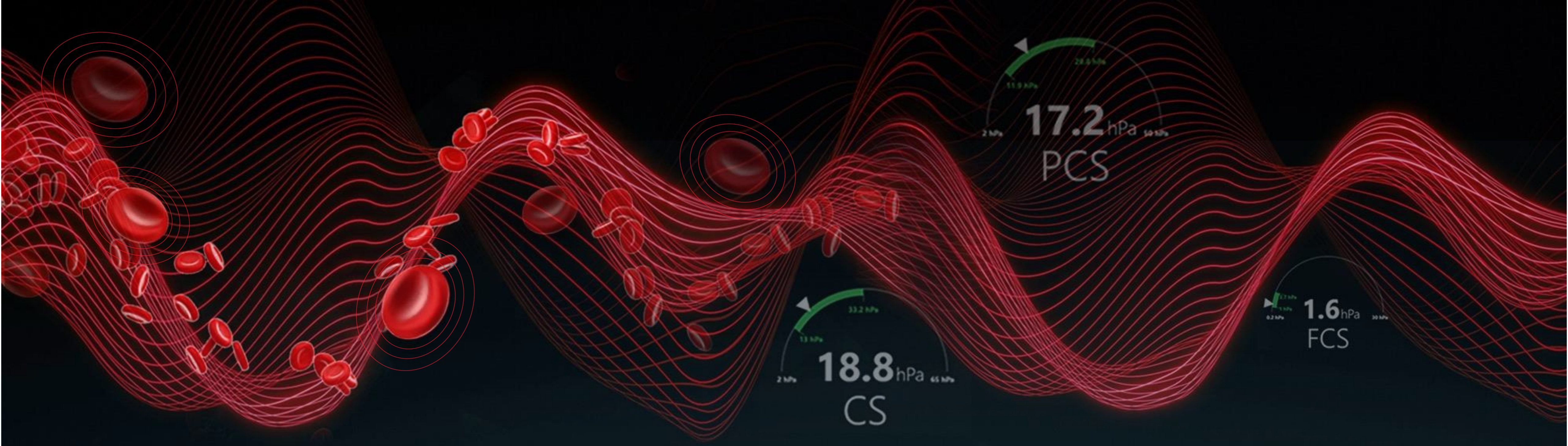

Overview of Quantra® QStat® for the management of TIC

Todd Allen, Clinical Development Director
HemoSonics, LLC.

THOR RCDC Conference October 7, 2024

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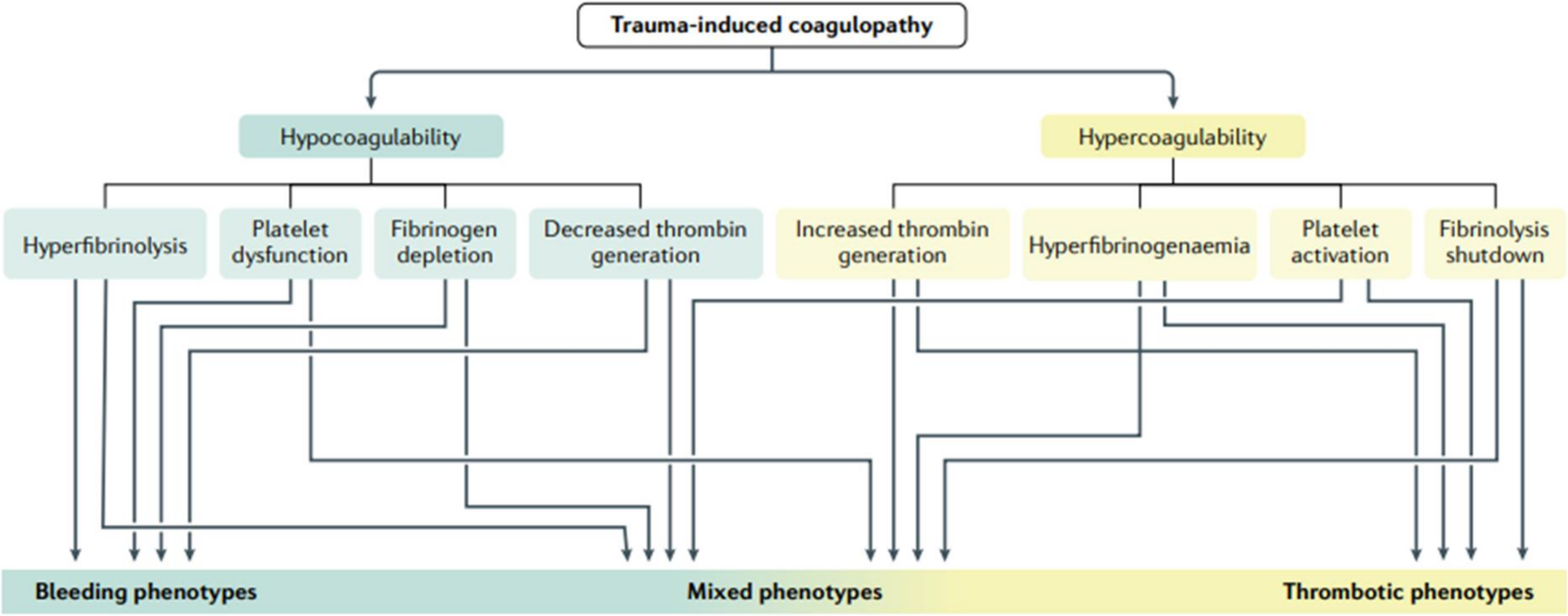
A Stago Group Company

Trauma

Coagulation Challenges

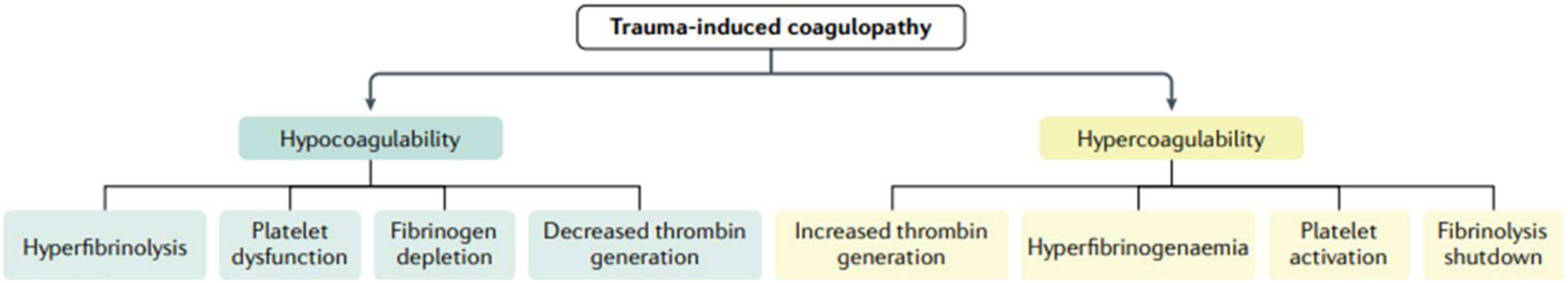


Moore, E.E., Nat Rev Dis Primers 2021

HemoSonics A Stago Group Company

Trauma

Coagulation Challenges



1) Thrombin generation / clot initiation

2) Fibrinogen contribution

3) Platelet contribution

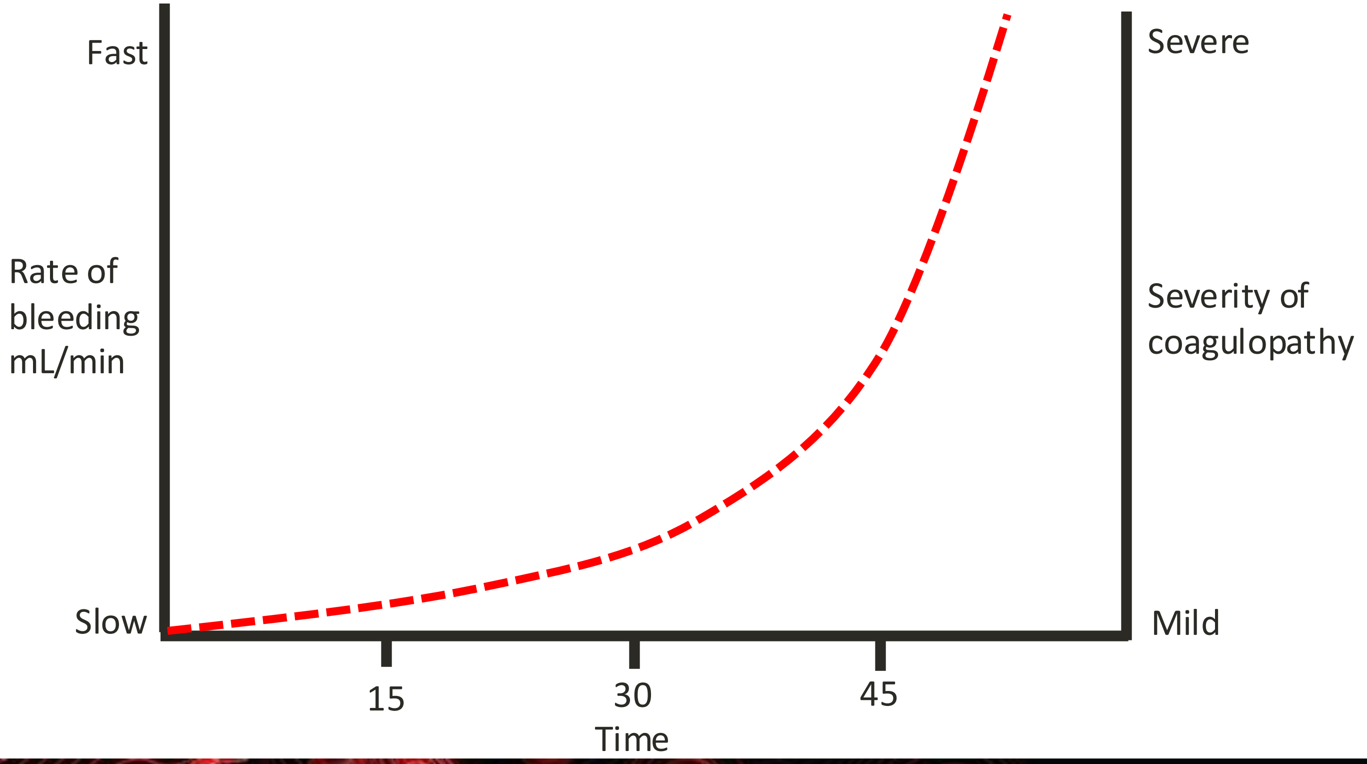
4) Dysregulated fibrinolysis

Moore, E.E., Nat Rev Dis Primers 2021

Key Clinical Value Proposition for QStat – Rapid Results

True point-of-care testing and clear actionable results

Being able to complete the testing at the true POC results in **less time between sample draw and results** that help guide therapy.

