Impact of Rapid Thromboelastrography (rTEG) on Intraoperative Blood Utilization in Cardiac Surgery

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Risk/Benefit of Blood Transfusion

Risks

- Infectious - viral, parasitic, bacterial, prion
- Immunologic – HTR, TRALI, GVHD, alloimmunization
- Non-immunologic (volume overload)

Benefits

- Difficult to find in the literature
- Practices learned and benefits assumed
- Practice changes over time, largely in response to appreciation of risks

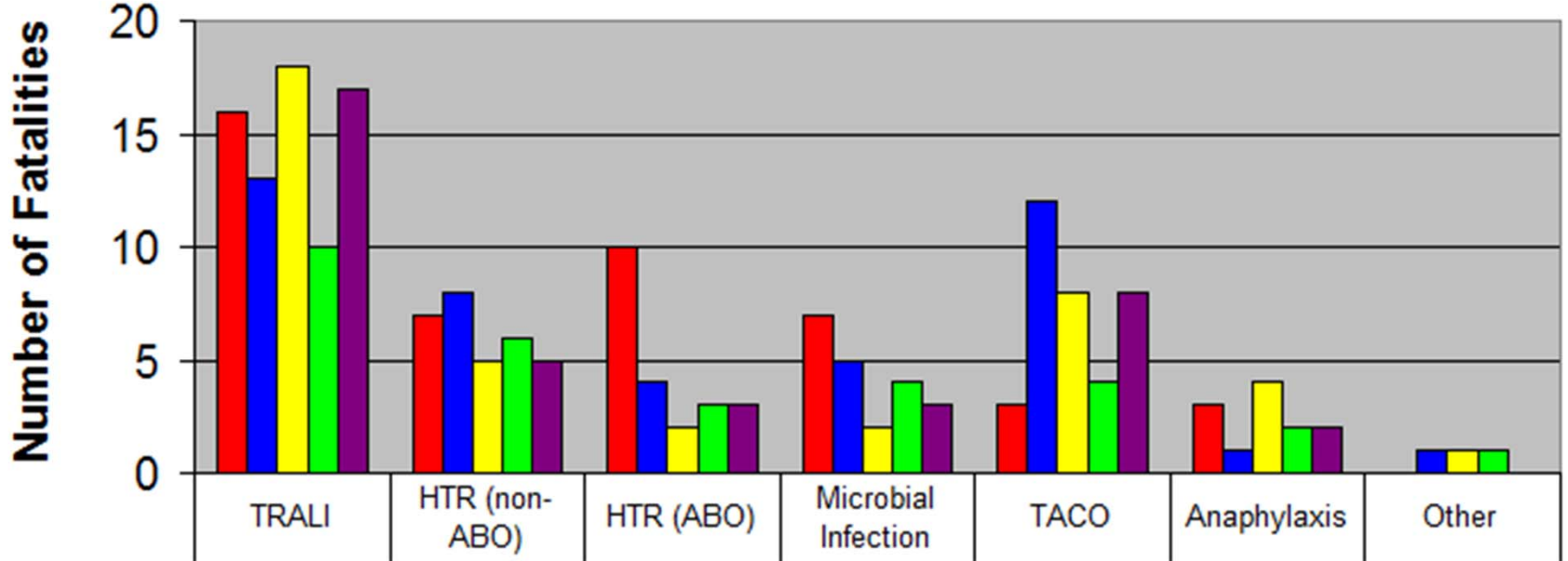
blood

2009 113: 3406-3417
Prepublished online Feb 2, 2009;
doi:10.1182/blood-2008-10-167643

Transfusion-related mortality: The ongoing risks of allogeneic blood transfusion and the available strategies for their prevention

Eleftherios C. Vamvakas and Morris A. Blajchman

Transfusion-Related Fatalities by Complication, FY2008- FY2012



	TRALI	HTR (non-ABO)	HTR (ABO)	Microbial Infection	TACO	Anaphylaxis	Other
FY08	16	7	10	7	3	3	0
FY09	13	8	4	5	12	1	1
FY10	18	5	2	2	8	4	1
FY11	10	6	3	4	4	2	1
FY12	17	5	3	3	8	2	0

Complication

Recent Transfusion Statistics

- New and established medical procedures require transfusion support; cardiothoracic surgery, hematopoietic and organ transplantation, trauma resuscitation, ECMO, VAD
- Widespread use of anti-platelet and anticoagulant drugs contribute to coagulopathies
- 15 million red cell units
- 2 million platelets
- 2.4 million plasma units
- 1 million cryoprecipitate

Cardiac Surgical procedures

- 50-60% of cardiac surgical patients receive blood
- 20% of nation's blood supply used in their support
- 120,470 patients undergoing CABG at 798 sites in US;
- Rates of transfusion of all components varied from 0->90%, independent of case mix, # of procedures performed at site
- Transfusion rates varied within hospital, between hospitals and between geographic regions; no differences in mortality

JAMA-2010;304:1568

40% of platelet transfusions, 30% of plasma transfusion may be inappropriate

Effect of Transfusion in Cardiac Surgery

- Evidence associating adverse outcomes with transfusion
- Increased post operative infections
- Increased in hospital and long term mortality

“Transfusion Liberalism”

- Despite lack of certainty of benefits of transfusion in many instances (and evidence of harm), resistance to change is great-the two largest RCTs in non-bleeding patients recommend restrictive over liberal transfusion strategy
- Cling to a precautionary bias against undertransfusion?
- Practice influenced by physician fear-perception of risk of transfusion has shifted over the past 2 decades
- Most transfusion thresholds are surrogate measures at best; hemoglobin for tissue oxygenation, platelet count and PT/PTT for in vivo clotting capability
- Lack of real-time functional data, transfusions tend to be empiric

Cardiovascular Surgery

- Patients undergoing cardiopulmonary bypass procedures have a variety of hemostatic alterations:
- Many are on platelet inhibitors (ASA, plavix)
- Hemodilution during CPB due to use of non-blood prime; factor and platelet deficiencies
- Hypothermia and circuit through CPB machine adversely affect platelet function
- Consumption of coagulation factors and platelets
- Anticoagulation with heparin while on bypass to prevent thrombosis

What can improve transfusion practice

- Transfusion algorithms based on best practice guidelines
- Point of care testing can reduce turn around time and provide more relevant data to support decision making
- Consider expanded POCT in cardiothoracic surgery to evaluate coagulation status

