Use of a 14% strict criteria threshold: all 5 studies showed a positive predictive value for normal sperm morphology in fertilisation, with all reaching significance; 6 of the 8 studies produced positive predictive values for prediction of pregnancy, with 2 reaching significance. The overall fertilisation rate per oocyte was 72.7% (4,511 out of 6,209) for the 14% group 4511/6209 (72.7%) per oocyte, and 83.6% (2,780 out of 3,325) for the greater than 14% group. The overall pregnancy rate per cycle was 24.3% (130 out of 534) for the 14% group, and 25.2% (164 out of 651) for the greater than 14% group.

Use of 'other' criteria: 2 of the 3 studies reached significance with respect to the positive predictive values for prediction of fertilisation. However, none of the studies reached significance.

**Authors' conclusions**

Although a true meta-analysis was not performed, the OR analysis clearly showed the advantage of accurately...
evaluating sperm morphology. Normal sperm morphology may not be absolute in its prediction of fertilisation and pregnancy, but it remains the most cost-effective means of diagnosing male fertility and assisting in the formulation of a treatment regimen.

CRD commentary
The review had a clearly identified research question, which was well defined in terms of target population, diagnostic test, and outcomes of interest. By limiting the literature search to one database and English language studies, some relevant articles may have been omitted. In addition, no attempt was made to identify unpublished data, and the impact of publication bias was not assessed. The authors state, however, that they do not contend that their review is complete.

Details of the methods used to select the primary studies were lacking. The validity of the primary studies was not assessed. This makes it difficult to assess the extent to which methodological flaws in the primary studies may have impacted upon the review findings.

Some details of the included studies were provided, though more information would have been helpful (e.g. the characteristics of oocyte donors, the criteria used to determine normal sperm morphology under different classification systems, and the definitions used to determine pregnancy in the different studies). The heterogeneity of the studies, as discussed by the authors, meant that a narrative review was appropriate. Heterogeneity was demonstrated using plots of ORs for the individual studies. The discussion mentioned numerous factors that might influence the predictive value of sperm morphology in fertilisation and pregnancy rates.

The validity of using ORs as a measure of predictive value is questionable. The conclusion referred to the cost-effectiveness of using normal sperm morphology, but no costs were mentioned.

There was insufficient evidence to support the authors’ conclusions.

Implications of the review for practice and research
The authors recommend that the following measures should be implemented world-wide: consensus has to be obtained on what constitutes a functionally normal spermatozoon, and which preparation methods are essential for the accurate evaluation of sperm morphology; laboratories committed to the evaluation of sperm morphology must ensure that they adhere to these basic principles, and implement the necessary training programmes and quality control procedures; consideration should be given to the development of computer technology to aid the process of standardisation. In addition, a study on a reference population is required to determine the normal sperm morphology threshold points distinguishing between fertile and infertile groups.

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