Retraction

Retracted: Imaging Diagnosis and Interventional Treatment for Hepatocellular Carcinoma Combined with Arteriovenous Fistula

Journal of Healthcare Engineering

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Z. Cai, M. Ran, J. Song, W. Zhen, and M. Li, "Imaging Diagnosis and Interventional Treatment for Hepatocellular Carcinoma Combined with Arteriovenous Fistula," *Journal of Healthcare Engineering*, vol. 2021, Article ID 6651236, 13 pages, 2021.

Research Article

Imaging Diagnosis and Interventional Treatment for Hepatocellular Carcinoma Combined with Arteriovenous Fistula

Zheng Cai [ID],[1] Maohui Ran,[2] Jiantao Song,[1] Wenrui Zhen,[1] and Mingjian Li[1]

[1]*The Second Affiliated Hospital of Zunyi Medical University, Zunyi 563000, Guizhou, China*
[2]*Affiliated Hospital of Zunyi Medical University, Zunyi 563000, Guizhou, China*

Correspondence should be addressed to Zheng Cai; 101026@zmu.edu.cn

In order to explore the imaging diagnosis methods and interventional treatment effects of hepatocellular carcinoma combined with hepatic arteriovenous fistula (HAVF), a total of 120 patients, who were diagnosed as hepatic carcinoma with arteriovenous shunting and underwent medical imaging diagnosis and interventional surgery therapy at a designated hospital by this study from December 2014 to December 2018, were chosen as study subjects. Digital subtraction angiography was performed to analyze the imaging features of hepatocellular carcinoma combined with HAVF in each patient; then, according to these imaging diagnosis results, gelatin sponge or coil was used to block the fistula; mitomycin, carboplatin powder, and lipiodol mixed emulsion was combined or separately utilized for hepatic tumor embolization, in which iodized oil embolization chemotherapy was used for patients with mild paralysis; gelatin sponge granule embolization chemotherapy was used for moderate paralysis patients at their first intervention, and, after about 1 month, if the sputum disappeared, iodized oil embolization was used again; and hepatic arterial infusion chemotherapy was used only for patients with severe paralysis. The results show that the central type of HAVF is characterized by early angiography of portal vein and large branches and tumor staining after portal vein's angiography; the peripheral type of HAVF is characterized by portal vein branching in hepatic tumor and double rail sign accompanied by the arterial branch; 112 cases of patients completed embolization chemotherapy; 8 cases of patients only received chemotherapy perfusion; in 109 cases of patients sputum disappeared or shunt decreased at first treatment; and in 113 cases of patients iodine oil was well deposited or the tumor was stably reduced; most of the symptoms of refractory ascites, diarrhea, and upper gastrointestinal bleeding were controlled or improved, and there were no complications such as pulmonary embolism and hepatic failure. Therefore, HAVF increases the difficulty of interventional therapy, but, as long as the positive and appropriate treatment measures are taken, it can still achieve better curative effect without serious complications, which can effectively alleviate the clinical symptoms of patients and improve the quality of life of patients. The results of this study provide a reference for the further researches on imaging diagnosis and interventional treatment for hepatocellular carcinoma combined with arteriovenous fistula.

1. Introduction

Hepatic arteriovenous fistula (HAVF) is an organic and functional abnormal pathway between hepatic artery and portal vein and between hepatic artery and hepatic vein, which is more common with hepatocellular carcinoma, trauma, hepatic hemangioma, cirrhosis, hepatic biopsy, hepatic abscess, and other diseases with the incidence rate of 14–63.2% [1]. HAVF is divided into three types: hepatic artery-portal vein fistula (HAPVF), hepatic artery-hepatic vein fistula (HAHVF), and mixed fistula; and HAPVF is divided into two types: central type and peripheral type; and primary hepatocellular carcinoma often invades the venous system of the hepatic and HAVF occurs [2]. The abnormal anastomosis of HAVF directs blood flow between the hepatic artery and the portal vein and hepatic vein. The presence of HAVF accelerates the spread of tumors in the hepatic and throughout the body, which not only is a cause of tumor cell metastasis in the hepatic, but can also cause portal hypertension. HAPVF can cause or aggravate the symptoms of portal hypertension, such as gastrointestinal bleeding and ascites; severe life can be critical; HAVF can

increase the chance of tumor cells spreading through the portal vein and hepatic vein to distant organs and can increase the false diagnosis of hepatic imaging positive rate [3]. In interventional therapy, lipiodol can cause pulmonary and systemic embolism through the shunt pathway, and hemodynamic changes due to shunt can directly affect the efficacy of transcatheter arterial chemoembolization (TACE) intervention, so understanding the imaging diagnosis and intervention of HAVF Treatment has important implications [4].

Digital subtraction angiography (DSA) examination is the gold standard for diagnosing HAVF, in which central HAPVF is located in the portal vein or the primary branch and peripheral HAPVF is located in the lower branch of the portal vein. It can also be divided into high, medium, and low flow types due to different flow rates; generally, the centre type flow rate is high, and the surrounding type flow rate is low [5]. The location and type of HAVF before interventional embolization can help to choose the interventional method and avoid the occurrence of ectopic embolization and improve the treatment effect. With the improvement of imaging examination technology, the detection rate of HAVF is gradually improved. Doppler ultrasound can find abnormal thickening of the blood supply artery and abnormal blood flow of the corresponding vein and it is rare to find a direct display of abnormal shunt between arteries and veins and enhanced computed tomography scans can be seen early in the arterial-portal vein [6]. DSA can clearly show the location and flow of HAVF, which is characterized by the dual-track sign of the portal vein in the arterial phase. The arterial phase portal vein contrast agent is filled; the contrast agent entering the hepatic vein branch or the right atrium of the vena cava during the arterial phase where the liver supplies blood to the blood vessel is not clear, and the tumor staining is not obvious. When the HAVF flow is low, the arterial and late portal vein branches or hepatic veins develop, and most mouthwashes appear to be chaotic [7]. Understanding the performance of the above DSA can guide the choice of interventional embolization methods to avoid complications [8].

In order to explore the imaging diagnosis methods and interventional treatment effects of hepatocellular carcinoma combined with hepatic arteriovenous fistula (HAVF), a total of 120 patients, who were diagnosed as hepatic carcinoma with arteriovenous shunting and underwent medical imaging diagnosis and interventional surgery therapy at a designated hospital by this study from December 2014 to December 2018, were chosen as study subjects. Digital subtraction angiography was performed to analyze the imaging features of hepatocellular carcinoma combined with HAVF in each patient; then, according to these imaging diagnosis results, gelatin sponge or coil was used to block the fistula; mitomycin, carboplatin powder, and lipiodol mixed emulsion was combined or separately utilized for hepatic tumor embolization, in which iodized oil embolization chemotherapy was used for patients with mild paralysis; gelatin sponge granule embolization chemotherapy was used for moderate paralysis patients at their first intervention, and, after about 1 month, if the sputum disappeared, iodized oil embolization was used again; and hepatic arterial infusion chemotherapy was used

only for patients with severe paralysis. The detailed chapters are arranged as follows: Section 2 introduces research materials and methods; Section 3 performs results analysis; Section 4 analyzes the imaging diagnosis and interventional treatment of hepatocellular carcinoma with arteriovenous fistula; Section 5 is discussion; Section 6 is conclusion.

