Comparative Study of Real-time Gray Scale Ultrasound Contrast and Spiral CT for Diagnosis of Liver Tumor Based on Imaging Technology

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Abstract
Objective: to make a comparative study on the method and application value of imaging technique in the diagnosis of liver tumor under the condition of enhanced CT diagnosis and ultrasound contrast. Methods: in this comparative study, 46 patients with liver tumor were examined, recorded and compared by contrast-enhanced ultrasound and enhanced CT, all images were analyzed retrospectively. Result: no significant difference between ultrasound contrast and CT diagnosis. Conclusion: contrast-enhanced ultrasound is a technique for the diagnosis of liver tumor by contrast agent, no radiation, no poison, there is no significant difference between the two in the diagnosis, the blood supply characteristics of liver tumor can be displayed.

Key words: Contrast-enhanced Ultrasound; Spiral CT Diagnosis; Contrast Agent; Liver Tumor.

Estudio Comparativo del Contraste con Ultrasonido en Escala de Grises en Tiempo real y la TC Espiral para el Diagnóstico de un Tumor Hepático Basado en Tecnología de Imagen

Resumen
Objetivo: realizar un estudio comparativo sobre el método y el valor de la aplicación de la técnica de imagen en el diagnóstico de un tumor de hígado bajo la condición de Enhanced CT diagnosis and ultrasonido de contraste.Métodos: en este estudio comparativo, 46 pacientes con tumor hepático fueron examinados, grabado y comparado por ultrasonido de contraste mejorado y mayor CT, todas las imágenes se analizaron retrospectivamente.Resultado: No hay diferencia significativa entre la ecografía y TC sin contraste.Conclusión: un ultrasonido de contraste mejorado es una técnica para el diagnóstico de tumor en el hígado por agente de contraste, no hay radiación, no hay veneno, no existe diferencia significativa entre los dos en el diagnóstico, el suministro de sangre características de un tumor de hígado puede ser mostrado.

Palabras clave: Ultrasonido de Contraste Mejorado; Tomografía Espiral Diagnostico; Agente de Contraste; Tumor de Hígado

1. Introduction

Contrast-enhanced ultrasound is a technique for the diagnosis of liver tumor by contrast agent, it has no radiation, no toxicity, and it is safe and stable in the process of use. However, for different patients, lesions, the use of different contrast agents. At present, micro-bubble contrast agent is the most important focus of medical attention [1].

Many years ago, the first generation contrast agent was invented by the German Schering and other medical experts, the micro-bubble acoustic contrast agent is unstable, and breaks when it vibrate slightly, if there is no fracture phenomena in the bubble, harmonic protective device is very weak, conversely, if a bubble burst in a symptom, the harmonic protector is very rich. When using a micro-bubble contrast agent, it is usually
used to identify and diagnose the disease by the advantage of its blasting moment [2]. And then, Italy Bolaik and other medical experts jointly invented the second generation of micro-bubble contrast agents, the advantage is that it has good stability, the contrast medium has a thin soft outer membrane, even if the external vibration of the outside world is not easy to break, it can send out extremely strong harmonic signals, and then get the diagnosis of the disease [3]. In recent years, some contrast agents have entered the United States for medical clinical use [4].

The article is divided into five parts, in the first chapter, the situation of contrast agent in foreign countries is briefly introduced; the second chapter introduces the status of contrast agent in China; the third chapter, based on the understanding of ultrasound contrast, describes the characteristics and advantages of ultrasound contrast diagnosis; and the statistical analysis of ultrasound contrast and CT in the diagnosis of liver tumor; in the fourth chapter, the status of contrast-enhanced ultrasound and CT in the diagnosis of liver tumors is studied by an example, the results show that there is no significant difference between the two in the diagnosis, and the implementation of ultrasound imaging is feasible in the medical field; the fifth chapter makes a summary of the full text, and makes a prospect for the next step.

