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Associations between Results of Post-Stroke NDT-Bobath Rehabilitation in Gait Parameters, ADL and Hand Functions

Korelacje między wynikami rehabilitacji metodą NDT-Bobath z zakresu reedukacji chodu, czynności życia codziennego oraz funkcji ręki

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Abstract

Background. In patients after a stroke there are variable disorders. These patients often need rehabilitation in more than one area beceause of multiple limitations of the ability to perform everyday activities.
Objectives. The aim of the study was to assess correlations – statistical relationships between observed gait parameters, ADL and hand functions – results of rehabilitation of patients after ischaemic stroke according to the NDT-Bobath method for adults.
Material and Methods. The investigated group consisted of 60 patients after ischaemic stroke, who participated in the rehabilitation programme. 10 sessions of the NDT-Bobath therapy were provided in 2 weeks (10 days of the therapy). The calculation of correlations was made based on changes of parameters: Bobath Scale (to assess hand functions), Barthel Index (to assess ADL), gait velocity, cadence and stride lenght. Measurements were performed in every patient twice: on admission (before the therapy) and after last session of the therapy to assess rehabilitation effects.
Results. The main statistically relevant corellations observed in the study were as follows: in the whole group of patients: poor and moderate (negative) correlation between changes of gait parameters and Bobath Scale and Barthel Index, moderate and severe (negative) correlation between changes of gait parameters and Bobath Scale and Barthel Index in the group of women, correlation between changes in Bobath Scale and Barthel Index in the group of patients with left side of paresis, (negative) correlation between changes of gait parameters and Bobath Scale in group of patients younger than 68 years, moderate, high and very high correlations between changes in gait parameters in groups of women, men, younger than 68 years and older than 68 years.
Conclusions. There have been observed statistically significant and favourable changes in the health status of patients, described by gait parameters, changes in hand functions and ADL. Based on the presented correlations there is an assumption that it is hard to achieve simultaneous recovery in all areas: gait parameters, hand functions and ADLs in two weeks of rehabilitation (**Adv Clin Exp Med 2013, 22, 5, 731–738**).

Key words: ischaemic stroke, NDT-Bobath, corellations, activities of daily living, hand functions, gait assessment.

Streszczenie

Wprowadzenie. U pacjentów po udarze często dochodzi do różnorodnych zaburzeń, co powoduje konieczność zapewnienia rehabilitacji jednocześnie w obszarze wielu deficytów w celu zapewnienia zdolności do wykonywania czynności życia codziennego.
Cel pracy. Celem badania była ocena korelacji – powiązań statystycznych – między wynikami rehabilitacji prowadzonej metodą NDT-Bobath dla dorosłych z zakresu wskaźników chodu, czynności życia codziennego i funkcji ręki.
Materiał i metody. Badaną grupę stanowiło 60 pacjentów po udarze niedokrwiennym objętych rehabilitacją przez 2 tygodnie (10 sesji rehabilitacji). Korelacje były obliczane na podstawie zmian wskaźników z zakresu funkcji ręki (mierzonej skalą Bobath), czynności życia codziennego (mierzonej wskaźnikiem Barthel) oraz parametrów chodu (prędkości, tempa i długości dwukroku). Pomiary te były wykonywane 2-krotnie: przy przyjęciu na rehabilitację oraz po 2 tyg. rehabilitacji w celu oceny jej wyników.

