THROMBOELASTOGRAPHIE ET COAGULOPATHIE

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CONFLIT D'INTERET

- **LFB** (2018) : Rédaction Brochure
- **TEM** (2018) : Topo / Consulting

INTRODUCTION

- **Coagulopathie Post Traumatique est fréquente :**
  - 20 – 30 % des Trauma

Rugeri et al. J Thromb Haemost 2007 ; Brohi et al. Curr opin Crit Care 2007

- **On se guide sur une « impression clinique »**
  - Notion de saignement important / FAST
  - Exactitude de « l'impression clinique » : **≈ 50 % … ?**

VoxSanguinis
The International Journal of Transfusion Medicine
ISBT International Society of Blood Transfusion
Vox Sanguinis (2017)
ORIGINAL PAPER
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DOI: 10.1111/vox.12545

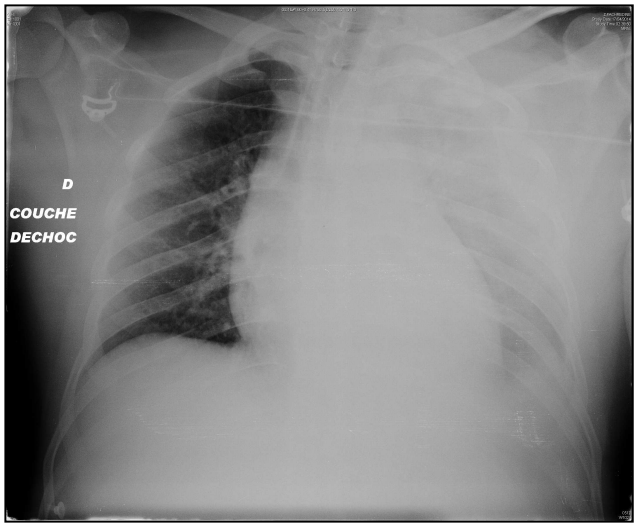
Prehospital parameters can help to predict coagulopathy and massive transfusion in trauma patients

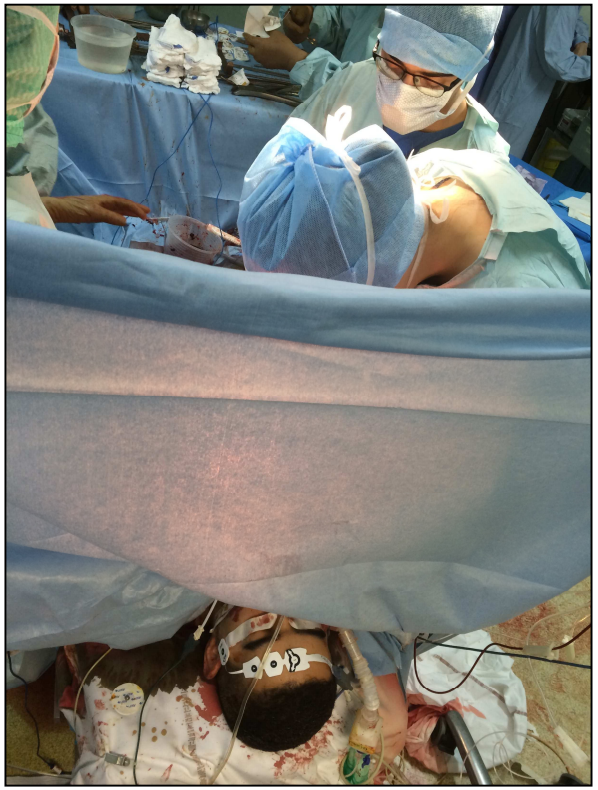
J.-S. David,[1,2] E.-J. Voiglio,[2,3] E. Cesareo,[4,5] O. Vassal,[1,2] E. Decullier,[6,7] P.-Y. Gueugniaud,[4,5] S. Peyrefitte[8] & K. Tazarourte[4,5]

	N	Threshold
Trauma-induced coagulopathy		
★ Shock index	444	>0·90
GCS	477	<8
MGAP	476	<18
ROC Criteria	476	*Present*
★ Injury severity score	485	>34
★ Noradrenaline	484	*Present*
★ Fluids (ml)	472	>1000

Y a t'il une coagulopathie ?

- Plaie Arme Blanche Parasternale
- Adm : PAS < 75 mmHg / Fc 100
- T+15 min : 1ière AC puis 2ème
- Posé en AC sur Table Opératoire
- Sternotomie de Sauvetage
- Plaie Tronc AP : Suture en quasi AC

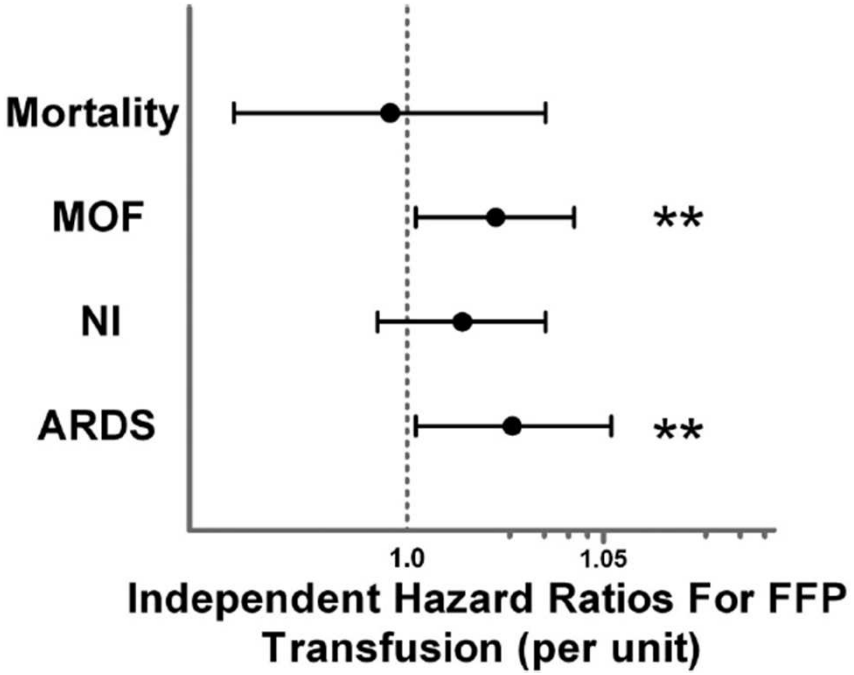


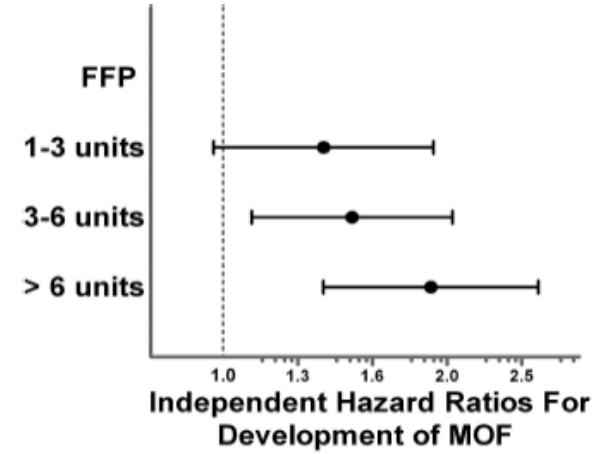


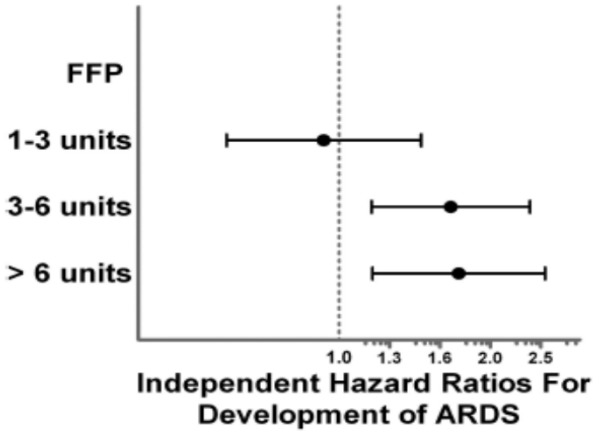
Adm	02h33		03h40	
TP	59		36	
Fib	2		1,6	
Hgb	125		94	
Ac L	12		11	
ROTEM	+		+	
Fibrinogène		3		1,5
CGR		2		
TXA		1		1

Fresh Frozen Plasma Is Independently Associated With a Higher Risk of Multiple Organ Failure and Acute Respiratory Distress Syndrome

Gregory A. Watson, MD, Jason L. Sperry, MD, MPH, Matthew R. Rosengart, MD, MPH, Joseph P. Minei, MD, Brian G. Harbrecht, MD, Ernest E. Moore, MD, Joseph Cuschieri, MD, Ronald V. Maier, MD, Timothy R. Billiar, MD, and Andrew B. Peitzman, MD, The Inflammation and the Host Response to Injury Investigators





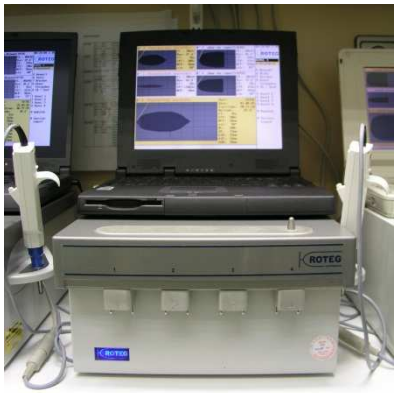


Each unit of FFP was independently associated with a 2.1% higher risk of MOF and a 2.5% higher risk of ARDS.

COMMENT FAIRE MIEUX ?

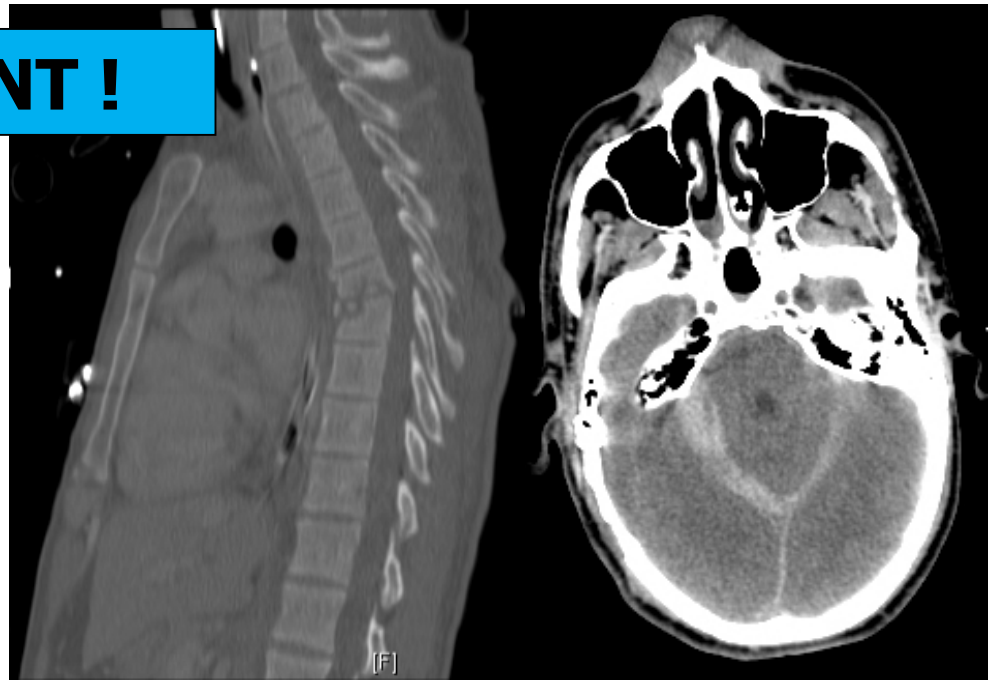
- **BIOLOGIE DÉLOCALISÉE !**
  - Au lit du patient
  - Utilisation simple / fiable
  - Avec les biologistes ++++

- **Détermination Rapide de l'INR**
- **Thromboélastométrie / Thrombélastographie**



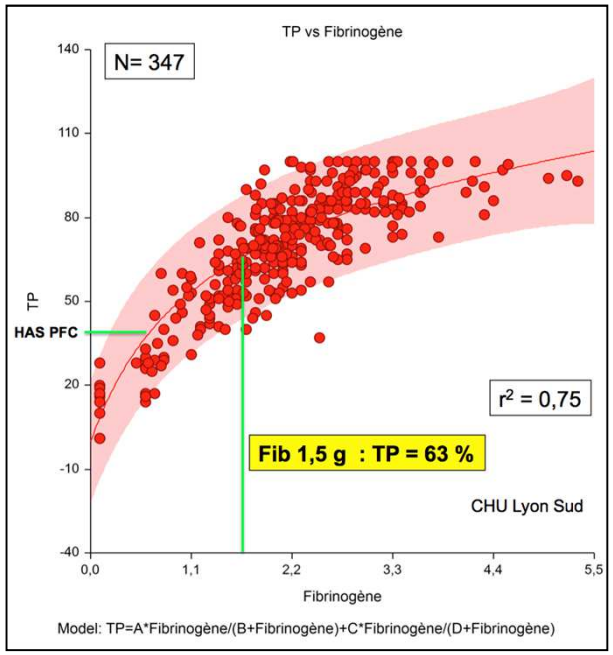
TQr/INR PAS SUFFISANT !

Grade A – 25 ans
Acc Quad – GCS 3
HSA Majeur – Oedème Cérébral
Fr Dorsale x (D4 ++)



	Admission
HemoCue	144
INRc	1,2
A5 Extem	36
A5 FibTem	5
INR	1,31
Fibr	1,4
Hgb	142
PLT	310

Clotta 1,5 g



BIOLOGIE STANDARD

British Journal of Anaesthesia **114** (2): 217–24 (2015)
Advance Access publication 8 September 2014 · doi:10.1093/bja/aeu303

BJA

Usefulness of standard plasma coagulation tests in the management of perioperative coagulopathic bleeding: is there any evidence?

T. Haas[1*], D. Fries[2], K. A. Tanaka[3], L. Asmis[4], N. S. Curry[5] and H. Schöchl[6,7]

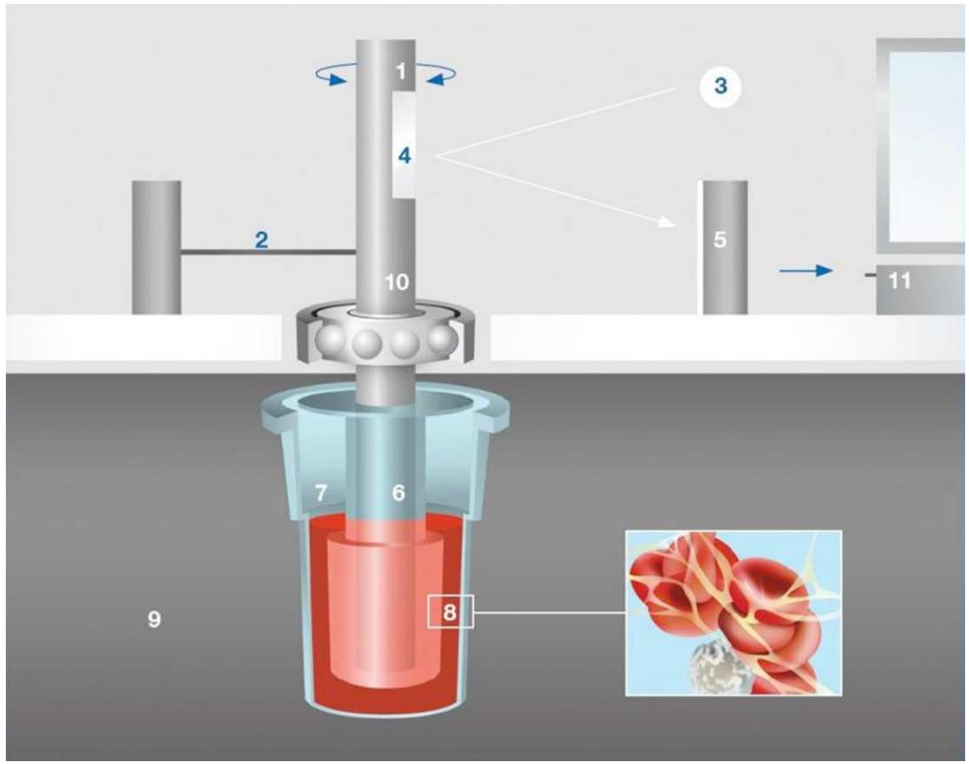
it seems questionable how long physicians are willing to continue using (late) results of SLTs as marker of coagulopathy or guidance for bleeding management. But as always, old and even bad habits die hard.

