

## PATHOGENETIC APPROACHES AND WAYS OF PREVENTION OF THROMBOEMBOLIC COMPLICATIONS IN TRAUMA PATIENTS

L. Yu. Ivashchuk

I. HORBACHEVSKY TERNOPIIL STATE MEDICAL UNIVERSITY

**Background.** *The study of thromboembolic complications prevention in trauma patients, who underwent surgery, is presented in the research.*

**Objective.** *Patients were examined in the Department of Traumatology of Ternopil Municipal Hospital. The first group, 263 people, (18.6 %) consisted of patients with polytrauma and unfavorable prognosis and significant disease severity. The second group comprised patients with combined trauma, 462 people (32.8 %) – a doubtful prognosis for life. The third group, 685 people (48.6 %) involved patients with isolated trauma and positive treatment outcome.*

**Methods.** *All patients, besides general clinical examination, underwent evaluation of the number of platelets, clotting time, duration of bleeding and study of coagulation (prothrombin index, prothrombin activity thrombotest, total fibrinogen, fibrinogen A, activated recalcification time). The venous system of lower limbs was examined using distal ascending phlebography, color Doppler and duplex ultrasonography SIMENS ACUSSON X 300.*

**Results.** *A comprehensive prophylaxis of thromboembolic complications was carried out using low-molecular weight heparin as well as essential complex kinetic treatment. Bemiparin in an appropriate dose was administered once a day for 10-14 days of postoperative stay in the hospital. For the patients with moderate risk and high surgery risk (major surgery, over 40 years old in age, obesity, and serious comorbidities) Bemiparin was administered at a dose of 5000-7500 IU per day during patients' stay in the hospital. In individuals with sub-acute and chronic thrombophlebitis of subcutaneous veins the surgical prophylaxis of thromboembolic complications was performed.*

**Conclusions.** *The combination of physical, drug and surgical prophylaxis prevented the thromboembolic complications in trauma patients.*

KEY WORDS: **thromboembolism; trauma; polytrauma; prevention; bemiparin.**

### Introduction

Thromboembolism is one of the most formidable complications after surgical interventions that cause high mortality. The frequency of thromboembolism depends on the duration of traumatic procedures and increases with the larger its dimension and expansion of indications for them, especially in the elderly patients [1]. The situation in the Departments of Traumatology and Orthopedics, where thromboembolic complications are present in more than a half of patients, is especially threatening [5].

Diagnosis, treatment and prediction of the consequences of thromboembolism in this category of patients are accompanied by

considerable difficulties. It is noteworthy that the largest number of fatal cases (up to 75.4 %) was registered not at the day of injury, but in 3-5 days after it or later [2, 4]. The etiology of thromboembolism has a multifactorial nature: varicose veins of lower extremities, phlebothrombosis of small pelvis veins, venous stasis of lower extremities, postoperative violation of blood rheology are the most important.

Significant cause of thromboembolic complications is the body's response to surgical trauma, which is accompanied by spasm of peripheral vessels, hypercoagulation and vascular wall injury, especially in cases of surgeries on lower extremities, hip joint and pelvic bones [6, 7, 8].

The deep veins thrombosis of lower extremities and pelvis complicates the postoperative period by 10-30% in the elder age group [3].

*Corresponding author: Larisa Ivashchuk, Department of General and Minimally Invasive Surgery, I. Horbachevsky Ternopil State Medical University, 1 Maydan Voli, Ternopil, 46001, Ukraine  
E-mail: ivashchuk\_lu@tdmu.edu.ua  
Phone number: +380679401031*

In many patients, the first clinical manifestation of deep vein thromboembolism may be thromboembolism of pulmonary artery [11]. With age in the body there are a number of hemodynamic (decreased shock, respiratory minute volume and blood circulation, increased peripheral vascular resistance) and hematologic changes (increase of aggregation and adhesion ability of platelets, activity of plasma coagulation factors, and concentration of fibrinogen), which contribute to the presence of deep vein thrombosis [9, 10].

### Methods

The patients of the Department of Traumatology of the Ternopil City Communal Emergency Hospital were examined. Over the last year, 1410 patients of different age groups were hospitalized: 588 (41.7 %) men, 822 (58.3 %) women.

During the study the patients were divided into 3 groups depending on the severity of the injury. The first group, 263 men (18.6 %), consisted of patients with polytrauma and unfavorable prognosis due to the significant disease severity. The second group consisted of patients 462 people (32.8 %), with a combined injury and doubtful prognosis for life. The third group, 685 people (48,6 %), involved patients with isolated trauma and positive treatment outcome (Table 1).

The patients of the first group were in a state of severe combined shock. They were given resuscitation aimed at correction of hemodynamics and function of external res-

piration. The comprehensive examination of those patients included clinical, laboratory and radiological methods by means of laparocentesis, thoracentesis, sonography, computed tomography scan.