Wyniki. Główne zaobserwowane statystycznie istotne korelacje były następujące: w całej grupie pacjentów: słaba i umiarkowana korelacja ujemna między zmianami z zakresu wskaźników chodu, wyników skali Bobath i wskaźnika Barthel, umiarkowana i wysoka korelacja ujemna między zmianami w zakresie parametrów chodu, wyników skali Bobath i wskaźnika Barthel w grupie kobiet, korelacja między zmianami wyników skali Bobath i wskaźnika Barthel w grupie pacjentów z porażeniem lewostronnym, korelacja ujemna między zmianami z zakresu wskaźników chodu i wyników skali Bobath w grupie pacjentów poniżej 68. r. ż., umiarkowana, wysoka i bardzo wysoka korelacja między poszczególnymi parametrami chodu w grupach: kobiet i mężczyzn oraz bez względu na wiek.
Wnioski. Zaobserwowano statystycznie istotne korzystne zmiany w stanie zdrowia pacjentów, odzwierciedlane w parametrach chodu, zmianach w wynikach testów oceniających funkcje ręki i czynności życia codziennego. W wyniku analizowanych korelacji można stwierdzić, że podczas 2 tygodni rehabilitacji trudno osiągnąć jednoczesną poprawę we wszystkich badanych obszarach: parametrach chodu, funkcjach ręki i czynnościach życia codziennego (**Adv Clin Exp Med 2013, 22, 5, 731–738**).

Słowa kluczowe: udar niedokrwienny, metoda NDT-Bobath, korelacje, czynności życia codziennego, funkcje ręki, ocena chodu.

Stroke is a big medical, social and financial problem. The number of people suffering from strokes is estimated worldwide to be 15 m, including 5 m deaths each year. Ischaemic stroke constitutes 80–85% of all stroke cases [1–6]. It is estimated that 60% of patients after stroke suffer from motor deficits, and 50% of them suffer from limited independence, need personal help/care in daily living or are unable to work and/or participate in community life [6, 7]. The aim of post-stroke rehabilitation is to restore the patient's best possible functioning, so there is a great interest in looking for more effective ways to do this. The aim of the study was to assess corellations – statistical relationships between observed gait parameters, activities of daily living (abbr. ADLs) and hand functions – results of rehabilitation of patients after ischaemic stroke according to the NeuroDevelopmental Treatment – Bobath (abbr. NDT-Bobath) for adults method. Corelations have been made based on changes of parameters: Bobath Scale (to assess hand functions), Barthel Index (to assess ADLs), gait velocity, cadence and stride lenght. Correlations analysis in the presented area can be very useful, because it can indicate predictive relationships exploited later in clinical practice.

NDT-Bobath method for adults is one of the leading methods in post-stroke rehabilitation [8–14], percived as not a set of exercises, but as a whole concept [15]. The main advantages of NDT-Bobath method are as follows:

– holistic, comprehensive, patient-oriented approach, used both in rehabilitation of children and adults, both in neurologic patients and in the other cases,

– continously developing approach, offered both as classic "pure" Bobath approach and eclectic (i.e. joined with other methods),

– painless techniques,

– high requirements for certified therapists' knowledge and experience ensures highest quality of the therapy [15].

Main disadvantages of NDT-Bobath method, wide discussed, are as follows:

– long-lasting and rather expensive therapy certification training causes a shortage of experienced NDT-Bobath therapists, especially in developing countries,

– widely discussed effectivity – despite the wide use of NDT-Bobath, there is a lack of studies in the area of outcomes for post-stroke rehabilitiation using NDT-Bobath method [16–20]. A review of 15 trials of NDT-Bobath treatment in adult patients with post-stroke hemiplegia performed by Paci [16] shows a lack of evidence proving significant positive differences between therapy using NDT-Bobath method and therapy using other methods. According to this review, it is hard to find NDT-Bobath method as the optimal type of treatment in adult patients with post-stroke hemiplegia. But simulaneously this paper describes both general methodological problems in evaluating effectiveness of physiotherapy for adults with hemiplegia and other, specific aspects of the NDT-Bobath method (therapy of tone anomalies, lack of standarized therapy protocols, various content of treatment sessions, various therapists' knowledge and experience, need for dedicated clinimetric tools, etc.) [16].

Material and Methods

The study involved 60 post ischaemic stroke patients. Study groups were established on the basis of the criteria described. Inclusion criteria were as follows: age above 18 years, time were each time confirmed by medical records. The patients' profiles are presented in Table 1.

