UDC 617-001.5-089:355.01
DOI http://doi.org/10.30978/GS-2025-4-42

ISSN 2786-5584 print
ISSN 2786-5592 online

Organization of evacuation of the wounded in wartime: the impact of patient routing on treatment outcomes and infection risks

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Combat-related limb injuries in modern warfare are characterised by high-energy tissue destruction, extensive soft-tissue defects, and a high risk of infectious complications. Evidence from previous military conflicts in Iraq and Afghanistan, as well as civilian trauma centres, indicates that optimal management of such patients requires not only appropriate surgical tactics but also timely routing to specialised orthoplastic centres. Early radical debridement and definitive wound coverage within the orthoplastic «fix and flap» concept and BOAST standards are associated with reduced infection rates, fewer reoperations, and avoidance of delayed amputations. Despite the central role of evacuation pathways, quantitative data on how different evacuation models influence clinical outcomes in contemporary war conditions remain limited.

Objective – to assess the effectiveness of two medical evacuation models – mass (stepwise) and targeted (selective) – in patients with combat-related injuries based on the length of hospital stay and surgical burden.

Materials and methods. A retrospective cohort study was conducted among patients admitted to a specialised orthoplastic centre. Patients were stratified into two groups: targeted evacuation (direct transport to the reconstructive centre ≤72 hours post-injury) and mass evacuation (stepwise transfer through ≥2 intermediate hospitals). The primary endpoints included the length of hospital stay and the number of surgical procedures per patient. Time from injury to admission was analysed as a key factor. Statistical methods included descriptive analysis and intergroup comparison using the t-test/Mann-Whitney U test ($p < 0.05$).

Results. The mean time from injury to hospital admission in the targeted evacuation group was 1.77 ± 0.32 days (range: 0–6), compared with 11.84 ± 1.45 days (range: 3–53) in the mass evacuation group – a sevenfold increase. Mean length of hospital stay was significantly longer in the mass group: 37.03 ± 3.68 vs. 27.27 ± 2.47 days in the targeted group ($p = 0.03$). The average number of surgical procedures per patient was 2.78 ± 0.33 vs. 2.36 ± 0.38, respectively ($p = 0.41$), excluding prior operations performed before referral. No delayed amputations related to infectious complications or reconstruction failure were observed in either group.

Conclusions. Targeted evacuation enables a significantly shorter time to specialised surgical care, leading to reduced hospital stay and a more predictable clinical course. Although differences in surgical burden were not statistically significant, a consistent trend toward fewer interventions was observed with targeted routing. Optimising medical evacuation systems is a critical determinant in the management of limb combat injuries and may be scaled to healthcare systems operating in wartime or resource-limited environments.

Keywords
combat-related injury, medical evacuation, targeted evacuation, orthoplastic surgery, reconstructive surgery, fix and flap, hospital length of stay, infection prevention, early radical debridement, trauma system organisation, plastic surgery, facial trauma, limb trauma.

ARTICLE • Received 2025-11-05 • Received in revised form 2025-11-23 • Published 2025-12-30
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The full-scale invasion of Ukraine by the Russian Federation on 24 February 2022 presented unprecedented challenges to the national healthcare system. Intense hostilities, particularly in the eastern and southern regions, led to a significant increase in military personnel suffering from mine-blast and gunshot injuries, polytrauma, massive blood loss, and a high risk of infectious complications [5, 7].

Frontline healthcare facilities have been operating under conditions of critical overload due to limited human resources, equipment, and infrastructure [5, 12]. Shortages of medical equipment, medications, and transport, along with the presence of multidrug-resistant pathogens (*Acinetobacter baumannii*, *Klebsiella pneumoniae*, *MRSA*), have further complicated the provision of adequate care [2, 7].

During the initial phase of the war, the absence of a clearly established patient routing system posed a substantial challenge. Casualties were often evacuated to the nearest healthcare facilities, regardless of their specialization. This practice led to overcrowding and elevated infectious risks [7], underscoring the need for a formalized medical evacuation system.