In diagnostics of prolonged bleeding without delay, against the background of anti-shock therapy, surgical interventions aimed at stopping it were performed. On the damaged segments of musculoskeletal system, with satisfactory standing of fragments, plaster casts and skeletal extracts were used in the presence of displacements.

In the second group of patients, treatment also began with actions for vital signs support (fight against bleeding, respiratory failure). All measures were carried out against the background of intensive anti-shock therapy and elimination of dominant internal organs damage after appropriate preoperative training. Later, with satisfactory hemodynamic parameters, urgent surgeries were carried out on injuries of the musculoskeletal system.

In cases of surgical interventions in the patients of the third group with severe predominant trauma of musculoskeletal system, among which there were fractures of thigh, leg bones, shoulder, forearm, foot, brush, shoulder girdle, metal osteosynthesis was carried out. Exceptions were the cases of severe placement and tear of limbs. Such patients underwent a primary surgical treatment of the wound or limb amputation without delay.

All patients, besides general clinical examination, underwent evaluation of the number of platelets, clotting time, duration of bleeding and study of coagulation: prothrombin index, prothrombin activity thrombotest, total fibrinogen, fibrinogen, fibrinogen A, activated recalcification time.

The venous system of lower extremities was studied by means of distal ascension phlebography, color dopplerography and duplex ultrasonography SIMENS ACUSSON X 300.

Accompanying pathology of cardiovascular, respiratory and endocrine systems was found in 1167 (82.8 %) persons.

In patients with decompensation of accompanying pathology (coronary heart disease, hypertension, non-specific chronic diseases of lungs, diabetes mellitus), preoperative preparation was conducted in a hospital setting.

The number of surgical interventions during the period of research in the department is 865 surgeries, including 410 urgent. The other patients were treated conservatively (Table 2).

**Table 1. The number of trauma patients, who were hospitalized**

Group	Number of patients	% of patients
I	263	18,6
II	462	32,8
III	685	48,6

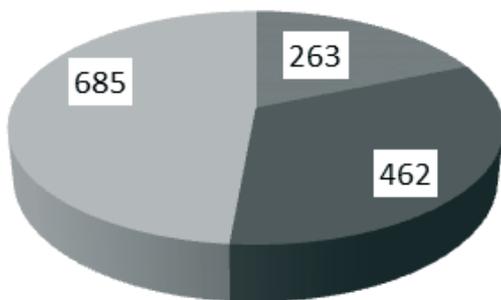


Fig. 1. The number of trauma patients, who were hospitalized.

**Table 2. Types of surgical interventions carried out in the Department of Traumatology**

Type of surgery	Quantity	Number of thrombo-embolic complications
1. Surgery of the segments of musculoskeletal system:		
1.1. Open reposition and metal osteosynthesis	376	17.2 %
1.1.1. Intramedullary blocking and metal osteosynthesis	44	
1.1.2. External fixing devices	25	
1.1.3. Repositioning	12	
1.1.4. Sketch plates	295	
1.2. Primary surgical treatment and metal osteosynthesis	74	10.0 %
1.3. Primary surgical treatment without metal osteosynthesis	191	
2. Joints surgery	<b>93</b>	44.2 %
2.1 Open reposition and metal osteosynthesis	38	
2.2 Removal of metal fixators	3	
2.3 Arthroscopy	3	
2.4 Endoprosthesis	49	
3. Reconstructive surgery	<b>31</b>	24.1 %
3.1. of soft tissues	27	
3.2. of bones	4	
4. Removal of metal sections	<b>56</b>	-
5. Minimally invasive intervention	<b>19</b>	-
6. Palliative treatment of metastatic bone lesion	<b>12</b>	4.5 %
7. Other	10	-

### Results

In the examined patients, a number of factors of postoperative thrombotic complications were defined: thrombotic complications in history, coagulation disorders, cardiovascular and malignant diseases, overweight, traumatic complications, and traumatic nature. Malignant diseases, breast cancer, prostate and rectum cancer were most commonly associated with pathological fractures of femur and shoulder bones.

Chronic cardiac insufficiency of the I-II degree was diagnosed in 651 (46.2 %) patients, varicose enlargement under skin of lower limbs veins – in 624 (42.2 %) patients. Obesity was evidenced in 237 (16.8 %) patients. Hypercoagulation was revealed in 270 (18.2 %) patients. Changes in the coagulogram did not always correspond to the severity and features of phlebothrombosis. Only in 6 out of 33 patients fibrinogen B was present within 8 days after the surgery. A slight increase in fibrinogen A was observed in 22.3 % and significant one (up to 9.9 g/l) in 24.2 % of patients. In all other patients, its content was decreased up to 1.45 g/l. the changes in other indicators were not significant that did not cause the need for additional instrumental survey methods.