The calculation of corelations has been made based on a change of parameters: Bobath Scale (to assess hand functions), Barthel Index (to assess ADL), gait velocity, cadence and stride length. Measurements were performed in every patient

Table 1. Patients' overall profile	
	Number and percentage
Side of paresis: Left Right	 30 (50%) 30 (50%)
Sex: Females Males	 30 (50%) 30 (50%)
Age (years): Min Max SD Mean Median	 42 86 10,3 65,7 68
Age brackets (years): 38–47 48–57 58–67 68–77 78–87	 2 (3,33%) 13 (21,67%) 13 (21,67%) 27 (45%) 5 (8,33%)
Time after cerebrovascular accident (CVA): 6 weeks – 6 months > 6 months – 1 year > 1 year – 2 years > 2 years – 3 years	 20 (33, 33%) 13 (21,67%) 14 (23, 33%) 13 (21, 67%)

twice: on admission (before the therapy) and after the last session of the therapy to assess rehabilitation effects.

Patients were treated according to the rules of the method by experienced therapists of NDT-Bobath method for adults with international certificates:

– IBITA recognized Basic Course "Assessment and Treatment of Adults with Hemiplegia – The Bobath Concept",

– IBITA recognized Advanced Course "Assessment and Treatment of Adults with Neurological Conditions – The Bobath Concept",

– additionally (earlier) EBTA recognized NDT-Bobath Basic Course.

10 sessions of the NDT-Bobath therapy were provided during the course of 2 weeks (10 days of the therapy – the therapy was performed every day through 5 days a week). Each session lasted 30 min.

The results of measurements were given as mean, median, maximal value, minimal value and SD. Changes between 1st and 2nd mesurements were calculated as a result of the substraction. To assess correlations and their strength, Spearman's rank correlation coeficients (Spearman's rhos) were calculated. Increasing rank correlation coefficient implies an increasing relationship between rankings. Value of Spearman' rank correlation

Table 2. Corellations between gait parameters. ADL and hand functions for whole group pf patients

	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	$r_S = 0.310$ ($p = 0.016$)						
Change of gait velocity	$r_S = -0.326$ ($p = 0.016$)	$r_S = -0.268$ ($p = 0.050$)					
Change of cadence	$r_S = -0.322$ ($p = 0.018$)	$r_S = -0.270$ ($p = 0.049$)	$r_S = 0.871$ ($p < 0.001$)				
Change of stride lenght	ns.	$r_S = -0.294$ ($p = 0.031$)	$r_S = 0.713$ ($p < 0.001$)	$r_S = 0.423$ ($p = 0.001$)			
Change of normalized gait velocity	$r_S = -0.352$ ($p = 0.009$)	$r_S = -0.320$ ($p = 0.018$)	$r_S = 0.962$ ($p < 0.001$)	$r_S = 0.905$ ($p < 0.001$)	$r_S = 0.702$ ($p < 0.001$)		
Change of normalized cadence	$r_S = -0.330$ ($p = 0.015$)	ns.	$r_S = 0.872$ ($p < 0.001$)	$r_S = 0.998$ ($p < 0.001$)	$r_S = 0.422$ ($p = 0.001$)	$r_S = 0.906$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.629$ ($p < 0.001$)	$r_S = 0.343$ ($p = 0.011$)	$r_S = 0.945$ ($p < 0.001$)	$r_S = 0.619$ ($p < 0.001$)	$r_S = 0.342$ ($p = 0.011$)

ns. = non significant.

Table 3. Corellations between gait parameters. ADL and hand functions depends on sex

