

Heart Program

Interval Changes in ROTEM Values During Cardiopulmonary Bypass



Christopher F. Tirotta, MD, MBA · Richard G. Lagueruela, MD · Danielle Madril, MD · Daria Salyakina, PhD, MS, CBA Weize Wang, MPH, MA . Thomas Taylor, BS . Jorge Ojito, CCP . Hyunsoo Lim, CCP . Robert Hannan, MD . Redmond Burke, MD

The Heart Program at Nicklaus Children's Hospital, Miami, FL

Background

The ROTEM (Tem International GmbH, Munich, Germany) is an enhanced modification of thromboelastography (TEG) (Haemonetics Corp., Braintree, MA), first described in 1948. Both are point-of care (POC) coagulation monitoring instruments that test the visoelastic properties of whole blood. Use of the ROTEM has been shown to reduce the need and amount of transfused blood products in pediatric cardiac surgery patients. Tirotta et al. demonstrated that administering human fibrinogen concentrate (HFC) at a dose of 70 mg/kg to neonates and infants undergoing cardiac surgery reduced the need for fresh frozen plasma (FFP) and cryoprecipitate.

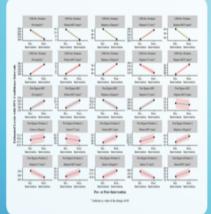
The purpose of this study is to quantify the changes that occur to the ROTEM values with cardiopulmonary bypass (CPB), and with distinct transfusion interventions during the course of the operation.

Methods

After receiving IRB exempt status from the Research Institute of Nicklaus Children's Hospital, we retrospectively reviewed 171 pediatric patients undergoing cardiac surgery requiring CPB; this incorporated the time period from June 1, 2015 to August 31, 2017. All the cases were done by the same anesthesiologist and surgeon. ROTEM assays were done at baseline prior to the start of surgery, on CPB prior to the administration of plateletpheresis, on CPB after plateletpheresis (25 cc/kg), off CPB immediately after the administration human fibrinogen concentrate (HFC) (55 mg/kg); there were also ROTEMs done in the post CPB period after the administration of further component therapy, if needed after the HFC administration. Through regression analysis we adjusted for the variation in blood products received by different patients.

Results

Results from GEE and Beta regression models suggested significant changes in HEPTEM CT after all four interventions, HEPTEM MCF after three out of the four interventions, FIBTEM MCF after three out of the four interventions, and in HEPTEM after all four interventions, adjusting for age groups and continuous values of the actual interventions (Table 1, Figure 1). Patients' fibrinogen levels decreased by 162.1 mg/dL (95% CI: -187.7 to -136.5) after CPB, but increased by 69.8 mg/dL (95% Cl: 58.3 to 81.2) and 73.1 mg/dL (95% Cl: 43.1 to 103.1) after receiving plateletpheresis and then HFC respectively. We also sub-analyzed the data for the various age groups: for patients 90 days or less (Table 2), patients from 90 days to two years (Table 3) and then for patients greater than two (Table 4).



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Outcome	Intervention	*	Procedurestion (MN C)	Part Manuelton (97% (I)	Change from Pro-to-Root. Intervention (RSV-1))	*
Replace CT (sec)	O'M Progradure	266	211.F(000A.20A4)	2004 (270 L 100 II)	78.0 (67.4, 90.5)	10.000
	CFR Foot products:	200	2843 (2753, 286.7)	2004/0003-20049	704199A-914	10.000
	First Ingens IEC	208	2017/07/6/2014	MARKELL STORY	1394 (964, 1818)	40.000
	For Ispen protets 2	100	255.7 (300.3, 596.0)	EMPORTOR MADE	-7641 (13.1-49.8)	40.000
Napton MOT (mm)	Officerobets	766	W1594.0LG	2010/12/20	201204-00	+0.001
	O'M Producedorio	200	10400A-000	500 6 (Std 5, 500 F)	1810 01716, 25100	10.00
	Post Ingress HFC	207	50 1 (SUA 50-2)	5040513.945	45113.18	0.579
	Profilegeos products 2	100	1011/0018-0480	962/5038/9840	120410	0.007
Filtram MCF (mm)	O'M Propoducts	200	15.1794.5.160	04/38/5/8	4041013-475	+0.000
	GRI Post products	276	44043.53	83177.946	1000.60	10.00
	Post/buses HFC	208	1913.840	10.1 (0.5, 3).00	1103.10	+0.000
	And bayes products 3	390	10.1 (0.5, 10.0)	204004.000	48143.18	0.117
Replace a (T)	CR Parameters	200	2012/01/2018	W2003-W2	0041003-0040	40.000
	CFR Post products		00 1 (05 E 50 S)	754/704-765	25.7 (22.6, 26.7)	10.00
	Professor HT	207	75.2986.75.75	9679038.968	63187-68	10.000
	Red legen probate 3	-	60 F 60 L 60 60	MARKA TEN	180340	0.000
Holes (7 (mr)	Rotifeges protein 2	360	361 (336, 416.4)	286.4 (2013, 3174)	46 (EVA, 46.3)	40.000
State MCF (mm)	Pot legen protein 2	360	941903.960	57,755.4,466	15 (1.1, 5.7)	0.005
tener a (F)	Post legens products 2	380	65.2 (65.4, 66.9)	004(07.1.70.0)	4.4 (0.0, 6.0)	40.000
Green (7 (sec)	For Ispen protects 2	30	763 (68.1.864)	74.8(87.8.804)	47180,025	0.000
Grant MCF (mark)	Post lupus products 2	30	50.4 (50.3, 40.5)	50.8 (MA. 45.2)	43 (64,75)	0.094
Column as (F)	Pot hapon products 2	30	1014 (105.2, 70.4)	75.1 (67.5, 76.2)	21114.44	0.284
FR-Dright Co.	CR Parameters	-	2754 (240 8 302 3)	TO A PER A TRANS	160,111,667,7,496,92	10.000
	CRI Past products	-	2012/06/2012 00:40	173.6 (965.6 1961.0)	68.0 DE3.81.25	40.000
	Bud bases MT	- 10	200312504.17810	2884(2338,3854)	7913 94013, 1695.00	81.001