Based on the data of the present review, there is no high-quality evidence to support that the traditionally applied trigger levels of ≥1.5-fold prolongation of aPTT/PT or INR are of great help to diagnose whether a patient suffers

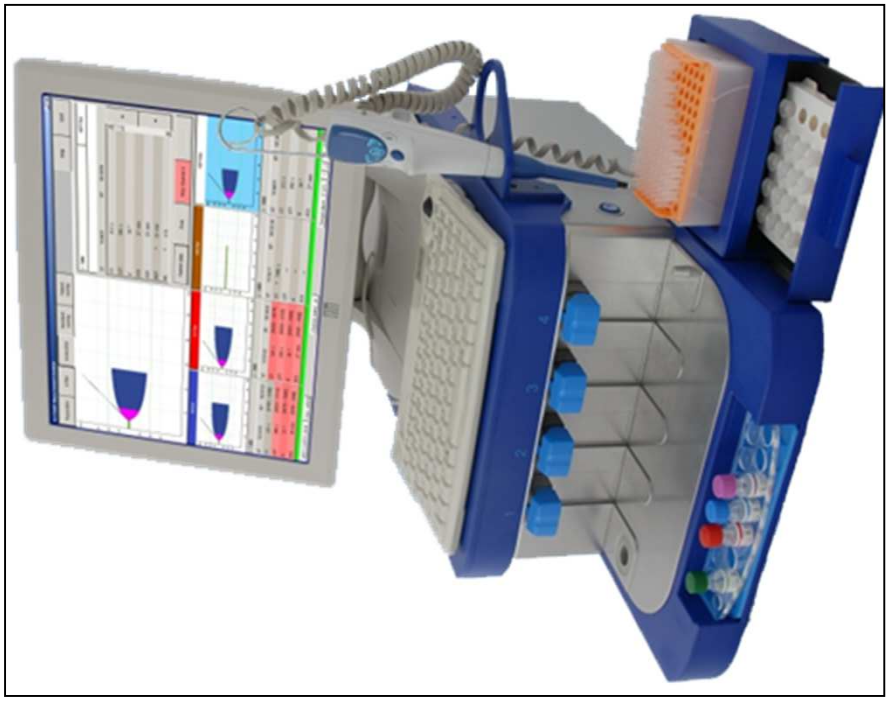
TP = Concentration de facteurs … Quid de l'agrégation plaquettaire ? Inflammation ?

TECHNIQUES VISCO-ELASTIQUES

- **Sang Natif ou Citraté**



- **Inventé en 1948**
- **Ajout d'activateur**
- **ROTEM :** 4 activateurs
  - INTEM : Ac Ellagic (TCA)
  - **EXTEM** : Fact Tissulaire (TP)
  - **FIBTEM** : CytoChal. D (FIB)
  - APTEM : Aprotinine (F.LYSE)
  - HEPTEM : INTEM + Héparinase
- **TEG :** 2 activateurs !
  - Kaolin (test classique)
  - **rTEG (FT)**
  - **Fibrinogène Fonctionnel**

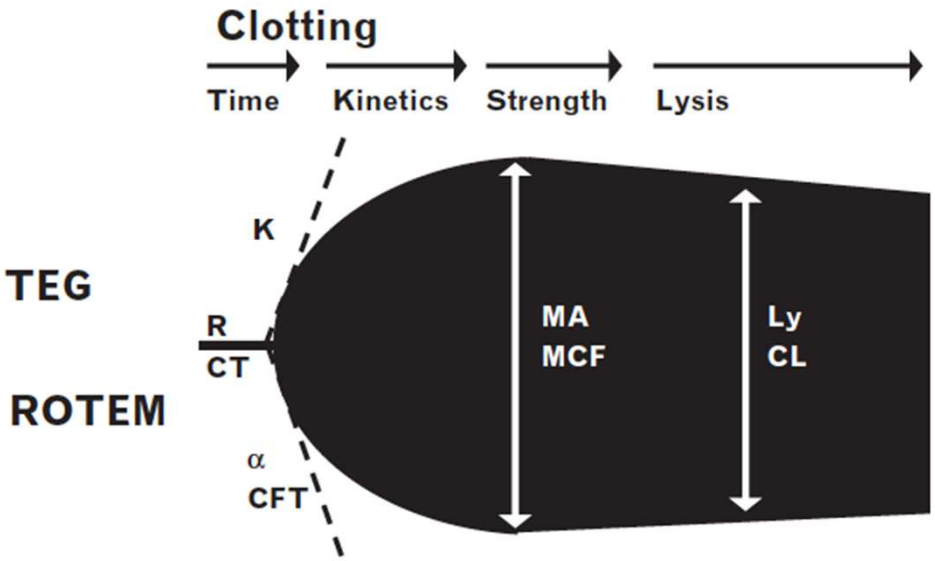


bjh review

The place of viscoelastic testing in clinical practice

Gregory A. Hans[1] and Martin W. Besser[2]

[1]Department of Anaesthesia and Intensive Care Medicine, CHU of Liege, Liege, Belgium and [2]Department of Haematology, Addenbrooke's Hospital, Cambridge, UK

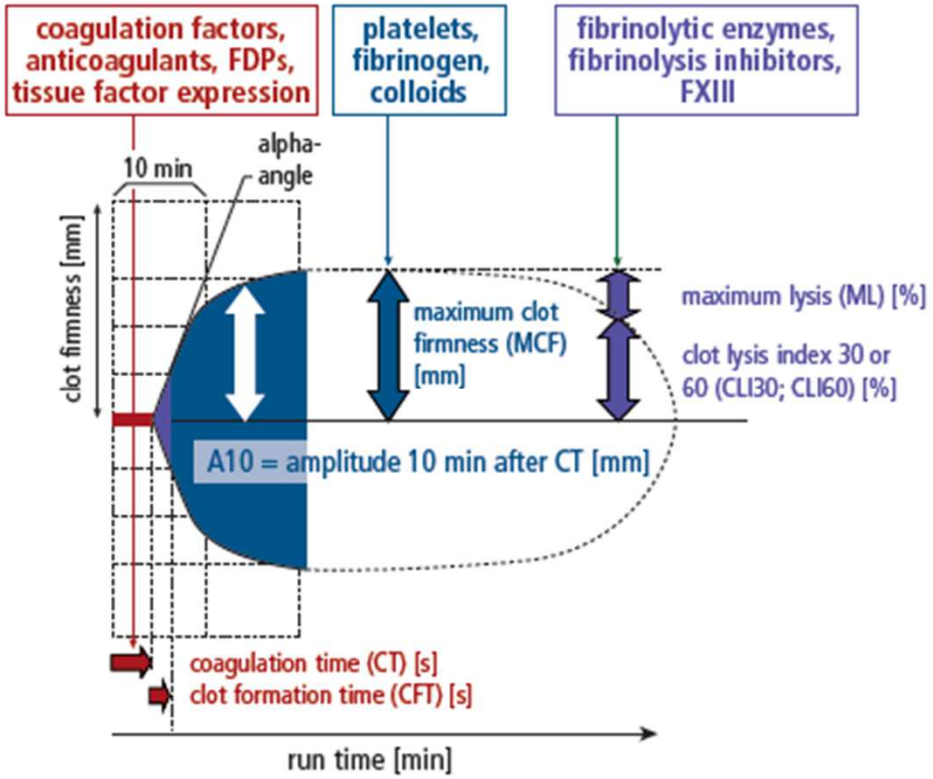


Thromboelastometry guided therapy of severe bleeding

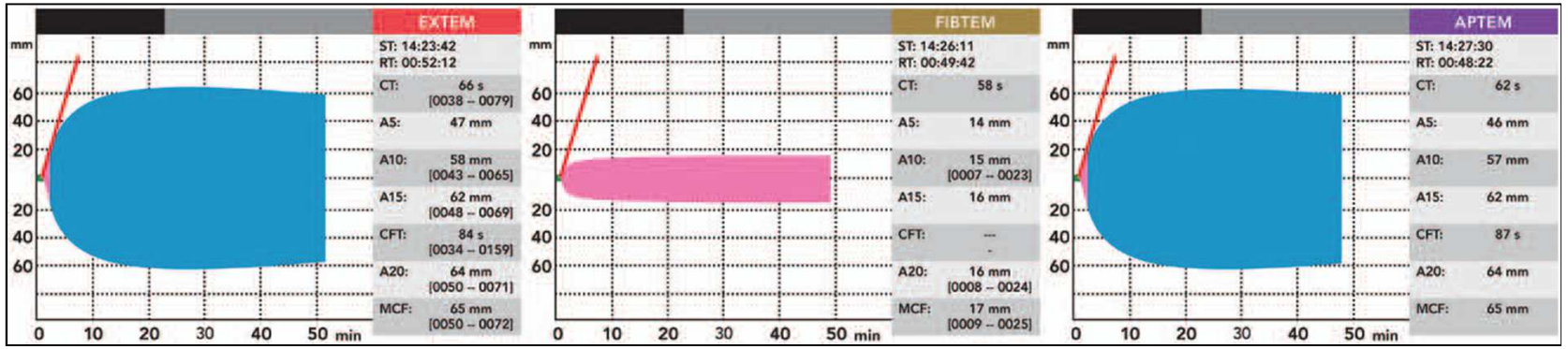
Essener Runde algorithm

H. Lier[1]; M. Vorweg[2]; A. Hanke[3]; K. Görlinger[4]

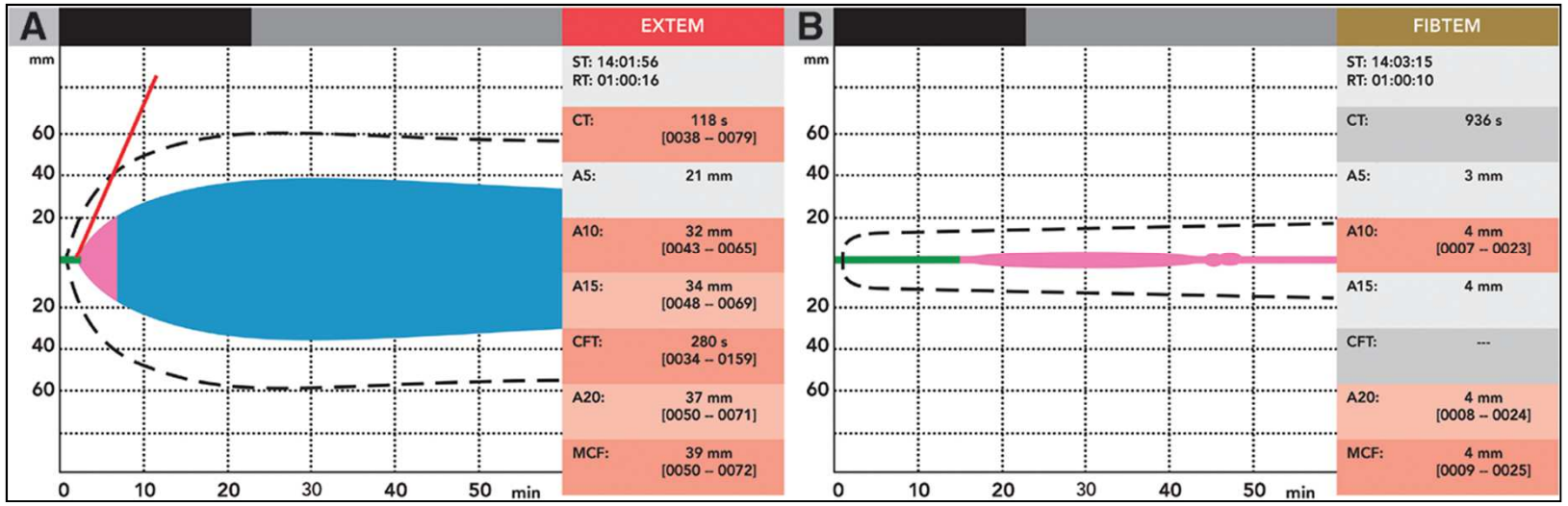
[1]Department of Anaesthesiology and Intensive Care Medicine, University Hospital Cologne, Germany; [2]Administrative Department OP-Management, Cologne City Hospitals, University of Witten / Herdecke, Cologne, Germany; [3]Department of Anaesthesiology and Intensive Care Medicine, Hannover Medical School, Hannover, Germany; [4]Tem International GmbH, Munich, Germany



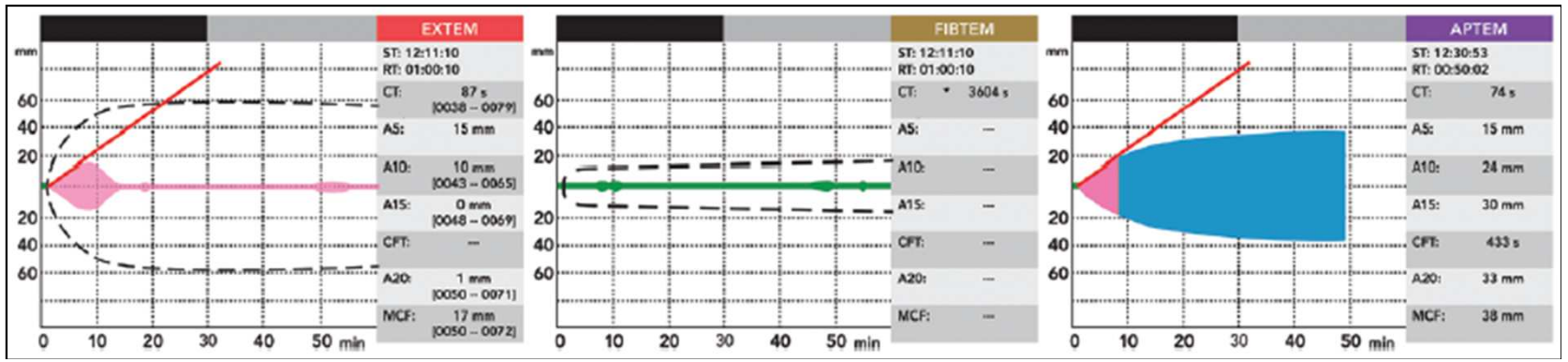
NORMAL



TIC



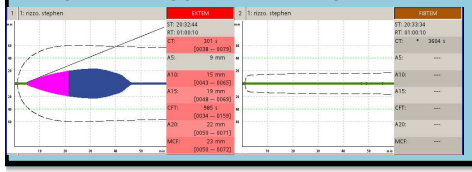
HF



ALGORITHME ROTEM CHOC HEMORRAGIQUE LYON SUD

Cibles Physiologique : Temp > 36°c pH > 7.2 Hgb > 70 g/L Ca ionisé > 1 mmol/L

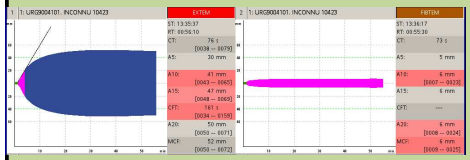
Etape 1 r Hyperfib inolyse ?



MCF EXTEM < 18 mm
CT FIB > 500 s

TXA : 1 g
PFC : 20 ml/Kg
Clottafact : 50 mg/kg

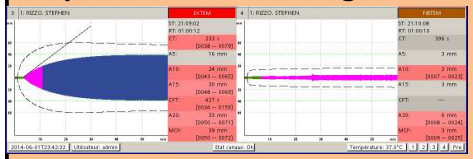
Etape 2 : Déficit isolé Fibrinogène ?



FIBTEM A5 < 7 mm
CT EXTEM < 106 s

A5 FIBTEM - Clottafact
5-6 mm : 25 mg/kg
3-4 mm : 50 mg/kg
≤ 2 mm : 75 mg/kg

Etape 3 : Déficit Fibrinogène et Facteurs ?

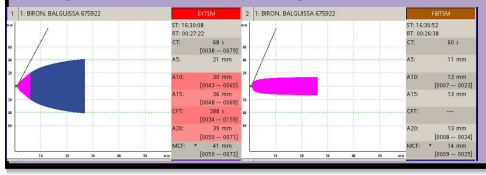


FIBTEM A5 < 7 mm
CT EXTEM > 106 s

A5 FIBTEM :
Clottafact selon A5 Fib

CT EXTEM :
107-135s : PFC 10 ml/kg
136-200s : PFC 20ml/kg
> 200s : PFC 30 ml/kg

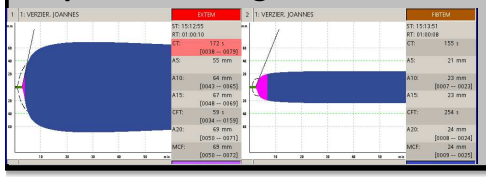
Etape 4 : Déficit Plaquette ?



FIBTEM A5 > 7 mm
CT EXTEM < 80 s
A5 EXTEM < 23 mm

Concentrés Plaquette selon poids

Etape 5 : Anticoagulant ?