Female							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	ns.						
Change of gait velocity	$r_S = -0.516$ ($p = 0.006$)	$r_S = -0.443$ ($p = 0.021$)					
Change of cadence	$r_S = -0.497$ ($p = 0.008$)	$r_S = -0.504$ ($p = 0.007$)	$r_S = 0.900$ ($p < 0.001$)				
Change of stride lenght	$r_S = -0.490$ ($p = 0.009$)	$r_S = -0.475$ ($p = 0.012$)	$r_S = 0.750$ ($p < 0.001$)	$r_S = 0.572$ ($p = 0.002$)			
Change of normalized gait velocity	$r_S = -0.538$ ($p = 0.004$)	$r_S = -0.514$ ($p = 0.006$)	$r_S = 0.926$ ($p < 0.001$)	$r_S = 0.911$ ($p < 0.001$)	$r_S = 0.748$ ($p < 0.001$)		
Change of normalized cadence	$r_S = -0.505$ ($p = 0.007$)	$r_S = -0.509$ ($p = 0.007$)	$r_S = 0.901$ ($p < 0.001$)	$r_S = 0.999$ ($p < 0.001$)	$r_S = 0.577$ ($p = 0.002$)	$r_S = 0.915$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.575$ ($p = 0.002$)	$r_S = 0.399$ ($p = 0.039$)	$r_S = 0.925$ ($p < 0.001$)	$r_S = 0.575$ ($p = 0.002$)	$r_S = 0.403$ ($p = 0.037$)
Male							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	ns.						
Change of gait velocity	ns.	ns.					
Change of cadence	ns.	ns.	$r_S = 0.835$ ($p < 0.001$)				
Change of stride lenght	ns.	ns.	$r_S = 0.608$ ($p = 0.001$)	ns.			
Change of normalized gait velocity	ns.	ns.	$r_S = 0.983$ ($p < 0.001$)	$r_S = 0.852$ ($p < 0.001$)	$r_S = 0.589$ ($p = 0.001$)		
Change of normalized cadence	ns.	ns.	$r_S = 0.836$ ($p < 0.001$)	$r_S = 0.996$ ($p < 0.001$)	ns.	$r_S = 0.849$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.629$ ($p < 0.001$)	ns.	$r_S = 0.990$ ($p < 0.001$)	$r_S = 0.606$ ($p = 0.001$)	ns.

ns. = non significant.

coeficient is inside the interval [–1, 1] and assumes the value: 1: the two rankings are the same – (positive) correlation, 0: rankings are (completely) independent, 1: one ranking is the reverse of the other – (negative) correlation.

Values of the corellation were perceived as: poor: < 0.3, moderate: 0.3–0.5, severe: 0.5–0.7, high: 0.7–0.9, very high: > 0.9. The level of statistical significance was set at $p < 0.05$. The data was analyzed with Statistica 9.0 Software.

The study was accepted by the appropriate Bioethical Committee. The subjects gave written informed consent before entering the study, in accordance with the recommendations of the Bioethical Committee, acting on the rules of Good Clinical Practice and the Helsinki Declaration after CVA – from 6 weeks to 3 years and diagnosis: ischaemic stroke.

Table 4. Corellations between gait parameters. ADL and hand functions depends on a side of paresis

