



1, 가 2, 3
1 . 1 . 1 . 1 . 2 . 3 . 1

Correlates of Depression and Anxiety in Acute Stroke Patients

Se Joo Kim M.D.¹, Do Hoon Kim M.D.¹, Nak Kyung Choi M.D.¹, Hyon Chul Kim M.D.¹,
Yoo Sun Moon M.D.², Hung Chul Kim³, and Chan Seung Chung¹

¹Department of Psychiatry, ²Department of Family Medicine, ³Department of Radiology,
Hallym University College of Medicine

Background: This study is aimed at the pathoanatomic correlates of depression and anxiety in acute stroke patients including subcortical lesion(periventricular hyperintensity, deep white matter hyperintensity, subcortical gray matter hyperintensity).

Methods: Sixty nine patients with acute stroke were recruited. Their brain lesions were measured using Brain MRI. Depressive or anxiety symptoms were rated by Beck depression inventory(BDI) or Beck anxiety inventory, respectively.

Results: There were significant correlation between depression and periventricular hyperintensity and deep white matter hyperintensity in acute stroke patients. There are no significant pathoanatomic correlations between anxiety and brain lesions on MRI.

Conclusion: Our findings suggest that the white matter lesion may increase the risk of depression after stroke. Prevention of asymptomatic cerebrovascular lesion could decrease the risk of depression in acute stroke patients as well as the risk of stroke.

Key Words: Acute stroke, Depression, Anxiety, Brain MRI, Subcortical lesion

200-060, 153 (che-
mical imbalance)
: 033-252-9970 가
: 033-244-0317 가
E-mail: dohkim@hallym.ac.kr 가

[HMP-99-N-01-0001]

6.

가

2,3)

가

MRI T2 (subcortical lesion)

4)

(periventricular hyperintensity, PVH), (deep white matter hyperintensity, DWMH)

5)

(subcortical gray matter hyperintensity, SGMH)

4)

가

Grasso

17,18)

6)

(silent infarction)

(silent

19,20)

가

가 7)

가

8)

19,21,22)

Robinson

(anterior pole)

9,10)

11,12)

13,14)

가

가

()

15,16)

8,16)

가

1.

1999 9 2002 6

2
 가
 7 10
 2,
 1)
 가
 1.5T

(signal Horizon Echo Speed, GE medical system)
 T2-weighted (repetition time(TR)
 2000 millisecond; echo time(TE), 100 millise conds) T1
 weighed inversion-recovery; TR, 2000 milliseconds;
 TE 100 milliseconds) orbitomeatal line
 5 mm
 coronal sagittal
 5 mm MRI T1

() MRI T2
 ,
 (perivascular fluid)
 MRI T1
 (PVH)
 0 =absent, 1 =caps or
 pencil-thin lining, 2 =smooth halo, 3 =irregular peri-
 ventricular hyperin- tensity extending into the deep
 white matter (DWMH)
 0 =absent, 1 =punctuate foci, 2 =beginning
 confluence of foci, 3 =large confluent area
 (SGMH) 0 =
 absent, 1 =punctuate, 2 =multipunctate, 3 =diffuse

2) Beck Depression Inventory (BDI)

가 . BDI Beck
 21
 25)
 10
 , 10

3) Beck Anxiety Inventory (BAI)

가 . Beck
 21
 26)
 10
 , 10

가 Fazeka 가
 23,24)
 18) (,)

4) Barthel's Index

Barthel's Index	가		1.		가
	가	가	가	가	
가	10	13 (30.2%)	43 (69.8%)	26 (69.2%)	30
가	0, 5, 10, 15	18 (30.8%)	68 (64.19 ± 9.48)	8 (30.8%)	
가	27)	95	62.86 ± 12.19		
가		95	17 (39.5%)	17 (65.4%)	
가			26 (60.5%)	9 (34.6%)	

5) (Social support system)

가	가	가	25
가	1	5	± 10.25
가		가	2.

(p=0.049, x² test).

65.12 ± 10.35, 62.49

3.

x² test가 Student t-test 가 (Table 1).

(, , , , (Table 2).

test가 x² test Mann-Whitney , , Fazeka , ,

Barthel's index grade 3(odd ratio 11.27, p<0.01), grade 2(odd ratio 7.19, p<0.05), grade 3(odd ratio 5.83, p<0.05), 90 Barthel's index(odd ratio 3.65, p<0.05) 가 ,

tic regression analysis)

SPSS 11.0(window version)

(Table 3).