Anesth Analg 1999

Thromboelastography-Guided Transfusion Algorithm Reduces Transfusions in Complex Cardiac Surgery

Linda Shore-Lesserson, MD*, Heather E. Manspeizer, MD*, Marietta DePerio, RN*, Sanjeev Francis, BS*, Frances Vela-Cantos, RN*, and M. Arisan Ergin, MD, PhD†

Departments of *Anesthesiology and †Cardiothoracic Surgery, Mount Sinai Medical Center, New York, New York

Thromboelastography in cardiac surgery

100 complex cardiac surgery patients

- Randomized to TEG guided transfusion algorithm or routine coagulation monitoring
- No difference in intraoperative transfusion but significantly fewer post-op & total transfusions in TEG group
- Suggests improved hemostasis due to earlier identification of coagulation abnormality lead to appropriate and timely intervention

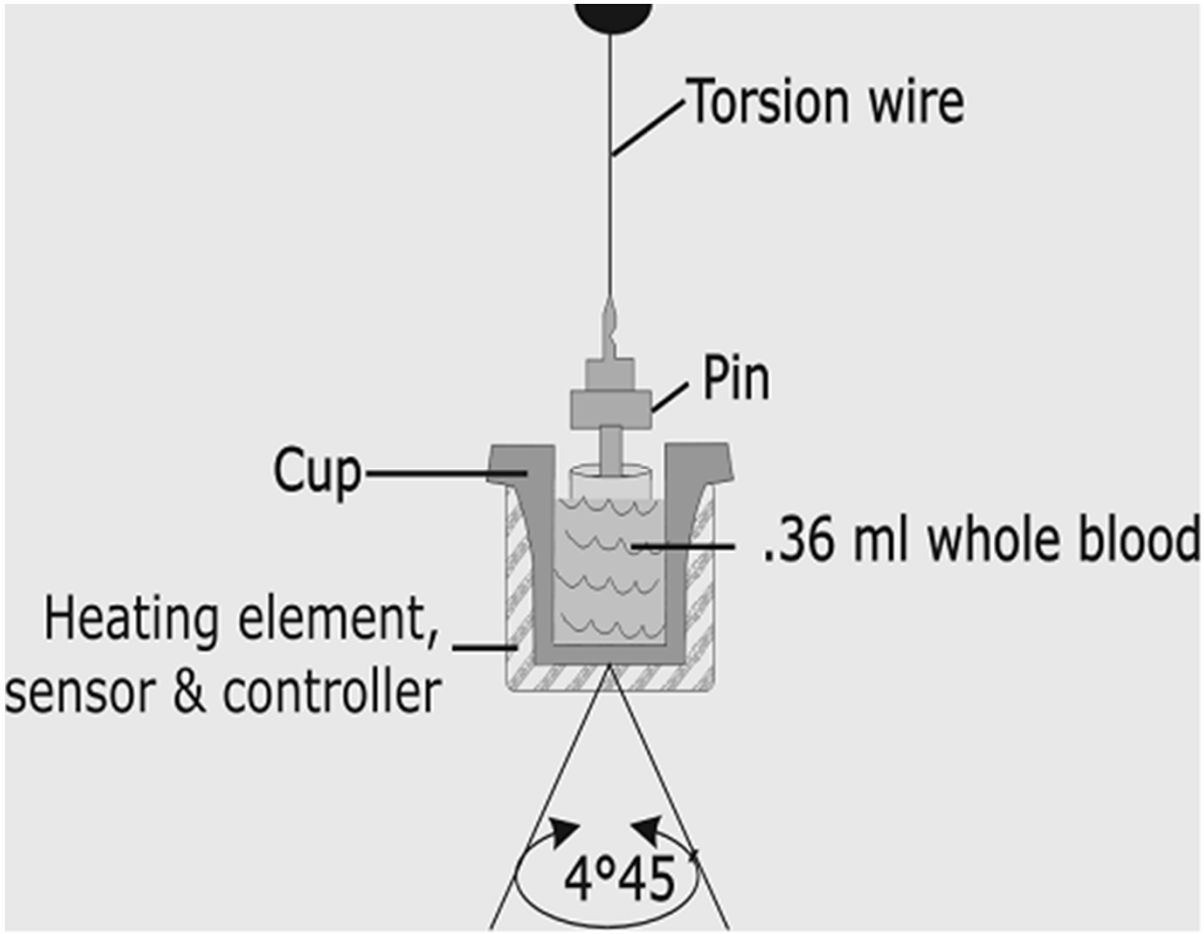
What is TEG?

- Thromboelastrograph (TEG) is A real time analyzer of whole blood for coagulation

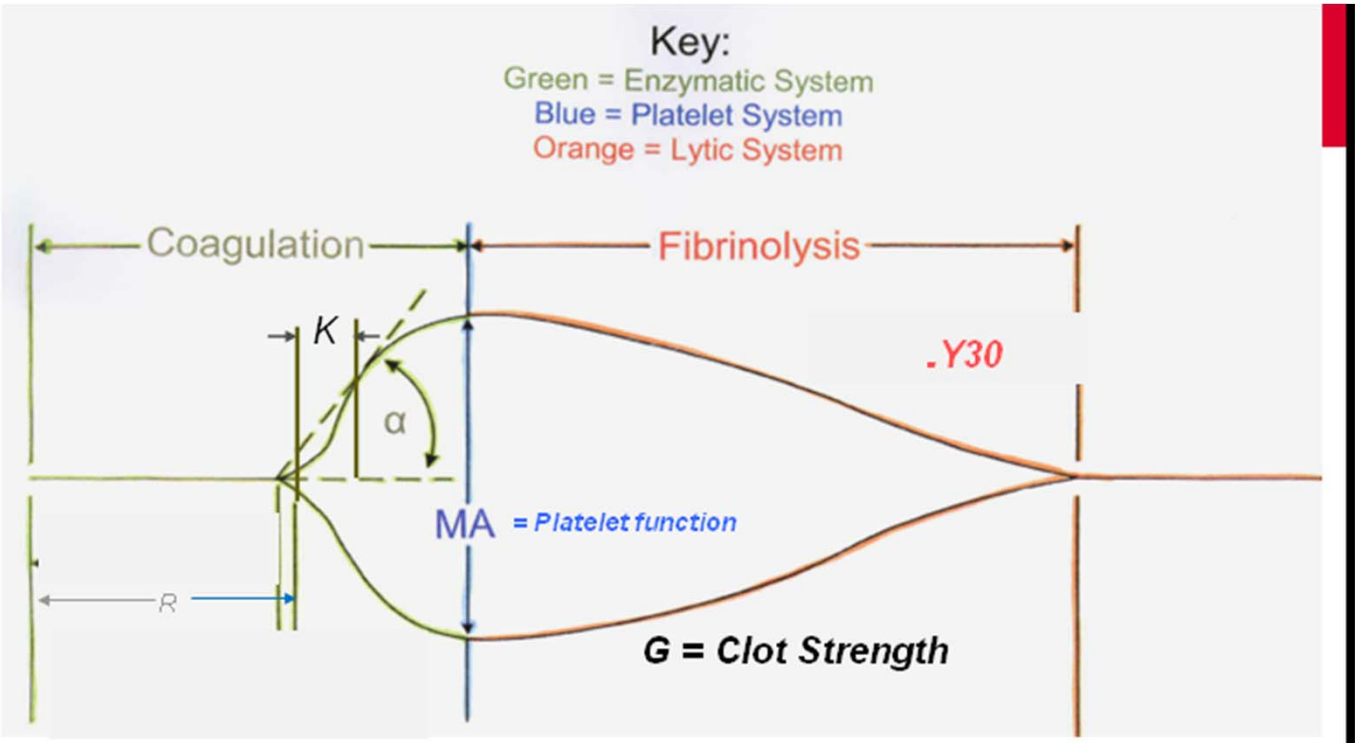
- Measures the viscoelastic properties of the hemostasis process functionally, the end-result being the hemostatic plug, or clot

