Blood film review by biomedical scientists

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ABSTRACT

This study aims to provide evidence of biomedical scientists' competence in blood film cytomorphology and to improve continuing assessment and training. Twenty photomicrographs are prepared from historical teaching slides, and a slide projector timer is designed and built to trigger slide advance automatically every 30 sec. Haematology staff in local district general hospitals take part in the study. During each visit, the test is explained and participants mark their observations on individual results sheets. Two sets (accepted and rejected) of observations are generated, which are validated by peer review. The accepted set is scored. No evidence is found to prove that members of each department were drawn from separate groups ($P=0.36$). Seniors and routine cytomorphologists are compared for each department and a non-zero difference in score was found ($P=0.00$). A comparison is made between the number of times a scored or non-scored observation is recorded, resulting in a probability that approaches zero. Thus, it is highly unlikely that the observations are drawn from one pool, and the test score and ability in cytomorphology would appear to be directly related. This study challenges the notion that unrestricted time, clinical data and a microscope are required for haematology blood film cytomorphology tests. Introduction of this type of test would provide biomedical science with a valuable assessment tool.

KEY WORDS: Blood cells. Hematologic tests. Quality control.

Introduction

Haematology biomedical scientists are primary oncology screeners. Their ability to recognise haematological abnormalities, in particular malignancy, has a direct bearing on how quickly patients are diagnosed and treated, and this has an effect on prognosis. Furthermore, these staff members are responsible for selecting slides that require clinical input and it is vital that this work is carried out to the highest standard.

A simple, inexpensive, objective and accurate cytomorphology test to assess individuals and departments is needed and this study aims to validate such a test by demonstrating that biomedical scientists are drawn from the same population, that the scoring process is not random and that the scores of seniors with responsibility for haematology cytomorphology are not drawn from the same population as the scores of other biomedical scientists.

Materials and methods

Twenty photomicrographs were presented for 30 sec each, during which time the participants noted their observations on individual results sheets that were later scored.

Photomicrographs were prepared from blood smears used for teaching. The blood smears had been prepared from venous blood anticoagulated with EDTA and stained with May-Grünwald–Giemsa (Sigma) using a method described previously.[1] Slides were coverslipped automatically (Leica CV5000). Selected fields were photographed (Leitz system) under a x50 objective lens using a x10 camera lens, a daylight filter and 100 ASA Fuji RDP III daylight slide film.

The slide projector timer, designed to trigger slide advance every 30 sec, was built in two parts and comprised the main electronic board (a pulse generator linked to a series of electronic counters that triggered a relay) and a regulated power supply assembled in a project box. This was connected to a Leitz Wetzlar projector.

A program was written to calculate the time between the advance of each slide, using the computer's onboard clock. The timer's accuracy was assessed in two ways: an adapted stopwatch (Casio) was triggered directly by the slide projector timer, and each presentation was checked using a standard wristwatch (Casio).

Eight district general hospitals in south-west England participated in the voluntary programme in April–June 2002. The departments were largely homogeneous, with a mean activity level (measured in full blood counts performed per day) of 846.88 (range: 400–1600). Individual laboratory managers selected staff who routinely performed haematology cytomorphology examinations to take the test. Permission to undertake the study was granted by North and East Devon Local Research Ethics Committee.

After initial introductions and distribution of results forms, the participants were shown an example photomicrograph (projected image size: 0.9 m^2) of a patient with megaloblastic anaemia in order to familiarise them with the test format. Microcytic and macrocytic erythrocytes were identified using a laser pointer, and the types of observation required were explained (eg chronic lymphocytic leukaemia was sighted as an example). During the test, participants used the results forms to note their observations and any conclusions. In addition, a feedback section was completed at the end of the test. After collection of the results forms, a brief description of each photomicrograph was given.

