Research Article

https://doi.org/10.23934/2223-9022-2022-11-2-226-231

The Prognostic Value of the Geriatric Index of Comorbidity for Predicting an Outcome in Patients Over 60 Years of Age With Polytrauma. Retrospective Cohort Study

R.I. Valieva✉, N.N. Zadneprovskiy, P.A. Ivanov

Department of Combined and Multiple Trauma
N.V. Sklifosovsky Research Institute for Emergency Medicine
3 B. Suharevskaya Sq., Moscow, 129090, Russian Federation

✉ **Contacts:** Rozalina I. Valieva, Junior Researcher, Department of Combined and Multiple Trauma, N.V. Sklifosovsky Research Institute for Emergency Medicine. Email: tiffozik@mail.ru

BACKGROUND Nowadays, since the older people are keeping and increasing their professional and social activity, the risk of injury in these patients is escalating. However, the results of polytrauma treatment among patients over 60 years old are worse than in the group of younger patients. This may be associated with the presence of concomitant somatic pathology, which worsens the prognosis of for survival among elderly and senile patients. In the modern literature, there is no description of effective tools for assessing the comorbid status in elderly and senile patients with polytrauma. Nevertheless, there are scales and indices of comorbidity developed for non-surgical patients. To increase the effectiveness of treatment of patients over 60 years of age with polytrauma and a several concomitant diseases, it is necessary to develop new or adapt one of the already created tools for assessing comorbid status.

PURPOSE OF THE STUDY To assess the dependence of the mortality rate in a group of patients with polytrauma over 60 years of age on the presence of concomitant somatic pathology and its severity, calculated by the geriatric index of comorbidity.

MATERIAL AND METHODS During the period from 2005 to 2020, 116 patients with polytrauma and chronic somatic pathology were treated at the Sklifosovsky Institute. The inclusion criteria for the study were the following: patients aged over 60 years old; или patients' age over 60 years old; the Injury Severity Score over 17, the presence of concomitant somatic pathology in patients. The exclusion criteria were the lack of complete necessary information in the medical history, patients' age being less than 60 years old. The Geriatric Index of Comorbidity was calculated for each patient. A retrospective analysis was conducted.

RESULTS A Geriatric Index of Comorbidity of 3 or more in the elderly patients with polytrauma was found prognostically unfavorable for survival (p=0.005). When implementing the Geriatric Index of Comorbidity rating system, the presence of concomitant somatic pathology was found to have the greatest impact on elderly and senile patients with polytrauma and Injury Severity Score 18–24 (p=0.001).

CONCLUSION The system of calculating the Geriatric Index of Comorbidity is advisable to use for assessing the risk of mortality from concomitant somatic pathology and its severity in patients with polytrauma over 60 years of age.

Keywords: polytrauma, elderly, polymorbidity, comorbidity index

Affiliations

Rozalina I. Valieva	Junior Researcher, Department of Combined and Multiple Trauma, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-6393-5183, tiffozik@mail.ru; 50%, participation in the organization of the study process, writing the text of the article
Nikita N. Zadneprovskiy	Researcher, Department of Combined and Multiple Trauma, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-4432-9022, zacuta2011@gmail.com; 25%, analysis or interpretation of the data obtained, writing the text of the article
Pavel A. Ivanov	Doctor of Medical Sciences, Head of the Scientific Department of Combined and Multiple Trauma, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-2954-6985, ipamailbox@gmail.com; 25%, organization of the studyprocess, correction and approval of the text of the article

ISS — (Injury Severity Score)

GIC — (Geriatric Index or Comorbidity) система оценки коморбидности

INTRODUCTION

The risk of injury among the elderly is progressively increasing, given the continuing social and professional activity among the elderly and senile people. In particular, people of this age group often become victims of traffic accidents, falls from a height [1, 2]. Even trauma seems minor at first glance received by a patient at home can lead to severe injuries. In the study of 2016, S. Kocuvan cites the following data: in 47.9% of cases, elderly people sustained various injuries due to a low-energy mechanism of injury [1].

In recent years, the treatment efficacy in patients with severe injuries has increased significantly. This is primarily due to the development and improvement of treatment algorithms, such as damage control orthopedics [3], damage control resuscitation [4], as well as early appropriate care [5]. Meantime, the treatment results in the group of patients older than 60 years remain inadequate. According to S. Aldrian and colleagues, mortality among elderly and senile patients with polytrauma is significantly higher than in younger patients [6]. The investigators showed that the mortality rate was 26.8% in the group aged from 16-64 years old, and 53.3% in the group aged from 65–91 years old. P.V. Giannoudis et al confirmed S Aldrian's argument [7]. In a study conducted in 2008, the mortality in the group of elderly and senile patients was also significantly higher than among younger patients. This figure averaged 42% among the patients older 60 years, while in the group of young and middle-aged patients it was 20%. The mortality curve increases significantly from 19% in the group of patients under 40 years old to 50% in the group over 75 years old.