What is TEG?

Haemoscope
Thrombelastograph
Analyzer


Torsion wire
Pin
Cup
.36 ml whole blood
Heating element,
sensor & controller
4°45'

What is TEG?



R *= Reaction time to end of thrombin burst*

K *= fibrin cross-linkage, fibrinogen function*

Angle *= fibrinogen function*

MA *= platelet function in mm*

G *= MA converted to Kdynes/cm*^{2}

LY30 *= Lysis 30 minutes after MA reached*

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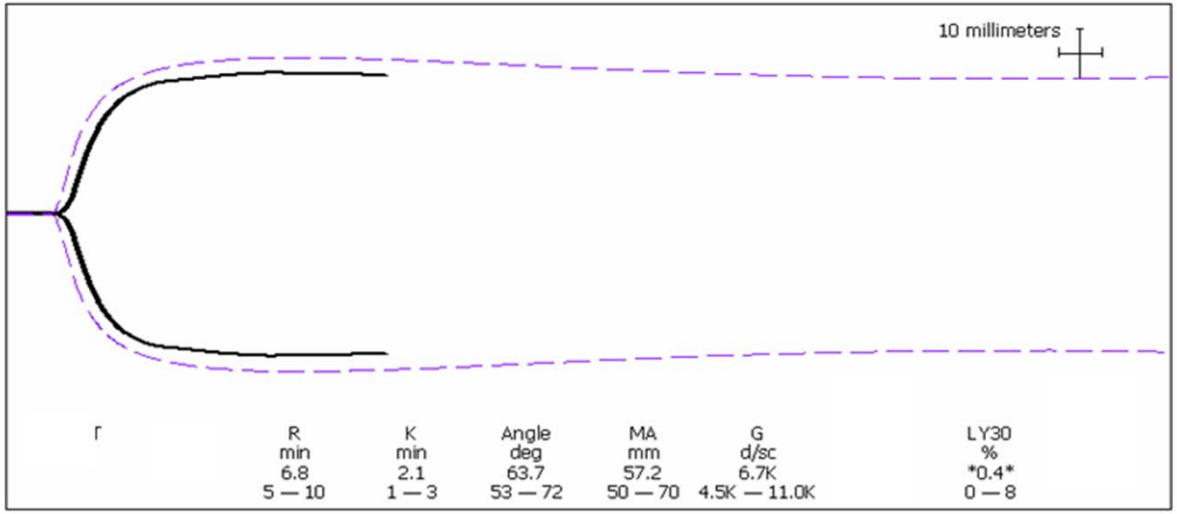
HAEMONETICS
THE Blood Management Company

TEG Tracing

Normal TEG® Tracing

1 Citrated kaolin



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What is Rapid TEG™ (rTEG)?

- Maximally and simultaneously activates the two clotting cascades
  - Kaolin → Intrinsic Pathway
  - Tissue Factor→ Extrinsic Pathway

- Reduces time to fibrin formation <1 min
  - Allows for rapid data availability

Standard TEG vs Rapid TEG™ Tracing Comparison

Tracing Comparison

1 Kaolin

Baseline

Sample: 5/16/2007 11:42-12:17

TEG ACT	SP	R	K	Angle	MA	G	CI	EPL	LY30
	min	min	min	deg	mm	d/sc		%	%
	6.2	7.2	1.9	62.5	64.1	8.9K	-0.6	0.0	*0*
		4 — 8	0 — 4	47 — 74	54 — 72	6.0K — 13.2K	-3 — 3	0 — 15	0 — 8

TEG ACT	SP	R	K	Angle	MA	G	CI	EPL	LY30
sec	min	min	min	deg	mm	d/sc		%	%
82.0	0.2	0.3	1.2	73.7	63.7	8.8K		0.0	*0*
		0 — 1	1 — 2	66 — 82	52 — 72				

