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Peri-Operative Warfarin Protocol to Decrease Length of Stay After Left Ventricular Assist Device Implantation

Laura Hencken

Gillian Grafton

Long To

Hassan Nemeh

Jennifer A. Cowger

(1145)

Safety of Once Daily Enoxaparin for Anticoagulation Bridging in Patients with HeartMate III Left Ventricular Assisted Device

M. Alom,[1] Y. Yaacoub,[1] G. Bhattal,[1] N. Kabra,[1] D. Rawitscher,[1] T. George,[2] S. Joseph,[3] and A. Afzal.[4] [1]Advanced Heart Failure and Transplant Cardiology, Baylor University Medical Center/The Heart Hospital Plano, Plano, TX; [2]Cardiothoracic Surgery, Baylor University Medical Center/The Heart Hospital Plano, Plano, TX; [3]Advanced Heart Failure and Transplant Cardiology, University of Maryland, College Park, MD; and the [4]Advanced Heart Failure and Transplant Cardiology, Baylor University Medical Center/Texas A&M School of Medicine, Plano, TX.

Purpose: Most centers bridge patients with Left Ventricular Assist Device (LVAD) patients with heparin drip to avoid thromboembolic complications based on data from HeartMate II. Because of improved hemocompatibility of third generation HeartMate III (HM3), Low molecule weight heparin like enoxaparin has been used to bridge to warfarin when the INR (International Normalized Ratio) is subtherapeutic. Once daily dosing has been used in select patients with higher bleeding risk. However, data supporting this approach is limited. We investigate the safety of using once daily Enoxaparin dosing to bridge subtherapeutic warfarin in patients on HMIII LVAD.
Methods: We conducted a retrospective review of patients who underwent HMIII LVAD implantation from 2018 to 2020. We identified 22 patients who received enoxaparin daily bridging after LVAD implantation. We investigated complications related to enoxaparin use and the necessary data parameters to determine the safety profile of once daily enoxaparin use. The primary outcome was in-pump thrombosis. Secondary outcomes included ischemic stroke, embolic phenomenon, acute kidney injury and bleeding events.
Results: 52 patients were screened, 22 patients of which bridged at least once with enoxaparin. 10 patients received multiple rounds of enoxaparin bridging over their course of follow up. The average enoxaparin course was 3-7 days and extended only if INR remains below 1.6. Enoxaparin was held once the INR reaches 1.8. There were no incidence of pump thrombosis, ischemic stroke or embolic phenomenon related to enoxaparin bridging. No significant events were noted in terms of worsening thrombocytopenia, anemia, renal function, bleeding events, or rates of infection.
Conclusion: Once daily enoxaparin dosing as a bridge to subtherapeutic anticoagulation with warfarin for HM III patients is a safe and effective method for preventing pump thrombosis while significantly reducing the need for hospital admissions for heparin bridging.

Table 1. Characteristics and Outcomes of patients who received enoxaparin daily after their HeartMate III Left Ventricular Assist Device (LVAD) implantation.

Total number of patients who had HMIII LVAD	52
Patient received enoxaparin after LVAD implantation	40% (n=22)
Mean age, years (range)	66.4 (48-81)
Sex	
• Males	86.3% (n=19)
• Females	13.6% (n=3)
Race	
• Caucasian or Not Hispanic/Latino	86.3% (n=19)
• African American	9% (n=2)
• South Asian	4.5% (n=1)
Co-morbidities	
○ History of Gastrointestinal bleeding	4.5% (n=1)
○ HTN	77.2% (n=17)
○ CKD	81.8% (n=18)
○ Type-II DM	45.4% (n=10)
○ History of ischemic stroke	18.1% (n=4)
incidence of pump thrombosis	0% (n=0)
incidence of ischemic stroke	0% (n=0)
incidence of other embolic phenomenon	0% (n=0)
incidence of acute kidney injury at the time of enoxaparin use	0% (n=0)
incidence of bleeding events related to enoxaparin use	0% (n=0)

(1146)

Peri-Operative Warfarin Protocol to Decrease Length of Stay After Left Ventricular Assist Device Implantation

L. Hencken,[1] G. Grafton,[2] L. To,[1] H. Nemeh,[3] and J. Cowger.[2] [1]Pharmacy, Henry Ford Hospital, Detroit, MI; [2]Cardiology, Henry Ford Hospital, Detroit, MI; and the [3]Cardiac Surgery, Henry Ford Hospital, Detroit, MI.

