panel and was therefore regarded as not typable. No association was found between any one pattern and the geographical areas or body sites from which isolates were obtained. Pairs of isolates from different body sites of the same patient produced the same pattern in one case and a very similar one in another. The isolates of the latter pair have exhibited differences using other techniques (data not shown).

Discussion

Branhamella catarrhalis is thought to be relatively inert biochemically because of its inability to utilise the routine carbohydrates used for identifying Gram negative cocci in the laboratory. One approach likely to be profitable in typing this organism is to analyse its enzyme profile rather than concentrating on particular substrates. Tests used in the identification and taxonomy of bacteria are most useful if they are present in either 0% or 100% of strains—that is, those that give consistent results. However, tests that are likely to be useful in typing a species are those that are positive in only some strains—that is, those that are likely to give inconsistent results. If a number of the latter tests are used against a single strain a discriminatory typing scheme is likely to result even if individually they are not thought to be useful. However, not all the potentially useful typing tests are exclusive to this group of inconsistently present enzymes. We found that all our isolates consistently produced most esterases, and analysis of isomers of these is a potentially useful typing method.⁴ Previous work on enzymes in this and other related

organisms has relied on electrophoretic methods.¹⁰ Our study shows that a kit of 20 easily detected enzymes has potential as a method of typing this genus quickly and relatively easily. Its use in a suspected outbreak would enable such a scheme to be epidemiologically validated. The 20 selected substrates are not yet available in a single package but this may be addressed by the manufacturers in the future.

We thank API-bioMerieux UK for the gift of the kits used in this study and all the microbiologists that donated isolates of *B. catarrhalis*.

- 1 Catlin BW. *Branhamella catarrhalis*: an organism gaining respect as a Pathogen. *Clin Microbiol Rev* 1990; 3:293-320.
- 2 Catlin BW. *Branhamaceae* fam. nov., a proposed family to accommodate the genera *Branhamella* and *Moraxella*. *Int J Syst Bacteriol* 1991;41:320-3.
- 3 Patterson TF, Patterson JE, Farrel P, Hierholzer WJ, Zervos MJ. Evaluation of restriction endonuclease analysis as an epidemiological typing scheme for *Branhamella catarrhalis*. *J Clin Microbiol* 1989;27:944-6.
- 4 Picard B, Gouillet P, Denamur E, Suermondt G. Esterase electrophoresis: a molecular tool for studying the epidemiology of *Branhamella catarrhalis* nosocomial infection. *Epidemiol Infect* 1989;103:547-54.
- 5 Peiris V. Protein profiles of *Branhamella catarrhalis*. *J Med Microbiol* 1989;30:v.
- 6 Vaneechoutte M, Verschraegen G, Claeys G, Van den Abeele A-M. Serological typing of *Branhamella catarrhalis* on the basis of lipopolysaccharide antigens. *J Clin Microbiol* 1990;28:182-7.
- 7 Riley TV, Taylor ML. A note on the susceptibility of *Branhamella catarrhalis* to heavy metals. *J Appl Bacteriol* 1989;67:185-9.
- 8 Dickinson DP, Loos BG, Dryja DM, Bernstein JM. Restriction fragment mapping of *Branhamella catarrhalis*: a new tool for studying the epidemiology of this middle ear pathogen. *J Infect Dis* 1988;158:205-8.
- 9 Humble MW, King A, Phillips I. API ZYM: a simple rapid system for the detection of bacterial enzymes. *J Clin Pathol* 1977;30:275-7.
- 10 Braude AI, McCutchan JA, Ison C, Sargeant PR. Differentiation of *Neisseriaceae* by isoenzyme electrophoresis. *J Infect Dis* 1983;147:247-51.

J Clin Pathol 1992;45:534-535

A viscometric method of measuring plasma fibrinogen concentrations

E Ernst, K L Resch, T Saradeth, A Maier, A Matrai (deceased)

Abstract

A technique based on deducing the viscosity of serum from that of plasma was compared with the commonly used Clauss method. The two methods correlated closely ($r = 0.914$). The reproducibility of the viscometric method was slightly poorer than the Clauss technique at low fibrinogen concentrations, equal to that at medium fibrinogen concentrations, and marginally better at high concentrations. Fibrinogen can therefore be measured reasonably accurately with the viscometric method, and can be recommended as an alter-

native for laboratories possessing a viscometer.

The identification of fibrinogen as a major cardiovascular risk factor¹ has increased the demand for a quick, simple, inexpensive and reproducible method to determine its plasma concentration. There are many methods of quantifying plasma fibrinogen; possibly the best² and certainly the most common is the Clauss method.³

Due to its large size and spherical shape, fibrinogen strongly influences plasma viscosity.¹ It is the only constituent of plasma that

Haemorheological Research Unit, Department of Physics Medical Rehabilitation, AKH, University of Vienna, Währinger Gürtel 18-20, 1097 Vienna, Austria
E Ernst
K L Resch
T Saradeth
A Maier

Correspondence to: Dr Ernst

Accepted for publication 1 October 1991

Measuring fibrinogen: correlation between Clauss and viscometric method

is missing in serum. Therefore, it should be quantifiable by deducting serum viscosity from plasma viscosity.⁴ The following is a re-evaluation of this forgotten method.