2. Materials and Methods

2.1. General Materials. A total of 120 patients, who were diagnosed as hepatic carcinoma with arteriovenous shunting and underwent medical imaging diagnosis and interventional surgery therapy at a designated hospital by this study from December 2014 to December 2018, were chosen as study subjects including 60 cases of HAPVF and 60 cases of HAHVF. These materials contain 40 males and 28 females; their ages are 34–86 years with an average of 55.74 ± 10.23 years old; their hepatocellular carcinoma pathology classification includes 34 cases of massive type, 41 cases of nodular type, and 45 cases of diffuse type (Table 1); the HAHVF contains 31 cases of central type and 29 cases of peripheral type (Table 2); their hepatic function includes 24 cases of Child A, 78 cases of Child B, and 18 cases of Child C according to hepatic function rating criteria (Table 3); their histological classification contains 113 cases of hepatocyte type and 5 cases of hepatic bile duct type and mixed type; their clinical classification includes 85 cases of simple type (there were no clinical manifestations and clinical examination showed no obvious cirrhosis), 8 cases of sclerosing type (clinical and laboratory tests have obvious cirrhosis manifestations), and 27 cases of inflammatory type (faster disease development accompanied by persistent cancerous hyperthermia or alanine aminotransferase continued to increase more than double); the tumor sizes are in 1–17 cm with an average size of 7.96 ± 4.23 cm; the α-fetoprotein level is in 1–58100 μg/L with an average level of 28950.56 ± 28095.64 μg/L; the clinical symptoms were mainly in 33 patients with ascites, 29 patients with gastrointestinal bleeding, 39 patients with anorexia and diarrhea, and 19 patients without obvious discomfort.

2.2. Inclusion and Exclusion Criteria. The inclusion criteria were the following: (1) patients who refused surgery treatment; (2) patients who did not meet the surgical resection; (3) patients who met the diagnostic criteria for primary hepatocellular carcinoma with HAHVF; and (4) patients without heart and kidney dysfunction.

The exclusion criteria were the following: (1) patients with poor general condition and signs of failure; (2) patients with extensive systemic metastasis of hepatocellular carcinoma: (3) patients with secondary infection or systemic infection; (4) patients with severe hepatic function disorders; and (5) patients with reverse portal blood flow or blocked portal vein trunk.

2.3. Imaging Diagnosis Methods. The digital subtraction angiography examination was as follows: transfemoral puncture, conventional superior mesenteric artery and celiac artery angiography, selective contrast and interventional therapy,

Table 1: Statistics of hepatic arteriovenous fistula (HAVF) type in the included materials [n (%)].

HAVF type	Massive type	Nodular type	Diffuse type	Total
HAPVF	19 (15.83)	24 (20.00)	33 (27.50)	76 (63.33)
HAHVF	10 (8.33)	15 (12.50)	9 (7.50)	34 (28.33)
Mixed fistula	5 (4.67)	2 (1.67)	3 (2.50)	10 (8.33)
Total	34 (28.33)	41 (34.17)	45 (37.50)	120 (100.00)

Table 2: Statistics of hepatic artery-hepatic vein fistula (HAHVF) type in the included materials [n (%)].

HAPVF type	Mild	Moderate	Severe	Total
Central type	11 (18.33)	12 (20.00)	8 (13.33)	31 (51.67)
Peripheral type	6 (10.00)	13 (21.67)	10 (16.67)	29 (48.33)
Total	17 (28.33)	25 (41.67)	18 (30.00)	60 (100.00)

Table 3: Child classification of hepatic function in the included HAVF patients [n (%)].

HAVF type	Child classification of hepatic function			Total
	A	B	C	
HAPVF	10 (8.33)	21 (17.50)	3 (2.50)	34 (28.33)
HAHVF	8 (6.67)	16 (13.33)	8 (6.67)	32 (26.67)
Mixed fistula	6 (5.00)	41 (34.17)	7 (5.83)	54 (45.00)
Total	24 (20.00)	78 (65.00)	18 (15.00)	120 (100.00)

total injection volume of contrast agent 20–35 mL/time, rate of 3–6 mL/s observe tumor blood supply, hepatic arteriovenous fistula, and tumor site. According to the arteriovenous fistula and the amount of blood in the shunt, there are two different methods: central type and peripheral type. Central type: if patients can overselect the intubation and pass the sputum into the tumor blood vessel, slowly inject iodine under fluoroscopy; the oil suspension is embolized, and then the catheter is withdrawn to the mouth to seal the mouth with gelatin sponge particles. If the catheter tip cannot pass over the fistula, first seal the fistula with gelatin sponge particles and then embolize. Peripheral type is mainly used for catheters that cannot be inserted into the fistula. Appropriate amount of gelatin sponge particles are used for embolization. The contrast agent is pushed by hand to observe the embolism of the oral cavity. After the TACE port is completely blocked, TACE can directly treat small blood flow. The DSA shows that the portal vein, hepatic artery, or inferior vena cava develops in advance during the hepatic artery or hepatic parenchyma, which is a combined HAVF. The HAVF angiography showed a portal vein with a large branch of the first or second stage or a peripheral portal vein with a parallel to the artery and HAVF manifests as early hepatic vein and reflux of contrast agent to right atrium.

2.4. Interventional Treatment Solutions. The treatment plan takes a different approach depending on the location of the arteriovenous fistula and the amount of blood diverted through it. For the central type, the method of intubating the fistula is used. According to the size of the fistula shown by the comparison, gelatin sponge particles, gauze or stainless steel ring can be used to embolize the fistula, and then perform TACE treatment. This requires slow perfusion of 4-Fu 1.0 μg, cisplatin 55 μg, hydroxycamptothecin 35 mg, doxorubicin 45 mg or mitomycin 25 mg, and lipiodol plus appropriate amount of suspension for embolization. In addition, it is also possible to intubate the fistula, which requires TACE local lesion treatment first, and then embolize the fistula according to the above method, and the rest will be treated with TACE. Peripheral type: the catheter can be inserted into the fistula; the treatment method is the same as before; the catheter cannot be inserted into the fistula, so use appropriate amount of gelatin sponge particles and embolize the contrast agent to observe the embolization of the fistula until the fistula is completely embolized and then use TACE. Small-area or hepatic portal vein fistula with small blood flow is directly treated with TACE and hepatic artery-hepatic vein fistula is to select gelatin sponge granules or gauze embolization according to the size of the mouth and then apply TACE.

2.5. Clinical Efficacy Criteria. Clinical efficacy is divided into three levels: complete remission, partial remission, and ineffective remission. Gastrointestinal hemorrhage: vomiting or blood in the stool disappears; fecal occult blood negative is complete remission; hematemesis or blood in the stool disappears; fecal occult blood positive is partial remission; hematemesis or blood in the stool remains ineffective. Ascites: abdominal water was significantly reduced by ultrasound at least to complete remission; equal reduction in ascites was partial remission; no significant reduction in ascites was ineffective. Esophageal varices: there is temporary esophageal sputum angiography; varicose veins to the upper part of the chest esophagus are severe; the middle part of the esophagus is moderate and only the lower part of the esophagus is mild. The esophageal varices were completely relieved from severe to mild or there was no obvious varicose; partial remission was changed from severe to moderate or moderate to mild; no significant change in varicose veins was ineffective.

2.6. Observation Indicators. When the patient's clinical indicators are restored, no adverse reactions are considered to be significant treatment; when the patient's clinical indicators are improved compared to the treatment activities, it is considered effective; regarding the patient's clinical items, if the indicator situation has not been improved or is becoming more serious, it is considered to be ineffective. Among them, the total clinical efficiency is the sum of significant efficiency.

2.7. Statistical Methods. The data of this study were analyzed by SPSS 19.0 statistical software. The measurement data and counting data were expressed by $\bar{x} \pm s$ and %, respectively. The t and P tests were used, and the results were statistically significant at $P < 0.05$.

