Risk factors for bedsore development among hospitalised patients

Czynniki ryzyka rozwoju odleżyn u chorych podczas hospitalizacji

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Summary

Aim of the study: The aim of this work was the identification of chosen bedsores risk factors among patients in whom bedsores developed during hospitalisation.

Material and methods: The tests were carried in four chosen hospital wards. The tested group constituted of 95 patients among whom bedsores developed during hospitalisation, and 683 patients from the risk group among whom bedsores did not develop. The analysis underwent registers of all patients endangered with bedsore development and their medical documentation. The criterion for introducing to the test were: bedsore development risk in the Norton scale, bedsores developed during hospitalisation, and an observation period of at least five days.

Results: Among patients with bedsores there were significantly more people with hypertension, diabetes, chronic obstructive pulmonary disease, asthma, arteriosclerosis, limited movement condition, higher temperature, and oedema ($p < 0.05$). Among constant variables the significant factors protecting from bedsore development were higher concentration of protein and haemoglobin. In terms of physical and mental state, mobility, and total Norton scale points, patients with bedsores that developed during hospitalisation achieved significantly lower results ($p < 0.05$).

Conclusions: Occurrence of concurrent diseases (hypertension, diabetes, asthma, chronic obstructive pulmonary disease) and symptoms connected with health state (higher temperature, oedema, limited movement) significantly influenced bedsore development among patients during hospitalisation. Low laboratory parameter values (protein and haemoglobin concentration) are risk factors for bedsore development. The risk of bedsore development decreases with the increase of point parameter values assessed in the Norton scale.

Key words: risk factors, bedsores, Norton scale.

Streszczenie

Cel pracy: Celem pracy była identyfikacja wybranych czynników ryzyka odleżyn w grupie chorych, u których odleżyny powstały podczas hospitalizacji.

Materiał i metody: Badania prowadzono na czterech wybranych oddziałach szpitala. Grupę badaną stanowiło 95 chorych, u których odleżyny rozwinęły się w trakcie hospitalizacji, oraz 638 chorych z grupy ryzyka, u których odleżyny nie powstały. Analizie poddano rejestry wszystkich chorych zagrożonych wystąpieniem odleżyn oraz ich dokumentację medyczną. Kryterium włączenia do badania stanowiły: ryzyko rozwoju odleżyn według skali Norton, występowanie odleżyn podczas hospitalizacji i co najmniej pięciodniowy okres obserwacji chorego.

Wyniki: Wśród chorych z odleżynami było istotnie więcej osób z nadciśnieniem tętniczym, cukrzycą, miażdżycą, przewlekłą obturacyjną chorobą płuc, astmą, ograniczoną sprawnością ruchową, stanami podgorączkowymi i obrzękami ($p < 0,05$). Spośród zmiennych ciągłych istotnymi czynnikami chroniącymi przed rozwojem odleżyn były wyższe stężenia hemoglobiny i białka. W zakresie stanu fizycznego i umysłowego, mobilności oraz łącznej punktacji skali Norton chorzy, u których doszło do wystąpienia odleżyn podczas hospitalizacji, osiągali znamiennie niższe wyniki ($p < 0,05$).

Wnioski: Występowanie chorób współistniejących (nadciśnienie tętnicze, cukrzyca, astma, przewlekła obturacyjna choroba płuc) oraz symptomy związane bezpośrednio ze stanem zdrowia (stany podgorączkowe, obrzęki, ograniczenie ruchomości) w istotny sposób wpływały na rozwój odleżyn u chorych podczas hospitalizacji. Niskie wartości parametrów laboratoryjnych (stężenie białka i hemoglobiny) predysponują do rozwoju odleżyn. Ryzyko rozwoju odleżyn maleje wraz ze wzrostem wartości punktowych parametrów ocenianych w skali Norton.

Słowa kluczowe: czynniki ryzyka, odleżyny, skala Norton.

Introduction

Patients with limited activity, in progressive phase of cancer, lying in bed, or sitting in wheelchairs are particularly vulnerable to bedsore development. Bedsores belong to wounds with multifactorial aetiology, and a significant role in their development is played also by skin condition [1-4]. In literature numerous risk factors are listed increasing the probability of bedsore development: external factors (Table 1) – independent of patients' health status but connected with the care environment, often dependent on the caregivers; and internal (Table 2) – hardly reversible, strictly related to the patient's health status [1, 3, 5].

