Original Article

Analysis of Influencing Factors of Anxiety and Depression in Patients with Intracranial Dural Arteriovenous Fistulas before Endovascular Treatment: A Retrospective Study

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Abstract

Background: Typical treatment of dural arteriovenous fistula (DAVF) emphasizes clinical procedures such as surgery, radiotherapy, and endovascular treatment. However, external factors of adverse psychological emotions in patients with DAVF before treatment have not yet been evaluated in a multicenter study. **Objectives:** This study aimed to fill the research gap regarding the effects of factors by evaluating the anxiety and depression status among patients with DAVF before and after endovascular treatment and identify factors influencing the development of anxiety and depression before their endovascular treatment. **Methods:** This retrospective study included 168 DAVF patients treated at two independent neurosurgical medical centers from December 2012 to December 2022. The Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD) were assessed before and after endovascular treatment. Demographic and clinical data were also collected. Statistical tests were performed to calculate the proportion of DAVF patients with anxiety and depression. A multivariate analysis was conducted to identify independent risk factors for anxiety and depression in patients with DAVF before endovascular treatment. **Results:** A significant decrease in the percentage of patients with anxiety and depression was observed in patients after endovascular treatment compared with before treatment. Patients with DAVF who were at a higher risk for anxiety and depression were females had multiple visits, comorbid conditions, and a lower economic status and were presented with symptoms. **Conclusion:** After endovascular treatment, the anxiety or depression symptoms of DAVF patients significantly improved. Our findings provide additional evidence to support the role of intravascular treatment in improved DAVF patients' psychological outcomes.

Keywords: Anxiety, depression, dural arteriovenous fistula, endovascular treatment, influencing factors

Introduction

Dural arteriovenous fistula (DAVF) is a rare abnormality in which an anomalous shunt between the arterial and venous system is located within the dura mater.[1-3] DAVF accounts for approximately 10-15% of all intracranial vascular malformations.[4,5] DAVF is characterized by hemorrhage, non-hemorrhagic neurological dysfunction, and venous hyperdynamic symptoms.[6] DAVF without cortical venous reflux is considered a benign lesion with a low risk of cerebral hemorrhage[7-9] and usually presents with relatively mild benign symptoms. Therefore, physicians do not recommend conventional treatment for such patients.[10] However, these benign symptoms can have physical and psychological impacts on the patient's life, resulting in chronic discomfort and reduced quality of life, which might prompt patients to seek treatment actively. In contrast, DAVF of Cognard type IIb-V or Borden types II and III usually involves persistent cortical venous drainage and reverse venous drainage. The natural course of this lesion is characterized by a high risk of bleeding, death, and progressive nerve damage, which seriously endangers the patient's life and health.[11] Within the first 2 weeks after initial bleeding, the probability of rebleeding can be up to 35%.[12,13]

Patients with DAVF experience anxiety regarding the recurrence of venous hyperdynamic symptoms and the risk of rupture and bleeding. Patients also express concerns about potential complications such as postoperative rebleeding, ischemic events, intracranial infection, neurological impairment, symptomatic cerebral vasospasm, and hematoma after femoral artery puncture.

There is an abundance of DAVF research studies that focuses on enhancing diagnostic accuracy, developing surgical techniques for endovascular treatment, and improving the efficacy of gamma knife radiosurgery. In contrast, studies on the anxiety and depression psychological status in patients with DAVF are lacking. These psychological studies are

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important because anxiety and depression are crucial factors affecting the treatment decision for DAVF. The importance is illustrated by patient's negative affective state influencing adherence and suicidal thoughts. This study aimed to analyze the factors contributing to anxiety and depression before and after endovascular treatment in patients with DAVF. The findings of this study provide a theoretical basis for targeted clinical prevention and intervention.

Materials and Methods

Research participants

A retrospective study was performed on 168 inpatients with DAVF at two independent neurosurgical medical centers, Zhangzhou Municipal Hospital of Fujian Province (National Advanced Stroke Center) and the Second Affiliated Hospital of Fujian Medical University (National Provincial Regional Medical Center), from December 2012 to December 2022. The study included 77 male and 91 female patients (age range, 20-81 years; mean age, 55.01 ± 12.28 years). The time to diagnosis of DAVF ranged from 0.1 months to 112.0 months, with a median value of 1.0 (0.1, 6.0) months.

The inclusion criteria for this study were as follows: (1) confirmed diagnosis of DAVF through digital subtraction angiography (DSA) and treatment with endovascular therapy; (2) education level equivalent to an elementary school level or higher; (2) stable vital signs, clear consciousness, normal speech function, and ability to complete the study; (3) complete clinical information; and (4) those who provided informed consent to participate in this study.