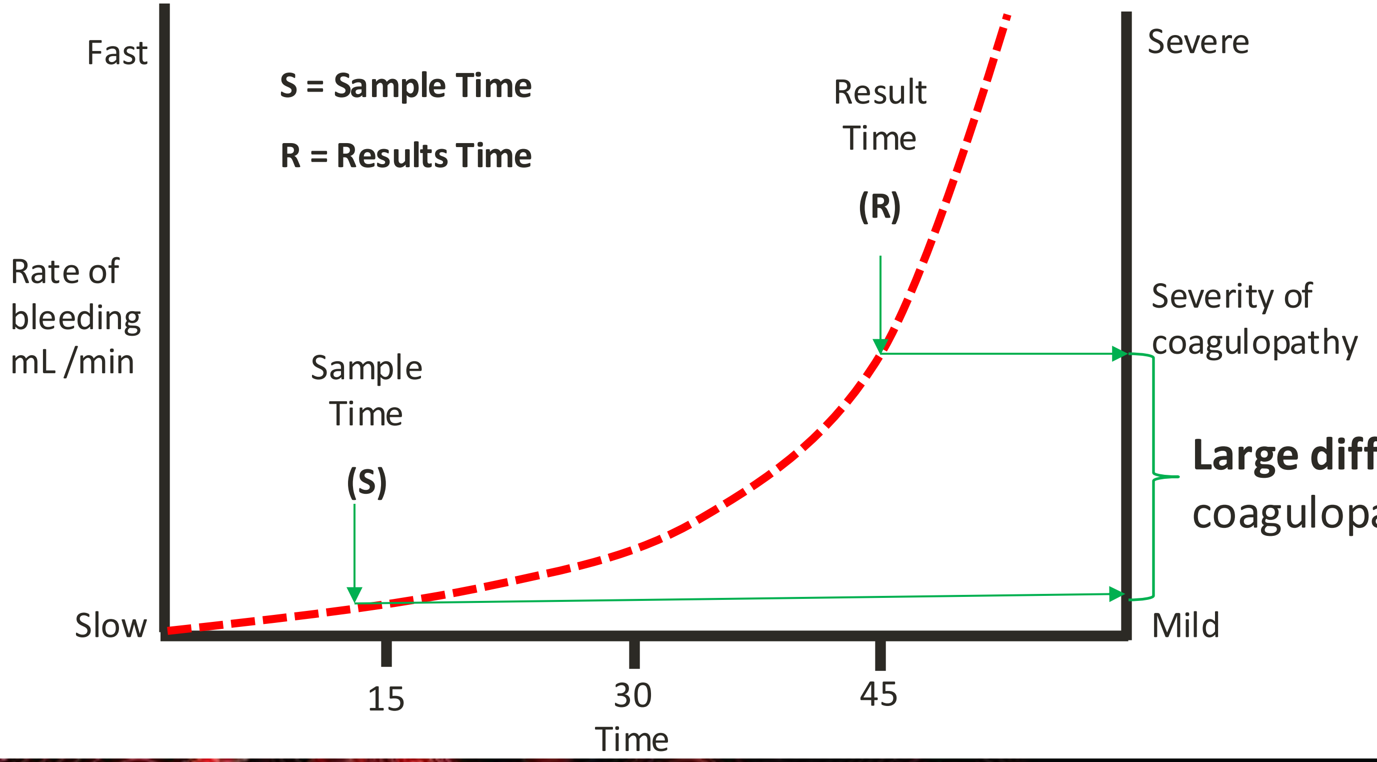


Left untreated, bleeding **increases in the rate of bleeding** and the **severity of coagulopathy over time**.

Key Clinical Value Proposition for QStat - Rapid Results

True point-of-care testing and clear actionable results

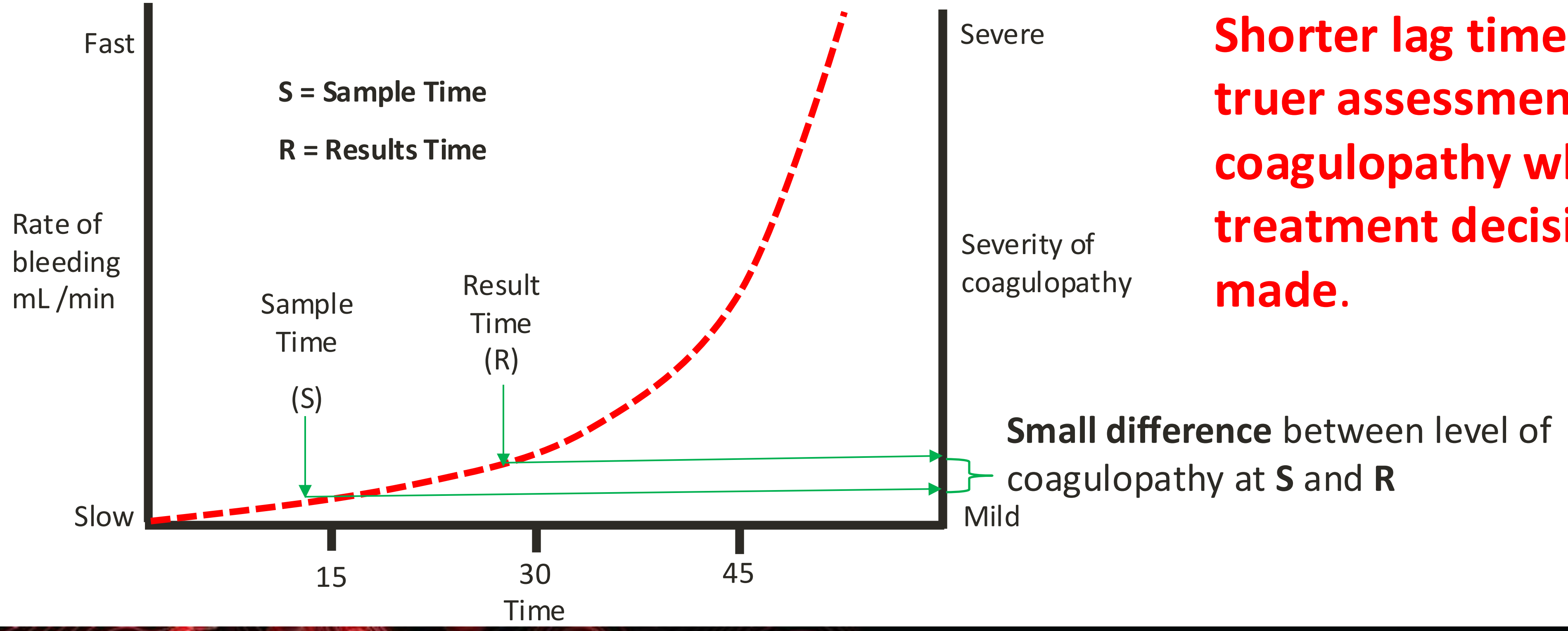
Being able to complete the testing at the true POC results in less time between sample draw and results that help guide therapy.



Large difference between level of coagulopathy at **S** and **R** times

True point-of-care testing and clear actionable results

Being able to complete the testing at the true POC results in **less time between sample draw and results** that help guide therapy.



Shorter lag time results in a truer assessment of coagulopathy when a treatment decision is being made.

