ASSESSMENT THE EFFECT OF PREOPERATIVE BEMIPARIN SODIUM AND ENOXAPARIN IN PATIENTS UNDERGOING ORTHOPAEDIC SURGERY

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Abstract

Background: Thromboembolic prophylaxis is recommended with low molecular weight heparins in trauma patients undergoing orthopaedic surgery. The aim of the present study was to evaluate the incidence of severe intraoperative bleeding in patients who received preoperative bemiparin or enoxaparin for prophylaxis against thromboembolism and undergoing orthopaedic surgery.

Methods: The study included 304 trauma patients with femoral neck fracture, femur fracture, pelvic fracture or obese patients with tibia fracture. The patients were classified in two group(n=152). Group B: The patients received once-daily subcutaneous bemiparin 3500 IU or 2500 IU before surgery. Group E: The patients received once-daily subcutaneous enoxaparin 40 mg or 30 mg before surgery. Bemiparin or enoxaparin was for prophylaxis against thromboembolism. The monitors included the arterial blood pressure, incidence of severe perioperative bleeding, amount of blood loss, hemoglobin level, transfused blood products, transfused fluids, urine output, arterial oxygen saturation, required pharmacological support, duration of anaesthesia and surgery. The statistics were described in terms of mean ± standard deviation, frequencies, and percentages.

Results: The incidence of perioperative bleeding, blood loss, transfused packed-red blood cells, fresh frozen plasma, and wound reopening increased significantly with preoperative bemiparin than the preoperative enoxaparin ($p<0.05$). The incidence of hypotension was higher in group B than group E ($p<0.05$). The requirement for pharmacological support was higher in group B than group E ($p<0.05$).

Conclusions: The preoperative bemiparin increases the incidence of perioperative bleeding, blood loss, transfused packed-red blood cells and fresh frozen plasma than the preoperative enoxaparin in trauma patients undergoing orthopaedic surgery.

Keywords: Trauma orthopaedic surgery, Bemiparin, Enoxaparin, Perioperative bleeding, Blood loss, Packed-red blood cells.

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Introduction

Low-molecular-weight heparins (LMWHs) are common and effective anticoagulants used as first-line prophylaxis against the venous thromboembolism in major orthopaedic surgery[1,2], and requiring prolonged immobilization due to trauma[3]. The low-molecular-weight heparins may cause surgical bleeding or bleeding in critical organs such as intracranial, spinal, retroperitoneal, or intraocular bleeding, or fatal bleeding[4,5].

Bemiparin is a second-generation LMWH that has shown greater efficacy than standard heparin in the prevention of venous thromboembolism after total hip replacement surgery[6], and other orthopaedic surgeries[4]. It has a very low mean molecular weight (3600 Dalton) and long half life (5.3 hours)[6,7].

Bemiparin may be started before or after surgery, whereas recommendations for other LMWHs in Europe primarily involve preoperative initiation[8].

Enoxaparin is the most widely prescribed anti-thrombin therapy in the world for the prophylaxis against venous thromboembolism. The ratio of anti-Xa to anti-IIa activity of bemiparin is approximately 8:1, and that of enoxaparin is 3.8:1, and therefore the bemiparin has a greater antithrombotic activity than enoxaparin[9,10].

We hypothesize that the use of bemiparin is associated with bleeding tendency, because of its higher antithrombotic activity than enoxaparin. The aim of the present study was to evaluate incidence of severe intraoperative bleeding (requiring blood transfusion) in patients who received preoperative bemiparin or enoxaparin for prophylaxis against deep venous thrombosis and undergoing orthopaedic surgery.

Methods and patients: After approval from the local ethics committee and obtaining written informed consent, an observation study included 304 patients who received preoperative bemiparin or enoxaparin and undergoing orthopaedic surgery through (2015-2017). The inclusion criteria were trauma patients with femoral neck fracture, femur fracture, pelvic fracture or obese patients with tibia fracture. The exclusion criteria were patients receiving antiplatelets (except aspirin) or anticoagulants, or patients with liver disease, renal disease, congenital or acquired bleeding disorder, hypersensitivity to low molecular weight heparins, thrombophilic disease, thrombocytopenia (platelet count <100,000/µl), non-controlled hypertension, or active gastrointestinal ulcer. The anaesthetist who conducted the cases and collected the data was blind to the preoperative bemiparin or enoxaparin. The patients were classified into two groups: Group B: The patients received once-daily subcutaneous bemiparin (bemiparin sodium; Hibor®, Laboratorios Farmacéuticos Rovi SA, Madrid, Spain) 3500 IU or 2500 IU before surgery for prophylaxis against deep venous thrombosis.