Methods

For reference the Clauss method (Multifibren, Behring AG, Marburg) was used.⁴ Plasma and serum viscosities were measured at 37°C.⁵ One hundred and ten subjects were studied (61 men, 49 women, mean age 52.7, range 19.5–84.5). Eighteen were apparently healthy, 19 had a history of coronary heart disease, 43 patients had been admitted for elective surgery, nine patients had non-inflammatory, and 22 inflammatory disorders. Venous blood samples were taken according to a standardised protocol.⁶ All measurements were done on fresh samples.

Each sample was tested four times with both methods. The means of these four results were correlated using Pearson's linear correlation coefficient. A formula was derived to convert the viscometer readings into absolute fibrinogen concentrations (in mg/dl): fibrinogen = 1725 (PV–SV) + 70 (PV = plasma viscosity, SV = serum viscosity).

Three samples were measured 10 times. Thus three individual coefficients of variation (CV) were calculated. The mean of the three was taken as a measure of accuracy of each method. As precision might vary as a function of plasma concentration, this procedure was repeated at nine different ranges of fibrinogen concentration (as determined by Clauss method).

Results

The correlation of the two methods (figure) was highly significant ($r = 0.914$, $p < 0.000001$). The table summarises the CVs obtained at

Coefficients of variation of Clauss and viscometric methods at various fibrinogen concentrations

Fibrinogen (g/l)	CV (%) Clauss method	CV (%) Viscometric method
< 2.00	2.95	10.98
2.00–2.49	3.34	9.97
2.50–2.99	4.89	8.82
3.00–3.49	4.21	5.72
3.50–3.99	4.09	6.35
4.00–4.49	5.10	4.83
> 4.49	4.37	4.33

various plasma concentrations for both methods. At low concentrations the viscometric method yielded higher CVs. In the medium range the viscometric technique gave marginally higher CVs; in the upper range it was slightly lower.

Discussion

The results suggest that the viscometric method is a useful approach to measure plasma fibrinogen—particularly in the upper range of normal, where fibrinogen measurements are most meaningful.¹

The original description does not detail reproducibility, but merely correlates data from two methods.⁴ The correlation coefficient was 0.80—slightly lower than the present one. Nevertheless, the author states that his method “offers possibilities of establishing a simple and accurate means for the quantitative measurement for fibrinogen”.³

There are three main fibrinogen fractions (340, 305, and 270 kilodaltons).⁷ These are all clottable and are thus picked up by the viscometric technique. Low molecular weight fibrinogens clot slower and may therefore be underestimated by clotting time methods.⁷ An official recommendation is published for viscometry,⁵ but not for measuring fibrinogen. Artefacts can almost totally be excluded for Newtonian viscometry but not for the Clauss method.² Cheap standards exist for viscometry (distilled water), but not for measuring fibrinogen. The viscometric method is quick (one to two minutes) and easy to handle⁸; there is no need for one way equipment, nor for purchasing reactants (as in the Clauss method). The viscometric technique does not need a dilution step, a notorious source of error in the Clauss method.²

One drawback of the viscometric method is its poorer reproducibility; yet the difference is not large. The viscometric method requires a relatively large sample volume; the Harkness viscometer⁵ needs 1 ml for three repetitive measurements. This translates into 4 ml of whole blood needed for one fibrinogen test. However, other viscometers use less volume and are equally accurate.⁸

We do not conclude that the viscometric technique should be universally adopted, but suggest that those who own a capillary viscometer might consider it as a cheap, quick, and reproducible alternative.

1 Ernst E. Fibrinogen, an independent cardiovascular risk factor. *J Int Med* 1990;227:365–72.

2 Palareti G, Maccaferri M. Specific assays of hemostatic proteins: fibrinogen. *Res Clin Lab* 1990;20:167–76.

3 Clauss A. Gerinnungsphysiologische Schnellmethode zur Bestimmung des Fibrinogens. *Acta Haematol* 1957;17:237–46.

4 Petersen WE. The viscometric determination of blood fibrinogen. *J Lab Clin Med* 1953;42:641–5.

5 International Committee for Standardization in Haematology. Recommendations for a selected method for the measurement of plasma viscosity. *J Clin Pathol* 1984;34:1147–52.

6 Ernst E, Matrai A. Pitfalls in blood sampling. *Haematologica* 1986;71:263–5.

7 Holm B, Nilsen DWT, Kierulf P, Godal HC. Purification and characterization of 3 fibrinogens with different molecular weights obtained from normal human plasma. *Thromb Res* 1985;37:165–76.

8 Ernst E, Matrai A. The measurement of plasma viscosity: a comparison of four instruments. *Clin Hemorheol* 1990;8:851–9.