Two primary approaches to medical evacuation can be distinguished:

- **Mass (non-specific) evacuation** – transportation to the nearest healthcare facility regardless of its profile; typical for critical situations but associated with facility overload and repeated hospitalizations.
- **Targeted (selective) evacuation** – routing to specialized centers based on injury severity and resource availability.

Targeted evacuation has been implemented in Ukraine since the second half of 2022. An example is evacuation by rail in cooperation with international organizations: between March and November 2022, more than 2,400 patients were successfully transported using specially equipped medical trains [12]. Appropriate patient routing enables delivery times of 2–8 hours from the moment of injury to a specialized facility, which significantly reduces complication rates [2]. The experience of the Lviv Military Hospital confirmed that early transfer and a multidisciplinary approach reduce infection rates and improve reconstructive outcomes [9].

International data also confirm the critical role of timing and a multidisciplinary approach in infection prevention. An analysis of combat injuries (Timing of Wound Coverage in Extremity War Injuries, JAAOS, 2006) demonstrated that delayed wound closure substantially increases the risk of infectious complications and amputations [8]. Current standards of the British Orthopaedic Association (BOA) and the British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) for trauma care, document number 4 (BOAST 4) – joint guidelines of the British Orthopaedic Association and the British Association of Plastic, Reconstructive and Aesthetic Surgeons for the management of open fractures–emphasize the need for radical debridement and orthoplastic defect coverage within the first 72 hours [6]. These principles underpin our protocol for targeted evacuation and reconstructive treatment in wartime conditions.

Objective – to evaluate the effectiveness of two medical evacuation models – mass (non-specific) and targeted (selective) – in patients with combat-related extremity injuries, using treatment duration and the number of surgical interventions as outcome measures.

To assess the effectiveness of two medical evacuation models – mass (stepwise) and targeted (selective) – in patients with combat-related injuries based on the length of hospital stay and surgical burden.

Materials and methods

A total of 59 patients requiring surgical treatment were included in the study. They were evacuated to the medical center of the Charitable Organization «Superhumans» between October 2024 and June 2025. The majority of patients sustained severe mine-blast injuries to the extremities that necessitated multistage reconstructive management.

Depending on the medical evacuation pathway, patients were stratified into two groups:

- Targeted (selective) evacuation – 22 patients – direct transportation to a reconstructive center within ≤72 hours after injury, with early radical debridement (≤ 24 hours after admission) and definitive wound closure within 5–7 days.
- Mass (general) evacuation – 37 patients – staged transportation through two or more intermediate medical facilities prior to admission to the reconstructive center.

Although allocation to evacuation pathways was not randomized, transportation routes were determined primarily by geographic and logistical factors rather than injury severity or wound characteristics that could influence treatment outcomes. Both groups included patients with comparable injury mechanisms and anatomical patterns, minimizing the risk of significant systematic bias when assessing the impact of evacuation models on clinical outcomes.

The results were analyzed using descriptive statistical methods. The Student's t-test was applied to compare mean values between the two samples. Data are presented as M ± m, where M denotes the

Table. **Comparative characteristics of treatment outcomes depending on the medical evacuation model**

Parameter	Targeted evacuation	Mass evacuation	p
Time from injury to admission to a specialized center, days (M ± m (min–max))	1.77 ± 0.32 (0–6)	11.84 ± 1.45 (3–53)	< 0.001
Length of inpatient treatment, days (M ± m)	27.27 ± 2.47	37.03 ± 3.68	0.03
Number of surgical interventions in the specialized center per patient (M ± m)	2.36 ± 0.38	2.78 ± 0.33	0.41
Cases of delayed amputations	0	0	–

arithmetic mean and m the standard error of the mean, reflecting the precision of the mean estimate. Differences were considered statistically significant at $p < 0.05$.

Artificial intelligence tools were used exclusively for linguistic editing and stylistic improvement of the text. The authors bear full responsibility for the content, data analysis, and conclusions presented in the article.

