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Introduction

Post-stroke complex regional pain syndrome (CRPS) is an important complication in stroke survivors, but little is known about its risk factors. The identification of factors associated with post-stroke CRPS is important for preventive measures and early diagnosis. In our previous study, the number of subjects was too small for risk factor analysis. Therefore, we investigated the risk factors of the occurrence of post-stroke CRPS for a larger number of subjects.

Methods

From January 1, 2022 to June 30, 2023, 226 first-ever stroke survivors in the subacute stage were retrospectively analyzed. Demographic data, diagnosis time of CRPS, duration of hospitalization, location of brain lesion, etiology, comorbidities, and some blood test findings were investigated. Clinical data included Medical Research Council (MRC) grade, Motricity Index, Fugl-Meyer assessment (FMA), grip strength, spasticity, National Institute for Health Stroke Scale (NIHSS), Modified Barthel Index (MBI), Berg Balance Scale (BBS), and Mini-Mental State Examination (MMSE). CRPS was clinically diagnosed by trained physicians using Budapest criteria, then confirmed by Three-Phase Bone Scan.

Results

Among a total of 226 subacute stroke patients, 45 were diagnosed with CRPS and 181 in the control group. In univariable analysis, supratentorial lesions and a history of coronary artery disease was predominant comorbidites in the CRPS group. **(Table 1)**

In clinical data, low scores of muscle strength, MBI, BBS, and MMSE on the affected side were observed in the CRPS group. Also, high score of NIHSS, and high portion of spasticity were observed in the CRPS group. In laboratory findings, plasma albumin level were low. **(Table 2)**

Independent risk factors for CRPS were the duration of hospitalization, FMA-U, plasma protein level. **(Table 3)**

The etiology of stroke, presence of a dominant or non-dominant hemisphere, unilateral or bilateral brain lesions, history of hypertension, diabetes mellitus, dyslipidemia and depression were not involved in the occurrence of CRPS.

Conclusions

Risk factors of post-stroke CRPS are the duration of hospitalization, the strength of affected upper limb and Protein-Energy Malnutrition. Supratentorial lesion, a history of coronary artery disease were associated with the occurrence of CRPS.

Table 1. Comparison of demographic characteristics between the case group and the control group

Variables	without CRPS (n=181) (%)	with CRPS (n=45) (%)	P
Age (years)	69.1 ± 12.7	67.5 ± 13.9	.477
Gender			.115
Male (%)	108 (59.7)	21 (46.7)	
Female (%)	73 (40.3)	24 (53.3)	
Duration of hospitalization	36.6 ±16.2	48.1 ± 21.2	.001*
Stroke type			.393
Ischemic	136 (75.1)	31 (68.9)	
heorrhagic	45 (24.9)	14 (31.1)	
Location of lesion (n=221)a			.015*
Supratentorial	142 (80.2)	42 (95.5)	
Infratentorial	35 (19.8)	2 (4.5)	
Type of paralysis			.869
Hemiplegia	151 (83.4)	38 (84.4)	
Quadriplegia	30 (16.6)	7 (15.6)	
affected side in hemiplegia (n=189)b			.583
Right	68 (45.0)	19 (50.0)	
Left	83 (55.0)	19 (50.0)	
Comorbidities			
Hypertension	137 (75.7)	34 (75.6)	.985
Diabetes mellitus	54 (29.8)	17 (37.8)	.304
Atrial fibrillation	32 (17.8)	8 (17.8)	.999
Coronary artery disease	16 (8.8)	0 (0)	.046*
Dyslipidemia	128 (70.7)	32 (71.1)	.959
Deep vein thrombosis	21 (11.6)	7 (15.6)	.471
Pulmonary thromboembolism	17 (9.4)	6 (13.3)	.417
Depression	20 (11.0)	5 (11.1)	.999

Values are presented frequency(%) or mean (±standard deviation). a. Cases with both supra and infra lesions were excluded. b. Quadriplegia was excluded. Among the total subjects, 205 patients had hemiplegia.

CRPS, complex regional pain syndrome; *P< 0.05.

Table 2. The clinical characteristics of the patients and control groups

Variables	without CRPS (n=181)	with CRPS (n=45)	p
Motricity index - Arm	46.6 ±22.3	30.3 ±17.5	.000*
Motricity index - Leg	44.7 ±21.4	32.2 ±18.4	.000*
FMA-UE (motor)	31.8±25.1	5.1 ±6.7	.000*
FMA-LE (motor)	15.5 ±10.5	6.3 ±5.6	.000*
Grip strength	5.42 ± 12.0	0.0 ±0.0	.000*
Spasticity (%)	23 (12.8)	15 (33.3)	.001*
NIHSS	8.44±5.4	11.40±4.1	.001*
MBI	34.7±24.2	19.16±15.2	.000*
BBS	12.1 ±15.1	2.07 ±3.9	.000*
MMSE	16.9 ±10.0	13.5 ±8.9	.043*
Lab findings			
25(OH)Vitamin D3 (ng/ml) (n= 25) ^o	21.01 ±10.7	15.9 ±8.11	.055
Protein (g/dl)	6.66 ±0.59	6.48 ±0.46	.054
Albumin (g/dl)	3.78 ±0.47	3.62 ±0.39	.045*
FDP (ug/ml)	4.35 ±6.36	6.86 ±10.6	.134
D-dimer (ng/ml)	2.01 ±3.0	3.13 ±4.7	.136

Values are presented mean (±standard deviation). ^o25(OH)Vitamin D3 were performed on 25 subjects.

CRPS, complex regional pain syndrome; FMA-UE/LE, Fugl Meyer Assessment of Upper/Lower Extremity; NIHSS; national Institute fo health stroke scale, MBI, modified barthel index; BBS; berg balance scale, MMSE, mini mental status examination; FDP; fibrinogen/fibrin degratation products; CI; confidential interval. *P< 0.05.

Table 3. Multivariate logistic regression model of factors related to the development of post-stroke CRPS

	p	aOR	95% CI	
Duration of hospitalization	.020*	.953	.915	.992
FMA-U (motor)	.004*	1.139	1.043	1.244
Protein (g/dl)	.028*	4.547	1.177	17.565
NIHSS	.063	1.153	.992	1.341

Nagelkerke R2 = 0.728, Regression model correct percentage = 94.1%.

CRPS, complex regional pain syndrome; aOR, adjusted odds ratio; CI, confidence interval; FMA-UE, Fugl Meyer Assessment of upper extremity; NIHSS, national Institute fo health stroke scale. *P< 0.05.