

## ORIGINAL ARTICLE

## A Pilot Study on the Correlation of Tongue Manifestation with the Site of Cerebral Infarction in Patients with Stroke\*

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**ABSTRACT** **Objective:** To discuss the correlation of tongue manifestation with the site of cerebral infarction in patients with acute cerebral infarction. **Methods:** From March 2008 to February 2009, 200 cases of hospitalized patients with first unilateral cerebral infarction were chosen in the Department of Neurology, Xuanwu Hospital. The correlation of different tongue color, fur texture, fur color with the site of cerebral infarction was analyzed. **Results:** The site of cerebral infarction in patients were compared between different tongue color by Chi-square test ( $P=0.314$ ), and further correspondence analysis demonstrated that there was correlation between red tongue and cortical-subcortical infarction group. The site of cerebral infarction in patients were compared between thick fur group and thin fur group, cortical-subcortical infarction occurred more frequently in the former ( $P=0.0008$ ). The site of cerebral infarction in patients were compared between dry fur group, moist fur group and smooth fur group, correspondence analysis demonstrated there was correlation between dry fur and cortical-subcortical group. The site of cerebral infarction in the patients were compared between white fur group, white-yellow fur group and yellow fur group ( $P=0.010$ ), and correspondence analysis demonstrated there was correlation between white fur and brainstem infarction; white-yellow fur has relationship with cortical infarction; subcortical infarction was weakly related with white-yellow fur; there was closer relationship between yellow fur and cortical-subcortical infarction. **Conclusion:** The change of tongue manifestation was associated with the site of cerebral infarction in patients, providing a new combining site for diagnosing cerebrovascular diseases by integrative medicine.

**KEYWORDS** cerebral infarction, tongue manifestation, fur color, fur texture, Chinese medicine

Tongue inspection is a kind of diagnostic method achieved by observing tongue fur, texture, and sublingual vein in patients. With a long history, tongue inspection was recorded in *Inner Canon of Yellow Emperor* (Huang Di Nei Jing) at the early age of 2,000 years ago, "patients with pyretic pulmonary disease appears...yellow fur."<sup>(1)</sup> And *Synopsis of Golden Chamber* (Jin Gui Yao Lue) described, "if patient appears fullness in chest, withered lips, bluish purple tongue etc, diagnosis of blood stasis can be made with high certainty."<sup>(2)</sup> It has long been recognized that changes of tongue manifestation are closely related to diseases,<sup>(3-12)</sup> and to the stage, the severity for epidemic and digestive diseases.<sup>(3-5)</sup> As an assistant method, with the help in diagnosing, observing disease progression, evaluating prognosis, determining clinical stages, and guiding dialectical treatment, it can be applied to cardiovascular, chronic disease, and tumor.<sup>(6-9)</sup> The study on sublingual vein suggested that tongue manifestation be of higher value on diagnosing blood stasis kind diseases such

as diabetes, hepatopathy, pneumocardial disease, tumor, etc.<sup>(10-12)</sup> Resent years, the studies about tongue manifestation changes of cerebral infarction are focus on the relationship between tongue manifestation and the stage of cerebral infarction,<sup>(13-17)</sup> seldom on the correlation between tongue manifestations and

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laboratory indices,<sup>(18)</sup> and there are few studies about the relationship between tongue manifestation and the site of cerebral infarction in the patients with acute cerebral infarction (ACI). This essay preliminarily investigated the relationship between tongue manifestation and the site of cerebral infarction in patients in order to provide a new combining site for researching cerebrovascular disease by integrative medicine.

## METHODS

### Patients Selection

A total of 200 cases of middle-aged and aged patients with first unilateral cerebral infarction in the Department of Neurology, Xuanwu Hospital affiliated to Capital Medical University (Beijing, China) from March 2008 to February 2009 were recruited in this study. All patients were examined by magnetic resonance imaging (MRI) and diffusion weighted imaging (DWI).