Results

At the first stage of the study, the organization of medical evacuation and the duration of transportation to the specialized reconstructive center were evaluated. Analysis of evacuation routes revealed significant differences between targeted and mass (staged) evacuation models in the time required for patient transport to the center of definitive surgical care (Table).

In the targeted evacuation group, patients were transported directly to a specialized orthoplastic center after injury. Transportation time in this group ranged from 0 to 6 days, with a mean interval from injury to hospitalization of 1.77 ± 0.32 days. The conceptual features of targeted routing and the opportunity for early primary surgical debridement upon admission to a specialized center are illustrated in Fig. 1.

In the mass (staged) evacuation group, patients were transported through several intermediate medical facilities. The interval between injury and admission to the reconstructive center ranged from 3 to 53 days, with a mean of 11.84 ± 1.45 days, which was nearly seven times longer than in the targeted evacuation group.

The characteristics of combat-related injuries requiring early orthoplastic planning upon admission to the specialized center are demonstrated on primary radiographs (Fig. 2).

Further analysis of clinical parameters revealed differences in the length of hospital stay between the groups. Patients evacuated via the mass (staged) pathway had a mean inpatient treatment duration of 37.03 ± 3.68 days, compared with 27.27 ± 2.47 days in the targeted evacuation group. This difference was statistically significant ($p = 0.03$).

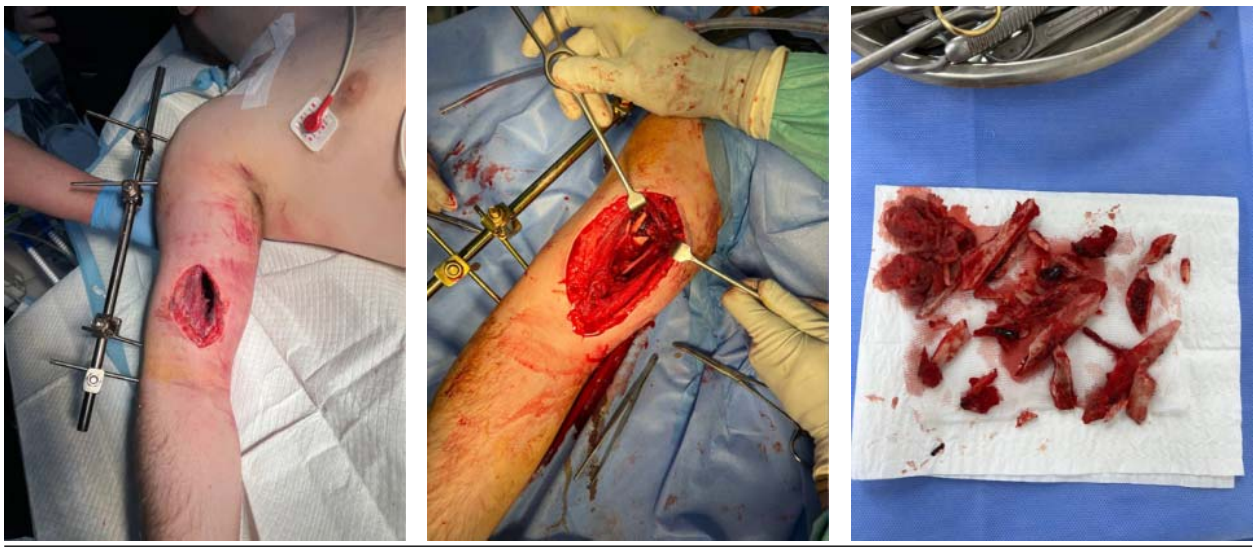

Figure 1. **Primary surgical debridement performed 48 hours after a mine-blast injury following targeted evacuation of the patient to the specialized orthoplastic center «Superhumans»**