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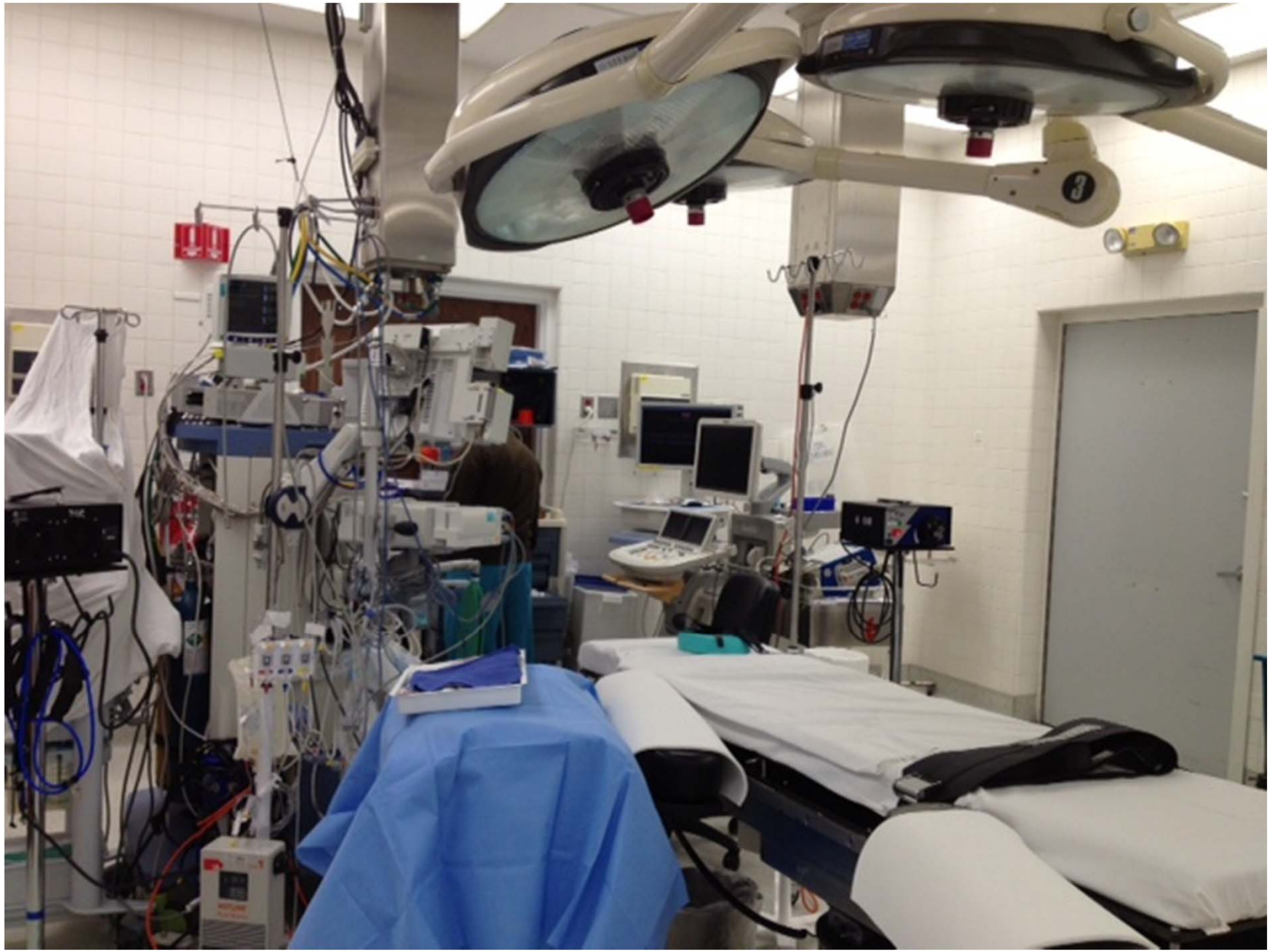
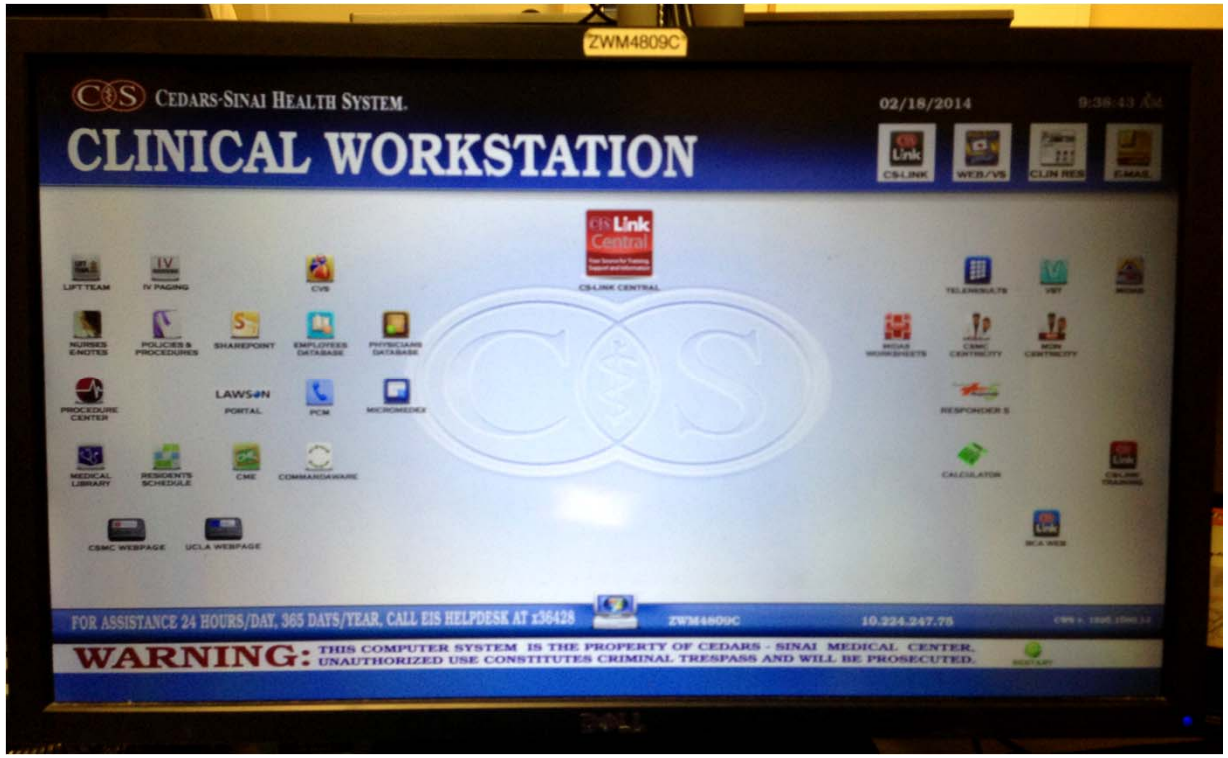