Product Overview

Quantra Hemostasis Analyzer

Quantra was designed to overcome common issues inherent in other VET technologies:

- **Ease of Testing Operation**
  Optimized for use at point-of-care

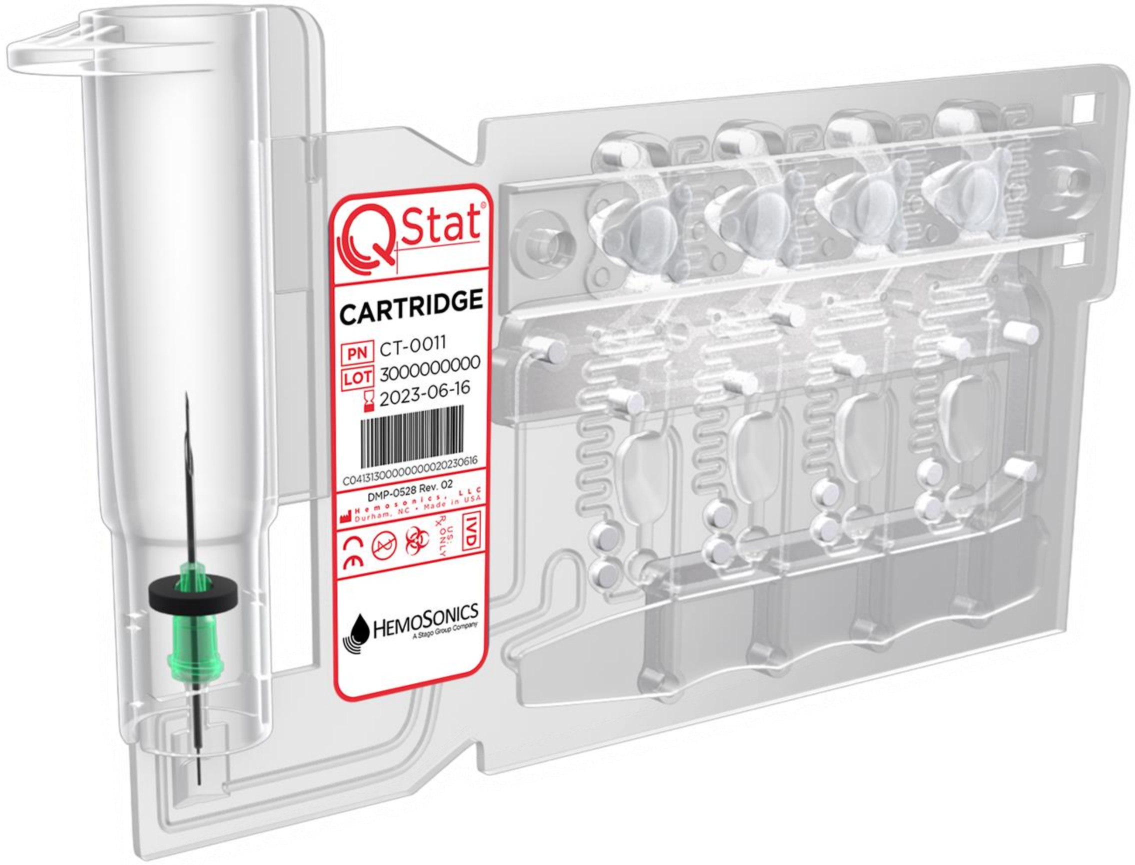
- **Ease of Interpretation**
  Facilitates scalability for training and increases confidence for clinical users

- **Speed to Actionable Result**
  Most clinically relevant results: 15 min or less

Product Overview

QStat® Cartridge

Parameter	Units	Measurement
Clot Time (CT)	sec	Intrinsic clot time in citrated whole blood
Clot Stiffness (CS)	hPa	Clot stiffness of the whole blood, extrinsic activation.
Fibrinogen Contribution to stiffness (FCS)	hPa	Contribution of fibrinogen activity to overall clot stiffness
Platelet Contribution to stiffness (PCS)	hPa	Contribution of platelet activity/count to overall clot stiffness
Clot Stability to Lysis (CSL)	%	Percentage of clot stiffness remaining after fibrinolysis



QStat is FDA cleared for use in **trauma** and **liver transplantation surgery**

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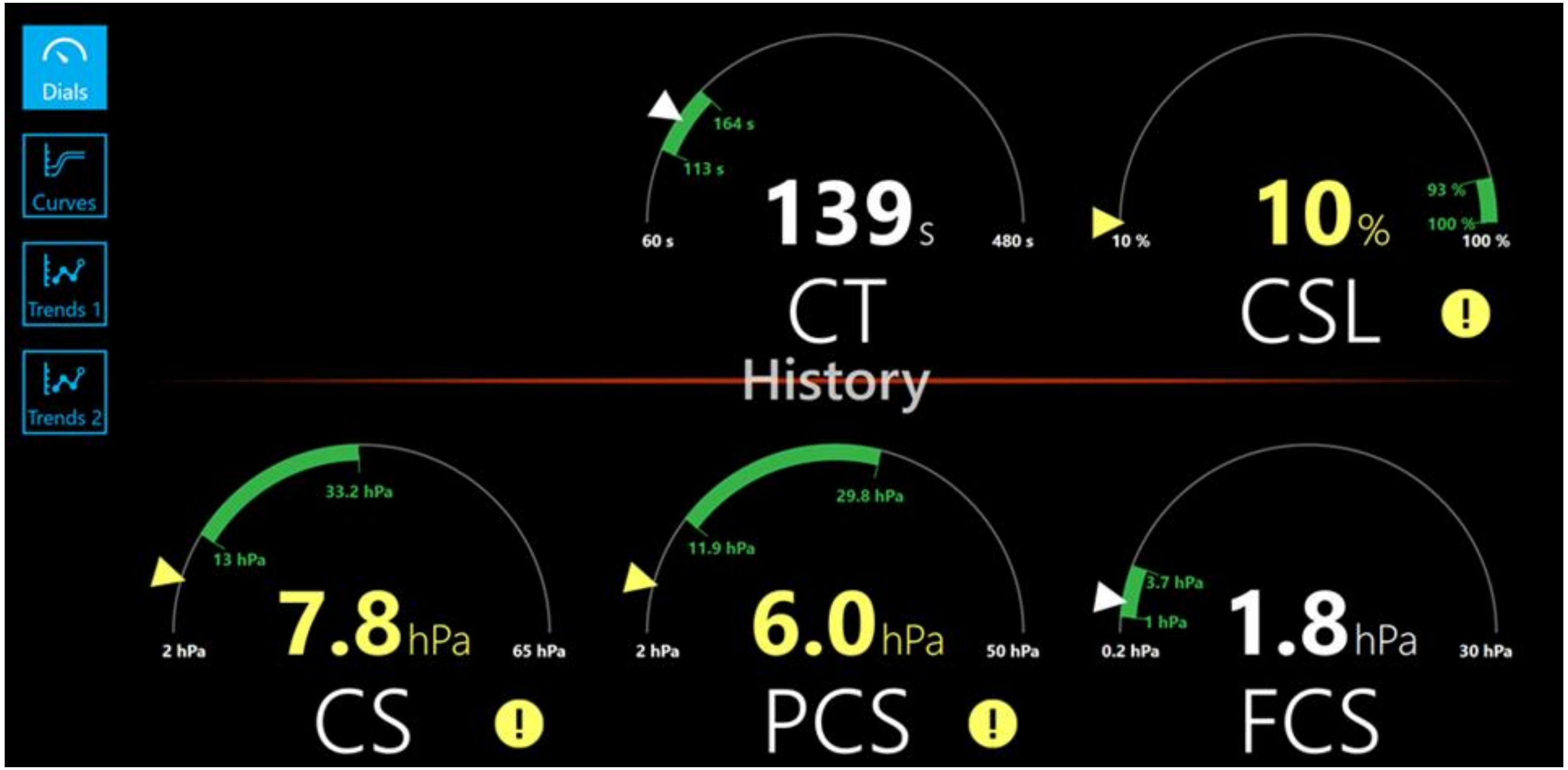
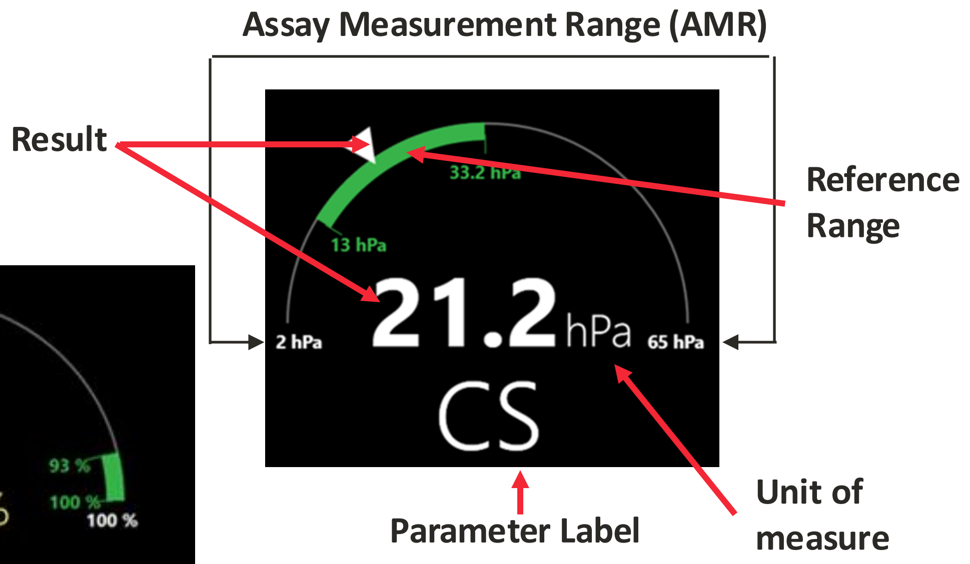
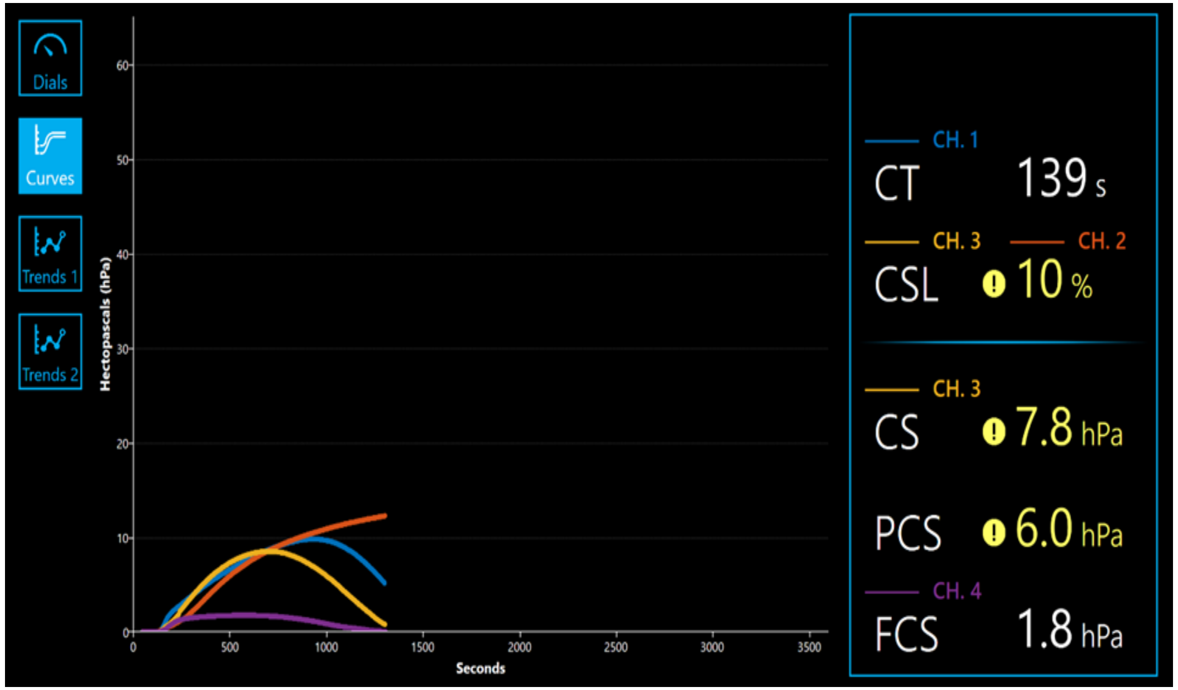
Basic Concepts Review

