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## CO-INCIDENCE OF SELECTED EFFECTS OF STROKE – PRELIMINARY FINDINGS

### WSPÓŁWYSTĘPOWANIE WYBRANYCH NASTĘPSTW UDARU – WYNIKI WSTĘPNE

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#### S u m m a r y

**Background.** Spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications are one of the most commonly observed effects in patients after stroke. There is still a need for research on predictors and early identification of such changes in order to minimize their incidence and negative influence to the recovery process.

**Objective.** To evaluate the incidence and relationship between the selected complications of stroke spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications.

**Results.** Among the 141 patients involved in the study, the results were as follows: spasticity was observed in 35.46%, contracture in 42.55%, pusher syndrome in 8.51%, hemispacial neglect in 4.26% and heterotopic ossifications were observed in 5.67%.

**Conclusions.** Our findings confirm presented relatively new and important basic and clinical information extending existing studies, especially co-occurrence of selected stroke results and factors influencing their incidence.

#### S t r e s z c z e n i e

**Tłó.** Spastyeczność, przykurcze, zespół odpychania, zespół zaniedbywania jednostronnego oraz skostnienia heterotopowe są jednymi z najczęściej spotykanych zmian w grupie pacjentów po udarze. Istnieje potrzeba badań nad predyktorami i wczesną identyfikacją ww. zmian, aby zminimalizować ich częstość występowania oraz negatywny wpływ na proces zdrowienia.

**Cel.** Ocenic występowania oraz powiązania pomiędzy wybranymi następstwami udaru: spastyecznością, przykurczami, zespołem odpychania, zespołem zaniedbywania jednostronnego oraz skostnieniami heterotopowymi.

**Results.** Wśród 141 pacjentów włączonych do badania spastyeczność została zaobserwowana u 35,46%, przykurcze u 42,55%, zespół odpychania u 8,51%, zespół zaniedbywania jednostronnego u 4,26%, a skostnienia heterotopowe u 5,67%.

**Wnioski.** Wyniki badania potwierdzają stosunkowo nowe i ważne podstawowe i kliniczne dane rozszerzające wiedzę z wcześniejszych badań, szczególnie w obszarze współ-występowania badanej grupy następstw udaru oraz czynników wpływających na ich wystąpienie.

**Key words:** stroke, spasticity, contracture, pusher syndrome, unilateral neglect, heterotopic ossification

**Słowa kluczowe:** udar, spastyeczność, przykurcz, zespół odpychania, zespół zaniedbywania jednostronnego, skostnienie heterotopowe

## INTRODUCTION

Despite recent advances in knowledge and clinical experience concerning the global stroke epidemic, stroke remains the second leading cause of preventable death and the fourth leading cause of the lost productivity. Risk factors for stroke and their associations are regarded as independent on the country and part of world. Major modifiable risk factors key for prevention of stroke are poor diet, lack of physical activity, obesity, smoking, excessive alcohol intake, lack of hypertension control, diabetes mellitus, atrial fibrillation, dyslipidemia, and stress/depression [1, 2, 3, 4]. Significance of stroke will grow, as the populations' age [5, 6]. Also, the incidence rate observed in 55 y.o. and younger people was relatively high (13.3%), and the most common risk factors in this group were smoking, hypertension, dyslipidemia, obesity and diabetes [7].

Despite various advanced prevention approaches and techniques number of post-stroke patients still increases; thus, there is a need to pay particular attention also to stroke causes, results, as far as novel therapies and rehabilitation methods.

Spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications are one of the most important negative effects of stroke. Their presence may significantly influence the way and effectivity of the therapy; thus, early diagnosis and proper qualification constitute key issue both in inpatient and outpatient treatment, rehabilitation and care. Patients are more severely compromised than those without. Incidence and especially co-incidence of the aforementioned changes often remains uneven or unknown. There is still a need for research on predictors and early identification of such changes in order to minimize their incidence and influence to the recovery process [8].

This study aimed at assessment of the incidence and relationships between selected complications of stroke spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications.

## METHODS

The objective of the investigation was to evaluate the incidence and relationships between selected complications of stroke spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications. Thus, study design was observational study.

The research was conducted among 141 adult patients who had undergone stroke. Clinical summary of the patients is presented in table 1.

Table 1. *Clinical summary of the patients*

	Patients n=141 (100%)
Age [years]:	
Min	18
Max	89
Mean	53.12
SD	18.65
Median	57
Sex:	
Females	61 (43.26%)
Males	80 (56.74%)
Time after cerebrovascular accident (CVA) [weeks]:	
Min	1
Max	520
Mean	41.3
SD	12.65
Median	38

Each patient was assessed once (at admission, before first session of rehabilitation) using following methods:

- poststroke spasticity (PSS), contracture, and increased muscle tone were measured with the Modified Ashworth Scale and the Tone Assessment Scale [9, 10],
- unilateral neglect clinically assessed with the European Stroke Scale [11],
- the Scale for Contraversive Pushing and the Burke Lateropulsion Scale was applied to assess pusher syndrome [12-15],
- heterotopic ossifications were assessed thanks to range-of motion limitations and medical imaging [16, 17].