TEG in OR Suite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CEDARS-SINAI HEALTH SYSTEM.
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02/18/2014
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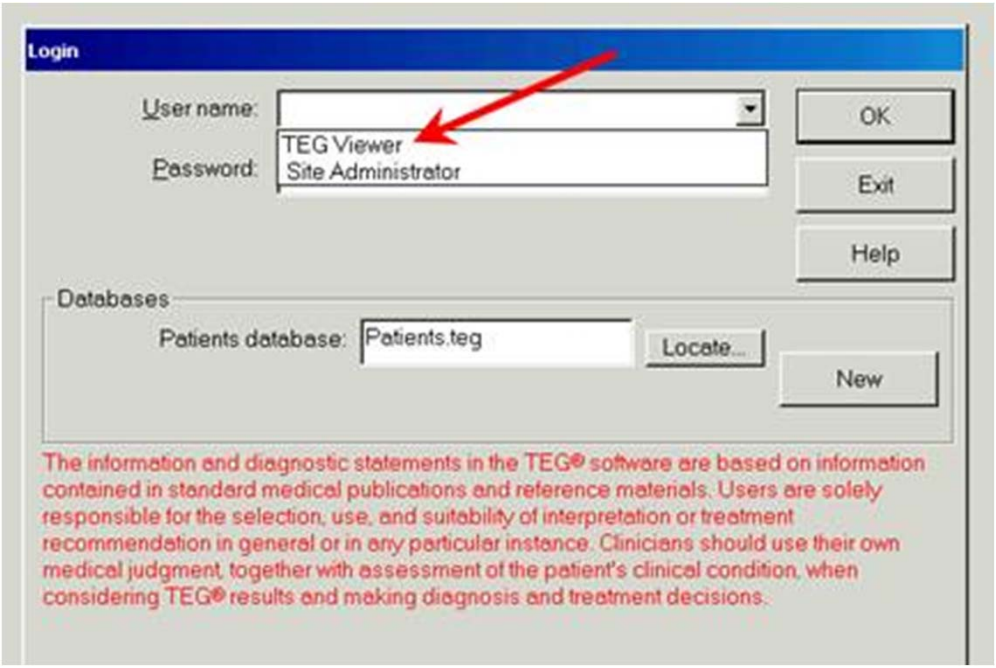
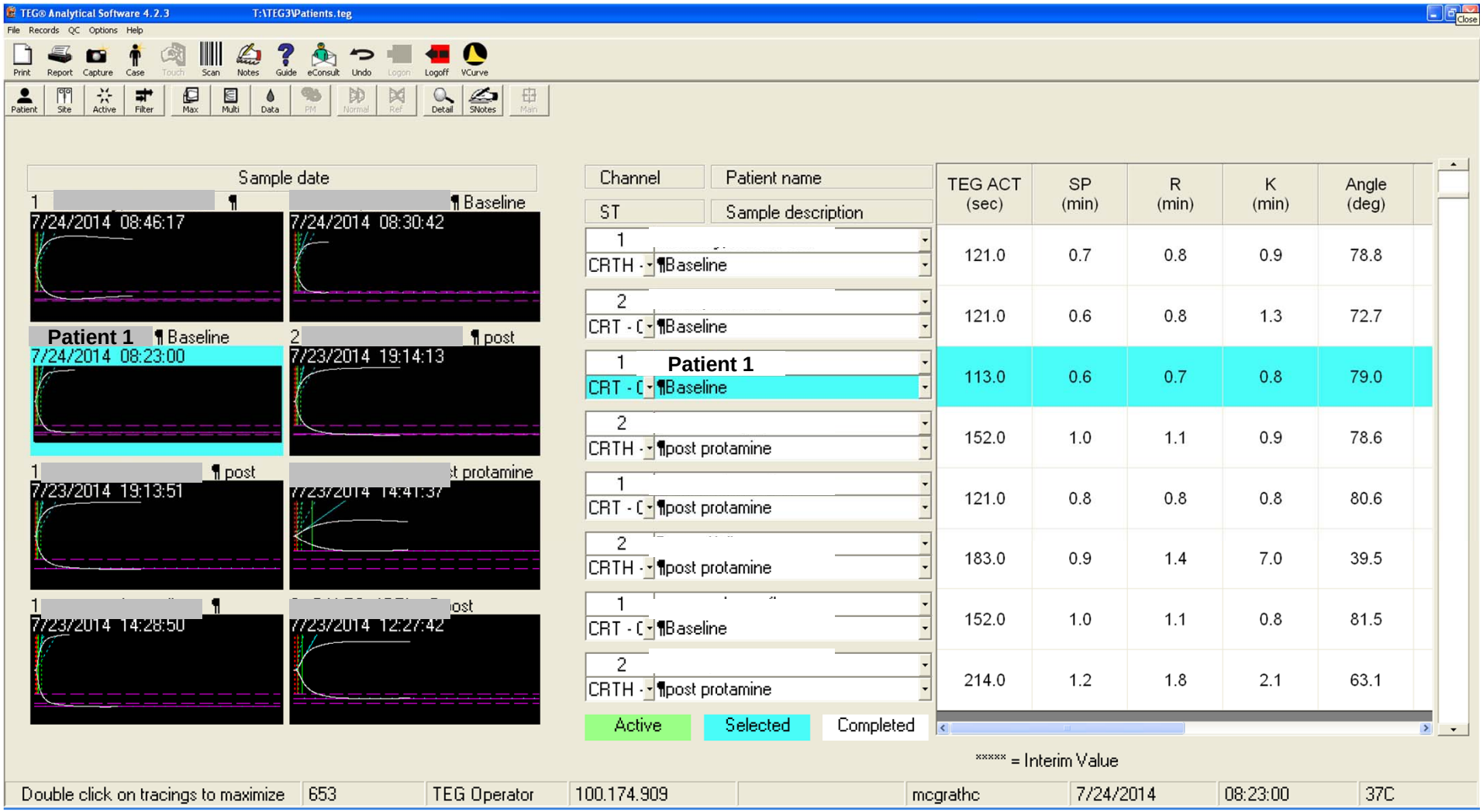
WEB/VS
CLIN RES
E-MAIL
CS-LINK CENTRAL
LIFT TEAM
IV PAGING
CVS
NURSES E-NOTES
POLICIES & PROCEDURES
SHAREPOINT
EMPLOYEES DATABASE
PHYSICIANS DATABASE
PROCEDURE CENTER
LAWSON PORTAL
PCM
MICROMEDEX
MEDICAL LIBRARY
RESIDENTS SCHEDULE
CME
COMMAND&WARE
CSMC WEBPAGE
UCLA WEBPAGE
TELEANALYTE
VIST
RESPONDER 5
CALCULATOR
FOR ASSISTANCE 24 HOURS/DAY, 365 DAYS/YEAR, CALL EIS HELPDESK AT x36428
ZWM4809C
10.224.247.75
WARNING: THIS COMPUTER SYSTEM IS THE PROPERTY OF CEDARS - SINAI MEDICAL CENTER. UNAUTHORIZED USE CONSTITUTES CRIMINAL TRESPASS AND WILL BE PROSECUTED.