Registration of bedsore development risk among patients with bedsore ulcers, as well as registration of those with bedsores developed during hospitalisation, enables the preparation and use of preventive, caring, and healing tools [6]. These data are necessary for planning individual care schedules and focusing them directly on modification, and even on elimination, of bedsore development risk factors before their influence makes irreversible changes such as necrosis and reduction of tissues [7].

The aim of this work was to identify chosen bedsore development risk factors among patients with bedsores that developed during hospitalisation.

Material and methods

The tests were carried out during one year in four chosen wards of a hospital in Bydgoszcz (wards of: general surgery, intensive medical care, neurology, and neurosurgery). Among all patients hospitalised in the mentioned wards a bedsore development risk assessment was made according to the Doreen Norton scale. Analysis underwent all patients endangered of bedsores registers and medical documentation of these patients (disease history and care). The criteria of introducing the tests were: bedsore development risk (≤ 14 Norton points at least in one assessment), bedsore appearance during hospitalisation, and at least five-day period of patient observation. The exclusion criterion was bedsore appearance in the moment of starting hospitalisation.

Statistical analysis was performed using Pearson's χ^2 test, Student's *t*-test, and Fisher's exact test. The quotient of bedsores development chances was calculated together with 95% trust interval. All statistical tests were carried out at a significance level of 5%.

The Bioethical Committee of Collegium Medicum in Bydgoszcz agreed to carry out the tests.

Tested group characteristics

The tested group consisted of 733 patients with bedsore development risk. This group was divided into two subgroups. The first group consisted of 95 patients (12,96%) among whom bedsores developed during hospitalisation, and the second group consisted of 638 patients among whom bedsores did not develop (control group). The average age for the group with bedsores was 70.42 ±14.31 years (min 21, max 97), and for the group without bedsores: 63.24 ±15.75 years (min 18, max 99). Men constituted 56.9% of the tested group (Table 3). A significant majority of the patients lived in the city (70.7%). Only 14.3% of them lived alone.

Results

To identify bedsore development risk factors during hospitalisation, demographic and clinic characteristics were compared for a group of 95 patients with bedsores that developed during hospitalisation and for patients without bedsores (n = 638).

Among the group of patients with bedsores there were significantly more people hospitalised because

Table 1. External bedsore development risk factors

External bedsore development risk factors
Skin and subcutaneous layer pressure
Friction and cutting forces
Skin maceration
Inappropriate care of immobilised patients
Injuries, badly made cast
Bad balanced diet in the case of immobilised patients
Stiff and abrasive underwear and linen
Iatrogenic infections
Social and financial conditions
Lack of specialist equipment, inevitable during immobilised patient care

Table 2. Internal bedsore development risk factors

Internal bedsore development risk factors
Skin condition – decreasing subcutaneous layer amount, dry skin, decreasing skin flexibility
General patient condition deterioration, cancer deterioration, dehydration, consciousness disturbances
Stroke, spinal cord injury, multiple sclerosis, pain disorder or lack of pain
Encopresis and incontinence
Circulatory insufficiency respiratory failure, arteriosclerosis, and diabetes
Immobilising patient, passivity in bed due to surgery and muscle weakness
Sex - among women tendency of bedsore development is two times greater than among men
Diseases that need radiotherapy and chemotherapy

Table 3. Tested group characteristics – demographic data

Demographic data		With bedsores		Without bedsores		Total	
		n	%	*n*	%	*n*	%
Sex	Men	55	57.9	362	56.7	417	56.9
	Women	40	42.1	276	43.3	316	43.1
	Total	95	100.0	638	100.0	733	100.0

Table 4. Number of hospitalisation reasons in the group of patients with bedsores that developed during hospitalisation and among patients without bedsores