3. Result Analysis

3.1. Performance and Classification of Digital Subtraction Angiography. HAHVF is generally characterized by early development of hepatic vein, during which the portal vein or branch development is seen in the arterial phase and is mainly divided into the central type and periphery type. The fistula is located in the portal vein and the primary branch of the arteriovenous fistula and portal vein trunk and branch visualization; peripheral angiography showed simultaneous portal vein branching along the arterial branch and double rail sign accompanied by arterial branches. The venous sputum DSA main manifestations included double rail sign accompanying the portal vein in the arterial phase, showing the filling of the portal vein contrast agent; the contrast agent enters the branch of the hepatic vein or the right atrium of the vena cava (Table 4). After iodized oil embolization, the iodized oil venous sign appeared, and the line sign was displayed in the portal vein tumor thrombus after angiography. All patients with moderate or severe arteriovenous fistula have a transient focal, multifocal, or diffuse contrast agent staining process before the venous branch is developed. Then, there was a vein development in the corresponding area, and no tubular communication between the arteries and veins was found that is consistent with the mechanism of the occurrence of hepatic arteriovenous fistula and is also supported in ultrasound. Ultrasound mainly found abnormal thickening of the blood supply artery and abnormal blood flow of the vein, and there was little direct display of abnormal shunt between arteries and veins.

Hepatocellular carcinoma combined with arteriovenous fistula is one of the main factors affecting the prognosis of hepatocellular carcinoma, and it is the focus and difficulty of endovascular treatment of hepatocellular carcinoma. At present, the treatment methods for HAVF are commonly used such as spring steel ring, gelatin sponge particles, anhydrous ethanol, and percutaneous transhepatic puncture and injection of anhydrous ethanol to close the mouth. The spring steel ring can permanently embolize the larger arterial branch, and the embolization site of the gelatin sponge particles is in the small and medium arteries, both of which are nonselective embolization [9]. At the same time as embolization, the tumor is often blocked by the blood supply artery of the tumor, so that the subsequent lipiodol emulsion embolization is not possible or peripheral vascular embolization is inadequate, which seriously affects the embolization effect of the tumor, and the amount of intravascular embolization of absolute ethanol is not easy to control. If reflux can lead to ectopic embolization, clinical application should not be promoted; the main adverse reactions after sputum and embolization were numbness, fever, and hepatic function changes. Symptomatic treatment generally has no serious consequences. Pain mainly occurs in the operation; preembolization prophylactic bolus lidocaine can be helpful; postoperative main manifestations of suffocation discomfort, mainly due to the ischemic reaction of the lesion, can be given a small amount of analgesic symptomatic treatment; the main cause of fever is tumor necrosis after TACE, which can be generally relieved after treatment.

According to DSA angiography, HAHVF is divided into three categories. The first category is the direct destruction of normal hepatic arteries and tumor veins. For the second type, early tumor vein development can be seen, but the shunt is long and slender. There is no clear passage between the artery and the vein. The tumor blood vessel is large and obviously twisted, or the tumor blood vessel is light to obvious with multiple blood type changes. For the third type, there are a large number of dense tumor blood vessels, and there is no obvious early venous development during the angiography, but arteriovenous short circuits are found when embolism exists. HAVF is performed in computed tomography or magnetic resonance imaging, central HAVF is located in the hilar, portal vein, and grade I branch is enhanced earlier than superior mesenteric vein or splenic vein, densely developed; density is close to enhanced abdominal aorta, there is nontumor hepatic parenchyma in the hepatic arterial phase, and the portal vein returned to normal. Peripheral HAVF is located in the surrounding hepatic parenchyma, and the branches of the portal vein level and below are enhanced earlier than the portal vein (Figure 1). The Doppler blood flow spectrum can be considered as HAVF: the multicoloured mosaic blood flow is in the venous lumen; for the hepatic portal vein in the portal vein, see reverse blood flow or two-way blood flow; the blood flow spectrum is the reverse artery sample, high-speed and low-resistance type; hepatic vein sputum can be measured in the hepatic vein, arterial-like, high-speed, and low-resistance blood flow spectrum; hepatic artery inner diameter is widened [10].

3.2. Treatment Results of Chemotherapy Embolization. Since the mouth of the HAPVF is located at the tumor, the blood between the tumor and the portal vein is directly transported, and intrahepatic dissemination and extrahepatic metastasis of the hepatocellular carcinoma are formed, followed by anterior hepatic sinus portal hypertension (Table 5). A large amount of high-pressure arterial blood directly enters the lower-pressure portal vein through the fistula, causing the portal pressure to rise further on the basis of the portal hypertension caused by the original cirrhosis or portal vein tumor thrombus, which may cause upper gastrointestinal bleeding. The original hepatic damage is aggravated and the life of the patient is seriously threatened [11]. Therefore, the treatment of such patients is to treat the primary hepatocellular carcinoma, block the hepatic artery-venous shunt, improve the hepatic circulation, relieve and eliminate the symptoms of gastrointestinal bleeding and ascites caused by portal hypertension, and at the same time further select the blood supply artery embolizing the tumor, protecting normal hepatic tissue, and reducing the probability of tumor spreading through the fistula. The hepatocellular carcinoma combined with HAVF increases the difficulty and risk of interventional embolization. However, as long as the patient's general condition permits, after a detailed understanding of the type of sputum, the size of the subflow, the presence or absence of portal collateral circulation, etc., a reasonable treatment plan is formulated and the treatment is still safe and

Table 4: Performances of digital subtraction angiography given different types of dynamic portal fistula, *n* (%). MF: mixed fistula.

| Group	With inverse hepatic blood flow				With portal vein tumor thrombus			
	Mild	Moderate	Severe	Total	Mild	Moderate	Severe	Total
HAPVF	9 (7.500)	12 (10.00)	23 (19.17)	44 (36.67)	14 (11.67)	9 (7.50)	17 (14.17)	40 (33.33)
HAHVF	13 (10.83)	6 (5.00)	11 (9.17)	30 (25.00)	7 (5.83)	10 (8.33)	11 (9.17)	28 (23.33)
MF	8 (6.67)	17 (14.17)	21 (17.50)	46 (38.33)	15 (12.50)	16 (13.33)	21 (17.50)	52 (43.33)
Total	30 (25.00)	35 (21.17)	55 (35.83)	120 (100.0)	36 (30.00)	35 (21.67)	49 (40.83)	120 (100.0)

(a)

(b)
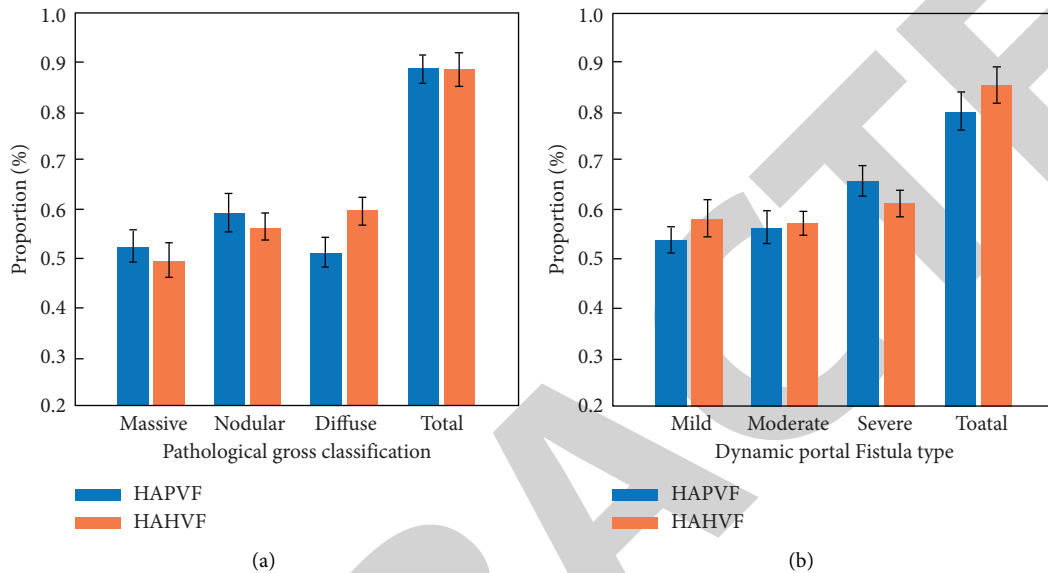
Figure 1: Comparison of relative proportions of different pathological gross classifications (a) and dynamic portal fistula types (b) in the HAPVF and HAHVF.

