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Differences in Clinical Indicators and Related Research between Patients with Internal Carotid Artery Insufficiency and Cerebral Artery Insufficiency

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ABSTRACT

Objective: To deeply analyze the differences in multiple clinical indicators between patients with internal carotid artery insufficiency and cerebral artery insufficiency, and provide a strong basis for clinical accurate differential diagnosis and the formulation of personalized treatment plans. Methods: From January to December 2024, 75 patients with internal carotid artery insufficiency and 40 patients with cerebral artery insufficiency were collected in Rongxian Traditional Chinese Medicine Hospital. A comprehensive detection of clinical indicators was carried out for all patients, covering blood routine, CRP, liver and kidney function, blood glucose, blood lipids, electrolytes, calcium and magnesium, hemorheology, and coagulation function. SPSS 22.0 software was used for statistical analysis of the data. The t-test was used for measurement data, and the χ^2-test was used for counting data. P < 0.05 was used as the standard for statistical significance of differences. Results: There were significant differences between the two groups of patients in terms of age, some blood lipid indices (the levels of LDL, TC, and HDL in the cerebral artery insufficiency group were all higher than those in the internal carotid artery insufficiency group), and some coagulation function indices (FIB and INR increased in the cerebral artery insufficiency group). However, there were no significant differences in most indices such as blood routine, CRP, liver and kidney functions, blood glucose, electrolytes, PT, TT, APTT, calcium and magnesium, and hemorheology. Conclusion: There are significant differences in some key clinical indicators between patients with internal carotid artery insufficiency and cerebral artery insufficiency, and these differences have important

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guiding value for clinical diagnosis and treatment.

1. INTRODUCTION

Arterial insufficiency, a common type of cerebrovascular disease, seriously threatens human health [1]. Among them, internal carotid artery insufficiency and cerebral artery insufficiency have certain similarities in clinical manifestations, both of which may cause symptoms such as dizziness, headache, and limb weakness. However, their pathogenesis and affected areas are significantly different [2, 3].

The internal carotid artery is mainly responsible for the blood supply to the anterior two-thirds of the cerebral hemisphere and part of the diencephalon. Its insufficiency is often closely related to atherosclerosis [4]. With the increase of age and the long-term effects of bad living habits (such as high-fat diet, smoking, etc.), lipid deposition and plaque formation gradually occur in the vascular wall of the internal carotid artery, leading to vascular stenosis and thus affecting cerebral blood perfusion [5, 6]. Cerebral artery insufficiency is more complex and involves multiple factors, including cerebral small vessel disease, vasospasm, and hemodynamic abnormalities [7, 8]. Accurately differentiating these two states of insufficiency is of great significance for formulating precise treatment plans and improving the prognosis of patients [4, 9]. See **Figure 1(A)-(D)** for carotid artery insufficiency and cerebral artery insufficiency.