Each of the aforementioned methods is assessed as valid, quick, easy-to-use, and commonly used in clinical practice. It allows replication of this study and makes its results useful in everyday clinical practice.

Data were collected using MS Excel 2013. All the data were analyzed using the software Statistica version 12. Where available the results were calculated as mean, median, minimum value, maximum value and standard deviation. The Shapiro-Wilk test was used as a test for the normality of data. T-student test and Wilcoxon's test were used to compare scores. Spearman's rho was used to assess correlations. The level of significance was set at  $p \leq 0.05$ .

The study was conducted in accordance with the Helsinki Declaration and the rules of Good Clinical Practice. Written informed consent was obtained from each patient before the study.

## RESULTS

Among the 141 patients involved in the study, the results were as follows: spasticity was observed in 35.46%, contracture in 42.55%, pusher syndrome in 8.51%, hemispatial neglect in 4.26% and heterotopic ossifications were observed in 5.67% (table 2). Rates of co-occurrence were relatively high, especially co-occurrence of spasticity and contractures (29.79%) (table 2).

Table 2. Co-occurrence: percentages in the whole group of patients

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Sole	35.46	42.55	8.51	4.26	5.67
Spasticity	-	29.79	4.26	1.42	5.67
Contracture		-	7.09	3.55	4.96
Pusher syndrome			-	2.84	0.71
Hemispatial neglect				-	0.71
Heterotopic ossification					-

Spasticity and contractures were most frequent in women, but pusher syndrome, hemispatial neglect and heterotopic ossifications were most common in men. Rates of co-occurrence were relatively high, especially co-occurrence of spasticity and contractures in women (36.07%) (table 3).

Table 3. Co-occurrence: percentages depending on sex

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Women					
Sole	45.9	49.18	6.56	1.64	3.28
Spasticity	-	36.07	3.28	1.64	3.28
Contracture		-	4.92	1.64	3.28
Pusher syndrome			-		0
Hemispatial neglect				-	0
Heterotopic ossification					-
Men					
Sole	28.75	37.5	12.5	6.25	7.5
Spasticity	-	23.75	5	1.25	7.5
Contracture		-	8.75	5	6.25
Pusher syndrome			-	5	1.25
Hemispatial neglect				-	1.25
Heterotopic ossification					-

Spasticity was equally frequent in all age groups. Contractures, pusher syndrome, hemispatial neglect and heterotopic ossifications were most frequent in younger patients. Rates of co-occurrence were relatively high, especially co-occurrence of spasticity and contractures in both age groups (table 4).

Table 4. Co-occurrence: percentages depending on age

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Patients younger than 57 (median)					
Sole	32.35	48.53	16.18	7.35	7.35
Spasticity	-	27.94	5.88	1.47	7.35
Contracture		-	11.76	5.88	5.88
Pusher syndrome			-	5.88	1.47
Hemispatial neglect				-	1.47
Heterotopic ossification					-
Patients $\geq$ 57 y.o. (median)					
Sole	32.88	34.25	4.11	1.37	5.48
Spasticity	-	26.03	1.37	1.37	4.11
Contracture		-	2.74	1.37	4.11
Pusher syndrome			-	0	0
Hemispatial neglect				-	0
Heterotopic ossification					-

Spasticity and pusher syndrome were the most frequent in patients  $\leq$  4 weeks after CVA and patients  $>$  12 months after CVA. Contractures, hemispatial neglect and heterotopic varied, but co-occurrence of spasticity and contractures in patients  $>$  12 months after CVA (table 5).

Table 5. Co-occurrence depending on time after CVA

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Patients $\leq$ 4 weeks after CVA					
Sole	36	40	8	0	6
Spasticity	-	30	8	0	4
Contracture		-	6	0	2
Pusher syndrome			-	0	0
Hemispatial neglect				-	0
Heterotopic ossification					-
Patients $>$ 4 weeks till 3 months after CVA					
Sole	28.21	30.77	7.69	2.56	7.69
Spasticity	-	17.95	2.56	0	5.13
Contracture		-	7.69	2.56	5.13
Pusher syndrome			-	2.56	0
Hemispatial neglect				-	0
Heterotopic ossification					-
Patients 4 -12 months after CVA					
Sole	29.63	59.26	14.81	11.11	7.41
Spasticity	-	29.63	0	7.41	7.41
Contracture		-	14.81	11.11	7.41
Pusher syndrome			-	3.7	0
Hemispatial neglect				-	3.7
Heterotopic ossification					-
Patients $>$ 12 months after CVA					
Sole	36	48	8	4	8
Spasticity	-	32	0	0	8
Contracture		-	4	4	8
Pusher syndrome			-	4	0
Hemispatial neglect				-	0
Heterotopic ossification					-

Moderate correlation was observed between spasticity and contractures and between pusher syndrome and hemispatial neglect (table 6). Other correlations, if observed, were rather weak (tables 6-9). Correlations varied depending on sex, age, and time after CVA (tables 6-9).