2. State of the Art

With the continuous progress of the medical community, in recent years, our country has already started production batch of the animal experiment of two kinds of ultrasound contrast agents, one kind is phospholipids ultrasound contrast agent, one kind of albumin ultrasonic micro-bubble agent[5]. One kind of phospholipids ultrasound contrast agent can be divided into two types, one kind is the powder micro-bubble, and its advantage is the solution and use type, the other is to make it at the time of need, which belongs to the precursor of micro-bubbles[6]. However, at present this kind of phospholipids ultrasound contrast agent has not yet been used in medical clinical trials. However, another kind of albumin ultrasonic micro-bubbles has been in the production stage [7]. Contrast-enhanced ultrasound techniques include a number of radiographic methods, among the contrast agent blasting method is a good use of the first generation blasting micro-bubble contrast agent, using the characteristics of manual triggering, to obtain the temporal image of liver tumor [8]. It was around 1960; contrast-enhanced ultrasound techniques have been used in cardiac clinical trials, and have achieved good results. In the aspect of acoustic contrast, most widely used in clinical practice, all kinds of diagnostic methods are superior to CT diagnosis, high safety performance, non radiation effect, no anaphylaxis, the cost of inspection is relatively low, it is of certain significance in the diagnosis of some lesions [9].

3. Methodology

3.1. Two methods of diagnosing liver tumors were described

In this study, the diagnosis of liver tumor by ultrasound contrast, the yum color ultrasound machine imported from Western Europe was used, the probe frequency is 2.5 Hertz, it has the technique of harmonic imaging, the mechanical parameters are 0.03-0.06. Contrast agents are selected from foreign companies, it is composed of phosphor-coated hexafluoride sulfur, the average diameter of the micro-bubbles is 2.5 microns, and the vast majority of the micro-bubbles are less than 8 microns in diameter. With the continuous progress of the medical community, in recent years, our country has already started production batch of the animal experiment of two kinds of ultrasound contrast agent, is a lipid ultrasound contrast agent, is a kind of albumin micro-bubble. Among one kind of phospholipids ultrasound contrast agent can be divided into two types, one kind is the powder micro-bubble, and its advantage is the solution and use type, the other is to make it at the time of need, which belongs to the precursor of micro-bubbles. However, this kind of phospholipids ultrasound contrast agent has not been used in the current medical clinical trials. After adding physiological saline to 25 mg of dry powder, a micro-bubble solution of 8 liters per milliliter concentration was prepared. In the extraction of 2.5 ml of solution, after the injection of the cubical vein, he imaging features of the tumor can be observed in real time, and the whole process can be recorded with a digital camera. For patients with obesity or liver cirrhosis, the contrast agent needs to be adjusted to 4.8 milliliters. After the end of the contrast, the playback video was carefully evaluated by more than two experienced doctors. In here, it is important to note that: there are three kinds of contrast enhancement methods for liver tumors, one is the whole type, that is the contrast agent quickly fills the whole tumor; two is a peripheral type, and the contrast agent is filled from the periphery of the liver tumor to the central position; the three is the central type, which spreads from the center of the focus to the periphery and fills the whole tumor [10].

The method of contrast time through the spiral CT, using the American Philip-Pu 8000 multilayer helical scanner, and the contrast agent uses the products imported from Germany, among its product concentration is
300 milligrams per milliliter and calculated according to the total amount of 1.5 milliliters per kilogram. Using a high pressure syringe to inject after the elbow vein, enter at a speed of about 3 milliliters per second, in approximately 30 seconds, can start the first phase of the whole liver scan, after 40 seconds, the overall scanning of the second phase is started, the last phase is scanned in about 4 minutes[11]. The comparison of the two diagnoses is as shown in the following figure:

![Diagram](image)

**Figure 1.** Diagnosis comparison between the two

### 3.2. Research data

In this study, 32 cases of common liver tumors were collected; two methods of real-time gray scale ultrasound and spiral CT were used to diagnose, respectively, the characteristics of the blood flow signals in the two methods of liver tumor.

