WEIGHT-BASED DOSING VS STANDARD CARE NOMOGRAM FOR IV HEPARIN

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Introduction

IV unfractionated heparin is a high-risk anticoagulation medication that binds to anti-thrombin, inactivating Factor IIa and Factor Xa, and prevents the conversion of fibrinogen to fibrin. Based on the Institute of Safe Medication Practice (ISMP), unfractionated heparin is considered a high-alert medication due to its significant risk of causing life-threatening bleeding or thrombosis. Since heparin is on the list of high-alert medications, cautious prescribing, dispensing, administering, and monitoring of the medication is important to prevent fatal adverse drug events.

At Kern Medical, we have two heparin protocols for specific indications: venous thromboembolism and acute coronary syndrome . In the heparin protocols, we provide targeted therapeutic range, initial dosing re-commendations, dosing adjustment recommendations, and monitoring parameters. Based on the indication, prescribers would order the specific heparin protocol and nurses would follow the outlined steps for heparin management stated on the protocol while clinical pharmacy provides monitoring and dosing recommendations for all patients on IV unfractionated heparin.

Prior to 2016, heparin dosing was based on standard care nomogram. However, studies showed that weight-based nomogram may be more effective than the standard care nomogram. In July 2017, a new heparin protocol was implemented with changes for weight-based dosing. This study aims to assess the efficacy of weight-based dosing for IV heparin compared to the standard care nomogram.

Objective

The main objective is to evaluate the effectiveness of weight-based dosing nomogram compared to the standard care nomogram for IV unfractionated heparin.

Methods

- Retrospective, chart review study
- Data for Standard Care Nomogram was collected from January 2016 to June 2016
- Data for Weight-based dosing Nomogram was collected from July 2017 to November 2017.
- Inclusion Criteria: IV heparin indicated for venous thromboembolism or acute coronary syndrome, use of targeted aPTT listed in protocol, and use of heparin flow sheet
- Exclusion Criteria: Different target aPTT from protocol, indications that are not included in the protocol, lack of documentation, and discontinuation of IV heparin after one dose
- Used heparin flowsheet and tracked time on drip and time therapeutic on drip

Nomogram Interventions

Group 1: Standard Care Nomogram

VTE: 80 units/kg bolus and 18 units/kg/hr infusion

6. **Orders for Heparin Infusion Adjustments:**

PTT	HEPARIN BOLUS	INFUSION ADJUSTMENT
A. less than 40 seconds	100 units/kg	Increase 300 units / hour
B. 40-50 seconds	100 units/kg	Increase 200 units / hour
C. 50-60 seconds	50 units/kg	Increase 100 units / hour
D. 60-100 seconds	NONE	**NONE. PTT Therapeutic** CONTINUE Present Infusion.
E. 100-149 seconds	NONE	**Reduce 100 units / hour**
F. Greater than 150 sec	NONE	**STOP INFUSION. After 2 hours, redraw PT,PTT and IMMEDIATELY resume infusion at 200 units/hour LESS than the previous infusion rate. REPEAT Step F if the 2 hours PTT is greater than 50 seconds. ** See Note Below!**

ACS: <67 kg – 4000 units bolus and 800 units/hr
≥67 kg – 5000 unit bolus and 1000 units/hr

	PTT	Heparin Bolus: Less than 67 kg or	Heparin Bolus: Greater than equal to 67 kg	Infusion Adjustment
A.	Less than or equal to 40 seconds	4000 units IV	5000 units IV	Increase 200 units/hour
B.	41-50 seconds	4000 units IV	5000 units IV	Increase 100 units/hour
C.	51-75 seconds	NONE		**NONE, PTT Therapeutic** Continue present infusion
D	76-99 seconds	NONE		Reduce 100 units/hour
E.	Greater than or equal to 100 seconds	NONE		**STOP INFUSION. After 2 hours, redraw PT/PTT and immediately resume infusion at 200 units per hour LESS than the previous infusion rate. REPEAT Step E if the 2 hour PTT is greater than 100 seconds. ** See note below!**

Group 2: Weight-based Dosing Nomogram

VTE: 80 units/kg bolus and 18 units/kg/hr infusion

PTT (seconds)	Heparin Re-Bolus (round to nearest 100 units)	Infusion Adjustment (Round to nearest 50 units)
A. < 40	80 units/kg Max 10,000 units	Increase by 4 units/kg/hr
B. 40-50	40 units/kg Max 5,000 units	Increase by 3 units/kg/hr
C. 51-59	40 units/kg Max 5,000 units	Increase by 2 units/kg/hr
D. 60-100	NONE	NONE. PTT Therapeutic CONTINUE present infusion
E. 101-120	NONE	Decrease by 1 unit/kg/hr
F. 121-140	NONE	Decrease by 2 units/kg/hr
G. 141-150	NONE	Decrease by 3 units/kg/hr
H. > 150	NONE	1. STOP infusion for 2 hours 2. After **2 hours, redraw PT/PTT and IMMEDIATELY resume infusion at 4 units/kg/hr LESS than previous rate. REPEAT Step H if the 2 hour PTT is greater than 150 seconds.**