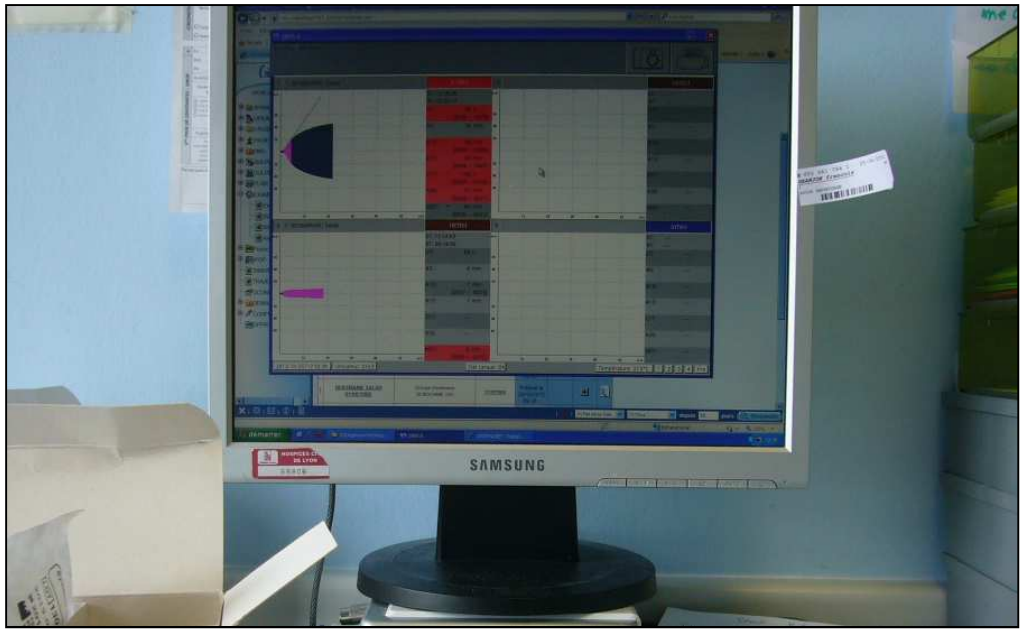
CT EXTEM Allongé

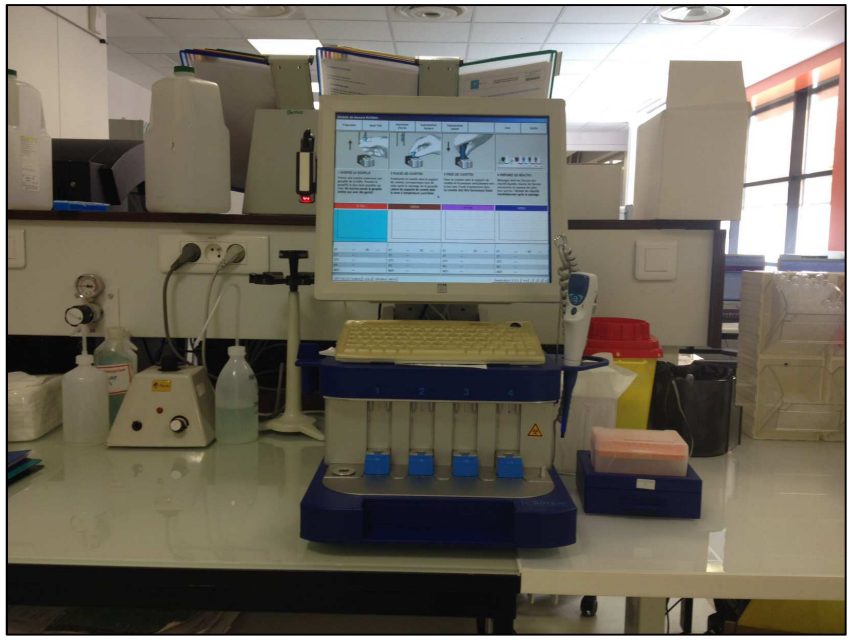
CCP selon Poids

Etape 6 : Cibles

FIBTEM A5 ≥ 7 mm – CT EXTEM < 106 s – A5 EXTEM ≥ 23 mm

RÉPÉTER ROTEM APRÈS CHAQUE ADMINISTRATION PSL

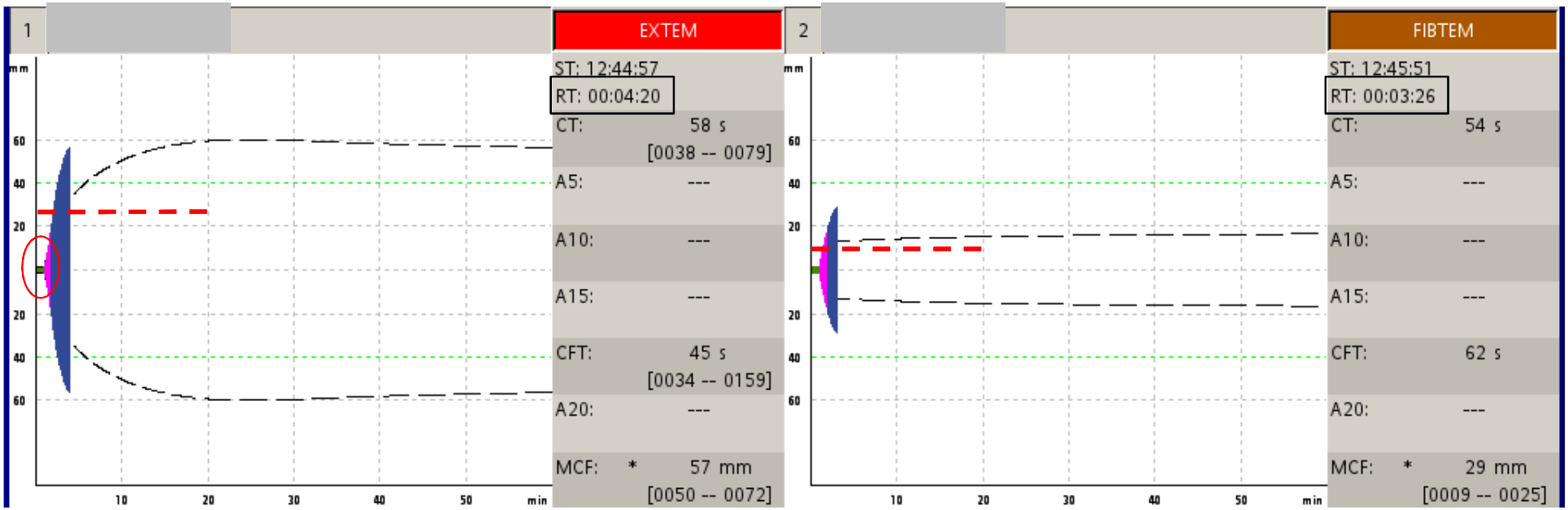


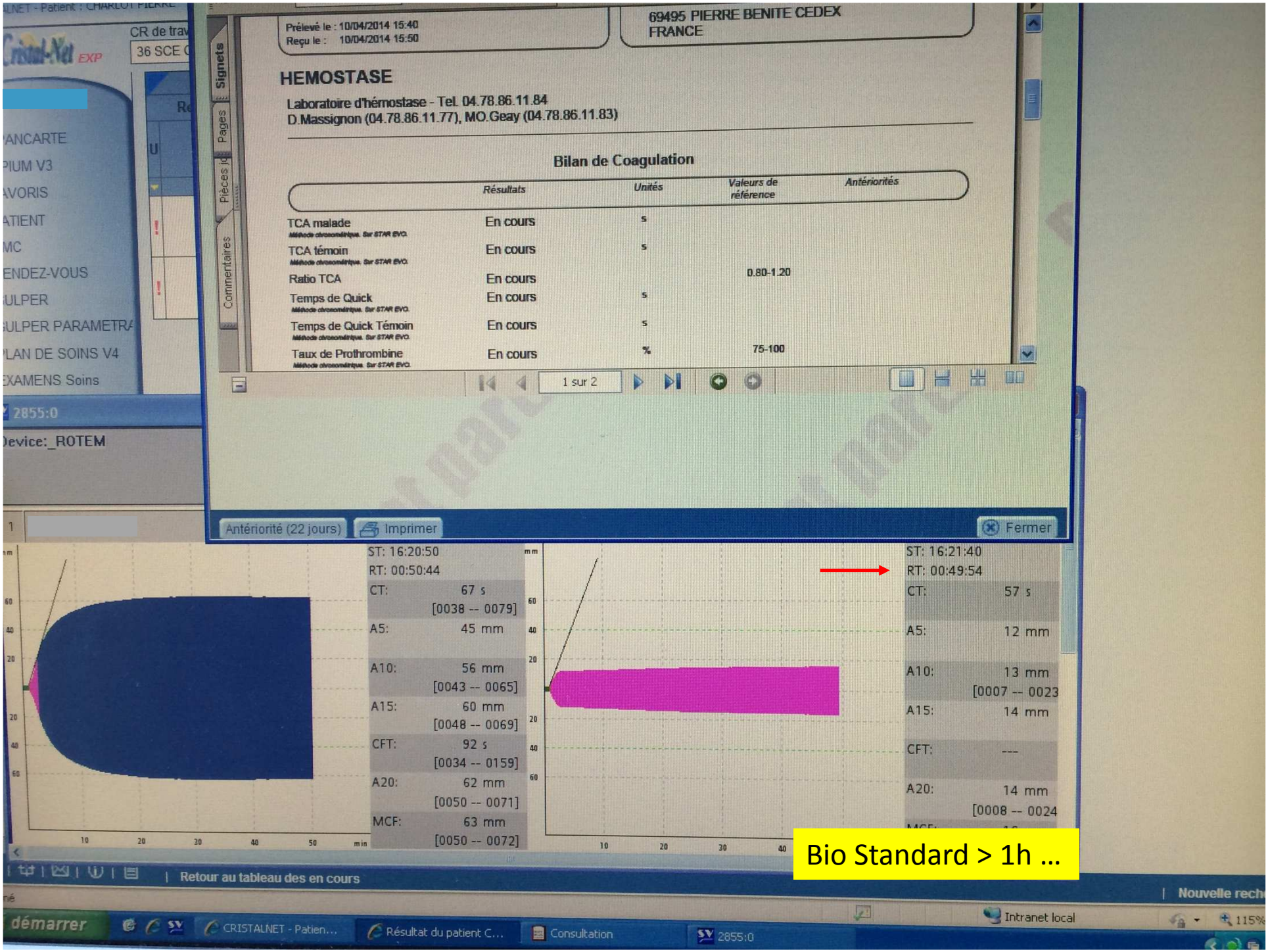


Lyon : Prélèvement au Déchocage puis Tube Citraté au Labo
Tube Pneumatique (Pas de modification Amplitude !)

COLLABORATION +++ AVEC BIOLOGISTE

DECISION ULTRA-PRECOCE
Sur CT / MCF : < 5 minutes !!

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Reçu le : 10/04/2014 15:50
69495 PIERRE BENITE CEDEX
FRANCE
HEMOSTASE
Laboratoire d'hémostase - Tel. 04.78.86.11.84
D.Massignon (04.78.86.11.77), MO.Geay (04.78.86.11.83)
Bilan de Coagulation
Résultats
Unités
Valeurs de référence
Antériorités
TCA malade En cours s
TCA témoin En cours s
Ratio TCA En cours 0.80-1.20
Temps de Quick En cours s
Temps de Quick Témoin En cours s
Taux de Prothrombine En cours % 75-100
1 sur 2
Antériorité (22 jours)
Imprimer
Fermer
ST: 16:20:50
RT: 00:50:44
CT: 67 s [0038 -- 0079]
A5: 45 mm
A10: 56 mm [0043 -- 0065]
A15: 60 mm [0048 -- 0069]
CFT: 92 s [0034 -- 0159]
A20: 62 mm [0050 -- 0071]
MCF: 63 mm [0050 -- 0072]
ST: 16:21:40
RT: 00:49:54
CT: 57 s
A5: 12 mm
A10: 13 mm [0007 -- 0023
A15: 14 mm
CFT: ---
A20: 14 mm [0008 -- 0024
Bio Standard > 1h ...
Retour au tableau des en cours
démarrer
CRISTALNET - Patien...
Résultat du patient C...
Consultation
2855:0
Intranet local

ADMISSION

Journal of Thrombosis and Haemostasis, 5: 289–295

ORIGINAL ARTICLE

Diagnosis of early coagulation abnormalities in trauma patients by rotation thrombelastography

L. RUGERI,* A. LEVRAT,† J. S. DAVID,† E. DELECROIX,* B. FLOCCARD,† A. GROS,† B. ALLAOUCHICHE† and C. NEGRIER*

*Laboratory of Haemostasis; and †Department of Anaesthesia, Intensive Care and EMS, Edouard Herriot Hospital, Hospices Civils de Lyon and Claude Bernard University, Lyon, France

To cite this article: Rugeri L, Levrat A, David JS, Delecroix E, Floccard B, Gros A, Allaouchiche B, Negrier C. Diagnosis of early coagulation abnormalities in trauma patients by rotation thrombelastography. *J Thromb Haemost* 2007; 5: 289–95.

Summary. *Background:* Reagent-supported thromboelastometry with the rotation thrombelastography (e.g. ROTEM®) is a whole blood assay that evaluates the visco-elastic properties during blood clot formation and clot lysis. A hemostatic monitor capable of rapid and accurate detection of clinical coagulopathy within the resuscitation room could improve management of bleeding after trauma. *Objectives:* The goals of this study were to establish whether ROTEM correlated with standard coagulation parameters to rapidly detect bleeding disorders and whether it can help to guide transfusion. *Methods:* Ninety trauma patients were included in the study. At admission, standard coagulation assays were performed and ROTEM parameters such as clot formation time (CFT) and clot amplitude (CA) were obtained at 15 min (CA_{15}) with two activated tests (INTEM, EXTEM) and at 10 min (CA_{10}) with a test analyzing specifically the fibrin component of coagulation (FIBTEM). *Results:* Trauma induced significant modifications of coagulation as assessed by standard assays and ROTEM. A significant correlation was found between prothrombin time (PT) and CA_{15}-EXTEM ($r = 0.66$, $P < 0.0001$), between activated partial thromboplastin time and CFT-INTEM ($r = 0.91$, $P < 0.0001$), between fibrinogen level and CA_{10}-FIBTEM ($r = 0.85$, $P < 0.0001$), and between platelet count and CA_{15}-INTEM ($r = 0.57$, $P < 0.0001$). A cutoff value of CA_{15}-

Keywords: coagulopathy, fibrinolysis, ROTEM, thromboelastometry, trauma patients.

Introduction

Trauma is a serious global health problem, accounting for approximately 10% of deaths worldwide [1]. Massive hemorrhage is one of the leading causes of death and despite improvement in trauma care it is still responsible for approximately 40% of trauma deaths [2]. Coagulopathy, which is encountered in 25–30% of trauma patients, is associated with a worse outcome [3,4], and constitutes one of the components of the classic lethal triad with hypothermia and metabolic acidosis [5,6]. Coagulopathy-related diffuse bleeding is complex and extremely difficult to manage. The multifactorial nature of post-traumatic coagulopathy involves consumption and dilution of clotting factors, dysfunction of platelets and the coagulation system, increased fibrinolytic activity, hypothermia, and metabolic acidosis [1]. Diagnosis of coagulopathy can be made clinically but coagulation monitoring is essential to directed care. Thrombelastography is a whole blood coagulation technique providing information on the initiation of coagulation, propagation kinetics, fibrin–platelet interaction, clot firmness and fibrinolysis [7,8].