Group E: The patients received once-daily subcutaneous enoxaparin (Clexane, Sanofi Winthrop Industrie, Seine Maritime, France) 40 mg or 30 mg before surgery for prophylaxis against deep venous thrombosis.

The bemiparin and enoxaparin were discontinued 12 hours before the surgery.

For all patients and under local anaesthesia, a radial arterial cannula and peripheral venous cannula G 18 or 16 were inserted. Anesthetic technique was done under general or spinal anaesthesia. General anaesthesia: Anaesthesia induction was started by preoxygenation with 100% oxygen, intravenous fentanyl (1-2µg/kg), etomidate (0.3mg/kg), and cisatracurium (0.2mg/kg). After tracheal intubation, and starting of mechanical ventilation, and the anesthesia was maintained with sevoflurane (1-3%), fentanyl infusion (1-3µg/kg/hr), cisatracurium (1-2µg/kg/min) and oxygen:air (50:50%). Spinal anaesthesia was done with intrathecal injection of 3.5 ml heavy marcaine (0.5%) and 25µg fentanyl. Some patients received ketamine (20-50 mg) during spinal anaesthesia technique. If the spinal anesthesia was inadequate, the patients were anesthetized with general anaesthesia. After surgery, some patients were transferred to ICU intubated and ventilated mechanically to be extubated in the ICU and the other patients were extubated and transferred to post-anaesthesia care unit with closed monitoring and observation for 2 to 4 hours and. Most of the patients were shifted to the ward, while other patients were transferred to the intensive care unit according to preoperative plan.

For all patients, the following variables were closely monitored; The heart rate, mean arterial blood pressure, the incidence of severe perioperative bleeding, amount of blood loss, haemoglobin level, transfused blood products, transfused fluids, urine output, arterial oxygen saturation, required pharmacological support, duration of anesthesia and surgery. The prothrombin time (PT), international normalized ratio (INR), activated partial thromboplastin time (aPTT), platelets, fibrinogen, D-dimer, platelets, fibrinogen, and D-dimer were measured before and after surgery.

Outcomes

The primary outcome was the severe intraoperative bleeding (requiring blood transfusion), which was assessed by incidence of patients suffering from severe intraoperative bleeding and the amount of intraoperative bleeding. A secondary outcome was the requirement for blood products and the occurrence of any adverse events.

Table 1

Preoperative data of patients (Data are presented as Mean±SD, number, %)

Variables			Group B (n=152)	Group E (n=152)	P-value
Age (year)			59.32±13.45	60.00±13.20	0.656
Weight (kg)			78.94±13.57	77.12±12.89	0.231
Gender	Male: Female		79:73	82:70	0.818
Types of surgery	Fresh cases		137	140	0.687
	Redo cases	Fracture neck femur	10	9	0.812
		Femoral IMN	5	3	0.473
Hypertension			114	106	0.369
Diabetes mellitus			86	91	0.641
Ejection fraction (%)			48.43±7.82	46.79±8.15	0.074
Ischemic heart disease			36	30	0.486
Bronchial asthma			38	33	0.587
Creatinine (mmol/L)			98.50±9.73	97.86±8.24	0.536
Elevated liver enzymes > 2 folds			12	17	0.435
Aspirin			81	83	0.908
Calcium channels-blockers			42	38	0.696
Diuretics			33	28	0.567
Smoking	Current smokers		46	51	0.622
	Ex-smokers		25	20	0.518
ASA II			49	56	0.469
ASA III			73	71	0.908
ASA IV			30	25	0.551
Preoperative timing of administration (day)			3.46±3.27	3.85±1.31	0.148
Bemiparin dose (IU)	106 patients	3500 (IU)	3197.37±460.92	-	-
	46 patients	2500 (IU)			
Enoxaparin dose (mg)	138 patients	40 mg	-	39.08±2.90	-
	14 patients	30 mg			

Group B: Bemiparin group; Group E: Enoxaparin group

Femoral IMN: Femoral intramedullary nail; ASA: American Society of Anesthesiologists Physical Status Score.