Table 1. Frequency of brain infarcts in acute stroke patients according to depression

Site	Depressive group	Control group	P- Value*
Frontal lobe ^a			
Absent	43(68.3)	20(31.7)	0.44
Present	5(83.3)	1(16.7)	
Temporal lobe ^a			
Absent	44(72.1)	17(27.9)	0.20
Present	4(50.0)	4(50.0)	
Parietal lobe ^a			
Absent	42(68.9)	19(31.1)	0.72
Present	6(75.0)	2(25.0)	
Occipital lobe ^a			
Absent	40(69.0)	18(31.0)	0.80
Present	8(72.7)	3(27.3)	
Cerebellum ^a			
Absent	37(64.9)	20(35.1)	0.09
Present	11(91.7)	1(8.3)	
Brain stem ^b			
Absent	26(65.0)	14(35.0)	0.43
Present	22(75.9)	7(24.1)	

*Fisher's exact text, ^b Pearson χ^2 test

Table 2. Volumes of brain infarcts in acute stroke patients according to depression

Site	Depressive group Mean \pm SD(mm ³)	Control group Mean \pm SD(mm ³)	P- Value*
Frontal lobe	1047.50 \pm 5633.71	199.52 \pm 914.33	0.46
Temporal lobe	5618.75 \pm 16322.47	847.98 \pm 2837.33	0.68
Parietal lobe	491.02 \pm 1329.42	224.46 \pm 915.76	0.24
Occipital lobe	1309.38 \pm 4976.94	598.57 \pm 1502.40	0.78
Cerebellum	459.68 \pm 1611.65	5387.14 \pm 24686.99	0.09
Brain stem	974.44 \pm 2564.99	5464.16 \pm 24670.05	0.36

*Mann-Whitney test

3.

Table 3. Odds ratios and 95% confidence intervals (CI) for depression after stroke using severity of various brain lesions

Risk factor	Depressive group N=48(69.6%)	Control group N=21(30.4%)	logistic regression model	
			aOR ¹⁾	95%CI
Age group(yrs) ¹⁾				
<65	22(71.0)	9(29.0)	1	-
≥65	26(68.4)	12(31.6)	0.89	0.31 2.55
Sex ²⁾				
male	30(69.8)	13(30.2)	1	-
female	18(69.2)	8(30.8)	1.00	0.34 2.96
PVH				
0	4(36.4)	7(63.6)	1	-
1	3(100)	0(0.0)	-	-
2	21(67.7)	10(32.3)	4.03	0.92 17.66
3	20(83.3)	4(16.7)	11.27**	1.97 64.50
DWMH				
0	6(42.9)	8(57.1)	1	-
1	12(80.0)	3(20.0)	7.19 [†]	1.18 43.83
2	15(78.9)	4(21.1)	5.83 [†]	1.19 28.43
3	15(71.4)	6(28.6)	4.24	0.92 19.51
SGMH				
0	9(69.2)	4(30.8)	1	-
1	6(54.5)	5(45.5)	0.52	0.09 2.83
2	21(75.0)	7(25.0)	1.34	0.31 5.79
3 [†]	12(70.6)	5(29.4)	1.04	0.21 5.13
Total infarct vol.(mm ³)				
0	35(70.0)	15(30.0)	1	-
1 10 ⁴	9(69.2)	4(30.8)	1.91	0.25 3.84
≥ 10 ⁴	4(66.7)	2(33.3)	0.56	0.14 6.00
Barthel's index				
≥90	8(50.0)	8(50.0)	1	-
<90	37(75.5)	12(24.5)	3.65 [†]	1.04 12.83

[†]p<0.05, **p<0.01,

adjusted odds ratio for age and sex except for 'age group' and 'sex'

¹⁾adjusted OR for older age group was calculated adjusting sex

²⁾ adjusted OR for female was calculated adjusting age

Abbreviation; PVH=Periventricular Hyperintensity, 0=absent, 1=caps or pencil-thin lining, 2=smooth halo, 3=irregular periventricular hyperintensity extending into the deep white matter; DWMH=deep white matter hyperintensity;0=absent, 1=punctuate foci, 2=beginning confluence of foci, 3=large confluent area; SGMH =subcortical gray matter hyperintensity, 0=absent, 1=punctuate, 2=mulipunctate, 3=diffuse; Cortical Vol=Cortical Volume, SSS= social support system score

(Table 4).