In these 30 cases, the ratio of men and women was 23:9, and the average age was 46.4±13.7. From the point of view of the disease, 19 cases of malignant tumor, 13 cases of benign liver disease, 7 cases of hepatic hemangioma and 6 cases of hepatic nodule hyperplasia were included. 23 cases were diagnosed by operation.

### 3.3. Real-time gray scale ultrasound contrast results of liver tumor

Before the diagnosis of contrast-enhanced ultrasound, the patient needs to be opened up and open to the patient, at the same time, to understand the clinical data of the patients, such as medical history, laboratory or other image data, determine the purpose of inspection, to determine whether it meets the inspection requirements, and get informed consent of the patients and their families in time. When the contrast agent is injected in the body, it is more important to exclude contraindications and so on, must comply with the requirements of the doctor.

After the results of ultrasound contrast, it showed that all the swelling of the liver was enhanced, the detection rate of blood flow signals reached 100%. The decline time and duration data are shown in the following table.

| Table 1. Contrast enhanced ultrasound time (second) for different liver tumors |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| Type of liver tumor         | The number of cases | Augmented start time | Enhanced fading time | Duration of enhancement |
| Malignant tumor             | 19               | 18±5             | 57±17             | 186±98           |
| Hepatic hemangioma          | 7                | 24±9             | 162±67            | 439±126          |
| Local nodular hyperplasia   | 6                | 20±4             | 146±47            | 317±57           |

It can be determined from this data table, comparison of the time data of malignant tumor, among P<0.01. However, the related data of the enhancement pattern of the liver tumor are shown in the following table.

| Table 2. ultrasound contrast method for liver tumor |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| Types                      | The number of cases | Holistic type | Peripheral type | Central type |
| Malignant tumor            | 19               | 13             | 3              | 3              |
| Hepatic hemangioma         | 7                | 0              | 5              | 2              |
| Local nodular hyperplasia  | 6                | 2              | 1              | 3              |

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3.4 Spiral CT results of liver tumors

It is necessary to complete the medical history, treatment and imaging data before the spiral CT examination is carried out, patients need to fasting carbohydrates in advance, keep quiet after injecting drugs and avoid a lot of activities [12]. For the identification of the disease, it is also necessary to determine the use of single or multi-layer spiral CT based on the specific circumstances, to expand the scanning range and improve the scanning speed, the information is handled more flexibly, and the ideal scanning effect is finally obtained.

Spiral CT scan of hepatic malignant tumor: in plain scavenging, all the masses were low density, 95.3% of the arterial phase was enhanced after the injection of the contrast agent, among 33.4% of the masses showed irregular necrosis, the portal phase showed that 94.6% of the mass was low density.

Results of spiral CT scan of hepatic hemangioma: the masses in the plain scan showed low density, and all the masses were enhanced at the later stage of the arterial phase, among about 84.1% of the masses were nodular and mass enhanced, the 33.7% shows the trend of enhancement from the periphery to the central, high density mass in the late stage [13].

Results of spiral CT scan of hepatic nodular hyperplasia: the plain scan shows the equal density of 61.3%, and the low density of 38.7%. All the masses were enhanced during the arterial period, 81% of them were evenly enhanced, 60% had high density in portal phase, and 40% showed equal density. Only one example shows no enhancement.

![Figure 2. Diagnosis result diagram](image)

3.5 The ability of two methods to diagnose liver tumor

The diagnosis of liver tumors was diagnosed by real-time gray - scale ultrasound, it is possible to judge the malignant lesion of the liver tumor when there is an early swelling and no further enhancement after 2 minutes, if it does not conform to this condition, it is a benign disease. In the diagnosis of spiral CT, the high density manifestation of the arterial mass and the low density in the portal phase are the basis for the malignant tumor, on the contrary, it is a benign disease. The specific data of this study, as shown in the following figure, have no statistical significance.

