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ASSESSING FALL RISKS IN ONCOLOGY PATIENTS UNDERGOING CHEMOTHERAPY

PROCENA RIZIKA OD PADA ONKOLOŠKIH PACIJENATA KOJI PRIMAJU HEMIOTERAPIJU

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Summary

Introduction. The adverse side effects of therapy, combined with cancer symptoms, can significantly impact the functional ability of patients. By assessing fall risks in patients undergoing chemotherapy and implementing preventive interventions, we can enhance the quality of life of these individuals. The study aimed to identify risk factors and evaluate the risk of falls in oncology patients receiving chemotherapy at a Day Hospital. **Material and Methods.** The study was conducted at the General Hospital in Vrbas and the Oncology Institute of Vojvodina. Patients were divided into two age groups. The instruments used for assessment included the Morse Fall Scale, Timed Up and Go Test, Berg Balance Scale, and Mini-Mental State Examination. The collected data were statistically analyzed. **Results.** The first group of patients had an average age below 65, while the second group's average age was above 65. Both groups had a higher portion of female patients. There were significant differences in cancer localization: the first group primarily had breast cancer, whereas the second group had a higher prevalence of colon cancer. Older patients took longer to complete the Timed Up and Go Test. In the older group, age was significantly associated with Timed Up and Go Test and Berg Balance Scale scores. Additionally, there was a notable correlation between Mini-Mental State Examination scores and Berg Balance Scale scores. **Conclusion.** Age, reduced physical ability and balance, and cognitive deficits are significant risk factors for falls in older oncology patients receiving chemotherapy in the Day Hospital setting.

Key words: Accidental Falls; Risk Assessment; Medical Oncology; Drug Therapy; Postural Balance; Cognition

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Sažetak

Uvod. Neželjena dejstva terapije sa simptomima maligne bolesti mogu da utiču na funkcionalnu sposobnost pacijenata. Procenom rizika od pada pacijenata koji primaju hemioterapiju i odabirom preventivnih intervencija može se uticati na poboljšanje kvaliteta života. Cilj studije je identifikacija faktora i procena rizika od pada onkoloških pacijenata koji primaju hemioterapiju u okviru dnevne bolnice. **Materijal i metode.** Istraživanje po tipu studije preseka je sprovedeno u Opštoj bolnici Vrbas i na Institutu za onkologiju Vojvodine. Pacijenti su bili podeljeni u dve starosone grupe. Primenjeni instrumenti su: Morzeova skala padova, Ustani i hodaj test, Bergova skala balansa i Mini-mental skala. Podaci su statistički obrađeni. **Rezultati.** Prva grupa pacijenata imala je manju prosečnu starost, a druga grupa veću od 65 godina. U obe grupe bilo je više pacijenata ženskog pola. Grupe su se statistički značajno razlikovale u lokalizaciji karcinoma. U prvoj grupi najveći broj njih imao je dijagnozu karcinoma dojke, a u drugoj grupi veći broj ispitanika imao je dijagnozu karcinoma debelog creva. Statistički značajne razlike utvrđene su na Ustani i hodaj testu (starijim osobama je potrebno više vremena za obavljanje aktivnosti u testu). U starijoj grupi ispitanika postoji statistički značajna veza starosti sa skorovima na Ustani i hodaj testu i Bergovoj skali balansa. U starijoj grupi ispitanika beleži se statistički značajna korelacija između skorova na Mini-mental testu i Bergovoj skali balansa. **Zaključak.** Godine starosti, lošije fizičko postignuće, lošija ravnoteža i deficit u kognitivnom statusu su faktori rizika za pad kod starijih onkoloških pacijenata koji primaju hemioterapiju u okviru dnevne bolnice.