Diagnosis	With bedsores		Without bedsores		Total		*p*-value
	n	%	*n*	%	*n*	%	
Neurological	20	21.1	208	32.6	228	31.1	0.023
Vascular	39	41.1	175	27.4	214	29.2	0.006
Surgical	24	25.3	124	19.4	148	20.2	0.187
Oncological	9	9.5	115	18.0	124	16.9	0.038
Other	3	3.2	16	2.5	19	2.6	0.710
Total	95	100.0	638	100.0	733	100.0	–

Table 5. Hospitalisation schedule in the group of patients with bedsores that developed during hospitalisation and those without bedsores

Admission type	With bedsores		Without bedsores		Total		*p*-value
	n	%	*n*	%	*n*	%	
Scheduled	8	8.4	100	15.7	108	14.7	0.063
Urgent	87	91.6	538	84.3	625	85.3	
Total	95	100.0	638	100.0	733	100.0	

of circulatory system diseases, and significantly fewer people hospitalised for neurological or oncological diseases (Table 4).

Among patients with bedsores that developed in hospital, in comparison to patients without bedsores, there were significantly more people among which the additional diagnosis was: arterial hypertension ($p = 0.049$), diabetes ($p = 0.031$), arteriosclerosis ($p < 0.001$), chronic obstructive pulmonary disease (COPD) ($p < 0.001$), asthma ($p = 0.006$), and the following appeared: limited movement ($p < 0.001$), higher temperature ($p < 0.001$), and oedema ($p < 0.001$).

Patients who developed bedsores during hospitalisation were more often (on the verge of statistical significance) hospitalized urgently (Table 5).

Patients with and without bedsores did not differ significantly considering sex, place of residence, living alone or with family, education level, stroke appearance, spinal cord injuries, and multiple organ injury ($p > 0.05$).

Among constant variables, significant intergroup differences concerned the length of hospitalisation, patient's age, protein and haemoglobin concentration levels, and parameters assessed in the Norton scale (Table 6). Patients with bedsores that developed in hospital were significantly longer hospitalised and were significantly older. Moreover, in this group, significantly lower protein concentration during hospitalisation, significantly lower haemoglobin concentration in the moment of admission, and low haemoglobin concentration during hospitalisation were stated.

Patients with bedsores that developed during hospitalisation were characterised by significantly lower physical state, mental state, mobility, and incontinence score in the Norton scale. Moreover, patients with bedsores that developed during hospitalisation had lower (on the verge of statistical significance) levels of activity assessed in the Norton scale.

However, significant intergroup BMI differences were not stated.

Variables in which significant or close to statistical significance intergroup differences were stated, were analysed in a one-dimensional model of logistic regression concerning their role as bedsore development risk factors during hospitalisation.

Among discrete variables, significant factors of bedsore development risk during hospitalisation were (starting from the strongest): limited condition level, higher temperature and oedema during hospitalisation, COPD,

Table 6. Statistic characteristics of constant variables in the group of patients with bedsores that developed in hospital and those without bedsores

Parameter		Bedsores	Average	SD	Median	q25	q75	Min	Max	*p*-value
Hospitalisation time		Yes	27.20	22.08	24	10	35	5	119	< 0.001
		No	13.32	9.91	10	8	15	5	106	
Age		Yes	70.42	14.31	74	62	80	21	97	< 0.001
		No	63.24	15.75	64	55	75	18	99	
BMI		Yes	25.76	6.00	25.39	22.22	27.68	12.91	50.77	0.900
		No	25.48	4.73	25.06	22.34	28.37	15.94	42.10	
Protein – the lowest concentration from all assessed during hospitalisation		Yes	4.89	1.04	4.84	4.32	5.62	2.30	7.97	0.002
		No	5.52	1.17	5.50	4.72	6.28	2.29	9.80	
Haemoglobin – concentration assessed on admission		Yes	11.33	2.69	11.00	9.65	13.40	4.70	18.90	< 0.001
		No	12.86	2.05	13.10	11.70	14.30	6.30	18.80	
Haemoglobin – lowest concentration of all assessed during hospitalisation		Yes	8.71	2.33	8.30	7.10	10.00	4.70	15.40	< 0.001
		No	10.50	1.77	10.45	9.10	11.70	5.10	16.30	
Norton scale	Physical state	Yes	1.99	0.97	2	1	3	1	4	< 0.001
		No	2.52	0.85	3	2	3	1	4	
	Mental state	Yes	2.31	1.17	2	1	3	1	4	< 0.001
		No	2.77	0.92	3	2	3	1	4	
	Activity	Yes	1.02	0.21	1	1	1	1	3	0.065
		No	1.08	0.36	1	1	1	1	4	
	Mobility	Yes	1.63	0.74	1	1	2	1	4	< 0.001
		No	2.07	0.73	2	2	3	1	4	
	Incontinence	Yes	1.57	0.85	1	1	2	1	4	< 0.001
		No	1.96	0.98	2	1	2	1	4	
	Norton total	Yes	8.52	3.24	8	5	11	5	16	< 0.001
		No	10.41	2.77	11	9	12	5	19	