Primary QStat Display: Dials Screen



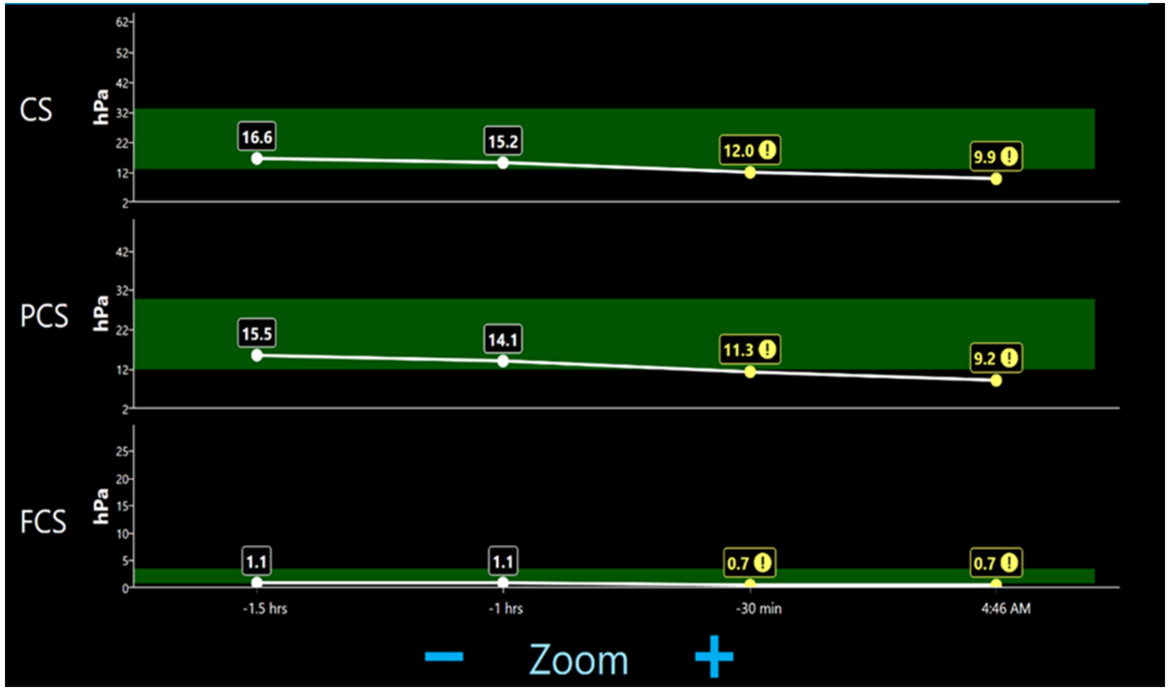


QStat Curves Screen



At a touch, there is also a **curve screen** that displays the individual curves in real-time for visualizing clot development dynamics.

QStat Trends Screen



Displays the results by parameter over time relative to their specific refences which can show trending to hypo- or hyper- coagulable results

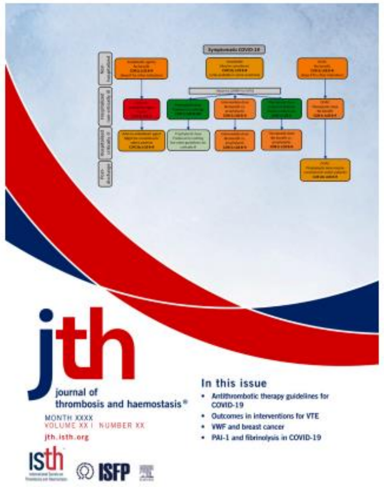
Performance of Quantra QStat

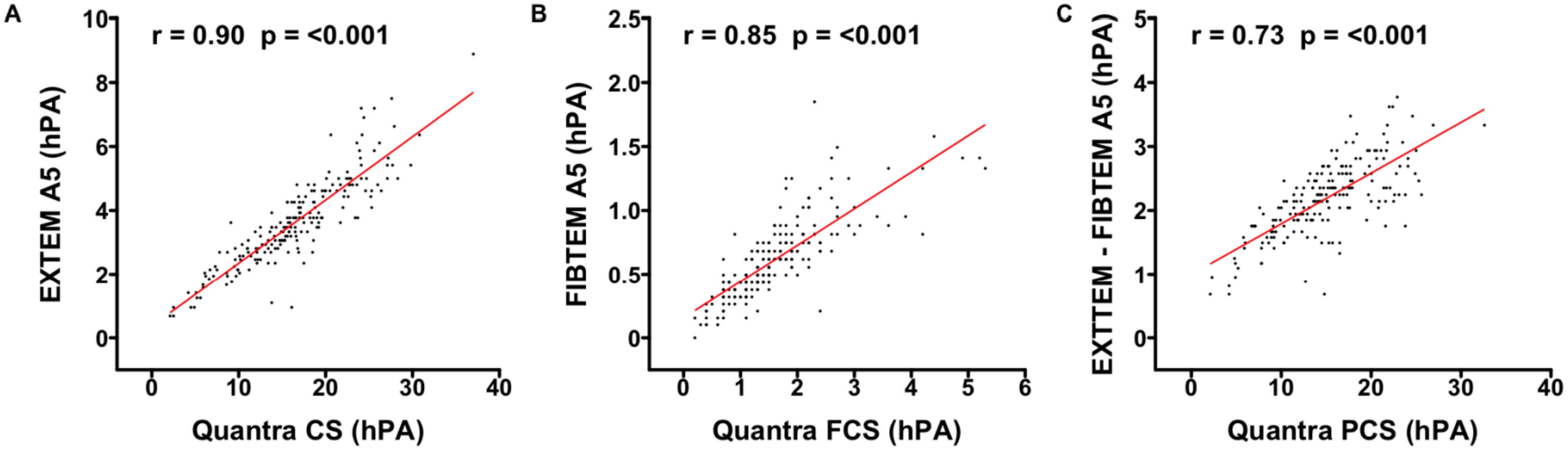
TIC requires rapid, reliable results to restore hemostasis

Performance vs ROTEM assays

Sonorheometry versus rotational thromboelastometry in trauma: a comparison of diagnostic and prognostic performance

Andrea Rossetto, M.D., Jared M. Wohlgemut, M.Sc., Karim Brohi, M.D., Ross Davenport, Ph.D.





Rossetto A, Wohlgemut JM, Brohi K, Davenport R, Sonorheometry versus rotational thromboelastometry in trauma: a comparison of diagnostic and prognostic performance, Journal of Thrombosis and Haemostasis (2023), doi: https://doi.org/10.1016/j.jtha.2023.04.031.

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Performance of Quantra QStat

TIC requires rapid, reliable results to restore hemostasis

Identified Quantra QStat Critical Cutoff Values

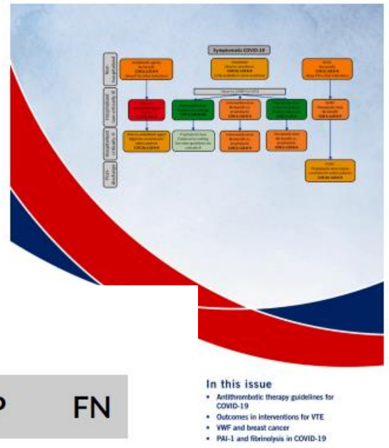

TABLE 2 Suggested Quantra cutoffs.

Parameters	Cutoff	Sensitivity	Specificity	NPV	PPV	Accuracy	TP	TN	FP	FN
Quantra CS for coagulopathy, (hPa)	15.3	0.81	0.73	0.95	0.38	0.74	21	92	34	5
Quantra FCS for hypofibrinogenemia (hPa)	1.6	0.81	0.60	0.88	0.47	0.66	38	64	43	9
Quantra PCS for thrombocytopenia (hPa)	13.3	0.83	0.72	0.97	0.28	0.73	19	122	48	4
Quantra CS for CAT (hPa)	16.4	0.80	0.61	0.89	0.44	0.67	44	89	56	11
Quantra CT for mortality at 6 h (s)	146	0.88	0.89	0.99	0.24	0.89	7	174	22	1

CAT, critical administration threshold; CS, clot stiffness; CT, clot time; FCS, fibrinogen contribution to clot stiffness; FN, false negative; FP, false positive; hPa, hectopascal; NPV, negative predictive value; PCS, platelet contribution to clot stiffness; PPV, positive predictive value; TN, true negative; TP, true positive.