Ključne reči: akcidentalni padovi; procena rizika; onkologija; hemoterapija; posturalni balans; kognicija

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Introduction

With the ageing population, there is an anticipated increase in the frequency of malignant diseases [1]. By 2030, the incidence of cancer in the older population is expected to reach 67% [2]. Advances in science and technology have led to the development of novel diagnostic and therapeutic modalities in oncology, result-

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Abbreviations

CRF – cancer related fatigue
CGA – Comprehensive Geriatric Assessment
EORTC – European Organisation for Research and Treatment of Cancer
MFS – Morse Fall Scale
TUG – Timed Up and Go Test
BBS – Berg Balance Scale
MMSE – Mini-Mental State Examination
SPSS – Statistical Package for the Social Sciences
MAHC – Missouri Alliance for Home Care

ing in complete recovery or prolonged survival for many patients with malignant neoplasms. However, the adverse side effects of these therapeutic modalities, particularly chemotherapy (such as polyneuropathy, joint pain, muscle pain, and cancer related fatigue (CRF)), combined with the symptoms of the malignancy itself, can significantly impact the overall condition and functional ability of patients. This includes muscle strength, activities of daily living and self-care, balance, gait, and cognitive functions, thereby increasing the risk of falls, especially in the elderly [3]. Falls are the leading cause of unintentional injuries. While definitions of falls vary, they commonly describe unintended incidents not caused by loss of consciousness or external force. Falls account for 40% of all deaths from injuries and 50% of urgent hospitalizations in individuals over 65 years of age. Additionally, 20% of these patients succumb to fall-related injuries within a year. Falls can lead to post-fall syndrome, characterized by loss of independence, immobilization, dependency, confusion, and depression, which further limit everyday activities [4]. The frequency of falls served as a measure of healthcare quality in both healthcare institutions and home environments. Insight into the likelihood of falls can be gained from various factors: anamnesis, disease history (primary disease and comorbidities), medication types, therapeutic modalities for the primary disease, type of cytostatic used and their side effects, socio-demographic data (age, gender), occupation, social status, living conditions, hobbies, lifestyle, etc. [5]. Although many studies have investigated the quality of life in oncology patients, there is limited knowledge about the frequency of falls in this population. Timely assessment of fall risk in oncology patients receiving chemotherapy and the implementation of specific preventive interventions can significantly impact and improve their quality of life. Numerous studies indicate that female gender, physical impairment and subsequent functional decline, depression, and cognitive impairment all increase the risk for falls [6]. Research suggests that a comprehensive geriatric assessment (CGA) can enhance the quality of care for individuals with carcinoma [7]. The European Organisation for Research and Treatment of Cancer (EORTC) recommends implementing some form of CGA in all elderly patients undergoing chemotherapy [8]. Based on the obtained results, fall prevention in oncology patients must include rehabilitation modalities whose effectiveness has been scientifically confirmed [9]. The aim of this study was to determine whether age, reduced physical ability, poor balance, and cognitive deficits in oncology patients receiving chemotherapy in the Day Hospital setting represent risk factors for falls.

Material and Methods

The study was conducted at the Day Hospital of the Department of Oncology at the General Hospital in Vrbas and the Day Hospital of the Oncology Institute of Vojvodina in Sremska Kamenica. This cross-sectional study included patients over 50 years of age, divided into two groups: one group aged 50-64 and another group aged 65 and older. All participants had a diagnosis of malignant neoplasm of various localizations and had received at least three cycles of chemotherapy at the time of the study. Data from the patients' medical records (name, gender, age, diagnosis, comorbidity) were utilized. Exclusion criteria included patients younger than 50, those with secondary deposits, and those with comorbidities such as epilepsy, ischemic heart diseases, and obstructive lung diseases. Participants received an introductory letter and a consent form. Ethical approval was obtained from the Ethics Commission of the Oncology Institute of Vojvodina in Sremska Kamenica and the General Hospital in Vrbas. Patient interviews, conducted at the end of a chemotherapy cycle, confirmed the data from medical records and assessed the patients' functional status.