Table 7. The role of discrete variables as bedsores development risk factors during hospitalisation

Factor	OR	(–) 95% CI	(+) 95% CI	*p* – one-dimensional model	*p* – multi-dimensional model
Limited condition	59.38	8.19	430.72	< 0.001	0.001
Higher temperature	8.17	5.10	13.09	< 0.001	0.108
Oedema	6.27	3.95	9.95	< 0.001	0.024
COPD	5.78	2.70	12.35	< 0.001	0.698
Arteriosclerosis	4.63	2.95	7.26	< 0.001	0.542
Asthma	3.16	1.33	7.49	0.009	0.502
Urgent admission	2.02	0.95	4.31	0.068	0.968
Vessel diagnosis	1.84	1.18	2.88	0.007	0.857
Diabetes	1.69	1.04	2.75	0.033	0.867
Arterial hypertension	1.56	1.00	2.42	0.051	0.420
Neurological diagnosis	0.55	0.33	0.93	0.025	< 0.001
Oncological diagnosis	0.48	0.23	0.97	0.042	0.337

COPD – chronic obstructive pulmonary disease

Table 8. The role of constant variables as bedsore development risk factors during hospitalisation

Factor	OR	(–) 95% CI	(+) 95% CI	*p* – one-dimensional model	*p* – multi-dimensional model
Long hospitalisation time	1.06	1.05	1.08	< 0.001	0.440
Older age	1.03	1.02	1.05	< 0.001	0.596
Higher Norton score	0.80	0.74	0.87	< 0.001	0.853
Higher haemoglobin concentration (during admission to the hospital)	0.74	0.67	0.82	< 0.001	0.587
Better mental state	0.63	0.50	0.78	< 0.001	0.725
Higher score according to Norton scale for: incontinence	0.60	0.45	0.79	< 0.001	0.488
Higher protein concentration (during hospitalisation)	0.58	0.40	0.85	0.005	0.036
Higher haemoglobin concentration (during hospitalisation)	0.58	0.49	0.67	< 0.001	0.391
Better physical state according to Norton scale parameters	0.49	0.37	0.64	< 0.001	0.119
Higher mobility according to Norton scale parameters	0.42	0.30	0.59	< 0.001	0.117
Higher activity according to Norton scale parameters	0.41	0.12	1.40	0.156	–

arteriosclerosis and asthma, circulatory system diseases, and diabetes. Moreover, risk factors close to significance turned out to be: urgent admission and arterial hypertension. However, significant factors that did not have any influence on bedsore development during hospitalisation were (starting from the strongest): oncological and neurological reasons for hospitalisation (Table 7).

From constant variables, significant bedsore development risk factors were (starting from the strongest): long hospitalisation time and higher patient's age. The significant factors protecting against bedsore development were (starting from the strongest): higher level of mobility assessed in the Norton scale, higher level of physical state assessed in the Norton scale, higher level of haemoglobin and protein during hospitalisation, higher score of incontinence and mental state in the Norton scale, higher level of haemoglobin during admission, and higher total score in the Norton scale (Table 8).

Variables that turned out to be significant risk/protection factors in one-dimensional analysis of logistic regression were analysed in a multi-dimensional model. In this way their significance as independent risk/protection factors proved to be: limited condition level and oedema appearance during hospitalisation (risk factors), as well as neurological hospitalisation and higher protein concentration during hospitalisation (protection factors).

