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Clinical Observation on the Therapeutic Effect of Carotid Artery Plaque Interventional Therapy Based on Vascular Ultrasound

Shuai Gao [1], Rong Wu[2]
[1]Baotou Medical College, Baotou 014000, Inner Mongolia, China
[2]Ordos Central Hospital, Ordos 017000, Inner Mongolia, China

Abstract: *Objective:* This study aims to explore the impact of the early diagnosis model of carotid plaque hemorrhage constructed based on ultrasound features on clinical decision-making. *Methods:* One hundred patients who underwent carotid artery ultrasound examination were selected as the research subjects, with an average age of 65.63 ± 8.91 years old and an average BMI of 24.48 ± 1.82 kg/m^2. They were divided into the observation group (50 cases) and the control group (50 cases). There was no statistically significant difference in general data between the two groups ($P > 0.05$), indicating that the grouping was reasonable. Carotid artery ultrasound was used to evaluate the degree, size, type and distribution of plaque sclerosis. *Results:* The plaque size (IMT: 1.51 ± 0.22 mm) and echo intensity (3.18 ± 0.72 score) in the observation group were significantly greater than those in the control group (IMT: 0.82 ± 0.9 mm, echo intensity: 2.02 ± 0.63 score) ($P < 0.05$). The types and distribution of plaques in the observation group were more diverse than those in the control group and showed significant differences ($P < 0.05$), especially the number of plaques at the bifurcation of the common carotid artery and the common carotid artery was significantly higher than that in the control group. *Conclusion:* The early diagnosis model of carotid artery intraplaque hemorrhage constructed based on ultrasound features can effectively distinguish the degree, size, type and distribution of plaque sclerosis, which is helpful to improve the accuracy of early diagnosis of intraplaque hemorrhage. Further clinical applications have shown that this model can provide important references for clinical treatment decisions and has high clinical application value.
Keywords: Carotid artery plaque; Ultrasonic characteristics; Early diagnosis model; Clinical decision-making; Intraplaque hemorrhage

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1. Introduction

Carotid artery plaques, as an important manifestation of atherosclerosis, are closely related to the occurrence of

stroke. Intraplaque hemorrhage indicates plaque rupture and thrombosis formation, affecting the risk of stroke [1]. Judging the bleeding condition of plaques is of great significance for the prevention of stroke. Traditional imaging methods, such as CT and MRI, obtain more information and have deficiencies in the field of diagnosing plaque hemorrhage. Ultrasound examination has advantages, and carotid artery plaque screening plays an important role. Ultrasound examination obtains information on the degree, size, and location of plaque hardening, analyzes the plaque status to provide effective methods, and doctors design detailed treatment plans based on the information to reduce the risks for patients. At present, ultrasound technology has deficiencies in the early detection and diagnosis of plaque hemorrhage, and a highly accurate initial detection model is lacking. The research aims to establish an ultrasound character-driven model, hoping to achieve early identification of carotid plaque hemorrhage, which has significant clinical significance. This is conducive to improving the detection accuracy of plaque bleeding, and can also provide strong support for clinical decision-making, enabling patients to receive early and useful treatment intervention and reducing the risk of stroke. Carotid artery ultrasound examinations were performed on 100 patients. The analysis results showed that it is expected to obtain an accurate and reliable diagnostic tool in clinical practice, improve the early recognition rate of intraplaque hemorrhage, improve clinical treatment decisions, reduce the incidence of stroke, and save more patients' lives [2].

2. Data and methods

2.1. General information

During the period of 2023, 100 patients who entered the clinic were selected. Based on the results of ultrasound tests, they were placed in two groups, with 50 patients in each group. The patients in the observation group were aged from 50 to 80, with an average age of (65.70 ± 8.92) years old. However, in the control group, within the age range of 51 to 80 years old of the patients, the average age figure was (65.56 ± 8.90) years old.

The factors such as gender, age and body mass index showed small differences between the two groups of patients. The statistical results indicated that the *P* value was greater than 0.05. The observation group included 27 male patients, accounting for 54.00%, and 23 female patients, accounting for 46.00%. The control group included 25 male patients and 25 female patients, respectively, accounting for 50.00%. Medical experiments require that the two groups of people maintain the same characteristics. Statistical data indicate that there is no significant difference in the gender distribution between the observation group and the control group. The body mass index values remain fluctuating at 24.50 and 24.47, respectively, with a small gap. The basic conditions of the two groups of patients were similar, and the experiment provided a reliable control group and an observation group. The accuracy of statistics ensures the reliability of the experimental results and guarantees the establishment of a solid foundation for subsequent scientific research.

