CICU ECMO Anticoagulation and Transfusion Guidelines

The purpose of this guideline is to prevent or limit bleeding and clotting events among patients requiring anticoagulation in the setting of ECMO support in the CICU at CHP. This guideline is not a substitute for clinical judgment, and frequent assessment of patient and circuit is essential to optimize management.

Unfractionated heparin is the first line anticoagulant for ECMO at CHP unless there is a documented patient allergy, history of heparin-induced thrombocytopenia (HIT), or physician/surgeon preference based on patient factors, in which case a direct thrombin inhibitor such as bivalirudin should be used.

Pre-ECMO	
Obtain baseline labs, if able	Type & screen (2 samples), if not active CBC, CMP, PT/INR, PTT, Fibrinogen, TEG, Antithrombin III (ATIII), ABG/VBG/Co-Ox/Lactate Anti-Xa (if already on heparin or lovenox)
Order blood cooler to bedside	2 units PRBC (not washed; order STAT for ECMO cannulation)

Initiation of ECMO		
ECMO circuit prime	500 units of heparin is added to the prime *Need for blood prime determined by patient weight, circuit size, and discussion with cannulating surgeon	
Patient heparin bolus • To be given on direction from the cannulating surgeon • Should be given even if planning to use bivalirudin for ongoing anticoagulation	**30-50 units/kg** (max. dose 10,000 units) *Delays in cannulation may warrant additional heparin bolus(es) at discretion of cannulating surgeon and CICU attending physician **Bolus may be held if severe active bleeding at discretion of cannulating surgeon and CICU attending	
Post-cannulation labs • Send as soon as possible after ECMO initiation	CBC, CMP, PT/INR, PTT, Anti-Xa, Fibrinogen, TEG (with and without heparinase), ATIII, ABG/VBG/Co-Ox/Lactate	
Initiation of anticoagulation infusion • Start within 15 min of target flow • In the event of active bleeding, anticoagulation may be held at discretion of surgeon and CICU attending • Timing of initiation for post-operative patients must be discussed with CT Surgery. Anticoagulation is generally held for 6 hours post-operatively. **If transitioning from heparin to bivalirudin, stop heparin infusion and start bivalirudin infusion right away. Check PTT after 2 hours on bivalirudin to ensure not supratherapeutic.* ***Bivalirudin should not be infused into the ECMO circuit, as this can cause subtherapeutic anticoagulation.*	**Standard Risk or High Clotting Risk**	**High Bleeding Risk**
	Initial heparin dose: <1 year old: 28 units/kg/hr >1 year old: 20 units/kg/hr *Max: 1600 units/hr **If BMI> 35, start at 14 units/kg/hr	**Initial heparin dose:** <1 year old: 14 units/kg/hr >1 year old: 10 units/kg/hr *Max: 800 units/hr **If BMI >35, start at 7 units/kg/hr
	Initial bivalirudin dose: GFR >60 cc/min: 0.3mg/kg/hr GFR 30-60 cc/min: 0.2mg/kg/hr GFR <30 cc/min: 0.1 mg/kg/hr Renal Replacement Therapy: 0.1mg/kg/hr	**Initial bivalirudin dose**: GFR >60 cc/min: 0.15mg/kg/hr GFR 30-60 cc/min: 0.1mg/kg/hr GFR <30 cc/min: 0.05mg/kg/hr Renal Replacement Therapy: 0.05mg/kg/hr

Ongoing management of anticoagulation and transfusion on ECMO			
Anticoagulation management in pediatric ECMO patients is challenging. The patient's condition and needs can change rapidly, requiring frequent assessments of bleeding and clotting risks and adjustment in management. • ***Anticoagulation titration will be informed by the patient's risk category, the condition of the patient, and the condition of the circuit. Titration should not be based on a single lab value or without consideration of the entire clinical picture.*** • ***Risk category, circuit condition, and anticoagulation goals should be documented in CICU Attending daily progress notes***			
Assessment of risk category • To be reviewed at least every shift	**Standard risk** • Patients without active bleeding or clotting concerns	**High bleeding risk** • Infants <3 mos within 48hr of cannulation • Post-operative patients • Recent or ongoing bleeding • Acute stroke • Post-arrest	**High clotting risk** • Clot formation in circuit • Sepsis or other hyperinflammatory state • Significant clotting history