From the above, we can conclude that the patient's age is an independent risk factor in the treatment of patients with polytrauma and it can negatively affect the treatment outcome.

Many investigators note that, regardless of other risk factors, the presence and severity of comorbidities have a significant impact on mortality in elderly patients. According to the study by L.B. Lazebnik et al., conducted in 2007, the mean number of chronic diseases among people aged over 60 years made about 5 [8]. According to the study by M. Van den Akker, the prevalence of polymorbidity accounts for about 10% in people under 19 years of age, while in the group of patients over 80 years of age it is as high as 78% [9]. According to A.A. Blazhenko and co-authors, one or more concomitant diseases are present in 81.5% of elderly and senile patients with severe injuries [10].

Currently, in the context of the development of evidence-based medicine, the measurement of comorbidity is becoming increasingly important. Many tools for assessing a patient's polymorbid condition have been developed, such as the Kaplan-Feinstein Index, the Satariano Index, Charlson and Fraiburg Comorbidity Indices, and others. Each developed tool for assessing comorbidity has its own advantages and disadvantages. Currently, none of the available tools is both versatile and easy to use in clinical practice. The issue regarding the equivalence of the impact of various concomitant diseases on patients' survival, the incidence of complications and their treatment efficacy also remains unresolved.

Based on the presented data, we came to the conclusion that the number of elderly and senile patients with polytrauma and many pre-existing concomitant diseases is increasing every year. These patients require a special approach to the treatment of both the underlying pathology and concomitant diseases.

Currently, there are no specific tools for assessing comorbid status in patients with severe trauma. Some investigators are adapting the already developed therapeutic tools for assessing polymobidity in elderly and senile patients for use in emergency traumatology. So our colleagues A.N. Blazhenko et al., in their study of 2016, proposed to use the Charlson Comorbidity Index to judge the severity of comorbidity in elderly patients with polytrauma [11].

Charlson Index was proposed in 1987 by M.E. Charlson [12]. This index has been used to assess the long-term prognosis in polymorbid patients. It is a scoring system (from 0 to 40) for the presence of certain comorbidities and is used to predict mortality. For its calculation, the scores corresponding to concomitant diseases are summed up, and one point is added for every ten years of life if the patient exceeds the age of forty. However, this index has a number of disadvantages.

- •When calculating polymorbidity, the severity of many diseases is not taken into account.
- • Some prognostically important diseases, such as some forms of coronary heart disease and chronic heart failure, are not considered in this Index calculation [13].
- •The Charlson Index has the least value in predicting the hospital length of stay, and in-hospital mortality compared to other indices and comorbidity scores [14].

The above shortcomings convinced us to continue exploring methods for assessing comorbidity in elderly patients. In our study, we proposed to use the Geriatric Index of Comorbidity (GIC) assessment system [15]. It was developed in 2002 by R. Rozzini and colleagues. This index allows assessing not only the presence of concomitant diseases and their number, but also their severity at the time of the patient admission to hospital. D. Zekry and colleagues have also concluded that GIC is one of the most accurate predictors of adverse outcomes, including in-hospital mortality among elderly patients [14], which, in our opinion, is very important in the treatment of patients aged over 60 years with polytrauma.

The study objective was to assess the relationship of mortality in the group of patients with polytrauma older than 60 years to the presence of concomitant somatic pathology and its severity as calculated by GIC.

MATERIAL AND METHODS

The study was designed as a retrospective cohort non-randomized study.

For the period from 01.01.2005 to 28.11.2020, 3243 patients with polytrauma were treated at the N.V. Sklifosovsky Research Institute for Emergency Medicine. Of all patients, the medical case history records of 176 elderly and senile patients with polytrauma were selected. According to the medical case history records, 116 of 176 patients had chronic diseases. Thus, the inclusion criteria for the study were: the patient age of 60 years old and over, the Injury Severity Score (ISS) higher 17, and the presence of concomitant somatic pathology in patients. The exclusion criteria were the absence of complete necessary information in the medical case history records and the age under 60 years old (Fig. 1).