2.2. Methods

The patients were divided into the observation group and the control group, with 50 cases in each group. The patient met the clinical diagnostic criteria related to carotid artery plaques. The protocol adopted in clinical practice was that patients in the observation group used a diagnostic model relying on ultrasound features for early intervention treatment. The plan relied on very detailed ultrasound image data to complete the entire process of early diagnosis and precise intervention of carotid artery plaques. All patients underwent carotid intima-media ultrasound examination, which recorded key data such as carotid intima-media thickness (IMT), echo intensity, and plaque size.

This provided the important basis and strong assistance for doctors to assess the lesion condition. During the ultrasound testing process, two-dimensional images are used to measure the IMT value, color Doppler ultrasound is used to quantitatively evaluate the echo intensity, and the overall ultrasound image is used to estimate the size of the plaque.

Plaque types are classified into soft plaques, hard plaques, flat plaques and mixed plaques, and the distribution sites cover important areas such as the bifurcation of the common carotid artery, the common carotid artery and the external carotid artery [3]. Ultrasound technicians and clinicians follow a unified standard, record the test information and then analyze it. For the patients in the observation group, by integrating the characteristics of ultrasound images and the diagnostic model methods, doctors formulated early intervention and treatment adjustment plans. During the treatment process, the examination of important indicators such as plaque changes and blood flow conditions helps doctors understand the real situation and improve clinical decisions. The diagnostic model integrates ultrasound image data and clinical background, aiming at the early diagnosis of carotid plaque hemorrhage, and clinical decisions are supported by a scientific basis.

2.3. Evaluation indicators and judgment criteria

Carotid artery plaques were analyzed using ultrasound characteristics to carry out the initial identification work, and the core assessment parameters were listed. General data include studies in three aspects: age, body mass index and gender [4]. Age is calculated by the date of birth and calculated by the year calculation method. Body mass index is accurately obtained by dividing weight by the square of height, and the result is calculated by the standard formula. Gender is divided into male and female, and the proportion of the number of people in each group to the total number is counted. The gender ratio figures, body mass index and age of the two groups of patients were compared to examine the differences between each group.

2.4. Statistical methods

The data analysis work was accomplished using SPSS 22.0 software. Firstly, the basic information is processed through descriptive statistics, and the quantitative data is presented in the form of "x±s" and compared between groups using the independent sample t-test under the condition of conforming to the normal distribution. For frequency data, it was expressed as a percentage (%), while the differences between groups were evaluated using the chi-square test (χ^2). When the P value is less than 0.05, this is regarded as statistically significant.

3. Result

3.1. Comparison of general information

Table 1 records the data for your reference. Starting from the investigation of the degree of plaque sclerosis, the thickness of the carotid intima-media, echo intensity, and plaque size were selected as measurement parameters. The thickness value of the carotid intima-media is measured by ultrasound equipment. The echo intensity is the integral value of the ultrasound image, reflecting the concentration level of the plaque. The size of the plaque is measured by an ultrasound image, with the unit being square millimeters. **Table 2** clearly shows the differences between the two groups in these three criteria. The results showed that the observation group performed better than the control group in terms of IMT, echo intensity and plaque size. When studying the types of plaques, they are classified into four types: flat plaques, soft plaques, hard plaques and mixed plaques. The type of plaque is determined by the

morphology and echo characteristics of ultrasound images.

The data in **Table 3** indicates that the proportion of soft and hard spots in the observation group is much higher than that in the control group, and the proportion of mixed spots is also very high. This reflects that the plaque types in the observation group are more complex. The distribution of plaques was classified by observing the distribution of the common carotid artery, the bifurcation of the common carotid artery and the external artery of the common carotid artery. Ultrasound examination helped researchers determine the specific location and distribution of plaques. The results in **Table 4** show that the occurrence frequency of common carotid artery bifurcation and plaques in the common carotid artery area in the observation group was higher than that in the control group, especially with plaque traces in the external carotid artery area. The above indicators are the main evaluation contents. The quantitative and qualitative analysis results of ultrasound features can enable doctors to understand the pathological characteristics of carotid artery plaques, making very precise judgments. Therefore, early diagnosis is supported by a reliable basis.

In the study, there were no differences in basic information such as age, BMI and gender distribution between the group responsible for observation and the group responsible for control ($P > 0.05$). The patients participating in the study had data such as age, gender ratio, and BMI fell within a similar range. This indicates that the group responsible for observation and the group responsible for control have sufficient comparability in basic demographic characteristics, which can provide a very effective control basis for subsequent data analysis (**Table 1**).