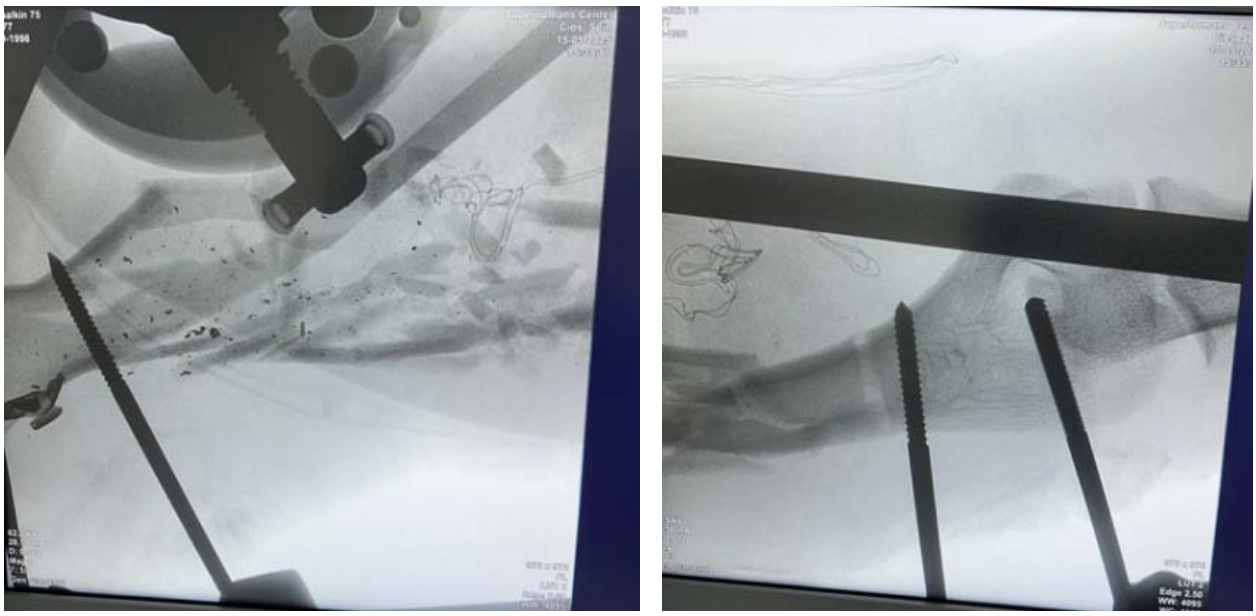

Figure 2. **Primary intraoperative radiograph demonstrating a comminuted fracture resulting from a mine-blast injury and the pattern of damage requiring early orthoplastic planning after targeted evacuation to a specialized center**