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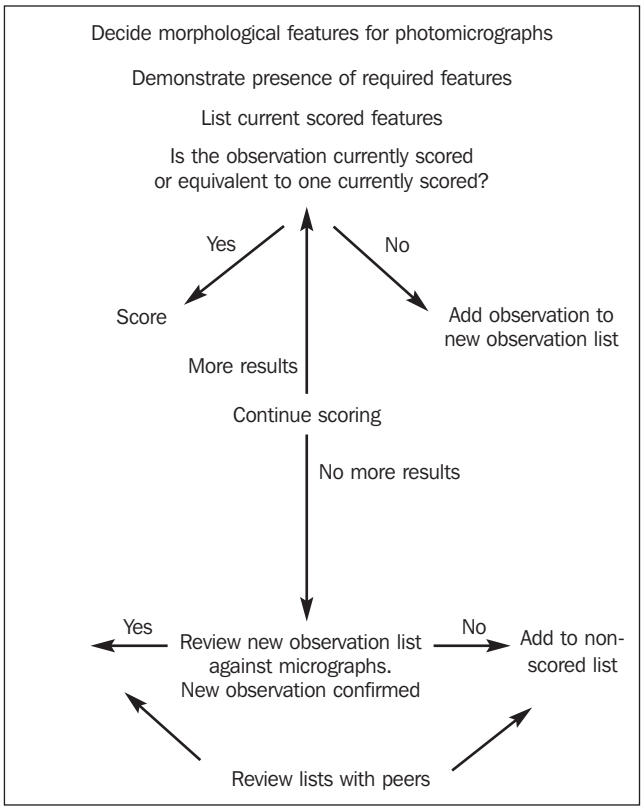

Fig. 1. Scoring scheme.

Figure 1 illustrates the scoring process. Scored observations by peer review is similar to the principle described by Rajamaki.[2] Terms taken as equivalent are shown in Table 1 and observations, comments and marks that were ignored are displayed in Table 2.

Statistical analysis

Departmental results were compared using the Kruskal-Wallis test, a non-parametric equivalent of ANOVA. Results between senior and routine staff were compared using an approximate two-sample *t*-test. A Mann-Whitney U test was used to analyse the number of participants who made scored versus non-scored observations.

Results

There was no evidence to suggest that members of each department who undertook the test were drawn from separate groups. As can be seen in Figure 2, the ranges defined by the first and third quartiles overlap and thus are likely (P=0.36) to be drawn from the same population. Department results are summarised in Table 3.

The difference between seniors and routine cytomorphologists was shown to be non-zero (P=0.00). Figure 3 shows senior and routine cytomorphologists' scores.

Data obtained were also analysed from the perspective of the observation, seeking to assess the likelihood of random assignment to either scoring or non-scoring from one pool. A finite number of observations was possible. If the process had been completely random then each observation would have been equally likely, resulting in an even distribution of participants per observation, regardless of whether the observation was scored or not.

This hypothesis was tested and a comparison was made between the number of times a scored and a non-scored observation was made. Results showed that probability approached zero and therefore it was highly unlikely that the grouping of scored (or non-scored) observations could have been drawn from one random pool. A diagrammatic representation of this data is shown in Figure 4.

There was a difference of 0.03 sec between the two methods used to check the automatic slide timer. Although

Table 1. Terms taken to be equivalent.

Alternant term	Term used
Dimorphic red cell picture	Anisocytosis
EDTA changes	Old
Fragments	Schistocytes
Hypogranulated neutrophil	Dysplastic neutrophil
Immature forms	Blasts
Left shift	Metamyelocyte
Pencil cells	Elliptocytes
Platelet anisocytosis	Large platelets
Right shifted neutrophil	Hypersegmented neutrophil
Degenerated RBC	Crenated RBC
Protein stain	Background stain
Reactive neutrophils	Toxic granulation
Dual red cell population	Anisocytosis
Apoptotic neutrophils	Degenerate neutrophils
Echinocyte	Acanthacyte
Pencil cells	Elliptocytes
Anisochromasia	Polychromasia
Degenerate WBCs	Degenerate neutrophils
Immature field	Myelocyte
Monocytes with immature forms	Monoblasts
CM_0L	CMML

Table 2. Observations, comments and marks ignored.