(Table 5).

, Fazeka

Table 4. Frequency of brain infarcts in patients according to anxiety

Site	Anxiety group	Control group	P- Value
Frontal lobe ^a			
Absent	30(47.6)	33(52.4)	0.37
Present	4(66.7)	2(33.3)	
Temporal lobe ^a			
Absent	30(49.2)	31(50.8)	0.48
Present	5(65.5)	3(37.5)	
Parietal lobe ^a			
Absent	31(50.8)	30(49.2)	0.97
Present	4(50.0)	4(50.0)	
Occipital lobe ^a			
Absent	30(51.7)	28(48.3)	0.51
Present	4(36.4)	7(63.6)	
Cerebellum ^b			
Absent	27(47.4)	30(52.6)	0.54
Present	7(58.3)	5(41.7)	
Brainstem ^b			
Absent	26(65.0)	14(35.0)	0.43
Present	22(75.9)	7(24.1)	

^aFisher's exact test, ^bPearson χ^2 test

Table 5. Volumes of brain infarcts in patients according to anxiety

Site	Anxiety group Mean \pm SD(mm ³)	Control group Mean \pm SD(mm ³)	P- Value [*]
Frontal lobe	1355.59 \pm 6661.40	239.43 \pm 986.76	0.39
Temporal lobe	3753.82 \pm 19383.88	628.50 \pm 2299.87	0.53
Parietal lobe	446.73 \pm 1264.20	374.11 \pm 1188.72	0.96
Occipital lobe	1355.59 \pm 5809.55	838.00 \pm 1700.47	0.39
Cerebellum	402.12 \pm 1666.16	3472.07 \pm 19106.18	0.53
Brainstem	765.25 \pm 2002.43	3518.64 \pm 19098.09	0.72

^{*}Mann-Whitney test

가 , (odd ratio 5.29, p < 0.05) (Table 6)

Barthel's index , 90 Barthel's index

Table 6. Odds ratios and 95% confidence intervals (CI) for anxiety after stroke using severity of various brain lesions

Risk factor	Anxiety group N=34(49.3%)	Control group N=35(50.7%)	logistic regression model	
			aOR ¹⁾	95%CI
Age group(yrs) ¹⁾				
<65	13(41.9)	18(58.1)	1	-
≥65	21(55.3)	17(44.7)	1.41	0.52 3.84
Sex ²⁾				
male	17(39.5)	26(60.5)	1	-
female	17(65.3)	9(34.6)	2.69	0.96 7.59
PVH				
0	5(45.5)	6(54.5)	1	-
1	1(33.3)	2(66.7)	0.60	0.04 9.64
2	14(45.2)	17(54.8)	1.00	0.24 4.20
3	14(58.3)	10(41.7)	1.44	0.31 6.67
DWMH				
0	5(35.7)	9(64.3)	1	-
1	8(53.3)	7(46.7)	1.27	0.25 6.34
2	9(47.4)	10(52.6)	1.33	0.31 5.74
3	12(57.1)	9(42.9)	1.74	0.40 7.52
SGMH				
0	8(61.5)	5(38.5)	1	-
1	6(54.5)	5(45.5)	0.57	0.10 3.13
2	11(39.3)	17(60.7)	0.42	0.11 1.72
3*	9(52.9)	8(47.1)	0.57	0.12 2.64
Total infarct vol.(mm ³)				
0	25(50.0)	25(50.0)	1	-
1 10 ⁴	6(46.2)	7(53.8)	1.04	0.28 3.85
≥ 10 ⁴	3(50.0)	3(50.0)	0.60	0.96 3.81
Barthel's index				
≥90	3(21.4)	13(81.3)	1	-
<90	28(54.9)	21(42.9)	5.29*	1.28 21.90

*p<0.05

adjusted odds ratio for age and sex except for 'age group' and 'sex'

¹⁾adjusted OR for older age group was calculated adjusting sex²⁾ adjusted OR for female was calculated adjusting age