### Diagnostic Criteria

#### Diagnostic Criteria of Western Medicine on Cerebral Infarction

In the light of Diagnostic Criteria of Various Types of Cerebrovascular Disease<sup>(19)</sup> and China Guideline for Cerebrovascular Disease Prevention and Treatment,<sup>(20)</sup> the location of cerebral infarction were determined by MRI and DWI.

#### Diagnostic Criteria of Chinese Medicine on Stroke

It is referred to Standard for Diagnosis and Therapeutic Effect Evaluation of Stroke drafted by the Collaborative Group of Acute Encephalopathy Affiliated to State Administration of Traditional Chinese Medicine of China by 1996.<sup>(21)</sup>

#### Criteria of Judgement on Tongue Manifestation

At present no criterion is generally accepted for quantitative analysis and classification for tongue manifestation, therefore we determine the classification by referring to the features of tongue manifestation described in a nationally planned textbook —Diagnostics of Chinese Medicine<sup>(22)</sup> chiefly edited by Prof. ZHU Wen-feng for higher education of "Eleventh Five-year Plan", and the pictures from tongue manifestation database available to the professionals in image-analysis system of tongue manifestation developed by Shanghai University of Traditional Chinese Medicine,<sup>(23)</sup> and clinical significance and appeared frequency of tongue

manifestation observed in clinic practice. Accordingly, tongue manifestation was classified as follows: 5 kinds of tongue colors: pale, pink, red, dark-red, and bluish purple (including entirely bluish purple, or obvious ecchymosis, or petechia appeared on the tongue); 3 kinds of lingual contours: plump or teeth-printed, normal or thin, and fissured; 6 kinds of fur textures: thin, thick, slippery, moist, dry, and greasy; and 3 kinds of fur colors: white, white-yellow (yellow appeared evenly on the white fur), and yellow.

### Inclusion and Exclusion Criteria

The patients included in the study met the following criteria: (1) in accordance with the diagnostic criteria; (2) onsets within 7 days; (3) aged from 40 to 85, irrespective of gender; (4) score from 7 to 20 on National Institutes of Health Stroke Scale (NIHSS),<sup>(24)</sup> (5) internal carotid artery system or vertebral basilar system infarction; (6) informed consent before participating in this study, which was approved by the local ethics committee.

The patients excluded from the study were those who were: (1) with transient ischemic attack (TIA); (2) with apoplexy caused by brain tumor, cerebral trauma, or hematologic disease confirmed by auxiliary examination; (3) having psychosis or osteoarthritis that influences nervous system functional assessment; (4) suffering from concurrent infection, hyperpyrexia, serious liver and kidney dysfunction, as well as diseases of hematopoietic and endocrine system.

### Observation Methods of Tongue Manifestation

The tongue manifestation were checked by two independent assessors who had abundant clinical experience of Chinese medicine (CM) and one was chief physician of CM. For examination of tongue manifestation the patients were prohibited from food of dyeing-tongue and asked to gargle after breakfast next morning. At the next 9:00–10:00 a.m. after hospitalization, patients were advised to face to the light, sitting up or lying on the back and open mouth to put out tongue naturally. The fur color and fur texture were examined twice, each observation undertaking within 30 s with an interval of 2–3 min between the two. Tongue pictures were taken by Panasonic DMC-LX1 digital camera in micro-distance photography pattern as a record for three levels ward round to estimate tongue manifestation.

**Statistical Analysis**

All data were analyzed by SPSS 11.5 software package for windows and adopted two-sided test at a common level of significance  $\alpha=0.05$ . Enumeration data were analyzed statistically by  $\chi^2$ -test and correspondence analysis. The statistical difference were accepted as  $P<0.05$ .