Sample Size Calculation

Power analysis was performed using the Chi square test for independent samples on the incidence of patients suffering from severe intraoperative bleeding, because it was the main outcome variable in the present study. A pilot study was done before starting this study, because there are no available data in the literature for the effect of the bemiparin and enoxaparin sodium on the incidence of severe intraoperative bleeding in trauma patients undergoing orthopaedic surgery. The results of the pilot study showed that the incidence of severe intraoperative bleeding was of 40 % in bemiparin group, and 25 % in enoxaparin sodium group. Taking power 0.8, alpha error 0.05, and beta 0.2, a minimum sample size of 152 patients was calculated for each group.

Statistical Analysis

Data were statistically described in terms of mean ± standard deviation (±SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using the paired *t* test. For comparing categorical

Table 2

Coagulation, blood losses and blood products transfusion profiles of patients (Data are presented as Mean±SD, number)

Variables			Group B (n=152)	Group E (n=152)	P-value
Preoperative coagulation profiles	PT (second)		10.33±1.68	10.47±1.53	0.448
	INR		1.04±0.12	1.06±0.10	0.115
	aPTT (second)		40.15±7.47	41.53±8.76	0.140
	Platelets (x10/µl)		283.35±69.44	275.71±65.96	0.326
	Fibrinogen (g/l)		3.64±0.52	3.55±0.49	0.121
	D-dimer (µg/ml)		0.23±0.10	0.25±0.12	0.115
Postoperative coagulation profiles	PT (second)		10.70±1.49	10.95±1.56	0.154
	INR		1.06±0.13	1.08±0.14	0.197
	aPTT (second)		38.64±6.86	40.08±7.25	0.076
	Platelets (x10/µl)		268.22±72.58	257.08±65.93	0.162
	Fibrinogen (g/l)		3.46±0.54	3.42±0.48	0.495
	D-dimer (µg/ml)		0.76±0.34	0.83±0.46	0.132
Blood loss and transfusion	Major bleeding [x]		-	-	
	Surgical bleeding		37	19	0.011
	Intraoperative blood loss (ml)		1726.14±323.75	635.42±289.72	0.011
	Postoperative blood loss (ml)		648.24±123.80	615.61±131.72	0.026
	Wound reopening		10	2	0.034
	P-RBC (unit)		3.40±1.73	2.65±1.68	0.001
	FFP (unit)		1.68±0.60	1.51±0.57	0.011
	HB(g/dl)	Preoperative	12.36±2.71	12.68±2.16	0.255
		Before transfusion	8.46±1.78	9.00±1.95	0.012
		After Transfusion	10.74±2.15	10.84±2.34	0.698

Group B: Bemiparin group; Group E: Enoxaparin group.

Major bleeding [x] [Bleeding in critical organs such as intracranial, spinal, retroperitoneal, or intraocular bleeding]

PT: Prothrombin time, INR: International normalized ratio, aPTT: Activated thromboplastin time, P-RBC: Packed- red blood cells, FFP: Fresh frozen plasma, HB: Haemoglobin.

Table 3

Heart rate and mean arterial blood pressure of patients (Data are presented as mean±SD)

Variable	Timepoints	Group B (n=152)	Group E (n=152)	P-value
Heart rate (bpm)	T0	77.75±7.47	79.14±7.15	0.098
	T1	79.75±9.38	80.14±10.56	0.733
	T2	85.44±12.20	81.58±14.32	0.011
	T3	88.17±14.45	82.98±12.78	0.001
	T4	87.56±14.84	82.90±13.90	0.005
	T5	87.19±13.76	83.40±13.15	0.014
	T6	84.35±12.68	81.40±12.29	0.040
	T7	82.06±11.46	80.38±10.57	0.185
	T8	80.22±10.38	79.74±10.14	0.683
Mean arterial blood pressure (mmHg)	T0	106.10±8.47	107.44±7.30	0.140
	T1	108.76±9.21	109.15±9.45	0.715
	T2	98.99±11.04	103.14±10.76	0.001
	T3	95.92±12.44	100.21±10.63	0.002
	T4	96.86±12.91	100.98±10.17	0.002
	T5	98.77±12.15	102.16±10.76	0.011
	T6	97.98±12.82	102.12±12.90	0.005
	T7	102.98±11.58	105.12±11.24	0.103
	T8	104.68±11.65	106.34±11.83	0.218

Group B: Bemiparin group; Group E: Enoxaparin group.