The exclusion criteria for this study were as follows: (1) the presence of impaired consciousness, cognitive dysfunction, severe mental illness, or recent severe psychiatric shock; (2) the inability to tolerate surgery or refusal to participate in the study; (3) critical condition, combined with severe infection, severe organ failure in heart, brain, kidney and other organs, malignancy, and other serious diseases; (4) intellectual or communication impairment; (5) pregnancy or lactation; (6) definitively traumatic or iatrogenic DAVF; (7) the patients harboring coexistence of DAVF and other neurovascular lesions, such as cerebral arteriovenous malformations, intracranial aneurysms, direct carotid-cavernous fistula, or Moyamoya disease. The Ethics Committee of Zhangzhou Municipal Hospital of Fujian Province (the approval number of the ethics committee: 2023LWB117) and the Ethics Committee of the Second Affiliated Hospital of Fujian Medical University (the approval number of the ethics committee: 2022-183) approved this study.

Research methods

Data collection and stratification

The demographic and clinical data were recorded. Demographic data included sex, age, education level, annual household income, and payment method for medical expenses. Clinical data comprised the total number of common chronic diseases, the number of DAVF-related visits, history of smoking, history of alcohol abuse, mode of DAVF detection, time of DAVF diagnosis, site of onset, Borden's type, venous drainage patterns predictive of the invasiveness and high bleeding risk, blood supply, orificium fistula flow rate, and the direction of venous reflux.

The education level was categorized into elementary school, middle school, high school, university, or above. Annual household income (RMB) was classified into four groups: ≤50,000, >50,000-100,000, >100,000-200,000, >200,000 Yuan (National Bureau of Statistics of China: the average annual household income of Chinese residents in 2022 [for a family of four, RMB] was 147,500 Yuan [equivalent to approximately $21,400]).

The payment method for medical expenses was classified as self-payment, resident medical insurance, new rural cooperative medical insurance, and employee medical insurance. Patients were coded as positive for alcohol consumption if they consumed alcohol more than 5 times a week. The common chronic diseases considered in this study included stroke, hypertension, diabetes, hyperlipidemia, hyperuricemia, coronary heart disease, chronic obstructive pulmonary disease, arthritis, and other related illnesses. The number of DAVF-related visits was defined as the number of hospital visits where DAVF was the primary cause of clinical symptoms. DAVF detection methods included symptoms such as headache, dizziness, pulsatile tinnitus, intracranial bruit, intracranial hemorrhage, and incidental findings from health examinations. The time to DAVF diagnosis was measured as to the time from the clinical manifestation of the disease to diagnosis by DSA. The disease site was classified into eight categories: the cavernous sinus, transverse/sigmoid sinus, tentorium cerebelli venous sinus/sinus confluence area, superior sagittal sinus, anterior cranial fossa base, tentorial area, other areas, and mixed type (including two or more regions).

Borden's classification system comprises three types: type I, type II, and type III. Cognard and Borden's classification systems are useful in determining the clinical condition of patients and guiding treatment strategies. However, Borden's classification system is more succinct and efficient, and the risk of bleeding varies between the three types. Hence, Borden's classification system was employed in this study.

Venous drainage patterns that indicate a higher risk of invasiveness and bleeding include the presence of cortical venous drainage, varicose or aneurysmal dilatation, large cerebral venous drainage, and pia mater venous drainage. DAVF can be split into two categories based on the source of blood supply: bilateral if it comes from two sources, unilateral for one.

The direction of venous reflux was categorized into two directions: forward and reverse. On the other hand, the orificium fistula flow rate was divided into two categories

based on the time of initial appearance of the orificium fistulae and the draining vein as well as the time of filling of the M1 segment of the middle cerebral artery. If the orificium fistulae and the draining vein appeared before the M1 segment of the middle cerebral artery was visualized, it was considered a high orificium fistula flow rate. Conversely, if they appeared after the M1 segment of the middle cerebral artery was visualized, it was considered a low orificium fistula flow rate.

Anxiety and depression status assessment

The Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD)[14] use a 5-point scale with a range of 0-4. HAMA assesses mental and somatic anxiety, with scores of 0-6 suggesting a normal state and scores of ≥7 indicating an anxious state. Scores of 7-13 suggest possible anxiety, 14-20 suggest definite anxiety, 21-28 suggest definite significant anxiety, and scores of ≥29 suggest severe anxiety. HAMD comprises seven major categories of factors, namely, anxiety somatization, body mass changes, cognitive impairment, day-night changes, block, sleep disturbance, and feelings of despair. Scores of 0-7 indicate a normal state, and ≥8 indicates a depressive state. Scores of 8-20 suggest possible depression, 21-35 suggest definite depression, and ≥36 suggest severe depression. Two qualified psychologists independently scored the patients' scores by talking to them and observing them 1-2 days before endovascular treatment, after the physician had a preoperative conversation focused on the pathogenesis of DAVF, clinical presentation, surgical risk, and postoperative complications. The psychologists scored the patients again before their discharge after treatment, and the results were averaged. The scale return rate was 100%.