Tools used for fall risk assessment

Morse Fall Scale (MFS): This scale assesses six variables influencing the likelihood of falls: history of falls, comorbidity, need for assistance in walking, intravenous therapy, gait, and mental status. Scores range from 0 to 125, with higher scores indicating higher risk for falls. Timed Up and Go test (TUG): This test measures the time a patient takes to stand up from a sitting position with their back leaned against a chair, walk three meters in their usual way of walking, return to the chair, and sit down again. Results reflect motor abilities, and specifically: 1-9 seconds (patient independent and ambulatory); 10-19 seconds (patient mostly independent); 20-29 seconds (patient with varied mobility); >30 seconds (diminished mobility). Berg Balance Scale (BBS): This scale assesses balance through tasks scored from 0 (cannot perform) to 4 (can perform without difficulty), with a maximum score of 56. Interpretation of the total score, based on the three-point Likert-type scale, defines three levels of fall risk: high risk (0-20 points), moderate risk (21-40 points), and low risk (41-56 points). Mini-Mental State Examination (MMSE): Initially designed to assess dementia severity, this scale is now a screening tool for cognitive status. It includes eleven tasks evaluating orientation in time and space, short term verbal memory, attention, delayed recall of verbal material, ability to name objects, ability to follow verbal or written instructions, sentence structure, and graphomotor skills (copying a drawing). The total scores categorize cognitive deficit levels, as follows: 25-30 (no cognitive deficit), 20-24

(mild cognitive deficit), 11-19 (moderate cognitive deficit), and 0-10 (profound cognitive deficit). Lower scores are indicative of higher cognitive deficit levels.

Descriptive statistics, including measures of central tendency (mean) and variability (standard deviation), as well as frequency measures for specific variables were used. Inferential statistics tested the significance of the hypotheses using the Chi-square test, Mann-Whitney U test, and Spearman's rank correlation coefficient. Statistical analysis was performed using statistic package for social sciences SPSS 20.0.

Results

The average age in the first group of patients was M=56.65 (SD=4.08), while the second, older group had

Table 1. Basic demographic and clinical characteristics of the sample with regard to age
Tabela 1. *Osnovna demografska i klinička obeležja uzorka u odnosu na starost*

Parameter *Parametar*	50-64 years/*godina* (n=34) number/*broj* (%)	≥ 65 years/*godina* (n=17) number/*broj* (%)	χ^2	p/*p*
Age/*Starost*				
$\overline{X}\overline{X}$+SD	56.65+4.08	70.41+4.37		
Gender/*Pol*				
Men/*Muškarci*	6 (17.6%)	5 (29.4%)	0.927	0.336
Women/*Žene*	28 (82.4%)	12 (70.6%)		
Cancer localization/*Lokalizacija karcinoma*				
Breast/*Dojka*	24 (70.6%)	6 (35.3%)		
Colon/*Debelo crevo*	8 (23.5%)	9 (52.9%)		
Lung/*Pluća*	0 (0%)	2 (11.8%)	10.341	**0.035**
Stomach/*Želudac*	1 (2.9%)	0 (0%)		
Uterus/*Materica*	1 (2.9%)	0 (0%)		

χ^2-Chi-square test/χ^2-*Hi-Kvadrat test*

Table 2. Distribution of categories on clinical scales with regard to age
Tabela 2. *Distribucija kategorija korišćenih kliničkih skala u odnosu na starost*