T0: Baseline; T1: 15 minutes after induction; T2: 30 minutes after induction; T3: 60 minutes after induction; T4: 90 minutes after induction; T5: 120 minutes after induction; T6: at the end of surgery; T7: one hour after surgery; T8: two hours after surgery.

data, Chi square (X^2) test was performed. Exact test was used instead when the expected frequency is less than 5. *P*-value less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

Table 1 shows no significant differences regarding the demographic data, co-morbidities, preoperative medications, ASA physical status and the preoperative time of bemiparin or enoxaparin administration (p>0.05). The bemiparin was given as a dose of 3500 IU for 106 patients and 2500 IU for 46 patients, and the mean dose was 3197.37±460.92 IU. The enoxaparin was given as a dose of 40 mg for 138 patients and 30 mg for 14 patients, and the mean dose was 39.08±2.90 mg.

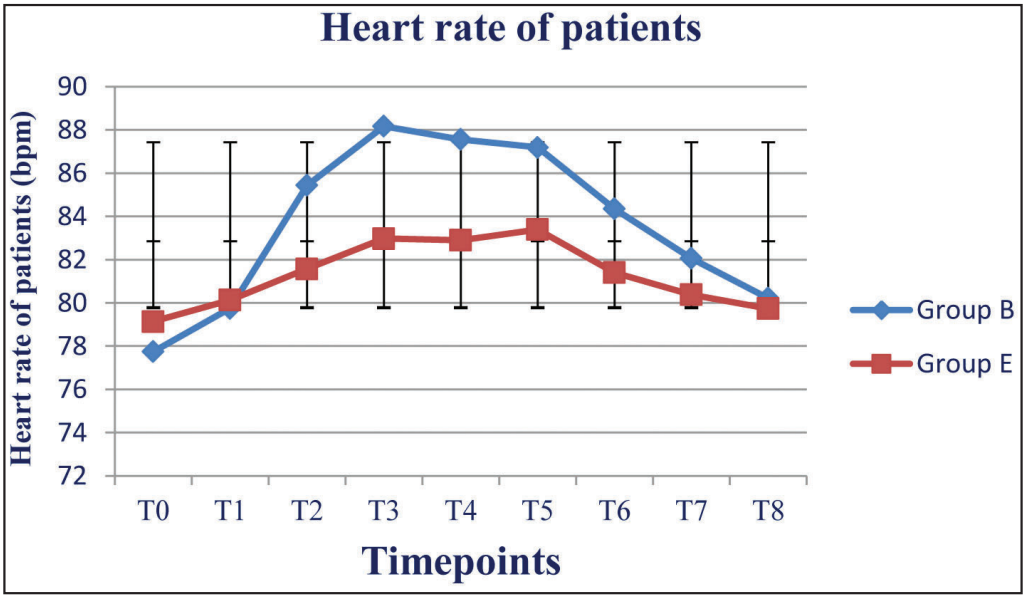
Table 2 shows no significant differences in the preoperative and postoperative coagulation profiles between the two groups (p>0.05). The postoperative D-dimer level through the 1st 24 hours after surgery increased significantly in patients of the two groups in comparison to the preoperative level (p<0.05), but the comparison between the two groups was insignificant (p>0.05). There was no major bleeding (any bleeding in critical organs such as intracranial, spinal, retroperitoneal, or intraocular bleeding) in patients of the two groups. The incidence of severe intraoperative bleeding (requiring transfusion) was higher in the patients of bemiparin group than enoxaparin group (p=0.011). The preoperative and postoperative amount of blood loss increased significantly in patients of bemiparin group compared to the enoxaparin group

(p=0.011, p=0.026 respectively). The incidence of wound reopening as a result of wound haematoma and postoperative wound bleeding was higher in the patients of bemiparin group than enoxaparin group (p=0.034). The number of transfused packed- red blood cells and fresh frozen plasma units was higher in patients of bemiparin group compared to the enoxaparin group (p=0.006, p=0.011 respectively). There was no significant differences in the preoperative hemoglobin between the two groups (p=0.255), the hemoglobin decreased significantly during surgery in patients of bemiparin group compared to the enoxaparin group (p=0.012). The postoperative hemoglobin increased in patients of the two groups after packed-red blood cells transfusion and the comparison between the two groups was insignificant (p=0.698).

