Non-governmental Organization
International Center of Scientific Research

PROCEEDINGS OF THE IX INTERNATIONAL SCIENTIFIC AND THEORETICAL CONFERENCE

THEORY AND PRACTICE OF MODERN SCIENCE

28.03.2025

KRAKÓW
REPUBLIC OF POLAND

SCIENTIA
COLLECTION OF SCIENTIFIC PAPERS

SCIENTIA
COLLECTION OF SCIENTIFIC PAPERS

with the proceedings of the

IX International Scientific and Theoretical Conference

Theory and practice of modern science

28.03.2025

Kraków, Republic of Poland

Kraków, 2025

UDC 082:001
T 44

https://doi.org/10.36074/scientia-28.03.2025

Chairman of the Organizing Committee: Goldenblat M.

Responsible for the layout: Babych Yu.
Responsible designer: Bondarenko I.

T 44 **Theory and practice of modern science**: collection of scientific papers «SCIENTIA» with Proceedings of the IX International Scientific and Theoretical Conference, March 28, 2025. Kraków, Republic of Poland: International Center of Scientific Research.

ISBN 979-8-88955-779-1 (series) Bowker
DOI 10.36074/scientia-28.03.2025

Papers of participants of the IX International Multidisciplinary Scientific and Theoretical Conference «Theory and practice of modern science», held on March 28, 2025 in Kraków are presented in the collection of scientific papers.

The conference is included in the Academic Research Index ReserchBib International catalog of scientific conferences and registered for holding on the territory of Ukraine in UKRISTEI (Certificate № 120 dated January 6th, 2025).

UDC 082:001

ISBN 979-8-88955-779-1

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POLYTRAUMA IN OBESE PATIENTS: RISKS AND PROBLEMS OF CORRECTION IN THE PERIOD OF EARLY MANIFESTATIONS OF TRAUMATIC DISEASE

Background. Obesity is considered one of the leading global health problems in the modern world, the relevance of which is growing. According to careful statistical estimates, since 1975, the prevalence of obesity worldwide has increased 3 times as of 2016 [1-3]. A significant proportion of the world's society is burdened with obesity. The prevalence of obesity among the adult population of the world reaches 13% [3]. According to a report by the World Health Organization, in 2022, 1 in 8 people in the world lived with obesity. Since 1990, the prevalence of obesity among adults worldwide has more than doubled, and obesity among adolescents has quadrupled. In 2022, 2.5 billion adults (18 years and older) were overweight. Of these, 890 million were living with obesity. In 2022, 43% of adults aged 18 and older were overweight, while 16% were living with obesity, and 37 million children under 5 were overweight. In 2022, more than 390 million children and adolescents aged 5–19 were overweight, including 160 million who were obese. About 16% of adults aged 18 years and older worldwide were obese in 2022. The worldwide prevalence of obesity more than doubled between 1990 and 2022 [2]. Presence of obesity is associated with increased morbidity, such as metabolic syndrome, diabetes mellitus and cardiovascular pathology. It can affect bone health and reproduction, it increases the risk of certain cancers. Obesity influences the quality of living, such as sleeping or moving [2]. Therefore, this problem creates a significant burden on the health care system. In the United States, it was reported that medical care for patients suffering from obesity resulted in additional costs of 147 billion dollars [5]. In a systematic review aimed at determining the economic impact of obesity, D. Withrow and D. Alter found that health care costs are 30% higher in obese individuals compared with normal-weight individuals [6]. They also found that premature mortality, accounting for up to 4 million deaths per year, is

strongly associated with obesity [6].