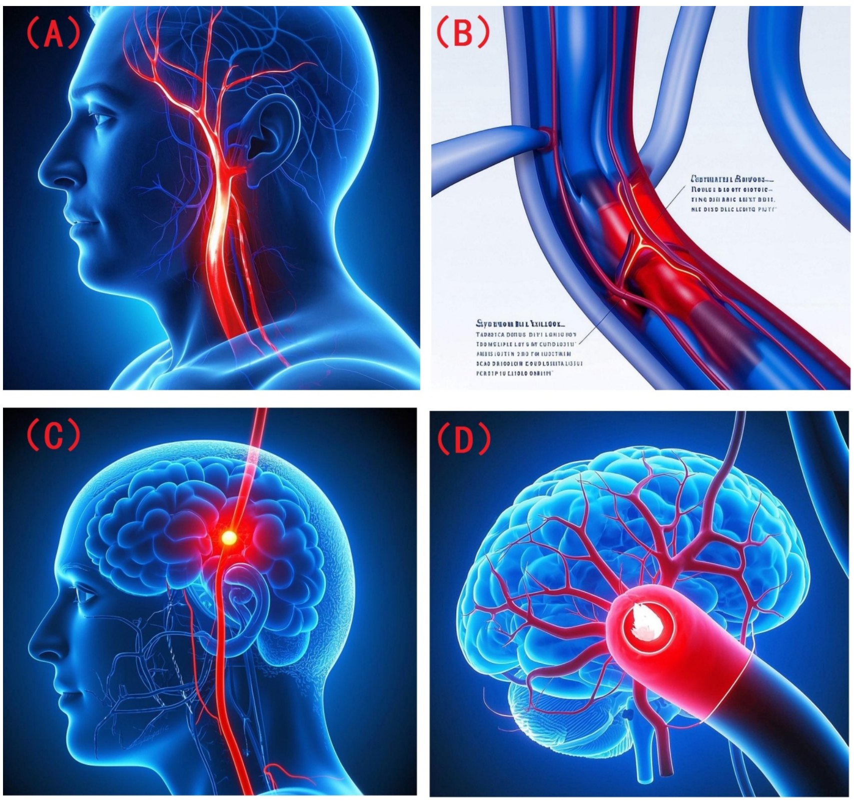

Figure 1. Schematic diagrams. (A) and (B) are schematic diagrams of carotid artery insufficiency; (C) and (D) are schematic diagrams of cerebral artery insufficiency.

Through in-depth analysis of patients' clinical indicators, the characteristics of the disease can be understood more comprehensively and accurately. Clinical indicators not only reflect the current physical condition of patients but also may provide important clues for the early diagnosis, disease monitoring, and treatment effect evaluation of the disease [10, 11]. However, at present, the research on the comprehensive comparison of clinical indicators between patients with internal carotid artery insufficiency and cerebral artery insufficiency is relatively scarce [12, 13]. Most studies only focus on a single or a few indicators, making it difficult to reveal the differences and potential associations between the two as a whole. This study aims to fill this gap. By systematically detecting multiple clinical indicators such as blood routine, CRP, liver and kidney function, blood glucose, blood lipids, electrolytes, calcium and magnesium, hemorheology, and coagulation function, this study deeply explores the differences in indicators between patients in the two states of insufficiency, provides a more comprehensive and reliable theoretical basis for clinical practice, and helps improve the diagnosis and treatment level of cerebrovascular diseases.

2. MATERIALS AND METHODS

2.1. Specimen Source

From January to December 2024, 75 patients with internal carotid artery insufficiency and 40 patients with cerebral artery insufficiency who visited Rongxian Traditional Chinese Medicine Hospital were selected. Inclusion criteria: diagnosed by clinical symptoms, imaging, etc.; aged over 18 years old. Exclusion criteria: Combined with severe dysfunction of vital organs such as the heart, liver, lungs, and kidneys (For the heart, NYHA Classes III - IV or LVEF less than 35%; for the liver, ALT and AST more than 5 times the upper limit of normal, TBIL more than 3 times with jaundice, ALB less than 30 g/L, INR > 2.0 or PT prolonged by more than 5 seconds; for the lungs, FEV1% less than 30% or FEV1/FVC < 50% accompanied by dyspnea, PaO_2 < 60 mmHg, etc.; for the kidneys, Scr more than 442 μmol/L, GFR less than 15 ml/min/1.73m^2, etc.).; with a history of major surgery or trauma in the recent period; suffering from blood system diseases and other diseases that affect the detection indicators.

2.2. Detection Indicators and Methods

Fasting venous blood of patients was collected to detect blood routine (WBC, NEUT#, LYMPH#, RBC, HGB, PLT, HCT, MCV, MCH, MCHC), CRP, liver function (TBIL, DBIL, IBIL, ALT, AST, AST/ALT, TP, ALB, GLO, A/G, PA, TBA, ALP, GGT, CHE), kidney function (CREA, UREA, UA), blood glucose (GLU), blood lipids (TC, TG, HDL, LDL), electrolytes (K, NA, CL), calcium and magnesium (CA, Mg), hemorheology (whole blood viscosity at different shear rates, plasma viscosity, hematocrit), and coagulation function (PT, INR, TT, APTT, FIB). The [specific instrument model] was used for detection, and the operation procedures were strictly followed.