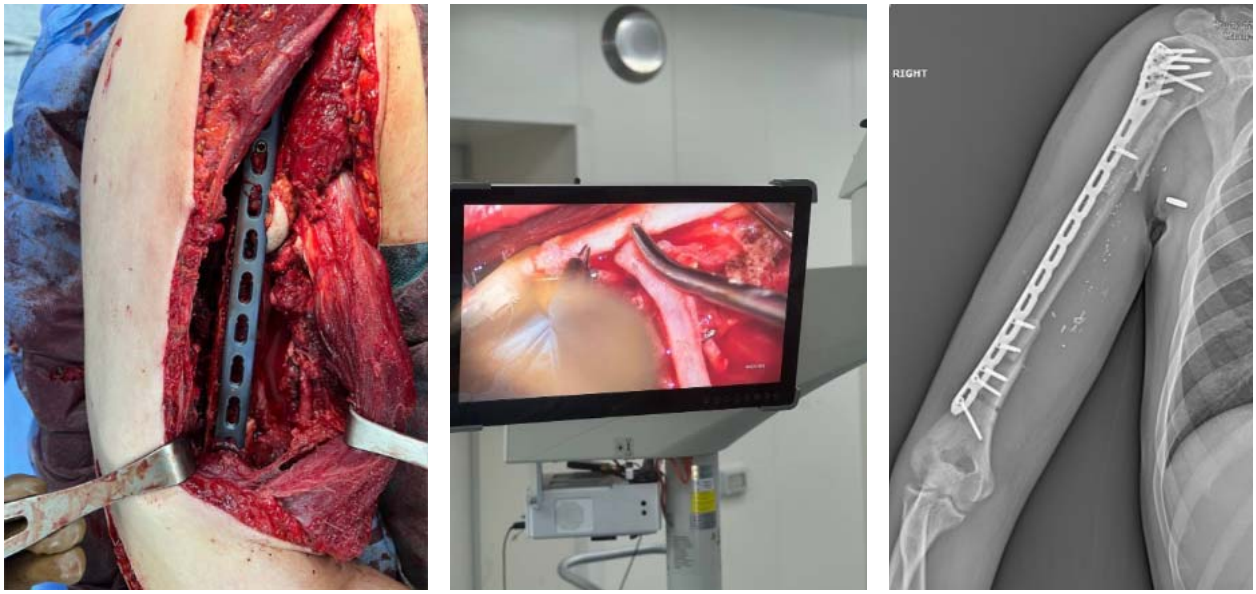

Figure 3. **Reconstruction with a free fibular flap performed on day 5 after injury following targeted evacuation of the patient and within the framework of early orthoplastic planning**

The mean number of surgical procedures per patient in the mass (staged) evacuation group was 2.78 ± 0.33, excluding at least one surgical intervention performed in general-profile facilities prior to admission to the specialized center. In the targeted evacuation group, the mean number of surgical procedures was 2.36 ± 0.38. No statistically significant difference was identified between the groups for this parameter ($p = 0.41$).

The feasibility of early definitive reconstructive intervention following targeted evacuation and early orthoplastic planning is illustrated by a clinical example of free fibular flap reconstruction (Fig. 3).

In both groups, a proportion of patients underwent amputations that were a consequence of the severity of the primary injury at the time of trauma. No cases of delayed amputations related to infectious complications, progression of tissue necrosis, or failure of reconstructive treatment were recorded in either group.

The mass (staged) evacuation group showed greater heterogeneity in clinical outcomes, as

evidenced by variability in wound healing rates and postoperative course. In contrast, the clinical course in the targeted evacuation group was more uniform and stable.

Discussion

Our findings demonstrate fundamental organizational differences between targeted and mass (staged) models of medical evacuation, primarily in the time required to transport wounded patients to a specialized orthoplastic center. The significantly shorter interval between injury and hospitalization in the targeted evacuation group facilitates early radical surgical debridement and timely planning of definitive reconstructive treatment, as demonstrated by the clinical examples presented (see Fig. 1–3).

The reduced length of inpatient treatment observed in patients after targeted evacuation may reflect a more controlled and predictable course of wound-healing. Early routing to a specialized center minimizes delays between treatment stages and helps avoid repeated or interim procedures that are often performed in non-specialized facilities during staged evacuation.

Although no statistically significant difference in the number of surgical interventions between groups was identified, this analysis included only procedures performed at the specialized reconstructive center «Superhumans». At the same time, patients evacuated via the mass (staged) model typically underwent additional surgical interventions at earlier stages of evacuation, including staged debridements and other urgent procedures, which were not included in the present count. This limitation should be considered when interpreting results on the number of operations. Comprehensive assessment of the total surgical burden, including interventions performed at all stages of medical evacuation, represents a promising direction for future research.

Infection control was assessed indirectly using clinically relevant surrogate markers, including length of hospital stay, stability of the clinical course, and absence of delayed amputations. This approach is consistent with established practices for analyzing infectious risks in complex combat trauma settings, where standardized microbiological endpoints are limited or not feasible.