Standard lab monitoring on ECMO		
Test	**Frequency**	**Considerations**
ABG	Q1hr initially	Consider spacing if stable without need for titration or intervention
VBG/co-ox/lactate	Q2hr initially	Consider spacing if stable without need for intervention
PTT	Q4hr until therapeutic x2 without rate change, then Q6hr	Consider spacing to Q12hr checks if Q6hr levels are stable x2
Anti-Xa for unfractionated heparin	Q4hr until therapeutic x2 without rate change, then Q6hr	**Do not send for patients on bivalirudin** Consider spacing to Q12hr checks if Q6hr levels are stable x2
CBC with platelet count	Q6hr	Check more frequently if patient is bleeding
PT/INR	Q12hr	Check more frequently if patient is bleeding
Fibrinogen	Q12hr	Check more frequently if patient is bleeding
AT-III	Q12hr until therapeutic on heparin, then QDay	**Do not send for patients on bivalirudin**
Renal function panel	Q12hr	Obtain more frequently if patient has significant renal dysfunction or requires renal replacement therapy
ECMO oxygenator gas	Q12hr	
TEG w/wo Heparinase*	QAM. If patient is bleeding, consider sending at that time	**Do not send heparinase TEG for patients on bivalirudin**
Hepatic function panel	QAM	
Plasma Hemoglobin	QAM	Consider sending rapid test if there is visible evidence of hemolysis
LDH	QAM	
Type and screen	Q72hr	

**Refer to Appendix A for TEG interpretation guidelines*

CICU ECMO Heparin Anticoagulation and Transfusion Guideline				
Anticoagulation titration and transfusion of blood products will be informed by the patient's risk category and the condition of the patient and the circuit. ***Decisions should not be made based on a single lab value or without consideration of the entire clinical picture.***				
		Standard Risk	**High Bleeding Risk**	**High Clotting Risk**
Starting heparin dose*		<1yo: 28 units/kg/hr >1yo: 20 units/kg/hr BMI >35: 14 units/kg/hr Max 1600 units/hr	<1yo: 14 units/kg/hr >1yo: 10 units/kg/hr BMI >35: 7 units/kg/hr Max 800 units/hr	<1yo: 28 units/kg/hr >1yo: 20 units/kg/hr BMI >35: 14 units/kg/hr Max 1600 units/hr
Anticoagulation goals**	AntiXa	0.3-0.5	0.1-0.3	0.3-0.7
	PTT	70-90 (<140)	50-70 (<120)	70-105 (<140)
	TEG-R	Greater than heparinase TEG-R	Greater than heparinase TEG-R	Greater than heparinase TEG-R
Indications and volumes for transfusion	FFP 10-15cc/kg (max 2 units)	INR >2 Heparinase TEG-R >15	INR >1.5 Heparinase TEG-R >12	INR >2 Heparinase TEG-R >15
	Platelets 10-15cc/kg (max 2 units)	PLT <50 (if >3mo) PLT <100 (if <3 mo) Heparinase TEG-MA <50	PLT <100 Heparinase TEG-MA <55	PLT <50 Heparinase TEG-MA <50
	Cryo 1 unit/10kg (max 10 units)	Fibrinogen <150 Heparinase TEG-K >5	Fibrinogen <200 Heparinase TEG-K >3	Fibrinogen <100 Heparinase TEG-K >5
	Antithrombin III*** Infant/child: 50 IU/kg Adult: [(Desired – current) x kg] / 1.4	Decrease heparin infusion by 20% after repletion	Decrease heparin infusion by 20% after repletion	Consider 10% decrease or no change to heparin infusion after repletion
	PRBCs 10-15cc/kg (max 2 units)	Consider maintaining Hb >8-10 Transfusion threshold will vary based on multiple patient factors and indicators of adequacy of oxygen delivery		

*Initiate heparin infusion within 15 minutes of target flow unless otherwise directed by cannulating surgeon or CICU attending

**Refer to CICU ECMO Heparin Titration Table for dose adjustments

***Antithrombin III repletion may be considered in cases of heparin resistance; refer to CICU ECMO Heparin Resistance Guideline

Transition to bivalirudin should be considered if patient exhibits signs of heparin induced thrombocytopenia (HIT) (Appendix B), heparin resistance, or ongoing hypercoagulability while on heparin.