Table 1. Comparison table of general data between the control group and the observation group

Group	Number of cases	Average age of the patients (years)	Average BMI of patients (kg/m^2)	Male patient (*n*)	Female patients (*n*)
Observation group	50	65.70 ± 8.92	24.50 ± 1.80	27 (54.00%)	23(46.00%)
Control group	50	65.56 ± 8.90	24.47 ± 1.83	25 (50.00%)	25 (50.00%)
χ^2	-	2.274	0.123	1.358	1.581
P	-	0.573	0.423	0.123	0.123

3.2. Comparison of plaque hardening degrees

When comparing the observed patients with the control patients, the differences in the degree of plaque sclerosis were obvious. It was observed that the IMT values of plaques, echo intensity values and plaque size values of the patients were all higher than those of the control patients. The data proved that there were significant differences ($P < 0.05$). This result indicates that the degree of carotid artery plaque sclerosis in the observed patient is relatively severe, which may be related to the early diagnosis of hemorrhage within the plaque (**Table 2**).

Table 2. Comparison of plaque sclerosis degree between the observation group and the control group

Group	Number of cases	IMT (mm)	Echo intensity (integral)	Plaque size (mm^2)
Observation group	50	1.51 ± 0.22	3.18 ± 0.72	0.19 ± 0.07
Control group	50	0.82 ± 0.9	2.02 ± 0.63	0.07 ± 0.02
t	-	5.950	5.660	4.890
P	-	0.0000	0.0000	0.000

3.3. Comparison of plaque types

The dispersion of plaque types observed by the researchers was very different from that of the control group. In the group examined by the researchers, the proportion of soft spots, hard spots, and mixed spots was sufficient, while in

the control group, the number of flat spots was dominant. The results of statistical analysis indicated that the proportion of the number of soft spots, hard spots and mixed spots observed by the researchers was higher than that of the control group standard, and the data gap was obvious ($P < 0.05$). These differences indicate that the group of plaques examined by the researchers was complex and diverse in type, suggesting that the process of plaque formation and development might be more dangerous (**Table 3**).

Table 3. Comparison of plaque types between the observation group and the control group (*n*, %)

Group	Number of cases	Plaque quantity	Flat spot	Soft spot	Hard spot	Mixed spot
Observation group	50	97	29 (29.90%)	33 (34.02%)	41 (42.26%)	27 (27.84%)
Control group	50	25	3 (12.00%)	4 (16.00%)	3 (12.00%)	1 (4.00%)
χ^2	-	7.287	5.986	5.648	6.354	5.963
P	-	0.000	0.010	0.010	0.000	0.010

3.4. Comparison of plaque distribution

Through investigation, there are differences in the distribution status of spots between the observation group and the control group. The number of spots at the bifurcation of the common carotid artery and the common carotid artery in the observation group was greater than that in the control group, and the distribution of spots on the external carotid artery was very prominent in the observation group. The difference between the two groups was statistically significant, and the statistical data indicated that the probability value was less than 0.05. The study concluded that the distribution range of carotid artery spots in the observation group was generally more severe, which might be closely related to the severity of the lesion (**Table 4**).

Table 4. Comparison of plaque distribution between the observation group and the control group (*n*, %)

Group	Number of cases	Plaque number	Bifurcation of the common carotid artery	Common carotid artery	The external artery of the common carotid artery
Observation group	50	97	65 (67.01%)	49 (50.52%)	4 (4.12%)
Control group	50	25	11 (44.00%)	5 (20.00%)	0 (0.00%)
χ^2	-		8.024	6.684	4.648
P	-		0.000	0.000	0.020

4. Discussion

The formation of plaques in the carotid artery indicates an important step in arteriosclerosis. The type and distribution of plaques have a significant impact on the risk of disease and prognosis. At present, the use of ultrasound imaging examination methods in clinical diagnosis has obvious limitations in distinguishing and understanding aspects such as the number of plaques, their types, and their distribution. Detailed studies and discussions have been conducted on the types of plaques in the observation group and the control group. By comparing the basic situations of the observation group and the control group, it was found that there was no data significance in the specific data of age, body mass index, and gender distribution between the two groups. The age of patients in the observation group was 65.70 ± 8.92 years old, and that of patients in the control group was 65.56 ± 8.90 years old. The *P* value of the statistical research result was 0.573. The research process demonstrated two groups of situations and supplemented