Purpose: A limitation to left ventricular assist device (LVAD) implantation is cost with fixed reimbursement rates for the LVAD implantation hospitalization regardless of hospital length of stay and costs. Patients must have a therapeutic INR on warfarin prior to discharge which can take days and delay discharge. The purpose of this study is to evaluate the impact of a peri-operative warfarin protocol on decreasing length of stay during index LVAD implantation.
Methods: This is a retrospective single center study of adult patients undergoing LVAD implantation between January 1, 2019 and December 31, 2020. Patients who died during the admission were excluded. Patients in the intervention group (INT) underwent LVAD between January 1-December 31, 2020. The peri-operative warfarin protocol included pre-operative vitamin K dosing according to INR, initiation of warfarin by post-operative day (POD) 3, and warfarin titration scheme. The historical control group (CON) included patients receiving LVADs between January 1-December 31, 2019. Warfarin start date was at the discretion of providers. All patients had a goal INR of 2-3. Endpoints included length of stay, post-operative warfarin start date, time to therapeutic INR, warfarin dosing requirements, pre-operative vitamin K dosing and bleeding complications.
Results: Seventy-seven patients were included; n=41 (53.2%) CON and n=36 (46.8%) INT. Total hospital length of stay was 35 [26,43] days in the CON group compared to 27.5 [24,35] days in the INT group (p=0.095). Warfarin was started earlier in the INT group (POD 5.5 [2.8,7.0]) compared to the CON group (POD 8 [6,14]) (p=0.004). Time to therapeutic INR remained the same between the two groups with a median of 6 days. Pre-operative vitamin K decreased from 15 [10,15] mg in the CON group to 5 [0.0,11.3] mg in the INT group (p=<0.001). There was no increase in bleeding with the peri-operative warfarin interventions: 8 bleeds in the CON group and 4 bleeds in the INT group.
Conclusion: Initiating warfarin earlier post-operatively may help decrease hospital length of stay after LVAD implantation without increasing bleeding events.

(1147)

Impact of Statins on the Incidence of Gastrointestinal Bleeding Events Among Patients with Continuous Flow Left Ventricular Assist Devices

H. Halawi,[1] J.E. Harris,[1] D. Putney,[1] D.T. Nguyen,[2] E.A. Graviss,[2] and M. Kassi.[3] [1]Department of Pharmacy, Houston Methodist Hospital, Houston, TX; [2]Department of Pathology and Genomic Medicine, Houston Methodist Research Institute, Houston, TX; and the [3]Department of Cardiology, Houston Methodist Hospital, Houston, TX.

Purpose: Patients with continuous flow left ventricular assist devices (CF-LVADs) are at an increased risk of gastrointestinal bleeding (GIB) events due to von Willebrand factor degradation, enhanced angiogenesis and endothelial dysfunction resulting from non-pulsatile flows of the device. LVAD patients also commonly receive statins for the primary or secondary prevention of cardiovascular disease. However, the impact of such therapy on the incidence of GIB is controversial. Importantly, literature regarding the impact of statins on GIB in LVAD patients is lacking.
Methods: This was a single-center, retrospective review of adult patients that underwent CF-LVAD implantation between May 2016 and January 2020. Patients were categorized based on statin use throughout the study period. The primary outcome was the composite of arteriovenous malformation (AVM) confirmed GIB and other major GIB events for up to 1-year post-LVAD implantation. Secondary outcomes included each of the components of the primary outcome, non-clinically relevant GIB, time to GIB, and frequency of GIB. Multivariable Cox regression was utilized to assess association between confounding variables and major GIB.
Results: Of the 123 patients who met inclusion criteria, 66 (54%) received statin therapy during the study period. No difference was observed in the primary outcome of major GIB between the statin and non-statin groups (21.2% vs. 12.3%, p=0.20). Similarly, AVM confirmed GIB (12.1% vs. 5.3%, p=0.20), other major GIB (9.1% vs. 7.0%, p=0.75), and non-