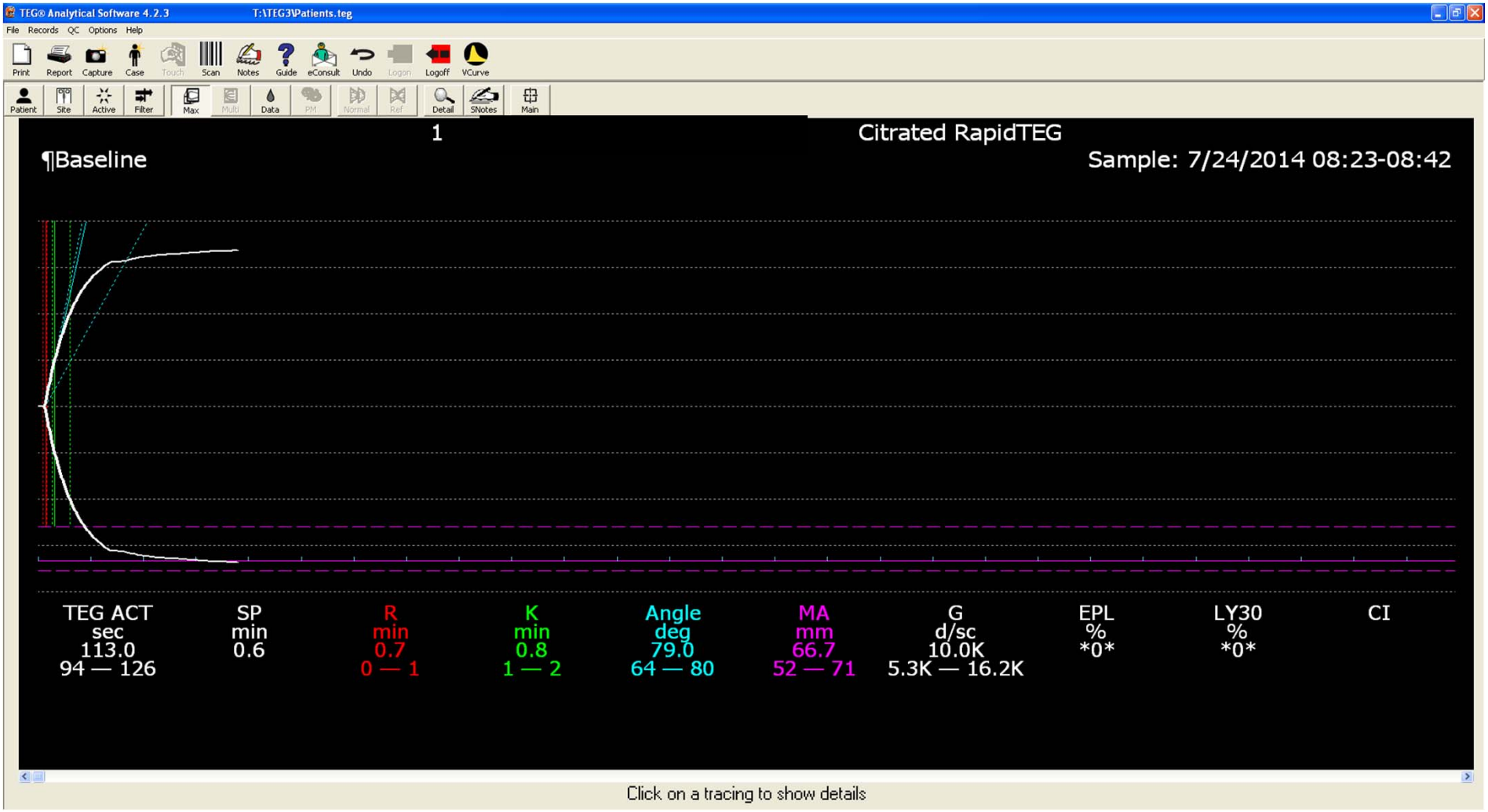
TEGViewer

TEGViewer6OR
TEGViewerCore

TEGViewer6OR
TEGviewerCore


Login
User name:
Password:
TEG Viewer
Site Administrator
OK
Exit
Help
Databases
Patients database:
Patients.teg
Locate...
New
The information and diagnostic statements in the TEG® software are based on information contained in standard medical publications and reference materials. Users are solely responsible for the selection, use, and suitability of interpretation or treatment recommendation in general or in any particular instance. Clinicians should use their own medical judgment, together with assessment of the patient's clinical condition, when considering TEG® results and making diagnosis and treatment decisions.


TEG® Analytical Software 4.2.3
T:\TEG3\Patients.teg
File Records QC Options Help
Print Report Capture Case Touch Scan Notes Guide eConsult Undo Logon Logoff VCurve
Patient Site Active Filter Max Multi Data PM Normal Ref Detail SNotes Main
Sample date
1 ¶ ¶ Baseline
7/24/2014 08:46:17
7/24/2014 08:30:42
Patient 1 ¶ Baseline
7/24/2014 08:23:00
2 ¶ post
7/23/2014 19:14:13
1 ¶ post
7/23/2014 19:13:51
t protamine
7/23/2014 14:41:37
1 ¶
7/23/2014 14:28:50
ost
7/23/2014 12:27:42
Channel
Patient name
ST
Sample description
1
CRTH - ¶Baseline
2
CRT - ¶Baseline
1 Patient 1
CRT - ¶Baseline
2
CRTH - ¶post protamine
1
CRT - ¶post protamine
2
CRTH - ¶post protamine
1
CRT - ¶Baseline
2
CRTH - ¶post protamine
Active
Selected
Completed
TEG ACT (sec)
SP (min)
R (min)
K (min)
Angle (deg)
121.0 0.7 0.8 0.9 78.8
121.0 0.6 0.8 1.3 72.7
113.0 0.6 0.7 0.8 79.0
152.0 1.0 1.1 0.9 78.6
121.0 0.8 0.8 0.8 80.6
183.0 0.9 1.4 7.0 39.5
152.0 1.0 1.1 0.8 81.5
214.0 1.2 1.8 2.1 63.1
***** = Interim Value
Double click on tracings to maximize
653
TEG Operator
100.174.909
mcgrathc
7/24/2014
08:23:00
37C