2.3. Statistical Analysis

SPSS 27.0 software was used to analyze the data. Measurement data were expressed as mean ± standard deviation (x ± s), and the t-test was used for comparison between groups; counting data were expressed as the number of cases and percentages, and the χ^2-test was used for comparison between groups. P < 0.05 was considered as having statistical significance.

3. RESULTS

3.1. General Information

In this study, a total of 75 patients were included in the internal carotid artery insufficiency group, with a mean age of 59.89 ± 12.53 years old, including 35 males and 40 females; 40 patients were included in the cerebral artery insufficiency group, with a mean age of 54.45 ± 15.14 years old, including 12 males and 28 females. Statistical analysis showed that there was a significant difference in age between the two groups (t = 2.0600, P = 0.0216), while there was no significant difference in gender composition (χ^2 = 2.9985, P = 0.0833). The relevant data are shown in **Table 1**.

Table 1. **Comparison of general information between the two groups.**

Group	Number of Cases	Age	Gender			
			Male	Female	χ^2 value	P value
Internal carotid artery insufficiency group	75	59.89 ± 12.53	35	40	0.6667	0.4142
Cerebral artery insufficiency group	40	54.45 ± 15.14	12	28	12.8000	0.0003
t value or χ^2 value	—	2.0600	2.9985		—	—
P value	—	0.0216	0.0833		—	—

3.2. Blood Routine Indicators

In the detection of various blood routine indicators, there were no significant differences in indicators such as WBC, NEUT#, LYMPH#, RBC, HGB, PLT, HCT, MCV, MCH, and MCHC between the internal carotid artery insufficiency group and the cerebral artery insufficiency group (P > 0.05 for all). The specific detection results are shown in **Table 2**.

Table 2. **Comparison of detection results of various blood routine indicators between the two groups.**

Group	Number of Cases	WBC	NEUT#	LYMPH#	RBC	HGB	PLT	HCT	MCV	MCH	MCHC
Internal carotid artery insufficiency group	75	6.82 ± 2.31	4.20 ± 2.14	1.95 ± 0.61	4.79 ± 0.81	128.80 ± 17.72	273.21 ± 59.28	39.3 ± 4.98	83.23 ± 10.92	27.33 ± 4.25	327.27 ± 10.85
Cerebral artery insufficiency group	40	6.83 ± 3.26	4.15 ± 2.86	2.00 ± 0.60	4.81 ± 0.72	132.80 ± 16.81	258.05 ± 65.72	40.51 ± 4.94	85.16 ± 9.98	28.00 ± 3.85	328.05 ± 10.92
t value	—	0.0172	0.0970	0.4210	0.1309	1.1734	1.2574	1.2444	0.9295	0.8313	0.3664
P value	—	0.4932	0.4615	0.3374	0.4481	0.1220	0.1063	0.1085	0.1776	0.2040	0.3575

3.3. CRP Indicators

In this study, 45 patients were included in the internal carotid artery insufficiency group, and the CRP of this group was 6.67 ± 18.87; 22 patients were included in the cerebral artery insufficiency group, and the CRP of this group was 13.05 ± 31.80. Calculation showed that there was no significant difference in CRP between the two groups (t = 0.8692, P = 0.1961). The relevant data are shown in **Table 3**.

Table 3. Comparison of CRP detection results between the two groups.

Group	Number of Cases	CRP
Internal carotid artery insufficiency group	45	6.67 ± 18.87
Cerebral artery insufficiency group	22	13.05 ± 31.80
t value	—	0.8692
P value	—	0.1961

3.4. Liver Function Indicators

In this study, 75 patients were included in the internal carotid artery insufficiency group, and 40 patients were included in the cerebral artery insufficiency group. In the detection of various liver function indicators, there were differences in indicators such as TP, ALB, GLO, and A/G between the cerebral artery insufficiency group and the internal carotid artery insufficiency group ($P < 0.05$), while there was no significant difference in the remaining indicators ($P > 0.05$). The specific data are presented in **Table 4**.

