뇌신경재활

게시일시 및 장소 : 10 월 18 일(금) 13:15-18:00 Room G(3F)

질의응답 일시 및 장소 : 10 월 18 일(금) 15:45-16:30 Room G(3F)

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Voxel-based Lesion-symptom Mapping of Post-stroke Complex Regional Pain Syndrome

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Introduction

Post-stroke complex regional pain syndrome (psCRPS) is characterized by swelling, pain and skin changes that appear on the affected wrist and hand. To date, psCRPS has been reported to be more common in patients with subluxation of the affected shoulder, weaker muscle strength, or less functional recovery. However, there is no study of precise neuroanatomical cerebral structures associated with psCRPS. For these reasons, we aimed to analyze the relationship between psCRPS and lesion location in post-stroke patients through this study.

Methods

Eighty patients with a first-ever unilateral ischemic or hemorrhagic stroke who were admitted to our hospital from 2009 to 2019 and whose scores of Korean version of mini mental status exam (K-MMSE) were or over 15 were included in this retrospective study. Thirty-eight patients who were diagnosed as psCRPS by IASP criteria were included in this retrospective study as an experimental group. They all met Research Diagnostic Criteria for CRPS based on Budapest criteria adopted by the International Association for the Study of Pain (IASP). Remaining forty-two patients who didn't appeal any kind of pain in their upper extremities were defined as a control group. Regions of interest (ROIs) were drawn manually on T1-weighted magnetic resonance images using 3d-slicer software, and data were normalized to a standard brain template in order to examine the neural correlates of psCRPS using voxel-based lesion-symptom mapping analysis. The ROIs of patient who had lesions in the left hemisphere were flipped to the right side. The diagnosis of CPD dichotomized and analyzed by the Liebermeister statistics. In only psCRPS group, the relationship between brain lesion location and the pain severity in Likert scale, from 0 (no pain at all) to 10 (the most severe pain someone can imagine) was recorded as visual analog scale (VAS) and they were entered into generalized linear model as dependent variables. After then, we performed lesion symptom mapping using analysis through generalized linear model. For all tests, we used a P-threshold of 0.01 corrected for multiple comparisons with permutation thresholding (5000 permutations).

Results

Analyses using voxel-wise subtraction and the Liebermeister statistics indicated that lesions of posterior internal capsule were associated with development of psCRPS (Pcorrected = 0.01, Table 2, Figure 1). Statistically significant correlations were found between VAS scores and lesions of cerebral peduncle and posterior internal capsule (Pcorrected = 0.01, Table 3, Figure 2).

Conclusion

Our results suggest that damages to the cerebral peduncle and posterior internal capsule which consists of corticospinal tract are associated with severity of pain induced by psCRPS. Future researches are needed to develop a neuroanatomical model of psCRPS.