Recently, the modified rotation thrombelastogram analyzer

Table 3 Correlation (r) between ROTEM® and standard coagulation

	Prothrombin time	Activated partial thromboplastin time	Fibrinogen	Platelets
EXTEM				
CT	0.53*	(–)	0.40*	(–)
CFT	0.62*	(–)	(–)	0.33*
CA_{15}	**0.66***	(–)	0.69*	0.56*
INTEM				
CT	(–)	0.47*	(–)	(–)
CFT	(–)	**0.91***	(–)	0.32*
CA_{15}	(–)	0.70*	0.66*	**0.57***
FIBTEM				
CA_{10}	(–)	(–)	**0.85***	(–)

Trauma :

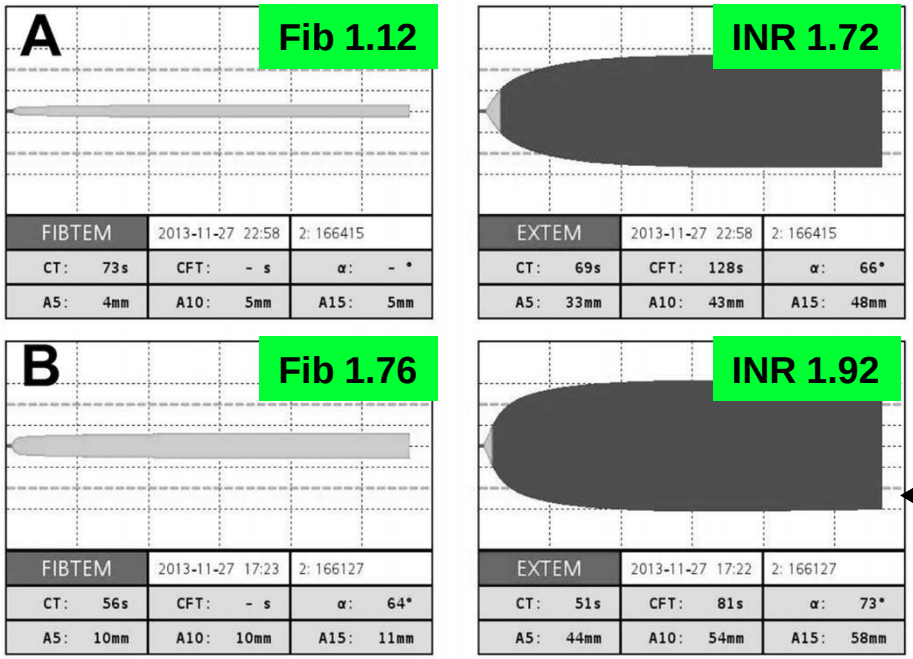
Tauber et al. BJA 2011

Hagemo JS et al. Crit Care 2015

Transfusion values	ROTEM® Cutoff values	Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	AUC
Prothrombin time > 1.5 of control value	CA_{15}-EXTEM = 32 mm	87 (72–87)	100 (99–100)	100 (83–100)	99 (98–99)	0.98
APTT > 1.5 of control value	CFT-INTEM = 112 s	100 (84–100)	74 (73–74)	23 (19–23)	100 (98–100)	0.94
Fibrinogen < 1 g L^{-1}	CA_{10}-FIBTEM = 5 mm	91 (72–93)	85 (84–86)	55 (45–60)	99 (97–100)	0.96
Platelets < 50×10^9 L^{-1}	CA_{15}-INTEM = 46 mm	100 (71–100)	83 (82–83)	17 (12–17)	100 (98–100)	0.92

Corrélation Bio/ROTEM Peut Etre Modifiée

- Anémie
- Fibrinogène bas
- Acidose sévère
- Administration PSL :

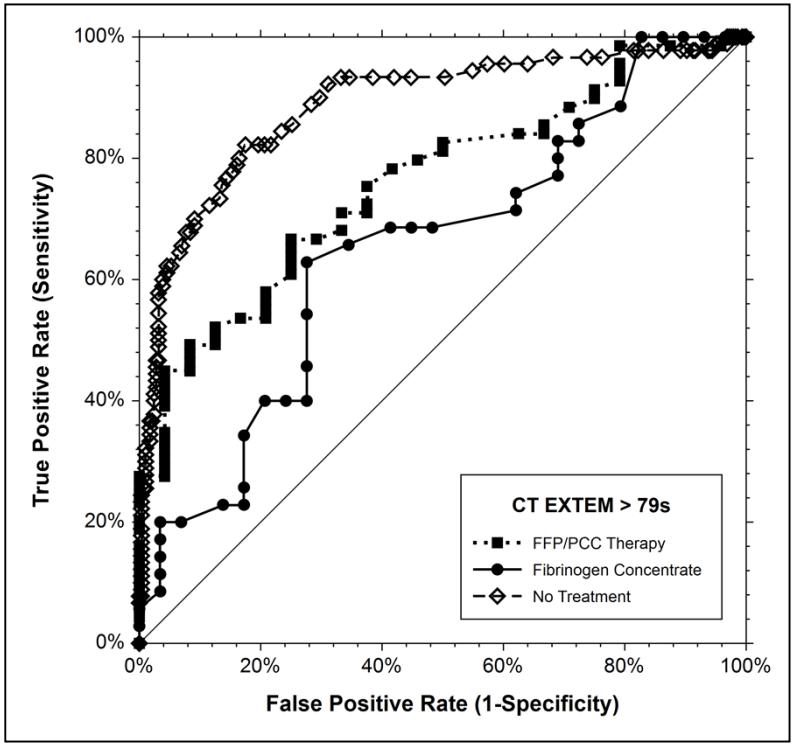


Après 3g Clottafact

ORIGINAL ARTICLE

Correlation between laboratory coagulation testing and thromboelastometry is modified during management of trauma patients

Jean-Stéphane David, MD, PhD, Maeva Durand, MD, Albrice Levrat, MD, Mathilde Lefevre, MD, Lucia Rugeri, MD, Marie-Odile Geay-Baillat, MD, Kenji Inaba, MD, MSc, *and* Pierre Bouzat, MD, PhD, *Lyon, France*



J Trauma 2016

FAUT CHOISIR !!

ÉCONOMIE DE PSL ?

- Chirurgie Cardiovasculaire Complexe (Redux)
- 152 Patients
- Etude Prospective Randomisée
- ROTEM / Agrégométrie / Multiplate
- Critère 1aire : Incidence Transfusion CGR

- **Résultats :**
  - **CGR** : 98 vs. 84%, p<0,05
  - **PFC** : 80 vs. 40%, p<0,05
  - **Plaquette** : 66 vs. 56%, p<0,05
  - Fibrinogène : 60 vs. 64%, NS
  - rFVIIa : 24 vs. 2%, p<0,05
  - Temps de Ventil : 827 vs. 316 min, p<0,05
  - ICU LOS : 24 vs. 21 jours, p<0,05

Point-of-Care Testing

A Prospective, Randomized Clinical Trial of Efficacy in Coagulopathic Cardiac Surgery Patients

Christian Friedrich Weber, Dr. med.,* Klaus Görlinger, Dr. med.,† Dirk Meininger, P.D. Dr. med.,‡ Eva Herrmann, Prof. Dr. rer. nat.,§ Tobias Bingold, Dr. med.,‡ Anton Moritz, Prof. Dr. med.,‖ Lawrence H. Cohn, M.D., Ph.D.,# Kai Zacharowski, Prof. Dr. med., Ph.D., F.R.C.A.**

ABSTRACT

What We Already Know about This Topic

- Cardiac surgical patients experience rapid changes in coagulation status

Table 6. Cumulative Costs of Transfused Allogenic Blood Products, Hemostatic Therapy (Including Coagulation Factor Concentrates), and Costs of Performed POC Analyses

	Conventional Group	POC Group
Allogenic blood products	—	—
Packed erythrocytes [72 €/U]	18,648	13,176
FFP [0.162 €/g]	13,530	4,665
PC [231 €/U]	28,755	15,123
Other hemostatic therapy	—	—
Desmopressin [3.3 €/μg]	3,128	3,412
Fibrinogen [233 €/g]	35,882	27,727
PCC [114 €/600 IU]	10,944	6,726
rVIIa [2,784 €/240 kIU]	44,544	5,568
Total blood products and hemostatic therapy	155,431	76,397
Expendable materials	—	—
POC Diagnostics		
ROTEM®	—	4,093
Multiplate®	—	2,427
Cumulative [€]	155,431	82,918
Mean costs per patient [€]	3,109	1,658

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Original Article

Change of transfusion and treatment paradigm in major trauma patients

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Summary

Trauma promotes trauma-induced coagulopathy, which requires urgent treatment with fixed-ratio transfusions of red blood cells, fresh frozen plasma and platelet concentrates, or goal-directed administration of coagulation factors based on viscoelastic testing. This retrospective observational study compared two time periods before (2005–2007) and after (2012–2014) the implementation of changes in trauma management protocols which directed coagulation management; admission of patients to designated trauma centres; whole-raphy scanning on admission; damage control surgery; permissive hypotension; restrictive administration of tranexamic acid. The incidence of massive transfusion (≥ 10 units of red gency department arrival until intensive care unit admission) was compared with the predict to the trauma associated severe haemorrhage score. All adult (≥ 16 years) trauma patients pr University Hospital Zürich with an injury severity score ≥ 16 were included. In 2005–2 trauma associated severe haemorrhage score that predicted the incidence of massive tran whereas in 2012–2014 the observed incidence was less than half that predicted (3.7% vs. 7.5% 2007, the proportion of patients transfused with red blood cells and fresh frozen plasma wa 2012–2014 in both the emergency department (43% vs. 17%; 31% vs. 6%, respectively), and a 37% vs. 16%, respectively). The use of tranexamic acid and coagulation factor XIII also incre 2012–2014 time period. Implementation of a revised trauma management strategy, which coagulation management, was associated with a reduced incidence of massive transfusion transfusion of red blood cells and fresh frozen plasma.

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Introduction

Trauma is a leading cause of death worldwide [1, 2]. Severe trauma frequently results in trauma-induced coagulopathy [3], which may increase mortality four-fold [4] and therefore requires This treatment may consist of administration of red blood cells (RBC), fresh frozen plasma (FFP) and platelet concentrates at a fixed-ratio [6], or administration of

ÉCONOMIE DE PSL ?

Table 2 Raw and adjusted differences in transfusion of allogeneic blood products and outcome between the two cohorts (2005–2007 and 2012–2014). Values are number (proportion), mean (SD) and odds ratio (95%CI).

	2005–2007 n = 323	2012–2014 n = 408	Raw OR (95%CI)	p value	Adjusted OR (95%CI)	p value
Massive transfusion	40 (12%)	15 (4%)	0.27 (0.15–0.50)	< 0.001	0.16 (0.06–0.42)	< 0.001
RBC in ED	138 (43%)	70 (17%)	0.28 (0.20–0.39)	< 0.001	0.23 (0.14–0.40)	< 0.001
RBC in first 24 h	170 (53%)	110 (27%)	0.33 (0.24–0.45)	< 0.001	0.27 (0.18–0.48)	< 0.001
FFP in ED	99 (31%)	24 (6%)	0.14 (0.09-0.23)	< 0.001	0.11 (0.05–0.21)	< 0.001
FFP in first 24 h	119 (37%)	67 (16%)	0.34 (0.24–0.48)	< 0.001	0.29 (0.17–0.49)	< 0.001
Platelets in ED	35 (11%)	37 (9%)	0.82 (0.50–1.34)	0.43	0.75 (0.38–1.46)	0.39
Platelets in first 24 h	55 (17%)	66 (16%)	0.94 (0.64–1.40)	0.76	0.62 (0.49–1.54)	0.62
Mortality (overall)	107 (33%)	88 (22%)	0.55 (0.39–0.76)	< 0.001	0.38 (0.22–0.65)	< 0.001
Mortality (at 24 h)	55 (17%)	40 (10%)	0.53 (0.34–0.82)	0.004	0.23 (0.01–0.54)	0.001
Hospital stay; days	18.0 (20.2)	15.4 (15.4)		0.12		
ICU stay; days	10.2 (11.3)	7.1 (10.1)		< 0.001		
Ventilator support; days	7.2 (9.2)	3.2 (6.2)		< 0.001		

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CRITICAL CARE

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RESEARCH Open Access

Trauma-induced coagulopathy: impact of the early coagulation support protocol on blood product consumption, mortality and costs

Giuseppe Nardi[1*], Vanessa Agostini[2], Beatrice Rondinelli[3], Emanuele Russo[4], Barbara Bastianini[1], Giovanni Bini[4], Simona Bulgarelli[2], Emiliano Cingolani[1], Alessia Donato[5], Giorgio Gambale[4] and Giulia Ranaldi[1]

Table 3 Impact of introduction of early coagulation support protocol on consumption of blood components[a]

			2011	2013	Missing	*P*-value
Patients with ISS >15 and ≥3 U of PRBC			130	96		
Blood components transfused within 24 hr						
	PRBC (U)	Mean (SD)	8.09 (6.7)	6.5 (4.8)	–	0.149
		Median (IQR)	5 (6.0)	4 (5.5)		
	PTL (U)	Mean (SD)	4.18 (5.9)	2.68 (4.75)	–	0.046
		Median (IQR)	0 (6)	0 (6)		
	Plasma (U)	Mean (SD)	8.97 (9.47)	4.21 (4.61)	–	<0.001
		Median (IQR)	6 (8)	4 (6)		
Outcome						
	Dead within 24 hr	n (%)	8 (6.15%)	3 (3.12%)	–	0.361
	Hospital mortality	n (%)	26 (20.0%)	13 (13.5%)	–	0.218

[a]IQR, Interquartile range; ISS, Injury Severity Score; PRBC, Packed red blood cells; PTL, Platelets; SD, Standard deviation.

Table 5 Estimated cost for blood, blood components, factors and point-of-care tests over the two periods (2011 versus 2013)

		Estimated cost for 1 U	2011		2013	
			Units (N)	Overall	Units (N)	Overall
PRBC		€186	1,048	€194,928	625	€116,250
Plasma		€60	1,167	€70,020	405	€24,300
PTL		€115	538	€61,870	258	€29,670
	Overall			€326,818		€170,220
	Balance					−€156,598
Fibrinogen		€400 (1 g)	0	0	134 g	€53,600
POC tests			0	0		€26,663
Overall			0	0		+€80,263
	Balance					−€76,335

[a]POC, Point of care; PRBC, Packed red blood cells; PTL, Platelets.

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Original Article

Effects of modification of trauma bleeding management: A before and after study

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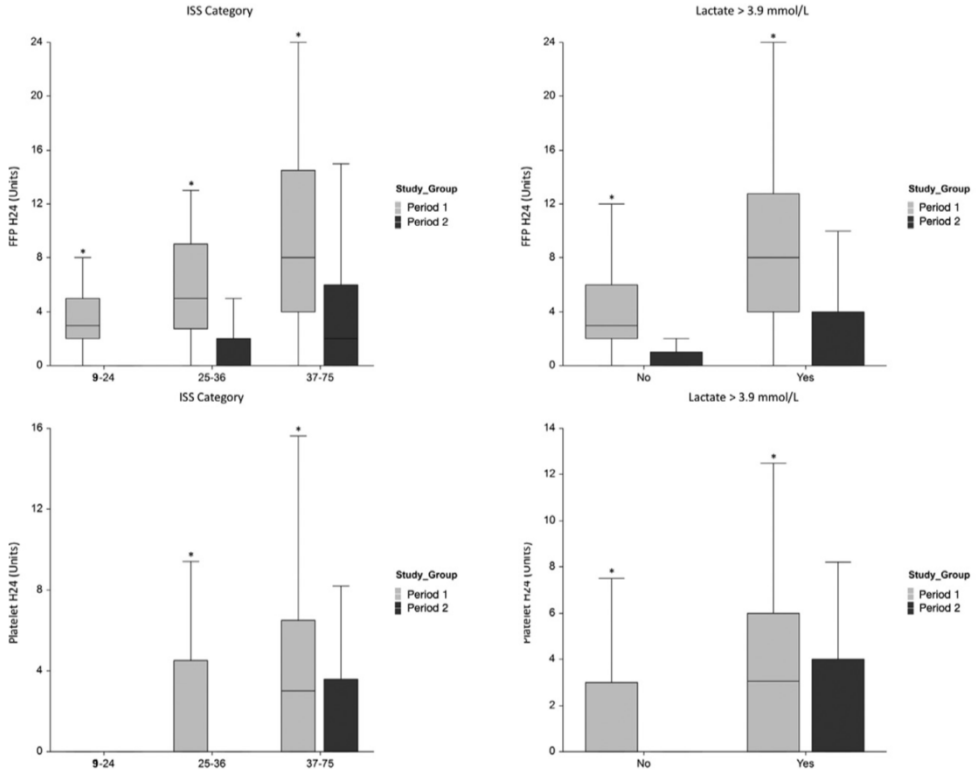
ABSTRACT

Objective: We hypothesised that the association of tranexamic acid (TXA) administration and thromboelastometry-guided haemostatic therapy (TGHT) with implementation of Damage Control Resuscitation (DCR) reduced blood products (BP) use and massive transfusion (MT).
Methods: Retrospective comparison of 2 cohorts of trauma patients admitted in a university hospital, before (Period 1) and after implementation of DCR, TXA (first 3-hours) and TGHT (Period 2). Patients were included if they received at least 1 BP (RBC, FFP or platelet) or coagulation factor concentrates (fibrinogen or prothrombin complex) during the first 24-hours following the admission.
Results: 380 patients were included. Patients in Period 2 (n = 182) received less frequently a MT (8% vs. 33%, $P < 0.01$), significantly less BP (RBC: 2 units [1–5] vs. 6 [3–11]; FFP: 0 units [0–2] vs. 4 [2–8]) but more fibrinogen concentrates (3.0 g [1.5–4.5] vs. 0.0 g [0.0–3.0], $P < 0.01$). Multivariate logistic regression analysis identified Period 1 as being associated with an increased risk of receiving MT (OR: 26.1, 95% CI: 9.7–70.2) and decreased survival at 28 days (OR: 2.0, 95% CI: 1.0–3.9). After propensity matching, the same results were observed but there was no difference for survival and a significant decrease for the cost of BP (2370 ± 2126 vs. 3284 ± 3812 €, P: 0.036).
Conclusion: Following the implementation of a bundle of care including DCR, TGHT and administration of TXA, we observed a decrease to the use of blood products, need for MT and an improvement of survival.



