CONGRÈS FRANÇAIS D'HÉMOSTASE

10 -12 MAI 2023

Gestion du saignement en péri opératoire, quels bénéfices pour l'anesthésiste réanimateur ?

Le traumatisé

Delphine Garrigue Huet

CHU Lille

SFTH SOCIÉTÉ FRANÇAISE DE THROMBOSE ET D'HÉMOSTASE

Stago BioCare

Contexte

ELSEVIER
Available online at ScienceDirect www.sciencedirect.com
Elsevier Masson France EM|consulte www.em-consulte.com/en
Journal Surgery

ORIGINAL ARTICLE

Preventable deaths in a French regional trauma system: A six-year analysis of severe trauma mortality

Journal of Visceral Surgery (2018) Girard E for the TRENAU group

Causes de décès	Toutes n = 503	EVITABLES n = 108
Trauma cranien	347 (69%)	20 (19%)
Choc hémorragique	87 (17%)	60 (56%)
SDMV	34 (7%)	13 (12%)
Respiratoire	19 (4%)	8 (7%)
Cardiaque	10 (2%)	4 (4%)
Choc septique	6 (1%)	3 (3%)

7484 trauma

503 décès (6,7%), 170 erreurs

« Morts potentiellement évitables »

Fréquence

	All Centres	London	Amsterdam	Oslo	San Francisco	TR-DGU
Number of patients	3646	628	477	617	236	1688
PTr > 1.2	1323 (36%)	84 (13%)	86 (13%)	174 (23%)	31 (13%)	948 (56%)

Prospective
2008 à 2014

Londres, Oslo, Amsterdam, Copenhague, Oxford, Cologne
n = 2287 patients
PTr > 1,2 pour 6,5 % des patients

Prospective
Nov 2017 mai 2018

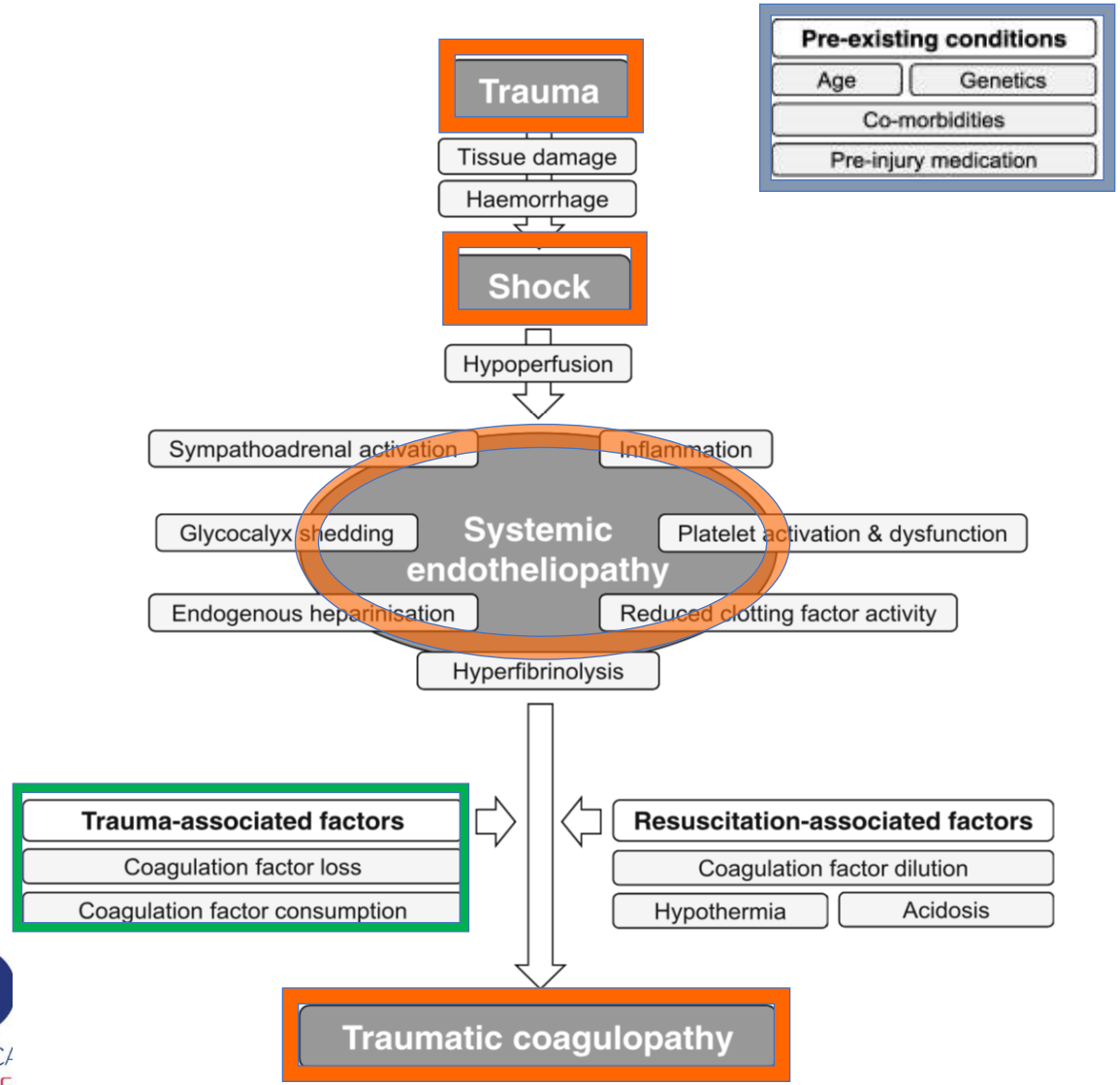
Lille n = 390 patients
PTr > 1,2 pour 23,9 % des patients

Frith D,. Definition and drivers of acute traumatic coagulopathy: clinical and experimental investigations. Thromb Haemost. 2010 Sep;8(9):1919-25
Baksaas-Aasen K. Data-driven Development of ROTEM and TEG Algorithms for the Management of Trauma Hemorrhage. An Surg 2018

Physio (logie/pathologie)

CRITICAL CARE 2019

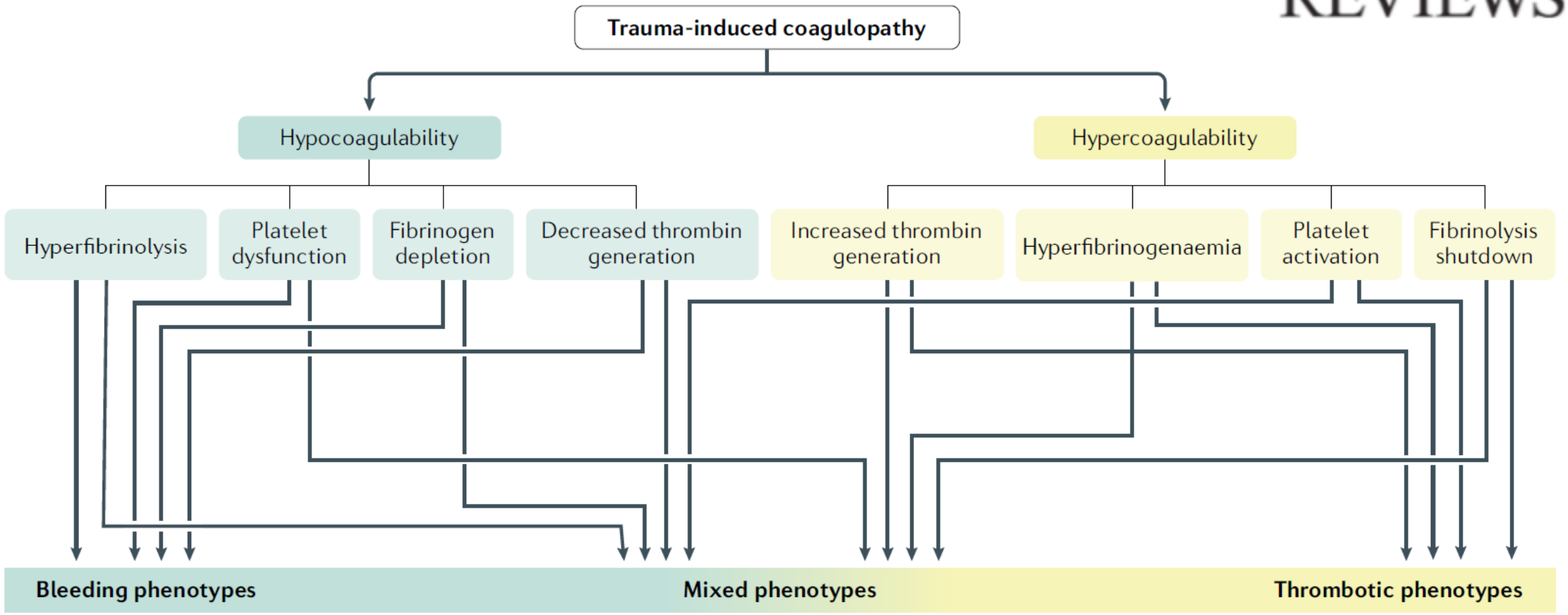
The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition
Spahn DR et al.



Coagulopathie :

- Plusieurs phénotypes
- Complexe
- Evolutive

Différents phénotypes



Dans les 6 premières heures

> 24 h

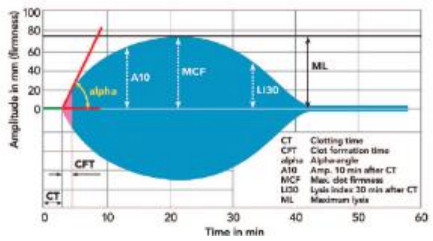
Thérapie « ratio »

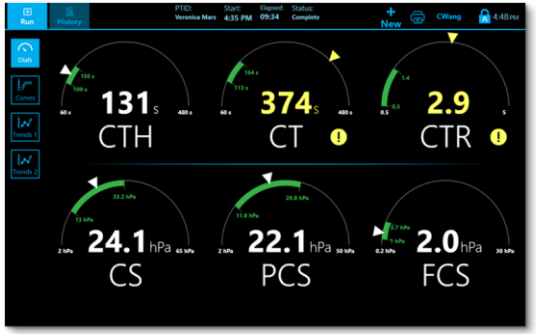
FFP
+
CUP
+
+
Fg
+
TNX Ac
+
Calcium

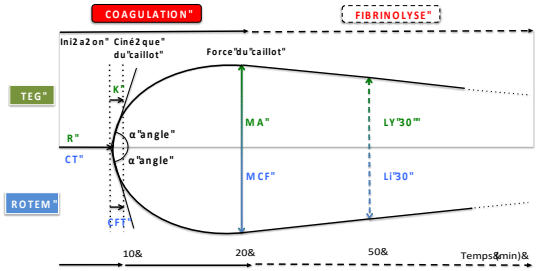
- PT < 1.5N
- Ratio 1:1-> 1:2
- Plaquettes 50-100.000/mm³
- Hemoglobine 7-9 g/dL
- Fibrinogène > 1.5 g/L (1C)
- TXA < 3h ++
- Ca2+ 1,1 et 1,3 mmol/L

Holcomb JB et al. JAMA 2015; PROPPR study*
Duranteau J et al. RFE SFAR 2016
Spahn DR et al . Crit Care 2019

Thérapie individualisée







+

+

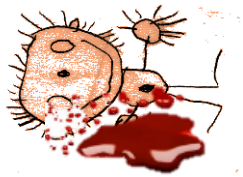
+

+

+

Paramètre mesuré	Paramètre de l'hémostase	Traitement proposé
R-time/CT (min)	Facteurs de la coagulation	Si ↗ : PFC ou CPP
Angle α (°)	Cinétique de la formation de fibrine (Fg)	Si ↘ : Fg
MA/MCF (mm)	Fg, plaquettes (nombre et fonction), FXIII	Si ↘ : Fg/ plaquettes
LY30/ LI30 (%)	Lyse du caillot 30' après MA (Fibrinolyse)	Si↗ : Acide Tnx
MA-FF/FIBTEM	Fibrinogène « fonctionnel »	Si ↘ : Fg

!