Fig. 1. Study flowchart

Note: GIC — (Geriatric Index or Comorbidity), comorbidity assessment system

Fig. 1. Study flowchart
Patients with polytrauma treated in 2008-2020 (n =3243)
Essential information on chronic diseases is unavailable (n =283)
Evaluated according to inclusion criteria (n =2960)
Excluded from the study (n =2808)
Patients under 60 years old (n =2748)
No chronic diseases (n =60)
Included in the study (n =116)
Group 1 GIC I (n =24)
Group 2 GIC II (n =82)
Group 3 GIC III (n =10)

The patient distribution by age in the study group was made in accordance with the Age Classification of the World Health Organization [16]. The age group of elderly patients (60-75 years old) included 82 subjects, the

age group of senile patients (76-90 years old) included 30 subjects, 4 people were qualified as long-livers (over 90 years old).

Among the 116 patients who participated in this study, 12 people died. The mortality rate was 10.3%.

The impact of comorbid diseases on the incidence of death among elderly patients with polytrauma was assessed by means of GIC. When calculating this index, each of 15 chronic conditions is generally graded on a 0—4 disease severity scale, where 0 = absence of disease, 1 = asymptomatic disease, 2 = symptomatic disease requiring medication but under satisfactory control, 3 = symptomatic disease uncontrolled by medical therapy, and 4 = life-threatening disease, or the most severe form of the disease. This index classifies patients into 4 classes according to the number and severity of concomitant diseases, there were no patients among the study group.

For all patients included in the study, the GIC was calculated and the patients were allocated into groups according to the CIG Class of increasing somatic comorbidity

The first group included patients who had one or more conditions with an individual disease severity grade equal or lower than 1 (GIC Class I; n = 24); the second group included patients who had one or more conditions with an individual disease severity grade of 2 (GIC Class II; n = 82); the third group included patients who had one condition with a disease severity of 3, other conditions having an individual disease severity equal to or lower than 2 (GIC Class III; n = 10). There were no patients in the study who could have been included in the fourth group (GIC Class IV), i.e. those who had had 2 or more conditions with a disease severity of 3 or one or more conditions with disease severity of 4. A complete description of the patients included in the study and the parameters studied are presented in Table 1.

Table 1
Distribution of the study group patients by age, severity of condition, and mortality

Parameter	GIC I (n=24)	GIC II (n=82)	GIC III (n=10)
Gender			
F (n=68)	8 (33.3%)	54 (65.8%)	6 (60.0%)
M (n=48)	16 (66.7%)	28 (34.2%)	4 (40.0%)
Age			
60–75 (n=82)	16 (66.7%)	58 (70.7%)	8 (80.0%)
76–90 (n=30)	8 (33.3%)	20 (24.4%)	2 (20.0%)
Over 90 (n=4)	0	4 (4.9%)	0
ISS			
18–24 (n=88)	16 (66.7%)	64 (78.0%)	8 (80.0%)
25–40 (n=28)	8 (33.3%)	18 (22.0%)	2 (20.0%)
Deaths (n=12)	1 (4.2%)	7 (8.5%)	4 (40.0%)

Notes: GIC — (Geriatric Index or Comorbidity) comorbidity assessment system; ISS — Injury Severity Score

Based on the data obtained, a retrospective analysis was made. Statistical processing and clinical data analysis were performed using the descriptive statistics characteristics; and the $\chi 2$ test was used to compare the hypotheses. Results were considered statistically significant ate p value less than or equal to 0.05. Statistical processing was performed using the Statistical package for the Social Sciences 26 (SPSS 26) software.

RESULTS

In order to solve the problem, the studied patients were divided into 2 subgroups: the survivors and the deceased. The number of patients with a favorable outcome (survivors) was 104. The mean age in this subgroup was 70.08±8.8 years old (M ± SD). The mean ISS score was 22.02±4.0 (M ± SD). A fatal outcome was recorded in 12 cases (deceased). The mean age in the patients of this subgroup was 75.3±9.09 (M ± SD); the ISS was 22.25±3.9 (M ± SD).

At the initial stage of the study, each patient was assessed for GIC. When calculating the data by using the χ2 test, the analysis showed that a fatal outcome was more likely in the group of patients with GIC III (p = 0.005).

In order to assess the impact of concomitant somatic pathology and the severity of the injuries on the treatment results 2.