Table 5: Treatment results of chemotherapy embolization given different fistula type and tumor embolization [*n* (%)]. MF: mixed fistula.

Group	Case of embolizing tumor by overpassing fistula				Case of embolizing tumor not by overpassing fistula			
	Mild	Moderate	Severe	Total	Mild	Moderate	Severe	Total
HAPVF	24 (20.00)	16 (13.33)	9 (7.50)	49 (40.83)	11 (9.17)	15 (12.50)	10 (8.33)	36 (30.00)
HAHVF	17 (14.17)	11 (9.17)	10 (8.33)	38 (31.67)	19 (15.83)	18 (15.00)	12 (10.00)	49 (40.83)
MF	11 (9.17)	13 (10.83)	9 (7.50)	33 (27.50)	16 (13.33)	10 (8.33)	19 (15.83)	35 (29.17)
Total	52 (43.33)	40 (33.33)	28 (23.33)	120 (100.0)	46 (38.33)	33 (27.5)	41 (34.17)	120 (100.0)

feasible and generally does not cause serious hepatic functional impairment and hepatic failure.

The hepatocellular carcinoma combined with HAVF increases the risk and difficulty of interventional therapy, and the high incidence of portal vein tumor thrombus also makes the patient's prognosis worse. However, for patients who have not completely occluded the portal vein or have collateral circulation to the hepatic, it is generally considered safe and effective to treat embolization. Chemotherapeutic drugs and embolic agents can flow through the fistula to nonlesional blood vessels due to the presence of the shunt, seriously affecting the treatment effect and ectopic embolism and systemic toxic side effects. Therefore, sealing the fistula is the key to treatment [12]. For central or high-flow HAPVF, due to portal vein stealing, the size of the fistula and the tumor vessels is unclear, there is conventional microcatheter superselection over the mouth angiography, and a pair of distal tumor vessels is treated with iodized oil

chemoembolization; then the catheter retreat to the vicinity of the pass (Figure 2). At this time, because a part of the blood vessels is blocked, the shunt and tumor blood vessels are often clearer, and then the mouth is blocked and the tumor is further embolized. For peripheral HAPVF, the chemotherapy drug is first infused, and then the microcatheter is first selected to the sputum to block the tumor, and the tumor blood vessel is embolized with the lipiodol emulsion, or the tumor is inserted into the tube and the tumor donor branch is avoided. For the flow rate or peripheral type HAPVF that is difficult to overselect the intubation, first test a small amount of lipiodol emulsion through the tumor blood supply artery.

The above-mentioned mechanism and imaging findings of hepatocellular carcinoma provide anatomical support for gelatin sponge granules to seal the fistula, but multifocal and diffuse fistula occlusion is still quite difficult; they are often in the fourth and fifth grades of arteriovenous after branching;
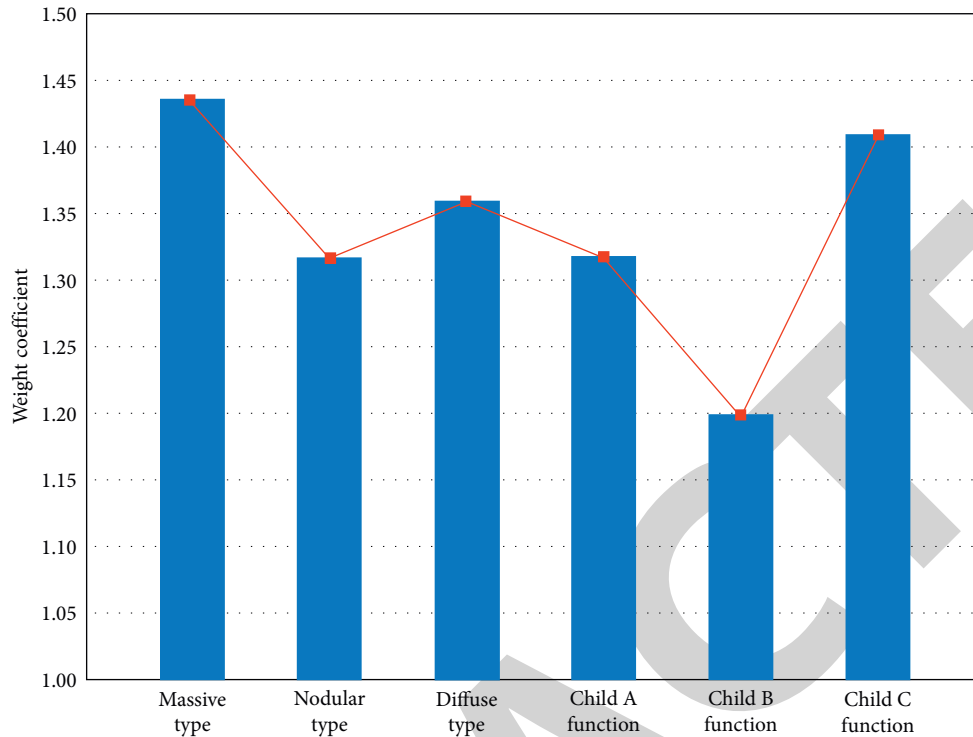
FIGURE 2: Weight coefficients of hepatic arteriovenous fistula type and hepatic function classification on imaging diagnosis.

the gelatin sponge granule blockage easily causes embolization of the blood supply artery itself, which brings obstacles to drug perfusion and lipiodol embolism. Heavy giant HAHVF is a safety consideration or a 5–6 mm steel ring embolization; for patients with central embolization of the main tumor thrombus, the closure of the fistula should be cautious, because it is easy to cause hepatic artery embolization. Moreover, such patients are not suitable for iodized oil tumor embolization even if they are successfully blocked because their hepatic function is extremely fragile; it is easy to induce hepatic coma if there is no effective rich collateral supply after normal embolization. Sometimes, the contrast dose or flow rate is not properly grasped, small hepatic HAVF cannot be found in time, and injection of lipiodol is prone to suppression, mistakenly entering the hepatic vein and entering the pulmonary circulation; sometimes the consequences are still very serious, so it is suggested that the injection of lipiodol during the operation begins in very slow speed to observe the direction of oil column movement, while paying attention to the observation of adverse reactions such as cough and timely correction of possible plugging [13].