Parameter *Parametar*	50-64 years/*godina* (n=34) number/*broj* (%)	≥ 65 years/*godina* (n=17) number/*broj* (%)	χ^2	p/*p*
Morse fall scale of MFS/*Morseova skala za procenu rizika za pad – MFS*				
0 – 24 = no risk of falls/*Nema rizika od pada*	32 (94.1%)	13 (76.5%)		
25 – 45 = low to moderate risk of falls *Nizak do umeren rizik od pada*	2 (5.9%)	3 (17.6%)	4.000	0.135
>46 = high risk of falls/*Visok rizik od pada*	0 (0%)	1 (5.9%)		
The Timed Up and Go test – TUG/*Test „Ustani i hodaj" – TUG*				
< 10 s = independent in walking/*Samostalan u kretanju*	31 (91.2%)	13 (76.5%)		
10– 19 s = mostly independent in walking *Uglavnom nezavisan u kretanju*	3 (8.8%)	4 (23.5%)	2.070	0.150
20 – 29 s = varied mobility/*Promenljiva pokretljivost*	0 (0%)	0 (0%)		
>30 s = diminished mobility/*Smanjena pokretljvost*	0 (0%)	0 (0%)		
Berg Balance Scale – BBS/*Bergova Skala Balansa – BBS*				
High risk of falls/*Visok stepen rizika od pada*	0 (0%)	0 (0%)		
Moderate risk of falls/*Srednji stepen rizika od pada*	0 (0%)	0 (0%)	-	-
Low risk of falls/*Nizak stepen rizika od pada*	34 (100%)	17 (100%)		
Mini mental state examination – MMSE/*Mini-mental test – MMSE*				
18 – 25 = cognitive dysfunction, dementia can be diagnosed *Kognitivna disfunkcija, može se dijagnostikovati demencija*	6 (17.6%)	5 (29.4%)		
26 – 28 = borderline cognitive dysfunction *Granična kognitivna disfunkcija*	15 (44.1%)	6 (35.3%)	0.968	0.616
29 – 30 = normal mental status/*Normalan mentalni status*	13 (38.2%)	6 (35.3%)		

χ^2-Chi-square test/χ^2-*Hi-kvadrat test*

Table 3. Differences in average achievement on clinical scales between the two age groups
Tabela 3. *Razlike u prosečnom postignuću na kliničkim skalama između dve starosne grupe*

Parameter *Parametar*	50-64 years/*godina* (n=34)		≥ 65 years/*godina* (n=17)		U/*U*	p/*p*
	Med	$\overline{X}\overline{X}$+SD	Med	$\overline{X}\overline{X}$+SD		
MFS	0.00	7.21 ± 8.54	15.00	17.06 ± 23.39	223.5	0.147
TUG	8.00	7.94±1.43	9.00	8.76 ± 1.25	183.0	**0.029***
BBS	54.00	54.59 ± 1.05	55.00	54.12 ± 1.73	264.0	0.603
MMSE	28.00	27.32 ± 2.46	28.00	26.76 ± 2.66	249.5	0.425

Legend/*Legenda*: MFS – Morse fall scale/*Morseova skala za procenu rizika za pad*; TUG – Timed Up and Go Test/*Test „Ustani i hodaj";* BBS – Berg Balance Scale/*Bergova Skala Balansa*; MMSE – Mini mental state examination/*Mini-mental test*; x – mean/*aritmetička sredina*; Med – median/*medijana;* SD – standard deviation/*standardna devijacija;* U – Mann-Whitney U-test/Men Vitnijev U-test*;*
*significant/*značajan*

Table 4. Correlation between the results on clinical scales and age in two subsamples
Tabela 4. *Korelacija postignuća na kliničkim skalama i starosti u dva poduzorka*

	50-64 years/*godina* (n=34)	≥ 65 years/*godina* (n=17)
	Age/*Starost*	Age/*Starost*
MFS	0.257	0.073
TUG	0.054	0.522*
BBS	-0.024	-0.549*
MMSE	-0.126	-0.289