Abbreviation; PVH=Periventricular Hyperintensity, 0=absent, 1=caps or pencil-thin lining, 2=smooth halo, 3=irregular periventricular hyperintensity extending into the deep white matter; DWMH=deep white matter hyperintensity; 0=absent, 1=punctuate foci, 2=beginning confluence of foci, 3=large confluent area; SGMH=subcortical gray matter hyperintensity, 0=absent, 1= punctuate, 2=multipunctate, 3=diffuse; Cortical Vol=Cortical Volume, SSS=social support system score

가 , / , ,)
 33)

가 , (limbic-thalamic-cortical circuit limbic-cortical-striatal-pallidal-thalamic circuit)

34,35)

(white matter lesion) 가

Krishnan 가 가

29), Salloway 가 가

30-32)

(laterality)

Carson 36) 143

Singh 37)

가

Greenwald 9,10-14)

(silent stroke) (, 가

(, 가

가

가

³⁰⁾

Barthel's index가 90

가

(loss)
(threatening)
³⁸⁾

(predispose),

(precipitate),

(perpetuate)

가 (vascular depression hypothesis)
³⁹⁾

가

가

Barthel's index 90

,
(limited de-
pressive ideation),

, (limited de-
(disability)

가

가

가

가

가

가

가

:

(, ,)

가

: 69

(subgroup)

가 , Beck Depression Inventory, Beck
Anxiety Inventory

가

가

:

가

가

:

-
- Neuropsychol Behav Neurol 1999;12:236-46
- 8) Chemerinski E, Robinson RG. The neuropsychiatry of stroke. *Psychosomatics* 2000;41:5-14
 - 9) Robinson RG, Price TR. Post-stroke depressive disorders: A follow-up study of 103 patients. *Stroke* 1982;13:635-41
 - 10) Robinson RG, Kubos KL, Starr LB, Rao K, Price TR. Mood changes in stroke patients: Relationship to lesion location. *Compr Psychiatry* 1983;24:555-66
 - 11) Sinyor D, Jacques P, Kaloupek DB, Becker R, Goldenberg M, Coopersmith HM. Post-stroke depression and lesion location: an attempted replication. *Brain* 1986;109:537-46
 - 12) Sharpe M, Hawton K, House A, Molyneux A, Sandercock P, Bamford J, Warlow C. Mood disorders in long-term survivors of stroke: Associations with brain lesion and volume. *Psychol Med* 1990;20:815-28
 - 13) Dam H, Peterson HE, Ahlgren P. Depression among patients with stroke. *Acta Psychiatr Scand* 1989;80:118-124.
 - 14) Williams JM, Little MM, Klein K. Depression and hemispheric site of cerebral vascular accident. *Arch Clin Neuropsychol* 1986;1:393-8
 - 15) Castillo CS, Schultz SK, Robinson RG. Clinical correlates of early and late-onset post-stroke generalized anxiety. *Am J Psychiatry* 1995;152:1172-9
 - 16) Astrom M. Generalized anxiety disorder in stroke patients: A 3-year longitudinal study. *Stroke* 1996;27:270-5
 - 17) Krishnan KR, Hays JC, George LK, Blazer DG. Six-month outcomes for MRI-related vascular depression. *Depress Anxiety* 1998;8:142-6
 - 18) Vataja R, Pohjasvaara T, Leppavuori A, Mantyla R, Aronen HJ, Salonen O, Kaste M, Erkinjuntti T. Neuropsychol Behav Neurol 1999;12:236-46
 - 1) Hershey L, Jaffe D, Greenough P, Yang S. Validation of cognitive and functional assessment instruments in vascular dementia. *Int J Psychiatry Med* 1987;17:183-92
 - 2) King RB. Quality of life after stroke. *Stroke* 1996;27:1467-72
 - 3) Clark MS, Smith DS. Abnormal illness behavior in rehabilitation from stroke. *Clin Rehabil* 1995;11:162-170
 - 4) Herrmann M, Bartels C, Schumacher M, Wallesch C-W. Poststroke depression: Is there a pathoanatomic correlate for depression in the postacute stage of stroke? *Stroke* 1995;26:850-6
 - 5) Barry S, Dinan TG. Alpha-2 adrenergic receptor function in poststroke depression. *Psychol Med* 1990;20:305-9
 - 6) Grasso MG, Pantano P, Ricci M, Iniso DF, Pace A, Padovani A, Orzi F, Pozzili C, Lenzi GL. Mesial temporal cortex hypoperfusion is associated with depression in subcortical stroke. *Stroke* 1994;25:980-985
 - 7) Beblo T, Wallesch C, Herrmann M. The crucial role of frontostriatal circuits for depressive disorders in the postacute stage after stroke. *Neuropsychiatry,*