4. Efficacy Analysis of Imaging Diagnosis and Interventional Treatment

4.1. Angiographic Features of Hepatocellular Carcinoma with Arteriovenous Fistula. The hepatic artery embolization chemotherapy has become the treatment of choice for advanced hepatocellular carcinoma, and the key for improving the efficacy is the availability of iodized oil embolization chemotherapy, in which it has been thought that the shunting of HAVF can make iodine oil cause ectopic embolization through sputum. Entering the portal vein can affect normal hepatic tissue, and entering the hepatic vein can form pulmonary embolism; therefore, it is not appropriate to use iodized oil embolism for such patients. Recently, scholars have used embolization of iodized oil directly on patients with hepatocellular carcinoma and HAVF, which can improve the curative effect without serious complications. The degree of hepatic HAVF is further divided into three levels of light, medium, and heavy, and the purpose is to determine a suitable treatment plan to improve the efficacy of such patients. In patients with mild hepatocellular carcinoma HAVF, the hepatic function is more than Child A grade, and it is more suitable for embolization chemotherapy directly with iodized oil. However, it is worth noting that the mild hepatic artery-hepatic vein fistula is more concealed and the angiography is more difficult to find, and the lipiodol can be returned to the pulmonary artery through the sputum. During the operation, it is often marked by the injection of 3–5 mL of lipiodol and the presence of occult light hepatic arteriovenous vein fistula should be considered at this time. The treatment method is to stop the injection of lipiodol in time and embolize the larger branch of the hepatic artery with gelatin sponge particles, so that the lipiodol is not blocked by the hepatic artery. The blood flow is flushed into the hepatic vein and returned to the pulmonary artery. Figure 3 shows the angiographic characteristics of different hepatocellular carcinoma with arteriovenous fistula.

The hepatocellular carcinoma combined with hepatic artery-portal fistula allows a large number of high-pressure arterial bloods to enter the portal system directly through the
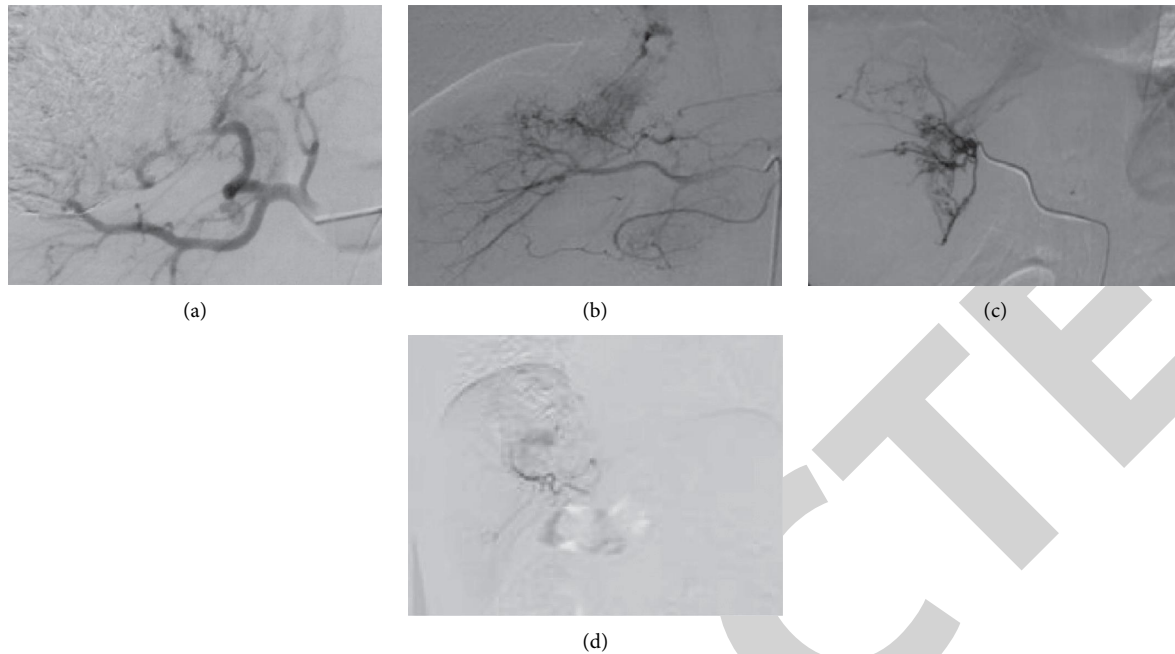
(a)

(b)

(c)

(d)

FIGURE 3: Angiographic characteristics of different hepatocellular carcinoma with arteriovenous fistula. (a) Primary hepatocellular carcinoma with severe portal vein fistula; (b) central type hepatic vein-hepatic vein fistula; (c) hepatic artery-hepatic vein fistula; (d) peripheral type hepatic artery fistula.

fistula, which further increases the portal pressure on the basis of cirrhotic portal hypertension, which also aggravates hepatic function damage and increases the incidence of upper gastrointestinal bleeding. Hepatic artery-hepatic vein sputum increases the incidence of pulmonary embolism and is one of the main factors affecting the prognosis of patients with hepatocellular carcinoma. Therefore, the treatment principle for such cases is considered to treat hepatic arteriovenous shunt, while treating primary hepatocellular carcinoma, improve blood supply to the hepatic, protect normal hepatic tissue, and alleviate gastrointestinal bleeding and ascites caused by portal hypertension. Such clinical symptoms reduce the chance of tumor metastasis through the fistula and hepatic hepatocellular vein fistula treatment because the hepatic hepatocellular vein fistula is often small and multiple and can be blocked with granules or gelatin sponge, and then TACE treatment is applied [14]. During embolization with ethyl iodide, if the sealing is not complete, a small amount of slow bolus should be given because the embolic agent enters the lungs more often and it is prone to pulmonary embolism. It corrects understanding and analysis of hepatic arteriovenous fistula combined with hepatocellular carcinoma which can effectively block the fistula to reduce portal pressure, improve hepatic blood supply, create opportunities for further treatment of hepatocellular carcinoma, prolong patient's survival time, and improve quality of life.

The control of primary hepatocellular carcinoma morbidities can increase the efficacy of TACE, significantly improve patient survival, and prolong survival. With the advancement of interventional techniques for hepatocellular carcinoma, some scholars believe that, for patients with hepatocellular carcinoma and HAVF, firstly, the fistula is

blocked, and then embolization is performed. The method of embolization is safe and reliable, which can improve the efficacy of hepatocellular carcinoma combined with HAVF. Some scholars have reported that the use of absolute ethanol to ablate the fistula multiple times until the angiography shows that the arteriovenous fistula is reduced or disappeared before TACE is performed and good results are obtained. However, embolic materials such as gelatin sponge, silk thread segments, polyvinyl alcohol particles, and spring coils are used to embolize the mouth. Because the material itself is bulky and the blood flow cannot be completely concentrated in the shunt channel, it is difficult for the embolic agent to reach the mouthwash. For accurate position, it is easy to cause the main artery of the hepatic tumor to be blocked by the main artery and not to perform TACE again. A microcatheter is applied to cross the fistula, insert itself into multiple tumor feeding arteries, and carefully inject the mixed chemotherapy drug and the appropriate amount of lipiodol under fluoroscopy; stop immediately when reflux occurs and then place the catheter head in the mouthwash with gelatin sponge or embolization of the mouthwash with absolute ethanol, slowly injecting the mixed emulsion to complete the chemoembolization without venous visualization [15].

4.2. Efficacy Comparison of Interventional Treatment under Different Embolization Modes. The small branches of the hepatic portal venules and hepatic artery pass through the hepatocyte boundary plate and enter the hepatic lobules, open to the hepatic sinus, through the hepatic sinus, and the latter merge into the interlobular vein and then merge into the hepatic vein. When the hepatic vein, the interlobular

vein, and the central venous return are blocked, the hepatic sinus pressure will increase. Through the common opening, the portal venule and the small branches of the hepatic artery can communicate to form a transvascular vascular-portal fistula. The branch of the anterior terminal hepatic arterioles in the portal area mainly passes through the fine capillary plexus around the interlobular bile duct and is introduced into the hepatic portal vein branch and finally into the hepatic sinus [16]. When the hepatic portal vein branch blood flow is blocked, the capillary plexus around the interlobular bile duct can be made. In dilation, through these expanded capillary plexus, the input venules communicate with the anterior terminal hepatic arterioles in the portal area to form an arterial-portal fistula of the vascular plexus (Figure 4). Some of the anterior terminal hepatic arterioles bypass these capillary plexus and direct blood into the hepatic sinus. When the sinus pressure increases, the blood in the hepatic sinus flows directly into the anterior terminal hepatic arterioles of the portal area, forming an artery through the hepatic sinus portal vein spasm. In the case of advanced hepatocellular carcinoma, most patients choose to undergo embolization without surgical indications, and the combination of arteriovenous fistula is considered to be a contraindication for embolism.