Rossetto A, Wohlgemut JM, Brohi K, Davenport R, Sonorheometry versus rotational thromboelastometry in trauma: a comparison of diagnostic and prognostic performance, Journal of Thrombosis and Haemostasis (2023), doi: https://doi.org/10.1016/j.jtha.2023.04.031.

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TIC Platelet Dysfunction

PCS and Platelet dysfunction

	Platelet count (per µl)		
	<50,000	<80,000	<100,000
	N = 5	N = 24	N = 76
Proposed QPlus cutoffs (hPa)	PCS < 11.2 (8.7, 15.0)	PCS < 12.1 (11.8, 12.7)	PCS < 14.1 (12.6, 16.0)
Sensitivity (%)	100 (100,100)	100 (98.8, 100)	89.5 (79.0, 100)
Specificity (%)	86.5 (78.0, 92.7)	83.7 (79.8, 86.4)	74.2 (61.0, 83.7)
PPV (%)	4.5 (3.7, 55.6)	16 (10.2, 22.4)	26.8 (18.1, 35.1)
NPV (%)	100 (100, 100)	100 (100, 100)	98.5 (97.2, 99.8)

Naik, *Thromb Res.* 2021

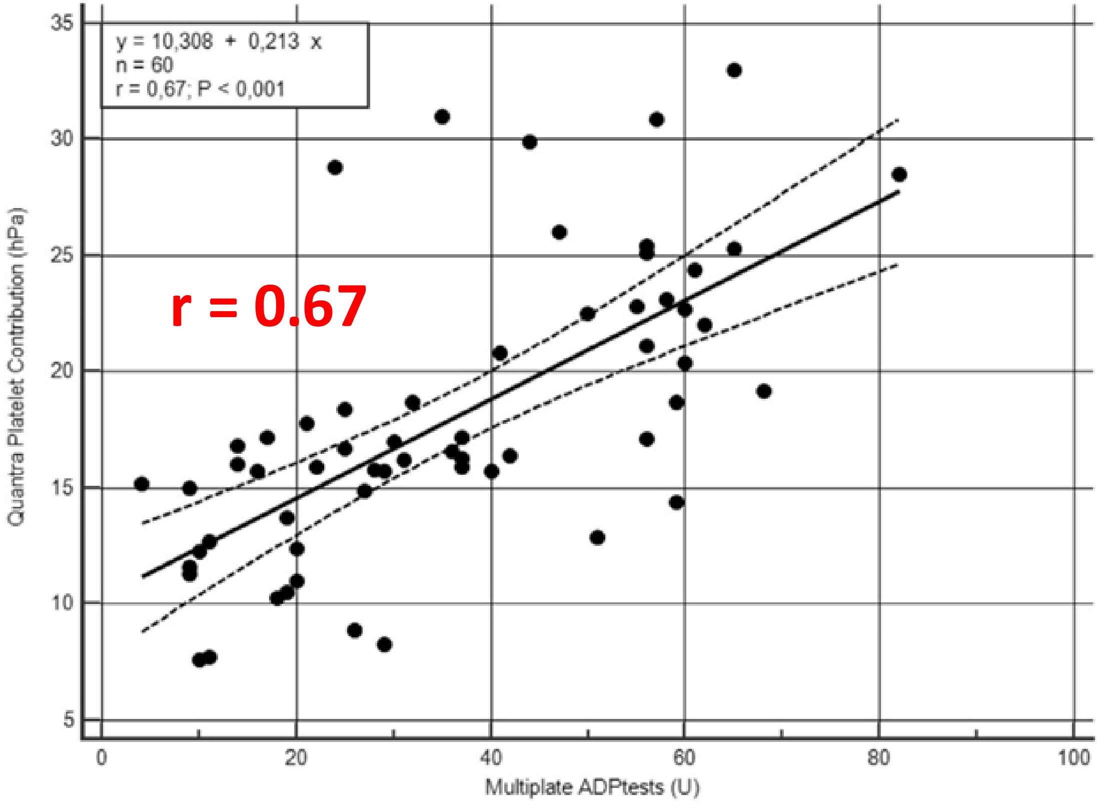
Table 5. Performance of Post-CPB Platelet Count and PFT in Predicting Major Bleeding

Variable	AUC (95% CI)[a]	P[b]	P[a]	Cutoff	Sensitivity% (95% CI)	Specificity% (95% CI)	PPV% (95% CI)	NPV% (95% CI)
QUANTRA PCS (hPa)	0.80 (0.61–0.99)	.001	.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)	.001	.006	155	80 (52–96)	70 (51–83)	57 (42–71)	87 (71–95)
ROTEM A10 PC (mm)	0.75 (0.51–0.99)	.004	.024	40	67 (38–88)	70 (51–85)	53 (37–68)	81 (66–90)
ROTEM PC (mm)	0.74 (0.50–0.99)	.008	.048	48	73 (45–92)	73 (58–94)	69 (48–84)	86 (73–94)
MEA ADPtest (U)	0.67 (0.42–0.91)	.064	.384	22	67 (38–88)	57 (37–74)	43 (31–57)	77 (61–88)
MEA TRAPtest (U)	0.62 (0.37–0.86)	.189	1.000	88	47 (21–73)	50 (31–69)	32 (20–67)	65 (51–77)

The Quantra QPlus PCS parameter result of 13.8 hPa was independently associated with a major bleeding events following CPB.

Baryshnikova, *Anesthesia & Analgesia.* 2022

Quantra PCS vs MEA ADP



Baryshnikova E, et al., J Cardiothorac Vasc Anesth. 2019

Performance of Quantra QStat

TIC requires rapid, reliable results to restore hemostasis

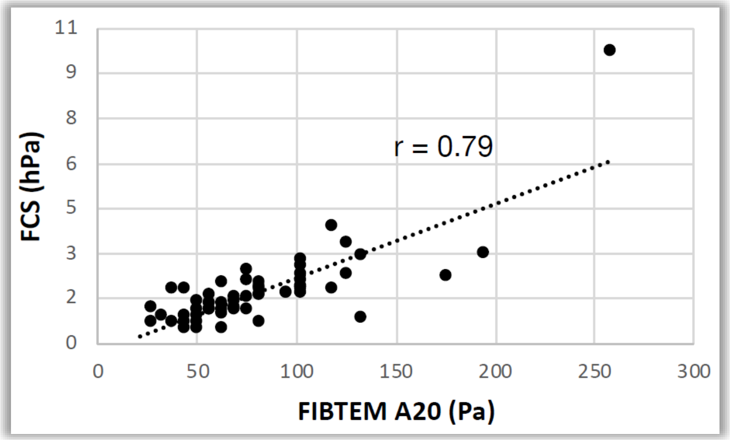
Performance vs ROTEM assays

Open access Original research

Trauma Surgery & Acute Care Open

Initial clinical experience with the Quantra QStat System in adult trauma patients

Edward A Michelson,[1] Michael W Cripps,[2] Bradford Ray,[3] Deborah A Winegar,[4] Francesco Viola[4]