		Estimates				
Outcome	Intervention		Perinterpention (RDS)	Peak Intervention (MVILC)	Charge from Pie-1s Post- Interspetton (RVILO)	1
Region (7 (sec)	CRI Pro products	130	2006/0003-21429	2007.0.0279.00, 2008.00	83.1 (73.4,94.6)	=0
	CFB Plot products	111	2011 A (27% A, 298.0)	258.9 (208.9, 223.7)	75.1 (40.6, 40.6)	40.0
	Fort Ispace HFC	108	207.8 (208.6, 225.0)	(98.9 (178.4, 108.0)	76.6 (50.0, 90.0)	40.0
	Feet bypess products 2	79.	20074 (2017), 167-63	279.8 (234.5, 105.1)	47.6176.0.41.0	85
Registers MCF (mont)	CRI Pro products	1.00	80.3 (SEA, 61.8)	36.9 (10.3, 16.0)	0011003-008	-
	CPB Pool products	11.7	36.9 (10.3, 56.0)	58.6 (58.8, 58.5)	\$67(BAA, \$6.0)	*
	Fort Square FFC	108	50/3 (50.3, 50.4)	54.3 (52.4, 54.0)	0.710.4.3.75	41
	Feet Ingrass products: 3	79.	\$63 (50 A, 55 K)	36.4 (50.3, 40.5)	23103,440	63
Falsen WCF (mm)	CR Pay products	117	149 (00.1, 167)	4103.46	489140A-88	-
	CFB Peak products	108	43 (13, 44)	24 (6.8, 8.0)	3.6(3.6,419)	40.0
	Post Ingrass HFC	167	24 (68, 28)	9.7 (6.6, 16.5)	3.2 (3.4, 10)	10
	Fact Supara products 2	71	14 (63, 50.0)	11.7 (984, 124)	14(0),100	40
Region o (1)	CR Pay products	1.00	75.3 (75.4, 76.9)	563 BEA 5670	03100A-00.0	101
	(PR Paul products	111	MINISTRA SERV	75.9 (70.4, 74.0)	23.4 (23.4, 23.5)	101
	Feet Inpace HTC	108	75.3 (684, 70.4)	86.0 (84.0, 86.0)	48175.03	40
	Froit Ingrass products: 2	79.	80.0 (00.3, 60.0)	683 (666, 75.0)	10 (1.9, 5.4)	60
Th (mg/A)	CPE Pro products	11.	200.4 (200.7, 200.6)	86.6 (77.6, 16.1)	10011004,084	10
	CRI Past products	111	85.4 (70.6, 10.6)	(48.1 (1014, 1014)	58.7 (96.5, 70.0)	**
	Ford Suppose SETC	10	20040300.0.100.20	207-3 (186-8, 186-5)	THERMAN	