1. Introduction

In order to improve the outcome of injured patients, Damage Control strategies have been implemented throughout the world during the last 15-years. Damage Control *Resuscitation* (DCR) seeks to minimise blood loss until definitive haemostasis is achieved. It includes permissive hypotension with restrictive fluid administration and early correction of the three components of the lethal triad: hypothermia, acidosis and the Trauma induced coagulopathy (TIC) [1]. TIC is a frequent phenomenon observed in 20 to 30 % of the injured patients [2], it reflects the severity of injury and bleeding, increases the requirement for blood and directly impacts outcome [2]. Treatment of TIC may involve administration of blood products (BP) at a fixed-ratio or the administration of BP combined with coagulation fa
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2352-5568/

Bundle of Care : DC / TXA / ROTEM

Laboratory analyses and blood product

	Period 1		Period 2	
	Unmatched	Matched	Unmatched	Matched
n	190	102	182	102
Laboratory analyses				
BD (mEq/L^{-1})	6.2 [3.7–11.7]	6.6 [3.9–12.1]	8.0 [4.9–13.4]	7.4 [5.2–11.7]
Lactate ($mmol/L^{-1}$)	3.1 [2.1–6.6]	3.3 [2.1–6.8]	3.3 [2.1–5.9]	3.2 [2.0–5.0]
PT_{ratio}	1.3 [1.1–1.7]	1.3 [1.1–1.7]	1.4 [1.2–1.6]	1.3 [1.2–1.6]
Fibrinogen (g/L^{-1})	1.6 [0.9–2.2]	1.6 [0.9–2.2]	1.5 [0.9–1.8][*]	1.6 [1.1–2.0]
Hemoglobin (g/dL^{-1})	10.6 [8.6–12.3]	10.6 [8.5–12.3]	10.1 [8.7–12.3]	11.0 [9.1–12.6]
Platelet ($10^9/L^{-1}$)	176 [123-233]	169 [130-225]	188 [146-227]	197 [151-241][‡]
Blood products administered				
RBC (U)	6 [3–12]	6 [2–12]	2 [1–5][b]	2 [0–4][a]
n (%)	181 (95)	96 (94)	137 (75)[b]	72 (71)[a]
FFP (U)	4 [2–9]	5 [2–9]	0 [0–2][b]	0 [0–2][a]
n (%)	163 (86)	84 (82)	60 (33)[b]	28 (27)[a]

Massive Transfusion

	OR	95% CI	AUC	*P*		OR	95% CI	*P*
Univariate analysis					Multivariate analysis			
Period 1 (yes)	5.39	2.93-9.92	0.686	< 0.001	Period 1 (yes)	25.92	9.66–69.51	< 0.001
Injury severity score	1.06	1.04-1.08	0.723	< 0.001	Injury severity Score	1.06	1.03–1.10	< 0.001
Base deficit	0.88	0.84-0.92	0.732	< 0.001	Base deficit	0.88	0.83–0.94	< 0.001
Hemoglobin	0.98	0.97-0.99	0.662	< 0.001	Hemoglobin	0.97	0.96–0.99	< 0.001
SBP < 90 mmHg (yes)	3.27	1.94-5.51	0.634	< 0.001	–			
PT_{ratio} > 1.2 (yes)	4.17	2.16-8.07	0.641	< 0.001	–			

The parameters that were significantly associated with massive transfusion are shown in the univariate analysis. For the multivariate regression analysis, calibration was assessed by the *Hosmer and Lemeshow* test (*P*: 0.18), AUC was 0.903 and the percentage of patients correctly classified was 87 %. OR: odds ratio. SBP (systolic blood pressure) and PT_{ratio} were not included in the final model.

Death Day 28

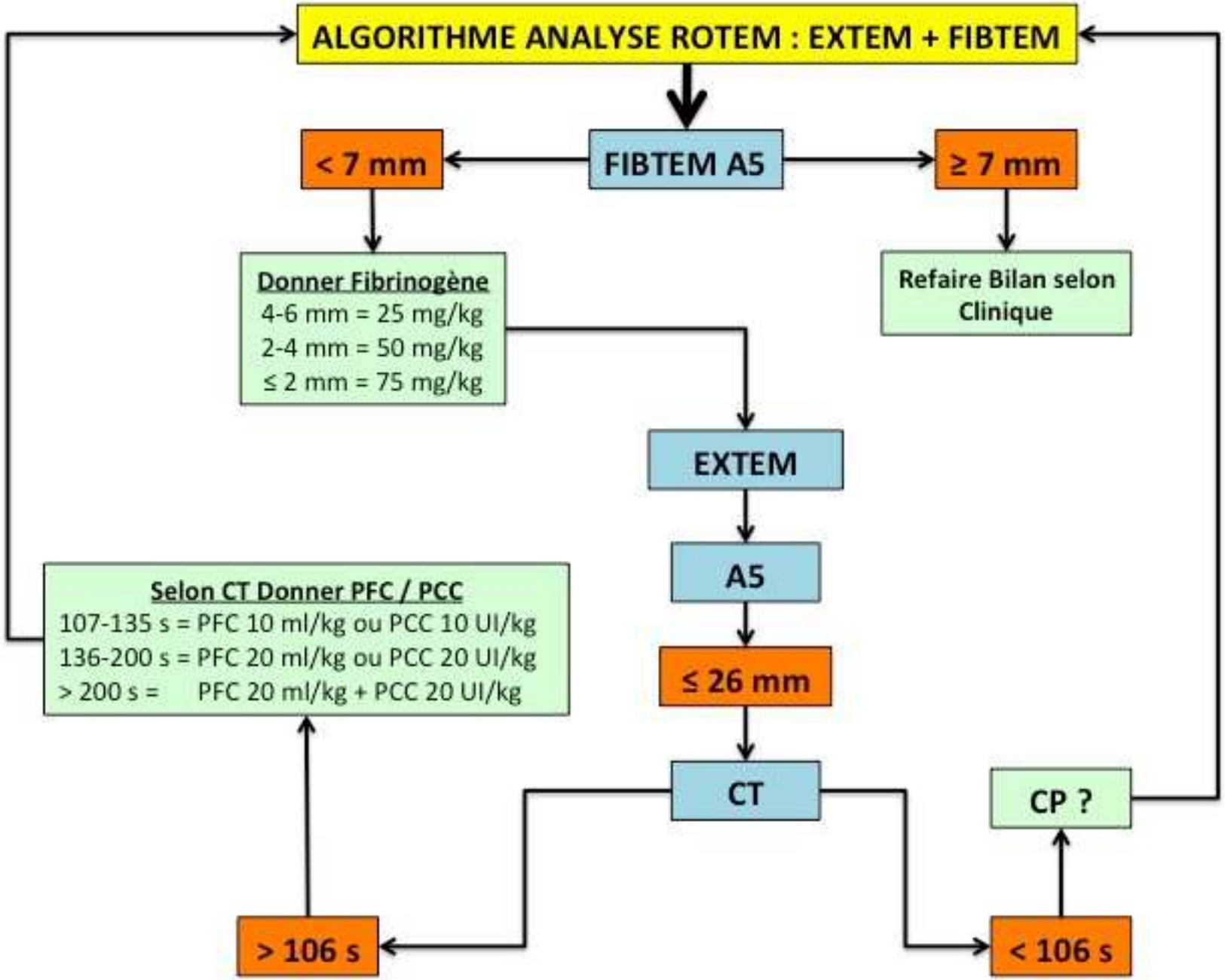
ysis to predict death at day 28.

	OR	95% CI	AUC	P		OR	95% CI	*P*
Univariate Analysis					Multivariate analysis			
Period 1 (yes)	0.79	0.52-1.22	0.529	0.196	Period 1 (yes)	2.12	1.06-4.24	0.033
Age	1.02	1.00-1.03	0.574	0.004	Age	1.04	1.02-1.08	< 0.001
GCS < 9	12.67	7.50-21.39	0.775	< 0.001	GCS < 9 (yes)	14.48	6.92-30.30	< 0.001
Injury severity score	1.10	1.07-1.12	0.806	< 0.001	Injury severity Score	1.05	1.02-1.08	0.002
Base deficit	0.85	0.82-0.89	0.741	< 0.001	Base deficit	0.86	0.81-0.91	< 0.001
SBP < 90 mmHg (yes)	2.63	1.65-4.18	0.604	< 0.001	-			

Cost ??

3.4. Comparison of blood products and CFC Cost between groups

After matching, a significant decrease to the overall cost of blood products and CFC was observed in Period 2 (2370 ± 2126 vs. 3284 ± 3812 €, *P*: 0.036).


ALGORITHME ANALYSE ROTEM : EXTEM + FIBTEM
FIBTEM A5
< 7 mm
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Donner Fibrinogène
4-6 mm = 25 mg/kg
2-4 mm = 50 mg/kg
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EXTEM
A5
≤ 26 mm
CT
Selon CT Donner PFC / PCC
107-135 s = PFC 10 ml/kg ou PCC 10 UI/kg
136-200 s = PFC 20 ml/kg ou PCC 20 UI/kg
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CP ?
> 106 s
< 106 s

Goal-directed Hemostatic Resuscitation of Trauma-induced Coagulopathy

A Pragmatic Randomized Clinical Trial Comparing a Viscoelastic Assay to Conventional Coagulation Assays

Eduardo Gonzalez, MD, Ernest E. Moore, MD,*† Hunter B. Moore, MD,* Michael P. Chapman, MD,* Theresa L. Chin, MD,* Arsen Ghasabyan, MPH,* Max V. Wohlauer, MD,* Carlton C. Barnett, MD,*† Denis D. Bensard, MD,*† Walter L. Biffl, MD,*† Clay C. Burlew, MD,*† Jeffrey L. Johnson, MD,*† Fredric M. Pieracci, MD, MPH,*† Gregory J. Jurkovich, MD,*† Anirban Banerjee, PhD,* Christopher C. Silliman, MD, PhD,*‡§ and Angela Sauaia, MD, PhD*¶*

Background: Massive transfusion protocols (MTPs) have become standard of care in the management of bleeding injured patients, yet strategies to guide them vary widely. We conducted a pragmatic, randomized clinical trial (RCT) to test the hypothesis that an MTP goal directed by the viscoelastic assay thrombelastography (TEG) improves survival compared with an MTP guided by conventional coagulation assays (CCA).

Methods: This RCT enrolled injured patients from an academic level-1 trauma center meeting criteria for MTP activation. Upon MTP activation, patients were randomized to be managed either by an MTP goal directed by TEG or by CCA (ie, international normalized ratio, fibrinogen, platelet count). Primary outcome was 28-day survival.

Results: One hundred eleven patients were included in an intent-to-treat analysis (TEG = 56, CCA = 55). Survival in the TEG group was significantly higher than the CCA group (log-rank $P = 0.032$, Wilcoxon $P = 0.027$); 20 deaths in the CCA group (36.4%) compared with 11 in the TEG group (19.6%) ($P = 0.049$). Most deaths occurred within the first 6 hours from arrival (21.8% CCA group vs 7.1% TEG group) ($P = 0.032$). CCA patients required similar number of red blood cell units as the TEG patients [CCA: 5.0 (2–11), TEG: 4.5 (2–8)] ($P = 0.317$), but more plasma units [CCA: 2.0 (0–4), TEG: 0.0 (0–3)] ($P = 0.022$), and more platelets units [CCA: 0.0 (0–1), TEG: 0.0 (0–0)] ($P = 0.041$) in the first 2 hours of resuscitation.

Conclusions: Utilization of a goal-directed, TEG-guided MTP to resuscitate severely injured patients improves survival compared with an MTP guided by CCA and utilizes less plasma and platelet transfusions during the early phase of resuscitation.

Keywords: coagulopathy, fibrinolysis, goal-directed, resuscitation, thrombelastography, transfusion

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Injury is the second leading cause of death worldwide and the most common for individuals 15 to 49 years of age.[1–3] The burden of injuries has decreased due to strategies such as injury prevention, advanced prehospital care, regionalized trauma systems, damage control operative techniques, advances in critical care medicine, and rehabilitation with reintegration into society.[4,5] However, in both civilian and military trauma, uncontrolled bleeding remains the leading preventable cause of death, with as much as 40% of injury-related mortality due to hemorrhage.[6–9] This is largely attributed to the exacerbation of bleeding by dysfunctional hemostasis. In 25% to 35% of patients with severe trauma, this trauma-induced coagulopathy is already present upon arrival to the emergency department (ED).[10,11]

Traditionally, assessment of hemostasis in the injured has been made with conventional coagulation assays (CCA) such as the international normalized ratio (INR) of prothrombin time, partial thromboplastin time (PTT), platelet count, and fibrinogen concentration. Viscoelastic assays of hemostasis (VHA) such as thrombelastography (TEG) (Haemonetics Corp, Niles, IN) and rotational

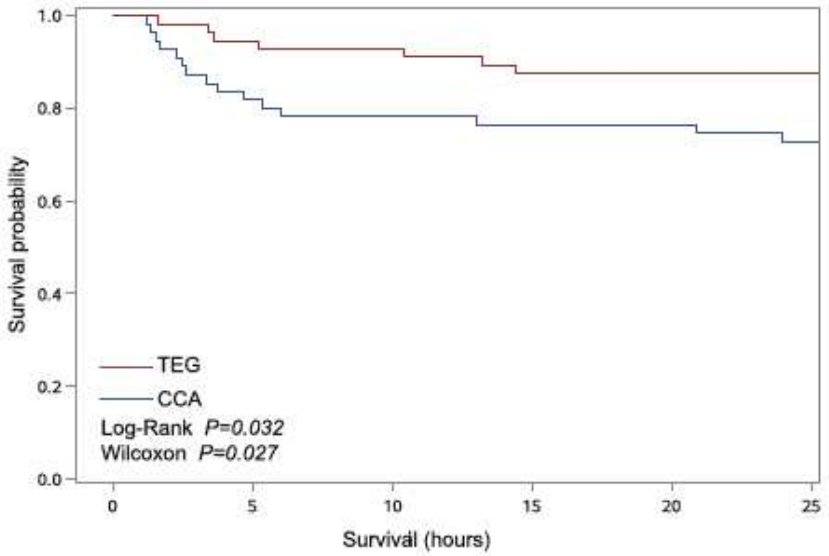


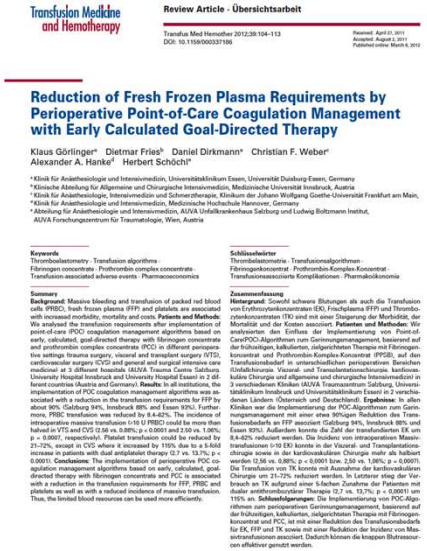
FIGURE 1. Kaplan-Meier estimates of survival by randomization group for patients analyzed as intention-to-treat. Survival in the TEG group was significantly higher than the CCA group (log-rank $P = 0.0324$, Wilcoxon $P = 0.0275$).

TEG

TABLE 2. Outcome of Mortality Stratified by Study Group

	Intention to Treat		
	CCA (N = 55)	TEG (N = 56)	*P*
Deaths, no. (% within group)	20 (36.4)	11 (19.6)	0.049
Time to death in hours from ED arrival, median (IQR)	4.2 (2.4–9.9)	10.4 (4.5–200.3)	0.181
Deaths occurring in the first 6 hours from ED arrival, no. (% within group)	12 (21.8)	4 (7.1)	0.032
Deaths occurring >6 h from ED arrival, no. (% within group)	8 (14.5)	7 (12.5)	0.785
Hemorrhagic deaths, no. (% within group)	11 (20.0)	5 (8.9)	0.110
TBI deaths, no. (% within group)	6 (10.9)	4 (7.1)	0.537
Organ failure, no. (% within group)	3 (5.5)	2 (3.6)	0.675

TEG / ROTEM : Littérature ?