For patients with hepatocellular carcinoma who are alone with HAPVF, a treatment plan should be developed based on the type of HAPVF and the size of the blood flow. If the portal vein is peripheral, because of the small blood flow, conventional chemoembolization is safe and effective, because only a small part of embolic agent enters the portal vein during embolization of the hepatic artery, causing embolization of the small branch of the portal vein around the tumor to form a tumor and double embolism; tumor necrosis is more complete. When HAPVF is the central type, if the blood flow rate is not large, the chemotherapy is embolized according to the conventional scheme, and the curative effect is better; if the blood flow is large, the embolic agent mainly enters the portal vein and less enters the hepatic artery, and the tumor will not reach embolism. The effect, on the contrary, will aggravate the damage of the hepatic, and it is easy to induce hepatic coma. At this time, it is better to use a gelatin sponge strip to effectively block the fistula before embolization. If the central HAPVF portal blood flow is hepatic, the contrast agent is thickened to the left esophageal vein to the esophageal vein, which is not suitable for embolization; otherwise, it will lead to pulmonary infarction [17]. If the HAPVF is small in the peripheral or central type, the portal vein is not completely occluded or completely occluded but the side branches are abundant and it is still safe to reduce the embolization dose or the central embolization during treatment.

The principle of treatment of central HAHAF is firstly using microcatheter to overselect the sputum and directly administer partial TACE treatment under fluoroscopy. At the end of the administration, as the vascular resistance increases, when there is more iodine oil or when the mouth is lost, it needs to retreat to the mouth. The mouthwash is closed with a gelatin sponge to reduce the flushing of the lipiodol by the blood. If the blood flow is not large, the catheter is difficult to cross the fistula, because the tumor has the effect of stealing blood; it can be slowly administered in front of the fistula under fluoroscopy, and the medicine basically enters the tumor artery across the fistula; then, according to the conventional scheme chemoembolization has a good effect. If the blood flow rate is large, the conventional TACE drug enters the hepatic artery less; not only does the tumor not reach the effect of embolism, but it will aggravate the hepatic damage and easily induce hepatic coma; when the partial flow is too large, the portal vein blood flow is hepatic. At this time, the embolic agent may enter the portal vein or even the esophageal vein, causing ectopic embolization. Therefore, coaxial microcatheters should be used as much as possible, and TACE should be passed over the HAPVF arterial fistula. After TACE, the catheter is retracted to the vicinity of the fistula, the size of the fistula is accurately measured, the arteriovenous shunt is observed, and a suitable embolic material embolization is selected.

5. Discussions

5.1. Formation Mechanism of Hepatocellular Carcinoma Combined with Arteriovenous Fistula. In the case of advanced hepatocellular carcinoma, most of the patients were treated with selective interventional embolization. In combination with arteriovenous fistula, it was previously considered a contraindication for embolism, in which the efficacy of interventional embolization is mainly related to the deposition effect of embolized lipiodol in the tumor. The blood flow of the tumor is reduced when the arteriovenous fistula is combined, and the fluid pressure change in the tumor blood vessel caused by the formation of the fistula is also formed. Directly affecting the deposition of iodized oil also reduces the effectiveness of interventional therapy. At the same time, due to the presence of sputum, lipiodol can enter the normal hepatic tissue with blood flow, cause hepatic damage, enter the gastrointestinal artery, cause ectopic embolization, and enter the lungs to cause pulmonary embolism. The presence of sputum also aggravates the pressure of the portal vein, causing portal hypertension. In severe cases, gastrointestinal bleeding can occur; therefore, the treatment of sputum has important clinical significance. In the treatment of hepatocellular carcinoma combined with arteriovenous fistula, the treatment of hepatocellular carcinoma should be the ultimate goal, and portal hypertension can also be reduced. For the hepatic artery and the portal vein or the hepatic vein, the main purpose of embolization is to determine the method according to the change of blood flow, so as to reduce the complications caused by embolization to achieve the purpose of treating tumor.

Figure 5 shows the impact factors of hepatic arteriovenous fistula type and hepatic function classification on imaging diagnosis. After hepatic arteriovenous angiography, hepatic arteriovenous fistula was selected; under the DSA surveillance, different embolization methods were selected according to the size of the fistula. The diverticulum flow rate was high, and the distal hepatic artery and branches of the fistula were basically not developed. The tip of the microcatheter passes through the mouth of the fistula to iodized oil
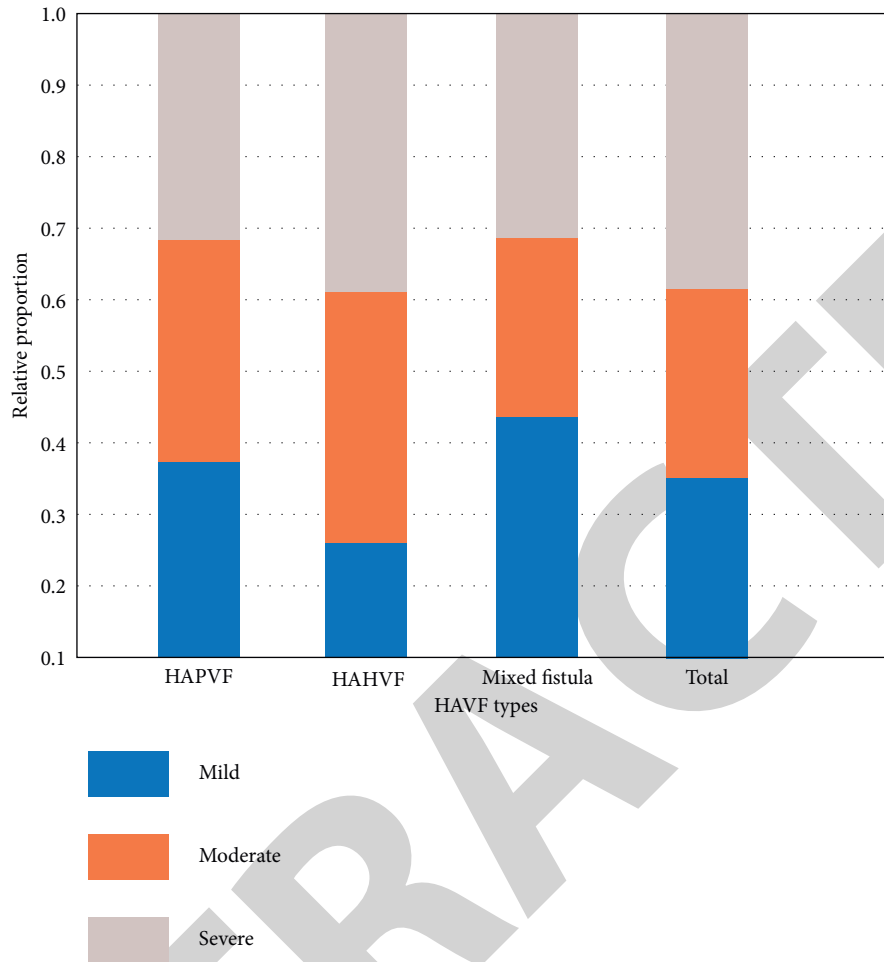
FIGURE 4: Relative proportions of different fistula type and tumor embolization.

