The American Journal of Surgery (2014) 207, 648-652

The American Journal of Surgery®

North Pacific Surgical Association

A retrospective analysis of the effectiveness of low molecular weight heparin for venous thromboembolism prophylaxis in trauma patients

Yaroslav Gritsiouk, B.S., Damian A. Hegsted, B.S., Piroska Schlesinger, B.S., Stuart K. Gardiner, Ph.D., Kelly D. Gubler, D.O., M.P.H.*

Legacy Emanuel Medical Center, 2801 N. Gantenbein, Suite 130, Portland, OR 97227, USA

KEYWORDS:
Low molecular weight heparin;
Deep vein thrombosis;
Pulmonary embolism;
Venous thromboembolism;
Trauma

Abstract

BACKGROUND: In trauma patients, Enoxaparin (a low molecular weight heparin, LMWH) prophylaxis for venous thromboembolism (VTE) risk reduction is unproven.

METHODS: Cohort analysis conducted consisting of all trauma patients age >13 admitted to Level-I trauma center and hospitalized >48 hours. VTE risk determined by the Risk Assessment Profile. High risk patients received LMWH unless contraindicated, while low and moderate risk patients received LMWH at attending surgeon's discretion. Odds ratio for VTE by logistic regression. VTE incidence, relative risk (RR), and number needed to treat (NNT) to prevent deep vein thrombosis (DVT) or pulmonary embolism determined by risk category.

RESULTS: Cohort consisted of 2,281 patients (1,211 low, 979 moderate, 91 high risks). VTE occured in 254 patients (11.1%). High-risk patients had significantly higher VTE incidence, odds ratio = 31.8 ($P < .001$). VTE was significantly reduced in high-risk patients receiving LMWH versus those who did not (.26 vs .53, $P = .02$). Among moderate and high risk, prophylactic LMWH reduced the incidence of pulmonary embolism (RR = .19, NNT = 40.4, $P = .01$), and trended toward reduced DVT incidence (RR = .81, NNT = 27.3, $P = .15$). LMWH lowered DVT incidence (RR = .52, NNT = 4.1, $P = .03$) in high risk patients.

CONCLUSION: Prophylactic LMWH is associated with reduction of VTE in trauma patients.

Deep vein thrombosis (DVT) and pulmonary embolism (PE), known collectively as venous thromboembolism (VTE), are common life-threatening conditions in acute trauma patients. A study by Geerts et al[1] found DVT incidence to be as high as 58% among patients without prophylaxis. PE is the 3rd most common cause of death in patients who survive the 1st 24 hours.[1,2] Multiple approaches have been recommended for VTE prophylaxis, including the use of sequential compression device (SCD),[3] low-dose unfractionated heparin (LDUH),[4] inferior vena cava filter,[5] and low molecular weight heparin (LMWH).[2,6–8] Conflicting data exist as to whether LMWH is more effective than LDUH for the prevention of VTE. Initial findings by Geerts et al[6] suggested that LMWH was more effective than LDUH in preventing VTE; however, a more recent study published by Arnold et al[4] concluded that there was no difference in efficacy

The authors declare no conflicts of interest.

Research Supported in part by: Legacy Health Research Foundation.

* Corresponding author. Tel.: +1-503-413-2100; fax:+1-503-413-2178.

E-mail address: DGubler@lhs.org

Manuscript received November 1, 2013; revised manuscript December 17, 2013

0002-9610/$ - see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2013.12.010

Table 1 Demographics

	LMWH	No LMWH	*P* value
Mean age	45.4	45.2	.82
Total male	332	1,259	.98
Total female	143	541	.98
Mean ISS	18.1	14.9	<.001

Comparison of various demographic factors of patients who received LMWH to those who did not.

ISS = injury severity score; LMWH = low molecular weight heparin.

Table 2 Logistic regression of VTE by RAP risk

RAP risk	Odds ratio	Low 95% CI	High 95% CI	*P* value
Low	.0369	.0262	.0502	<.001
Moderate	6.0797	4.2004	8.9909	<.001
High	31.82	16.80	61.15	<.001

Logistic regression of odds ratio of developing VTE by RAP risk group. Associated *P* values in right-hand column.