<table>
<thead>
<tr>
<th>Inspection method</th>
<th>Sensitive</th>
<th>Specific</th>
<th>Accuracy</th>
<th>Positive values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound contrast</td>
<td>100</td>
<td>81.7</td>
<td>93.4</td>
<td>91.2</td>
</tr>
<tr>
<td>Spiral CT</td>
<td>94.7</td>
<td>81.9</td>
<td>89.4</td>
<td>89.7</td>
</tr>
</tbody>
</table>

It can be seen from the previous table, there was no significant difference in the effect of the two methods in the diagnosis of liver tumors, and the sensitivity was very high, there is no significant difference in diagnostic accuracy, it has been proved that ultrasonography and spiral CT have a certain stability and feasibility in the diagnosis of liver tumors.
4. Result Analysis and discussion

4.1 Discussion of results

With the support of image technology, to perform an ultrasound contrast, the signal of blood flow in the liver tumor can be detected without trauma; this technique has been applied to the diagnosis of liver tumors. Due to technical limitations and slow blood flow in tumors and so on, some objective factors are affected, two aspects of the sensitivity and specificity of ultrasound contrast in the detection and diagnosis, it's a little bit worse than the spiral CT. With the development of micro-bubble contrast agent in recent years, the sensitivity of liver tumors detected by contrast-enhanced ultrasound has been constantly improved [14]. This technique has increasingly shown that the liver tumor enhancement process can dynamically observe and detect the advantages of high blood flow signals in the tumor, in particular, it is beneficial to the detection, diagnosis and identification of liver tumors, the prospect of medical application is very bright. This article is at the time of specific research, the second generation ultrasound contrast agent was adopted, the main component is phospholipids, the external part is soft and strong, and the stability is high, the micro-bubbles are easy to resonate under low pressure and are reflected, at the same time, it can be maintained for a long time in the blood, therefore, there is enough time to observe the dynamic changes in the increase of liver tumor. The harmonic imaging technique can display the overall process of the contrast signal into the internal tumor of the liver and disappear in real time, to detect the different characteristics of liver tumor in the process of increase.

Traditional conventional CT scan showed a lack of scanning and partial hepatosomal scanning, in recent years, with the continuous development of technology, spiral CT has overcome these deficiencies. With only one breath holding the breath, the whole liver scan can be performed during the period of the artery or the portal vein, a comprehensive display of blood supply characteristics of liver tumors, the opportunity to detect the focus is greatly increased, and it also improves the accuracy of the detection and diagnosis of the lesion.

The blood flow required by the liver is mainly supplied by the hepatic artery. This difference determines the difference between the tumor and the liver in the hepatic artery, and the portal arteries, this is the theoretical basis for the detection and diagnosis of liver tumors by two different ways of ultrasound contrast and spiral CT. In this study, the diagnosis of liver tumors was detected; the two methods were used to detect the enhancement of the liver tumor during the arterial period, and the overall characteristics. Contrast-enhanced ultrasound shows that the enhancement duration of the liver tumor is longer, and the declination is fast, and the odds of a benign tumor are low, this shows the characteristics of rapid enhancement and rapid declination. However, after the CT scan, it shows that the tumor of the liver shows a low density mass during the portal period, and it also increases the basic characteristics of the tumor. In the early stage of ultrasound contrast, it can be found that when the contrast agent enters the liver, the enhancement of the liver tumor begins around the liver, after a long period of continuous, reach the highest intensity; and on the spiral CT scan, it is manifested by the enhancement of the round hepatic nodule or the shape of the lump, and the duration is as long. Such similarities and differences are related mainly with liver vascular sinusoids by liver and body composition, blood flow speed, because of these factors lead to liver contrast agent import restrictions, therefore, the detection of liver tumors has obvious specific characteristics. In the presence of nodules in the liver, the blood supply is mainly involved in the branch of the hepatic artery, which is called the disease of rich blood supply. In short, the use of these two methods for the diagnosis of liver tumors was found to be significantly enhanced in the early stages, starting from the central position, and the degree of reinforcement is uniform, but in the portal period, the density is high or equal, but in the late stage, it shows low density. Therefore, these two methods can all show the characteristics of blood flow in different liver tumors, and the diagnosis of liver tumors is benign, sensitive, specific and accurate, statistics show that there is no significant difference between the two.