Legend/*Legenda*: MFS – Morse fall scale/*Morseova skala za procenu rizika za pad*; TUG – Timed Up and Go Test/*Test „Ustani i hodaj";* BBS – Berg Balance Scale/*Bergova Skala Balansa*; MMSE – Mini mental state examination/*Mini-mental test*;
*Spearman's rank correlation coefficient; p < 0.05; **p < 0.01;/*Spirmanov test rang korelacije*; *p < 0.05; **p < 0.01*

an average of M=70.41(SD=4.37). Gender distribution analysis using the Chi-square test revealed no statistically significant difference between groups (p>0.05), indicating both groups had significantly more female than male participants. The two groups showed significant differences in cancer localization (p=0.035). In the 50-64 age group, breast cancer was more prevalent, whereas in the older group, colon cancer was more common. Additionally, participants over 65 included cases of breast cancer and lung cancer, while the younger age group had instances of colon, uterine, and stomach cancers **(Table 1)**. Chi-square tests applied to clinical scales assessing motor, physical, and cognitive abilities (MFS, TUG, BBS, MMSE) showed no statistically significant difference in category distribution between the groups. Specifically, MFS results indicated that most participants had no or low to moderate risk for falls. TUG analysis revealed most patients in both groups were independent in walking. BBS results showed a low risk for falls, with no balance disorder. MMSE test indicated most participants had normal cognitive status or borderline cognitive dysfunction **(Table 2)**. The Mann-Whitney U test indicated no significant differences in average values on clinical scales between the study groups, except for the TUG test, where older patients had higher average scores (p=0.029), suggesting they required more time to perform the test activities **(Table 3)**. Correlation analysis demonstrated that in participants over 65, there was a statistically significant negative relationship between age and measures of physical and motor functioning (TUG and BBS test). This negative correlation implies that higher scores on one dimension were linked to lower scores on the other, indicating that older participants took more time on the TUG test, reflecting poorer functioning, and had lower BBS scores, indicating poorer balance **(Table 4)**. Intercorrelation analysis of the clinical scales revealed several significant correla-

Table 5. Intercorrelations between clinical scales in two independent age samples
Tabela 5. *Interkorelacije primenjenih kliničkih skala nezavisno u dva starosna poduzorka*

	50-64 years/*godina* (n=34)				≥ 65 years/*godina* (n=17)			
	MFS	TUG	BBS	MMSE	MFS	TUG	BBS	MMSE
MFS	1	0.198	- 0.370**	0.097	1	0.018	-0.241	0.092
TUG		1	-.297*	-0.238		1	-0.259	-0.247
BBS			1	0.369**			1	0.449**
MMSE				1				1

Legend/*Legenda*: MFS – Morse fall scale/*Morseova skala za procenu rizika za pad*; TUG – Timed Up and Go Test/*Test „Ustani i hodaj";* BBS – Berg Balance Scale/*Bergova Skala Balansa*; MMSE – Mini mental state examination/*Mini-mental test*;
* Spearman's rank correlation coefficient; p < 0.05; **p < 0.01/* *Spirmanov test rang korelacije; p < 0.05; **p< 0.01;*

tions in both age groups. In participants aged 50-64, there was a statistically significant negative correlation between scores on the BBS, MFS and TUG scales. This suggests that better balance, as measured by the BBS scale, was associated with a lower risk for falls as measured by the MFS scale and shorter time to complete the TUG test, indicating greater walking independence. Additionally, a statistically significant positive correlation was found between MMSE and BBS scores in the younger age group, indicating that better cognitive function was associated with better balance. In the group aged 65 and older, there was a statistically significant moderate positive correlation between MMSE and BBS scores, similar in the younger group, indicating that better cognitive performance was linked to better balance **(Table 5)**.