embolization, and the distal end of the fistula is subjected to high-pressure disinfection gelatin sponge coarse particle embolization, and the proximal end of the coil is closed to the fistula; if the microcatheter head end cannot pass over the fistula, the coil is first used close to the fistula; confirm the occlusion of the fistula and then perform the hepatic arterial angiography [18]. According to the intrahepatic artery branch and the hepatic tumor angiography, determine whether to do the tumor iodized oil embolization treatment, which ends the iodine oil embolization over the mouth and then uses the high-pressure disinfection gelatin sponge coarse particles plus anhydrous alcohol mixture to close the mouth. If it cannot pass the fistula, perform the first infusion chemotherapy; then make the catheter tip close to the mouth, and use high-pressure disinfection gelatin sponge coarse particles plus anhydrous alcohol mixture to close the mouth; for medium and low partial flow, use directly iodized oil plus autoclaved gelatin sponge particles to embolize tumor lesions and close fistula. The first fractional flow is iodized oil embolism lesion; then select the bypass vessel with ultra-autoclaved gelatin sponge anhydrous alcohol mixture fistula closure [19].

The HAHVF hepatic angiography can be seen in the arterial phase or early arterial vein visualization of the hepatic vein and portal vein to confirm the presence of arteriovenous fistula. If the catheter is superselected to the vicinity of the fistula, the area and size of the fistula can be displayed, and the hepatic artery can be seen with the expansion of the portal vein. Sometimes, collateral circulation of cancerous portal hypertension and tumor thrombus development are seen. Contrast examination confirmed that HAHVF should be occluded after the fistula, according to the degree of tumor vascular development to determine whether the tumor is treated with iodized oil embolization. The contraindications are the same as those for simple primary hepatocellular carcinoma. Hepatic function and various biochemical indicators were significantly lower than normal and the disease course was not proportional, often accompanied by mild to moderate cirrhosis, oliguria, and moderate to large amount of ascites. On one hand, there are portal fistulas, which are caused by hepatic artery-portal vein short circuit, insufficient blood supply to the liver, worsening liver damage, and cirrhosis. On the other hand, because the pressure of the hepatic artery is much higher than the pressure of the portal vein, it further hinders the return of the portal vein, aggravates the portal hypertension, and causes more ascites and oliguria. Due to the difficulty in the surgical treatment of HAHVF, especially in the advanced
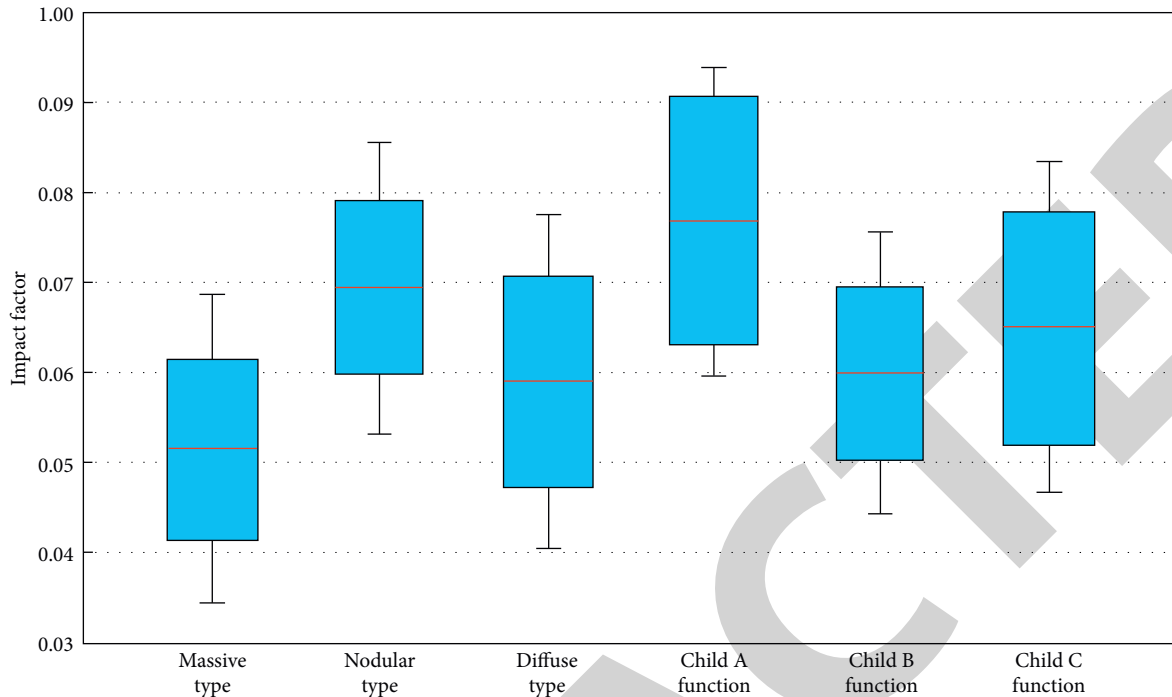
Figure 5: Impact factors of hepatic arteriovenous fistula type and hepatic function classification on imaging diagnosis.

stage of primary hepatocellular carcinoma, the opportunity for surgical treatment is lost, and the embolization of the tumor is easy to cause portal vein or pulmonary embolism, which is a contraindication. Therefore, the fistula is first performed and the superselective occlusion is especially necessary.

5.2. Clinical Significance of Embolization in the Treatment of Hepatocellular Carcinoma. The primary hepatocellular carcinoma is very easy to invade the hepatic vein or portal vein system, and its incidence rate is more than 60%. The main mechanism is direct invasion of the tumor; the tumor feeding artery passes through the tumor sinus entry vein or the artery branch because portal dilation is tumor. Erosion is to direct drainage of the arterial vein and pathological expansion of the nourishing artery around the portal vein; the role of tumor vascular endothelial growth factor results in the formation of a neovascular network between the hepatic artery and the portal vein. The occurrence of HAPVF is related to the location of the tumor, most of which is located near the hilum and close to the trunk of the portal vein. In the presence of HAPVF, a large amount of high-pressure arterial blood directly enters the portal vein through the fistula, causing the portal vein pressure to rise further, aggravating the formation of upper gastrointestinal bleeding and ascites. At the same time, the presence of HAPVF prevented chemotherapy embolization of cancer and embolization must reach the level of capillaries [20]. On the one hand, it blocks the hepatic artery-portal vein shunt and relieves gastrointestinal bleeding and ascites caused by portal hypertension and on the other hand facilitates superselective embolization of tumor blood vessels, protects normal

hepatic tissue, and reduces distant metastasis. The embolization materials commonly used are mitomycin powder, stainless steel ring, polyvinyl alcohol particles, and gelatin sponge particles, and the choice of embolic material is mainly based on the size of HAPVF.