Compared with the spiral CT after the injection of the contrast agent, real time gray-scale ultrasound imaging can continuously observe all the dynamic processes of the contrast agent entering the liver tumor and the liver body after the contrast, but you can only focus on a lump at a time. The advantage of spiral CT is after a one-time injection of contrast agent, the image of all the lumps inside the liver tumor can be scanned, but it is also difficult to accurately determine the time of the highest concentration, this is because the contrast agent also has a cycle of individual differences [15].

The two methods of diagnosis of liver tumors in this study showed that the performance of the liver tumor was different when the liver tumor was enhanced; this is due to different contrast agents. The ultrasound contrast agent is composed mainly of micro-bubbles, and is a blood pool type contrast agent; the spiral CT contrast agent participates in the blood circulation in the early stage, but then penetrates into the blood vessel. Therefore, liver tumors may be gradually filled in the late stage of CT, in contrast, angioma shows an increase in peripheral contrast and no signal in the center. Of course, the metabolism of the contrast agent in the body, further research is also needed, there are fewer examples in this study, and more large-scale research is needed.
4.2 The future development trend of two diagnostic methods

On the premise of the development of the current society, such as information, network and other technologies, spiral CT has three main development directions, respectively: improve the resolution of the three aspects of time, space, and density. No matter which direction in these three directions, in the end, the image resolution will be improved effectively, that is to say, you can use the least dose of ray and the shortest time to get a more definite location and qualitative diagnosis. The time angle is mainly to increase the width of the detector, and improve the speed of rotation, the space angle, one is to reduce the thickness of the detector, one is to increase the unit on the detector. The density contrast angle is mainly to improve the material application of contrast agent.

And contrast-enhanced ultrasound, there are two main development directions, one is the ultrasonic dynamic diagram, which can be used to evaluate the dispersion, and the other is the identification of the liver mass, which can be applied to all the parenchyma organs and some smaller superficial organs. At the same time, for patients, there are two main trends that are focused on, one is how to maximize the benefit of the patient in many unessential methods of examination, and one is the problem of the safety of radiation.

However, due to the late start of related research in China, R & D investment is relatively small, on the whole, there are many aspects of the gap between the European and American countries, a large number of proprietary technologies are also in foreign companies, but, with the continuous improvement of China's comprehensive strength, our country has a great improvement in the development of these two methods.

5. Conclusions

Contrast-enhanced ultrasound and spiral CT are important supplements and developments in combination with traditional diagnostic models. The most important of the physicians is the combination of theory and practice, for the diagnosis of liver tumors, it is necessary to improve learning and skillful operation on the basis of technology. Whether it is contrast-enhanced ultrasound or spiral CT, doctors are required to be able to master the criteria for identification of liver tumors, at the same time; these methods are used more skillfully. In particular, it should be considered according to the specific situation of the patient, to consider the advantages of ultrasound imaging, we should also consider the advantages of spiral CT, even in complex situations, you need to combine them. In the case of an inaccurate identification of the disease through a certain method, we should also be good at summarizing and learn from the advanced experience in the industry, improve the professional level of diagnosis of liver tumor.

However, compared to ordinary patients, both of these two diagnostic methods have high cost, How to reduce medical costs while ensuring the level of diagnosis is the next step to be studied. Although some achievements have been achieved in this study, but there is a future problem that has not been imagined, so in
the future in-depth study in the future to be further explored to achieve better. In the production of contrast agents, it is also hoped that the medical community will pay attention to it; Medical researchers can continue to study the contrast agent, and advance the development of medicine.

References