Endovascular treatment strategy

The right femoral artery was punctured using the modified Seldinger technique. The patient was then systematically heparinized in a stepwise manner. The microcatheter was placed as close to the orificium fistulae as possible under the guidance of road mapping. Dimethyl sulfoxide was slowly injected into the microcatheter, followed by a slow injection of Onyx gel under close fluoroscopic observation. The injection was stopped when the orificium fistulae were embolized or when there was reflux of Onyx gel in the artery distal to the microcatheter or into other supply arteries. If the embolization outcome was unsatisfactory, catheterization and gel injection were performed via other supply arteries until the embolization outcome was satisfactory. The DSA or computed tomography (CT) images were re-examined immediately after the operation. Transvenous or combined trans-arteriovenous access was considered appropriate for patients with challenging arterial access or ineffective arterial embolization.

Statistical analysis

The data were analyzed using SPSS 22.0 software. The Shapiro–Wilk test was used to assess the normality of the measurement data. Normally distributed data are reported as the mean ± standard deviation, whereas non-normally distributed data are presented as medians and quartiles [M (P_{25}, P_{75})]. The nonparametric signed rank-sum test was used to analyze the HAMA and HAMD scores before and after endovascular treatment. Additionally, the percentage of patients experiencing anxiety and depression before discharge before endovascular treatment vs. after treatment was analyzed using the paired samples χ^2 test. Multivariate logistic regression analysis was used to examine the risk factors for anxiety and depression in patients with DAVF before endovascular treatment. Statistical significance was set at $P < 0.05$.

Results

General information

The study included 168 patients with DAVF, comprising 77 males and 91 females. The patient age ranged from 20 to 81 years, with a mean age of 55.01 ± 12.28 years. The time to diagnosis of DAVF ranged from 0.1 to 112.0 months, with a median time of 1.0 (0.1, 6.0) months [Table 1].

Comparison of the anxiety status before and after endovascular treatment

There was a statistically significant difference in the percentage of patients with anxiety before endovascular treatment (after the physician's preoperative talk) and after endovascular treatment (before discharge), which were 51.2% and 28.0% ($P < 0.01$), respectively [Table 2].

The pre-treatment and post-treatment mental anxiety scores of 168 patients with DAVF ranged from zero to 19 and 0 to 13, respectively. Their somatic anxiety scores ranged from zero to 12 before treatment and zero to 9 after treatment, while their total HAMA scores ranged from zero to 30 before treatment

Table 1: General information of 168 patients with dural arteriovenous fistula who received endovascular treatment

	Number	%
Sex		
Male	77	45.8
Female	91	54.2
Education level		
Elementary school	58	34.5
Middle school	65	38.7
High school	37	22.0
University or above	8	4.8
Annual household income (RMB)		
≤50,000	33	19.6
>50,000-100,000	61	36.3
>100,000-200,000	49	29.2
>200,000	25	14.9
History of smoking		
No	129	76.8
Yes	39	23.2
History of alcohol abuse		
No	145	86.3
Yes	23	13.7

and zero to 22, after treatment. Moreover, patients with DAVF exhibited significantly lower scores for mental anxiety, somatic anxiety, and total HAMA after endovascular treatment compared with before treatment (all $P < 0.01$) [Table 3 and Figure 1].

Comparison of the depression status before and after endovascular treatment

The proportion of patients exhibiting depressive symptoms before and after endovascular treatment was 47.0% and 32.7%, respectively, with a significant statistical difference observed ($P < 0.01$) [Table 4].

In this study, 168 patients with DAVF were assessed for various parameters before and after endovascular treatment. The anxiety somatization scores, body mass change scores, cognitive impairment scores, day-night change scores, block scores, sleep disturbance scores, and sense of despair scores had a range of 0-10, 0-3, 0-8, 0-2, 0-6, 0-5, and 0-5, before treatment and 0-7, 0-3, 0-7, 0-2, 0-5, 0-4, and 0-5, respectively, after treatment. The total HAMD scores ranged from 0-30 before and 0-22 after treatment. The nonparametric signed rank-sum test revealed statistically significant differences in anxiety somatization, cognitive impairment, day-night change, block, sleep disturbance, and total HAMD scores before and after endovascular treatment (all $P < 0.01$). However, the differences in body mass change scores and sense of despair scores before and after treatment were not statistically significant [Table 5 and Figure 1].