	the commencer create board		ach of the ROTEM values a	and other recibion passers gas to be	mpeup when yo quin to its	nge.
Outcome		Estimates				
	Intervention	*	Pre-intervention (99% CI)	Post Intersection (HOX-1)	Charge from Pro- to Post Intervention (95% (1)	
Napton (7 (sec)	OR Pre-products	79	234.8 (200.5, 234.3)	1054(2864),307.0	300.2 (76.1, 124.3)	+0.00
	CPS Post products	79	314.2 (201.7, 196.7)	200.7(340.4),270.5)	40.9 (155.0, 36.0)	0.00
	Foot Sypera HFC	76	2867 (286.9, 279.4)	406.2 (200.0, 540.3)	235.4 (236.4, 104.3)	<0.00
	Proti bypasa products 2	60	404.3 (380.3, 584.6)	309.2 (279.6, 398.6)	18511286,733	9.00
	CPS Pre-products	79	63.6 (60.6, 64.7)	30.1 (28.1, 33.9)	40.1194.3-909	+0.00
Hostern MCF	CPB Post products	79	36.5 (28.2, 31.0)	55.6 (58.4, 57.9)	25.1 (30.6, \$17.7)	10.00
(mm)	Prot types HTC	74	55.4 (50.1, 57.7)	50.8 (50.9, 56.8)	-0.014.0, 0.75	9.34
	Proti bypasa products 2	62	53.6 (50.8, 56.4)	57.7 (54.6, 66.6)	4102,60	0.05
	CPS Per-products	76	16.805.2.16.70	14/30.420	4831483,489	+0.00
	CPS Post products	79	3.6 (3.5, 4.2)	7.7(6.6.67)	4.1 (3.0, 5.2)	10.00
79 February 2017 (1994) 177 3.6 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.7 (19.4 (19.	Post hypera HFC	70	27(62,640)	10.1 (9.0, 11.2)	2.4 (5.5, 5.0)	10.00
	2.0 (0.2, 1/8)	9.54				
Haptern at (*)	CPS Pre-products	76	27.4 (% 2, 76.3)	37.1 (38.5, 46.6)	4031464-963	+0.00
	CPB Post products	797	37,7 (00.6,41.6)	75.8 (88.8, 74.5)	34.6 (30.0, 30.1)	10.00
	Post hypera HFC	74	75.8 (48.7, 74.5)	62.4 (58.6, 65.9)	441103.43	10.N
	Post hypera products 2	62	63.2 (50.3, 66.7)	49.1 (90.2, 73.6)	6.0 (1.1, 10.0)	9.75
File (mg/H)	Off the products	39	2013 (HBS, 145.7)	80.6(573, 5962)	-2555 (265A, -267.5)	0.00
	CPS Post products	18	76.0 (58.0, 96.0)	160,913469,370,59	83.9 (96.5, 103.7)	0.000
	Prof Supera HFC	107	9965 (1906 6, 171.70	2014/0483-2043	673 (985, 1258)	0.00

Salate 4. Secolo Sens SET a	nd Severalized Street Mont	World Dr. o.	ach of the NOTEM subsect	n and term agent obler than I		
		Estimates				
Outcome	Intervention	*	Pre-limitaryemblum (99% CI)	Aust Intervention (95%-1)	Charge from Pier to Post Intervention (RSA (1))	*
	CPB Per products	47	206.0 (106.0, 214.0)	205.8(211.1; 259.8)	29.8 (3.6, 16.9)	0.14
	CPB Post products	18	296.2 (215.6, 296.6)	210.0(384.), 207.0	49.2158.2,735	0.25
Hepton (7 (un)	Post hypera HPC	36	281027.193	298,7(219.6,250.6)	103143,3480	9.25
	Post hypera products (55	251.8 (100.5, 250.7)	200.2/200.0,200.0	464 (103, 963)	8.80
Repton MCF	CPB Per products CPB Post products Post bypes (RFC	15	58.8 (57.4, 46.6) 46.3 (40.7, 46.6) 56.4 (40.7, 57.6)	46.07(62.8, 46.10) 56.7(66.7, 66.7) 49.8(67.8, 56.7)	187(183, 44) 34(18,344) 43173,531	63 63 67
	Post hypera products 2	56	49.7 (49.5, 51.4)	50.3 (50.8,55.7)	25.21 (M.Z., P.M.) 30.31 (A.E., 24.6) -06.61 (3.0, -06.2) -10.61 (3.6, -06.0) 5.41 (5.6, -06.0)	0.01
Filters MCF (mm)	CPB Per groduits CPB Post products Post types (RTC	58 15 35	\$2,000,000 \$2,00,00 \$2,00,00	6.8 (8.9, 3.7) 7.6 (6.3, 38.4) 10.6 (9.4, 11.6)	0412.339	0.75 0.75 10.9
	Post hypera products 2	56	385 (84, 11.9)	\$107A,3140	25.21 (M.2, P.M. 36.31 (M.2, 24.0) -04.01 (M.2, 44.0) -14.01 (M.2, 44.0) -14.01 (M.2, 14.0) -14.01 (M	0.04
Nepton a (1)	ON Per products	67	78.2175.4, 76.95	80.7(563,644)	1231163, 430	10.0
	Prof byses products 2	55	65.1815.663	474 983 2 7159	2410.410	0.31

Conclusions

CPB induced profound pertubations in ROTEM values. Administration of plateletpheresis and then HFC significantly improved these values by quantifiable amounts.

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The authors have no disclosu