Spahn DR, et al. Crit Care 2019
Gonzales et al. Ann Surg, 2016

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SAINT-MALO Palais des Congrès Le Grand Large

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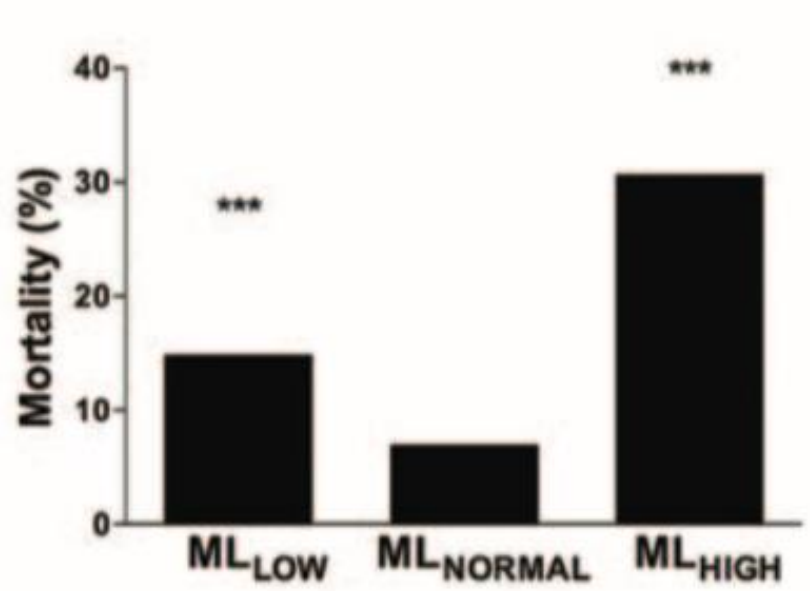
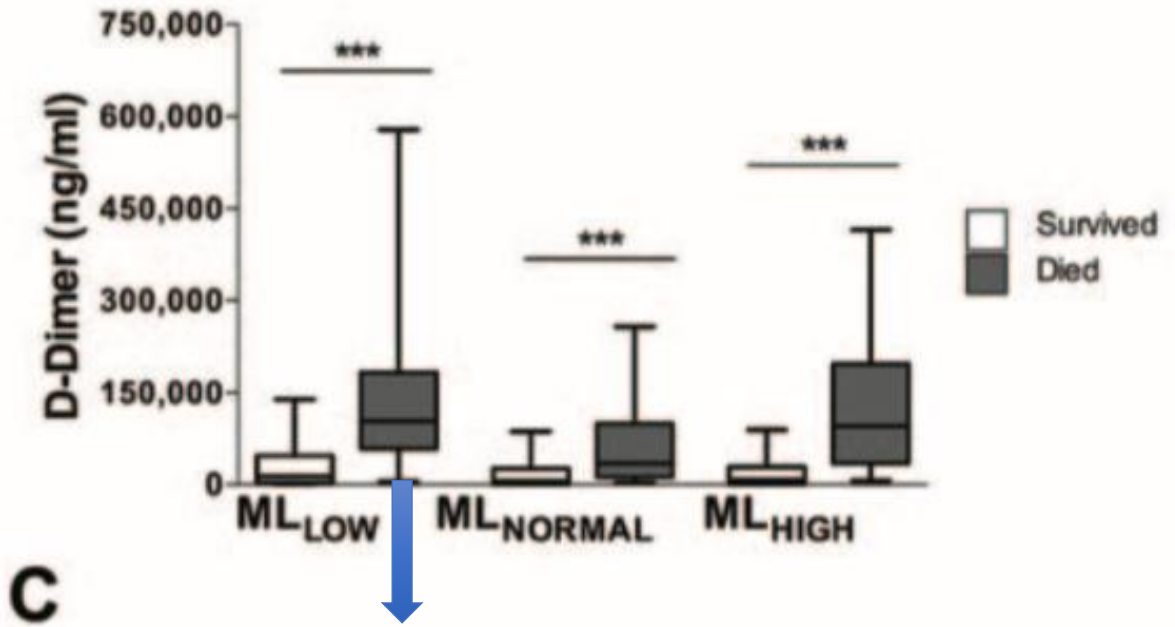
The S100A10 Pathway Mediates an Occult Hyperfibrinolytic Subtype in Trauma Patients

Gall Les et al. Tactic partners. Ann Surg 2019;269(6)

N=914

S100A = R endothélial du plasminogène et du tPA
30 % patients shutdown dont 46 % ont des DD élevés





Mortalité 7 x supérieure pour TC

TXA Administration in the Field Does Not Affect Admission TEG after Traumatic Brain Injury

J Trauma Acute Care Surg. 2020 November ; 89(5): 900–907.

Alexandra L. Dixon,

Prospective, randomisée
219 placebo, 229 1+1 gr, 259 bolus 2 gr

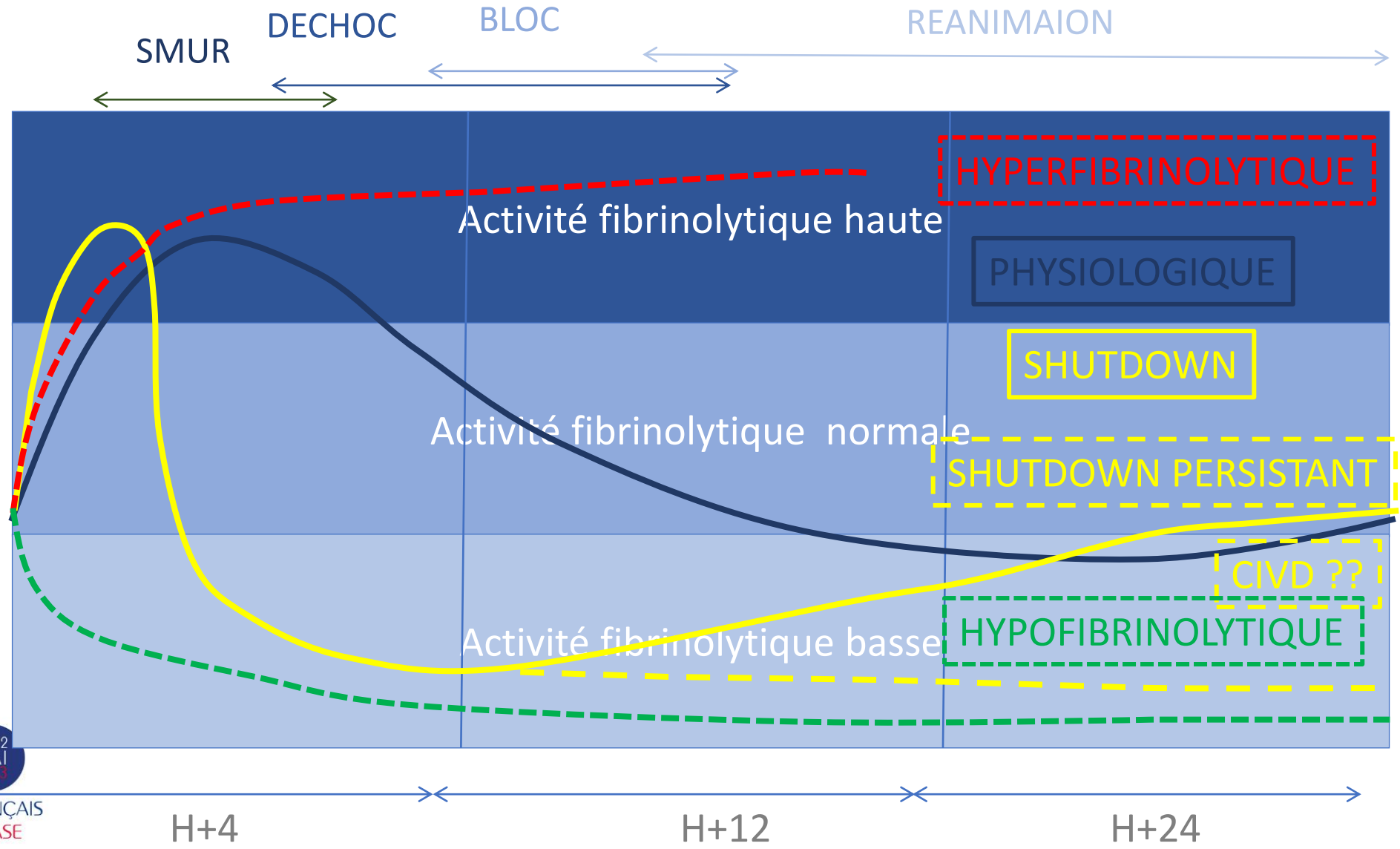
There were no statistically significant differences in any thromboelastography (TEG) values obtained on arrival to the Emergency Department or six hours after admission between treatment groups (p>0.05; Table 2), including no difference in LY30 between the three groups at either time point (p>0.05).

Factor	Time	Treatment	Mean (95% CI)	p
D-dimer	Admission	PB	8.8 (7.7-9.8)	0.055
		BM	7.2 (6.3-8.2)	
		BO	7.1 (6.2-8.0)	
	6 hours	PB	8.2 (7.2-9.2)	*<0.001*
		BM	5.7 (4.9-6.5)	
		BO	5.9 (5.1-6.7)	
PAP	Admission	PB	2733 (2489-2977)	*<0.001*
		BM	2101 (1881-2320)	
		BO	1800 (1612-1987)	
	6 hours	PB	2582 (2350-2814)	*0.02*
		BM	2120 (1916-2323)	
		BO	2240 (2044-2436)	

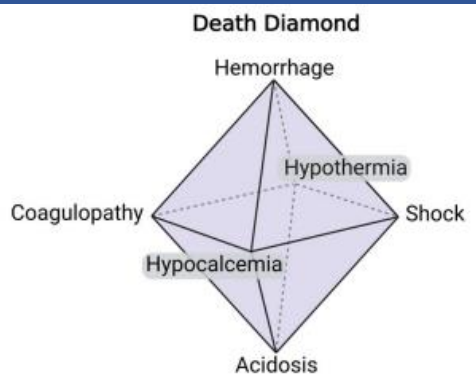
TEG = mauvais outil pour diagnostiquer une fibrinolyse ?

Fibrinolyse / shutdown

Moore HB et al. Anesth Analg. 2019 Sep;129(3):762-773
Roberts DJ et al. J Trauma Acute Care Surg 2019 ;86(2) :206-13
Roberts I et al. Transfusion 2016,56:115-8.



Calcium ionisé



Ionised calcium concentrations remained significantly associated with the MA on the TEG, after adjusting for platelet counts, fibrinogen concentrations, INR and aPTT

Variables	Slope of the variable (95% confidence interval)	*P*-value
Ionised calcium concentration (per 0·1 mmol L^{-1} increment)	1·1 (0·3 to 1·9)	0·011
Platelet count (per 10×10^9 L^{-1} increment)	0·2 (0·13 to 0·24)	0·001
Fibrinogen concentration (per g L^{-1} increment)	1·7 (1·2 to 2·3)	0·001
aPTT (per second increment)	−0·1 (−0·05 to −0·14)	0·001
INR (per unit increment)	0·7 (−1·3 to 2·7)	0·486

TABLE 3. Multivariable Analysis of Calcium Concentrations With ROTEM and Transfusion

ROTEM*	Coefficient	*p*	95% Confidence Interval
EXTEM			
CFT (s)	−6.86	0.005	−11.59 to −2.13
Alpha (°)	0.95	0.018	0.17–1.73
A10 (mm)	1.78	<0.001	0.84–2.72
A20 (mm)	1.69	<0.001	0.84–2.54
MCF (mm)	1.53	<0.001	0.71–2.35
ML (%)	−1.85	0.131	−4.25 to 0.55
FIBTEM			
CFT (s)	60.27	0.580	−168.5 to 289.0
Alpha (°)	0.66	0.444	−1.03 to 2.35
A10 (mm)	0.63	0.131	−0.19 to 1.45
A20 (mm)	0.74	0.096	−0.13 to 1.61
MCF (mm)	0.64	0.151	−0.24 to 1.52
ML (%)	−1.53	0.390	−5.05 to 1.98
Transfusions**			
Blood units in 24 h	−0.55	0.005	−0.93 to −0.16
Plasma units in 24 h	−0.54	0.003	−0.91 to −0.18
Platelet units in 24 h	−0.78	0.001	−1.26 to −0.31

*Multivariable regression analysis results of calcium concentration with viscoelastic testing results controlling for age, Injury Severity Score, platelet count, base excess, sex, and prehospital crystalloid volume.

**Multivariable Poisson regression analysis results of admission calcium with 24-hour transfusion requirements controlling for age, Injury Severity Score, base excess, and prehospital crystalloid volume and additionally controlling for hemoglobin for RBC transfusions regression, INR for FFP transfusions regression, and platelet count for platelet transfusions regression.

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KM Ho, CB Yip. Concentration-dependent effect of hypocalcemia on in vitro clot strength in patients at risk of bleeding : a retrospective cohort study. Transfusion Med. 2016.26 57_62
ZA Matthay et al. J Trauma Acute Care Surg. 2020;89: 871–879.

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Plaquettes

Characterization of platelet dysfunction after trauma

Kutcher ME, Redick BJ, McCreery RC, Crane IM, Greenberg MD, Cachola LM, Nelson MF, Cohen MJ.