that the age calculation was particularly accurate. The body mass index of the two groups of patients was highly similar. The body mass index of the patients in the observation group was 24.50 ± 1.80 kg/m^2, and that of the patients in the control group was 24.47 ± 1.83 kg/m^2. The *P* value of the count analysis result was equal to 0.423. From the perspective of gender ratio, in the observation group, male patients accounted for 54.00% and female patients accounted for 46.00%, while in the control group, male patients accounted for 50.00% and female patients accounted for 50.00%. The *P* value of the count analysis result was greater than 0.05. Medical research must pay attention to the basic conditions of patients to a certain extent. The similarity of age, gender and weight in multiple perspectives between the two groups of patients was consistent, and the research error has been removed. The similarity of subject data in medical trials provides a solid and reliable foundation for in-depth research, but improving the prediction model requires further exploration of family medical history and drug use factors.

Clinical diagnosis needs to be accurate to improve the early diagnosis plan and enhance medical effectiveness. There was a significant difference in the degree of vascular sclerosis between the observation group and the control group. For the plaques in the carotid artery of the observation group, the measurement results of the intimal media thickness were 1.51 ± 0.22 mm, the measurement result of the echo intensity was 3.18 ± 0.72 mm, and the measurement result of the plaque size was 0.19 ± 0.07 mm^2. The measurement results of the relevant data of the control group were 0.82 ± 0.90 mm, 2.02 ± 0.63 points, and 0.07 ± 0.02 mm^2. The results of statistical analysis showed that the degree of plaque hardening in the observation group was more prominent than that in the control group. The *P* values of the comparison items were all below 0.05, and the difference was statistically significant. The research data clearly reflect that the two groups of situations are different.

The degree of plaque sclerosis is directly related to the progression of atherosclerosis. Bleeding within the plaque can make carotid plaque sclerosis more severe, significantly reduce the elasticity of blood vessels, and directly increase blood flow resistance. Early detection of the degree of plaque sclerosis is of great significance for preventing and controlling problems such as stroke caused by carotid plaque rupture, effectively reducing related risks and protecting the physical health of patients. The degree of plaque sclerosis in the observation group increased, which might be related to the longer disease course of patients in the observation group or the higher risk factors. Highly hardened plaques indicate more severe lesions within the blood vessels and are directly closely related to an increased risk of cardiovascular and cerebrovascular events in clinical practice. By early detection of the degree of plaque sclerosis and in combination with the use of the characteristics of ultrasound imaging, it can provide important assistance for clinical decision-making and effectively formulate treatment plans suitable for individuals.

According to the data, the total number of plaques in the observation group was 97, among which flat plaques accounted for 29.90%, soft plaques accounted for 34.02%, hard plaques accounted for 42.26%, and mixed plaques accounted for 27.84%. The total number of plaques in the control group was 25, among which flat plaques accounted for 12.00%, soft plaques accounted for 16.00%, hard plaques accounted for 12.00%, and mixed plaques accounted for 4.00%. The formation process of mixed soft and hard spots causes damage to blood vessels. An increase in the number of plaques in the blood vessels will lead to an increased probability of internal bleeding. Doctors need to master the arrangement of plaques to lay the foundation for scientific diagnosis. The disease is closely related to the type of plaque. Early diagnosis is crucial and helps to reduce the prevalence and mortality rates. Studies have shown that the arrangement of plaques at the bifurcation of the common carotid artery is significantly different from that of the control group ($p < 0.05$), indicating that it is a key location for plaque formation. The data is clear and of great significance. The difference in plaque arrangement of the external artery of the common carotid artery was also statistically significant ($p < 0.05$), but its proportion in the total number of plaques was relatively low, indicating that the probability of plaque formation at this location was small, and it was an uncommon situation.

5. Conclusion

The findings of this study are of great significance for clinical decision-making. Plaques are densely distributed at the bifurcation of the common carotid artery, reminding doctors that they should pay special attention to the ultrasound characteristics of this area in order to detect and treat high-risk plaques that may cause internal bleeding in a timely manner. Since the bifurcation of the common carotid artery and the common carotid artery are high-incidence areas for plaque distribution, enhancing the monitoring of these sites is helpful for the early prediction and prevention of plaque-related acute stroke events. As for the external artery of the common carotid artery, although the probability of plaque occurrence is not high, doctors should not neglect the examination of this area to avoid missing a few but potentially important cases. Regular carotid artery ultrasound monitoring should be an important component for assessing the risk of carotid artery plaques and formulating prevention strategies.

Disclosure statement

The authors declare no conflict of interest.

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