Obesity creates many serious problems in patients with traumatic disease. In conditions of polytrauma, when the severity of the patient's condition is much more severe than the simple sum of the severity of individual injuries, and there is a syndrome of mutual aggravation, obesity significantly aggravates the course of all periods of traumatic disease, and patients need long-term intensive therapy [3, 8]. In a prospective study, American clinicians showed that critically ill obese patients had a more than 2-fold increased risk of bacteremia, respiratory and urinary tract infections. The risk of mortality increased 7-fold compared to a group of patients with normal body weight [9]. Studies show that obesity has a detrimental effect on polytrauma patients undergoing fracture surgery. Obese patients have significantly increased total hospital stay, intensive care unit admissions, intensive care unit length of stay, and need for mechanically controlled ventilation. The duration of ventilation increases with increasing body mass index. In addition, obesity increases the incidence of acute renal failure. Since 41.1% of our population is obese, specialized intensive care strategies for obese people such as nutrition, fluid support, early mobilization, and other active prevention methods should be used to reduce the length of intensive care unit stay [2, 3, 7]. The purpose of our work was to increase the amount of relevant information on the role of obesity in patients with polytrauma, to provide a detailed understanding of the mechanisms of pathogenesis of the development of multiple organ dysfunction in such patients and to develop an improved strategy for intensive care.

Materials and methods. To write a scientific review, we used the collection of information on the mechanisms of pathogenesis of critical conditions in patients with obesity. We studied the results of current studies in patients with obesity on specialized sites for medical professionals on the Internet.

Results. Trauma patients are at high risk of secondary multi-organ dysfunction and thromboembolic events, which are major causes of subsequent morbidity and mortality. Venous thromboembolism, clinically manifested as pulmonary embolism or deep vein thrombosis, is a life-threatening but potentially preventable complication following trauma. Trauma, as a strong trigger for venous thromboembolism, is a leading cause of global mortality and disability. Patients with severe trauma face a dual threat: post-traumatic hemorrhage and post-traumatic thrombotic events. Acute traumatic coagulopathy is inevitable after severe trauma, such as shock, low perfusion, and vascular injury leading to severe hypercoagulability. One of the focuses of intensive care is to identify and manage bleeding and hypercoagulability as soon as possible and initiate targeted treatment. The incidence of venous thromboembolism may be 13 times higher in polytrauma

than in not traumatic patients. Sixty percent of patients with an injury severity score ≥45 on the ISS score develop a hypercoagulation state within 1 hour of injury, and these patients are four times more likely to die than without a bleeding disorder (46.0% vs. 10.9%) [10].

Patients are at risk for hypercoagulability soon after traumatic injury, although the risk is highest within a week of injury. Many thromboembolisms are diagnosed within the first few days, and a significant number are detected within the first 24 hours after injury; the hypercoagulation state persists even after the patient is discharged. A recent study shows that the occurrence of pulmonary embolism within 72 hours accounts for 41.5% of all pulmonary embolisms in trauma patients. A retrospective study of 267743 patients with trauma, including pelvic fractures, vertebral fractures, and spinal cord injuries, found that the incidence of venous thromboembolism was highest at 3 months and decreased to normal by 12–15 months. Regardless of the type of injury, trauma-induced coagulopathy with bleeding threat usually resolves within 24 hours of injury, and hypercoagulability is becoming a more common coagulation disorder [10, 11]. Zangbar B. et al (2025) conducted a study in 119906 patients who had suffered a severe injury. They analyzed complications in patients with normal body weight, in patients with overweight and in patients with obesity. 30356 (26.8%) patients suffered from obesity. All complications caused by blood coagulation disorders (stroke, transient ischemic attack, deep vein thrombosis, acute coronary syndrome, pulmonary thromboembolism) occurred more often among obese patients ($p<0.001$ for all comparisons) [12].