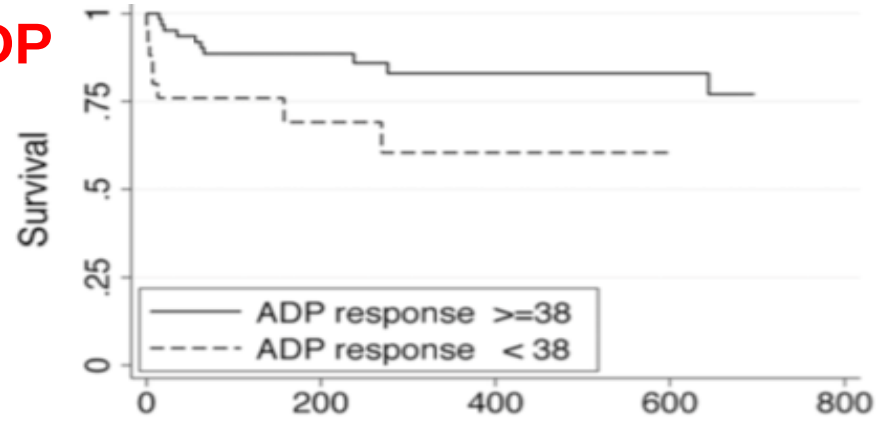
The Journal of Trauma and Acute Care Surgery®

n=110
376 prélèvements

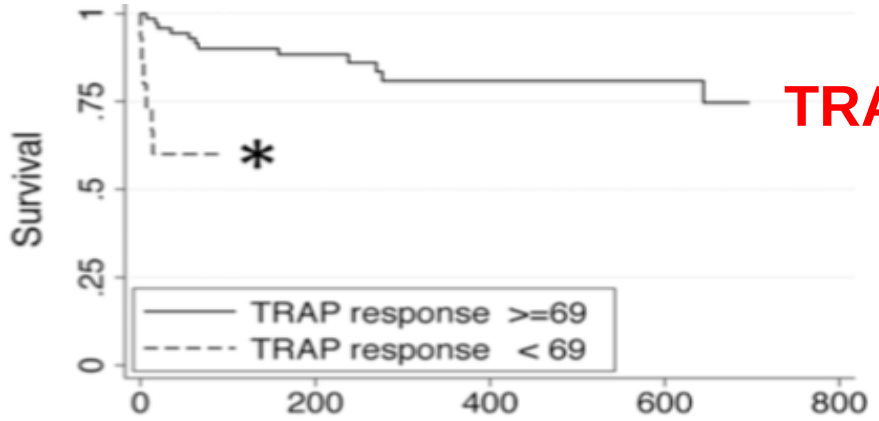
- ADP
- TRAP
- AA
- Collagen

46% ≥ 1 dysf°
= **mortalité** x 10

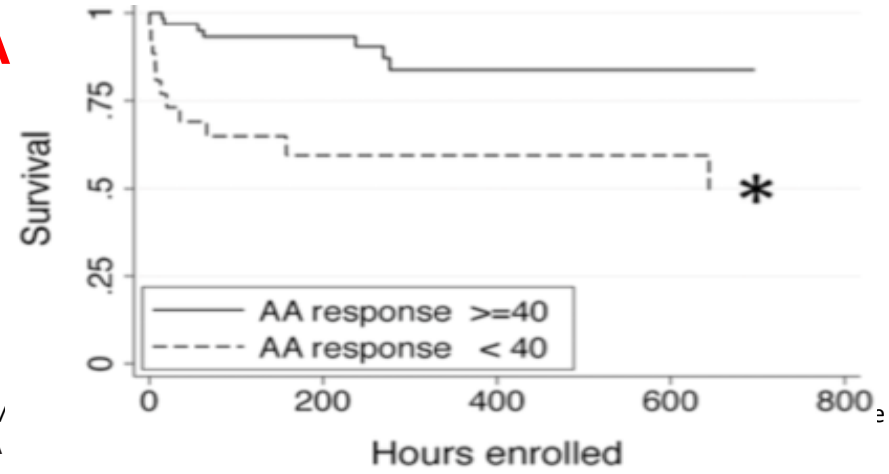
ADP



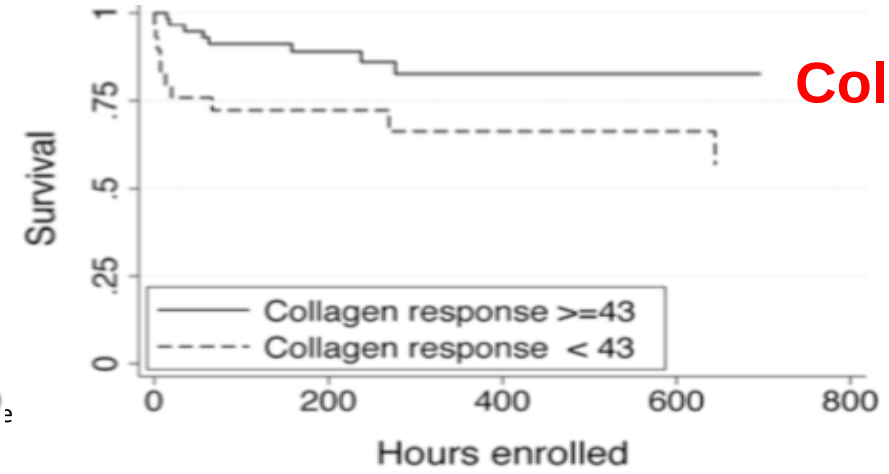
TRAP



AA



Collagen



Plaquettes

Multiplate Platelet Function Testing upon Emergency Room Admission Fails to Provide Useful Information in Major Trauma Patients Not on Platelet Inhibitors

P Pommer J. Clin. Med. **2022**, 11, 2578

Rétrospective
n=328, ISS : 29
72 TC isolé
141 pas de TC
115 polytrau dont TC

Besoins transfusionnels 6 et 24 H
Dysfonction plaquettaire
Mortalité

Table 3. Multiplate test results upon ER admission adjusted and unadjusted for platelet count.

Multiplate Tests	TBI Group	MT Group	MT + TBI Group	*p*-Value
Number of patients with test results below reference ranges				
ADP test, *n* (%)	12 (16.7)	26 (18.4)	26 (22.6)	0.5553
ASPI test, *n* (%)	21 (29.2)	33 (23.4)	36 (31.3)	0.3458
TRAP test, *n* (%)	17 (23.6)	32 (26.7)	29 (25.2)	0.8941
Unadjusted for platelet count (AUC)				
ADP test	83 (55–106)	81 (58–107)	77 (55–107)	0.8890
ASPI test	93 (61–121)	99 (74–120)	96 (61–117)	0.4694
TRAP test	126 (95–148)	126 (97–148)	121 (90–145)	0.9020
Adjusted for platelet count (AUC/platelet count × 100)				
ADP test	39 (27–51)	34 (26–45)	38 (28–46)	0.1882
ASPI test	43 (33–56)	43 (33–50)	45 (33–54)	0.3941
TRAP test	57 (45–78) [b]	52 (40–68)	55 (41–72)	0.0430

ER, emergency room; TBI, traumatic brain injury; MT, major trauma; ADP, adenosine diphosphate; ASPI, arachidonic acid test; TRAP, thrombin-receptor-activating peptide; AUC, area under the curve; Kruskal–Wallis test and Dunn's multiple comparison, [b] TBI vs. MT $p < 0.05$.

Plaquettes

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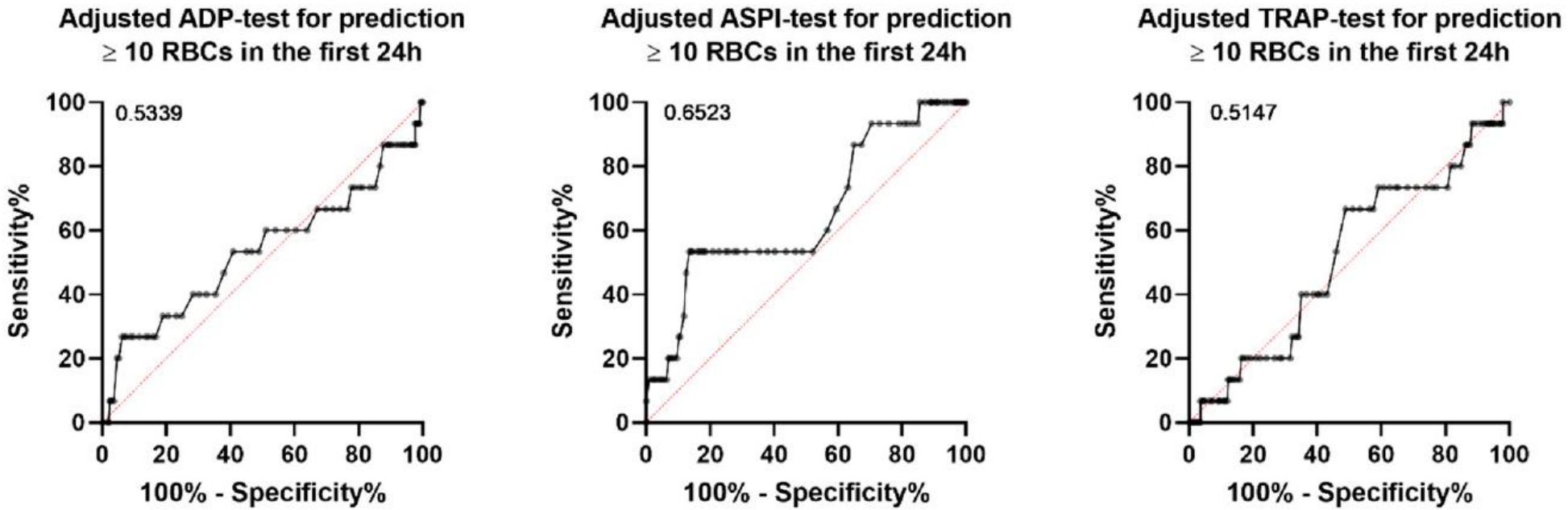


Figure 2. ROC curves for transfusion of 10 RBCs within 24 h adjusted for platelet count. ADP, adenosine diphosphate; ASPI, arachidonic acid test; TRAP, thrombin-receptor-activating peptide; ROC, receiver operating characteristics.

Pas de corrélation avec la transfusion massive ni la mortalité

Sonorhéométrie

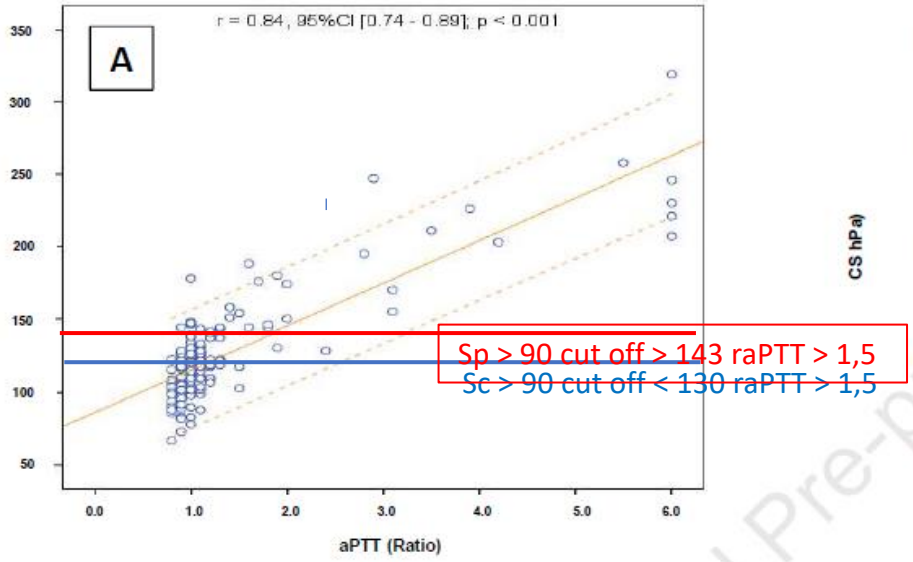
G Duclos et al. Blood coagulation test abnormalities in trauma patients detected by sonorheometry: A retrospective cohort study. Research and pratctice in thrombosis and haemostasis. 2023. in proof

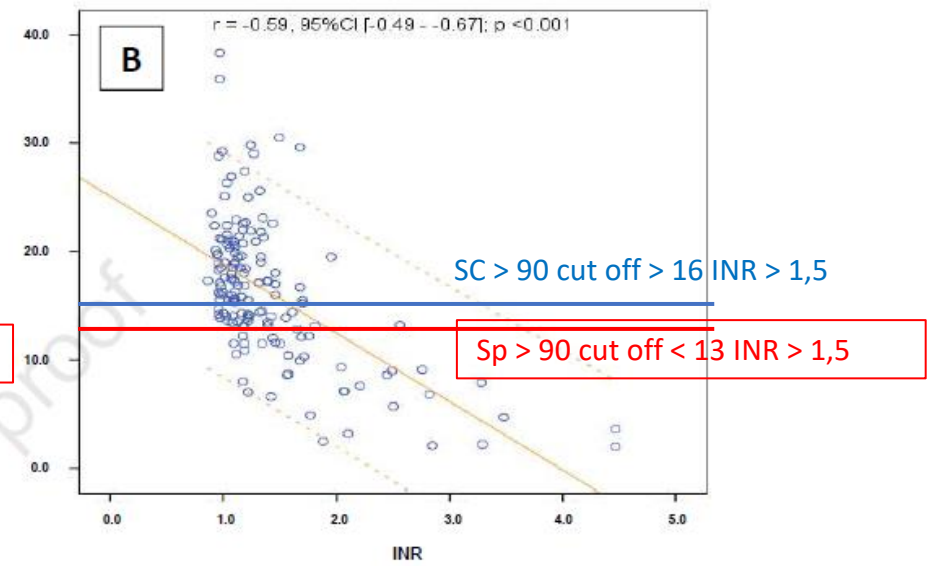
N=156

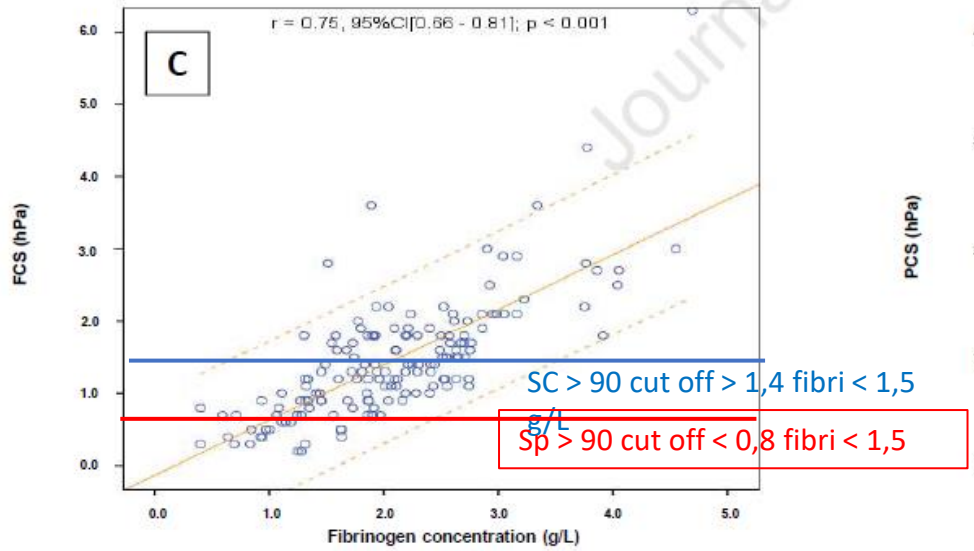
ISS 22 [10-37]
47 % transfusés
INR > 1,5 24 %