Ignored comments
(&)
+
?
Irregular red cells
Lymphocyte with no qualifier
Monocyte with no qualifier
Monomorphic
Neutrophil with no qualifier
Slight
Ferritin results to follow
Suggest check LFT
Suggest check PV
DCT and retics to follow

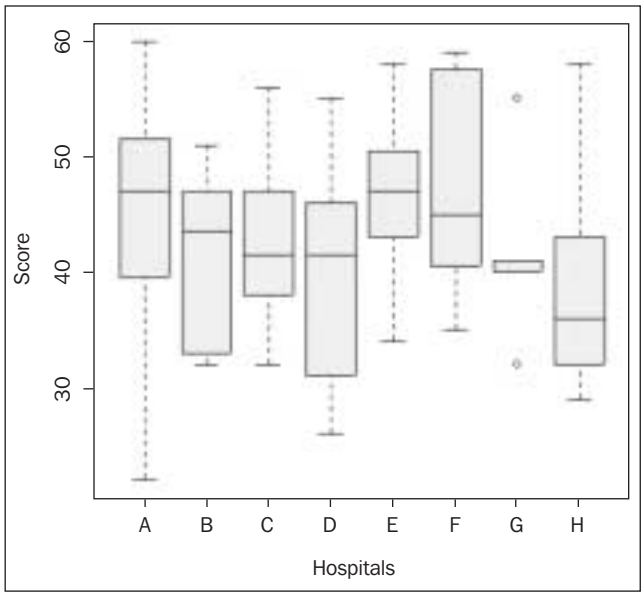

Fig. 2. Description of departmental results.

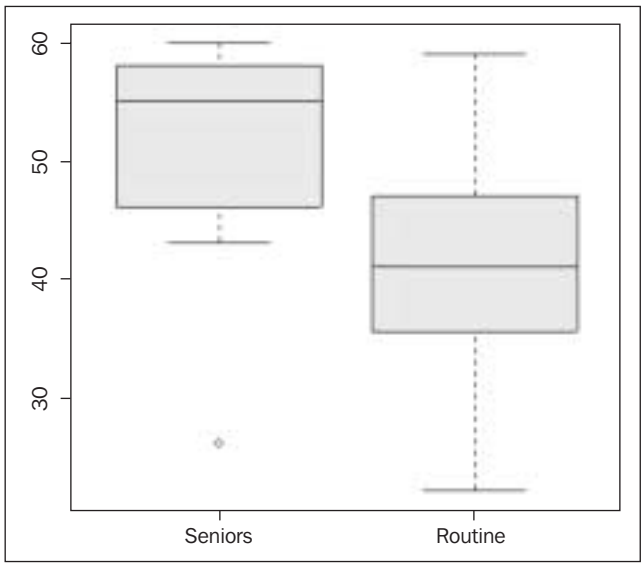

Fig. 3. Participants' scores (%) grouped by biomedical scientist grade.

this was significant (P=0.02) it was not important. Mean result for the wristwatch method was 29.99 sec (SD: 0.04 sec), while that for the computer method was 29.96 sec (SD: 0.03). Both methods were precise but slightly inaccurate.

Discussion

The haematology cytomorphology standardised objective test described here would appear to be the first to provide evidence of competence in this area. The test is used here to examine biomedical scientists who routinely perform haematology cytomorphology but could be used to establish and maintain competence by routine testing of all haematology biomedical scientists. This could be followed up with a local educational programme designed to meet the needs identified by the test.