The observed findings are consistent with international data. In particular, the study Timing of Wound Coverage in Extremity War Injuries (JAAOS, 2006) demonstrated that delayed wound closure is associated with an increased risk of infectious complications and amputations, while the multicenter TIDOS study confirmed the substantial impact of infection on clinical outcomes in military patients [10]. Current BOA–BAPRAS standards (BOAST 4) emphasize the necessity of early debridement and orthoplastic defect coverage within 72 hours [6], which underpins the «fix and flap» concept proposed by S. Gopal et al. [1].

Our data indicate that these principles remain applicable even in the context of full-scale hostilities. However, given the high-energy nature of mine-blast injuries, the interval to definitive defect closure may be safely extended to 5–7 days, provided that BOAST 4 recommendations are followed and a multidisciplinary orthoplastic team is involved.

The prevalence of multidrug-resistant pathogens among Ukrainian military patients is among the highest in Europe. Under these conditions, the key factor in preventing infectious complications is not prolonged antibiotic therapy, but rapid routing of wounded patients to specialized centers capable of providing early orthoplastic treatment.

Formalized injury severity scoring systems (ISS, NISS) were not applied in this study due to its retrospective design and the lack of complete standardized data across all stages of evacuation, which should be considered a limitation. Nevertheless, the comparability of groups in terms of injury mechanisms and anatomical patterns allows the observed differences to be interpreted primarily in the context of the organizational model of medical evacuation rather than the severity of the primary injury.

Conclusions

Targeted evacuation ensures rapid patient transport to a specialized reconstructive center (mean time: 1.77 ± 0.32 days versus 11.84 ± 1.45 days under mass (staged) evacuation), facilitating early radical wound debridement and reducing clinical variability during treatment.

Mass (staged) evacuation is associated with a longer inpatient treatment duration (37.03 ± 3.68 days versus 27.27 ± 2.47 days in the targeted evacuation group, $p = 0.03$) and greater heterogeneity in clinical outcomes.

The mean number of surgical interventions did not differ statistically significantly between groups (2.78 ± 0.33 in the mass evacuation group and 2.36 ± 0.38 in the targeted evacuation group, $p = 0.41$), excluding procedures performed in general-profile facilities before admission to the specialized center. Although this difference did not reach statistical significance, the clinical trend suggests fewer interventions with targeted evacuation, consistent with the concept of early routing to specialized centers.

No delayed amputations related to infectious complications or failure of reconstructive treatment were recorded in either group, demonstrating the effectiveness of the treatment protocols and infection control measures.

Future studies will focus on evaluating the impact of evacuation routes on the structure, staging, and final outcomes of surgical treatment.

Declaration of interests

The authors declare no conflict of interest.

Authors contributions

Conception and design – D. Turkevych, A. Vilenskyi; acquisition of data – S. Kuchabskyi, M. Farmaha; analysis and interpretation of data – D. Turkevych, A. Vilenskyi, M. Farmaha; drafting the article – D. Turkevych; critical revision of the article — Y. Medvid, A. Vilenskyi, S. Tucker