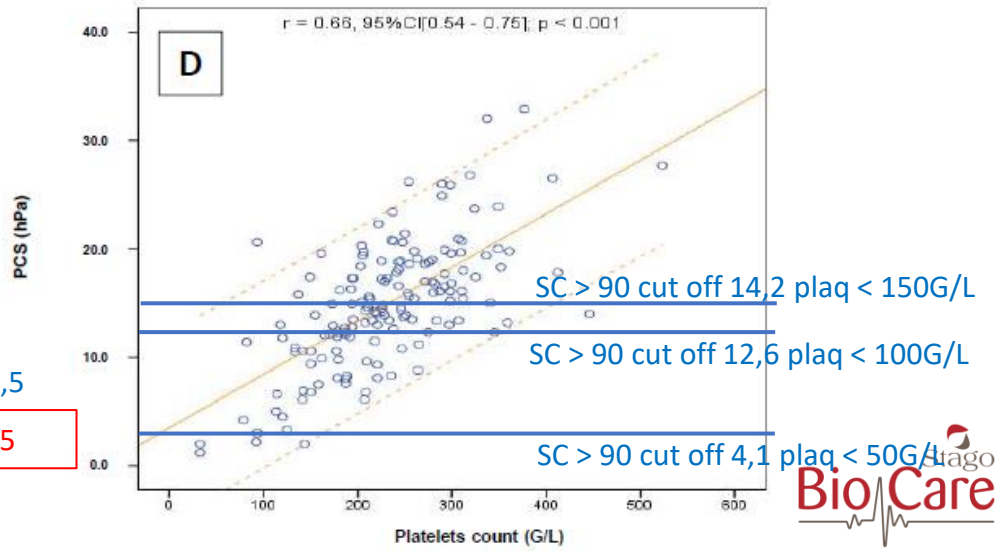
Délai rendu
CS 5 [4-6] min
CSL 11 [11-12] min

Aucune fibrinolyse









Thérapeutique

Goal-directed Hemostatic Resuscitation of Trauma-induced Coagulopathy

Annals of Surgery 2016 E Gonzalez

111 traumatisés sévères

Protocole de transfusion basée sur la biologie classique

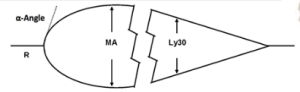
30-45 min

INR → PFC
Fibrinogène→cryoprécipité
NFS→Plaquettes
D-dimères→Ac tranexamique

4 CGR + 2 plasmas

Protocole de transfusion basée sur le TEG -

5 min



ACT → PFC
Angle alpha→cryoprécipité
MA→Plaquettes
LY30→Ac tranexamique

	36,4%	**Mortalité J28**	19,6%	**p=0,049**
	11 (6-16)	**CGR H24**	9,5 (5-16)	NS
> H2	6 (4-9)	**PFC H24**	5 (3-9)	NS
> H2	1 (0-2)	**Plaquettes H24**	1 (0-2)	NS
	1 (0-2)	**Fibrinogène H24**	0 (0-2)	**0,04**

ORIGINAL

Viscoelastic haemostatic assay augmented protocols for major trauma haemorrhage (ITACTIC): a randomized, controlled trial

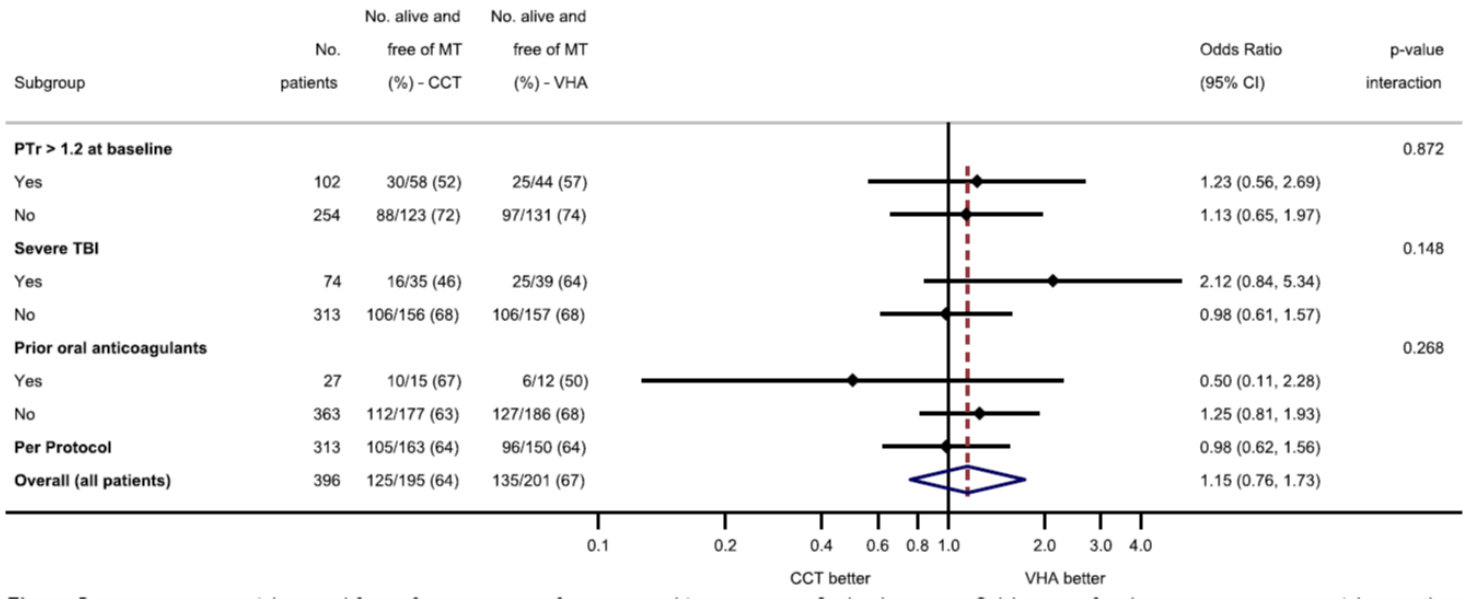
K. Baksaas-Aasen[1], L. S. Gall[2], J. Stensballe[3], N. P. Juffermans[4], *Intensive Care Med (2021) 47:49–59*

Trauma sévères

201 Tests visco-élastique

195 biologie standard

Objectif principal mortalité à 24 h
Sans transfusion massive (10 CGR/24h)



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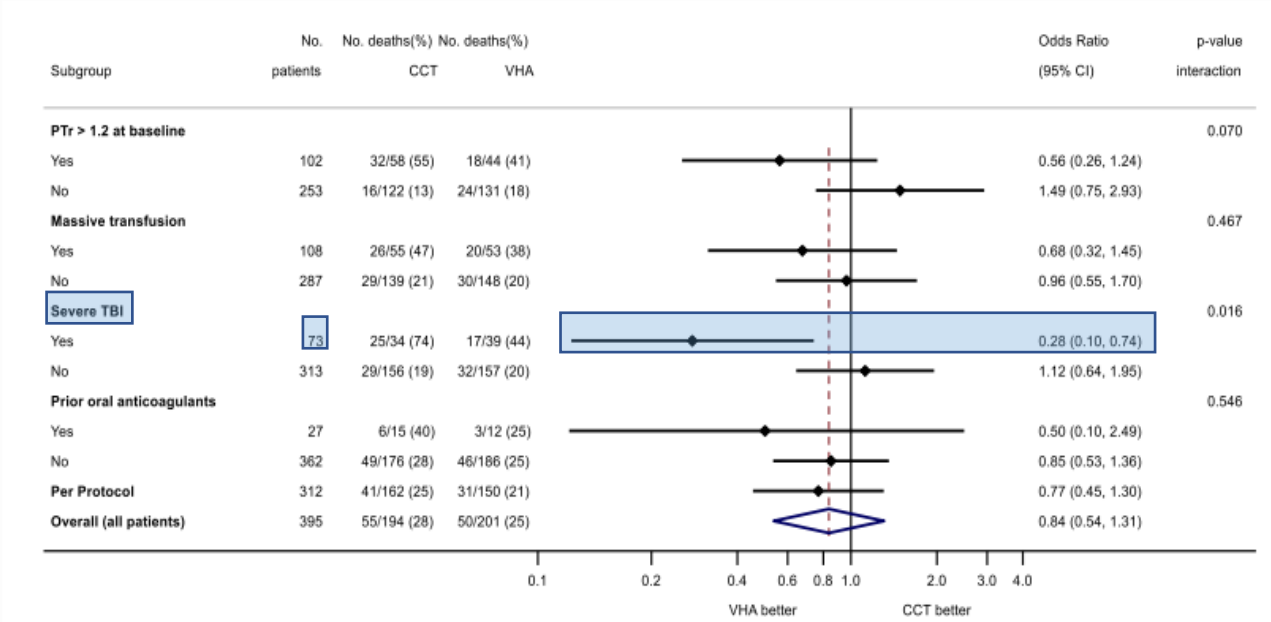
Trauma craniens

39 Tests visco-élastique

35 biologie standard

Objectif principal mortalité à 24 h

Fig. S1 28-day mortality in pre-specified subgroups



Conclusion


- Intérêts des test visco-élastiques :
  - Pour le pronostic : probable
  - Pour le diagnostic : probable (précocité, évaluation complète de l'hémostase)
  - Thérapeutique : probable (précocité, suivi, Tt ciblé)

- Limites :
  - Pour le diagnostic : AOD et antiplaquettaires, fibrinolyse….
  - Pour guider les traitements, impact sur la morbi-mortalité à confirmer .

GIHP Groupe d'intérêt en hémostase péri-opératoire

Inserm
Institut national de la santé et de la recherche médicale

HEGP
Hôpital Européen Georges Pompidou

Université Paris Cité

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10-12 MAI 2023

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SOCIÉTÉ FRANÇAISE DE THROMBOSE ET D'HÉMOSTASE

Symposium Stago BioCare

Tests viscoélastiques : du besoin clinique à la biologie délocalisée

La gestion du saignement en situation d'urgence : point de vue d'anesthésistes-réanimatrices

Pr Anne GODIER

Service d'Anesthésie-Réanimation, hôpital Européen Georges Pompidou, Paris

INSERM UMRS 1140, Université Paris Cité

Liens d'intérêt : Aguettant, Alexion, Bayer Healthcare, BMS-Pfizer, Boehringer Ingelheim, Sanofi, CSL Behring, LFB, Octapharma, Stago, Viatris

Congrès Français d'Hémostase

10-12 MAI 2023

SFTH Société Française de Thrombose et d'Hémostase

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HEGP Hôpital Européen Georges Pompidou

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La gestion du saignement en chirurgie cardiaque: point de vue d'anesthésistes-réanimatrices

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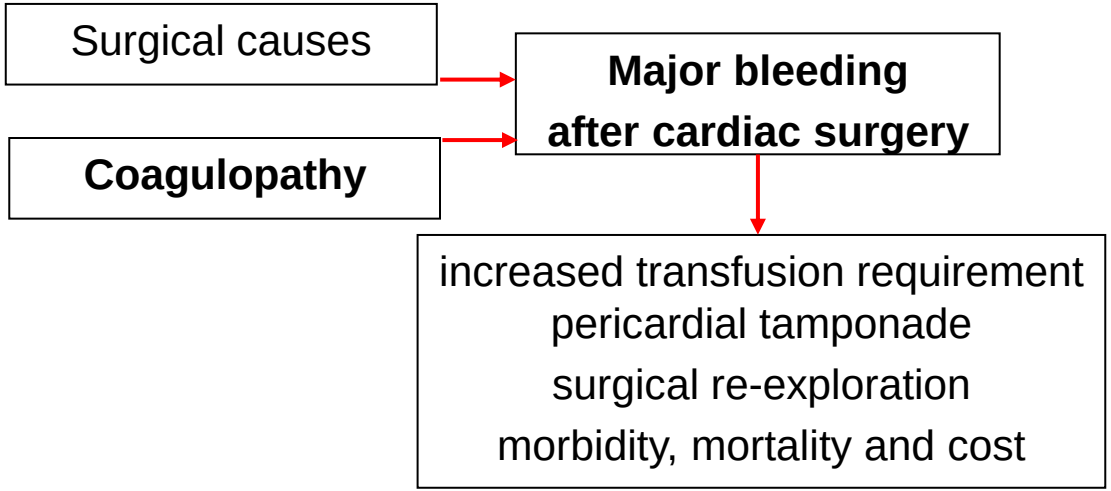
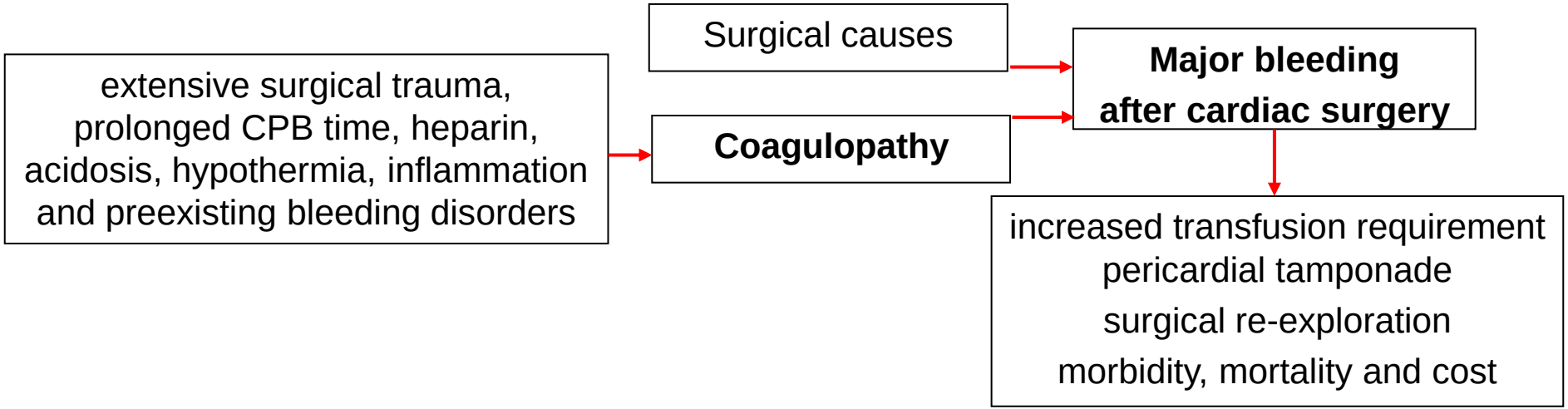
INSERM UMRS 1140, Université Paris Cité