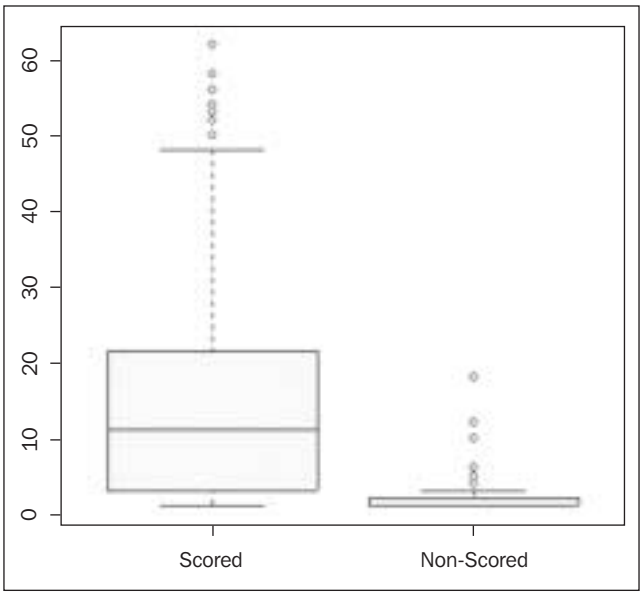

Fig. 4. Percentage of participants that observed each scored and non-scored observation.

The test does not suffer from the deficiencies of current schemes,[2–5] which distribute between nine and 16 individual cases each year. If three surveys were conducted annually, the study method presented here could distribute 60 cases, a number which could be increased as required. Therefore, it would provide much wider scope for detecting deficiencies in knowledge.

Some schemes[2,5] do not attempt to control which participants undertake the test and thus are open to self-selection and bias. In common with others,[3,4] the test described here has the potential to investigate all participants and therefore gain a representative picture of each department and every individual.

Most other schemes[2–5] place practically no time limit on the cytomorphology test, a feature that is unrealistic in a modern laboratory and one that is open to bias. The current study used a set time period, which is convenient, practical and eliminates a potential source of bias.

Other schemes[2–5] do not assign an objective score to the performance of each department. Quality control should provide evidence of competence[2,5] and UKNEQAS states that a quality control scheme should enable the detection of inadequate performance by a participating laboratory. Rajamäki's method[2] does provide a score but its potency is diluted by the requirement for subjective, clinically significant findings, without providing the full clinical setting for an appropriate judgement.

However, use of an objective test that describes photomicrographs has one shortcoming. It does not test the subjective decision about which haematology cytomorphological features should be reported in a specific circumstance. Two schemes[2,5] do not provide sufficient clinical detail to test this aspect of haematology cytomorphology, while the others are either likely to have tested it[3] or could be adapted to do so.[4]

To solve this problem, the test described here could be adapted so that each slide is presented on a computer screen, in a similar manner to the assessment devised by Bain.[4] A standard response form, similar to Rajamäki's results sheet,[2] would be presented on the screen, together

Table 3. Scores by department and grade.

		Department							
		A	B	C	D	E	F	G	H
Seniors	*n*	2	2	1	2	2	2	1	2
	Median	57.50	48.00	56.00	36.00	52.00	58.50	55.00	50.50
	1st quartile	56.25	46.50	56.00	31.00	49.50	58.25	55.00	46.75
	3rd quartile	58.75	49.50	56.00	41.00	54.50	58.75	55.00	54.25
Routine	*n*	5	4	9	4	9	9	4	5
	Median	43.00	37.00	41.00	41.50	47.00	43.00	40.50	33.00
	1st quartile	36.00	32.75	38.00	37.75	40.00	40.00	38.00	31.25
	3rd quartile	47.00	43.25	44.00	46.00	50.00	57.00	41.00	35.00

with clinical details and a request that only clinically significant observations be noted. In this way, a biomedical scientist's judgement would be examined.

Adapting the method to run on a personal computer would help to solve a significant problem with the new method. Acquisition of a photomicrograph that includes all the cytomorphological features that define the condition of interest proved extremely difficult. Cells that define a particular condition are often present in different fields, so the solution to the problem would be to take photomicrographs from as many fields as necessary and combine them using a computer program to produce the exact field required. □

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6 The R Foundation for Statistical Computing, version 1.9.1. www.r-project.org.