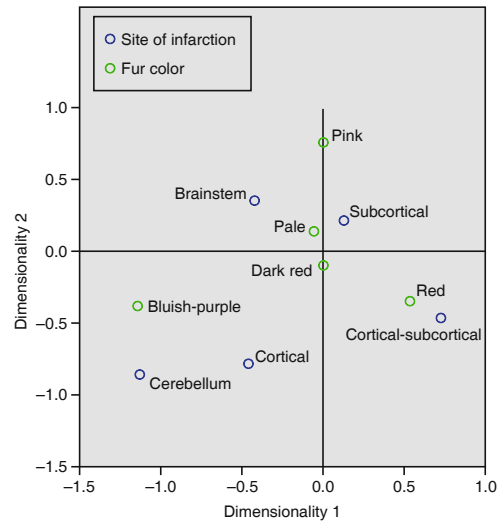
**RESULTS**

**General Information of Enrolled Cases**

A total of 200 patients were enrolled, aged 40–83 years with a mean of  $59.89 \pm 10.79$  years, 156 being males and 44 females. The patients were subjected to examination of tongue manifestation, and revealed a distribution as follows: 41 patients in the group of pink tongue (20.5%), 15 patients in the group of pale tongue (7.5%), 50 patients in the group of red tongue (25.0%), 72 patients in the group of dark-red tongue (36.0%), 22 patients in the group of bluish-purple tongue (11.0%); 117 patients in the group of thick fur (58.5%), 83 in the group of thin fur (41.5%); 19 in the group of slippery fur (9.5%), 137 in the group of moist fur (68.5%), 44 in the group of dry fur (22.0%); 149 in the group of greasy fur (74.5%), 51 in the group of non-greasy fur (25.5%); 75 in the group of white fur (37.5%), 80 in the group of white-yellow fur (40.0%), and 45 in the group of yellow fur (22.5%).

**Tongue Color and the Site of Cerebral Infarction in ACI Patients**

By Chi-square test, the site of cerebral infarction in patients from different tongue color groups were compared ( $P=0.314$ ), and by correspondence analysis the scattered points of red tongue were closer to that of cortical-subcortical infarction group, and both regions of scattered points were farther from the original point, suggesting there was relationship between them (Table 1 and Figure 1). And from Table 1, we can see that in 50 cases with red tongue,



**Figure 1. Correspondence Analysis of Tongue Color and the Site of ACI**

cortical-subcortical occupied 12 cases.

**Fur Texture and the Site of Cerebral Infarction in ACI Patients**

The site of cerebral infarction in patients from different fur texture groups was analyzed by Chi-square test, revealing significant difference in the site of cerebral infarction between thick and thin fur group. Further analyses demonstrated that cortical-subcortical infarction occurred frequently in thick fur group was higher than that in thin group, showing significant statistical difference ( $P=0.0008$ , Table 2). By Chi-square test the site of cerebral infarction in patients from moist, greasy, and dry fur groups were determined ( $P=0.291$ ), and by correspondence analysis the scattered points of dry fur and that of cortical-subcortical infarction groups were closer, and both regions were farther from the original point, suggesting relationship existed between dry fur and cortical-subcortical infarction (Table 3 and Figure 2). And from Table 3, we can see that in 44 cases with red tongue, cortical-subcortical occupied 12 cases.

**Table 1. Comparing the Site of Cerebral Infarction with Tongue Colors in Patients with ACI [Case (%)]**

Group	Cortical	Subcortical	Cortical-subcortical	Brainstem	Cerebellum	Total
Pink	1 (2.4)	24 (58.5)	4 (9.8)	11 (26.8)	1 (2.4)	41
Pale	2 (13.3)	7 (46.7)	2 (13.3)	4 (26.7)	0 (0)	15
Red	4 (8.0)	26 (52.0)	12 (24.0)*	6 (12.0)	2 (4.0)	50
Dark-red	5 (6.9)	31 (43.1)	14 (19.4)	18 (25.0)	4 (5.6)	72
Bluish-purple	3 (13.6)	9 (40.9)	1 (4.5)	6 (27.3)	3 (13.6)	22
Total	15	97	33	45	10	200

Notes: Chi-square test:  $\chi^2=18.18$ ,  $P=0.314$ . \*Red tongue group had correlation with cortical-subcortical group

**Table 2. Comparing the Site of Cerebral Infarction in Patients of the Thick and Thin Fur Groups [ Case (%) ]**

Group	Cortical	Subcortical	Cortical-subcortical	Brainstem	Cerebellum
Thin fur	3 (3.6)	46 (55.4)	5 (6.0)	25 (30.1)	4 (4.8)
Thick fur	12 (10.3)	51 (43.6)	28 (23.9)*	20 (17.1)	6 (5.1)

