

The use of Rotational Thromboelastometry (ROTEM) to reduce blood product utilization during high-risk neonatal cardiac surgery, a quality improvement initiative

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Introduction

- In an ongoing effort to reduce blood product utilization, we identified neonatal aortic arch reconstruction, arterial switch and the Norwood procedure as surgeries with the highest incidence and volume of blood transfusions at our center.
- We developed a protocol based on intraoperative ROTEM to guide post cardiopulmonary bypass transfusions.
- Data was collected and compared to historical practice.

Methods

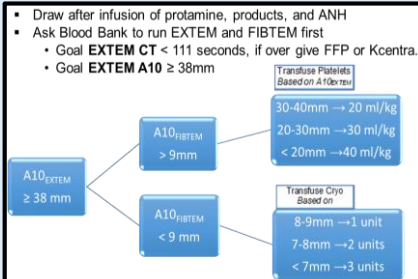
- As this is a quality initiative, IRB approval was not required.
- Original Data: collected retrospectively from September 2018-April 2019.
- Phase I: ROTEM data collected prospectively from April 2019-March 2020. Data was used for logistical purposes only.
- Based on Romlin et al [1], Faraoni et al [2] and data collected during Phase I, we developed an algorithm using ROTEM to guide blood transfusion during these high risk procedures. (Figures 1 and 2)
- ROTEM: April-November 2021 the algorithm was instituted and data was prospectively collected.
- Data collected included age, weight, primary procedure, STAT score, CPB time, aortic cross clamp time, volume and type of blood products used, ROTEM data, coagulation profile upon arrival to the Cardiac Intensive Care Unit (CTICU), chest tube output at 6 and 24 hours and the use of activated factors.
- No ROTEM: Data for patients where the algorithm was not followed.

ROTEM Protocol

Figure 1: CPB ROTEM products administration guide

- Draw upon rewarm and after second FFP 20 ml/kg given
- Ask Blood Bank to run HEPTTEM and FIBTEM first:
 - HEPTTEM CT goal < 240 seconds, HEPTTEM CFT goal < 110 seconds:
 - If over give 20 units/kg Kcentra
 - HEPTTEM MCF goal >50mm, if less order platelets
 - 40-50mm, order 20 ml/kg
 - 30-40mm, order 30 ml/kg
 - < 30mm, order 40 ml/kg
 - FIBTEM MCF goal > 9mm if less, order Cryoprecipitate
 - 8-9mm, order 1 unit
 - 7-8mm, order 2 units
 - <7mm, order 3 units

Figure 2: Post CPB ROTEM products administration guide



Results

Figure 3: OR Blood Products data

** P 0.011, * P 0.058 ROTEM vs No ROTEM, □ P 0.004 ROTEM vs Original

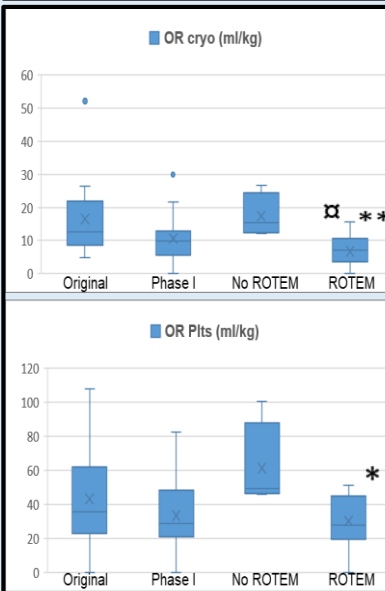


Figure 4: Post Products ROTEM data

• * P 0.01 ROTEM vs No ROTEM, ¥ P < 0.0001 ROTEM vs Original, € P 0.009 ROTEM vs Original and β P 0.02 ROTEM vs Original

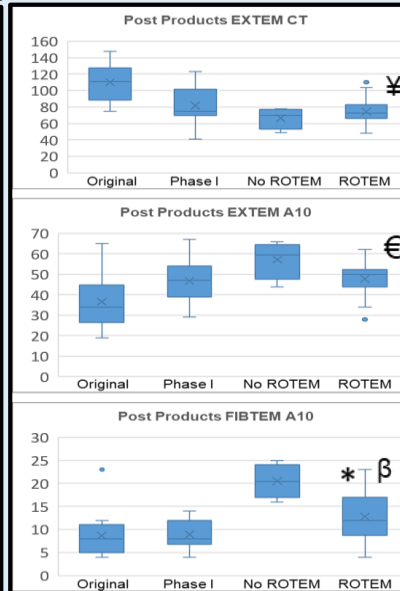


Table 1: CTICU and use of factors data (Average ± SD)

	Original data	Phase I	ROTEM	No ROTEM
Number	17	24	23	4
CT Output 6 hours (ml/kg)	21±22	19±27	13±8	37±52
CT Output 24 hours (ml/kg)	32±22	37±58	26±16	49±60
ICU FFP (N) (ml/kg)	(5)13±6	(3)40±30	(2)16±8	(2)30±17
ICU Platelets (N) (ml/kg)	(5)12±3	(9)19±22	(2)35±21	(2)28±6
ICU Cryoprecipitate (N) (ml/kg)	(2)11±7	(5)9±2	(2)8±6	(2)17±16
FVIIa (N) (N of 2 doses)(mcg/kg)	(4)(3)159±46	(7)(0)84±17	(4)(1)68±43	(4)(1)113±44
FEIBA (N) (units/kg)	(3)29±18	(3)43±49	0	0
Kcentra(N) (units/kg)	0	(8)18±4	(20)17±8	(4)33±19

Table 2: Coagulation profile upon arrival to CTICU (Average ± SD)
* P 0.01 (ROTEM vs No ROTEM)

	Original data	Phase I	ROTEM	No ROTEM
1st CTICU Platelets (10 ³ /ul)	202±59	189±79	197±63	301±159
1st CTICU Fibrinogen (mg/dl)	319±80	333±91	274±77	371±73
1st CTICU PT (S)	17±3	17±4	16±2 *	12±2 *
1st CTICU PTT(S)	50±28	59±36	57±25	50±16
1st CTICU INR	1.39±0.3	1.36±0.4	1.3±0.26 *	0.93±0.25 *

Discussion

- There were no differences in terms of demographics or type and complexity of operations between the Original and ROTEM groups.
- Intraoperatively the ROTEM group received significantly less volume of platelets and cryoprecipitate (Figure 3).
- In the CTICU, the ROTEM group not only received less overall volume transfused, but less incidence of transfusion and less CT output (Table 1).
- Targeted administration of blood products based on the CPB ROTEM resulted in a better coagulation profile. (Table 2 and Figure 4)
- When ROTEM is not followed (No ROTEM group), there was an increase in number and doses of FEIBA, Kcentra, and aFVII without improved hemostasis and volume of transfusions with the possible added risk of thrombosis

Conclusion

- ROTEM may have a role in reducing blood product administration in high-risk neonatal cardiac surgery.
- A larger sample size may demonstrate a stronger correlation between specific ROTEM values and a targeted volume of products administered.

References:

- Romlin BS et al Anesth Analg 2011; 112:30
- Faraoni D et al. Eur J Anaesth 2015; 32:320