Table 2: The anxiety status before and after endovascular treatment in 168 patients with dural arteriovenous fistula (cases)

Before endovascular treatment*	After endovascular treatment**		Number
	No anxiety	Have anxiety	
No anxiety	79	3	82
Have anxiety	42	44	86
Number	121	47	168

*: After the physician's preoperative talk; **: before discharge after endovascular treatment

Analysis of the factors influencing the anxiety state

A binary logistic regression analysis was performed on 168 patients with DAVF to determine the risk factors for anxiety

Table 3: Comparison of the Hamilton Anxiety Scale scores before and after endovascular treatment in 168 patients with dural arteriovenous fistula [M (P_{25}, P_{75}), points]

	Number	Psychogenic anxiety scores	Somatic anxiety scores	Points
Before endovascular treatment*	168	5.0 (2.0, 7.0)	2.0 (1.0, 5.0)	7.0 (3.0, 12.0)
After endovascular treatment**	168	3.0 (1.0, 4.0)	1.0 (0.0, 2.0)	4.0 (1.0, 7.0)
Z		-11.29	-11.21	-11.21
P		<0.01	<0.01	<0.01

*: After the physician's preoperative talk; **: before discharge after endovascular treatment

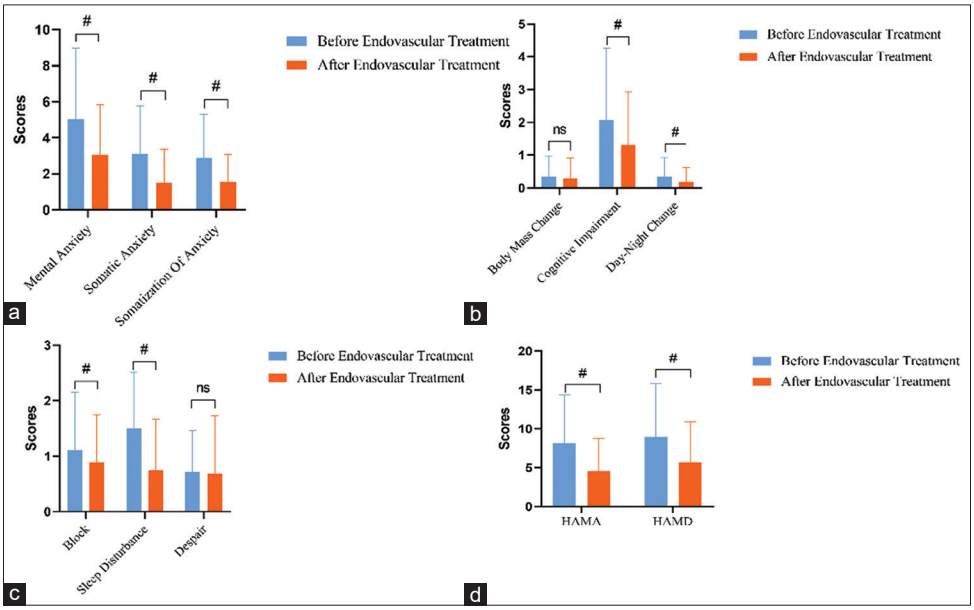

Figure 1: Comparison of the Hamilton Anxiety Scale (HAMA) and the Hamilton Depression Scale (HAMD) scores before and after endovascular treatment (expressed as the mean and standard deviation). (a) Patient's mental anxiety scores, somatic anxiety scores, and somatization of anxiety scores before and after endovascular treatment. (b) Patient's body mass change scores, cognitive impairment scores, and day-night change scores before and after endovascular treatment. (c) Patient's block scores, sleep disturbance scores, and sense of despair scores before and after endovascular treatment. (d) Patient's HAMA scores and HAMD scores before and after endovascular treatment. ns: no significant difference; #: $p < 0.01$