Liens d'intérêt : Aguettant, Alexion, Bayer Healthcare, BMS-Pfizer, Boehringer Ingelheim, Sanofi, CSL Behring, LFB, Octapharma, Stago, Viatris


Surgical causes
Coagulopathy
Major bleeding
after cardiac surgery
increased transfusion requirement
pericardial tamponade
surgical re-exploration
morbidity, mortality and cost


Surgical causes
extensive surgical trauma, prolonged CPB time, heparin, acidosis, hypothermia, inflammation and preexisting bleeding disorders
Coagulopathy
Major bleeding after cardiac surgery
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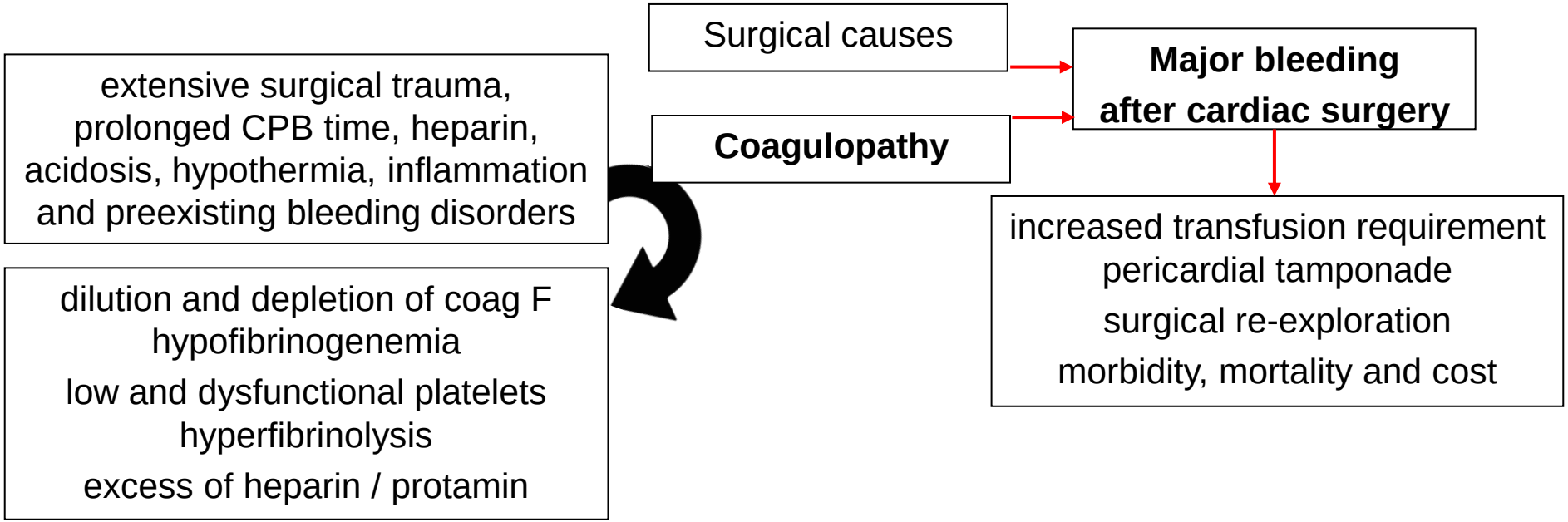
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Surgical causes

Major bleeding after cardiac surgery

Coagulopathy

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hypofibrinogenemia
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excess of heparin / protamin

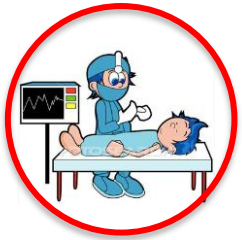
increased transfusion requirement
pericardial tamponade
surgical re-exploration
morbidity, mortality and cost

Prompt diagnosis of coagulopathy
- to guide hemostatic treatment
- to provide targeted therapies

standard laboratory testing (platelet count, PT, aPTT, Fg)
long turnaround time
lack of specificity

reversal of excess heparinization
fibrinogen and coagulation factor
platelet transfusion
antifibrinolytic agents

VET?



Monitorage: Tests standards de laboratoire

Development of a rapid emergency hemorrhage panel

Chandler WL et al. **TRANSFUSION** 2010

Diagnostic rapide de coagulopathie

- guider le traitement hémostatique
- choisir des thérapies ciblées

Tests standards de laboratoire:
Num plaquettaire, TP, TCK, Fibg, anti-Xa

Manque de spécificité

Délais trop longs

Panel hémorragique d'urgence

4 tests
TP, Fibrinogène,
Ht, plaquettes

Test
Immédiat

centrifugation
rapide

35+/-37 min

14+/-3 min
(6-28)

Letter to the Editor

Elodie Boissier*, Mathieu Sévin-Allouet, Aurélie Le Thuaut, Solène De Gaalon, Marc Trossaërt, Bertrand Rozec, Karim Lakhal and Jean-Christophe Rigal

A 2-min at 4500 *g* rather than a 15-min at 2200 *g* centrifugation does not impact the reliability of 10 critical coagulation assays

TQ, INR, TCA, TCK, fibrinogène, temps de thrombine, Facteur II, Facteur V, antithrombine, activité anti-Xa héparine

Tests viscoélastométriques

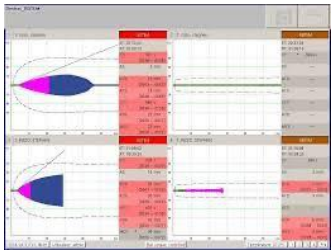
ROTEM

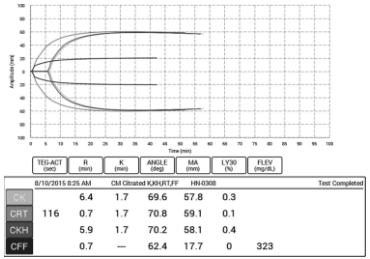
TEG

Quantra

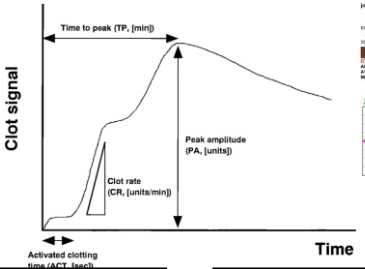
Sonoclot

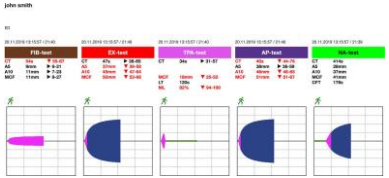
ClotPro





CK		6.4	1.7	69.6	57.8	0.3	
CRT	116	0.7	1.7	70.8	59.1	0.1	
CKH		5.9	1.7	70.2	58.1	0.4	
CFF		0.7	—	62.4	17.7	0	323





Caractéristiques du caillot

initiation de sa formation
génération d'un clou fibrinoplaq
stabilité
lyse

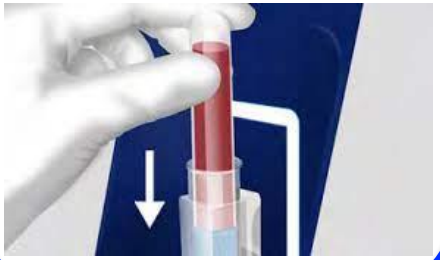
Contribution relative

Fact de coagulation / Fg
Plaquettes
Fibrinolyse
Anticoagulants/AAP

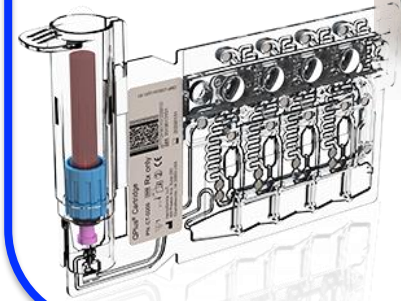
Traitement

Fact de coagulation / Fg
Plaquettes
Agents antifibrinolytiques
Réversion spécifique

ROTEM Sigma

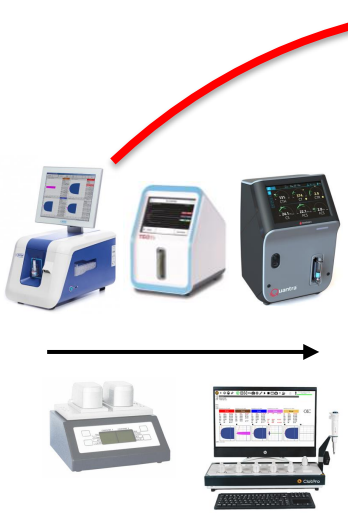


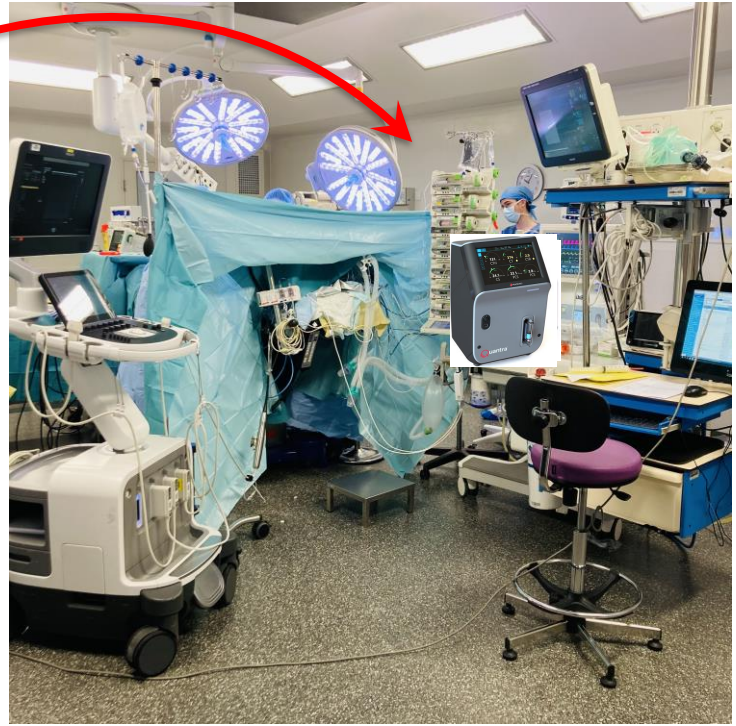
Quantra



TEG 6S

ClotPro





Use of preoperative VET: predicting bleeding?

Small studies

Variable definitions of major bleeding

→ preoperative VET does not predict bleeding in cardiac surgery

- *Cherng Y-G. Preoperative evaluation and postoperative prediction of hemostatic function with thromboelastographyin patients undergoing redo cardiac surgery. Acta Anaesthesiol Sin. 1988.*
- *Sharma A. Does incorporation ofthromboelastography improve bleeding prediction following adultcardiac surgery? Blood Coagul Fibrinolysis.*
- *Mumford A. Does incorporation ofthromboelastography improve bleeding prediction following adultcardiac surgery? Res Pract Thromb Haemost. 2017.*
- *Meesters MI. Predictionof postoperative blood loss using thromboelastometry in adultcardiac surgery: cohort study and systematic review.J Cardiothorac Vasc Anesth. 2018.*
- *Davidson SJ. CanROTEM thromboelastometry predict postoperative bleeding aftercardiac surgery? J Cardiothorac Vasc Anesth. 2008.*

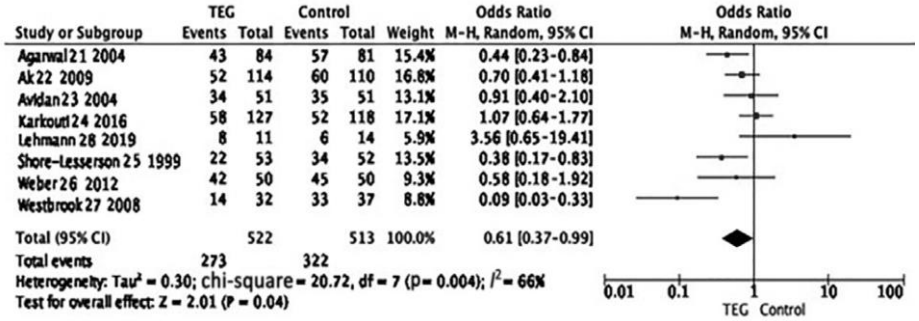
The use of perioperative VET: reducing bleeding?