Notes: Chi-square test:  $\chi^2=17.37$ ,  $P=0.002$ , \* $P=0.0008$ , compared with thin fur group

**Table 3. Comparing the Site of Cerebral Infarction in Patients of the Moist, Greasy, and Dry Fur Groups [Case (%) ]**

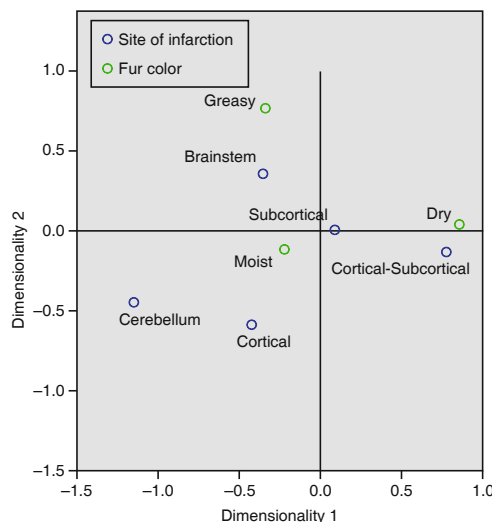
Group	Cortical	Subcortical	Cortical-subcortical	Brainstem	Cerebellum	Total
Moist fur	12 (8.8)	65 (47.4)	19 (13.9)	32 (23.4)	9 (6.6)	137
Greasy fur	1 (5.3)	9 (47.4)	2 (10.5)	6 (31.6)	1 (5.3)	19
Dry fur	2 (4.5)	23 (52.3)	12 (27.3)*	7 (15.9)	0 (0)	44
Total	15	97	33	45	10	200

Notes: Chi-square test:  $\chi^2=9.64$ ,  $P=0.291$ . \*Dry fur group had correlation with cortical-subcortical group

**Table 4. Comparing the Site of Cerebral Infarction in Patients of the White, White-Yellow, or Yellow Fur Groups [Case (%) ]**

Group	Cortical	Subcortical	Cortical-subcortical	Brainstem	Cerebellum	Total
White fur	5 (6.7)	33 (44.0)	7 (9.3)	24 (32.0)*	6 (8.0)	75
White-yellow fur	7 (8.8) <sup>△</sup>	43 (53.8)	12 (15.0)	17 (21.3)	1 (1.3)	80
Yellow fur	3 (6.7)	21 (46.7)	14 (31.1) <sup>▲</sup>	4 (8.9)	3 (6.7)	45
Total	15	97	33	45	10	200

Notes: Chi-square test:  $\chi^2=19.96$ ,  $P=0.010$ . \*White fur group had correlation with brainstem group, <sup>△</sup>white-yellow fur group had correlation with cortical group, <sup>▲</sup>yellow fur group had correlation with cortical-subcortical group



**Figure 2. Correspondence Analysis of Dry, Moist Greasy Fur and the Site of ACI**

**Fur Color and the Site of Cerebral Infarction in ACI Patients**

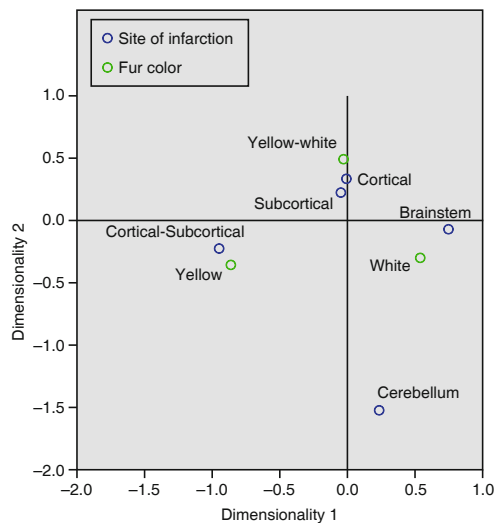
The site of cerebral infarction in patients from different fur color groups were compared by Chi-square test ( $P=0.010$ ), and by correspondence analysis the scattered points of white fur and that of brainstem group were closer and further from the original point, suggesting there was relationship

between them; the scattered points of white-yellow fur were closer to that of the cortical infarction group, suggesting there was relationship between them; the scattered points of white-yellow fur and that of subcortical infarction were closer but the latter was closer to the original point, which suggested subcortical infarction had weakly relationship with white-yellow fur; the scattered points of yellow fur were very close to that of the cortical-subcortical group and both regions were farther from the original point, suggesting there was closer relationship between them (Table 4 and Figure 3).