References

1. Gopal S, Majumder S, Batchelor AG, Knight SL, De Boer P, Smith RM. Fix and flap: the radical orthopaedic and plastic treatment of severe open fractures of the tibia. J Bone Joint Surg Br. 2000 Sep;82(7):959-66. doi: 10.1302/0301-620x.82b7.10482. PMID: 11041582.
2. Khersonska TB. Organization of medical evacuation of servicemen with combat injuries of the maxillofacial region in the area of the Anti-Terrorist Operation / Joint Forces Operation in Donetsk and Luhansk regions. Problemy viiskovoi okhorony zdorovia. 2020;27:60-68. Ukrainian. doi: 10.32751/2310-4910-2020-27-06.
3. Kovalchuk V, Kondratiuk V, McGann P, Jones BT, Fomina N, Nazarchuk O, Fomin O, Kovalenko I. Temporal evolution of bacterial species and their antimicrobial resistance characteristics in wound infections of war-related injuries in Ukraine from 2014 to 2023. J Hosp Infect. 2024 Oct;152:99-104. doi: 10.1016/j.jhin.2024.06.011. Epub 2024 Jul 10. PMID: 38997008.
4. Ljungquist O, Nazarchuk O, Kahlmeter G, Andrews V, Koithan T, Wasserstrom L, Dmytriiev D, Fomina N, Bebyk V, Matuschek E, Riesbeck K. Highly multidrug-resistant Gram-negative bacterial infections in war victims in Ukraine, 2022. Lancet Infect Dis. 2023 Jul;23(7):784-786. doi: 10.1016/S1473-3099(23)00291-8. Epub 2023 May 23. PMID: 37236220.
5. Mueller A, Salek M, Oszer A, Evseev D, Yakimkova T, Wlodarski M, Vinitsky A, Kizyma R, Pogorelyy M, Zuber M, Escalante J, Lipska E, Fendler W, Nowicka Z, Szyszka A, Kacharian A, Rodriguez-Galindo C, Wise PH, Agulnik A, Mlynarski W; SAFER Ukraine collaborative. Retrospective comparative analysis of two medical evacuation systems for Ukrainian patients affected by war. Eur J Cancer. 2024 Oct;210:114271. doi: 10.1016/j.ejca.2024.114271. Epub 2024 Aug 8. PMID: 39232428.
6. Nanchahal J, Nayagam S, Khan U, Moran C, Barrett S, Sanderson F, Pallister I. Standards for the Management of Open Fractures of the Lower Limb. London: BOA/BAPRAS; 2020.
7. Quinn J, Panasenko SI, Leshchenko Y, Gumeniuk K, Onderková A, Stewart D, Gimpelson AJ, Buriachyk M, Martinez M, Parnell TA, Brain L, Sciulli L, Holcomb JB. Prehospital Lessons From the War in Ukraine: Damage Control Resuscitation and Surgery Experiences From Point of Injury to Role 2. Mil Med. 2024 Jan 23;189(1-2):17-29. doi: 10.1093/milmed/usad253. PMID: 37647607.
8. Sherman R, Rahban S, Pollak AN. Timing of wound coverage in extremity war injuries. J Am Acad Orthop Surg. 2006;14(10 Spec No.):S57-61. doi: 10.5435/00124635-200600001-00013. PMID: 17003209.
9. Sinyuk M, Polishchuk V, Yuschak P, Burachok I. Management of war-related facial wounds in Ukraine: the Lviv military hospital experience. BMJ Mil Health. 2025 Jan 28;171(1):12-15. doi: 10.1136/military-2023-002527. PMID: 38124117.
10. Tribble DR, Conger NG, Fraser S, Gleeson TD, Wilkins K, Antonille T, Weintrob A, Ganesan A, Gaskins LJ, Li P, Grandits G, Landrum ML, Hospenthal DR, Millar EV, Blackbourne LH, Dunne JR, Craft D, Mende K, Wortmann GW, Herlihy R, McDonald J, Murray CK. Infection-associated clinical outcomes in hospitalized medical evacuees after traumatic injury: trauma infectious disease outcome study. J Trauma. 2011 Jul;71(suppl. 1):S33-42. doi: 10.1097/TA.0b013e318221162e. PMID: 21795875; PMCID: PMC4265636.
11. Uren H, Aliieva N, Matolinets N, Hemsley C, Holcomb JB, Samchuk O, Herych H. Cumulative antibiogram results of over 6800 diagnostic isolates from the First Lviv Territorial Medical Union, Ukraine. Lancet Infect Dis. 2025 Apr;25(4):e200-e201. doi: 10.1016/S1473-3099(25)00116-1. Epub 2025 Mar 8. PMID: 40064191.
12. Walravens S, Zharkova A, De Weggheleire A, Burton M, Cabrol JC, Lee JS. Characteristics of Medical Evacuation by Train in Ukraine, 2022. JAMA Netw Open. 2023 Jun 1;6(6):e2319726. doi: 10.1001/jamanetworkopen.2023.19726. PMID: 37351882; PMCID: PMC10290241.