In the event of active bleeding, refer to CICU ECMO Active Bleeding Guideline. Anticoagulation should be held for major bleeding.

CICU ECMO Heparin Titration Table

The antifactor Xa assay (anti-Xa) is the preferred lab value to guide heparin therapy as it is the most specific test for heparin effect, though PTT can also be used to monitor anticoagulation with heparin. Heparin therapy is influenced by factors such as AT-III levels, diuresis, CRRT, and plasma exchange. Anti-Xa levels are falsely low in hemolysis, hyperbilirubinemia, and hyperlipidemia. Heparin infusions are typically dosed between 10 units/kg/hr and 40 units/kg/hr. Significant deviations from protocol must be discussed with CCM, CT Surgery, and the ECMO/Perfusion team.*

Anticoagulation titration will be informed by the patient's risk category and the condition of the patient and the circuit. Decisions should not be made based on a single lab value or without consideration of the entire clinical picture.

Anti-Xa level	PTT	Response	Testing
0.2-0.3 below goal	15-30 sec below goal	Increase heparin infusion by 20%**	Recheck 4hr after rate adjusted
0.1 below goal	5-15 sec below goal	Increase heparin infusion by 10%**	Recheck 4hr after rate adjusted
At goal	At goal	No change	Recheck Q4hr until 2 consecutive values within range, then Q6hr for an additional 2 consecutive values within range, then consider spacing to Q12hr
0.1 above goal	5-15 sec above goal	Decrease heparin infusion by 10%	Recheck 4hr after rate adjusted
0.2-0.3 above goal	15-30 sec above goal	Decrease heparin infusion by 20% Consider holding heparin infusion for 30 minutes	Recheck 4hr after infusion restarted and/or rate adjusted
0.4 or more above goal	>35 sec above goal	Decrease heparin infusion by 30% Consider holding heparin infusion for 60 minutes	Recheck 4hr after infusion restarted and/or rate adjusted

**The following adjustments should be considered:*

- *Anti-Xa level decreases by 0.03-0.05 IU/mL per 100mg/dL increase in plasma hemoglobin*
- *Anti-Xa level decreases by 0.03-0.05 IU/mL per 6mg/dL increase in total bilirubin*

*** Refer to Heparin Resistance Guideline if heparin infusion is greater than or equal to 40 units/kg/hr*

CICU ECMO Bivalirudin Anticoagulation and Transfusion Guideline				
Anticoagulation titration and transfusion of blood products will be informed by the patient's risk category and the condition of the patient and the circuit. ***Decisions should not be made based on a single lab value or without consideration of the entire clinical picture.***				
		Standard Risk	**High Bleeding Risk**	**High Clotting Risk**
Starting bivalirudin dose*		GFR >60cc/min: 0.3 mg/kg/hr GFR 30-60cc/min: 0.2 mg/kg/hr GFR <30cc/min: 0.1 mg/kg/hr RRT: 0.1mg/kg/hr	GFR >60cc/min: 0.15 mg/kg/hr GFR 30-60cc/min: 0.1 mg/kg/hr GFR <30cc/min: 0.05 mg/kg/hr RRT: 0.05mg/kg/hr	GFR >60cc/min: 0.3 mg/kg/hr GFR 30-60cc/min: 0.2 mg/kg/hr GFR <30cc/min: 0.1 mg/kg/hr RRT: 0.1mg/kg/hr
Anticoagulation goals**	PTT	70-90	50-70	70-105
Indications and volumes for transfusion	FFP 10-15cc/kg (max 2 units)	INR >2.5***	INR >2***	INR >2.5***
	Platelets 10-15cc/kg (max 2 units)	PLT <50 (if >3mo) PLT <100 (if <3 mo) TEG-MA <50	PLT <100 TEG-MA <55	PLT <50 TEG-MA <50
	Cryo 1 unit/10kg (max 10 units)	Fibrinogen <150 TEG-K >5	Fibrinogen <200 TEG-K >3	Fibrinogen <100 TEG-K >5
	PRBCs 10-15cc/kg (max 2 units)	Consider maintaining Hb >8-10 Transfusion threshold will vary based on multiple patient factors and indicators of adequacy of oxygen delivery		