Table 4. Comparison of detection results of various liver function indicators between the two groups.

Group	Number of Cases	TBIL	DBIL	IBIL	ALT	AST	AST/ALT	TP	ALB	GLO	A/G	PA	TBA	ALP	GGT	CHE
Internal carotid artery insufficiency group	75	10.93 ± 4.87	3.51 ± 2.17	7.42 ± 3.11	18.43 ± 12.87	19.49 ± 8.76	1.36 ± 0.80	73.12 ± 5.65	45.99 ± 4.13	27.14 ± 3.61	1.72 ± 0.27	234.9 ± 56.39	5.25 ± 3.9	76.5 ± 20.2	31.79 ± 20.21	9277.83 ± 2082.32
Cerebral artery insufficiency group	40	10.97 ± 4.08	3.44 ± 1.52	7.53 ± 3.19	21.88 ± 15.79	21.23 ± 8.28	1.14 ± 0.36	77.22 ± 6.13	47.56 ± 3.93	29.66 ± 4.31	1.63 ± 0.23	243.37 ± 70.5	5.94 ± 5.57	84.6 ± 41.39	42.76 ± 57.85	9816.33 ± 2510.93
t value	—	0.0443	0.2016	0.1790	1.2634	1.0337	2.0276	3.5980	1.9741	3.3293	1.7893	0.7020	0.6976	1.1659	1.1621	1.2281
P value	—	0.4824	0.4203	0.4292	0.1054	0.1521	0.0225	0.0003	0.0259	0.0007	0.0384	0.2426	0.2441	0.1247	0.1257	0.1118

3.5. Kidney Function Indicators

In this study, 72 patients were included in the internal carotid artery insufficiency group, with CREA of 80.97 ± 29.95, UREA of 4.28 ± 1.97, and UA of 345.03 ± 88.56; 40 patients were included in the cerebral artery insufficiency group, with CREA of 74.15 ± 27.78, UREA of 4.5 ± 1.92, and UA of 350.47 ± 118.4. There were no significant differences in kidney function indicators such as CREA, UREA, and UA between the two groups ($P > 0.05$ for all). See **Table 5** for details.

Table 5. Comparison of detection results of various kidney function indicators between the two groups.

Group	Number of Cases	CREA	UREA	UA
Internal carotid artery insufficiency group	72	80.97 ± 29.95	4.28 ± 1.97	345.03 ± 88.56
Cerebral artery insufficiency group	40	74.15 ± 27.78	4.5 ± 1.92	350.47 ± 118.4
t value	—	1.1844	0.5714	0.2538
P value	—	0.1198	0.2846	0.4002

3.6. Blood Glucose Indicators

In this study, 71 patients were included in the internal carotid artery insufficiency group, with a blood glucose level of 6.05 ± 3.24; 35 patients were included in the cerebral artery insufficiency group, with a blood glucose level of 6.15 ± 2.73. There was no significant difference in blood glucose between the two groups ($t = 0.1571$, $P = 0.4378$). The detailed data are shown in **Table 6**.

Table 6. Comparison of blood glucose detection results between the two groups.

Group	Number of Cases	GLU
Internal carotid artery insufficiency group	71	6.05 ± 3.24
Cerebral artery insufficiency group	35	6.15 ± 2.73
t value	—	0.1571
P value	—	0.4378

3.7. Blood Lipid Indicators

In this study, 69 patients were included in the internal carotid artery insufficiency group and 38 patients were included in the cerebral artery insufficiency group. The detection of various blood lipid indices showed that the LDL level in the cerebral artery insufficiency group was higher than that in the internal carotid artery insufficiency group ($t = 2.0340$, $P = 0.0228$). Moreover, there were also significant differences in the TC and HDL levels between the cerebral artery insufficiency group and the internal carotid artery insufficiency group (TC: $t = 1.7068$, $P = 0.0461$; HDL: $t = 1.7427$, $P = 0.0429$), while there was no statistically significant difference in the TG level ($P = 0.3149$). The specific data are shown in **Table 7**.