ACS: 60 units/kg bolus and 12 units/kg/hr infusion

PTT (seconds)	Heparin Re-Bolus (Round to nearest 100 units)	Infusion Adjustment (Round to nearest 50 units)
A. ≤ 40	30 units/kg Max 2,000 units	Increase by 2 units/kg/hr
B. 41-50	NONE	Increase by 1 unit/kg/hr
C. 51-75	NONE	NONE. PTT Therapeutic CONTINUE present infusion
D. 76-99	NONE	Decrease by 1 unit/kg/hr
E. 100-129	NONE	Decrease by 2 units/kg/hr
F. ≥ 130	NONE	1. STOP infusion for 2 hours 2. After **2 hours, redraw PT, PTT and IMMEDIATELY resume infusion at 4 units/kg/hr LESS than the previous rate. REPEAT Step F if the 2 hour PTT is greater than 130 seconds.**

Results

Figure 1. Weight-Based vs Standard Care Indications

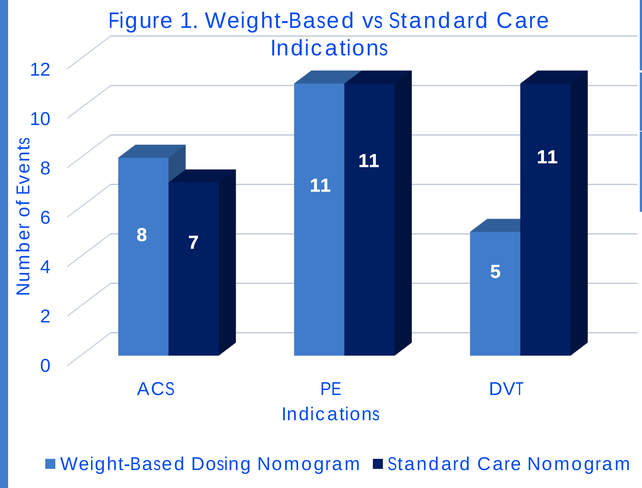

Table 1. DEMOGRAPHICS	Standard Care Nomogram	Weight-Based Dosing Nomogram
Age (years)	Mean: 50.8 Range: 23-90	Mean: 57.4 Range: 26-89
Weight (kg)	Mean: 92.7 Range: 48-198	Mean: 80.6 Range: 52.2-122.5

The weight-based dosing nomogram has older patients compared to the standard care nomogram. However, the weight-based dosing nomogram group weighed less compared the standard care nomogram (Table 1). The weight-based dosing nomogram and standard care nomogram had similar amount of patients with acute coronary syndrome and pulmonary embolism. However, the standard care nomogram had more patients with deep venous thromboembolism compared to the weight-based dosing nomogram (Figure 1).

Standard care nomogram had more total hours on the heparin drip compared to the weight-based nomogram. When comparing efficacy, the weight-based nomogram group had more hours therapeutic on the heparin drip and took an average of less time to the first therapeutic aPTT compared to the standard care nomogram group (Table 2).

Table 2. EFFICACY	Standard care Nomogram (N=30)	Weight-based Nomogram (N=23)
Total hours on drip (Mean)	60.6 (14-283)	52.98 (6-236.5)
Total hours therapeutic on drip (Mean)	29.8 (0-128)	32.45 (0-160.17)
Mean % of time in therapeutic range	41.5%	57.0%
Mean time to first therapeutic aPTT (hours)	16.4 (3-79)	13.28 (6-32)

Conclusions

After assessing the efficacy of the standard care nomogram and comparing it to the weight-based dosing nomogram implemented in the new IV heparin administration protocol, we can see that numerically patients spend more time in therapeutic aPTT in the weight-based dosing group compared to the standard care nomogram. It also takes less time for patients to reach therapeutic aPTT compared to the standard care nomogram.

However, despite these differences, there are several limitations in the study. With the advent oral direct acting anticoagulants (DOACs) and low molecular weight heparins (LMWH), heparin is not as frequently used as it once was, which led to relatively small sample size of patients in each arm. Furthermore, the data collection from the Standard Care arm came from a routine medication use evaluation (MUE) and lacked some statistical data to allow for a statistical comparison between groups. A third limitation is that safety measures were not assessed in the study so we could not determine if one nomogram was associated with more adverse events than the other. Another limitation is that when the new heparin protocol was rolled-out hospital-wide, staff may have not received adequate education or training to the protocol changes. Since heparin infusions are infrequently utilized, staff training and competency assessments are likely warranted. There were cases of incorrect initial dosing and dosing adjustments when using the weight-based dosing protocol that may be due to some degree of unfamiliarity with new protocol. This improper use of the weight-based dosing nomogram possibly influenced the data and underestimated the efficacy of the weight-based data.

Despite the limitations, after changing the IV heparin protocol to weight-based dosing, there are numerical improvements in total hours in therapeutic aPTT while on the heparin drip and time to first therapeutic aPTT. Overall this change in the IV heparin protocol suggests a trend towards improvement in patient outcomes. However, future research is necessary and planned to further assess safety and efficacy of heparin infusion protocols.

References

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