before endovascular treatment as the independent variable. Independent variables included patient age (in ascending order), male sex, smoking, alcohol consumption, education level (with university or above as the reference), annual household income (RMB) (>200,000 Yuan as the reference), the mode of DAVF detection (symptoms), payment method for medical expenses (with employee health insurance as the reference), the total number of common chronic diseases (with none as the reference), the number of DAVF-related visits (with one visit as the reference), the site of onset (with cavernous sinus area as reference), unilateral cerebral artery supply, high orificium fistula flow rate, Borden's typing (with type I as the reference), venous drainage patterns predictive of the invasiveness and high bleeding risk (cortical venous drainage, varicose or aneurysmal dilatation, large cerebral venous drainage, or pia mater venous drainage), and reverse reflux direction. The results suggested that being a female (*OR* = 5.40, 95% CI: 2.01-14.53, *P* = 0.001), experiencing symptoms at the time of DAVF detection (OR = 3.51, 95% *CI*: 1.11-11.14, *P* = 0.033), having a higher number of DAVF-related visits (*P* = 0.002), greater number of common chronic diseases (*P* = 0.007), and lower annual household income (*P* = 0.004) were associated with increased risk of anxiety. The risk of anxiety increased by 4.46 times (*P* = 0.005) and 20.49 times (*P* = 0.005) for patients who had 2-3 visits and >3 visits, respectively, compared with those with only one visit. Patients with one, 2-3, and >3 common chronic diseases had 8.65 times (*P* = 0.003), 7.08 times (*P* = 0.009), and 12.25 times (*P* = 0.002) higher risk of developing anxiety, respectively, than those without any common chronic diseases. Patients with an annual household income of ≤50,000 Yuan and >50,000-100,000 Yuan had 20.20 times (*P* = 0.001) and 9.21 times (*P* = 0.009) the risk of experiencing anxiety, respectively, compared with patients with an annual income of >200,000 Yuan. In addition, patient age, male sex, smoking, alcohol consumption, education level, the payment method for medical expenses, site of onset, unilateral cerebral artery supply, high orificium fistula flow rate, Borden's type, venous drainage patterns predictive of the invasiveness and high bleeding risk, reverse reflux direction, and annual household income of >100,000-200,000 Yuan were not associated with anxiety (all *P* > 0.05) [Table 6 and Figure 2].

Table 4: The depression status before and after endovascular treatment in 168 patients with dural arteriovenous fistula (cases)

Before endovascular treatment*	After endovascular treatment**		Number
	No depression	Have depression	
No depression	87	2	89
Have depression	26	53	79
Number	113	55	168

*: After the physician's preoperative talk; **: before discharge after endovascular treatment

Analysis of the factors influencing depressive states

A binary logistic regression analysis was performed on 168 patients with DAVF to evaluate the association between depression before endovascular treatment as the dependent variable and various factors such as patient age (in ascending order), male sex, smoking, alcohol consumption, education level (with university or above as the reference), annual household income (RMB) (>200,000 Yuan as the reference), the mode of DAVF detection (symptoms), the payment method for medical expenses (with employee health insurance as the reference), the total number of common chronic diseases (with none as the reference), the number of DAVF-related visits (with one visit as the reference), the site of onset (with cavernous sinus area as reference), unilateral cerebral artery supply, high orificium fistula flow rate, Borden's type (with type I as the reference), venous drainage patterns predictive of the invasiveness and high bleeding risk (cortical venous drainage, varicose or aneurysmal dilatation, large cerebral venous drainage, or pia mater venous drainage), and reverse reflux direction as independent variables. The study found that being a female (*OR* = 5.42, 95% *CI*: 2.12-13.84, *P* = 0.001), having a higher number of DAVF-related visits (*P* = 0.008), having a higher number of common chronic diseases (*P* = 0.026), and having a lower annual household income (*P* = 0.006) were risk factors for depression. Patients with 2-3 visits and >3 visits had 3.42 times (*P* = 0.013) and 10.14 times (*P* = 0.011) higher risk of depression, respectively, compared with those with only one visit. Patients with one, 2-3, and >3 comorbid common chronic diseases had 5.00 times (*P* = 0.018), 6.56 times (*P* = 0.008), and 8.09 times (*P* = 0.006) higher risk of depression, respectively, compared with those with no comorbid common chronic diseases. Patients with an annual

Table 5: Comparison of the Hamilton Depression Scale scores before and after endovascular treatment in 168 patients with dural arteriovenous fistula [*M* (P_{25}, P_{75}), points]

	Anxiety somatization scores	Body mass change scores	Cognitive impairment scores	Day-night change scores	Blocking scores	Sleep disturbance scores	Sense of despair scores	Points
Before endovascular treatment*	2.0 (1.0, 5.0)	0.0 (0.0, 1.0)	1.0 (0.0, 4.0)	0.0 (0.0, 1.0)	1.0 (0.0, 2.0)	2.0 (1.0, 2.0)	1.0 (0.0, 1.0)	7.0 (3.0, 15.0)
After endovascular treatment**	1.0 (0.0, 3.0)	0.0 (0.0, 0.0)	1.0 (0.0, 2.0)	0.0 (0.0, 0.0)	1.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	4.0 (1.0, 9.0)
Z	-9.4	-1.1	-8.4	-4.8	-3.0	-8.8	-0.3	-10.9
P	<0.01	0.256	<0.01	<0.01	0.003	<0.01	0.761	<0.01