*Initiate bivalirudin infusion within 15 minutes of target flow unless otherwise directed by cannulating surgeon or CICU attending. Bivalirudin should not be infused into the ECMO circuit, as this can cause subtherapeutic anticoagulation.
**Refer to CICU ECMO Bivalirudin Titration Table for dose adjustments
***Bivalirudin can artificially prolong the PT/INR

In the event of active bleeding, refer to CICU ECMO Active Bleeding Guideline. Anticoagulation should be held for major bleeding.

CICU ECMO Bivalirudin Titration Table		
Anticoagulation titration will be informed by the patient's risk category and the condition of the patient and the circuit. Decisions should not be made based on a single lab value or without consideration of the entire clinical picture.		
PTT	**Response**	**Testing**
15-30 sec below goal	Increase bivalirudin infusion by 25% of the current rate	Recheck 2-4hr after rate adjusted
5-15 sec below goal	Increase bivalirudin infusion by 15% of the current rate	Recheck 2-4hr after rate adjusted
At goal	No change	Recheck Q2-4hr until 2 consecutive values within range, then Q6hr for an additional 2 consecutive values within range, then consider spacing to Q12hr
5-15 sec above goal	Decrease bivalirudin infusion by 15% of the current rate	Recheck 2-4hr after rate adjusted
15-30 sec above goal	Decrease bivalirudin infusion by 25% of the current rate	Recheck 2-4hr after infusion restarted and/or rate adjusted
>35 sec above goal	Hold bivalirudin infusion for 15 minutes, then decrease dose by 30% of prior rate • *Mild to moderate renal dysfunction (GFR >30 cc/min): hold for 45 minutes, then decrease rate by 40% of prior rate* • *Severe renal dysfunction (GFR <30 cc/min or on Renal Replacement Therapy: hold for 2 hours, recheck PTT prior to restarting infusion to determine rate.*	Recheck 2-4hr after infusion restarted and/or rate adjusted
NOTE: Use of CRRT, plasma exchange, hemodialysis, and hemofiltration will increase bivalirudin clearance. Consider increasing bivalirudin infusion during pheresis, particularly if anticoagulation is subtherapeutic prior to plasmapheresis. Check PTT immediately after treatment and 4 hours later to guide dosing.		

CICU ECMO Active Bleeding Guideline

In the event of active, potentially life-threatening bleeding, anticoagulation may need to be held. The bleeding status of the patient, the condition of the ECMO circuit, and the patient's labs must be closely monitored during this period. For bleeding or oozing from non-surgical sites, every attempt will be made to quantify the amount of bleeding. Increased flows should be considered, if possible, in the setting of sub-therapeutic anticoagulation. Any changes in the circuit should be reported to CCM and CT Surgery. The patient's status will be re-evaluated at least every 6 hours to assess anticoagulation reinstitution, risk category, and lab/transfusion goals.

Clinical scenario	Considerations for management	
Minor bleeding • *Bleeding not requiring surgical intervention* • *Bleeding requiring <20cc/kg/day or <2 units PRBCs*	• Reassess patient's risk category and adjust anticoagulation/transfusion parameters as appropriate • Titrate anticoagulation and administer blood products as indicated	

Major or potentially life-threatening bleeding
• *Bleeding requiring surgical intervention*
• *Bleeding >8cc/kg/hr or requiring MTP*
• *Bleeding requiring >20cc/kg/day or >2 units PRBCs*
• *Intracranial hemorrhage*
• *Clinical Discretion*
 	