Table 2

GIC class for groups with different ISS scores in the subgroups with different treatment outcomes

Parameter	ISS 18–24 (n=88)		ISS 25–40 (n=28)	
	Survivors	Deceased	Survivors	Deceased
GIC I	16 (18.2%)	0	7 (25.1%)	1 (3.6%)
GIC II	59 (67.1%)	5 (5.7%)	16 (57.1%)	2 (7.1%)
GIC III	4 (4.5%)	4 (4.5%)	2 (7.1%)	0
Confidence level	0.001		0.847	

Notes: GIC − (Geriatric Index or Comorbidity) comorbidity assessment system; ISS − Injury Severity Score

From Table 2 it follows that at ISS 25-40 the relationship of the severity of somatic comorbidity to death was not statistically significant.

Accordingly, the obtained results led to the conclusion that concomitant somatic conditions and their severity) has the greatest impact on the mortality rate in polytrauma with ISS scores of 18-24.

Thus, in patients over 60 years of age, comorbidity is one of the factors determining the treatment outcome. Moreover, regardless of the age and severity of the injuries, the greatest number of poor outcomes occurs at GIC Class III.

DISCUSSION

Approaches to the treatment of elderly and senile patients with polytrauma should be different from the polytrauma treatment algorithms for younger patients. When treating this group of patients, a set of indicators should be taken into account, including age, comorbid conditions and the ISS in each individual elderly or senile patient.

Studying recent literature sources, we have found that the patient's age is an independent risk factor in the treatment of patients with polytrauma and an older age can adversely affect the treatment outcome. Since this parameter is a non-modifiable risk factor, there is no way to influence it during treatment. Whereas the comorbid status is a modifiable risk factor and it is possible to adjust the patient's treatment algorithm depending on the presence of certain diseases and their combinations.

At the moment, there are no criteria for assessing comorbidity in the group of elderly and senile patients with polytrauma. All proposed scoring systems have been developed for non-surgical patients. Research in this field is ongoing and there is a need to assess the polymorbid status in elderly and senile patients with polytrauma. Our colleagues headed by A.N. Blazhenko tried to adapt the most commonly applied Charlson Comorbidity Index to be used in patients over 60 years old with polytrauma. But this index has a number of shortcomings that call into question the possibility of its use for this group of patients.

Comorbidity assessment system of GIC discussed in this study is a more appropriate tool for assessing comorbid somatic pathology among elderly and senile patients with polytrauma. This is due to the fact that this Index takes into account a larger number of significant therapeutic pathologies (рассм. замену на somatic diseases/somatic conditions) and their severity, and also allows us to more accurately predict the length of hospital stay and the mortality, unlike the Charlson Index. The use of this (какого "этого"? Последним упоминался Индекс Чарльсона! Замените, точно указав какого индекса) index will contribute to reducing the length of hospital stay and improving the treatment results in elderly and senile patients with polytrauma. However, our study was limited by a small patient sample size, and therefore, additional studies are required to identify or create the best system for assessing comorbidity in polytrauma patients older than 60 years. Also, in future, it is advisable to create a combined tool for assessing the injury severity and comorbid status in elderly and senile patients with polytrauma. This will make it possible to objectively evaluate the severity condition in

this patient group, taking into account both the nature of injuries and the somatic concomitant pathology, which in turn, will help to improve treatment outcomes and reduce mortality in this group of patients.

This is due to the fact that this Index takes into account a larger number of significant therapeutic pathologies somatic diseases and their severity, and also allows us to more accurately predict the length of hospital stay and the mortality, unlike the Charlson Index. The use of this index will contribute to reducing the length of hospital stay and improving the treatment results in elderly and senile patients with polytrauma. However, our study was limited by a small patient sample size, and therefore, additional studies are required to identify or create the best system for assessing comorbidity in polytrauma patients older than 60 years. Also, in future, it is advisable to create a combined tool for assessing the injury severity and comorbid status in elderly and senile patients with polytrauma. This will make it possible to objectively evaluate the severity condition in this patient group, taking into account both the nature of injuries and the somatic concomitant pathology, which in turn, will help to improve treatment outcomes and reduce mortality in this group of patients.

CONCLUSIONS

1. The Geriatric Index of Comorbidity as a comorbidity assessment system can be used in polytrauma patients older 60 years to assess the mortality risk associated with the presence of concomitant somatic pathology and its severity.

2. Geriatric Index of Comorbidity Class 3 or more in polytrauma patients of older age groups is associated with unfavorable prognosis for survival.

3. When using the Geriatric Index of Comorbidity evaluation system, the concomitant somatic pathology was found to have the greatest impact on elderly and senile polytrauma patients with the Injury Severity Score of 18-24.