*: After the physician's preoperative talk; **: before discharge after endovascular treatment

Table 6: Analysis of factors influencing anxiety before endovascular treatment in 168 patients with dural arteriovenous fistula

Independent variables	Regression coefficient	Standard error	Waldχ^2	OR	95%CI	*P*
Female	1.69	0.51	11.179	5.40	2.01-14.53	0.001
The mode of DAVF detection (symptoms)	1.26	0.59	4.535	3.51	1.11-11.14	0.033
Annual household income (RMB)[a]						
≤50,000	3.01	0.93	10.402	20.20	3.25-125.49	0.001
>50,000-100,000	2.22	0.85	6.833	9.21	1.74-48.65	0.009
The total number of common chronic diseases experienced[b]						
1	2.16	0.72	9.030	8.65	2.12-35.30	0.003
2-3	1.96	0.75	6.778	7.08	1.62-30.87	0.009
>3	2.51	0.80	9.828	12.25	2.56-58.70	0.002
The number of DAVF-related visits[c]						
2-3	1.50	0.53	8.067	4.46	1.59-12.53	0.005
>3	3.02	1.07	8.022	20.49	2.54-165.65	0.005

a: >200,000 Yuan as the reference; b: With none as the reference; c: with one visit as the reference

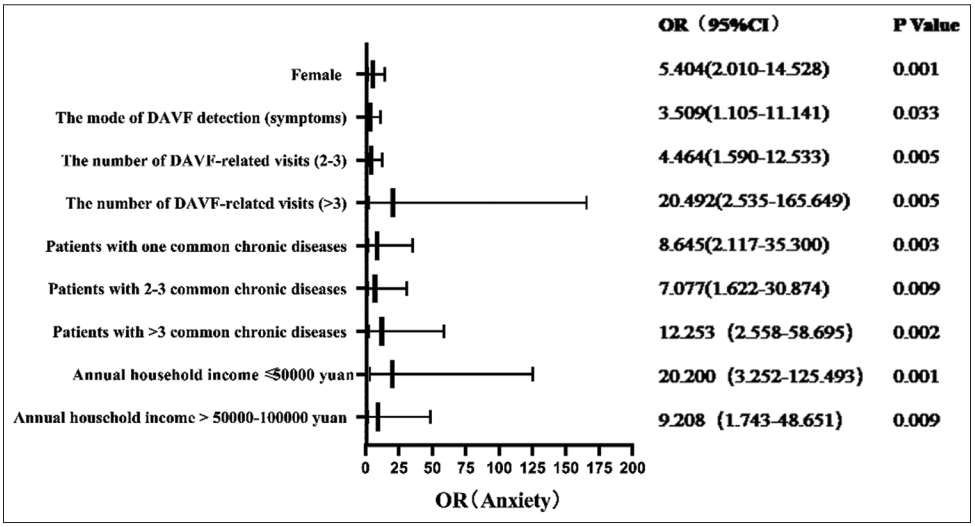

Figure 2: Odds ratio chart of the risk factors for anxiety

income of ≤50,000 Yuan and >50,000-100,000 Yuan had 13.35 times (P = 0.003) and 5.02 times (P = 0.037) higher risk of depression, respectively, compared with patients with an annual household income of >200,000 Yuan. Patient age, male sex, smoking, alcohol consumption, education level, the payment method for medical expenses, the mode of DAVF detection, the site of onset, unilateral cerebral artery supply, high orificium fistula flow rate, Borden's type, venous drainage patterns predictive of the invasiveness and high bleeding risk, reverse venous reflux direction, and an annual household income of >100,000-200,000 Yuan were not associated with depression (all P > 0.05) [Table 7 and Figure 3].

Discussion

The diagnosis of DAVF can be challenging due to its diverse and complex clinical presentation, which might lead to misdiagnosis and underdiagnosis.[15] Pulsatile tinnitus and headache are common symptoms of transverse-sigmoid sinus arteriovenous fistulae in European and American populations. However, in Asian populations, cavernous sinus arteriovenous fistulae are more prevalent and typically present with proptosis, papilledema, ophthalmoplegia, and dysopia.[16-19] Katz *et al*.[20] reported a case of reversible major depressive disorder caused by sagittal sinus DAVF, which was successfully treated after surgical intervention. Additionally, Nakagawa *et al*.[21] reported a case of DAVF combined with depression, wherein endovascular treatment resulted in improved depressive symptoms.