Diseases of thrombophlebitis of subcutaneous or deep veins of lower extremities were revealed in 72 (15.3 %) persons.

The choice of anesthetic method also affected the number of thrombotic complications. One of the main causes of thromboembolic complications in trauma patients in the postoperative period is spasm of peripheral vessels caused by operational stress, which leads to tissue ischemia and thrombosis. The stress response of the body in general with anxiety is the result of insufficiency of blockade of nerve impulses that are transmitted through the sympathetic nervous system.

The number of phlebothrombosis in patients who underwent surgery under general anesthesia with artificial ventilation was high – 22 cases (68.3 %). The decrease in the number of complications took place due to significant reduction of stress pulses in cases of spinal anesthesia (9 patients (27.2 %)) and conductive anesthesia in combination with intravenous anesthesia (2 patients (4.5 %)).

### Discussion

Prevention of thrombotic complications was aimed at elimination of pathogenetic parts of phlebothrombosis, such as decreased blood flow, increased blood coagulation, damage of vascular wall and dependence on the risk factors presence.

The mechanism of action was physical, drug and surgical methods of prevention of thrombophlebitis of lower extremities. Over time,

these methods were applied preoperatively, sub-operatively and postoperatively.

Preventive measures were taken on the 1<sup>st</sup>-2<sup>nd</sup> day of hospital stay.

All patients fully underwent a prophylaxis of thromboembolic complications by means of low molecular weight anticoagulants and compulsory complex of kinetic therapy. Bemiparin (low molecular weight heparin (LMWH), Zibor 2500, Berlin-Chemie AG) at an appropriate therapeutical dose was prescribed from the 1<sup>st</sup> day of patients' stay in the hospital for 10-14 days of the postoperative period once a day subcutaneously in the stomach area. For the patients with moderate risk and high surgery risk (major interventions, over 40 years old in age, obesity, and serious co-morbidities) Bemiparin was prescribed at a dose of 5000-7500 IU per day while patients stay in the hospital [12, 13].

In case of changes of venous tract of legs, in the patients with a great anamnesis, elastic stockings and elastic bandings were worn.

Suboperative procedures into ankle joint, early arousal of the patient after surgery, medical physical exercises were performed for all patients.

Venotonics (Detralex, Phlebodia-600, etc.) were used in the complex treatment of the patients with chronic venous insufficiency [14].

In persons with subacute and chronic thrombophlebitis of subcutaneous veins the surgical prophylaxis of thromboembolic complications was performed. A crossectomy

was carried out in 9 (1.9 %) patients, as the first stage before surgical intervention.

Not taking into account the complex of preventive measures, in 4-5 days after surgery, in 10 patients (1.1 %) thrombophlebitis of shin varicose veins, in 12 (1.3 %) - iliofemoral thrombosis developed, in 8 (0,9 %) patients deep thrombosis of lower extremities veins was diagnosed. Drug therapy was effective in 16 people. 4 patients had ligation of thighs large subcutaneous vein. In 1 case, small intestinal tract was observed. There were no cases of lethal death associated with thromboembolic complications. No hemorrhagic complications were present.

Thus, the development of pathogenetic mechanisms of thromboembolic complications in the complex measures for their prevention allowed decreasing the number of postoperative complications and mortality in trauma patients.

### Conclusions

In trauma patients, who undergo surgical intervention, a high risk of thromboembolic complications is established that is a prerequisite for the preventive measures.

Prevention of thromboembolic complications should be complex and individual, taking into account the nature of the injury, the dimension of surgical intervention, and the associated risk factors.

The combination of physical, drug and surgical prophylaxis prevent thromboembolic complications in trauma patients.

## ПАТОГЕНЕТИЧНІ ПІДХОДИ ТА ШЛЯХИ ПРОФІЛАКТИКИ ТРОМБОЕМБОЛІЧНИХ УСКЛАДНЕНЬ У ТРАВМАТОЛОГІЧНИХ ХВОРИХ

Л. Ю. Іващук

ТЕРНОПІЛЬСЬКИЙ ДЕРЖАВНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ ІМЕНІ І. Я. ГОРБАЧЕВСЬКОГО, ТЕРНОПІЛЬ, УКРАЇНА

**Вступ.** Розглянуто питання профілактики тромбоемболічних ускладнень у травматологічних хворих.

**Мета.** Пацієнтів відділення травматології Тернопільської міської лікарні було поділено на кілька груп. Перша група налічувала 263 особи (18,6%) з політравмою, несприятливим прогнозом і у тяжкому стані. Другу групу (462 хворих або 32,8% вибірки) склали пацієнти з комбінованою травмою та сумнівним прогнозом для життя. Третя група налічувала 685 осіб (48,6% вибірки) - пацієнти із ізольованою травмою та сприятливим прогнозом.