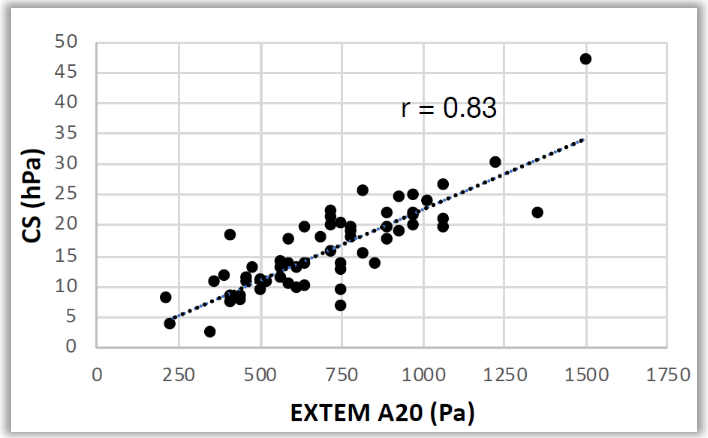


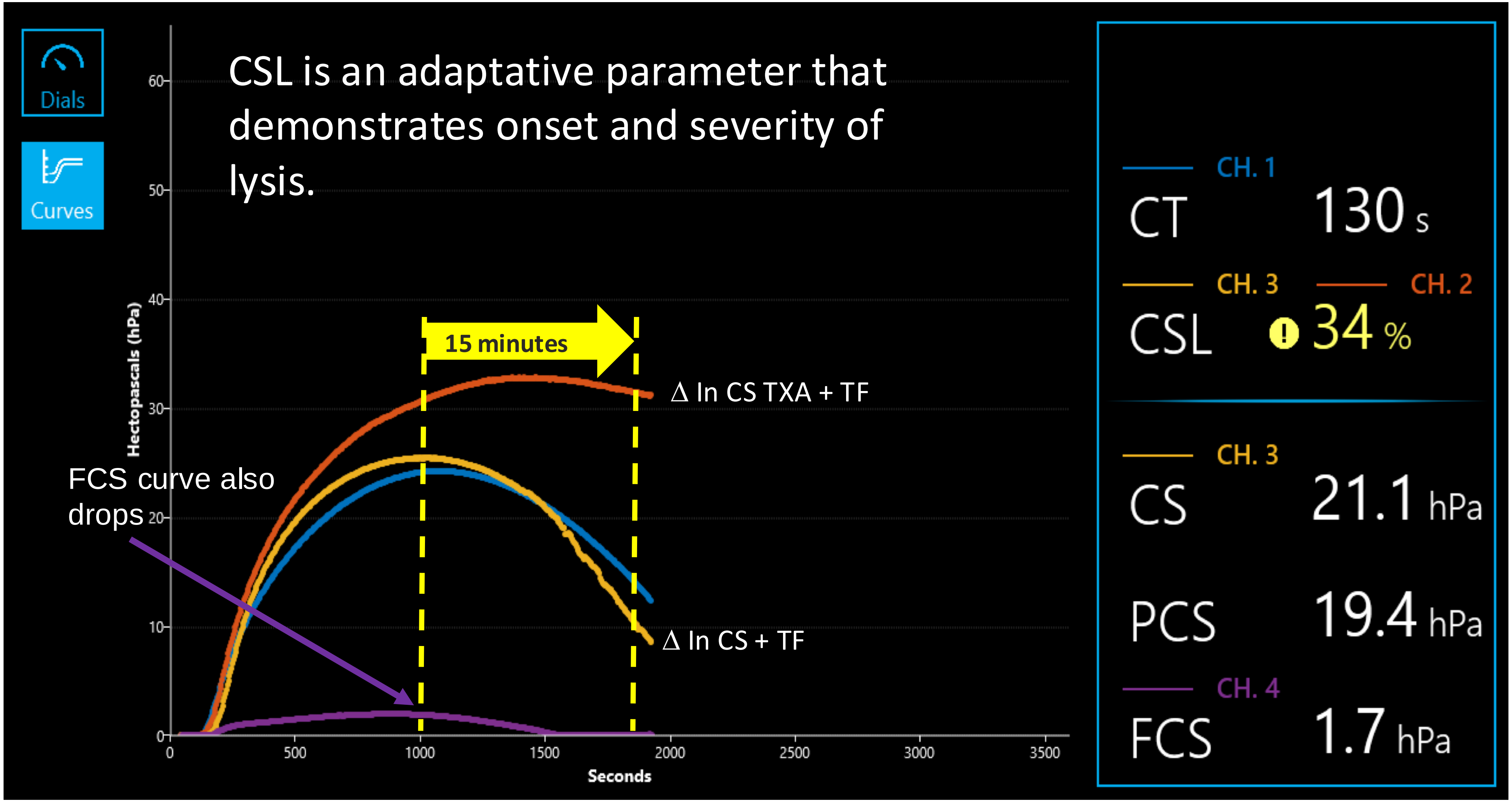
Table 3 Concordance analysis of QStat CSL versus ROTEM EXTEM ML

		ROTEM EXTEM	
		ML >15% (fibrinolysis +)	ML ≤15% (fibrinolysis –)
Quantra QStat	CSL <93% (fibrinolysis +)	5	2
	CSL ≥93% (fibrinolysis –)	0	51
Overall agreement	96.6%		

CSL, clot stability to lysis; ML, maximum lysis.

Michelson EA, Cripps MW, Ray B, Winegar DA, Viola F. Initial clinical experience with the Quantra QStat System in adult trauma patients. Trauma Surg Acute Care Open. 2020

Hyperfibrinolysis Detection on QStat



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Quantra QStat – Detection of hyperfibrinolysis and evidence of resolution after TXA

Upon arrival to ER | **After TXA treatment**

Michelson EA, Cripps MW, Ray B, Winegar DA, Viola F. Initial clinical experience with the Quantra QStat System in adult trauma patients. Trauma Surg Acute Care Open. 2020

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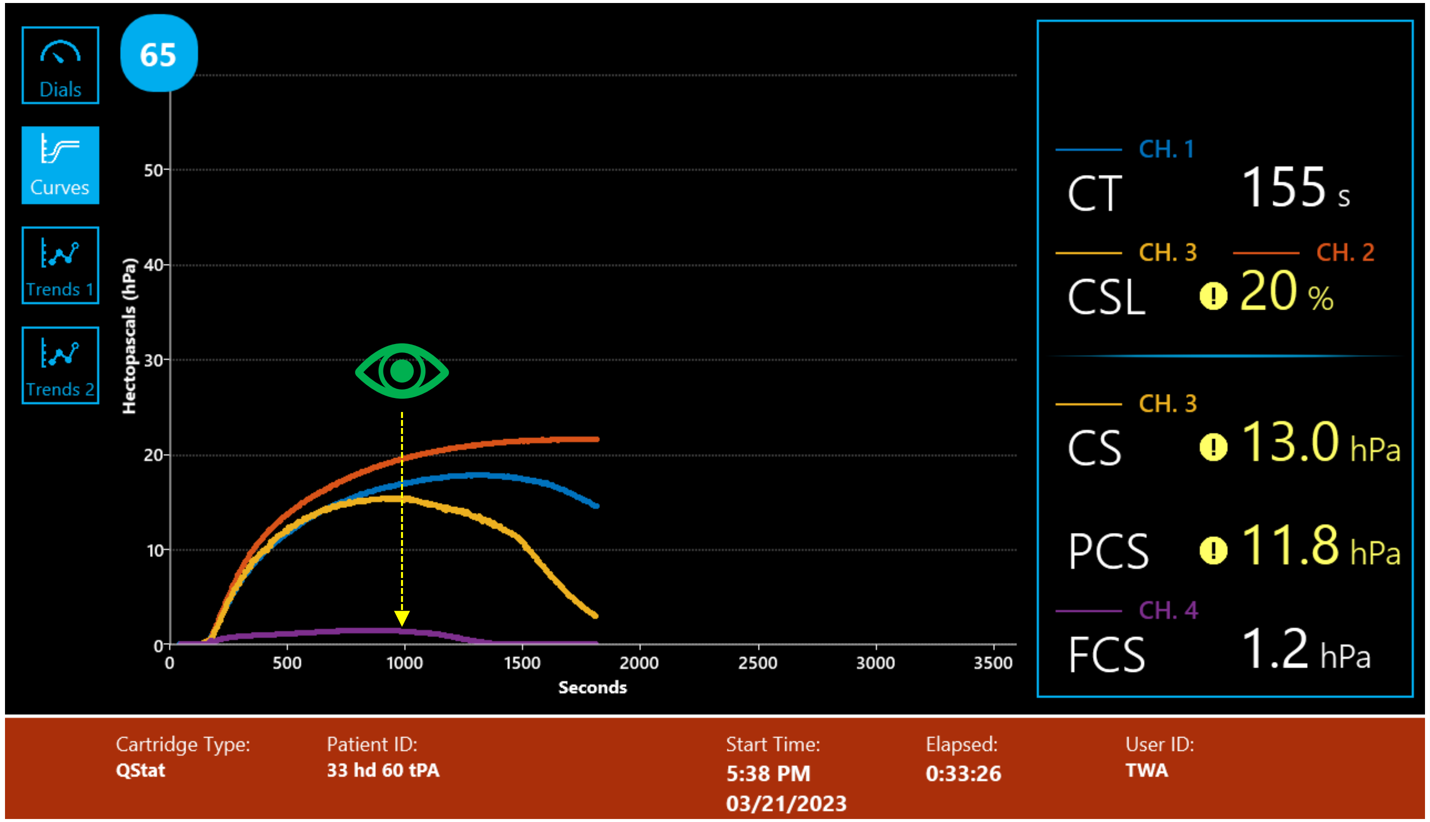
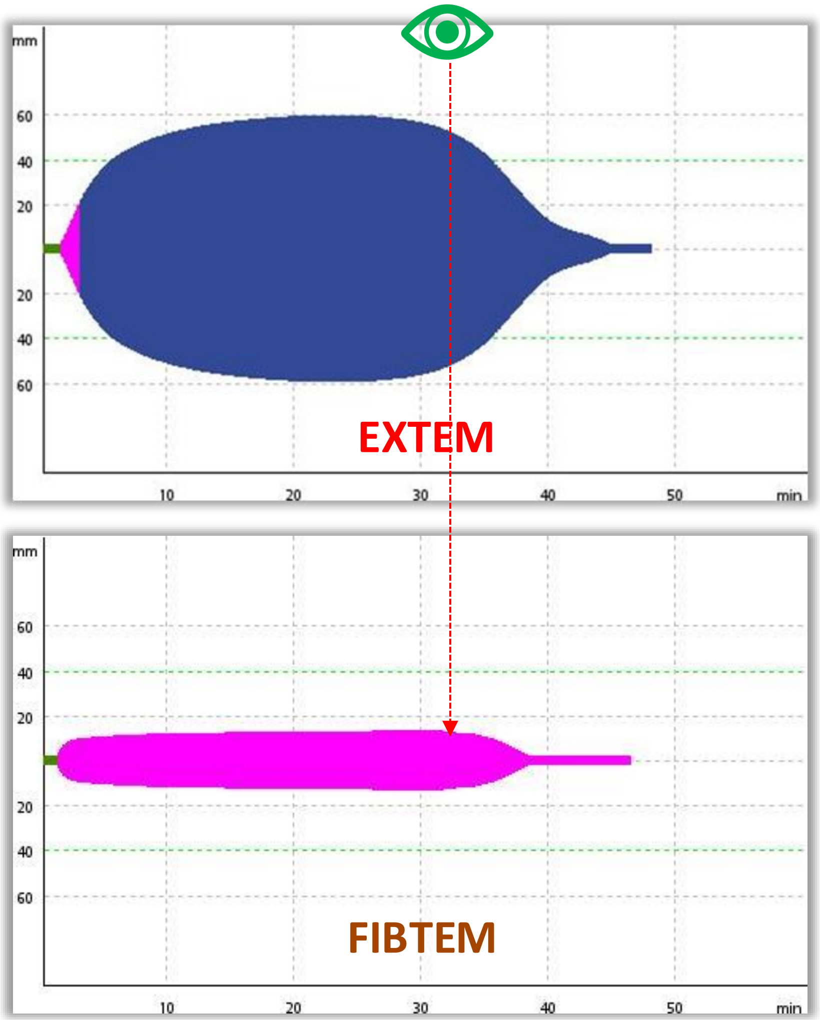
Hemodilution and tPA Spiking Study

33% HD + 60 U/ml tPA





CT: 86 sec
A10: 53 mm
A20: 59 mm
MCF: 59 mm
ML: 100%
LI30: 90%
LI60: - %

CT: 72 sec
A10: 15mm
A20: 16mm
MCF: 16mm
ML: 100%
LI30: 69%
LI60: - %

Practical time to detect HF; Quantra 16 min ROTEM 33 min

Please visit the poster presentation for complete information.