In this study, 51.2% and 47.0% of the 168 patients with DAVF were found to have anxiety and depression, respectively, before undergoing endovascular treatment. After endovascular treatment, the percentage of anxiety and depression in all 168 patients with DAVF was significantly lower than that before endovascular treatment. The factors influencing anxiety and depression in DAVF patients are diverse and multifaceted. In this study, female patients, patients with clinical symptoms, those with multiple visits, those with more comorbid underlying diseases, and those who were

Table 7: Analysis of factors influencing depression before endovascular treatment in 168 patients with dural arteriovenous fistula

Independent variables	Regression coefficient	Standard error	Waldχ^2	OR	95% CI	*P*
Female	1.69	0.48	12.440	5.42	2.12-13.84	0.001
Annual household income (RMB)[a]						
≤50,000	2.59	0.86	9.045	13.35	2.47-72.29	0.003
>50,000-100,000	1.61	0.77	4.372	5.02	1.11-22.77	0.037
The total number of common chronic diseases experienced[b]						
1	1.61	0.68	5.637	5.00	1.32-18.87	0.018
2-3	1.88	0.71	7.007	6.56	1.63-26.41	0.008
>3	2.09	0.77	7.452	8.09	1.80-36.28	0.006
The number of DAVF-related visits[c]						
2-3	1.23	0.50	6.116	3.42	1.29-9.05	0.013
>3	2.32	0.92	6.390	10.14	1.68-61.07	0.011

a: >200,000 Yuan as the reference; b: with none as the reference; c: with one visit as the reference

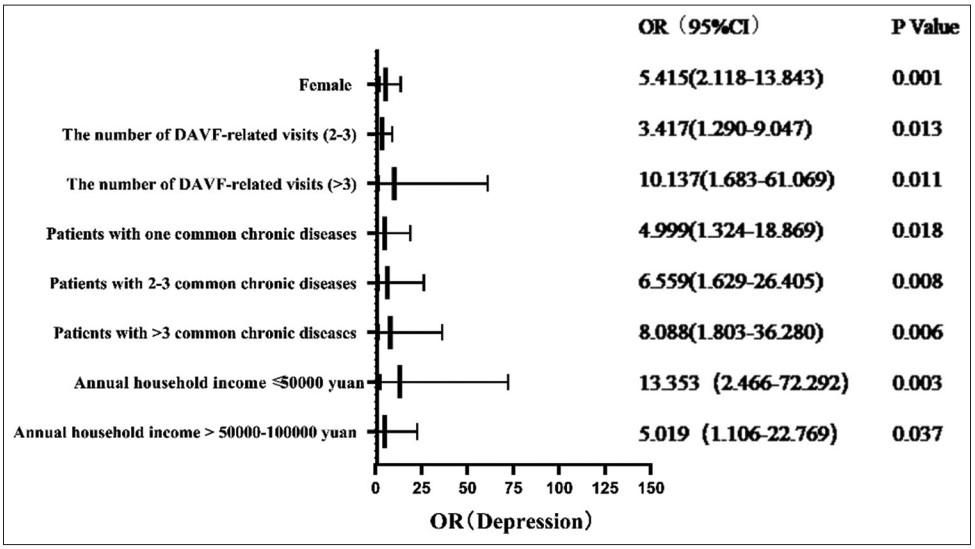

Figure 3: Odds ratio chart of the risk factors for depression

economically disadvantaged were more likely to develop anxiety and depression.

Several retrospective studies conducted over 10 years have indicated that the proportion of intracranial hemorrhage in men with DAVF is significantly higher than in women.[22,23] In particular, patients with DAVF who have trans-sinus reflux into the pial vein with a venous lake or significant venous dilatation and those with DAVF who have direct molluscum venosum reflux are at high risk of intracranial hemorrhage.[24,25] In this study, female patients with DAVF were more likely to develop anxiety and depression than male patients, and there are multiple reasons for this phenomenon. Psychologically, women are more emotional and sensitive, making them more prone to mental health problems. In terms of the lesion site, DAVF in the cavernous sinus region is more common in female patients, which is associated with a lower risk of intracranial hemorrhage but might result in prolonged mild symptoms due to the lack of active treatment, causing long-term discomfort and physical and psychological shock, resulting in a reduced quality of life, and ultimately anxiety and depression. Additionally, women today have more prominent social responsibilities and might bear a heavier psychological burden when facing diseases, as they not only have more family responsibilities but also face work pressure in the workplace.