Discussion

In the literature there are many proofs that chronic disease appearance (internal factors) is not neutral in the aetiopathogenesis of bedsore development. The great danger, however, is connected with the appearance of general symptoms of basic disease and undesirable actions and complications connected with treatment methods [8-12]. The most common risk factors are: fever, undernourishment, anaemia, immobilisation, perfusion disorders, pain, traumas, neurological diseases, long surgical procedures, incontinence, diabetes, and skin damage [1, 8, 9, 12-14]. Researchers in their publications state that the risk factors that appear most often as independent predictors of bedsore development concern three basic branches: mobility/activity of patients, tissue perfusion disorders (including diabetes), and skin state. Moreover, among patients treated in intensive care wards, risk factors include also: the length of stay in the intensive care ward, mechanical ventilation presence and the duration of its usage, usage of interrupted haemodialysis or constant vain-vain hemofiltration, and sedative medications. They conclude that there is no single factor that can explain the risk of bedsore development, but rather the complicated influence of many factors increases the probability of bedsore development [15, 16].

In the presented material, co-occurrence of chronic diseases (diabetes, arterial hypertension, asthma, COPD, arteriosclerosis) and higher temperature were significant factors of bedsore development during hospitalisation. Limited condition level, however, and oedema occurrence, based on statistical analysis, were stated as independent bedsore development risk factors.

Lowering tissue perfusion may be an important bedsore development factor undergoing assessment.

In this research an attempt was made to identify it on the basis of haemoglobin concentration. In double assessment (on the day of admission and the lowest concentration of all assessed during hospitalisation), between average values of haemoglobin in groups of patients with and without bedsores, there is a statistically significant difference. In this research the haemoglobin concentration among patients with bedsores developed during hospitalisation was on average 11.33 ±2.69 g/dl (min 4.7, max 18.9). However, the lowest values during the whole stay were on average at the level of 8.71 ±2.33 g/dl (min 4.7, max 15.4). Other researchers stated that haemoglobin concentration in a group of 87 people with bedsores was at an average of 7.6 ±1.6 g/dl (min 5.4, max 11.6) [17]. In other work with reference to patients treated in a surgical ward, it was stated that those who were in need of supplementary blood were more prone to bedsore development (close to significant statistical dependence; $p = 0.076$) [18]. In tests of patients treated in an intensive care ward, differences in haemoglobin concentration among both groups of patients were not significant [19].

Higher concentration of protein during hospitalisation was taken as a significant factor of protection against bedsore development. Similar conclusions can be drawn also from other tests [19, 20].

Such factors as long hospitalisation time or older age of the patient are commonly stated as predictors for bedsore development [1, 3, 10, 12, 21, 22]. They are often connected with a physical condition disorder, up to the total immobilisation state. Both parameters constitute important elements of assessing patients' state, both during admission and during the hospitalisation period. This procedure of nursery assessment of bedsore development risk ease scales [1, 23, 24]. One of the recommended tools for this is the Norton point scale. In the tested group significantly lower scores of parameters such as: physical and mental state, mobility and incontinence, and total score in the Norton scale were seen in patients with bedsores that developed during hospitalisation ($p < 0.05$). Average point values in terms of patients' activity were on the verge of statistical significance ($p = 0.065$). Similar results were gained during tests carried out in 2009 in the same place, among group of people hospitalised in a general surgery clinic. Patients among whom bedsores developed scored significantly lower average point values in the Norton scale than those among whom bedsores did not develop [25]. Also, Terekeci et al. received results suggesting that low values in the Norton scale among patients treated in an intensive care ward increased the risk of bedsore development [19].

On the basis of nursery assessment of bedsore development risk profile, care-therapeutic activities towards every patient have to be planned and realized. Among individually picked actions, we have to take into account, mainly, encouragement to move and passive removal of pressure by changing the patient's position more often [1, 8, 26, 27].

Conclusions

Occurrence of co-morbidities (arterial hypertension, diabetes, asthma, COPD) and symptoms directly connected with health status (higher temperature, oedema, mobility limitation) in a significant way influences bedsore development during hospitalisation. Low values of laboratory parameters (protein and haemoglobin concentration) are predictors of bedsore development.

Bedsore development risk decreases with the increase of point values of parameters assessed in the Norton scale.

The authors declare no conflict of interest.

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