Viscoelastic Blood Tests Use in Adult Cardiac Surgery: Meta-Analysis, Meta-Regression, and Trial Sequential Analysis

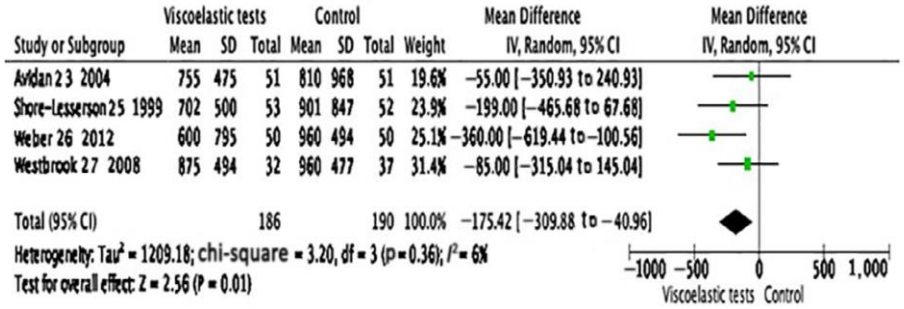
JOURNAL OF CARDIOTHORACIC AND VASCULAR ANESTHESIA
2020

Meco M, Montisci A, Giustiniano E, Greco M, Pappalardo F, Mammana L, Panisi P, Roscitano C, Cirri S, Donatelli F, Albano G

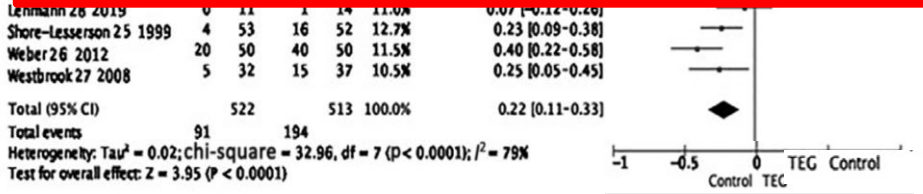
Red blood cell exposition *

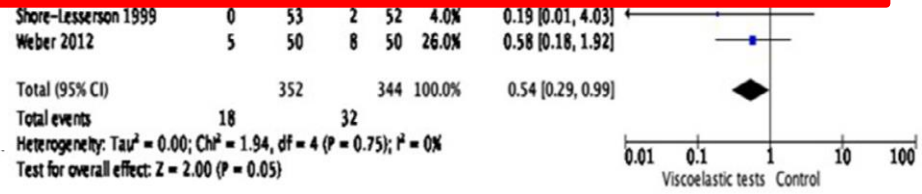


24-hour postoperative bleeding *



→ the use of VET is effective in reducing bleeding, transfusion and the need for redo surgery





Viscoelastic Blood Tests Use in Adult Cardiac Surgery: Meta-Analysis, Meta-Regression, and Trial Sequential Analysis

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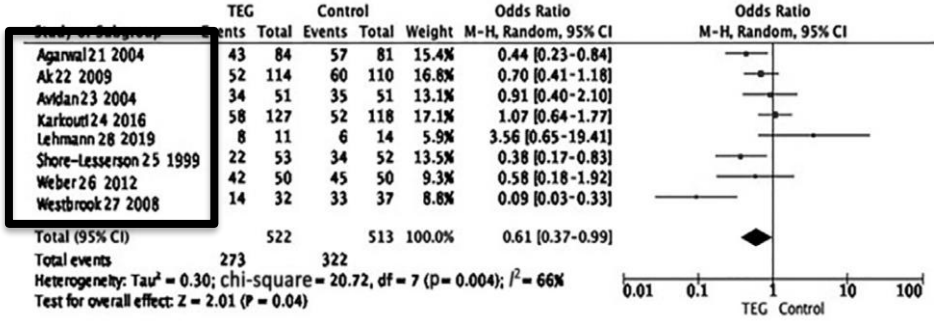


Study or Subgroup	TEG Events	TEG Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Agarwal 21 2004	43	84	57	81	15.4%	0.44 [0.23-0.84]
Ak 22 2009	52	114	60	110	16.8%	0.70 [0.41-1.18]
Avidan 23 2004	34	51	35	51	13.1%	0.91 [0.40-2.10]
Karkouti 24 2016	58	127	52	118	17.1%	1.07 [0.64-1.77]
Lehmann 28 2019	8	11	6	14	5.9%	3.56 [0.65-19.41]
Shore-Lesserson 25 1999	22	53	34	52	13.5%	0.38 [0.17-0.83]
Weber 26 2012	42	50	45	50	9.3%	0.58 [0.18-1.92]
Westbrook 27 2008	14	32	33	37	8.8%	0.09 [0.03-0.33]
Total (95% CI)		522		513	100.0%	0.61 [0.37-0.99]
Total events	273		322			

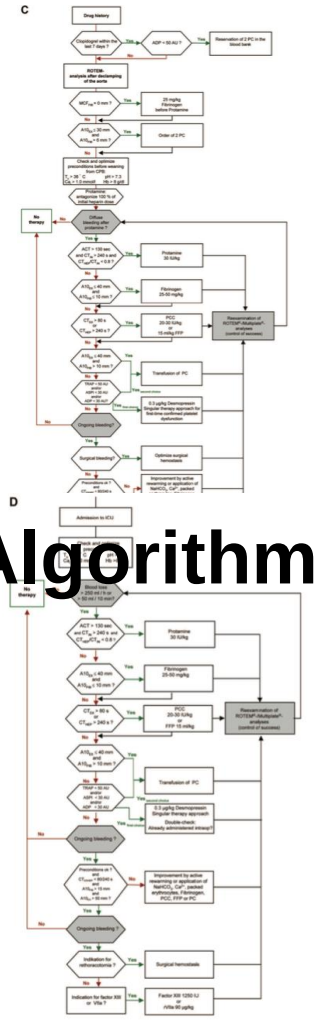
Heterogeneity: Tau² = 0.30; chi-square = 20.72, df = 7 (p = 0.004); I^2 = 66%
Test for overall effect: Z = 2.01 (P = 0.04)

Odds Ratio M-H, Random, 95% CI

0.01 0.1 1 10 100

TEG Control

+ Algorithms



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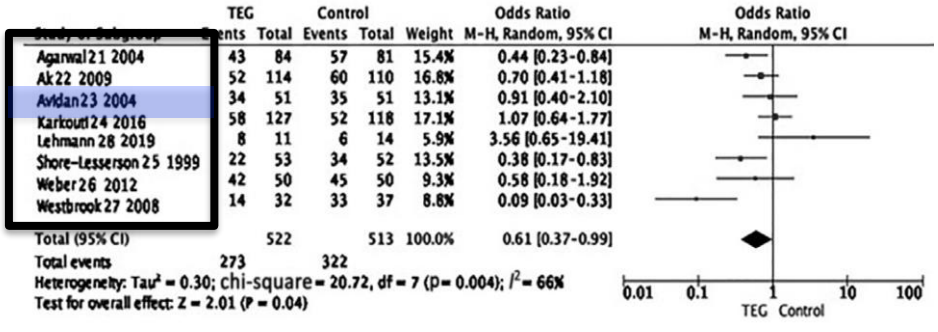
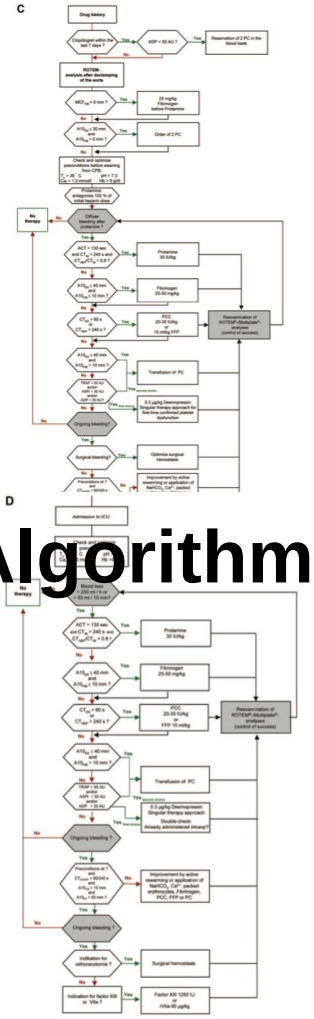
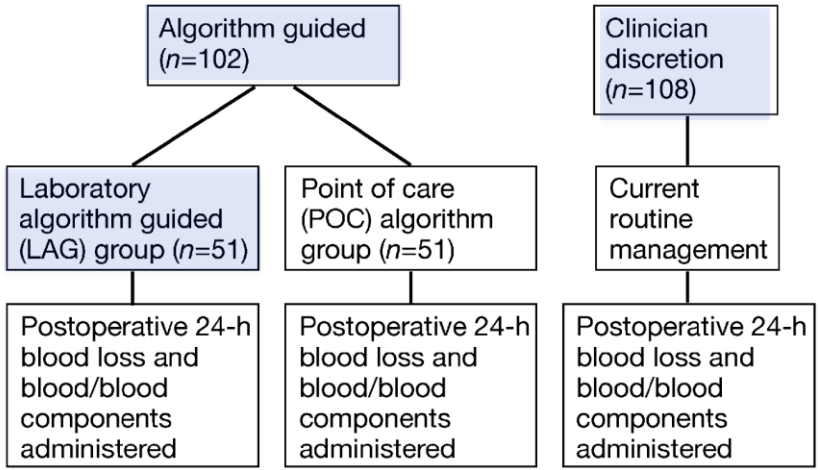


+ Algorithms



Comparison of structured use of routine laboratory tests or nearpatient assessment with clinical judgement in the management of bleeding after cardiac surgery

Avidan MS. Br J Anaesth. 2004



Following algorithms based on structured clinical practice with standard laboratory tests reduces the transfusion of RBCs and blood components when compared with clinician discretion.

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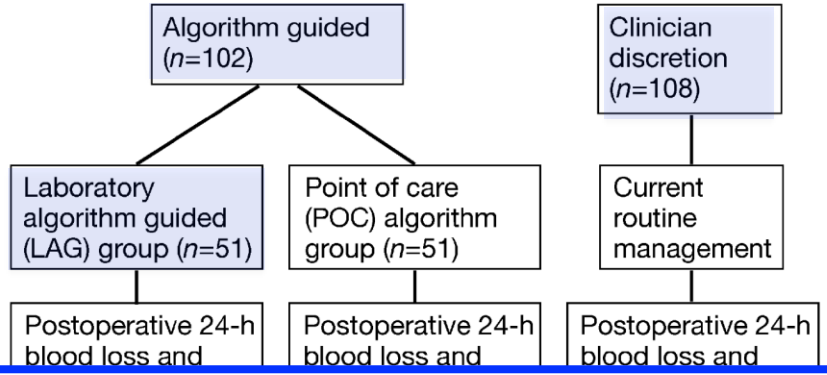
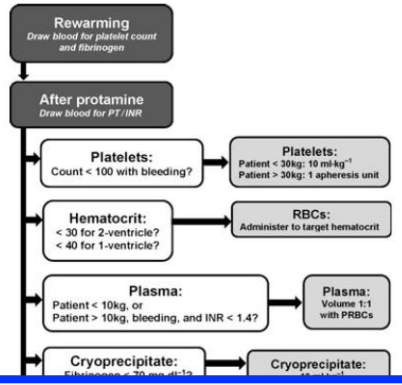


clinical practice with standard laboratory tests reduces the transfusion of RBCs and blood components when compared with clinician discretion.

Implementation of a transfusion algorithm to reduce blood product utilization in pediatric cardiac surgery.

Whitney G. Paediatr Anaesth. 2013

clinical judgment



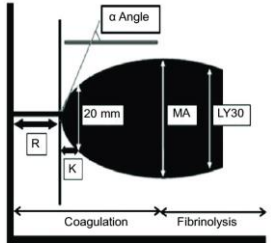
algorithm in pediatric cardiac surgery significantly reduces perioperative blood product utilization and mortality compared to clinical judgment

→ use of standardised haemostatic algorithms with pre-defined intervention triggers

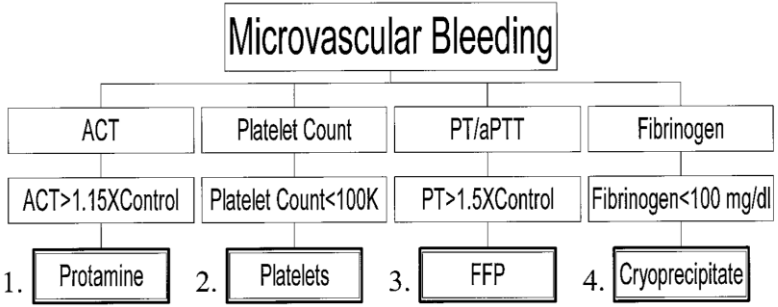
Thromboelastography-Guided Transfusion Algorithm Reduces Transfusions in Complex Cardiac Surgery

Shore-Lesserson L, Manspeizer HE, De Perio M, Francis S, Vela-Cantos F, Ergin MA.