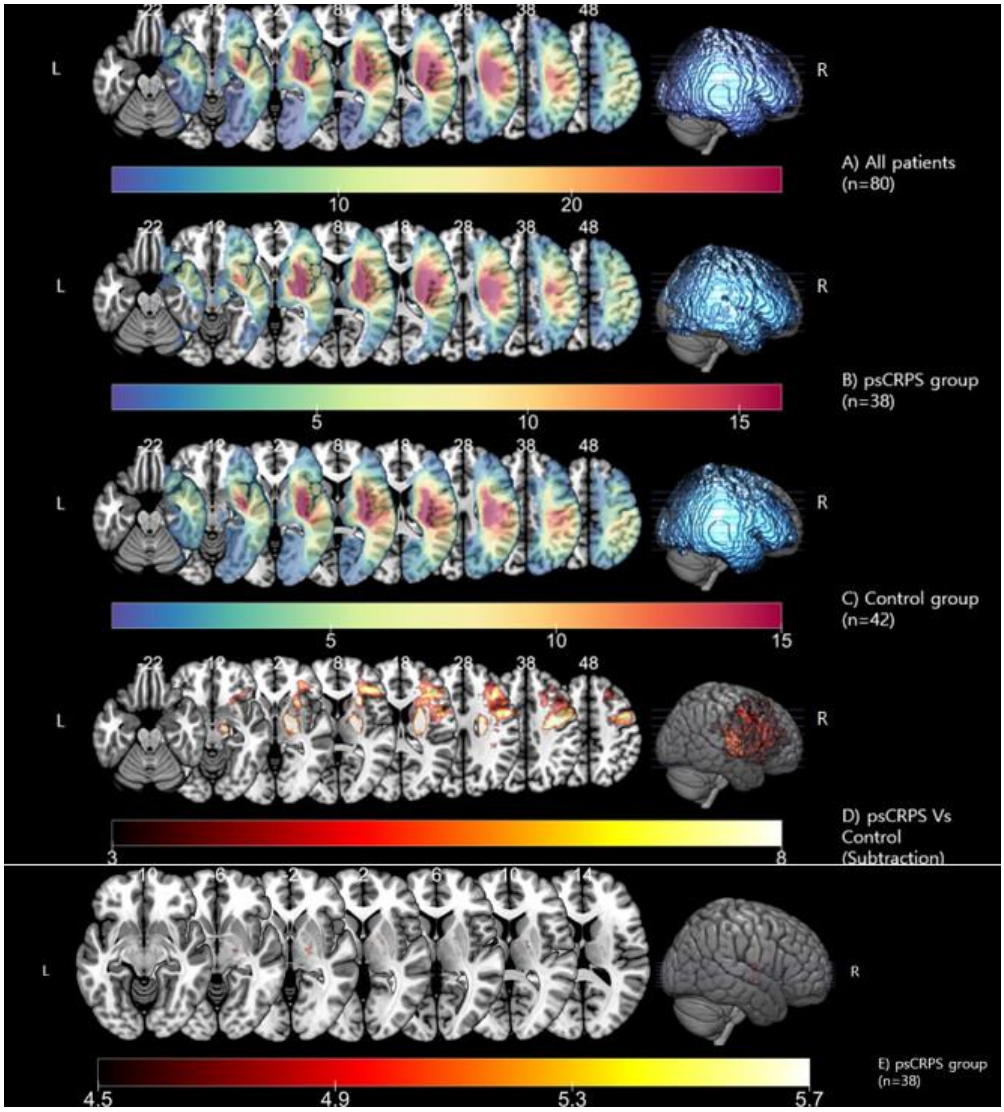

Figure 1. From top to bottom, A) overlay lesion plots for all patients, B) psCRPS group, C) control group, D) CPD group overlay subtracted with control group overlay, and E) Voxel-based lesion-symptom maps showing lesioned areas significantly associated with pain VAS scores (P-threshold of 0.01 corrected for multiple comparisons with 5000 permutation thresholding). Color bars indicate the numbers of lesion overlap of Z-scores. White numbers over slices indicate Montreal Neurological Institute (MNI) z-coordinates.

Table 1. Baseline characteristics of subjects.

	psCRPS group (n=38)	Control group (n=42)	p value
Age (years)	63.3±10.3	62.7±10.9	0.793
Sex (M/F)	21/17	24/18	0.866
Etiology (Hemorrhage/Infarction)	20/18	23/19	0.849
Sides of lesioned hemisphere (Right/Left)	19/19	21/21	1.000
Duration from stroke onset (days)	43.4±28.8	38.1±27.1	0.491
Lesion volume (voxels)	9087.8±10479.4	8346.2±9742.7	0.744
MQS	32.7±10.8	8.2±3.9	**<0.001***

Continuous variables are expressed as mean ± standard deviation. * p<0.05

psCRPS: post-stroke Complex Regional Pain Syndrome, MQS: Medication Quantification Scale

Table 1. Significant regions associated with A) prevalence of psCRPS by Liebermeister statistics, and B) severity of psCRPS by analysis using generalized linear model.

A)

Peak ROI	Peak Z MNI coordinate			Peak Intensity†	Volume	Composition
	x	y	z	(Z-scores)	(voxels)	
Posterior Internal Capsule	18	-6	8	5.42	40	77.5% Posterior Internal Capsule

B)

Peak ROI	Peak Z MNI coordinate			Peak Intensity‡	Volume	Composition
	x	y	z	(Z-scores)	(voxels)	
Posterior Internal Capsule	20	-4	2	5.78	76	65.8% Posterior Internal Capsule; 13.1% Thalamus ; 17.1% Globus Pallidus

Minimum 10 voxels in acquired space.

psCRPS: post-stroke Complex Regional Pain Syndrome, ROI: Region Of Interest

† Liebermeister Z-scores

‡ Z-scores of analysis using generalized linear model