Table 3 shows the changes in the heart rate and mean arterial blood pressure of patients. There were no changes in the heart rate and mean arterial blood pressure before anaesthesia and at 15 minutes after anesthesia induction (p>0.05).Then, there was an increase in the heart rate after 15 minutes of induction and during the procedure in patients of bemiparin group and minimal changes in the heart rate in the patients of enoxaparin group and the comparison between the two groups was significant (p<0.05), and after the procedure, the heart rate returned approximately to the baseline (p>0.05) [Figure 1]. There was no a decrease in the mean arterial blood pressure after 15 minutes of induction and during the procedure and, the decrease was more in bemiparin group compared to the enoxaparin group (p<0.05) and after the procedure, the mean arterial blood pressure returned approximately to the baseline (p>0.05) [Figure 2]. The increase in the heart rate and the decrease in the mean arterial blood pressure were associated with the blood loss during the procedure and improved after blood transfusion, fluid administration, ephedrine, dopamine and norepinephrine.

Table 4 shows the intraoperative data and outcome of patients. There was no significant difference in the types of surgery, types of anesthetic technique, intraoperative urine output, partial pressure of carbon dioxide and arterial oxygen saturation (p>0.05). The duration of anesthesia and surgery was prolonged in the patients of bemiparin group than enoxaparin group (p=0.015, p=0.012 respectively). The required fluids transfusion (crystalloids and hesteril 6 %) were more in the patients of bemiparin group than enoxaparin group (p=0.019, p=0.014 respectively). There was no significant difference in the incidence of hypertension and bradycardia between the two groups (p=0.465, p=0.558 respectively). The incidence

Figure 1: Heart rate of patients
Group B: Bemiparin group; Group E: Enoxaparin group



T0: Baseline; T1: 15 minutes after induction; T2: 30 minutes after induction; T3: 60 minutes after induction; T4: 90 minutes after induction; T5: 120 minutes after induction; T6: at the end of surgery; T7: one hour after surgery; T8: two hours after surgery.

Table 4

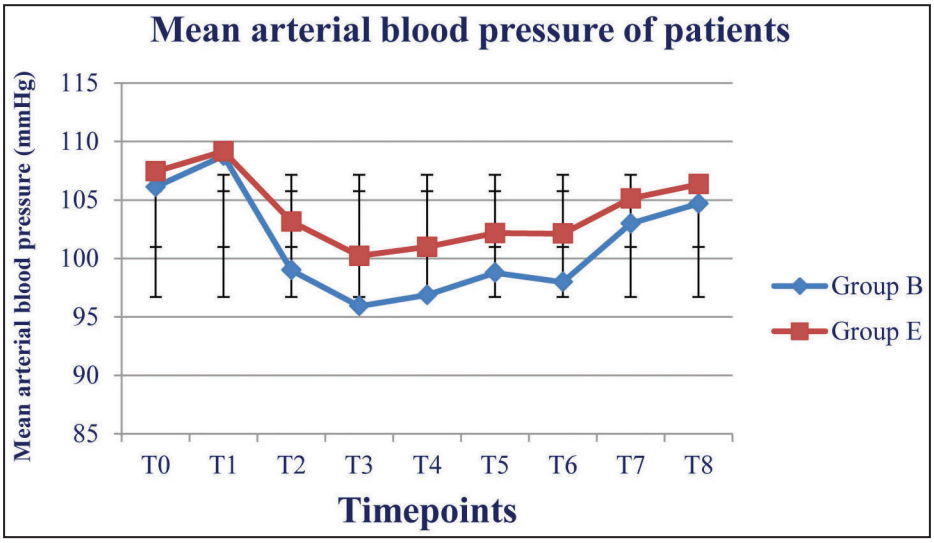
Intraoperative data and outcome of patients (Data are presented as Mean±SD, number, %)