Організація евакуації поранених в умовах війни: як маршрутизація впливає на лікування та інфекційні ризики

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Бойові пошкодження кінцівок в умовах сучасної війни характеризуються високою енергетикою ураження, значним дефектом тканин і високим ризиком інфекційних ускладнень. За даними, отриманими під час військових конфліктів в Іраку та Афганістані, а також згідно із досвідом цивільних травматологічних центрів, ефективне ведення таких пацієнтів потребує не лише адекватної хірургічної тактики, а й своєчасної маршрутизації до спеціалізованого ортопластичного центру. Раннє проведення радикальної некректомії та остаточного закриття дефектів відповідно до концепції ортопластичного підходу «fix and flap» і стандартів BOAST асоціюється зі зниженням частоти інфекційних ускладнень, повторних операцій

і потреби у відстрочених ампутаціях. Попри ключову роль медичної евакуації, кількісні дані щодо впливу її різних моделей на клінічні результати в умовах сучасної війни обмежені.

Мета — оцінити ефективність двох моделей організації медичної евакуації — масової (етапної) і прицільної (селективної) у пацієнтів із бойовою травмою за показниками тривалості госпіталізації та кількості хірургічних втручань.

Матеріали та методи. Проведено ретроспективне когортне дослідження пацієнтів, госпіталізованих у спеціалізований ортопластичний центр. Пацієнтів розподілили на дві групи залежно від маршруту евакуації: прицільна (безпосереднє транспортування до реконструктивного центру) та масова (етапна через ≥ 2 проміжні медичні заклади). Первинні кінцеві точки — тривалість стаціонарного лікування та кількість оперативних втручань на одного пацієнта, додаткова — час від поранення до госпіталізації. Статистичний аналіз передбачав описову статистику та порівняння груп із використанням t-критерію або U-тесту Манна — Уїтні ($p < 0,05$).

Результати. Середній час від моменту травми до госпіталізації в групі прицільної евакуації становив (1,77 ± 0,32) доби (0—6 діб), у групі масової евакуації — (11,84 ± 1,45) доби (3—53 доби), що в 7 разів довше. Середня тривалість стаціонарного лікування була суттєво більшою в групі масової евакуації ((37,03 ± 3,68) і (27,27 ± 2,47) доби, $p = 0,03$). Середня кількість операцій становила 2,78 ± 0,33 у групі масової евакуації та 2,36 ± 0,38 у групі прицільної евакуації ($p = 0,41$) без урахування втручань, виконаних у попередніх стаціонарах. Випадків відстрочених ампутацій, пов'язаних з інфекційними ускладненнями або неефективністю реконструктивного лікування, не зареєстровано.

Висновки. Прицільна евакуація забезпечує значно коротший час до спеціалізованого хірургічного втручання, що асоціюється зі скороченням тривалості госпіталізації та прогнозованішим клінічним перебігом. Незважаючи на відсутність статистично значущих відмінностей за кількістю оперативних втручань, клінічна тенденція свідчить про менше хірургічне навантаження за прицільної евакуації. Оптимізація маршруту медичної евакуації є критичним чинником лікування бойових травм кінцівок і може бути впроваджена в систему охорони здоров'я в умовах воєнних дій або ресурсних обмежень.

Ключові слова: бойова травма, медична евакуація, цільова (селективна) евакуація, ортопластична хірургія, реконструктивна хірургія, фіксація та клаптеве покриття, тривалість перебування в лікарні, профілактика інфекцій, раннє радикальне видалення некротичних тканин, організація системи травматологічної допомоги, пластична хірургія, травма обличчя, травма кінцівок.

FOR CITATION

Turkevych D, Kuchabskyi S, Medvid Y, Vilenskyi A, Farmaha M, Tucker S. Organization of evacuation of the wounded in wartime: the impact of patient routing on treatment outcomes and infection risks. General Surgery (Ukraine). 2025:(4);42-48. http://doi.org/10.30978/GS-2025-4-42.