Title: USE OF THE THROMBELASTOGRAPH TO PREDICT AND ASSESS THE MANAGEMENT OF EXCESSIVE BLEEDING AFTER OPEN HEART SURGERY

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Introduction. The thrombelastograph (TEG) provides information on the interaction of all coagulation precursors and has been shown to be sensitive to both hyper- and hypocoagulable states. Although the TEG has gained popularity because of its usefulness during liver transplantation, its wide-spread clinical usage is limited. Patients undergoing open-heart surgery represent another clinical group where rapid assessment of coagulation status is imperative as they are known to be at a relatively high risk to develop postoperative bleeding of multifactoral etiologies. The present study was designed to assess whether the TEG might be useful in predicting which patients would develop bleeding postoperatively, in diagnosing the hemostatic defect and in assessing the management of these bleeding patients.

Methods. After approval by institution's Human Investigation Committee and our patients informed consent, adults scheduled to undergo open-heart surgery were studied. All patients were treated with standard surgical and anesthetic techniques for CABG and valvular replacements. A preoperative history was taken to elicit any bleeding tendency and to obtain a record of all preoperative medications which might interfere with the coagulation process. Preoperative coagulation profiles (PT, aPTT, platelets, fibrinogen, FSP) and a baseline TEG (Biclot 816 Thromboelastograph, Logos Scientific) were obtained. Post procedure, prior to leaving the operating room a second coagulation profile and TEG were obtained. Additional tests were performed in the surgical intensive care unit when chest tube drainage was > 150 cc/hr and before and after any of the following interventions; 1. platelets, FFP, or cryo were administered, 2. Additional protamine, Amicar, or heparin ordered. Hourly chest tube output was monitored for 24 hrs. If a patient returned to the operating room for re-exploration, he re-entered the protocol.

Results. No patient gave a history of bleeding tendency and none were on anticoagulants preoperatively. Postoperatively 27 patients had nominal bleeding that did not require therapy (Group 1) while 7 patients developed significant bleeding which required intervention and treatment (Group 2). Table 1 presents the TEG data and coagulation profiles for the study patients. Two way ANOVA with repeated measures was used to compare groups 1 and 2.

Discussion. Morbidity and mortality risks increase as excessive bleeding develops after open-heart surgery. Also the increased awareness of potential complications associated with transfusion of blood products dictates their use be justified. The TEG as a single test which evaluates the coagulation process from onset through completion may allow the rapid and accurate detection of a hemostatic defect thus promoting more rationale treatment. In this study, the TEG values of of R, K, α° and the aPTT correctly predicted those patients who would bleed excessively postoperatively. Although the aPTT values of patients in Groups 1 and 2 were significantly different, the aPTT values of the Group 2 patients were still within normal limits for our laboratory (24-31 sec) and thus not likely to promote suspicion. The fact that the R, K and α° values of the Group 2 patients not only differed from those in Group 1, but also are accepted as grossly abnormal, adds discriminative power to the predictive value of the TEG as compared to the aPTT.

As an information gathering study, no attempt was made to influence therapy based on TEG data. However retrospective analysis of all patient's postoperative therapy suggest TEG information would have aided clinical judgement and could have been used to direct therapy. Two illustrative cases are presented in Table 2. Significantly patient one's TEG normalized after protamine therapy and bleeding slowed from > 150 cc/hr to < 60 cc/hr. This diminished bleeding occurred prior to transfusion of platelets and FFP. Patient 2 bled 60-80 cc/hr for the first three postoperative hours. His TEG suggests adequacy of the coagulation process although he received FFP and platelets. As more information is collected in this ongoing study, the TEG's ability to specifically diagnose hemostatic defects and assess management strategies will be further delineated.

In conclusion, the present study shows the TEG to be a more discriminative predictor of which patients will develop postoperative bleeding than the standard coagulation profile.

Table 1

	Group 1		Group 2		
	Preop	Post Bypass	Preop	Post Bypass	P
Rmm*	34 ± 25	25 ± 10	85 ± 69	169 ± 206	.001
Kmm	11 ± 8	9 ± 4	26 ± 16	50 ± 63	.000
α°	47 ± 16	48 ± 12	27 ± 16	22 ± 11	.001
MAmm	54 ± 6	51 ± 6	52 ± 12	45 ± 12	.164
MA'mm	46 ± 11	47 ± 8	40 ± 19	42 ± 13	.235
PT%	73 ± 12	36 ± 11	70 ± 14	37 ± 7	.865
aPTTsec	25 ± 2	28 ± 2	26 ± 2	31 ± 5	.009
Plt K	298 ± 66	139 ± 53	220 ± 53	115 ± 6	.150
Fib mg%	362 ± 91	254 ± 57	382 ±116	263 ± 65	.416

*Chart speed/mm 1 min, data mean ± SD, P = P value

Table 2

Patient	1 A	B	C	D	2 A	C & D
Rm	38	27	30	20	21	18
Kmm	32	7	12	5	7	6
α°	19	53	49	61	53	56
MAmm	32	50	52	54	60	61
MA'mm	30	46	45	50	59	60
PT%	40	46	39	54	38	43
aPTTsec	29	26	27	26	28	25
Plt K	70	76	94	104	134	206
Fib mg%	190	194	165	215	260	280

Data times: A=Post bypass pretherapy; B=Post 75 mg protamine; C=Post 2 units plts; D=Post 2 units FFP