Multiple Faces of Liver Hemangiomas

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Hemangioma is the most common benign liver tumor with the prevalence of about 1-2% in the general population\(^1\). Typical findings of hemangiomas in various imaging findings are as following:

**US:** homogeneous, well-defined, hyper-echoic mass (Figure 1).

**CT:** hypodensity mass at plain CT; peripheral nodular enhancement, central filling-in, and persistent enhancement throughout delayed phase at intravenous contrast CT (Figure 2).

**MR:** low signal intensity (SI) at T1W; high SI at T2W/heavy T2W similar to fluid; peripheral nodular enhancement, central filling-in, and persistent enhancement throughout delayed phase at intravenous gadolinium (Figure 3).

**Red Blood Cell (RBC) scan:** decreased radio-nuclide activity at the early phase; increased activity at the delayed blood-pool phase (30-50 min) (Figure 4).

However, atypical appearance of hemangioma is not uncommon, and found in approximately 20-40% of cases\(^1\). Fortunately, atypical hemangioma in one modality is usually typical in other modalities, thus, helping with the diagnosis. This article is a pictorial essay of multiple features of atypical hemangiomas, emphasizing on appearance of visual images. The purpose is to remind people that an incidental finding of

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**Figure 1** Typical hemangioma.
US reveals a well-defined, homogeneous echogenic mass at right lobe liver (arrow).

**Figure 2** Typical hemangioma
Contrast enhanced CT reveals peripheral nodular enhancement with central filling-in pattern (arrows).
Figure 3  Typical hemangioma
MRI shows a mass to have homogeneously low SI at T1W (A), and high SI at T2W (B) images. After IV gadolinium, there is peripheral nodular enhancement (C), central filling-in (D) and persistent enhancement throughout delayed phase (E).

Figure 4  Typical hemangioma.
RBC scan shows increased radionuclide activity at delayed blood-pool phase (arrow).
Atypical #1: low-echoic mass at US
US shows a well-defined, low-echoic mass at right lobe of the liver (A), secondary to fatty echogenic liver background. MRI reveals characteristic findings of a hemangioma, which includes low SI at T1W (B), high SI at T2W (C) images. After IV gadolinium, there is peripheral nodular enhancement (D), central filling-in and persistent enhancement throughout delayed phase (E).

Atypical #2: low-echoic mass with echogenic rim at US
This pattern is believed to be secondary to previous internal hemorrhage, necrosis, scarring or myxomatous change, changing the typical hyper-echoic liver mass at various imaging modalities, although appear atypical for hemangioma, is probably still a hemangioma. Brief explanation for each atypical finding is provided, if possible.

Atypical #1: low-echoic mass at US (Figure 5)
The main reason for low-echoic appearance is mostly secondary to background fatty liver. Fatty liver appears high-echoic at US, and any focal mass, including hemangioma, will show low-echoic relative to the liver.

Atypical #2: low-echoic mass with echogenic rim at US (Figure 6)
This pattern is believed to be secondary to previous internal hemorrhage, necrosis, scarring or myxomatous change, changing the typical hyper-echoic
mass into low-echoic mass with echogenic rim. It is reported to be the most frequent sonographic pattern for atypical hemangiomas, found in about 40% of cases(1).

**Atypical #3: high density rim at plain CT (Figure 7)**

Similar to atypical #2, this pattern is believed to be secondary to previous internal hemorrhage, necrosis, scarring or myxomatous change. While US reveals echogenic rim, plain CT shows high density rim. However, after IV contrast, enhancement pattern should be characteristic of a hemangioma.

**Figure 7** Atypical #3: high-density rim at plain CT.
Plain CT shows hyperdense rim mass (A). After IV contrast, this mass shows peripheral nodular enhancement (B) with central filling-in pattern, characteristic of a hemangioma.

**Figure 8** Atypical #4: giant hemangioma
US shows a large echogenic mass with central scar. This mass measures about 10 cm in size. MRI shows typical enhancement of a hemangioma (not shown).