Patients with intracranial aneurysms detected due to symptoms such as headache and dizziness are more likely to experience anxiety and depression than those with incidental findings discovered during physical examination.[26] Similarly, the present study involving DAVF as an intracranial vascular malformation demonstrated that patients who had DAVF detected by symptoms such as headache, pulsatile tinnitus, and proptosis were more prone to anxiety than those with incidental findings discovered during physical examination. The presence of disease symptoms acts as an "alarm" for physical abnormalities, creating tremendous stress for patients during the treatment process and increasing the risk of psychiatric problems.

Repeated visits to healthcare facilities can aggravate a patient's anxiety and depression, as they might develop an exaggerated sense of their disease severity. In this study, the primary reasons for multiple visits among patients with DAVF included the uneven distribution of medical resources, unbalanced medical standards, and lack of knowledge about the disease. Interestingly, a significant proportion of these patients initially visited departments such as ophthalmology and otorhinolaryngology, instead of neurological specialties. Due to limited expertise, physicians in these departments did not consider the possibility of cerebrovascular disease, did not advise patients to undergo cranial magnetic resonance imaging or DSA examination, and only provided symptomatic support treatment. The lack of standardized specialist treatment resulted in patients repeatedly visiting without improvement, ultimately increasing their degrees of anxiety and depression.

Chronic underlying diseases do not directly cause anxiety and depression in patients. However, as the number of such diseases increases, the body's function might deteriorate, and the long-term treatment of multiple chronic diseases could lead to a decline in self-efficacy, self-confidence in treatment behavior, and disease resistance, resulting in negative psychosocial changes. These factors are directly associated with anxiety and depressive states.

Patients with lower economic status experience limited availability of healthcare resources and lessened options for accessing care. This situation places them at higher not only during treatment but also under enormous financial pressure. Consequently, their emotional state might become negative and depressed, leading to a decrease in their level of hope for life and an increased likelihood of experiencing anxiety and depression.

Education level is a significant factor that can contribute to anxiety and depression. Insufficient knowledge and awareness about DAVF by patients might explain this phenomenon. Moreover, DAVF might have a slowly progressive natural course that does not significantly affect patients' lives in the short term. Therefore, elderly patients with low education levels might tolerate relatively mild and prolonged symptoms. The limited sample size of patients (eight cases) with university or higher education levels in this study might also have contributed to the confounding factor. Nevertheless, education level plays a crucial role in patient compliance with treatment and the choice of intervention.

With the shift from a biomedical approach to a bio-psycho-social medical model, increasing focus is paid to the relationship between the mind and body in the context of disease. Treatment now encompasses not only the relief of symptoms and disease improvement but also the promotion of physical and mental health. Female patients and those with clinical symptoms, multiple visits, more comorbid underlying diseases, and lower economic status have a higher incidence of anxiety and depression in DAVF cases. Therefore, neurosurgeons and psychiatric nurses should incorporate psychosomatic factors into the comprehensive preoperative evaluation of patients with DAVF. Furthermore, interventions such as health education, psychological guidance, and support should be provided to patients with anxiety and depression in clinical practice. These measures can help improve DAVF patients' understanding of surgery, enhance their overall disease awareness, correct their misconceptions about the disease, reshape their perceptions of the disease, and reduce their anxiety and depression.

The present study has some limitations. First, the small sample size of this study could lead to bias. In the future, selecting a larger sample size and conducting multicenter assessments with updated psychiatric assessment tools will help evaluate the psychiatric status of patients with DAVF more objectively. Moreover, differences in ethnicity, culture, education, and economy between China and Western countries could lead to diverse manifestations of psychiatric disorders in patients with DAVF. Additionally, studies with more collaborative centers, larger sample sizes, and longer follow-ups are needed to further validate the findings of this study.

Conclusion

This study examined the psychiatric profile of patients with DAVF before and after a multicenter intervention. After undergoing endovascular treatment, the percentage of patients with anxiety and depression decreased significantly. Factors such as female sex, clinical symptoms, multiple visits, more comorbid underlying diseases, and lower economic status were associated with an increased likelihood of developing anxiety and depression. Therefore, a psychosomatic evaluation should be included in the overall assessment of this patient population. Overall, the study provides a scientific basis for endovascular therapy to improve the anxiety and depression psychological status in patients with DAVF.

Ethic statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Zhangzhou Municipal Hospital of Fujian Province (the approval number of the ethics committee: 2023LWB117) and the Ethics Committee of the Second Affiliated Hospital of Fujian Medical University (the approval number of the ethics committee: 2022-183).

Informed consent statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from all patients to publish this paper.

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Conflicts of interest

There are no conflicts of interest.

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