Table 7. Comparison of detection results of various blood lipid indicators between the two groups.

Group	Number of Cases	TC	TG	HDL	LDL
Internal carotid artery insufficiency group	69	4.77 ± 1.24	1.79 ± 2.46	1.21 ± 0.33	3.19 ± 1.07
Cerebral artery insufficiency group	38	5.21 ± 1.34	1.63 ± 0.91	1.33 ± 0.36	3.64 ± 1.14
t value	—	1.7068	0.4835	1.7427	2.0340
P value	—	0.0461	0.3149	0.0429	0.0228

3.8. Electrolyte Indicators

In this study, 66 patients were included in the internal carotid artery insufficiency group, with K being 4.05 ± 0.43, NA being 140.31 ± 2.77, and CL being 103.81 ± 3.15; 30 patients were included in the cerebral artery insufficiency group, with K being 4.03 ± 0.27, NA being 141.17 ± 2.87, and CL being 103.83 ± 3.03. There were no significant differences in electrolyte indicators such as K, NA, and CL between the two groups (all $P > 0.05$). See **Table 8** for details.

Table 8. Comparison of detection results of various electrolyte indicators between the two groups.

Group	Number of Cases	K	NA	CL
Internal carotid artery insufficiency group	66	4.05 ± 0.43	140.31 ± 2.77	103.81 ± 3.15
Cerebral artery insufficiency group	30	4.03 ± 0.27	141.17 ± 2.87	103.83 ± 3.03
t value	—	0.2765	1.3943	0.0292
P value	—	0.3914	0.0845	0.4884

3.9. Calcium and Magnesium Indicators

In this study, 65 patients were included in the internal carotid artery insufficiency group, with CA being 2.28 ± 0.13 and Mg being 0.89 ± 0.12; 29 patients were included in the cerebral artery insufficiency group, with CA being 2.33 ± 0.15 and Mg being 0.89 ± 0.09. There were no significant differences in CA and Mg indicators between the two groups (all $P > 0.05$). The relevant data are shown in **Table 9**.

Table 9. Comparison of calcium and magnesium detection results between the two groups.

Group	Number of Cases	CA	Mg
Internal carotid artery insufficiency group	65	2.28 ± 0.13	0.89 ± 0.12
Cerebral artery insufficiency group	29	2.33 ± 0.15	0.89 ± 0.09
t value	—	1.6416	0.0000
P value	—	0.0537	0.5000

3.10. Hemorheology Indicators

In this study, 66 patients were included in the internal carotid artery insufficiency group. In terms of hemorheology indicators such as whole blood viscosity at different shear rates, plasma viscosity, and hematocrit, there were no significant differences compared with the 32 patients included in the cerebral artery insufficiency group (all $P > 0.05$). The detailed data are shown in **Table 10**.

3.11. Coagulation Function Indicators

In this study, 61 patients were included in the internal carotid artery insufficiency group, with PT being 11.81 ± 0.76, INR 0.98 ± 0.06, TT 15.02 ± 1.14, APTT 27.98 ± 3.09, and FIB 3.47 ± 0.96. 23 patients were included in the cerebral artery insufficiency group, with PT being 12.13 ± 0.84, INR 1.01 ± 0.07, TT 14.66 ± 0.99, APTT 27.48 ± 3.39, and FIB 3.91 ± 1.22. The FIB and INR in the cerebral artery insufficiency group were higher than those in the internal carotid artery insufficiency group ($t = 1.7354$, $P = 0.0461$; $t = 1.9511$, P = 0.0297), while there were no statistically significant differences in the levels of PT, TT, and APTT (P > 0.05). The specific data are shown in Table 11.

Table 10. Comparison of detection results of various hemorheology indicators between the two groups.