CI = confidence interval; RAP = Risk Assessment Profile; VTE = venous thromboembolism.

and that the use of LDUH resulted in significantly lower pharmacy costs to the hospital and patient. Mechanical prophylaxis with SCD has been shown to be a useful tool in preventing DVT, but because of its nature it cannot be implemented on patients with multiple extremity injuries which constitute a large proportion of trauma patients.[2,9,10] As reported by McMurtry et al,[11] the use of inferior vena cava filters has not been shown to decrease the overall incidence of PE, and because of this they should only be implemented in high-risk patients who have contraindications to anticoagulation.[2] The data for the effectiveness of LMWH are lacking; only one study by Knudson et al[8] in 1996 that consisted of 372 subjects has found that the use of LMWH was associated with decreased incidence of DVT in trauma patients. In 2008, Adams et al[12] published a large series consisting of nearly 3,000 subjects over the course of 4 years and found that aggressive ultrasound (US) screening with prophylactic treatment with LMWH resulted in a significant decrease in VTE incidence. The study failed to quantify the effectiveness of LMWH in decreasing the prevalence of VTE but rather advocated for an aggressive screening and prophylaxis protocol. Aggressive US screening and the use of LMWH prophylaxis as a recommendation require a significant demand on hospital resources; however, there has been no cost analysis performed to our knowledge with respect to the effectiveness of such a protocol. The purpose of this article is to evaluate the efficacy of Enoxaparin, an LMWH, for the prevention of VTE in trauma patients.

Methods

We performed a retrospective cohort analysis of all trauma patients 13 years of age and older admitted to an American College of Surgeons-verified Level-I trauma center and hospitalized for more than 48 hours during the years 2003 and 2006. VTE risk assessment was based on the Risk Assessment Profile (RAP), a tool proposed by Greenfield et al[13] and validated in a large retrospective cohort by Hegsted et al.[14] Patients were classified as low, moderate, or high risk. By trauma service protocol, all high-risk patients received LMWH as well as mechanical prophylaxis if not contraindicated and were screened using US at 3-day intervals. Low- and moderate-risk patients had US screening after 1 week and received LMWH prophylaxis at the discretion of the attending surgeon. If patients had below-knee superficial thrombosis, they were screened at 3-day intervals for evidence of proximal progression. Repeat duplex in high-risk patients was performed by protocol. Mechanical prophylaxis was utilized for all low-, moderate-, and high-risk patients and consisted of SCD. PE was detected by computed tomography angiography or postmortem examination. The accuracy of the data abstraction was tested by inter-rater reliability on 2% of the patient charts and agreement was quantified by calculating observed agreement, Cohen's kappa coefficient, and prevalence-adjusted bias-adjusted kappa coefficient (PABAK). For each individual, we determined the risk of VTE according to categorical placement in low-, moderate-, and high-risk groups as determined by the RAP. Logistic regression was performed to determine the odds ratio of developing VTE based on the risk group. We then determined the proportion of individuals in each risk category that received prophylactic LMWH, which we considered as any amount ≥ 1 dose for the purpose of this study. Within each risk category we determined the relative risk (RR) and number needed to treat (NNT) to prevent VTE or PE, using univariate logistic regression.

Results

In the cohort of 2,281 patients, there were 2,077 blunt and 204 penetrating injuries, 1,596 male and 685 female, with a mean age of 45.2 years and a mean ISS of 15.5. In the cohort, 254 (11.1%) patients developed VTE. This analysis included 1,211 patients at low risk, 979 patients at moderate risk, and 91 patients at high risk. Analysis of data reliability showed a high level of agreement among the

Table 3 Patients by risk category

	Lovenox	No Lovenox	Ratio
Low	126	1,068	.44
Moderate	311	655	1.77
High	38	50	2.84

Patients who received LMWH compared to those who did not by risk category.

LMWH = low molecular weight heparin.