Left							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	$r_S = 0.452$ ($p = 0.012$)						
Change of gait velocity	ns.	ns.					
Change of cadence	ns.	ns.	$r_S = 0.879$ ($p < 0.001$)				
Change of stride lenght	ns.	ns.	$r_S = 0.656$ ($p < 0.001$)	ns.			
Change of normalized gait velocity	ns.	ns.	$r_S = 0.970$ ($p < 0.001$)	$r_S = 0.915$ ($p < 0.001$)	$r_S = 0.591$ ($p = 0.001$)		
Change of normalized cadence	ns.	ns.	$r_S = 0.877$ ($p < 0.001$)	$r_S = 0.999$ ($p < 0.001$)	ns.	$r_S = 0.914$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.469$ ($p = 0.016$)	ns.	$r_S = 0.881$ ($p < 0.001$)	$r_S = 0.408$ ($p = 0.039$)	ns.
Right							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	ns.						
Change of gait velocity	$r_S = -0.625$ ($p < 0.001$)	$r_S = -0.466$ ($p = 0.012$)					
Change of cadence	$r_S = -0.566$ ($p = 0.002$)	$r_S = -0.552$ ($p = 0.002$)	$r_S = 0.878$ ($p < 0.001$)				
Change of stride lenght	$r_S = -0.489$ ($p = 0.008$)	$r_S = -0.390$ ($p = 0.040$)	$r_S = 0.807$ ($p < 0.001$)	$r_S = 0.548$ ($p = 0.003$)			
Change of normalized gait velocity	$r_S = -0.603$ ($p = 0.001$)	$r_S = -0.540$ ($p = 0.003$)	$r_S = 0.967$ ($p < 0.001$)	$r_S = 0.894$ ($p < 0.001$)	$r_S = 0.822$ ($p < 0.001$)		
Change of normalized cadence	$r_S = -0.575$ ($p = 0.001$)	$r_S = -0.556$ ($p = 0.002$)	$r_S = 0.884$ ($p < 0.001$)	$r_S = 0.998$ ($p < 0.001$)	$r_S = 0.561$ ($p = 0.002$)	$r_S = 0.901$ ($p < 0.001$)	
Change of normalized stride lenght	$r_S = -0.472$ ($p = 0.011$)	$r_S = -0.377$ ($p = 0.048$)	$r_S = 0.788$ ($p < 0.001$)	$r_S = 0.530$ ($p = 0.004$)	$r_S = 0.995$ ($p < 0.001$)	$r_S = 0.806$ ($p < 0.001$)	$r_S = 0.543$ ($p = 0.003$)

ns. = non significant.

Results

The study focused on determining the correlations observed as a result of therapy conducted according to the NDT-Bobath method rules in a group of patients after ischaemic stroke in the area of selected parameters, so there is no control group.

A statistically relevant poor and moderate correlation between changes of gait parameters and Bobath Scale and Barthel Index was observed in the whole group of patients (Table 2).

A statistically relevant moderate and severe correlation between changes of gait parameters and Bobath Scale and Barthel Index was observed in the group of women (Table 3).

A statistically relevant correlation between changes in Bobath Scale and Barthel Index was observed in the group of patients with left side of paresis (Table 4).

A statistically relevant correlation between changes of gait parameters and Bobath Scale was observed in the group of patients younger than 68 years (Table 5).

Table 5. Corellations between gait parameters, ADL and hand functions depends on age bracket

Younger then 68 years (median)							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	ns.						
Change of gait velocity	$r_S = -0.394$ ($p = 0.028$)	ns.					
Change of cadence	$r_S = -0.374$ ($p = 0.038$)	ns.	$r_S = 0.928$ ($p < 0.001$)				
Change of stride lenght	ns.	ns.	$r_S = 0.772$ ($p < 0.001$)	$r_S = 0.596$ ($p < 0.001$)			
Change of normalized gait velocity	$r_S = -0.417$ ($p = 0.020$)	ns.	$r_S = 0.950$ ($p < 0.001$)	$r_S = 0.932$ ($p < 0.001$)	$r_S = 0.766$ ($p < 0.001$)		
Change of normalized cadence	$r_S = -0.391$ ($p = 0.030$)	ns.	$r_S = 0.928$ ($p < 0.001$)	$r_S = 0.999$ ($p < 0.001$)	$r_S = 0.588$ ($p = 0.001$)	$r_S = 0.933$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.788$ ($p < 0.001$)	$r_S = 0.614$ ($p < 0.001$)	$r_S = 0.989$ ($p < 0.001$)	$r_S = 0.779$ ($p < 0.001$)	$r_S = 0.607$ ($p < 0.001$)
Older than 68 years							
	Change of Bobath Scale	Change of Barthel Index	Change of gait velocity	Change of cadence	Change of stride lenght	Change of normalized gait velocity	Change of normalized cadence
Change of Barthel Index	ns.						
Change of gait velocity	ns.	ns.					
Change of cadence	ns.	ns.	$r_S = 0.712$ ($p < 0.001$)				
Change of stride lenght	ns.	ns.	$r_S = 0.637$ ($p = 0.001$)	ns.			
Change of normalized gait velocity	ns.	ns.	$r_S = 0.953$ ($p < 0.001$)	$r_S = 0.842$ ($p < 0.001$)	$r_S = 0.586$ ($p = 0.003$)		
Change of normalized cadence	ns.	ns.	$r_S = 0.705$ ($p < 0.001$)	$r_S = 0.995$ ($p < 0.001$)	ns.	$r_S = 0.836$ ($p < 0.001$)	
Change of normalized stride lenght	ns.	ns.	$r_S = 0.459$ ($p = 0.028$)	ns.	$r_S = 0.886$ ($p < 0.001$)	ns.	ns.

ns. = non significant.