TEG® Analytical Software 4.2.3
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File Records QC Options Help
Print Report Capture Case Touch Scan Notes Guide eConsult Undo Logon Logoff VCurve
Patient Site Active Filter Max Multi Data PM Normal Ref Detail SNotes Main
1
Citrated RapidTEG
¶Baseline
Sample: 7/24/2014 08:23-08:42
TEG ACT sec 113.0 94 — 126
SP min 0.6
R min 0.7 0 — 1
K min 0.8 1 — 2
Angle deg 79.0 64 — 80
MA mm 66.7 52 — 71
G d/sc 10.0K 5.3K — 16.2K
EPL % *0*
LY30 % *0*
CI
Click on a tracing to show details

TEG® Analytical Software 4.2.3 T:\TEG3\Patients.teg

File Records QC Options Help

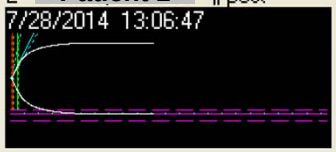
Print Report Capture Case Touch Scan Notes Guide eConsult Undo Logon Logoff VCurve

Patient Site Active Filter Max Multi Data PM Normal Ref Detail SNotes Main

Sample date

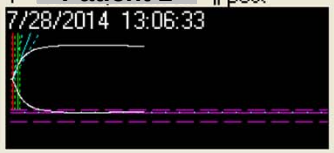
2 **Patient 1** ¶post

7/28/2014 13:06:47



1 **Patient 1** ¶post

7/28/2014 13:06:33



1 **Patient 1** ¶Baseline

7/28/2014 08:32:12

Channel	Patient name	TEG ACT (sec)	SP (min)	R (min)	K (min)	Angle (deg)
ST	Sample description					
2	**Patient 1**	121.0	0.6	0.8	1.8	67.8
CRTH -	¶post protamine					
1	**Patient 1**	136.0	0.8	0.9	1.6	71.9
CRT - (	¶post protamine					
1	**Patient 1**	136.0	0.8	0.9	1.3	72.7
CRT - (	¶Baseline					

Active Selected Completed

***** = Interim Value

Double click on tracings to maximize | 3 | TEG Operator | 010171341 | | spauldingn | 7/28/2014 | 13:06:47 | 37C

PRELIMINARY

TEG® Analysis

Generated: 7/25/2014 8:50:24AM

DEPT OF PATHOLOGY AND LAB MEDICINE
8700 BEVERLY BL, LOS ANGELES, CA 90048
MAHUL B. AMIN, M.D., DIRECTOR

Database: T:\TEG3\Patients.teg

Patient: ID: SSN: Birthdate: Age: Gender:	Sample Date: 7/24/2014 Time on: 08:23 Off: 08:42 Duration: 19 min
Sample type: Citrated RapidTEG Description: Baseline	Channel: 1 Sample status: Finished Temp: 37
Additional notes:	Site ID: Operator ID: mcgrathc
	Ordered by:
	Platelet drugs administered: No Bleeding state: Patient temperature:
	Accession #: Analyzer SN: S111103558

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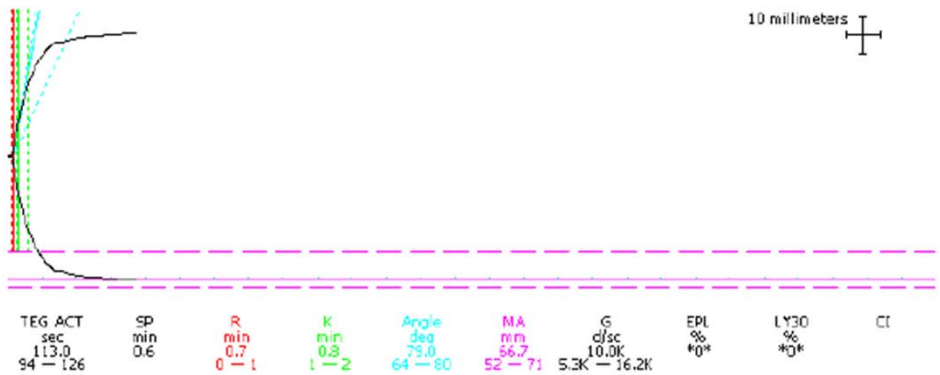


Result reported:

Reported date:
Reported by:

Sample data:		Units:	Normal values:
TEG ACT:	113.0	sec	(94 — 126)
SP:	0.6	min	
R:	0.7	min	(0 — 1)
K:	0.8	min	(1 — 2)
Angle:	79.0	deg	(64 — 80)
MA:	66.7	mm	(52 — 71)
G:	10.0K	d/sc	(5.3K — 16.2K)
EPL:	*0.0*	%	
LY30:	*0.0*	%	

Interim values are surrounded by asterisks - Results final

	When and Where?	What tube?
Platelet Mapping	-Pre OP - Performed in Specialty Coag Lab	1 Blue top tube 1 Green top tube
Baseline rTEG	-After induction of Anesthesia -Performed in OR Suite	1 Blue top tube -Clear cup -Heparinase cup if patient is on heparin pre-op
Post protamine rTEG	-Same time as ACT is drawn post protamine -Performed in OR Suite	1 Blue top - Clear cup and heparinase cup

Experience with rTEG in Cardiac Cases

- 154 cases in first 4 months that used rTEG
  - Isolated AVR: 26
  - Isolated CABG: 35
  - Isolated MVR: 23
  - TAH: 9
  - VAD: 9
  - Heart Transplant: 9
  - Aortic aneurysm resection and/or aortic root repair: 9
  - Combined (CABG, AVR, MVR, TVR) and Re-dos, etc: 43

Impact on Isolated CABG and AVR

	Baseline Data	First 4 months of rTEG-guided cases	**% decrease in utilization**
AVR			
* **plasma**	1.2	0.43	**64%**
* **platelet**	0.6	0.23	**62%**
CABG			
* **plasma**	1.4	0.53	**62%**
* **platelet**	0.8	0.38	**53%**