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Reduction of Fresh Frozen Plasma Requirements by Perioperative Point-of-Care Coagulation Management with Early Calculated Goal-Directed Therapy

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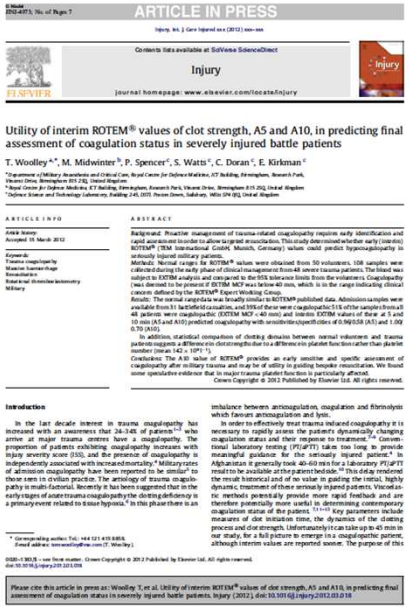
Keywords
Thromboelastometry · Transfusion algorithms · Fibrinogen concentrate · Prothrombin complex concentrate · Transfusion-associated adverse events · Pharmacoeconomics

Schlüsselwörter
Thrombelastometrie · Transfusionsalgorithmen · Fibrinogenkonzentrat · Prothrombin-Komplex-Konzentrat · Transfusionsassoziierte Komplikationen · Pharmakoökonomie

Summary
Background: Massive bleeding and transfusion of packed red blood cells (PRBC), fresh frozen plasma (FFP) and platelets are associated with increased morbidity, mortality and costs. **Patients and Methods:** We analysed the transfusion requirements after implementation of point-of-care (POC) coagulation management algorithms based on early, calculated, goal-directed therapy with fibrinogen concentrate and prothrombin complex concentrate (PCC) in different perioperative settings trauma surgery, visceral and transplant surgery (VTS), cardiovascular surgery (CVS) and general and surgical intensive care medicine) at 3 different hospitals (AUVA Trauma Centre Salzburg, University Hospital Innsbruck and University Hospital Essen) in 2 different countries (Austria and Germany). **Results:** In all institutions, the implementation of POC coagulation management algorithms was associated with a reduction in the transfusion requirements for FFP by about 90% (Salzburg 94%, Innsbruck 88% and Essen 93%). Furthermore, PRBC transfusion was reduced by 8.4–62%. The incidence of intraoperative massive transfusion (>10 U PRBC) could be more than halved in VTS and CVS (2.66 vs. 0.88%; p < 0.0001 and 2.50 vs. 1.06%; p = 0.0007, respectively). Platelet transfusion could be reduced by 21–72%, except in CVS where it increased by 115% due to a 5-fold increase in patients with dual antiplatelet therapy (2.7 vs. 13.7%; p < 0.0001). **Conclusions:** The implementation of perioperative POC coagulation management algorithms based on early, calculated, goal-directed therapy with fibrinogen concentrate and PCC is associated with a reduction in the transfusion requirements for FFP, PRBC and platelets as well as with a reduced incidence of massive transfusion. Thus, the limited blood resources can be used more efficiently.

Zusammenfassung
Hintergrund: Sowohl schwere Blutungen als auch die Transfusion von Erythrozytenkonzentraten (EK), Frischplasma (FFP) und Thrombozytenkonzentraten (TK) sind mit einer Steigerung der Morbidität, der Mortalität und der Kosten assoziiert. **Patienten und Methoden:** Wir analysierten den Einfluss der Implementierung von Point-of-Care(POC)-Algorithmen zum Gerinnungsmanagement, basierend auf der frühzeitigen, kalkulierten, zielgerichteten Therapie mit Fibrinogenkonzentrat und Prothrombin-Komplex-Konzentrat (PPSB), auf den Transfusionsbedarf in unterschiedlichen perioperativen Bereichen (Unfallchirurgie, Viszeral- und Transplantationschirurgie, kardiovaskuläre Chirurgie und allgemeine und chirurgische Intensivmedizin) in 3 verschiedenen Kliniken (AUVA Traumazentrum Salzburg, Universitätsklinikum Innsbruck und Universitätsklinikum Essen) in 2 verschiedenen Ländern (Österreich und Deutschland). **Ergebnisse:** In allen Kliniken war die Implementierung der POC-Algorithmen zum Gerinnungsmanagement mit einer etwa 90%igen Reduktion des Transfusionsbedarfs an FFP assoziiert (Salzburg 94%, Innsbruck 88% und Essen 93%). Außerdem konnte die Zahl der transfundierten EK um 8,4–62% reduziert werden. Die Inzidenz von intraoperativen Massivtransfusionen (>10 EK) konnte in der Viszeral- und Transplantationschirurgie sowie in der kardiovaskulären Chirurgie mehr als halbiert werden (2,66 vs. 0,88%; p < 0,0001 bzw. 2,50 vs. 1,06%; p = 0,0007). Die Transfusion von TK konnte mit Ausnahme der kardiovaskulären Chirurgie um 21–72% reduziert werden. In Letzterer stieg der Verbrauch an TK aufgrund einer 5-fachen Zunahme der Patienten mit dualer antithrombotischer Therapie (2,7 vs. 13,7%; p < 0,0001) um 115% an. **Schlussfolgerungen:** Die Implementierung von POC-Algorithmen zum perioperativen Gerinnungsmanagement, basierend auf der frühzeitigen, kalkulierten, zielgerichteten Therapie mit Fibrinogenkonzentrat und PCC, ist mit einer Reduktion des Transfusionsbedarfs für EK, FFP und TK sowie mit einer Reduktion der Inzidenz von Massivtransfusionen assoziiert. Dadurch können die knappen Blutressourcen effektiver genutzt werden.



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Injury, Int. J. Care Injured xxx (2012) xxx–xxx

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Injury

journal homepage: www.elsevier.com/locate/injury

Utility of interim ROTEM® values of clot strength, A5 and A10, in predicting final assessment of coagulation status in severely injured battle patients

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Trauma coagulopathy
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Resuscitation
Rotational thromboelastometry
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ABSTRACT

Background: Proactive management of trauma-related coagulopathy requires early identification and rapid assessment in order to allow targeted resuscitation. This study determined whether early (interim) ROTEM® (TEM International GmbH, Munich, Germany) values could predict hypercoagulopathy in seriously injured military patients.
Methods: Normal ranges for ROTEM® values were obtained from 50 volunteers. 108 samples were collected during the early phase of clinical management from 48 severe trauma patients. The blood was subject to EXTEM analysis and compared to the 95% tolerance limits from the volunteers. Coagulopathy (was deemed to be present if EXTEM MCF was below 40 mm, which is in the range indicating clinical concern defined by the ROTEM® Expert Working Group.
Results: The normal ranges data was broadly similar to ROTEM® published data. Admission samples were available from 31 battlefield casualties, and 35% of these were coagulopathic (11% of the samples from all 48 patients were coagulopathic (EXTEM MCF <40 mm) and interim EXTEM values of these at 5 and 10 min (A5 and A10) predicted coagulopathy with sensitivities/specificities of 0.96/0.58 (A5) and 1.00/0.70 (A10).
In addition, statistical comparison of clotting dynamics between normal volunteers and trauma patients suggests a difference in clot strengths due to a difference in platelet function rather than platelet number (mean 142×10^9/l).
Conclusions: The A10 value of ROTEM® provides an early sensitive and specific assessment of coagulopathy after military trauma and may be of utility in guiding bespoke resuscitation. We found some speculative evidence that in major trauma platelet function is particularly affected.

Introduction

In the last decade interest in trauma coagulopathy has increased with an awareness that 24–34% of patients[1,2] who arrive at major trauma centres have a coagulopathy. The proportion of patients exhibiting coagulopathy increases with injury severity score (ISS), and the presence of coagulopathy is independently associated with increased mortality.[3] Military rates of admission coagulopathy have been reported to be similar[4] to those seen in civilian practice. The aetiology of trauma coagulopathy is multi-factorial. Recently it has been suggested that in the early stages of acute trauma coagulopathy the clotting deficiency is a primary event related to tissue hypoxia.[5] In this phase there is an imbalance between anticoagulation, coagulation and fibrinolysis which favours anticoagulation and lysis.

In order to effectively treat trauma induced coagulopathy it is necessary to rapidly assess the patient's dynamically changing coagulation status and their response to treatment.[6–8] Conventional laboratory testing (PT/aPTT) takes too long to provide meaningful guidance for the seriously injured patient.[9] In Afghanistan it generally took 40–60 min for a laboratory PT/aPTT result to be available at the patient bedside.[10] This delay rendered the result historical and of no value in guiding the initial, highly dynamic, treatment of these seriously injured patients. Viscoelastic methods potentially provide more rapid feedback and are therefore potentially more useful in determining contemporary coagulation status of the patient.[11–13] Key parameters include measures of clot initiation time, the dynamics of the clotting process and clot strength. Unfortunately it can take up to 45 min in our study, for a full picture to emerge in a coagulopathic patient, although interim values are reported sooner. The purpose of this

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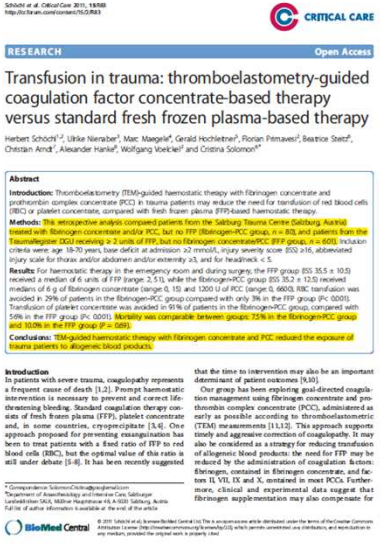

Schöchl et al. Critical Care 2011, 15:R83
http://ccforum.com/content/15/2/R83

CRITICAL CARE

RESEARCH Open Access

Transfusion in trauma: thromboelastometry-guided coagulation factor concentrate-based therapy versus standard fresh frozen plasma-based therapy

Herbert Schöchl[1,2], Ulrike Nienaber[3], Marc Maegele[4], Gerald Hochleitner[5], Florian Primavesi[2], Beatrice Steitz[6], Christian Arndt[7], Alexander Hanke[8], Wolfgang Voelckel[2] and Cristina Solomon[9*]

Abstract

Introduction: Thromboelastometry (TEM)-guided haemostatic therapy with fibrinogen concentrate and prothrombin complex concentrate (PCC) in trauma patients may reduce the need for transfusion of red blood cells (RBC) or platelet concentrate, compared with fresh frozen plasma (FFP)-based haemostatic therapy.

Methods: This retrospective analysis compared patients from the Salzburg Trauma Centre (Salzburg, Austria) treated with fibrinogen concentrate and/or PCC, but no FFP (fibrinogen+PCC group, n = 80), and patients from the Traumaregister DGU receiving ≥ 2 units of FFP, but no fibrinogen concentrate/PCC (FFP group, n = 603). Inclusion criteria were: age 18–70 years, base deficit at admission ≥-2 mmol/L, injury severity score (ISS) ≥16, abbreviated injury scale for thorax and/or abdomen and/or extremity ≥3, and for head/neck < 5.

Results: For haemostatic therapy in the emergency room and during surgery, the FFP group (ISS 35.5 ± 10.5) received a median of 6 units of FFP (range: 2, 51), while the fibrinogen+PCC group (ISS 35.2 ± 12.5) received medians of 6 g of fibrinogen concentrate (range: 0, 15) and 1200 IU of PCC (range: 0, 6600). RBC transfusion was avoided in 29% of patients in the fibrinogen+PCC group compared with only 3% in the FFP group (P< 0.001). Transfusion of platelet concentrate was avoided in 91% of patients in the fibrinogen+PCC group, compared with 56% in the FFP group (P< 0.001). Mortality was comparable between groups: 7.5% in the fibrinogen+PCC group and 10.0% in the FFP group (P = 0.69).

Conclusions: TEM-guided haemostatic therapy with fibrinogen concentrate and PCC reduced the exposure of trauma patients to allogeneic blood products.

Introduction

In patients with severe trauma, coagulopathy represents a frequent cause of death [1,2]. Prompt haemostatic intervention is necessary to prevent and correct life-threatening bleeding. Standard coagulation therapy consists of fresh frozen plasma (FFP), platelet concentrate and, in some countries, cryoprecipitate [3,4]. One approach proposed for preventing exsanguination has been to treat patients with a fixed ratio of FFP to red blood cells (RBC), but the optimal value of this ratio is still under debate [5-8]. It has been recently suggested that the time to intervention may also be an important determinant of patient outcomes [9,10].

Our group has been exploring goal-directed coagulation management using fibrinogen concentrate and prothrombin complex concentrate (PCC), administered as early as possible according to thromboelastometric (TEM) measurements [11,12]. This approach supports timely and aggressive correction of coagulopathy. It may also be considered as a strategy for reducing transfusion of allogeneic blood products: the need for FFP may be reduced by the administration of coagulation factors: fibrinogen, contained in fibrinogen concentrate, and factors II, VII, IX and X, contained in most PCCs. Furthermore, clinical and experimental data suggest that fibrinogen supplementation may also compensate for

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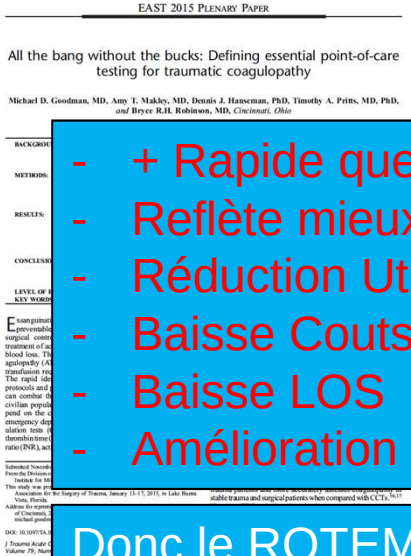

EAST 2015 PLENARY PAPER

All the bang without the bucks: Defining essential point-of-care testing for traumatic coagulopathy

Michael D. Goodman, MD, Amy T. Makley, MD, Dennis J. Hanseman, PhD, Timothy A. Pritts, MD, PhD, and Bryce R.H. Robinson, MD, *Cincinnati, Ohio*

BACKGROUND:
METHODS:
RESULTS:
CONCLUSION:
LEVEL OF EVIDENCE:
KEY WORDS:

Exsanguinating irreversible surgical control treatment of blood loss. The agulopathy (A transfusion re The rapid id protocols and can combat civilian popula pend on the emergency dep ratio (INR), a

Submitted November From the Division Institute for M This study was pr Association for the Vista, Florida.

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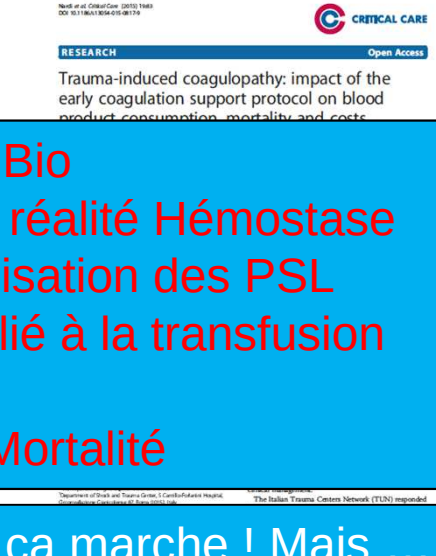
DOI: 10.1097/TA.0

J Trauma Acute Volume 79, Num

2012 Annual Meeting of the American Association for the Surgery of Trauma, January 13-17, 2015, in Lake Buena



RESEARCH Open Access

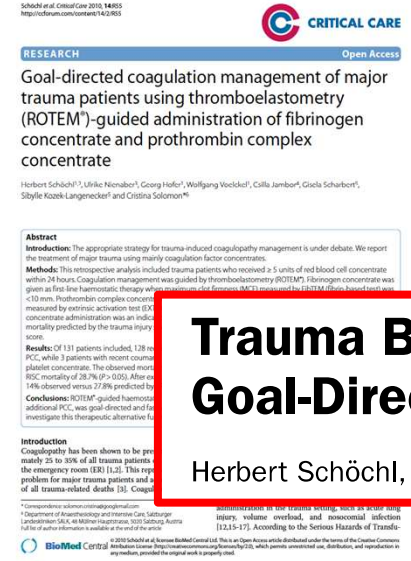
Trauma-induced coagulopathy: impact of the early coagulation support protocol on blood

'The Italian Trauma Centers Network (TUN) responded

- + Rapide que Bio
- Reflète mieux réalité Hémostase
- Réduction Utilisation des PSL
- Baisse Couts lié à la transfusion
- Baisse LOS
- Amélioration Mortalité

Donc le ROTEM ça marche ! Mais …
ROTEM ?
Concentrés de Facteurs ?

David JS et al. Crit Care 2011



Schöchl et al. Critical Care 2010, 14:R55
http://ccforum.com/content/14/2/R55

CRITICAL CARE

RESEARCH Open Access

Goal-directed coagulation management of major trauma patients using thromboelastometry (ROTEM®)-guided administration of fibrinogen concentrate and prothrombin complex concentrate

Herbert Schöchl[1,2], Ulrike Nienaber[3], Georg Hofer[3], Wolfgang Voelckel[2], Csilla Jambor[4], Gisela Scharbert[5], Sibylle Kozek-Langenecker[2] and Cristina Solomon[6*]

Abstract

Introduction: The appropriate strategy for trauma-induced coagulopathy management is under debate. We report the treatment of major trauma using mainly coagulation factor concentrates.