As for the standards for the prevention of thromboembolic complications in obese patients, they are still not clearly developed. There are no unambiguous interpretations of the fact that obese patients have a higher risk of complications caused by hypercoagulability. Authoritative recommendations for solving this problem do not apply to all areas of surgery at once. European guidelines on the prevention of perioperative venous thromboembolism had divided into cases in bariatric and non-bariatric surgery. Obese patients may have an increased risk of venous thromboembolism, but data on orthopedic surgery are contradictory. In addition, there are no clear recommendations on the features of the prevention of thromboembolic complications in those patients who have a body mass index (BMI) less than 40 kg/m^2. Comparisons had made only for groups of patients with BMI values greater than or less than 40 kg/m^2. For patients undergoing bariatric surgery for the prevention of thromboembolic complications, European experts recommend the use of both low molecular weight heparins and unfractionated heparin and fondaparinux. Moreover, experts consider an increase in the dose of anticoagulants

justified only for patients with BMI > 40 kg/m^2, or with a weight of 150 kg or more. Therefore, these aspects of prevention have not been developed and need to be addressed, especially for patients with polytrauma [13].

On the one hand, weight gain should be associated with an increase in the dose of medications prescribed per 1 kg of body weight. On the other hand, adipose tissue is metabolically few active, the rate of volumetric blood flow through it is significantly lower than through other tissues, such as muscle, nerve, endocrine gland tissue, etc. Thus, a simple calculation of the dose of medications per 1 kg of body weight can easily lead to an overdose, and when using anticoagulants - to bleeding. That is why anticoagulants for obese patients are currently administered based not on the actual, but on the expected body weight. This helps to avoid complications in the form of bleeding [14].

Similar complications in obese patients may arise when calculating the volume of fluid administered during infusion therapy. The volume of fluid required and safe for the patient may be easily exceeded if one does not take into account that adipose tissue contains significantly less water than other tissues. Excess water that enters the body, if the volume of fluid for parenteral administration has calculated per 1 kg of body weight, may accumulate not only in soft tissues, but also in the interstitial compartment of the lungs. This will lead to the development of interstitial pulmonary edema and acute respiratory failure syndrome. In the study Wrzosek A. et al (2023) fluid volumes were significantly higher in non-survivors than in survivors at the end of the second day of ICU stay (2.77 vs. 2.14 ml/kg/h) and non-survivors had a highly positive fluid balance (6.21 compared with 2.48 L in survivors). Excessive fluid administration in consequence leads to fluid accumulation, which is associated with several serious complications including pulmonary edema, cardiac failure, delayed wound healing, tissue breakdown and impaired bowel function [15]. There is an opinion that for patients with obesity it is necessary to adhere to the goal-directed therapy, which has aimed at achieving and maintaining certain indicators. Such indicators for patients with obesity during hemodynamic correction can be the level of average arterial pressure and a certain level of central venous pressure. Of course, achieving the necessary goals should be combined with an adequate rate of diuresis and evacuation of nitrogenous waste and excess acids from the body [16]. Currently, there are opportunities to monitor the amount of water in the lungs. Monitoring the amount of water in the lungs in polytrauma obese patients during fluid resuscitation can be very important for improving the quality of intensive care and reducing the number of complications in this patient group [17].

It is believed that the threshold for perioperative echocardiography should be lower in obese patients to fully assess the dynamic cardiovascular changes resulting from fluid imbalance. Despite the obvious challenges with volume and rate of fluid administration in obese patients, the principles of intravenous fluid administration and maintenance remain the same as in non-obese patients. The nature of fluid loss determines whether a resuscitative or supportive approach is adopted, as well as the type of fluid used, be it crystalloids, colloids, or blood products. However, assessing cardiac contractility in patients with high body weight, which is mainly due to obesity, can also be difficult. In our studies, we found that cardiac output values calculated per 1 kg of body weight or per 1 cm^2 of body surface area were significantly lower in obese patients than in patients with normal body weight. Ultrasound examination is often not objective in critically ill patients. Cardiac output values obtained with transthoracic cardiography are often lower than those index obtained with thermodilution and impedance methods of assessing myocardial contractility [18]. A cardiac index value that is insufficient for effective perfusion in a patient with normal body weight may well provide compensation in an obese patient, since adipose tissue does not require a large volume of blood flow, and the problem is the prevention of thrombus formation and thromboembolic complications. There are still no recommendations regarding the required cardiac index in obese patients to avoid pulmonary fluid accumulation and cardiorespiratory failure. The cardiac output is largely dependent on the state of venous return, and therefore it makes sense to develop target «end points» for achieving the required level of central venous pressure to ensure effective preload. This preload should also not promote fluid accumulation in the interstitial compartment of the lungs. Fluid overload can also potentially lead to aggravation of abdominal compartment syndrome and the development of encephalopathy [19, 20].