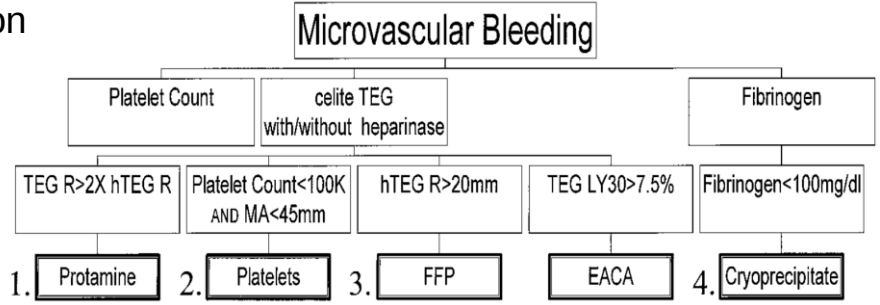
Anesth Analg.
1999



cardiac surgical
patients
at moderate to high risk
of transfusion



R



	Intraoperative			Postoperative			Total		
	TEG	Control	*P*	TEG	Control	*P*	TEG	Control	*P*
Packed red blood cells (mL)	267 ± 423	346 ± 449	0.4	103 ± 252	177 ± 318	0.27	354 ± 487	475 ± 593	0.12
Fresh-frozen plasma (mL)	22 ± 101	113 ± 407	0.4	33 ± 169	146 ± 378	0.13	36 ± 142	217 ± 463	<0.04
Platelet concentrates (mL)	22 ± 75	41 ± 122	0.6	11 ± 46	42 ± 107	0.3	34 ± 94	83 ± 160	0.16
Packed red blood cells	17/53	23/52	0.2	10/53	16/52	0.16	22/53	31/52	0.06
Fresh-frozen plasma	3/53	8/52	0.1	2/53	11/52	<0.007	4/53	16/52	0.002
Platelet concentrates	5/53	8/52	0.4	3/53	9/52	0.06	7/53	15/52	<0.05

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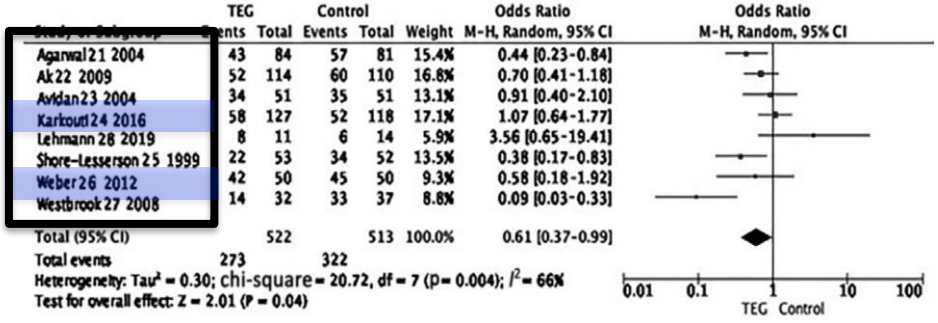

Platelet function testing

Complex cardiac surgery

Bleeding

Laboratory

Hemoglobin, plat count, INR, aPTT, fibringen
n=50

Algorithm

ROTEM Multiplate
n=50

↘ RBC : 5 (4;9) *vs* 3 (2;6) $p < 0.001$
↘ FFP and Platelet transfusion
↘ Postoperative mechanical ventilation time
↘ Length of intensive care unit stay

Weber C. Aneesthesiology 2012

Complex cardiac surgery

Usual care
n=3555

Algorithm

transfusion algorithm
ROTEM
PlateletWork
n=3847

Outcome	Relative Risk (95% Confidence Interval)	*P* Value
Red blood cell transfusions	0.91 (0.85–0.98)	0.02
Platelet transfusions	0.77 (0.68–0.87)	<0.001
Plasma transfusions	0.98 (0.86–1.12)	0.79
Cryoprecipitate or fibrinogen concentrate transfusions	1.26 (0.94–1.69)	0.11
Major bleeding*	0.83 (0.72–0.94)	0.004

Karkouti, Circulation 2016

Platelet function testing

Complex cardiac surgery

Bleeding

Laboratory

Hemoglobin, plat count, INR, aPTT, fibringen
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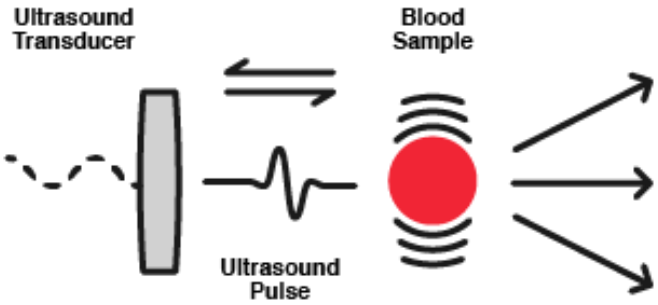
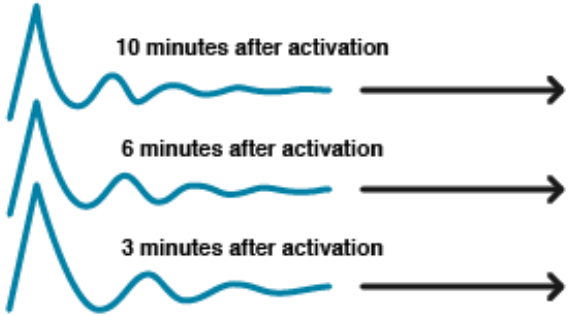
Major bleeding*	0.83 (0.72–0.94)	0.004

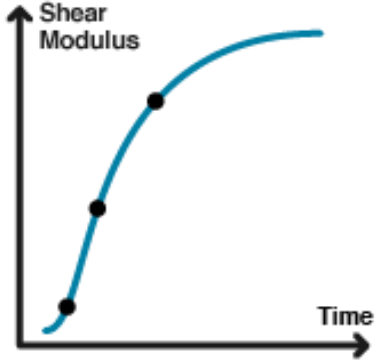
Karkouti, Circulation 2016

Use of VET: assessment of platelet dysfunction?

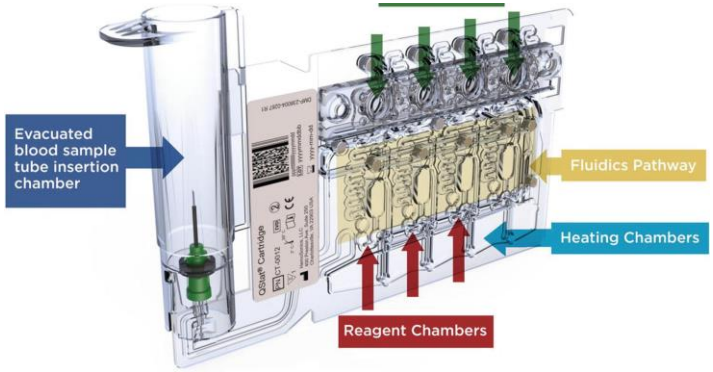

150
CTH
154
CT
1.0
CTR
17.5
CS
14.9
PCS
2.6
FCS
Quantra


Ultrasound Transducer
Blood Sample
Ultrasound Pulse


10 minutes after activation
6 minutes after activation
3 minutes after activation


Shear Modulus
Time

Quantra®
Hemostasis Analyzer



Quantra Cartridge

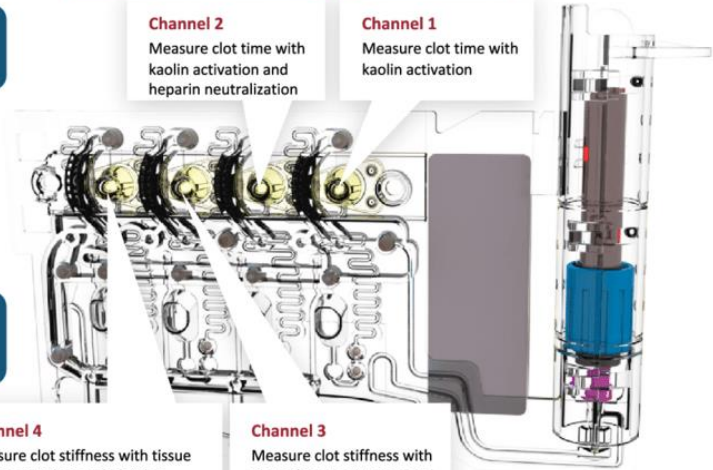
Heparinase Clot Time (CTH)

Clot Time (CT)

Clot Time Ratio (CTR) = CT/CTH

Channel 2
Measure clot time with kaolin activation and heparin neutralization

Channel 1
Measure clot time with kaolin activation



Platelet Contribution (PCS) = CS - FCS

Channel 4
Measure clot stiffness with tissue factor activation and platelet inhibition and heparin neutralization

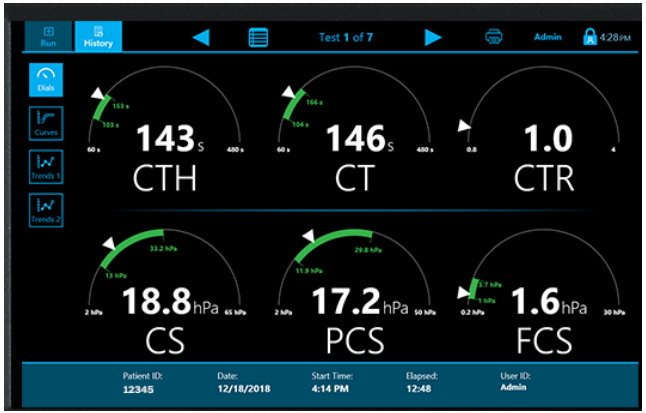
Channel 3
Measure clot stiffness with tissue factor activation and heparin neutralization

Fibrinogen Contribution (FCS)

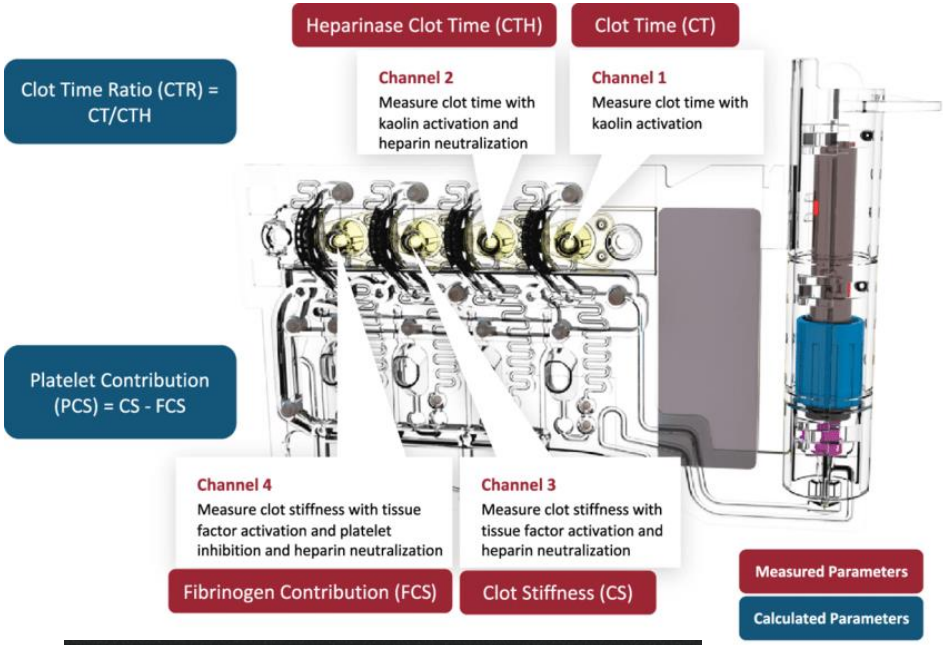
Clot Stiffness (CS)

Measured Parameters

Calculated Parameters

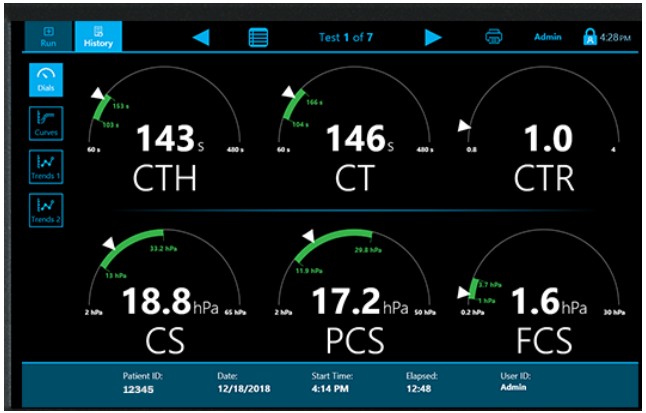


Quantra®
Hemostasis Analyzer



On peut mesurer :
Per-CEC : CTH, FCS, PCS

Post-CEC : CT, CTH, CT ratio
FCS, PCS



Use of VET: assessment of platelet dysfunction?