QUANTRA® QSTAT® SYSTEM EXHIBITS RAPID DETECTION OF FIBRINOLYSIS

Todd Allen, BS, Theresse Gregory, BS, Brianna Baswell, BS, Francesco Viola, PhD
HemoSonics, LLC, Durham, NC, USA

Background and Objective

Hyperfibrinolysis (HF) from traumatic injury remains a cause of critical bleeding. Viscoelastic testing (VET) is a practical way to identify HF, however, the sensitivity of VET to detect moderate or mild HF has been disputed[1]. The Quantra QStat System uses an ultrasound-based clot detection technology to measure changes in clot stiffness. QStat parameters include overall clot stiffness (CS), fibrinogen contribution to stiffness (FCS), and a unique parameter to detect fibrinolysis, Clot Stability to Lysis (CSL)[2]. CSL compares curves obtained with and without tranexamic acid (TXA) and reports the divergence as a percentage. CS, FCS, and CSL are measured via tissue factor (TF) activation.

The objective of this work was to compare HF detection between QStat vs established HF parameters obtained with the ROTEM EXTEM and FIBTEM assays (both TF-based assays). We hypothesized that QStat would detect HF faster than ROTEM.

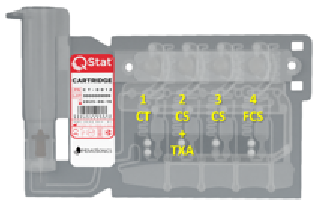


Figure 1. QStat Four Channel Cartridge.

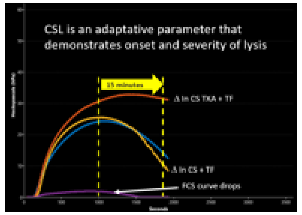


Figure 2. Development of CSL parameter.

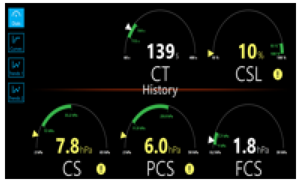


Figure 3a. QStat Dial Screen. CT = Clot time; PCS = Platelet contribution to CS.

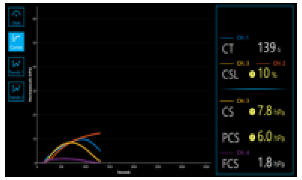


Figure 3b. QStat Curve Screen. CT = Clot time; PCS = Platelet contribution to CS.

Methods

Forty paired whole blood (WB) samples were collected from 5 healthy donors at a Level I trauma center and contrived with matched amounts of tissue plasminogen activator (tPA) to achieve final concentrations of 50 to 90 U/mL. Samples were analyzed with QStat, EXTEM, and FIBTEM assays. In addition to the time to compute the CSL parameter, the time required to reduce clot stiffness in the CS and FCS curves (yellow and purple curves in Figure 2, respectively) by 5, 10, and 15% from peak level was determined offline. For the EXTEM and FIBTEM assays, the LOT (Lysis Onset Time) parameter was used as the time for positive identification of lysis. The Lysis Onset Time is the time from the start of the test to when 15% ML occurs.

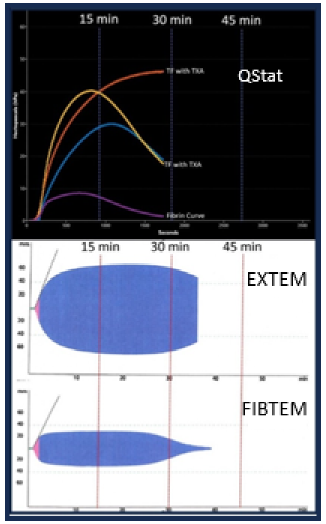


Figure 4. Example of paired samples spiked with 68 U/mL tPA. QStat curves (top panel) demonstrating fibrinolysis compared to EXTEM and FIBTEM curves (bottom panel).

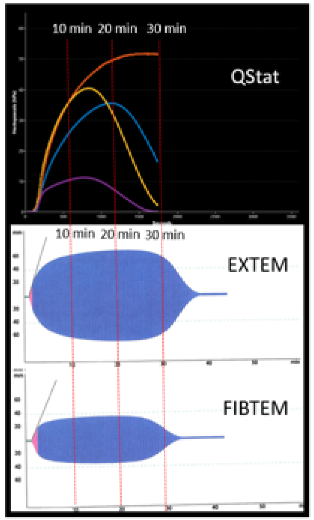


Figure 5. Example of paired samples spiked with 90 U/mL tPA. QStat curves (top panel) demonstrating fibrinolysis compared to EXTEM and FIBTEM curves (bottom panel).

Results

Quantra QStat CS and FCS curves had significantly shorter times (min) to detect a 15% reduction in clot stiffness compared to equivalent ROTEM-based assays. The reporting of the QStat CSL parameter was also significantly faster than the equivalent ROTEM parameter.

Assays / Parameters	5% (min)	10% (min)	15 % (min)
QStat CS assay curve	21.4 (3.9)	23.1 (4.3)	24.5 (4.6)
QStat FCS assay curve	19.7 (4.2)	20.9 (4.4)	21.9 (4.6)
EXTEM LOT	N/A	N/A	37.2 (6.4)
FIBTEM LOT	N/A	N/A	33.4 (6.4)
QStat CSL	minutes to parameter completion 32.3 (2.7)		
*Data expressed as mean (standard deviation)			

Times Comparison	*p*
Clot Stiffness Loss: 15% QStat CS assay vs EXTEM LOT	< 0.01
Clot Stiffness Loss: 15% QStat FCS assay vs FIBTEM LOT	< 0.01
CSL time vs EXTEM LOT	< 0.01

Table 1. Measured times to decreased clot stiffness/firmness from peak. CS = Clot Stiffness; FCS = Fibrinogen contribution to Clot Stiffness; CSL = Clot Stability to Lysis; LOT = Lysis Onset Time; N/A = Not applicable as time was not assessed.

Conclusion

QStat detected HF more quickly than ROTEM assays in this experimental WB model. More research in traumatically injured patients is underway to validate this preliminary conclusion.

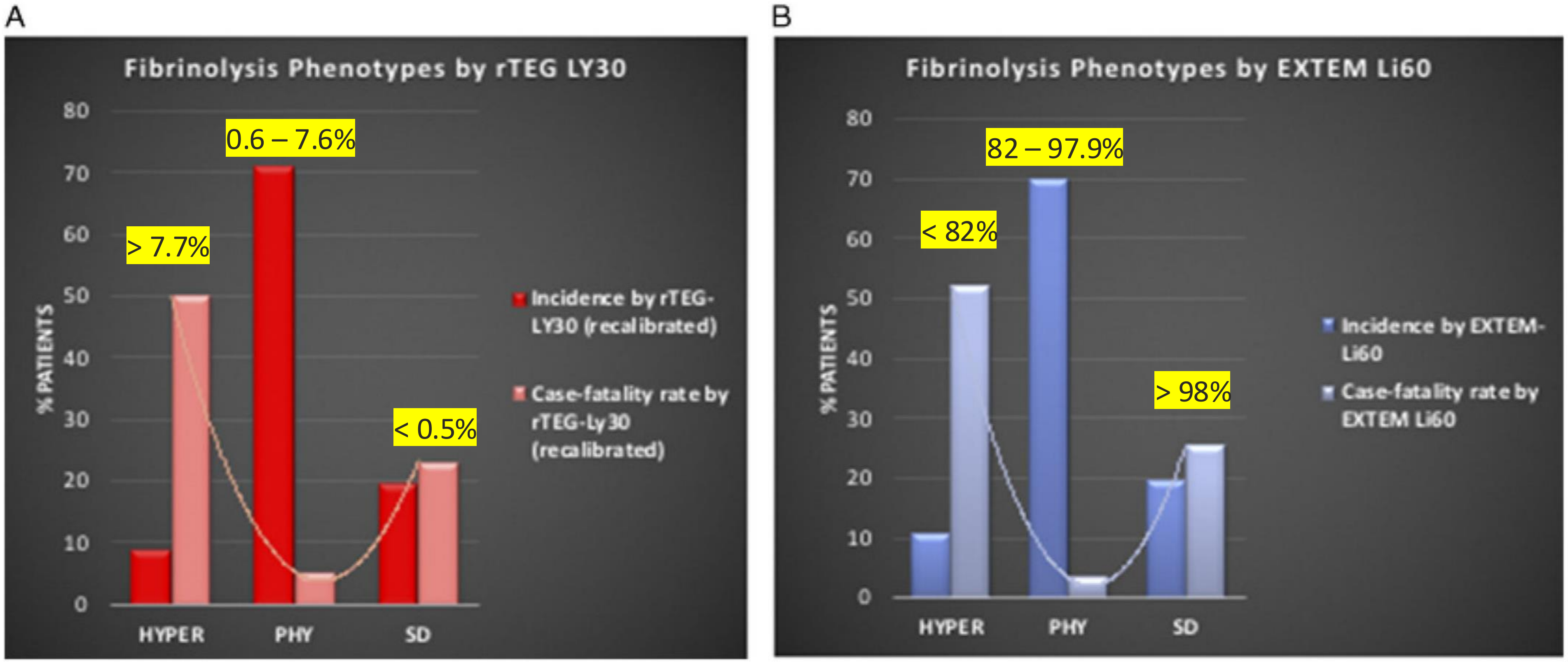
References

1. Raza et al., *J. Thromb. Haemost.* 2013
2. Michaelson et al., Trauma Surg Acute Care Open. 2020

Funding/Disclosures

This study was funded by HemoSonics, LLC. The authors are employed by HemoSonics, LLC, a medical device company that is commercializing the Quantra and the QStat Cartridge.