Conclusion. The problem of intensive care in patients with polytrauma who are obese is currently relevant and complex, as it should take into account the solution of many issues. Until now, principles of prevention of thromboembolic complications for such patients have not been developed. The issues of adequate fluid resuscitation, which should ensure effective cardiac output, improve microcirculation processes, and at the same time not create a danger of fluid accumulation in the lungs, are difficult to solve. Fluid overload is dangerous due to the development of acute respiratory failure, abdominal compartment syndrome and other complications that are associated with an increase in the time of patients' stay in the intensive care unit, the total duration of hospitalization, an increase in the cost of treatment and an increase in patient mortality.

References:

1. Collaboration NCDRF (2017) Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *Lancet (London).* 390 (10113), 2627-2642. doi: 10.1016/S0140-6736(17)32129-3
2. World Health Organization (2024) Obesity and overweight. *World Health Organization.* [01 March 2024] https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
3. Elmhiregh A., Ahmed A.F., Dabboussi A.M., Ahmed G.O., Abdelrahman H. & Ibrahim T. (2022) The impact of obesity on polytraumatized patients with operatively treated fractures. *Injury.* 53(7), 2519 – 2523. https://www.sciencedirect.com/science/article/pii/S0020138322002480
4. Nguyen N.T., Magno C.P., Lane K.T., Hinojosa M.W. & Lane J.S. (2008) Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey, 1999 to 2004. *J Am Coll Surg.* 207(6), 928–934. doi: 10.1016/j.jamcollsurg.2008.08.022
5. Finkelstein E.A., Trogdon J.G., Cohen J.W. & Dietz W. (2009) Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood).* 28(5), w822-w831. doi: 10.1377/hlthaff.28.5.w822
6. Withrow D., & Alter D.A. (2011) The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. *Obes Rev.* 12 (2), 131-141. doi: 10.1111/j.1467-789X.2009.00712.x
7. The GBD 2015 Obesity Collaborators (2017) Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *New Engl J Med.* 377(1), 13-27. DOI: 10.1056/NEJMoa1614362
8. Spitler C.A., Hulick R.M., Graves M.L., Russell G.V. & Bergin P.F. (2018) Obesity in the Polytrauma Patient. *Orthopedic Clinics.* 49(3), 307 – 315. https://www.orthopedic.theclinics.com/article/S0030-5898(18)30034-8
9. Bochicchio G.V., Joshi M., Bochicchio K., Nehman S., Tracy J.K. & Scalea T.M. (2006) Impact of obesity in the critically ill trauma patient: a prospective study. *J Americ Coll Surg.* 203(4), 533 – 538. doi: 10.1016/j.jamcollsurg.2006.07.001
10. Mi Y-H. & Xu M-Y. (2022) Trauma-induced pulmonary thromboembolism: What's update? *Chinese Journal of Traumatology*. 25(2), 67 – 76. https://www.sciencedirect.com/science/article/pii/S1008127521001279
11. Godzik J., Mcandrew C.M., Morshed S., Kandemir U. & Kelly M.P.(2014) Multiple Lower-extremity and Pelvic Fractures Increase Pulmonary Embolus Risk. *Orthopedics.* 37(6), e517–e524. https://journals.healio.com/doi/10.3928/01477447-20140528-50
12. Zangbar B., Lin N., Rafieezadeh A., Kirsch J., Shnaydman I., Eckenberg L., Froula G., Klein J., Bronstein M. & Prabhakaran K. (2025) Obesity portends an increased risk of thromboembolic events in severely injured geriatric trauma, a retrospective study. *The American Journal of Surgery*. 240, 116139. https://www.americanjournalofsurgery.com/article/S0002-9610(24)00691-3/abstract