REFERENCES

1. Kocuvan S, Brilej D, Stropnik D, Lefering R, Komadina R. Evaluation of major trauma in elderly patients – a single trauma center analysis. *Wien Klin Wochenschr*. 2016;128(Suppl 7):535–542. PMID: 27896468 https://doi.org/10.1007/s00508-016-1140-4
2. Richmond TS, Kauder D, Strumpf N, Meredith T. Characteristics and outcomes of serious traumatic injury in older adults. *J Am Geriatr Soc*. 2002;50(2):215–222. PMID: 12028201 https://doi.org/10.1046/j.1532-5415.2002.50051.x
3. Pape HC, Hildebrand F, Pertschy S, Zelle B, Garapati R, Grimme K, et al. Changes in the management of femoral shaft fractures in polytrauma patients: from early total care to damage control orthopedic surgery. *J Trauma*. 2002;53(3):452–461. PMID: 12352480 https://doi:10.1097/00005373-200209000-00010
4. Holcomb JB. Damage Control Resuscitation. *J Trauma*. 2007;62(6 Suppl):S36–37. PMID: 17556961 https://doi:10.1097/ta.0b013e3180654134
5. Nahm NJ, Como JJ, Wilber JH, Vallier HA. Early appropriate care: Definitive stabilization of femoral fractures within 24 hours of injury is safe in most patients with multiple injuries. *J Trauma*. 2011;71(1):175–185. PMID: 21336198 https://doi.org/10.1097/TA.0b013e3181fc93a2
6. Aldrian S, Nau T, Koenig F, Vécsei V. Geriatric polytrauma. *Wien Klin Wochenschr*. 2005;117(4):145–149. PMID: 15847195 https://doi.org/10.1007/s00508-004-0290-y
7. Giannoudis PV, Harwood PJ, Court-Brown C, Pape HC. Severe and multiple trauma in older patients; incidence and mortality. *Injury*. 2009;40(4):362–367. PMID: 19217104 https://doi:10.1016/j.injury.2008.10.016
8. Lazebnyk LB, Konev YV, Drozdov VN, Efremov LI. Polypharmacy: Geriatric aspect of the problem. *Consilium medicum*. 2007;9(12):29–34. (in Russ.).
9. Van den Akker M, Buntix F, Metsemakers JFM, Roos S, Knottnerus JA. Multimorbidity in general practice: Prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases. *J Clin Epidemiol*. 1998;51(5):367–375. PMID: 9619963 https://doi.org/10.1016/S0895-4356(97)00306-5
10. Blazhenko AA, Sabodashevsky OV, Mukhanov ML, Konovalov EV, Konovalov YV, Solodky DA. Polytrama Features in Patients Older Than 60 Years. *Innovative Medicine of Kuban*. 2016;(1):38–42. (in Russ.).
11. Blazhenko AN, Dubrov VE, Mukhanov ML, Kartashova SV, Zobenko VYa, Blazhenko AA, et al. The Impact of Somatic Pathology on the Level of Mortality in Elderly Patients with Polytrauma. *Polytrauma*. 2016;(2):11–17. (in Russ.).
12. Charlson ME, Pompei P, Ales HL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis*. 1987;40(5):373–383. PMID: 3558716 https://doi.org/10.1016/0021-9681(87)90171-8
13. Vertkin AL, Rumyantsev MA, Skotnikov AS. Comorbidity. *Clinical Medicine (Russian Journal)*. 2012;(10):4–11. (in Russ.).
14. Zekry D, Loures Valle BH, Lardi C, Graf C, Michel JP, Gold G, et al. Geriatrics index of comorbidity was the most accurate predictor of death in geriatric hospital among six comorbidity scores. *J Clin Epidemiol*. 2010;63(9):1036–1044. PMID: 20236800 https://doi.org/10.1016/j.jclinepi.2009.11.013
15. Rozzini R, Frisoni GB, Ferrucci L, Barbisoni P, Sabatini T, Ranieri P, at al. Geriatric Index of Comorbidity: validation and comparison with other measures of comorbidity. *Age Ageing*. 2002;31(4):277–285. PMID: 12147566 https://doi.org/10.1093/ageing/31.4.277
16. Kishkun AA. Biologiya stareniya. In: Kishkun AA. (ed.) *Biologicheskiy vozrast i starenie: vozmozhnosti opredeleniya i puti korrektsii*. Moscow: GEOTAR-Media Publ.; 2008. Pt. 2. pp. 8–22. (in Russ.).