Fibrinolysis: Normal, Hyper and Hypo (referred to as Shut Down)



Fibrinolysis Shut Down (SD) phenotype has not been established with Quantra CSL. It might be reasonable to consider that it is occurring if the patient is severely injured and has a CSL > 99%.

Figure 1.
Incidence of fibrinolysis phenotypes and mortality rate by fibrinolysis strata. A U-shaped distribution is illustrated using both (*A*) rTEG and (*B*) EXTEM assays.

Stettler GR, J Trauma Acute Care Surg. 2019

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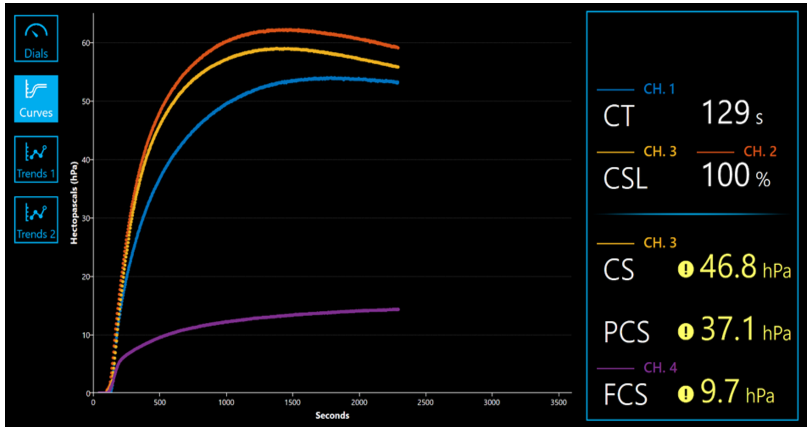
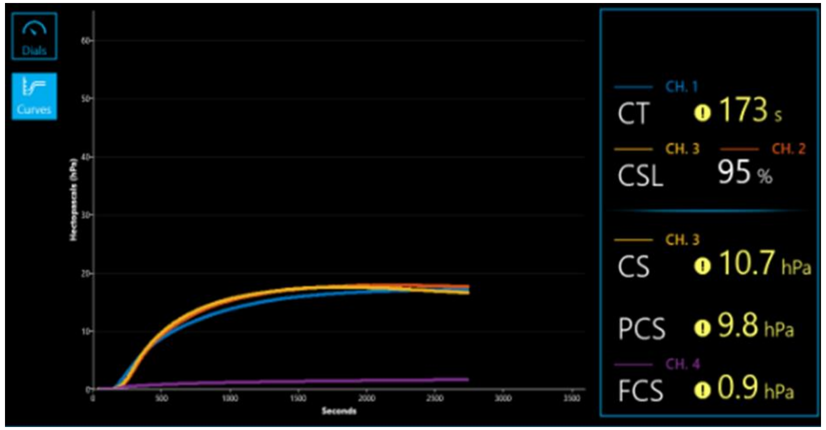
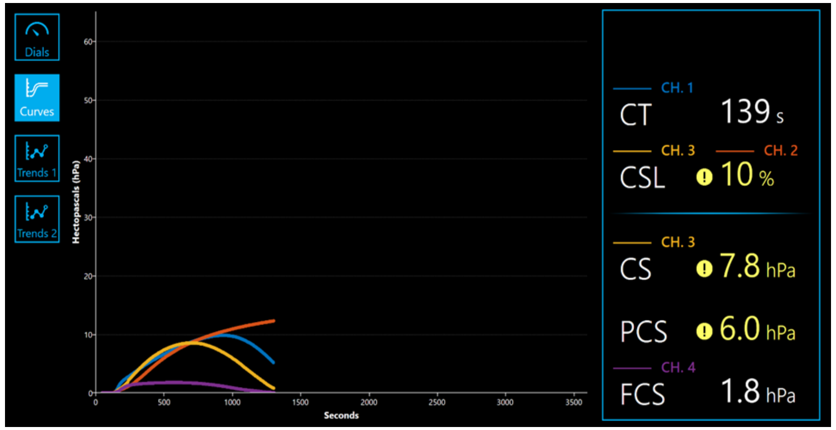
Fibrinolysis: Possible phenotypes on Quantra QStat

This is early speculation of the phenotype differences with CSL. More work needs to be done to categorize the phenotypes as the previous work as done with TEG and ROTEM.







Shutdown*

CSL 100%

Physiologic Lysis

CSL = 92 - 99%

Hyperfibrinolysis

CSL < 90%

***Fibrinolysis Shut Down (SD) phenotype has not been established with Quantra CSL**. It might be reasonable to consider that it is occurring if the patient is severely injured and has a CSL > 99%.

Trauma Publications


The Quantra® System and SEER Sonorheometry

41

Todd W. Allen, Deborah Winegar, and Francesco Viola

Introduction

The use of whole blood viscoelastic testing (VET) for perioperative and critical bleeding management has seen important evolutionary changes in both technology and clinical application over the last decade. To this effect, the clinical use of VET is approaching the standard of care with increasing numbers of practice guideline recommendations [1–5] in clinical settings where bleeding is a major contributor to poor patient outcomes and increasing costs that are associated with bleeding and blood transfusions. Such clinical areas where bleeding is prevalent are cardiovascular surgery, liver transplantation, obstetric hemorrhage, multilevel spine surgery, and trauma.

While conventional thromboelastometry (ROTEM®, Instrumentation Laboratory, Bedford, MA) and thromboelastography (TEG®, Haemonetics Corp, Braintree, MA) have been the principal VET technologies to date, a novel ultrasound-based VET device named the Quantra® Hemostasis Analyzer (Quantra) (HemoSonics, LLC, Charlottesville, VA) has recently been introduced for clinical use. The Quantra was designed with two main objectives in mind: (1) to further refine VET clot detection methodology and (2) to improve usability factors inherent to other VET platforms that impede broader clinical adoption. The approach taken to improve the usability of VET leverages a novel technology to simplify operator interface, decrease turnaround time to actionable results, and make the interpretation of results easy to understand by clinicians with minimal VET experience.

Measurement Principles

Viscoelasticity refers to a series of properties that characterize how solid materials respond to an applied deformation. When fibrin is produced and polymerized into a three-dimensional structure during coagulation, a viscoelastic solid is formed which exhibits a combination of viscous and elastic behaviors [6]. The viscoelastic properties of the clot evolve dramatically during the process of fibrin network assembly and further change as the platelets aggregate and contract to consolidate the fibrin network. After coagulation, fibrinolysis begins the process of fibrin degradation and the clot returns to a fluid state.

The Quantra uses a patented ultrasound-based technology called Sonic Estimation of Elasticity via Resonance (SEER) sonorheometry that can measure the dynamic evolution of the viscoelastic properties of a clot during the process of

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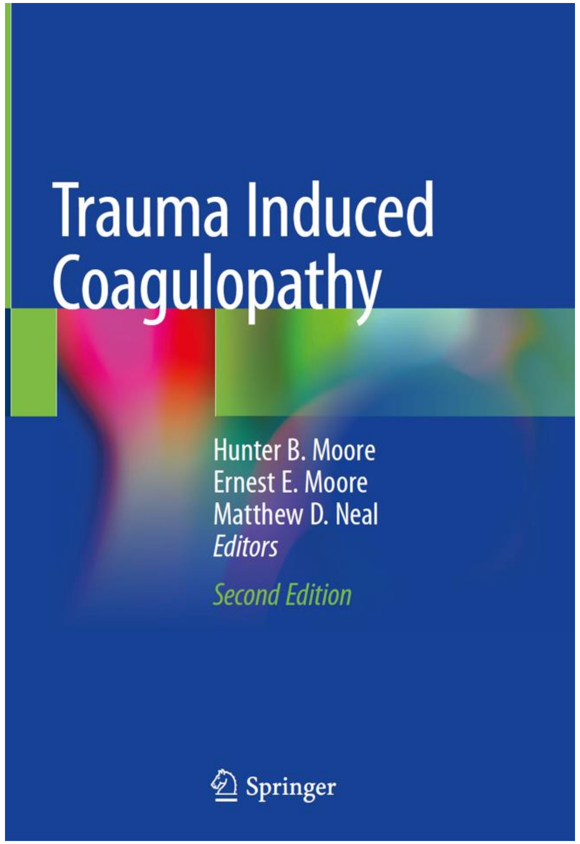
F. Viola
HemoSonics, LLC, R&D, Charlottesville, VA, USA

H. B. Moore et al. (eds.), *Trauma Induced Coagulopathy*,
https://doi.org/10.1007/978-3-030-53606-0_41

Comprehensive review of the Quantra® Hemostasis Analyzer with QStat and QPlus®



Allen, T.W., Winegar, D., Viola, F. (2021). The Quantra® System and SEER Sonorheometry. In: Moore, H.B., Neal, M.D., Moore, E.E. (eds) Trauma Induced Coagulopathy. Springer, Cham. https://doi.org/10.1007/978-3-030-53606-0_41

Quantra: Viscoelastic testing reimagined…
Bleeding management refined.

Thank you!

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