TACE uses microcatheter technology to achieve accurate and dense intratumoral embolization, and the portal vein blood supply of small hepatocellular carcinoma is also large. Superselective subsegment embolization makes the terminal small arteries and venules in the tumor occlude the best and the embolization effect while maximizing the protection of normal hepatic tissue. The patient used microcatheter superselective subsegment embolization, and the density of iodized oil deposition was more ideal than that of microcatheter superselective subsegment embolization, showing the advantage of using microcatheter subsegment embolization. Small hepatocellular carcinoma generally has a relatively long survival period and requires multiple interventions, in which it is inevitable that hepatic function damage will occur during TACE treatment (Figure 6). Therefore, it is considered that subsegment embolization should be achieved as much as possible in the treatment of small hepatocellular carcinoma with TACE. However, for patients with a long interval of TACE treatment for the first time or again, it is important to find the comprehensiveness of treatment in order to find other hidden lesions in the hepatic. The experience is to retract the catheter into the hepatic artery or the left and right hepatic artery trunks and then inject a proper amount of lipiodol into the superselective subsegment to prevent the omission of smaller lesions and to achieve both diagnosis and treatment. Common complications of small hepatocellular carcinoma TACE treatment mainly include
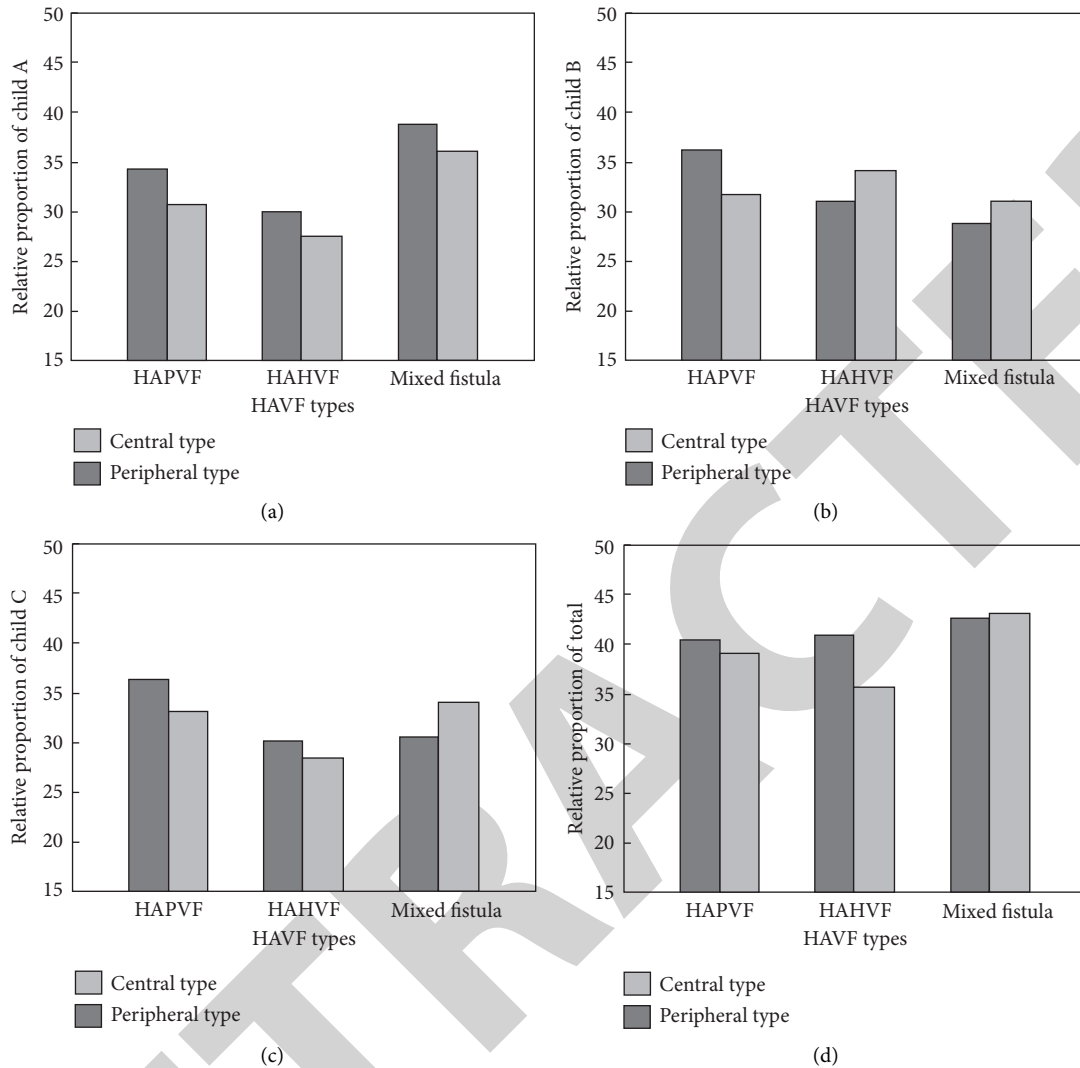
Figure 6: Distributions of relative proportion of Child classification of hepatic function in the central and peripheral type.

postembolic syndrome, cholecystitis, hepatic dysfunction, and gastroduodenal lesions; generally symptomatic support can be treated [21].

Hepatic artery-portal sputum has obvious stealing function, which causes a large amount of hepatic artery blood to be shunted to the portal vein, hepatic ischemia, and hypoxia. After the fistula is blocked, the blood flow of the hepatic recovers or is close to normal; the hepatic artery-hepatic arterial blood enters the hepatic and improves the metabolism of hepatocytes. The hepatic function of the hepatic artery-portal vein is improved after the patient is blocked and the main reason is the hepatic artery; after the closure of the portal vein, hepatic hemodynamics returned to normal. Hepatocellular carcinoma with hepatic artery-portal shunt, direct TACE treatment, and embolic agents can enter the portal system through the fistula to cause plugging. In the case of finding difficulty in controlling upper gastrointestinal bleeding, spring rims or large particles of polyvinyl alcohol granules should be selected according to the specific conditions of DSA examination to block the mouthwash and minimize the pressure on the portal vein

[22]. After the control of gastrointestinal bleeding and improvement of hepatic function, hepatic artery embolization chemotherapy is performed to reduce the complications associated with intervention and to obtain time for follow-up treatment and prolong the survival time of patients. Although the microcatheter can be used to cross the shunt mouth to enter the branch of the hepatic artery, the hepatic artery embolization is performed before the fistula to treat the tumor, and then the shunt mouth is blocked. However, when the upper digestive to the hemorrhage occurs, the body is in a state of stress, and the hepatic artery is simultaneous embolization of unpredictable risks; the experience is to first block the fistula and then hepatic artery embolization after hemorrhage control.

6. Conclusions

A total of 120 patients diagnosed as HAVF were chosen as study subjects in this study to explore imaging diagnosis and interventional treatment for hepatocellular carcinoma combined with arteriovenous fistula. The results show that

the central type of HAVF is characterized by early angiography of portal vein and large branches and tumor staining after portal vein's angiography; the peripheral type of HAVF is characterized by portal vein branching in hepatic tumor and double rail sign accompanied by the arterial branch; 112 cases of patients completed embolization chemotherapy; 8 cases of patients only received chemotherapy perfusion; in 109 cases of patients sputum disappeared or shunt decreased at first treatment; and in 113 cases of patients iodine oil was well deposited or the tumor was stably reduced; most of the symptoms of refractory ascites, diarrhea, and upper gastrointestinal bleeding were controlled or improved, and there were no complications such as pulmonary embolism and hepatic failure. Therefore, HAVF increases the difficulty of interventional therapy, but, as long as the positive and appropriate treatment measures are taken, it can still achieve better curative effect without serious complications, which can effectively alleviate the clinical symptoms of patients and improve the quality of life of patients. According to DSA angiography, normal hepatic arteries and tumor veins may be directly destroyed; obvious early tumor vein development will shunt and elongate. There is no clear channel between the artery and the vein in the clear channel, and the tumor blood vessels are dense and obviously twisted. No obvious early venous development was observed during angiography, but arteriovenous short circuits during embolization would appear. The results of this study provide a reference for the further researches on imaging diagnosis and interventional treatment for hepatocellular carcinoma combined with arteriovenous fistula.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

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