**DISCUSSION**

Concerning tongue color, red and dark red tongue appeared most frequently (36.0% and 25.0%, respectively) in the patients with ACI, the formation mechanism of which mainly lies in tongue epithelium atrophied, thinned, or its vessel dilated and congested, and by the theory of CM they are mainly seen in heat syndrome.

Concerning tongue body, the frequency of plump and teeth-printed tongue is 91.5%, suggesting there might be qi deficiency or dampness-fluid retention



**Figure 3. Correspondence Analysis of Fur Color and the Site of ACI**

in patients before cerebral infarction. In our study the frequency of fissured tongue is 51.5%, in normal elders the morbidity of fissured tongue is 8.2% reported by Cao, et al,<sup>(25)</sup> 2% reported by Yang, et al<sup>(26)</sup> and 40% in patients with cerebral infarction in other research. The frequency of fissured tongue in our report is higher than that of the formers, to which might be related with disease nature, the nature of cerebral infarction is deficiency in origin, that is, deficiency in yin-fluid, in blood, or in Stomach (Wei) qi before episode, additionally heat syndrome appeared in most patients at the acute stage, which can damage fluid and cause excessive yin-fluid consumption thereby tongue cracked.

Regarding to tongue fur, the frequency of greasy fur is 74.5%, thick fur 58.5%, suggesting disturbed circulation of qi and blood and abundant pathogenic factors obviously exist in patients with cerebral infarction at acute stage, and phlegmatic hygrois occurred frequently. The frequency of moist fur is 68.5%, slippery fur 9.5%, dry fur 22.0%, suggesting deficiency of Spleen (Pi) and Stomach qi exists in most patients with cerebral infarction in normal time, though heat syndrome appeared in most patients, but in which their body fluid unimpaired. On fur color, the frequency of white-yellow fur is 40.0%, white fur 37.5%, yellow fur 22.5%, which demonstrates white-yellow fur can be seen in the majorities at acute stage, suggesting interior heat syndrome mostly appears in patients with cerebral infarction at acute stage seldom at severe stage.

In conclusion, most patients with cerebral

infarction at acute stage demonstrate red or dark red, plump or teeth-printed tongue, thick-greasy or white-yellow fur, suggesting phlegm-heat and blood stasis are commonly seen in patients with ACI.

On tongue manifestation, by correspondence analysis we found that red tongue and dry fur have relationships with cortical-subcortical infarction, suggesting that red tongue or/and dry fur indicate cortical-subcortical infarction existed in the patients. Patients with cortical-subcortical infarction had comparatively large cerebral infarction volum, severe inflammatory reaction, obvious heat syndrome, it was accordance to previous study.<sup>(27)</sup>

By correspondence analysis on fur color, we found there was relationship between white fur and brainstem infarction, between white-yellow fur and subcortical infarction, and yellow fur has closer relationship with cortical-subcortical infarction, suggesting white, white-yellow, yellow fur respectively indicate brainstem, subcortical, and cortical-subcortical infarction existed in the patients. On fur texture, by Chi-square test we found the frequency of cortical-subcortical infarction in the thick fur group was higher than that in the thin fur group. Briefly, the appearance of red, dry, yellow and thick fur indicates cortical-subcortical infarction in most cases, which might be related to that the patients of this kind usually with large infarction size and severe inflammatory reaction.

This essay is limited from small stratified sample, and its credibility would be enhanced if we increase the sample size. Furthermore, the pathogenetic condition of enrolled cases was relative light, and there was no death, critically ill patients should be included in the next step.

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