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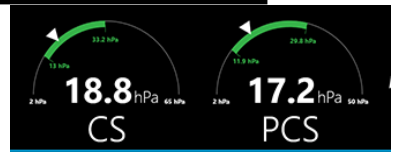
Cardiac surgery:
- Low platelet count
- Platelet dysfunction after CBP

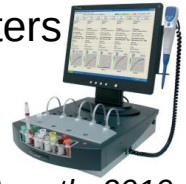
Prospective cohort study
30 patients before and after CPB



Quantra-derived parameters

Conventional laboratory tests: plat count

Rotational thromboelastography derived parameters



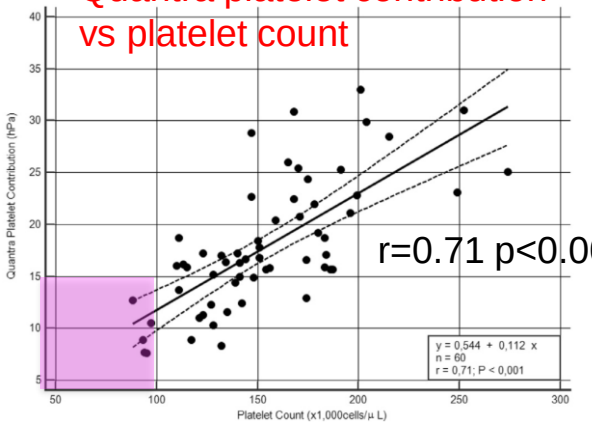
Platelet function using multiplate aggregometry

Baryshnikova E, J Cardiothorac Vasc Anesth. 2019

Similar results with ROTEM:
→ platelet contribution to clot strength

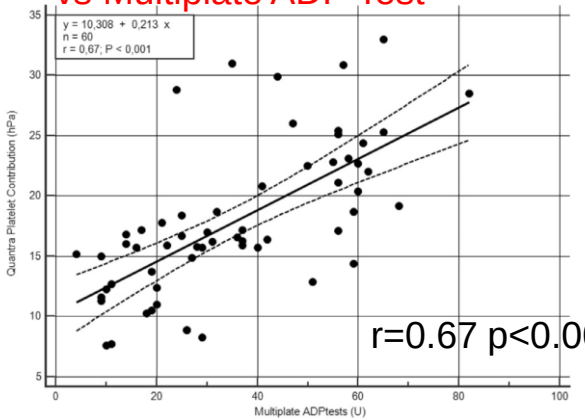
Solomon C. Anesth Analg. 2015 *Ranucci Platelet 2019*

Quantra platelet contribution vs platelet count



r=0.71 p<0.001

Quantra platelet contribution vs Multiplate ADP Test



r=0.67 p<0.001

Use of VET: assessment of platelet dysfunction?

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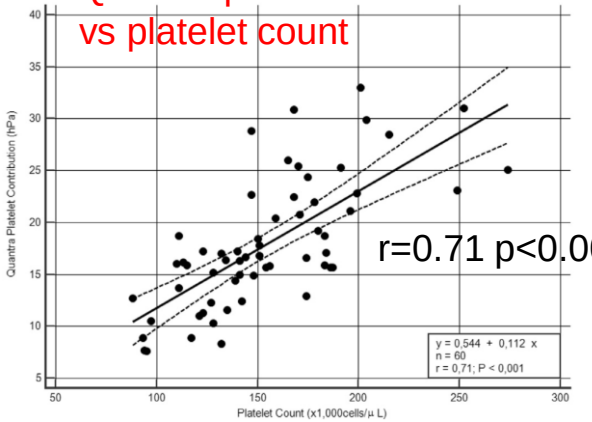


r=0.71 p<0.001

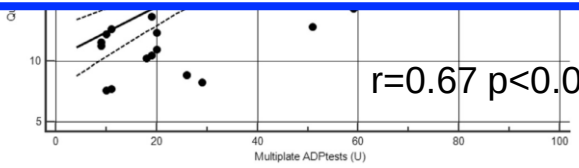
Quantra platelet contribution

→ **VET parameters of platelet contribution: interaction platelet count / function**

Similar results with ROTEM:
→ platelet contribution to clot strength

Solomon C. Anesth Analg. 2015

Ranucci Platelet 2019



r=0.67 p<0.001

Contribution plaquettaire : interprétation?

Multivariable linear regression model
for association between Multiplate tests, platelet count, and Quantra platelet contribution

Independent variables	Coefficient	Std. Error	t	P	r	r^2
Constant	2.0279					
ADP AUC (U)	0.1137	0.03568	3.187	0.0023	0.39	0.152
Platelet count (x1,000 cells/μL)	0.07661	0.01757	4.361	0.0001	0.50	0.250

Contribution plaquettaire du Quantra

15% Fonction plaquettaire (ADP)

25% Numération plaquettaire

60% inconnu

Baryshnikova E,
J Cardiothorac Vasc Anesth. 2019

Are Viscoelastic Tests Clinically Useful to Identify Platelet-Dependent Bleeding in High-Risk Cardiac Surgery Patients?

Anesth Analg 2022

Baryshnikova E, Di Dedda U, Ranucci M

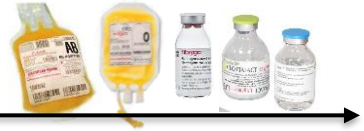
n=45

clopidogrel<7j
prasugrel<7j
ticagrelor< 5j

avant et
après CEC

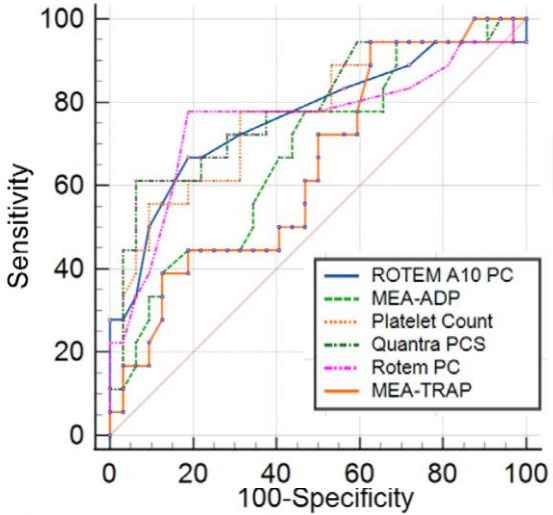
ADP test
TRAP test

PCS
Platelet contribution
to clot stiffness



MCF PC
A10 PC
EXTEM-FIBTEM

hémorragie
majeure
18(36%)

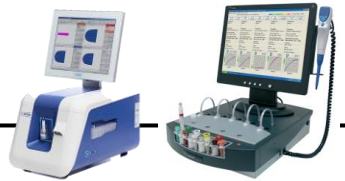


Performance of Post-CPB Platelet Count and PFT in Predicting Major Bleeding

Variable	AUC (95% CI)[a]	*P*[a]	Cutoff	Sensitivity% (95% CI)	Specificity% (95% CI)	PPV% (95% CI)	NPV% (95% CI)
QUANTRA PCS (hPa)	0.80 (0.61–0.99)	.006	13.8	73 (45–92)	70 (51–86)	55 (39–70)	84 (65–92)
Platelet count (×1000/μL)	0.77 (0.55–0.98)	.006	155	80 (52–96)	70 (51–83)	57 (42–71)	87 (71–95)
ROTEM A10 PC (mm)	0.75 (0.51–0.99)	.024	40	67 (38–88)	70 (51–85)	53 (37–68)	81 (66–90)
ROTEM PC (mm)	0.74 (0.50–0.99)	.048	48	73 (45–92)	73 (58–94)	69 (48–84)	86 (73–94)
MEA ADPtest (U)	0.67 (0.42–0.91)	.384	22	67 (38–88)	57 (37–74)	43 (31–57)	77 (61–88)
MEA TRAPtest (U)	0.62 (0.37–0.86)	1.000	88	47 (21–73)	50 (31–69)	32 (20–67)	65 (51–77)

Population that may benefit from VET?

Single-centre, prospective, randomized trial

algorithm based on standard laboratory assays INR, platelet count, fibrinogen, ACT	algorithm based on VET 

Patients undergoing elective cardiac surgery at high risk for perioperative bleeding.
High bleeding risk surgery included a combined CABG/valve procedure, a double or triple valve procedure or a redo surgery

interim analysis

Blood loss and transfusion requirements (RBC FFP) did not differ between groups
Bleeding was less frequent and blood loss was lower than expected:
Chest tube drainage volume <400 ml after 24 h in both group

Bleeding patients

Weber 2012
Karkouti 2016

High Bleeding risk surgery

Endocarditis
Heart Transplant
Acute type A aortic dissection
Surgery with CPB-time >150 min
Redo surgery ?

Lehmann F. BMC Anesthesiology 2019

Assessment of a Quantra-Guided Hemostatic Algorithm in High-Bleeding-Risk Cardiac Surgery

Zlotnik D, Abdallah GA, Lang E, Boucebci KJ, Gautier CH, François A, Gaussem P, Godier A.

JOURNAL OF CARDIOTHORACIC AND VASCULAR ANESTHESIA
2023

HEGP
Hôpital Européen Georges Pompidou

Standard laboratory testing-Guided Haemostatic Algorithm

30 min before weaning from CPB

if « yes »

Anormal bleeding or risk of anormal bleeding according to clinician discretion?	Fresh frozen plasma

After protamin → Laboratory analysis

Diffuse bleeding ?

if « yes »

No	ACT>110% basal ACT ?	2500 UI Protamine
	Fibrinogen<1.5 g/L ?	Fibrinogen concentrates
	Platelet count<50G/L ?	Platelet transfusion
	Ptratio>1.4 ?	Fresh frozen plasma
Yes	ACT>110% basal ACT ?	2500 UI Protamine
	Fibrinogen<2 g/L ?	Fibrinogen concentrates
	Platelet count<100G/L ?	Platelet transfusion
	Ptratio>1.4 ?	Fresh frozen plasma

Treat also hypothermia, hypocalcemia, acidosis, anemia

Quantra-Guided Haemostatic Algorithm

30 min before weaning from CPB → First Quantra analysis

if « yes »

FCS<1,3 hPa ?	Fibrinogen concentrates
PCS<14,1 hPa ?	Platelet transfusion
CTH>186 sec ?	Fresh frozen plasma

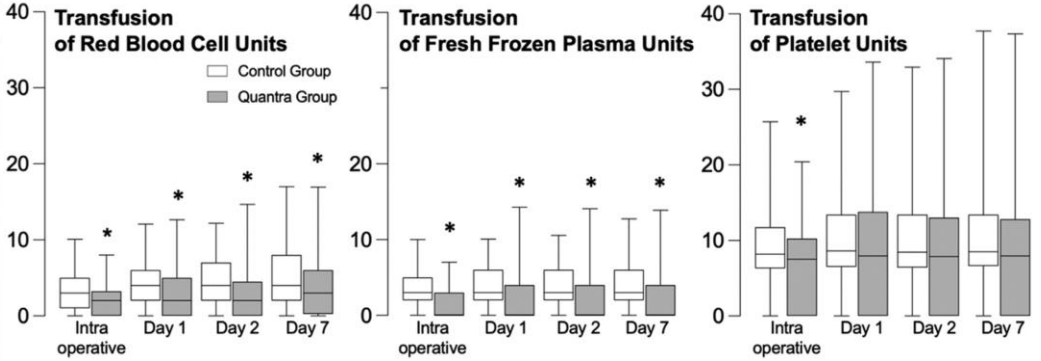
After protamin → Second Quantra analysis

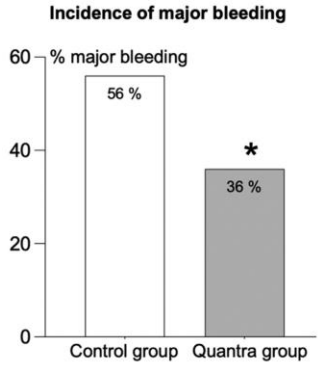
Diffuse bleeding ?

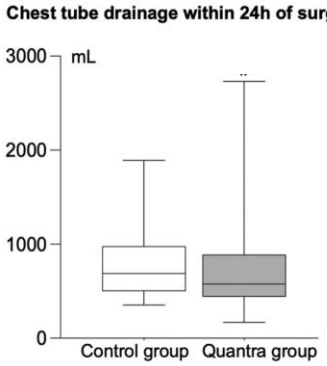
if « yes »

No	CTR >1.4 ?	2500 UI Protamine
	FCS<1.3 hPa ?	Fibrinogen concentrates
	PCS<11.2 hPa ?	Platelet transfusion
	CTH>186 sec ?	Fresh frozen plasma
Yes	CTR >1.4 ?	2500 UI Protamine
	FCS<1.9 hPa ?	Fibrinogen concentrates
	PCS<14.1 hPa ?	Platelet transfusion
	CTH>186 sec ?	Fresh frozen plasma

Treat also hypothermia, hypocalcemia, acidosis, anemia







EACTS
European Association For Cardio-Thoracic Surgery

2017

eacta
European Association of Cardiothoracic Anaesthesiologists

The evidence supports the use of perioperative POC testing in patients having cardiac surgery to reduce transfusion requirements.

NICE National Institute for Health and Care Excellence

2014

Cardiac surgery

The ROTEM system and the TEG system are recommended to help detect, manage and monitor haemostasis during and after cardiac surgery.

ESAIC

2023

Cardiovascular surgery

We suggest the use of point-of-care haemostatic testing over conventional coagulation assays for the management of coagulopathy in cardiac surgery. 2C

Conclusion: role of VET in cardiac surgery

- Strong evidence: use of standardised haemostatic algorithms with pre-defined intervention triggers over clinicians' discretion for the management of coagulopathy.

- Moderate evidence: use of VET over standard laboratory assays for the management of coagulopathy

- More data needed: use of platelet function testing in combination with VET

- Population: Bleeding patients
  Patients facing high bleeding risk surgery