13. Arcelus J.I., Gouin-Thibault I. & Samama C.M. (2024) European guidelines on peri-operative venous thromboembolism prophylaxis: first update. Chapter 10: Surgery in the obese patient. *European Journal of Anaesthesiology.* 41(8), 607 – 611. Doi: 10.1097/EJA.0000000000002000
14. Alessa M., Gramish J., Almodaimegh H., Khobrani M.A., Hornsby L. & Alhifany A.A. (2021) Utilization of Adjusted Body Weight for Dosing Unfractionated Heparin in Obese Patients with Venous Thromboembolism: A Retrospective Matched Cohort Study. *Tropical J Pharmaceutical Research.* 20(1), 191-195. https://www.ajol.info/index.php/tjpr/article/view/204833
15. Wrzosek A., Drygalski T., Garlicki J., Woroń J., Szpunar W., Polak M., Droś J., Wordliczek J. & Zajączkowska R. (2023) The volume of infusion fluids correlates with treatment outcomes in critically ill trauma patients. *Front Med (Lausanne)* 9, Article 1040098. doi: 10.3389/fmed.2022.1040098
16. Di Giacinto I., Guarnera M., Esposito C., Falcetta S., Cortese G., Pascarella G., Sorbello M. & Cataldo R. (2021) Emergencies in Obese Patients: a Narrative Review. *J Anesth Analg Crit Care.* 1, 13. https://pmc.ncbi.nlm.nih.gov/articles/PMC8590435/
17. Li H-L. (2021) Respiratory Monitoring in Mechanical Ventilation: Extravascular Lung Water Monitoring. *Springer Nature.* [First Online: 28 January 2021] pp. 207 – 217. https://link.springer.com/chapter/10.1007/978-981-15-9770-1_5
18. Cole M., Gilhooly D. & Moonesinghe S.R. (2021) Oxford Textbook of Anaesthesia for the Obese Patient: Chapter 26. Fluid Management in the Obese Patient. *Oxford Academic.* [Published: April 2021] pp. 245 – 252. https://academic.oup.com/book/30620/chapter-abstract/258955005?redirectedFrom=fulltext&login=false
19. Popowicz P., Newman R.K. & Dominique. E. (2023) Abdominal Compartment Syndrome. *National Library of Medicine. StatPearls.* Last Update: September 20, 2023. https://www.ncbi.nlm.nih.gov/books/NBK430932/
20. Ouchi A., Sakuramoto H., Hoshino H., Matsuishi Y., Sakaguchi T., Enomoto Y., Hoshino T., Shimojo N. & Inoue Y. (2020) Association between fluid overload and delirium/coma in mechanically ventilated patients. *Acute Med Surg.* 7(1), e508. doi: 10.1002/ams2.508

SCIENTIFIC PUBLICATION

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WITH THE PROCEEDINGS OF THE IX INTERNATIONAL SCIENTIFIC AND THEORETICAL CONFERENCE

«THEORY AND PRACTICE OF MODERN SCIENCE»

March 28, 2025 **|** Kraków, Republic of Poland

in English and Ukrainian

All papers have been reviewed. Organizing committee may not agree with the authors' point of view. Authors are responsible for the correctness of the papers' text.

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Signed for publication 28.03.2025. Format 70×100/16.
Offset Paper 80gsm. Times New Roman and Open Sans typefaces.
Digital color printing. Conventionally printed sheets 15,6.
Circulation: 50 copies. Printed from the finished original layout.

Publisher [PDF]: Primedia E-launch LLC
TX 75001, United States, Texas, Dallas. E-mail: info@primediaelaunch.com

Publisher [printed copies]: LLC UKRLOGOS Group
21005, Ukraine, Vinnytsia, Zodchykh str. 18, office 81. E-mail: info@ukrlogos.in.ua
Certificate of the subject of the publishing business: ДК № 7860 of 22.06.2023.