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Waveform analysis of clotting test optical profiles in the diagnosis and management of disseminated intravascular coagulation (DIC)

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Summary Transmittance waveform charts the changes in light transmittance on standard coagulation assays, such as the prothrombin time (PT) and activated partial thromboplastin time (APTT). Analysis and characterization of these data on photo-optical coagulation analysers provides additional qualitative and quantitative information to that obtained using the clotting time alone. The most thoroughly evaluated clinical application is that of the biphasic APTT waveform with disseminated intravascular coagulation (DIC). The degree of waveform abnormality correlates directly with the severity of haemostatic dysfunction and allows for both the prediction and monitoring from non-overt to overt DIC. As its performance is simple and rapid, this provides the means for targeting therapeutic intervention to an earlier stage of DIC. The recent identification that the mechanism underlying the biphasic waveform is a complex that exists *in vivo* between C reactive protein with very low density lipoprotein, provides potentially important insights into the molecular pathogenesis of DIC. Thus, in addition to the immediate clinical utility in diagnostic practice, it has important applications as a research tool. Preliminary experience in the application of this technology to the diagnosis and management of the haemophilias and the lupus anticoagulant syndrome has also provided evidence of the power and utility of waveform analysis in essentially simple clotting assays.

Keywords Clot waveform analysis, DIC, diagnosis, coagulation test

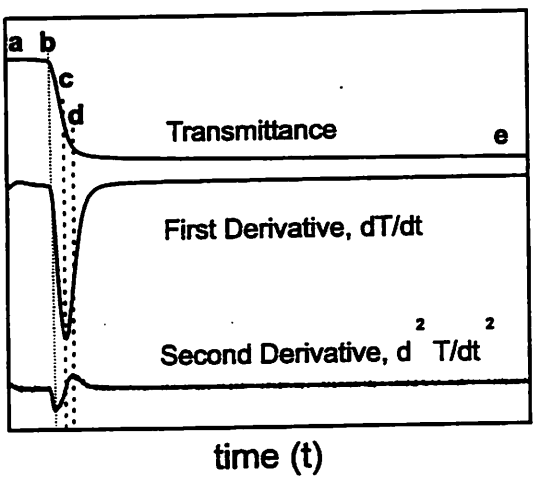

Figure 4. A normal transmittance waveform and plots of the first and second derivatives are shown. In order to monitor changes in the waveform the transmittance plot has been divided into 3 phases using the second derivative:
- Pre-coagulation (a-b)
- Coagulation (b-d)
- Post-coagulation (d-e).

Table 1. MDA® analyser PT and APTT clot waveform parameters. Points A-E refer to waveform reference points shown in Figure 4.

Phase	Parameter	Description
Pre-coagulation (A-B)	Slope_1	Initial slope of line fit to data from point A to B.
	Delta_1	Amplitude of signal change from point A to B.
Coagulation (B-D)	Index_min_2	Time at point B (onset of coagulation, clot time).
	Min_2	Minimum value of second derivative (coagulation acceleration at point B).
	Index_min_1	Time at point C (coagulation mid-point).
	Min_1	Minimum value of first derivative (rate of change at point C; coagulation velocity or slope at coagulation mid-point).
	Index_max_2	Time at point D (end of coagulation phase).
	Max_2	Maximum value of the second derivative (coagulation deceleration at point D).
Post-coagulation (D-E)	Slope_3	Post-coagulation slope, slope of line fit from point D to E.
	Delta	Amplitude of total signal change between point A and E.