CCM and CT Surgery must be notified
	• **Hold anticoagulation; discuss with CCM and CT Surgery Attending**
	  ○ Circuit must be closely monitored for clot buildup
	  ○ Holding anticoagulation must be reassessed Q6hr at a minimum
	• Transfuse blood products as indicated
	• Consider plasmapheresis, particularly if concern for DIC
	• Consider massive transfusion protocol (MTP) for ongoing bleeding >8cc/kg/hr
	  ○ Blood component therapy should be administered in a ratio of **10cc/kg PRBCs : 10cc/kg PLT : 10cc/kg FFP**
	• Consider transfusion of whole blood
	• Consider use of **Adjunctive Medications for Bleeding Management** *(see table below)*	

Site-specific considerations for management of bleeding *Patient moves to High Bleeding Risk category for transfusion thresholds* *Severe bleeding at any site may require holding anticoagulation*	Cannula site bleeding	• Notify CT surgery team to evaluate • Consider Surgicel and occlusive dressing

	Intracranial or intraventricular hemorrhage	• CT head (if identified on head ultrasound)
		• Hold anticoagulation
		• Neurosurgery consult
		  ○ Discuss potential or need for intervention
		  ○ Discuss risk/benefit and plan for anticoagulation
		  ○ Establish plan for interval re-imaging
		• Monitor CBC/coags and fibrinogen q4hr and transfuse products as indicated
		• Continuous EEG (if not in place)
		• Assess readiness/urgency for decannulation based on global clinical status and severity of bleed

	Oropharyngeal bleeding or epistaxis	• ENT consult • Oxymetolazine (Afrin), packing with TXA- or aminocaproic acid-soaked gauze, and other topical therapies may be used • Discuss need for operative exploration with cauterization for severe and/or refractory bleeding
	GI bleeding	• Optimize acid blockade with IV H2 blocker and IV PPI • Decrease or discontinue suction on sump • Hold feeds (if not NPO) and obtain abdominal imaging • Consider GI consult for endoscopy
	Airway bleeding/ pulmonary hemorrhage	• Pulmonology consult; consider bronchoscopy, CT chest • Increase PEEP • Consider inhaled tranexamic acid +/- inhaled factor VII • Consider IV methylprednisolone for diffuse alveolar hemorrhage
Resuming anticoagulation after bleeding event	• Must be discussed with CCM and CT Surgery • Consider restarting anticoagulation lower than prior therapeutic rate • Monitor closely for recurrent bleeding, adjust risk category as indicated	

Disseminated intravascular coagulation (DIC)	
*DIC is a hematologic emergency characterized by microvascular fibrin deposition and thrombus formation with concurrent fibrinolysis and consumption of clotting factors and platelets, leading to **bleeding, clotting, and multiorgan failure**. Common triggers in CICU patients include sepsis, endothelial injury, liver failure, shock, and intravascular hemolysis. The ECMO circuit can also trigger a DIC-like state (circuit DIC). Characteristic lab abnormalities include **thrombocytopenia**, **hypofibrinogenemia**, **elevated PT/INR**, **elevated D-dimer, and elevated plasma hemoglobin.***	
Management of DIC	• Identify and treat underlying cause • Strongly consider plasmapheresis and circuit change • Transfuse products as indicated by clinical status to restore depleted components while treating underlying cause • Consider adjunctive pharmacologic agents based on clinical picture and TEG

Transfusion Considerations for Bleeding Management
Massive transfusion protocol

• To activate, call Blood Bank at 864-9962. Components include:
  ○ 1 unit of whole blood + 3 units of PRBCs (available in 5 minutes)
  ○ 4 units of FFP (available in 5 minutes)
  ○ 1 dose of platelets (available in 15 minutes)

Whole blood administration
• For massive bleeding, uncrossmatched O-negative whole blood may be administered in 10ml/kg aliquots for pediatric patients (1 unit aliquots for older children/adults)