Table 6. Correlations in the whole group of patients

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Spasticity	-	0.540 p=0.000	n.s.	n.s.	0.274 p=0.001
Contracture		-	0.204 p=0.015	0.181 p=0.032	n.s.
Pusher syndrome			-	0.400 p=0.000	n.s.
Hemispatial Neglect				-	n.s.
Heterotopic ossification					-

n.s. – not significant

Table 7. Correlations depending on sex

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Females					
Spasticity	-	0.599 p=0.000	n.s.	n.s.	n.s.
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	n.s.	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-
Males					
Spasticity	-	0.487 p=0.000	n.s.	n.s.	0.355 p=0.001
Contracture		-	0.242 p=0.030	n.s.	n.s.
Pusher syndrome			-	0.527 p=0.000	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-

Table 8. Correlations depending on age

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Patients younger than 57 (median)					
Spasticity	-	0.524 p=0.000	n.s.	n.s.	0.339 p=0.004
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	0.488 p=0.000	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-
Patients ≥ 57 y.o. (median)					
Spasticity	-	0.629 p=0.000	n.s.	n.s.	n.s.
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	n.s.	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-

Table 9. Correlations depending on time after CVA

	Spasticity	Contracture	Pusher syndrome	Hemispatial neglect	Heterotopic ossification
Patients ≤ 4 weeks after CVA					
Spasticity	-	0.663 p=0.000	0.393 p=0.004	n.s.	n.s.
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	n.s.	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-
Patients > 4 weeks till 3 months after CVA					
Spasticity	-	0.446 p=0.004	n.s.	n.s.	n.s.
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	0.562 p=0.000	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-
Patients 4 -12 months after CVA					
Spasticity	-	0.538 p=0.004	n.s.	n.s.	0.436 p=0.023
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	n.s.	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-
Patients > 12 months after CVA					
Spasticity	-	0.614 p=0.001	n.s.	n.s.	n.s.
Contracture		-	n.s.	n.s.	n.s.
Pusher syndrome			-	0.692 p=0.000	n.s.
Hemispatial neglect				-	n.s.
Heterotopic ossification					-

## DISCUSSION

Author aimed at presentation of the incidence and relationships between the selected negative effects of stroke: spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications. Such comprehensive approach is rare.

Low number of relevant studies makes compartmental studies difficult. Results of this study are similar to those published by other authors, but more detailed. Spasticity was observed in 35.46%, contractures in 42.55%, pusher syndrome in 8.51%, hemispatial neglect in 4.26% and heterotopic ossifications in 5.67% of patients. Incidence varies depending on sex, age, and time after CVA. According to the literature, prevalence of PSS ranges from 4% to 42.6%, including 4-27% in patients 1-4 weeks poststroke, 19-26.7% in patients 1-3 months poststroke, and 17-42.6% in patients >3 months poststroke [18]. Incidence of the unilateral neglect in patients with acute stroke was assessed by Siekierka-Kleiser et al.: 32.69% [19]. Pusher syndrome was

observed in 9.4-28% post-stroke survivors [20-22]. According to the recent review of Allison et al., incidence of spasticity in poststroke survivors with weakness ranged from 33% to 78%, and contractures were present in >50%. Related impairments and their co-occurrence is relatively common and may negatively influence the time course of the therapy. There is a need to admit that spasticity may appear within 1 week after the stroke, and contracture within two weeks, and continue to develop over 3-6 months [23]. Thus, clinicians should be prepared not only to intervene early but also act over a prolonged time period of recovery.

The new and important aspects of the study are rates of co-occurrence were relatively high, especially co-occurrence of spasticity and contractures. Reported co-occurrence varies depending on sex, age, and time after CVA. This report is reported as preliminary and very general – values of measurements and their analysis will be reported in future detailed publications.

Limitations of current study may constitute used diagnostic methods and low number of factors regarded as predictors of selected complications of stroke which may limit the strength of the findings. Many prognostic signs should be taken into consideration. To optimize the final evaluation there is need to use the combinations of both factors and complications. There is an intention to continue this study on bigger sample of patients based on randomized controlled trial design. Further studies are needed to examine increased difficulty of the therapy, rehabilitation and care associated with co-occurrence of the described post-stroke impairments to enable multidisciplinary therapeutic team to develop targeted interventions and achieve therapeutic goal(s).

## CONCLUSIONS

Our findings confirm presented new and important basics and clinical information extending the existing studies, especially co-occurrence of complications and factors influencing their incidence.

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