**Figure 9** Atypical #5: rapid, complete filling-in with arterioportal (AP) shunt
A small hemangioma shows rapid, complete filling-in pattern at portovenous phase CT (A) with peritumoral geographic enhancement (B) characteristic of AP shunt. At delayed phase CT (C), the hemangioma shows persistent enhancement, but disappearance of the AP shunt.
Atypical #4: giant hemangioma (Figure 8)
Hemangioma is called giant when it reaches 6-12 cm, depending on different series. Typical hemangioma is about 2-3 cm in size. Giant hemangioma usually shows heterogeneous echogenicity at US, secondary to necrosis or fibrosis. IV contrast CT or MR studies usually clarify the nature of hemangioma.

Atypical #5: rapid, complete filling-in with arteriportal (AP) shunt (Figure 9)
After IV contrast, rapid filling-in pattern is occasionally seen in small hemangiomas, of which approximately 42% are less than 1 cm(2). Hemangiomas with rapid enhancement have small vascular spaces and large interstitium with high arterial inflow and rapid outflow(3). Rapid, filling-in pattern is usually accompanied with AP shunt, visualized as temporary peritumoral enhancement seen during arterial phase(3,4). This AP shunt is secondary to hyperdynamic status of arterial inflow/outflow of these small hemangiomas.

Atypical #6: slow filling-in pattern (Figure 10)
After IV contrast, slow filling-in hemangiomas are noted to have relatively large vascular spaces but small inflow arteries(2). At CT/MRI, only a dot of contrast is sometimes visualized and has been called “a bright dot sign”(5).

Atypical #7: poor enhancement (Figure 11)
Poorly enhanced hemangioma, after IV contrast, is thought to be secondary to previous hemorrhage,
Figure 12  Atypical #8: multiple hemangiomas
Contrast-enhanced CT scan shows multiple hemangiomas; some show rapid filling-in pattern (A, B) and the other shows typical enhancement pattern (C). T2W MRI (D, E, F) shows bright signal intensity of all lesions, and angiogram (G) shows puddles of enhancement, both characteristics of hemangiomas.

Figure 13  Atypical #9: not so bright signal at T2W MRI
T2W MRI shows a hemangioma (large arrow) to be less bright than the CSF (small arrows). This may be secondary to sclerosis or fibrosis.
necrosis, scarring or myxomatous change. In this particular case, US and RBC scan will help confirm the nature of a hemangioma.

**Atypical #8: multiple hemangiomas** (Figure 12)

Multiple hemangiomas are found in about 10% of cases\(^6\). They consist of a few scattered lesions, but fortunately, with typical enhancement.

**Atypical #9: not so bright signal at T2W MRI** (Figure 13)

The typical hemangioma shows very bright signal at T2W, so called “bright as a light bulb”, secondary to long T2 relaxation time of the lesion. The “not so bright” pattern is usually associated with a rapid filling-in pattern with small vascular spaces, which causes decreasing of T2 relaxation time, thus more rapid decaying of the signal\(^7\). Another reason is that a hemangioma may be sclerosed, hyalinized or fibrosed, therefore, causing losing of the signal\(^8\).

These 9 atypical patterns of liver hemangiomas, mentioned above, are encountered by the author. However, there are other rare and unusual patterns, described in the literature, that the author has yet seen a case. These include calcified, hemangioma, pedunculated hemangioma, bleeding hemangioma, hemangioma with capsular retraction, growing hemangioma, and hemangioma with fluid-fluid levels\(^9-11\).

Finally, I would like to propose a practical algorithm when one encounters a liver incidentaloma.

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**CONCLUSIONS**

1. Hemangioma should always be in differential diagnosis of a hepatic incidentaloma, no matter how it looks on US/CT.
2. MRI is usually able to verify definite diagnosis and is an imaging of choice for confirmation of a hemangioma.
3. RBC SPECT may play a role, if MRI is equivocal.

**REFERENCES**