**Методи.** Усім пацієнтам, окрім загального клінічного обстеження, визначали наступні показники: протромбінний індекс, протромбінову активність, тромботест, загальний фібриноген, фібриноген В, фібриноген А, активований час рекальцифікації. Венозну систему нижніх кінцівок було досліджено за допомогою дистальної висхідної флебографії, кольорового доплерівського та дуплексного УЗД із Simens Acusson X 300.

**Результати.** Усім хворим у повному об'ємі було проведено профілактику тромбоемболічних ускладнень шляхом застосування низькомолекулярних гепаринів і обов'язковим комплексом кінетерапії. Bemiparin у відповідній дозі вводили один раз на день протягом 10-14 днів під час післяопераційного перебування в стаціонарі. Для пацієнтів з помірним і високим ризиком (обширне оперативне втручання, вік понад 40 років, ожиріння і серйозні супутні захворювання) беміпарин вводили у дозі 5000-7500 МО на добу під час перебування пацієнтів у стаціонарі. У осіб з помірно гострим і хронічним тромбофлебітом підшкірних вен проводили хірургічну профілактику тромбоемболічних ускладнень.

**Висновки.** Поєднання фізичної, фармакологічної та хірургічної профілактики запобігало тромбоемболічним ускладненням у травматологічних хворих.

КЛЮЧОВІ СЛОВА: **тромбоемболія; травма; політравма; профілактика; беміпарин.**

## References

1. Vinnik YuA, Volos YuB, Shmanko YuV. Prevention of thromboembolic complications in cancer patients. X congress of oncologists of Ukraine: Materials of Congress. Kyiv. 2001;140-145 [In Russian].
2. Grint v GA, Tantsyura VP, Peschanyi RYe, Vysokiy AG. The role of hemodynamic disorders in the choice of tactics of surgical treatment of victims with combined trauma of the chest and limbs. Journal of Emergency and Restorative Medicine. 2011;5(2): 230-232 [In Russian].
3. Yefetova TS. Prevention of microcirculatory disorders caused by operational trauma and associated complications in radical surgery for stomach cancer. Clinical Surgery. 2012;8:37-41 [In Russian].
4. Maz enko OV, Kuzmin VYu. Analysis of mortality victims with isolated and combined trauma. Clinical Surgery. 2008;12:21-23 [In Ukrainian].
5. St odubtseva MB, Demyanenko EN, Shpakov EI. Intensive therapy of pulmonary embolism in cancer patients using fractiparin. X Congress of Oncologists of Ukraine: Materials of Congress. Kyiv. 2001; 56-68 [In Russian].
6. Protsyk AI. The fundamental approach to providing medical care to victims of prehospital polytrauma. Clinical Surgery. 2015;4:28-29 [In Ukrainian].
7. Savel v VS. Prevention of postoperative venous thromboembolic disorders. The Russian Consensus. 2010; 20 [In Russian].
8. Sayenko VF, Mazur AP, Grubnik VV, Fillipenko VA, Kobza II, Popik MP, Kalinin OG, Krivoruchko IA, Boyko VV. Assessment of the risk of venous thrombosis and embolism in surgical patients. Clinical Surgery. 2003;8:5-8 [In Russian].
9. Kakkar AK, Williamson RCN. Prevention of venous thromboembolism in cancer patient. Semin. Thromb. Hemost. 2009;25:239-243.
10. Geerts WH, Pineo GF, Heit JA. Prevention of venous thromboembolism. The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. CHEST. 2004;126:338-400.
11. Suchkov IA, Martinez-Gonzalez J, Schellong SM, Garbade T, Falciani M. Bemiparin DVT Study Group. Comparison of Once-Daily Bemiparin with Twice-Daily Enoxaparin for Acute Deep Vein Thrombosis: A Multicenter, Open-Label, Randomized Controlled Trial. Clinical drug investigation. 2018 Feb 1;38(2):181-9.
12. Ciccone MM, Cortese F, Corbo F, Corrales NE, Al-Momen AK, Silva A, Zito A, Pinto M, Gesualdo M, Scicchitano P. Bemiparin, an effective and safe low molecular weight heparin: a review. Vascular pharmacology. 2014 Jul 1;62(1):32-7.
13. Muñoz L, González AB, De Rada PD, Valenti A, Valenti JR. Rivaroxaban is as efficient and safe as bemiparin as thromboprophylaxis in knee arthroscopy. Musculoskeletal surgery. 2014 Jun 1;98(1): 21-5.
14. Kuznetsov MR, Sapelkin SV, Boldin BV, Leont'ev SG, Neskhodimov LA. Recanalization of lower-limb deep veins as an index of efficacy of treatment for acute venous thrombosis. Angiology and vascular surgery. 2016; 22(3):82-8 [In Russian].

Received: 2018-05-14