Adjunctive Medications for Bleeding Management*		
In the event of continued coagulopathy with bleeding despite appropriate titration of anticoagulation and transfusion, adjunctive pharmacologic agents may be considered. Prior to administration, the use of these agents should be discussed among CCM, CT Surgery, and ECMO/Perfusion.		
Medication	**Dosing**	**Special considerations**
Protamine	Reversal of heparin: 1-2 mg/kg (OR dosing 4 mg/kg; max dose outside of the OR is 50mg)	
Aminocaproic acid (Amicar)	Loading dose of 100 mg/kg followed by continuous infusion of 25-30 mg/kg/hr	Dose based on ideal body weight Should never be given through ECMO circuit
Tranexamic acid (TXA)	<u>Systemic</u> Loading dose of 100 mg/kg followed by continuous infusion of 10 mg/kg/hr <u>Inhaled</u> (1st line for pulm. hemorrhage) ≤25 kg: 250 mg Q6hr >25 kg: 500 mg Q6hr	Consider if bleeding with TEG evidence of primary hyperfibrinolysis (low-normal MA)
Factor VII (rFVIIa)	<u>Systemic</u> 90 mcg/kg per dose May repeat dose q2hr until hemostasis is achieved <u>Inhaled</u> (2nd line/refractory pulm. hemorrhage) 50 mcg/kg/dose; max 5000 mcg/dose	First dose may be given without special approval; subsequent doses require approval from Hematology/Oncology or Transfusion Medicine
Prothrombin complex concentrate (K-Centra)	50 units/kg per dose	First dose may be given without special approval; subsequent doses require approval from Hematology/Oncology or Transfusion Medicine

**Refer to CHP Formulary for complete dosing and administration information*

CICU ECMO Thrombosis Guideline	
Clinical scenario	**Considerations for management**
Minor clotting in circuit (DOES NOT require circuit intervention)	• Ensure anticoagulation is therapeutic • Adjust risk category and anticoagulation/transfusion goals as indicated • Evaluate for underlying hypercoagulable state (sepsis, DIC) • Evaluate for heparin resistance and consider change in anticoagulant
Major clotting (DOES require circuit intervention) ***CCM and CT surgery must be notified***	• Ensure anticoagulation is therapeutic; consider heparin bolus • Adjust risk category and anticoagulation/transfusion goals as indicated • Evaluate for underlying hypercoagulable state (sepsis, DIC) • Evaluate for heparin resistance and consider change in anticoagulant • Consider plasmapheresis
Prevention of clotting during clamp trial	• Administer heparin bolus (25-50 units/kg) immediately prior to clamp trial while on bivalirudin ○ Consider repeating heparin boluses Q30 min if prolonged low flow state/ clamp trial is anticipated • Areas of low flow in the circuit, including pigtails, stopcocks, and claves, require special attention and frequent flushing by the ECMO Specialist for patients on bivalirudin
Prevention of clotting when adding extracorporeal circuits to ECMO circuit (i.e. CRRT)	• A second anticoagulant (i.e. citrate or epoprostenol) should be used regionally in the CRRT circuit to prevent clotting • Consider increasing bivalirudin infusion rate during plasmapheresis, particularly if PTT is subtherapeutic prior to initiation

CICU ECMO Heparin Resistance Guideline

Heparin resistance should be considered when the following criteria are met:

- Heparin infusion rate exceeds 40 units/kg/hr
- Lab measures of anticoagulation remain subtherapeutic (PTT, anti-Xa, heparinase TEG-R) despite continued uptitration of heparin infusion to 40 units/kg/hr or higher
- Concerns about fibrin or clot buildup in circuit

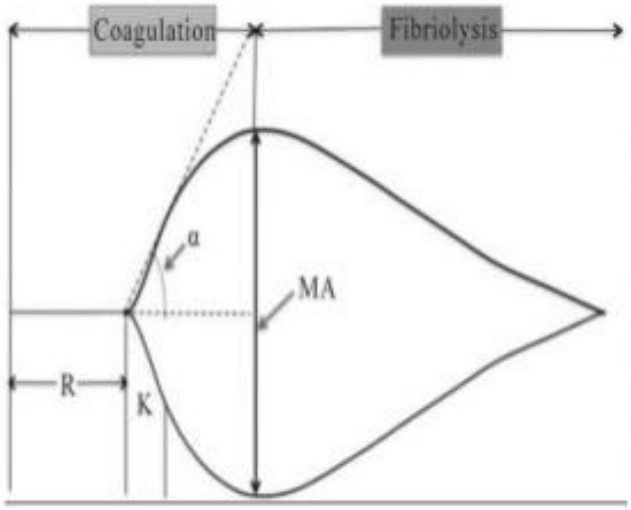
Management options include:

Consider **AT III repletion** to goal 60-80% in neonates and patients with significant ongoing protein losses (e.g. high volume drain output)

- Dosing:
  - Infant/child: 50 IU/kg
  - Adult: [(Desired – current ATIII level) x kg] / 1.4
- Decrease heparin infusion by 20% following ATIII administration
  - If patient is in the High Clotting Risk category with subtherapeutic measures of anticoagulation and concern for clot buildup in the circuit, consider decreasing heparin infusion by 10% or making no change to heparin infusion after ATIII administration

- Consider transition from heparin to bivalirudin

Appendix A: Interpretation of TEG tracing



TEG parameter	Correlations with phase of coagulation
Reaction time (min)	Time between initiation of coagulation cascade to initial formation of fibrin
Kinetic time (min)	Time between initial formation of fibrin to specific clot firmness (20 mm)
α-angle (degrees)	Rate of fibrin formation and crosslinking
Maximum amplitude (mm)	Maximum clot strength
Lysis-30 (%)	Fibrinolysis 30 minutes after maximum amplitude

Parameter	Definition	Normal Values (w/heparinase)*	Intervention if abnormal
Reaction Time (R)	• Time to activate intrinsic pathway, generate thrombin, and initiate fibrin deposition • Dependent on **amount and function of coagulation factors** • Influenced by **coagulation factor deficiency, anticoagulation**	1-6 min	If prolonged, consider FFP transfusion
Kinetics (K)	• Time from beginning of clotting to formation of clot with specific strength • Dependent on **concentration of fibrinogen and its activation, and platelets (to lesser extent)**	0.4-3.2 min	If prolonged, consider cryoprecipitate transfusion
Alpha (angle)	• Measure of maximal speed of thrombin generation, fibrin deposition, and cross- linking • Dependent on **concentration of fibrinogen, and platelets (to lesser extent)**	55-78 degrees	If low, consider cryoprecipitate transfusion
Maximum amplitude (MA)	• Maximal mechanical strength of clot • Dependent on **platelet number and function and fibrin cross-linking** • Influenced by **thrombocytopenia, platelet dysfunction, and antiplatelet agents**	51-69mm	If low, consider platelet transfusion
Lysis at 30 minutes (LY30)	• Speed of endogenous fibrinolysis • Dependent on **plasmin, plasminogen, and activators**	0-8%	If increased, consider antifibrinolytics (e.g., TXA)

**As defined by CHP Clinical Laboratory*

Appendix B: Evaluation for Heparin Induced Thrombocytopenia (HIT)

4 T's Clinical Assessment Tool

- **Low score (0-3 points)**: low probability of HIT (0-3%)
- **Medium (4-5 points) and High (6-8 points) scores**: 24-61% do not have HIT

	2 points	1 point	0 points
Thrombocytopenia	• >50% platelet drop (nadir >20 x 10^9/L) and no surgery within 3 days	• >50% platelet drop and surgery within 3 days • 30-50% platelet drop • Platelet nadir 10-19 x 10^9/L	• <30% platelet drop • Platelet nadir <10 x10^9/L
Timing of thrombocytopenia or thrombosis	• Day 5-10 (no previous exposure) • <24 hours and exposure within 5-30 days	• Timing unclear or >10 days • <24 hours and exposure within 31-100 days	• </=4 days and no exposure within 100 days
Thrombosis	• Confirmed thrombosis • Injection site necrosis • Anaphylaxis after heparin bolus • Adrenal hemorrhage	• Recurrent venous thrombosis • Unconfirmed thrombosis • Injection site erythema	• Suspected thrombosis
Other causes	• None evident	• Sepsis without known source • Ventilator initiation • Other possible cause	• Surgery (within 72 hours) • Bacteremia/fungemia • Chemo/rad (within 20 days) • Other likely cause

Linkins L, Dans A, Moores, LK et al, Chest 2012; 141(2 Suppl)e495S-e530S.

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