- Magnetic resonance imaging correlates of depression after ischemic stroke. *Arch Gen Psychiatry* 2001;58:925-931
- 19) Masuda J, Nabika T, Notsu Y: Silent stroke: Pathogenesis, genetic factors and clinical implications as a risk factor. *Curr Opin Neurol* 2001;14:77-82
- 20) Steffens DC, Krishnan KR. Structural neuroimaging and mood disorders: Recent findings, implications for classification, and future directions. *Biol Psychiatry* 1998;43:705-712
- 21) Fujikawa T, Yamawaki S, Touhoda YI. Incidence of silent cerebral infarction in patients with major depression. *Stroke* 1993;24:1631-4
- 22) Krishnan KR. Depression as a contributing factor in cerebrovascular disease. *Am Heart J* 2000;140:70-6
- 23) Fazekas F. Magnetic resonance signal abnormalities in asymptomatic individuals: their incidence and functional correlates. *Eur Neurol* 1989;29:164-8
- 24) Schmidt R, Fazekas F, Kleinert G, Offenbacher H, Gindl K, Payer F, Freidl W, Niederkorn K, Lechner H. Magnetic resonance imaging signal hyperintensities in the deep and subcortical white matter. A comparative study between stroke patients and normal volunteers. *Arch Neurol* 1992;49:825-7
- 25) Beck's Depression Inventory (1). 1986;24:487-502
- 26) Beck Anxiety Inventory 1997;16(1):185-97
- 27) Mahoney FBD. Functional evaluation: The Barthel Index. *Md State Med J* 1965;14:61-5
- 28) 1985
- 29) Krishnan KR, McDonald WM, Doraiswamy PM, Tupler LA, Husain M, Boyko OB, Figiel GS, Ellinwood EHJ. Neuroanatomical substrates of depression in the elderly. *Eur Arch Psychiatry Clin Neurosci* 1993;243:41-6
- 30) Salloway S, Malloy P, Kohn R, Gillard E, Duffy J, Rogg J, Tung G, Richardson E, Thomas C, Westlake R. MRI and neuropsychological differences in early- and late-onset geriatric depression. *Am J Neurology* 1996;46:1567-74
- 31) Coffey CE, Figiel GS, Djang WT, Weiner RD. Subcortical hyperintensity on magnetic resonance imaging: A comparison of normal and depressed elderly subjects. *The American Journal of Psychiatry* 1990;147:187-9
- 32) Zubenko GS, Sullivan P, Nelson JP, Belle SH, Huff FJ, Wolf GL. Brain imaging abnormalities in mental disorders of late life. *Archives of Neurology* 1990;47:1107-11
- 33) Greenwald BS, Kramer-Ginsberg E, Krishnan KR, Ashtari M, Auerbach C, Patel M. Neuroanatomic localization of magnetic resonance imaging signal hyperintensities in geriatric depression. *Stroke* 1998;29:613-7
- 34) Soares JC, Mann JJ. The anatomy of mood disorders-review of structural neuroimaging studies. *Biol Psychiatry* 1997;41:86-106
- 35) Tupler LA, Krishnan KR, McDonald WM, Dombek CB, D'Souza S, Steffens DC. Anatomic location and laterality of MRI signal hyperintensities in late-life depression. *J Psychosom Res* 2002;53:665-76

- 36) Carson AJ, MacHale S, Allen K, Lawrie SM, Dennis M, House A, Sharpe M. Depression after stroke and lesion location: A systematic review. *Lancet* 2000;356:122-6
- 37) Singh A, Herrmann N, Black SE. The importance of lesion location in poststroke depression: A critical review. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie* 1998;43:921-7
- 38) Finlay-Jones R, Brown G. Types of stressful life event and the onset of anxiety and depressive disorders. *Psychol Med* 1981;11:803-15
- 39) Alexopoulos GS, Meyers BS, Young RC, Campbell S, Silbersweig D, Charlson M. 'Vascular depression' hypothesis. *Arch Gen Psychiatry* 1997; 54:915-22