A statistically relevant moderate, high and very high correlations between changes in gait parameters were observed in groups of women, men, younger than 68 years and older than 68 years (Table 3, 5).

There was not observed statistically relevant correlations depends on the time following CVA.

Discussion

The achieved results of rehabilitation, observed as changes of gait parameters, Bobath Scale and Barthel Index, were statistically relevant and reflected the recovery (change was > 0).

The observed poor and moderate statistically relevant (negative) correlation between changes of gait parameters and Bobath Scale and Barthel Index in the whole group of patients can suggest that during the 2 weeks of the therapy, it is hard to achieve simultaneous recovery in all areas: gait parameters, hand functions and ADLs. This is very significant, but cannot exclude that with a longer period of rehabilitation this correlation could change, because recovery of hand function can be, in selected cases, more complicated than gait re-education.

This (negative) correlation was moderate and severe in the group of women, but did not exist in the group of men. In both groups, moderate, high and very high correlations between changes in gait parameters were observed.

A statistically relevant correlation between changes in Bobath Scale and Barthel Index was observed in the group of patients with left side of paresis. Recovery of hand function can influence ADL abilities, but the same correlation was not observed in patients with right side of paresis. In this group of patients, (negative) correlation between changes of gait parameters and Bobath Scale and Barthel Index were observed. This confirms the assumption that it is hard to achieve simultaneous recovery in all areas: gait parameters, hand functions and ADLs.

In the group of patients younger than 68 years statistically relevant (negative) correlation between changes of gait parameters and Bobath Scale was observed. In both groups of age moderate, high and very high correlations between changes in gait parameters were observed.

The results of the study inspire me to provide further evidence in the area of post-stroke rehabilitation based on the NDT-Bobath approach. The analysis of differences among results in tables 1, 2, and 3 allow us to formulate the general hypostheses as follows:

– both patients' functional status on admission (before the therapy) and quick achievment of recovery in ADLs can determine the effectivity of further therapy in the area of gait quality, gait parameters and hand functions,

– cortical neuroplasticity can be limited and can depend on the patient's age – short period of rehabilitation (two weeks) reduces the possibility of simultaneous significant recovery in ADLs, gait parameters and hand functions.

I hope to verify the aforementioned hypostheses during my further research.

Unfortunately, there is a lack of studies using NDT-Bobath method for adults to compare the outcomes of this study. Widely discussed systematic literature review of Paci [16] demonstrated fiteen clinical trials, but its results show no evidence proving the effectiveness of NDT-Bobath method. Paci perceived as necessary further investigations to develop outcome measures concerning the goals of the Bobath approach (motor performance, etc.). As one of criteria in the study should be the therapists' extensive knowledge about NDT-Bobath method for adults, confirmed by international certificates and several years of experience [15, 17]. To sum up, only their outcomes of the therapy can be compared.

There is a need to provide further studies in the area of independent sources of knowledge necessary to estimate the correlations between results of the rehabiltiation conducted according to the NDT-Bobath method for adults in post-stroke patients, capable of detecting even more general dependencies.

The author conclude that the findings confirm that NDT-Bobath method for adults can be an effective therapy in adult patients after ischaemic stroke. There have been observed statistically significant and favourable changes in the functional status of patients, described by gait parameters, changes in hand functions and ADL. Based on the presented correlations, there is an assumption that it is hard to achieve simultaneous recovery in all areas: gait parameters, hand functions and ADLs in two weeks of rehabilitation.

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