Discussion

In patients suffering from carcinoma, a key step in the assessing fall risk is documenting their fall history. A previous fall increases the likelihood of subsequent fall by fourfold [5]. The total score on the MFS test indicates fall probability and identifies risk factors, but does not provide guidance on preventing falls. For patients who have already fallen, further assessment using the TUG test is necessary [10]. The TUG test, which evaluates the time taken to rise from a chair, walk and return, helps in understanding a patient's fall risk. Difficulty maintaining balance on one leg, as assessed by the BBS, indicates a predisposition to fall-related injuries. The MMSE test identifies patients with cognitive impairments, which can contribute to falls [11]. Previous studies have shown that age 65 and older is a significant risk factor for falls, justifying the assessment of gait and related variables to predict falls [12]. In our study, participants over 65 exhibited a significant relationship between age and physical/motor functioning. Older patients in this group took longer to complete the TUG test, indicating poorer functioning, and scored lower on the BBS test, indicating poorer balance. Similar studies have confirmed a correlation between MMSE results and the occurrence of falls [12]. In our own study, there was a statistically significant moderate positive correlation between MMSE and BBS scores in participants over 65, suggesting that poorer cognitive performance is associated with poorer balance. MMSE results can be influenced by factors such as education level, fear, stress, anxiety, depression, and illness adaptation mechanisms, which were not considered in this study. We recommend including specific psychological testing in fall risk assessment to understand the impact of psychological factors on cognitive and functional abilities. Additionally, the MMSE and other test results can be affected by CRF, which was not formally screened for in our patients but was indicated by patient-reported symptoms. The CGA tests are typically used for the geriatric population (over 65), but this study included a control group aged 50-64. In this younger group, there was a statistically significant negative correlation of moderate intensity between BBS, MFS, and TUG scores, indicating that better balance is associated with a lower risk of falls and greater mobility independence. Additionally, there was a statistically significant positive correlation between MMSE and BBS scores, indicating that better cognitive function is associated with better balance. The study validated the use of fall risk assessment instruments in both age groups but lacked comparison with age-matched individuals without carcinoma, which would help determine the sensitivity of these instruments in cancer patients undergoing chemotherapy. Future research should investigate whether oncology patients have a higher fall risk compared to their non-cancer counterparts.

The WHO's global report on fall prevention in the elderly highlights female gender as a risk factor for falls [4]. However, a 2007 study found no gender-based difference in risk fall assessment [12]. Our study's gender ratio was unbalanced, with more female participants, which could influence carcinoma frequency and fall risk assessments. The sample was heterogeneous regarding cancer type and treatment phase, and the sample size was small. A larger sample would help validate the hypothesis that gender is a risk factor for falls. Patients with cancers other than breast and colon often do not receive chemotherapy in day hospital setting, making our results less generalizable to other cancer types (brain, cervix, pancreas, kidneys, etc.). This raises the question of whether screening instruments should be modified or new ones developed to assess fall risk based on cancer localizations and treatment modalities. EORTC recommends concerning CGA instruments for all elderly chemotherapy patients, but we used the MFS due to day hospital conditions.

None of the tests included questions on external fall risk factors related to the patient's environment, such as living and working conditions or home hazards (e.g., carpets, slippery surfaces, stairs, elevators, handrails, wheelchair ramps, pets, toilet and bed adaptability, etc.) [13]. These external factors, as reported by patients, often contribute to falls. Standardizing screening instruments to assess environmental conditions could help prevent falls in oncology patients at home. The Missouri Alliance for Home Care's 10 (MAHC-10) – Fall Risk Assessment Tool could partially address environmental differences [14].

Although chemotherapy is known to increase fall risk, our data suggest that its side effects may not directly cause falls but rather contribute indirectly by affecting cognitive status. Further research should examine specific side effects of each chemotherapy agent. Four main obstacles hinder progress in geriatric oncology: lack of consensus on a comprehensive geriatric oncology assessment standard, lack of standardized patient risk classification, insufficient information on the psychometric properties of assessment tools, and poor quality of patient and clinician/researcher reports. These issued are crucial for assessing study results, making it essential to adequately report details and outcomes in future studies [15].

Conclusion

Age is a significant risk factor for falls in oncology patients receiving chemotherapy in the Day Hospital setting.

Poorer physical ability and balance are risk factors for falls in elderly oncology patients undergoing chemotherapy in the Day Hospital setting.

In elderly oncology patients receiving chemotherapy in the Day Hospital setting, cognitive deficits are positively associated with balance deficits, which represent a fall risk factor.

In oncology patients receiving chemotherapy in the Day Hospital setting, better balance is associated with better functional abilities, greater mobility independence, and reduced risk for falls.

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