* per case

Impact on Isolated CABG and AVR

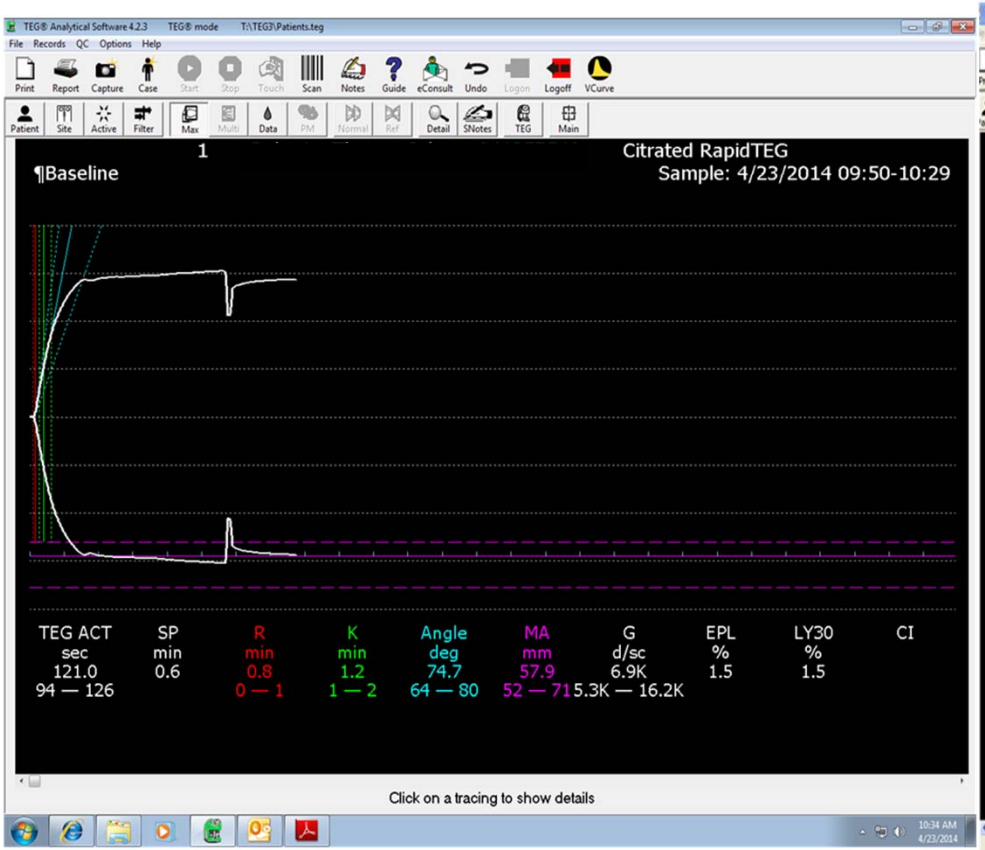
- 22 out of 35 isolated CABG cases did not use any plasma or platelets
- 18 out of 26 isolated AVR cases did not use any plasma or Platelets

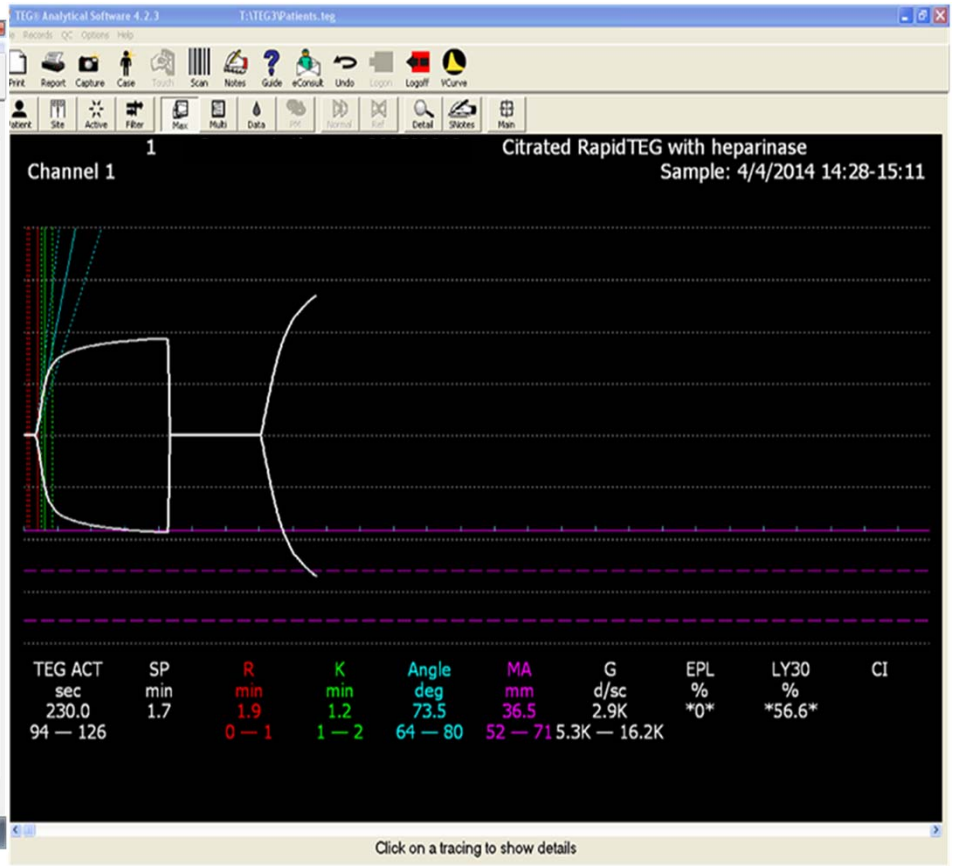
Total Artificial Heart (TAH) and Ventricular Assist Devices (VAD)

	First 4 month of rTEG-guided cases
TAH	n= 9
* **plasma**	1.8
* **platelet**	0.3
LVAD	n=9
* **plasma**	1.4
* **platelet**	1.1

* per case

Technical Challenges





Summary

- Implementation of rTEG has helped decrease utilization of non-RBC components
- This approach requires multi-disciplinary collaboration between the laboratory, surgeons, anesthesiologist and specialized teams including perfusionists
- Technical challenges may preclude widespread use at the point of care