Variables			Group B (n=152)	Group E (n=152)	P-value
Type of surgery	Fracture neck femur		33	27	0.471
	Femur intramedullary nail		37	39	0.682
	Femoral plate		28	34	0.395
	Fracture tibia		45	47	0.900
	Fracture pelvis		9	5	0.412
Types of anaesthetic technique	General anaesthesia		77	82	0.646
	Spinal anaesthesia		69	62	0.487
	Spinal-general anaesthesia		6	8	0.785
Intraoperative urine output (ml)			865.73±237.13	880.42±243.35	0.594
Duration of anaesthesia (minutes)			190.58±36.43	181.20±30.80	0.015
Duration of surgery (minutes)			174.68±35.15	165.35±29.42	0.012
Fluids transfusion	Crystalloids (ml)		2605.12±563.26	2468.35±442.94	0.019
	Hesteril 6% (ml)		620.63±94.17	595.25±86.45	0.014
Hypertension (SAP≥20% above Baseline)			26	32	0.465
Hypotension (SAP≤20% below Baseline)			64	45	0.023
Tachycardia (HR>100 bpm)			59	41	0.028
Bradycardia (HR<60 bpm)			13	16	0.558
Ephedrine			64	45	0.023
Dopamine			29	16	0.035
Norepinephrine			17	6	0.017
Nitroglycerine			9	13	0.375
Partial pressure of carbon dioxide (PaCO2) (mmHg)			36.32±3.24	35.90±3.41	0.271
Arterial oxygen saturation (SPO2) (%)			99.18±0.21	99.20±017	0.362
Intensive care unit admission			27	15	0.046
Postoperative mechanical ventilation			12	4	0.039
Wound complication (Haematoma)			9	2	0.031
Postoperative deep venous thrombosis		Distal	2	3	0.652
		Proximal	1	1	1.000
Pulmonary embolism			-	-	
Post-dural puncture headache			-	-	
Neurological complications			-	-	
ICU length of stay (days)			2.72±1.20	3.05±1.22	0.018
Hospital length of stay (days)			13.57±3.46	12.95±3.84	0.140
Mortality			4	1	0.176

Group B: Bemiparin group; Group E: Enoxaparin group.

SAP: Systolic blood pressure; HR: Heart rate; ICU: Intensive care unit.

Figure 2: Mean arterial blood pressure of patients
Group B: Bemiparin group; Group E: Enoxaparin group



T0: Baseline; T1: 15 minutes after induction; T2: 30 minutes after induction; T3: 60 minutes after induction; T4: 90 minutes after induction; T5: 120 minutes after induction; T6: at the end of surgery; T7: one hour after surgery; T8: two hours after surgery.

of hypotension and tachycardia was higher in the patients of bemiparin group than enoxaparin group (p=0.023, p=0.028 respectively). The requirement for ephedrine, dopamine and norepinephrine was higher in the patients of bemiparin group than enoxaparin group (p=0.023, p=0.035, p=0.017 respectively). The comparison of the number of patients required for nitroglycerine was insignificant between the two groups (p=0.375). The number of patients required for ICU admission and postoperative mechanical ventilation was higher in the patients of bemiparin group than enoxaparin group (p=0.046, p=0.039 respectively). The incidence of postoperative wound haematoma was higher in the patients of bemiparin group than enoxaparin group (p=0.031). The incidence of distal postoperative deep venous thrombosis (calf veins) was two cases in bemiparin group and three cases in enoxaparin group (p=0.652), and the incidence of proximal postoperative deep venous thrombosis (femoral and popliteal veins) was one case in bemiparin group and one case in enoxaparin group (p=1.000). The deep venous thrombosis was diagnosed clinically and by ultrasound Doppler. There was no pulmonary embolism. There were no cases suffered from post-dural puncture headache or neurological complications in both groups. The ICU length of stay was pronged in the patients of bemiparin group than enoxaparin group (p=0.018), but the comparison of hospital length of stay was insignificant between the two groups (p=0.140).

The incidence of mortality was higher in the patients of bemiparin group than enoxaparin group, but the comparison between the two groups was insignificant (p=0.176).

Discussion

The present study showed that the preoperative bemiparin increased the incidence of bleeding, amount of intraoperative and postoperative blood loss, number of transfused packed- red blood cells and fresh frozen plasma units, wound haematoma and wound reopening compared to the preoperative enoxaparin. Also, as a result of bleeding and prolonged hemostasis, the duration of surgery was prolonged in the bemiparin group than enoxaparin group. The blood loss was associated with an increase in the heart rate in bemiparin group and a decrease in the mean arterial blood pressure in bemiparin group more than the enoxaparin group.