Methods: This retrospective analysis included trauma patients who received ≥ 5 units of red blood cell concentrate within 24 hours. Coagulation management was guided by thromboelastometry (ROTEM®). Fibrinogen concentrate was given as first-line haemostatic therapy when maximum clot firmness (MCF) measured by EXTEM (fibrin based test) was <10 mm. Prothrombin complex concentr
platelet concentrate. The observed mort
RISC mortality of 28.7% (P > 0.05). After ex
14% observed versus 27.8% predicted by

Conclusions: ROTEM®-guided haemost
additional PCC, was goal-directed and fa
investigate this therapeutic alternative fo

Introduction

Coagulopathy has been shown to be pr
mately 25 to 35% of all trauma patients
the emergency room (ER) [1,2]. This rep
problem for major trauma patients and a
of all trauma-related deaths [3]. Coagu

administration in the trauma setting, such as acute lung injury, volume overload, and nosocomial infection [12,15-17]. According to the Serious Hazards of Transfu-

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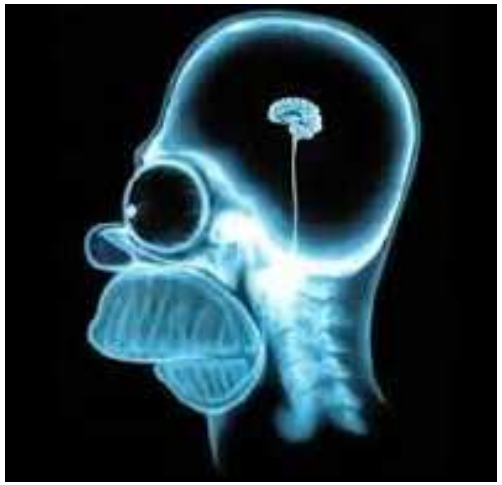
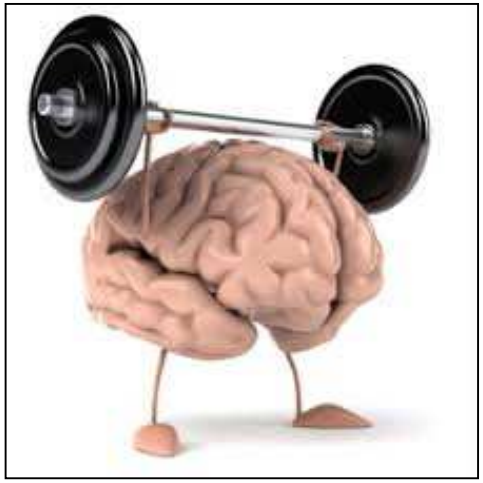
Trauma Bleeding Management: The Concept of Goal-Directed Primary Care

Herbert Schöchl, MD*† and Christoph J. Schlimp, MD†



Fixed ratio versus goal-directed therapy in trauma

Herbert Schöchl[a,b], *Marc Maegele*[c], *and Wolfgang Voelckel*[a]



Purpose of review
This article compares the strategy of a fixed transfusion ratio of plasma and platelet concentrates to red blood cells to reconstitute 'whole blood' with the concept of individualized goal-directed coagulation therapy (GDCT).

Recent findings
Current data suggest that an early and high ratio of plasma and platelet concentrate transfusion, predominantly in a fixed 1 : 1 : 1 ratio with red blood cells, is associated with improved outcome. However, the optimal ratio is still under discussion. Moreover, storage time considerably affects the hemostatic competence of these products and no universal standard for the composition of these 'transfusion packages' has been established. Some European trauma centers instituted the concept of GDCT in trauma patients, which is based on early diagnosis of the coagulation deficit using point-of-care viscoelastic tests (VETs). These tests provide rapid information about the underlying hemostatic deficiencies, allowing targeted coagulation therapy according to the individual deficits of the patient. Treatment algorithms have been established for the administration of coagulation factor concentrates, and plasma and platelet concentrate based on VET results.

Summary
Individualized GDCT, guided by VET, offers several advantages over fixed ratio coagulation therapy. Studies comparing both hemostatic strategies are warranted.

Keywords
goal-directed coagulation therapy, ratio-driven coagulation therapy, trauma-induced coagulopathy, viscoelastic tests

INTRODUCTION

Despite substantial improvement in acute trauma care, uncontrolled bleeding remains the primary cause of preventable death [1,2]. Most of these patients die within 3–6 h of hospital admission [3]. Thus, many trauma centers implement massive transfusion protocols to rapidly identify patients at risk for massive transfusion and administer hemostatic agents without substantial time delay [4,5]. Recent data suggest that early transfusion of high ratios of plasma and platelet concentrate, predominantly in a fixed 1 : 1 : 1 ratio with red blood cells (RBCs), is associated with improved outcome in patients with severe bleeding [6▪▪].

Some European trauma units have established a more targeted approach to treat coagulopathic trauma victims. Viscoelastic tests (VETs), most commonly rotational thromboelastometry (ROTEM, TEM International GmbH, Munich, Germany) or thrombelastography (TEG, Haemonetics Corporation, Niles, Illinois, USA], are used to evaluate the hemostatic capacity of trauma patients. Tailored hemostatic therapy, largely consisting of purified coagulation factor concentrates (CFCs), can then be applied [7–13].

FIXED RATIO COAGULATION THERAPY

The concept of damage-control resuscitation has been adopted in many military and civilian trauma centers [14,15], and is essentially based on restricted fluid therapy, permissive hypotension, and consequent maintenance of normothermia [14]. Early and aggressive transfusion of plasma has been

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Correspondence to Herbert Schöchl, AUVA Trauma Centre Salzburg, Austria and Ludwig Boltzmann Institute for Experimental and Clinical Traumatology, AUVA Research Centre, Donaueschingenstrasse 13, 1200 Vienna, Austria. Tel: +43.664 34 22 945;
e-mail: herbert.schoechl@auva.at

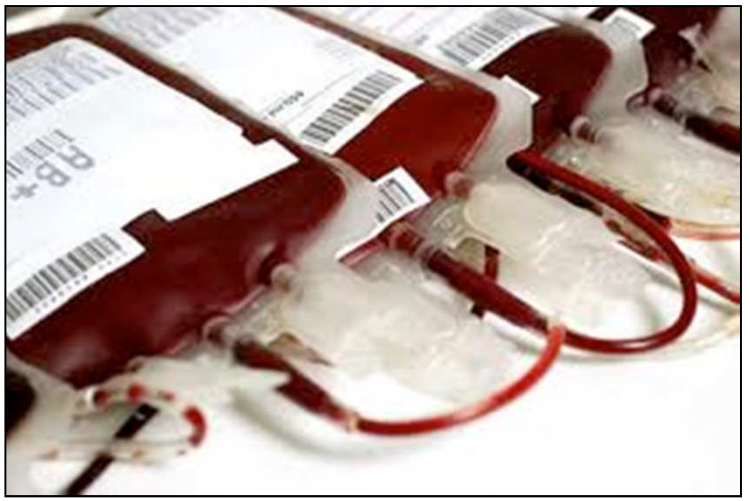
Curr Opin Anesthesiol 2016, 29:234–244
DOI:10.1097/ACO.0000000000000278

STRATEGIE DE TRAITEMENT AU PFC

TRAITEMENT À L'AVEUGLE

« L'Abondance de la Mitraille compense l'Imprécision du Tir »

Michel Ney, Maréchal de France (1769-1815)



En Attendant la Biologie …

Early Goal Directed Therapy

Diagnostic Précoce

Thromboélastométrie

Traitement Ciblé

Concentrés Facteurs

- Fibrinogène
- C. Prothrombinique

TRAITEMENT CIBLE

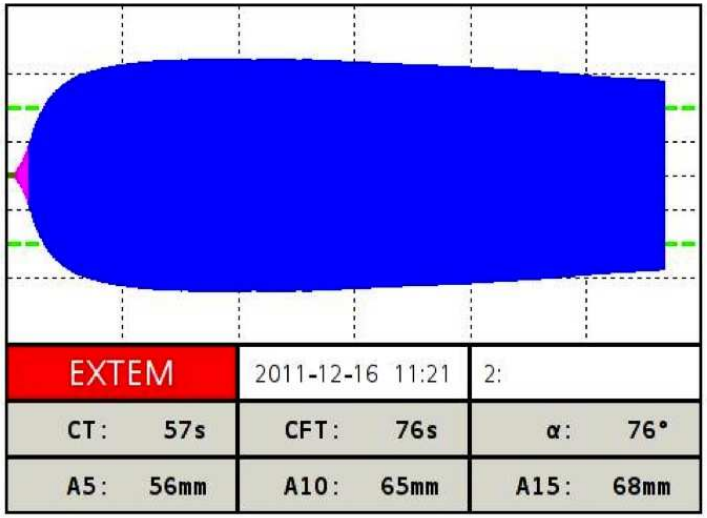
Définition Précise de la Cible puis Traitement Spécifique

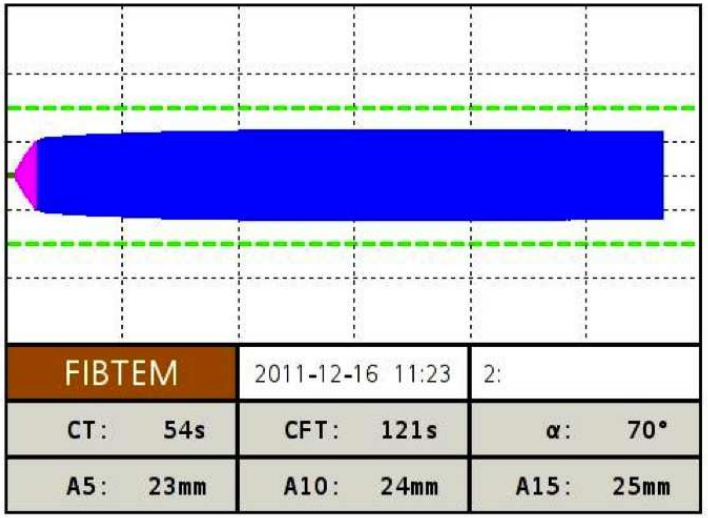
ET EN DEHORS DE LA TRAUMATO ?

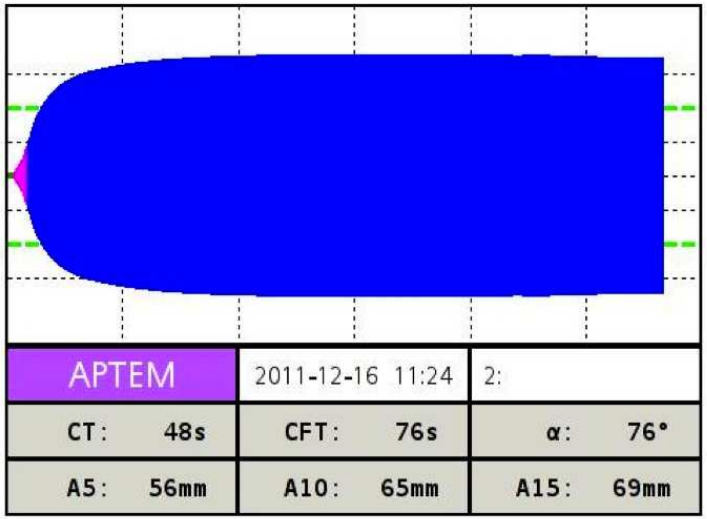
NOUVEAU : LE ROBOT CHIRURGIEN

ETAT DE CHOC POST OPERATOIRE

Bricker J12 | PAS 75 mmHg, FC 110, Hgb 52 gr (HemoCue) | **Que faites vous ?**







	Pré-opératoire	Per-opératoire	Post-opératoire
Heure	10:50	12:45	16:13
Hémoglobine ($g.L^{-1}$)	43	86	105
TP (%)	45	44	50
INR	1,81	1,88	1,57
Fibrinogène ($g.L^{-1}$)	4	3,1	4
CGR	3	0	0
PFC	0	0	0
Acide Tranexamique	1 g	0	0


HÉMORRAGIE DIGESTIVE

Hémorragie Digestive Grave

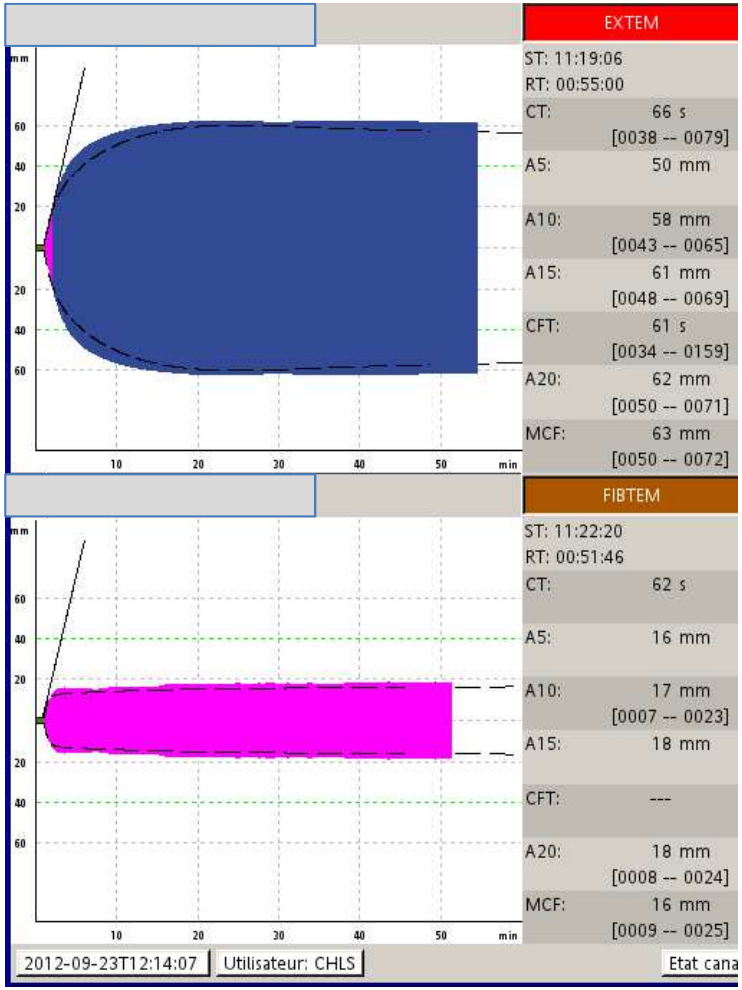
Pas de publication sur Hgie Digestive !
Transplantation hépatique : x publications ….
Roullet S et al. Liver Transplant 2015

Madame Paulette L, 57 ans, antillaise et accro au rhum …
En métropole depuis 15 J …
Adressée au déchocage pour Hémorragie Digestive grave
HemoCue à l'admission : 2,5 g/dL
INR (Coaguchek) : 3,7
Hémoglobine : 2,5 g/dL / Plaquette : 197 G/L
PAS 90 mmHg, FC 105 batt.min^{-1}

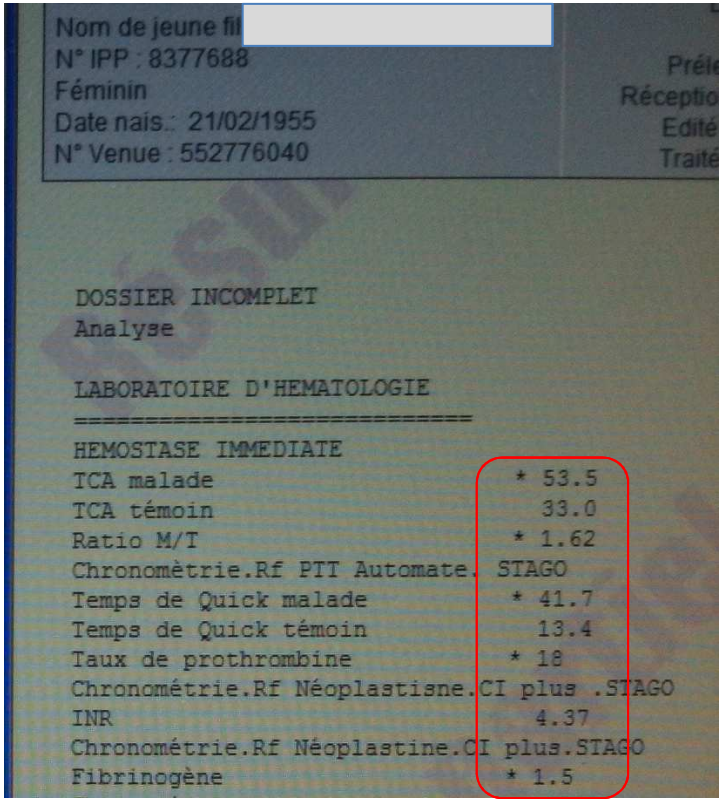
QUE FAITES VOUS ?