Group	Number of Cases	*Whole Blood Viscosity - Shear Rate --1	*Whole Blood Viscosity - Shear Rate --5	*Whole Blood Viscosity - Shear Rate --50	*Whole Blood Viscosity - Shear Rate --100	*Whole Blood Viscosity - Shear Rate --200	*Plasma Viscosity	Hematocrit
Internal carotid artery insufficiency group	66	21.75 ± 4.39	9.63 ± 1.91	5.03 ± 1.06	4.52 ± 0.97	4.17 ± 0.91	1.34 ± 0.09	0.39 ± 0.04
Cerebral artery insufficiency group	32	22.13 ± 4.58	9.79 ± 2.03	5.1 ± 1.15	4.58 ± 1.06	4.23 ± 1	1.36 ± 0.11	0.40 ± 0.04
t value	—	0.3962	0.3810	0.2982	0.2786	0.2963	0.9581	1.1606
P value	—	0.3467	0.3523	0.3833	0.3908	0.3840	0.1713	0.1252

Table 11. Comparison of detection results of various coagulation function indicators between the two groups.

Group	Number of Cases	PT	INR	TT	APTT	FIB
Internal carotid artery insufficiency group	61	11.81 ± 0.76	0.98 ± 0.06	15.02 ± 1.14	27.98 ± 3.09	3.47 ± 0.96
Cerebral artery insufficiency group	23	12.13 ± 0.84	1.01 ± 0.07	14.66 ± 0.99	27.48 ± 3.39	3.91 ± 1.22
t value	—	1.6718	1.9511	1.3354	0.6439	1.7354
P value	—	0.0516	0.0297	0.0942	0.2618	0.0461

4. DISCUSSION

Through the comparative analysis of multiple clinical indicators of patients with internal carotid artery insufficiency and cerebral artery insufficiency in this study, a series of clinically significant differences were found.

The age difference was relatively significant in this study. The average age of patients in the internal carotid artery insufficiency group was higher than that in the cerebral artery insufficiency group. This is consistent with previous research results [14]. Aging is an important risk factor for atherosclerosis. With the increase of age, the function of vascular endothelium is damaged, the proliferative ability of vascular smooth muscle cells decreases, and lipids are more likely to deposit on the vascular wall, thus accelerating the process of internal carotid artery atherosclerosis and making the situation of insufficient blood supply more common [15].

In terms of blood lipid indices, the levels of LDL, TC, and HDL in the cerebral artery insufficiency group were all significantly higher than those in the internal carotid artery insufficiency group. LDL, as a key factor in atherosclerosis, an increase in its level can promote the formation of foam cells, thereby accelerating the development of atherosclerotic plaques [16]. Meanwhile, the elevation of total cholesterol (TC) levels indicates abnormal lipid metabolism in the body. Excessive cholesterol will deposit on the vascular wall, increasing the risk of vascular occlusion. Although high-density lipoprotein (HDL) is generally regarded as "good cholesterol", in this study, the increase in HDL levels in the cerebral artery insufficiency group may be a compensatory response of the body to atherosclerosis. These changes in a series of blood lipid indices suggest that patients with cerebral artery insufficiency may have more complex lipid metabolism disorders, leading to the accumulation of LDL, TC, etc. on the vascular wall and affecting the normal function of cerebral arteries. Related studies have shown that an increase in LDL levels is closely related to the risk of cerebral artery stenosis and cerebral infarction [17]. The results of this study further support this view and also highlight the potential impact of TC and HDL in the development of cerebral artery insufficiency.

In terms of coagulation function, the PT and INR in the cerebral artery insufficiency group increased, reflecting the enhanced activity of the extrinsic coagulation pathway and a hypercoagulable state of the blood in this group [18]. Vascular endothelial injury is relatively common in patients with cerebral artery insufficiency. The damaged endothelial cells can release tissue factors, activate the extrinsic coagulation pathway, and promote thrombus formation [19]. This hypercoagulable state may further exacerbate the blood supply disorder of the cerebral artery and increase the risk of cerebral infarction. Some studies have pointed out that the hypercoagulable state is one of the important risk factors for ischemic cerebrovascular diseases [11], and the results of this study echo this.