Many of the published articles were reviewed regarding the prophylactic anticoagulant effect of the bemiparin and it was found; first: bemiparin is most

commonly used in elective cases undergoing total hip or knee replacement; second: in all cases, the bemiparin was given six hours postoperatively, while the enoxaparin was used preoperatively; third : there was no enough and detailed data about the preoperative prophylactic anticoagulant effect of the bemiparin alone or compared with preoperative enoxaparin in traumatic orthopedic surgery such as patients with femoral neck fracture, femur fracture, pelvic fracture or obese patients with tibia fracture[4,6,11-17]; fourth: the review of bemiparin in 6456 orthopedic patients, 415 of them had hip fracture, and 1446 had lower limb surgery showed no data whether the bemiparin started preoperative or postoperative[4], while enoxaparin was given preoperatively and its effect was clearly studied during surgery.

One showed that the preoperative bemiparin was associated with more bleeding than postoperative bemiparin in patients undergoing total knee replacement[17]. Therefore some studies recommend to give the bemiparin postoperatively and to start the enoxaparin preoperatively to avoid the incidence of bleeding in hip surgery[18] and total knee surgery[11]. Another showed that the mean intraoperative blood loss in the bemiparin group was higher than in the control group in patients undergoing benign gynecologic surgery ($p=0.001$)[5]. A prospective study in cancer patients reported that the preoperative bemiparin was associated with more bleeding tendency than postoperative bemiparin and the bleeding rates did not significantly differ between patients given low or high bemiparin prophylactic doses[19].

A literature review showed that the preoperative and postoperative enoxaparin administration were not associated with major bleeding events in patients undergoing hip and knee arthroplasty[20].

Contrary to the present study, one study compared the postoperative bemiparin 3500 IU/day with the preoperative enoxaparin 4000 IU/day in total knee arthroplasty and found the bemiparin was safer than enoxaparin with regard to mean blood loss through drainage (415 ml vs 599 ml, $p=0.046$) and surgical wound complications (8% vs 31%, $p=0.003$)[21], and the same finding was reported by other studies[11,22,23], but the these studies compared the bemiparin with unfractioned heparin. One study showed that the incidence of injection site haematoma was significantly higher with enoxaparin than with bemiparin[17].

Another study compared the bemiparin with unfractionated heparin as a bridging therapy in the perioperative management of patients on vitamin K antagonists. The procedures were such as endoscopy, bronchoscopy, arthroscopy, or general surgery. The study showed no incidence of major bleeding and the incidence of minor bleeding was 4.3% with bemiparin and 6.1 % with unfractionated heparin ($p>0.05$)[24].

The previous studies showed that the bemiparin is most commonly used through 6-12 hours postoperatively in elective cases such as arthroscopy, total hip or knee replacement and not used preoperatively in trauma patients to avoid the risk of perioperative bleeding as showed by the present study. Therefore it is better to use enoxaparin in trauma patients as the anti-Xa to anti-IIa activity of bemiparin is approximately 8:1[22], and that of enoxaparin is 3.8:1[25,26]. This means that more inhibitory effect of Xa and IIa leads to more bleeding as found clinically by the present study and supported by the studies that recommend to use the bemiparin only for postoperative prophylaxis against thromboembolism in Europe[11,17,27-29].

One study found that bemiparin prophylaxis was not associated with spinal haematoma, fatal bleeding or bleeding in critical organs in 937 cases anaesthetized by neuraxial anaesthesia, but the bemiparin prophylaxis started 6 hours after surgery and given for 5-6 weeks after total hip or knee replacement[13], and the same results were documented by other studies in different surgeries[2,4,12,22,30-32].

There was no incidence of spinal or epidural haematoma in patients anaesthetized by spinal anaesthesia in patients of the two groups and this finding correlates with the results of other studies[2,4,12,21,22,30-32].

The postoperative D-dimer level increased significantly in patients of the two groups in comparison to the preoperative level and this may be related to the surgical trauma and blood transfusion during the procedure[33-35].

There were some limitations in the present study; first the anti-Xa activity was not measured, as the kits were not available in the main laboratory; second:

there were no details about the preoperative bemiparin in trauma orthopaedic patients for comparison with the findings of the present study; third: it was an observation study.

Conclusion

The preoperative bemiparin increases the incidence of perioperative bleeding, blood loss, transfused packed-red blood cells and fresh frozen plasma than the preoperative enoxaparin in trauma patients undergoing orthopaedic surgery.

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