Hémorragie Digestive Grave

4 CGR (2 O neg et 2 iso groupes)
Exacyl 1 g
Je fait le RoTem !!



4 CGR (2 O neg et 2 iso groupes)
Exacyl 1 g
Si pas de RoTem : PFC ????



PSE Sandostatine
Erythro
Ligature VO sous AG
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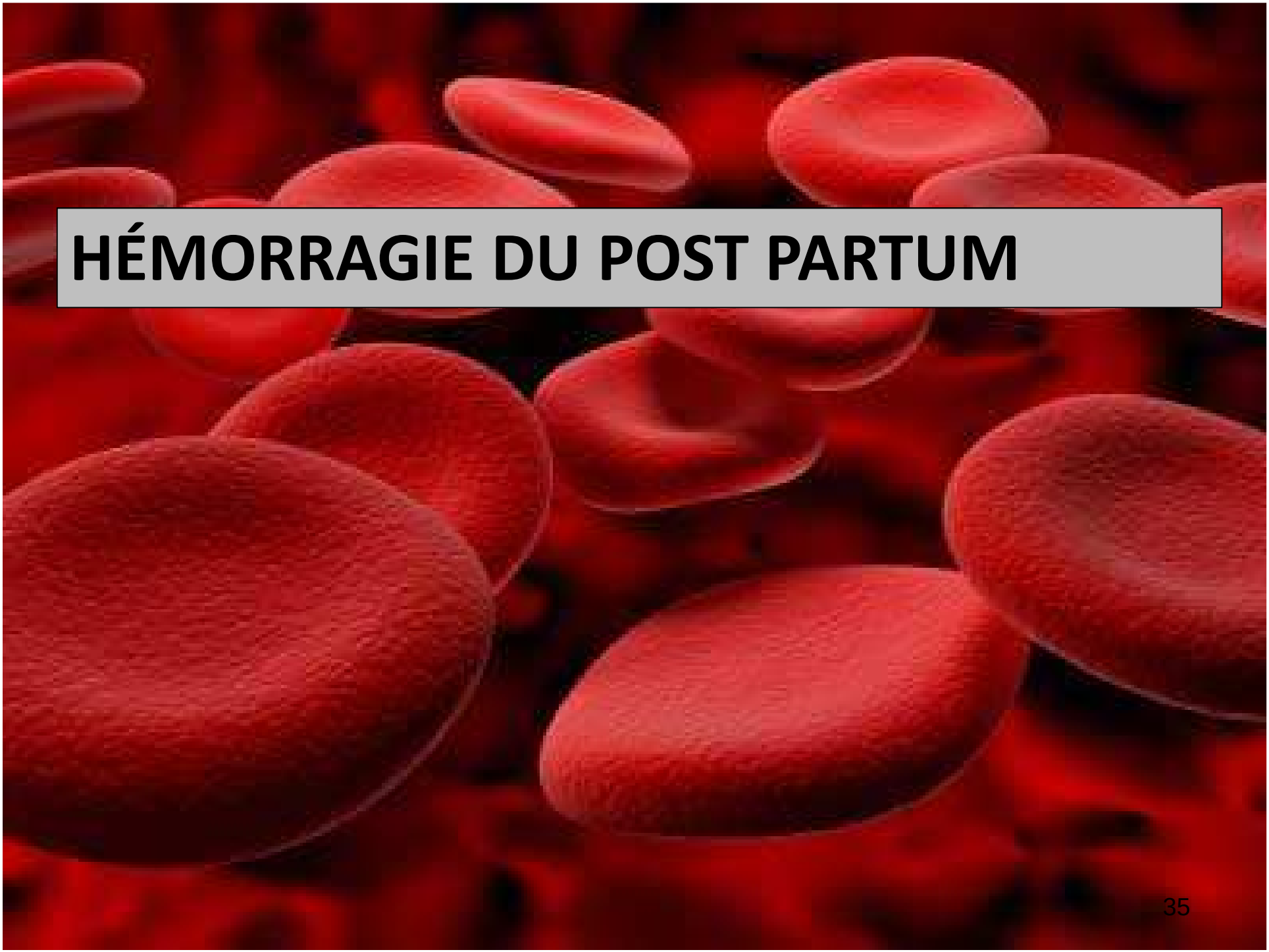
HÉMORRAGIE DU POST PARTUM

Hémorragie du Post Partum

- Un certain nombre de Publication
- Situation potentiellement à très haut risque !
- Contexte émotionnel ++
- Coagulopathie qui peut apparaître très vite (> 1500-2000 ml)
- Indispensable d'avoir un moyen de monitoring moderne
- Eviter Transfusion inutile / Consommation de Fibrinogène

BJA

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doi: 10.1093/bja/aex181
Advance Access Publication Date: 19 July 2017
Obstetrics

OBSTETRICS

Viscoelastometric-guided early fibrinogen concentrate replacement during postpartum haemorrhage: OBS2, a double-blind randomized controlled trial

P. W. Collins[1,*], R. Cannings-John[2], D. Bruynseels[3], S. Mallaiah[4], J. Dick[5], C. Elton[6], A. D. Weeks[7], J. Sanders[8], N. Aawar[2], J. Townson[2], K. Hood[2], J. E. Hall[9] and R. E. Collis[3] on behalf the OBS2 study team[†]

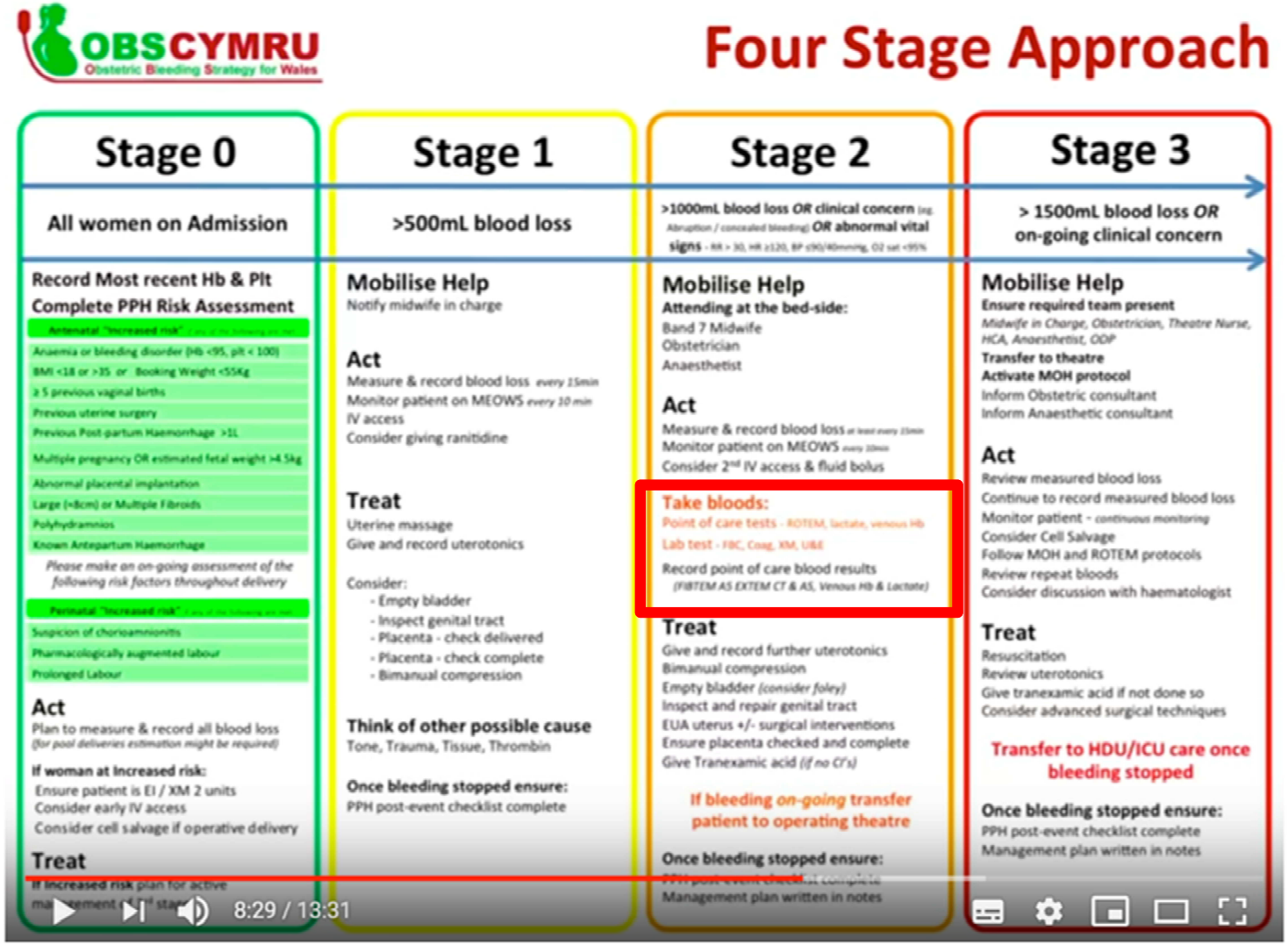
BJA

British Journal of Anaesthesia, 119 (3): 422–34 (2017)

doi: 10.1093/bja/aex245
Obstetrics

Viscoelastometry guided fresh frozen plasma infusion for postpartum haemorrhage: OBS2, an observational study

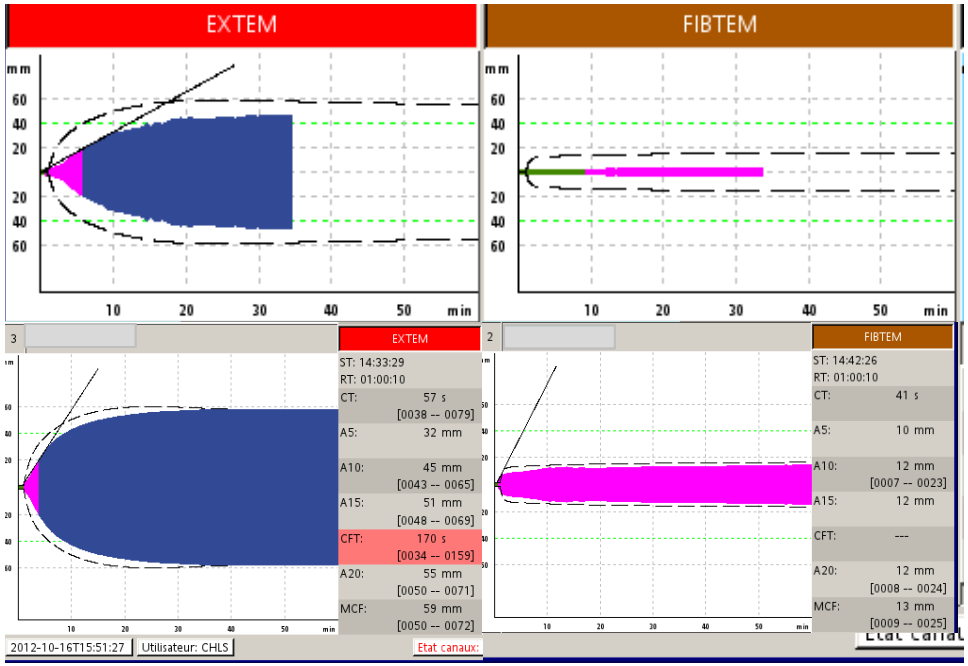
P. W. Collins[1,*], R. Cannings-John[2], D. Bruynseels[3], S. Mallaiah[4], J. Dick[5], C. Elton[6], A. Weeks[7], J. Sanders[8], N. Aawar[2], J. Townson[2], K. Hood[2], J. Hall[9], K. Harding[10], R. Gauntlett[11] and R. Collis[3], on behalf of the OBS2 study team[†]



https://www.youtube.com/watch?v=m1_Ze_16yz0

Hémorragie du Post Partum

16 Octobre – Maternité Lyon Sud
Obèse – Toxémie gravidique
Césarienne – X parités utérus cicatriciel
Saignement +++ 30-60 min après en SSPI
Hémoglobine : 7,5 g/dL – Nalador / Exacyl ➔ ROTEM !

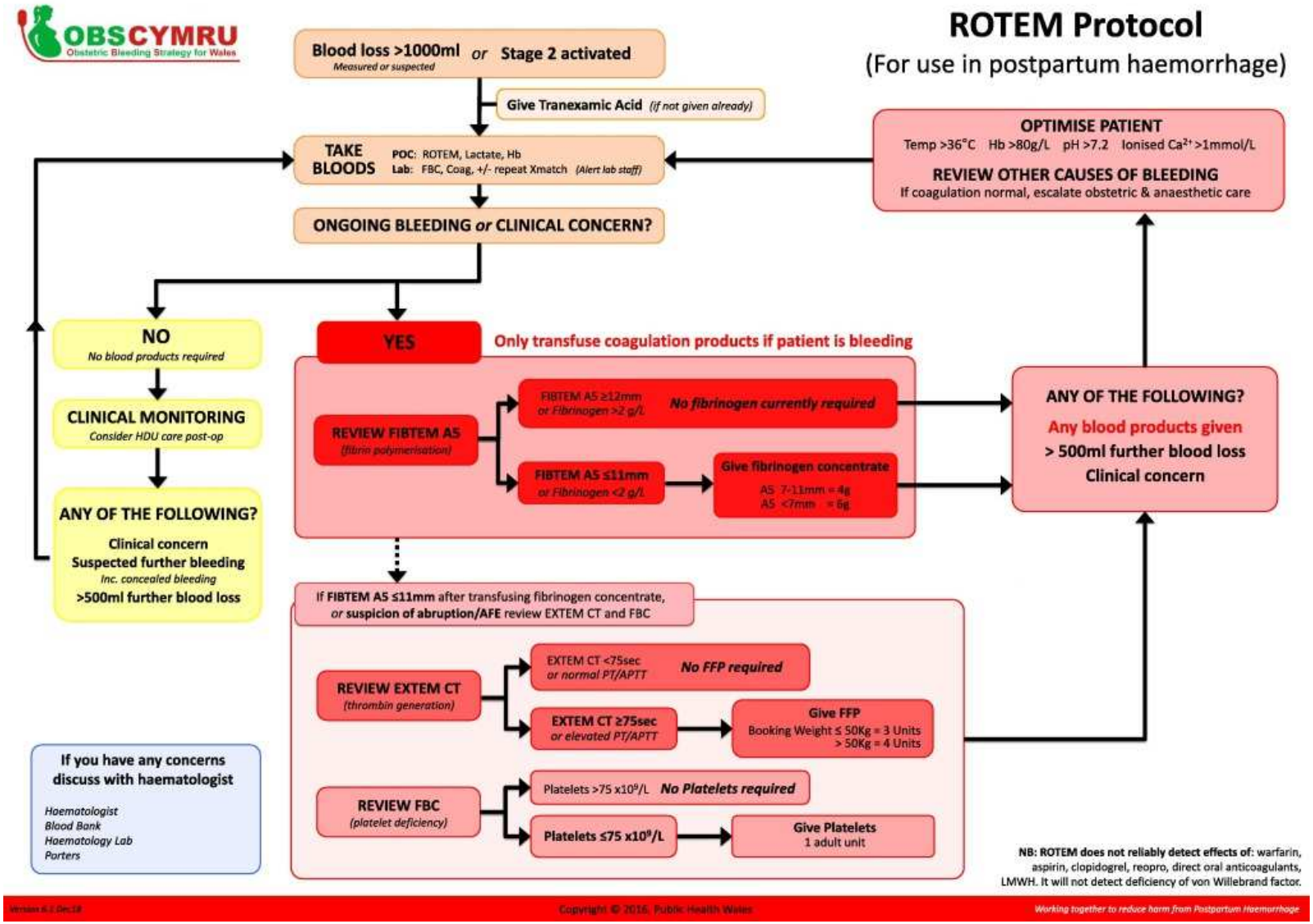


	13h30	14:32
Hgb	74	67
Plaq	93	94
TP	36	75
TQr	1,82	1,16
Fibrinogène	1,5	3,2

PCC + FIB

+ Ballon de Bakri → Stop Saignement
Annulation Embolisation

Hémorragie du Post Partum



Collins PW et al. *Int J Obst Anesthesia* 2019

CONCLUSION

- **Très difficile de diagnostiquer coagulopathie / Clinique**
- **Biologie déportée**
- **Taux de facteur (Bio Standard) pas suffisant**
- **Techniques visco-élastique**
- **Economie PSL / Baisse des couts / Baisse TM**
- **Amélioration pronostic**
- **Avec les Biologistes +++**

IL EST TEMPS D'EVOLUER !