There were no obvious differences between the two groups in most indicators such as blood routine, CRP, liver and kidney function, blood glucose, electrolytes, calcium and magnesium, and hemorheology. This indicates that the body's responses of patients with internal carotid artery insufficiency and cerebral artery insufficiency are relatively consistent in these aspects. However, this does not mean that these indicators are of no value in the overall assessment of the disease. The blood routine can reflect whether the patient has infections, anemia, etc., and is of great significance for judging the general state of the patient's body [12]. As an inflammatory indicator, although there was no difference between the two groups in this study, other studies have found that CRP may increase in the acute phase of cerebrovascular diseases and is related to the severity of the disease [13]. Liver and kidney function indicators can reflect the patient's metabolic and detoxification functions and have a guiding role in the selection of treatment regimens [14]. The stability of indicators such as blood glucose, blood lipids, and electrolytes is crucial for maintaining the balance of the body's internal environment, and any abnormality of these indicators may affect the occurrence and development of cerebrovascular diseases [20]. Hemorheological indicators can reflect the fluidity and viscosity of blood. Although there was no difference between the two groups in this study, in some chronic cerebrovascular diseases, abnormal hemorheology may promote thrombus formation [21].

The results of this study provide an important reference for clinical diagnosis and treatment. In clinical practice, for patients suspected of having cerebrovascular insufficiency, doctors should pay attention to the factor of age, especially the condition of the internal carotid artery in elderly patients. At the same time, detecting blood lipid and coagulation function indicators is helpful for differentiating between internal carotid artery insufficiency and cerebral artery insufficiency and formulating personalized treatment plans according to the characteristics of different indicators. For example, for patients with cerebral artery insufficiency and elevated LDL, lipid-lowering treatment should be actively carried out to delay the process of atherosclerosis; for patients with hypercoagulable blood, appropriate anticoagulant treatment can be considered to prevent thrombus formation [17, 18].

However, this study has certain limitations. The samples were only from Rongxian Traditional Chinese Medicine Hospital, and the sample size was relatively small, which may have regional limitations and affect the universality of the results. In the future, the sample range can be expanded to cover people from different regions and ethnic groups to enhance the reliability of the research results. In addition, this study is a cross-sectional study, making it difficult to clarify the causal relationship between various indicators and the occurrence and development of the disease. Prospective cohort studies can be carried out for in-depth exploration in the follow-up [19, 22].

In conclusion, this study revealed the differences in multiple clinical indicators between patients with internal carotid artery insufficiency and cerebral artery insufficiency, providing valuable information for clinical diagnosis and treatment. However, further in-depth research is still needed to comprehensively improve the understanding, diagnosis, and treatment levels of these two diseases.

5. CONCLUSION

There are significant differences in age, some blood lipid indicators, and some coagulation function indicators between patients with internal carotid artery insufficiency and cerebral artery insufficiency. These differences have important suggestive significance for the accurate differential diagnosis of the two diseases in clinical practice and provide a reference basis for formulating personalized treatment plans. Clinicians should pay attention to these differential indicators and comprehensively evaluate the patient's condition during the diagnosis and treatment process.

6. LIMITATIONS OF THE STUDY

The samples of this study were from a single hospital, and the sample size was limited, so it may not be able to represent the situation of patients in all regions. Moreover, the study design was cross-sectional, making it impossible to determine the causal relationship between the indicators and the disease. In addition, due to various reasons (such as patients' reluctance to be tested, doctors not prescribing tests, etc.), not all cases had inspection results for some indicators in this study, which also presented certain limitations. Follow-up studies need to expand the sample scope and conduct prospective studies to overcome these limitations and further explore the internal mechanisms and clinical characteristics of internal carotid artery and cerebral artery insufficiency.

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CONFLICTS OF INTEREST

All authors declare that there are no conflicts of interest. During the research design, data collection, analysis, and article writing process, there was no interference from any external factors that might affect the fairness of the research results.

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