

Hepatocellular Carcinoma with Tumor Thrombus in the Inferior Vena Cava and Right Atrium

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Abstract. Tumor thrombus (TT) in the inferior vena cava (IVC) and right atrium (RA) is rarely encountered. We have diagnosed before death and treated a case of hepatocellular carcinoma (HCC) with TT in the IVC and RA, accompanied by a brain metastasis. The image characteristics on computed tomography (CT), magnetic resonance imaging (MRI), and conventional angiography are discussed.

Key words: Hepatocellular carcinoma—Tumor thrombus—Inferior vena cava—Right atrium—Brain metastasis—Computed tomography—Magnetic resonance imaging—Angiography

Tumor thrombus (TT) of hepatocellular carcinoma (HCC) in the inferior vena cava (IVC) and right atrium (RA) is rarely encountered, although HCC involves vascular structures in the liver, such as the portal vein (frequently) and/or the hepatic vein (less frequently). Because of the advances in imaging modalities, most cases can be diagnosed while patients are alive. We describe and review such a case herein.

Case Report

A 55-year-old man had been suffering from general fatigue and slight fever 2 months prior to consulting a clinic. He started to have edema in lower extremities a month later and was referred to Yamada Hospital, Gifu City. He was diagnosed with decompensated liver cirrhosis due to chronic viral hepatitis type C and multicentric liver tumors at the hospital. On January 22, 1992, he was referred and admitted to our department for further diagnoses and treatments.

He was 158 cm tall and weighed 53.5 kg. Blood pressure was 150/70 mmHg. Pulse rate was 90 beats/min and regular. Respiratory rate

was 18 times/min and regular. Body temperature was 36.6°C. Consciousness was clear. Pigmentations were noted in the whole body, especially in the lower extremities. There were telangiectasia on the face and vascular spiders on the anterior chest; however no palmer erythema was noticed. Jaundice, anemia, and malnutrition were not evident on inspection. No lymph nodes on the body surface were palpated. Hard tumor (3 cm in size) compatible with bone metastasis was palpated at the right fifth rib on the posterior axillary line without tenderness. Dilatations of the superficial vein on the anterior chest and abdomen were remarkable. Hard liver was palpated by five-finger width on the midsternal line, and by four-finger width on the right hypochondrium, but the spleen was not palpated. There was no fluid wave due to ascites. The edema in the lower extremities was remarkable.

Laboratory tests were as follows: RBC, $2.81 \times 10^6/\text{mm}^3$; Hb, 9.9 g/dl; Plt, $7.8 \times 10^4/\mu\text{l}$; Alb, 3.7 g/dl; GOT, 110 IU; GPT, 72 IU; γ -GTP, 105 IU; HBsAg, negative; HCV antibody, positive; HPT, 60.8%; α -fetoprotein, 3840 ng/ml; PIVKA II, 2.293 AU/ml. Urinalysis and occult blood in the stool were negative.

Computed tomographic (CT) scan (TCT-900S, TOSHIBA Corporation, Tokyo, Japan) of the abdomen in axial image at 10-mm thickness with 10-mm interleave by 2-s scan showed that the right and caudate lobe of the liver were enlarged. A $11 \times 13 \times 15$ cm low-attenuated tumor occupied most of the right hepatic lobe, which showed "nodule-in-nodule" pattern corresponding to the CT feature of HCC. In the remaining liver, a few 2–4 cm in diameter low-attenuated nodules were scattered. Some parts of the tumors protruded from the liver margins. A small amount of perihepatic ascites was noted. The gallbladder, pancreas, kidneys, and spleen showed no abnormalities. No involvements in the regional lymph nodes were noticed on CT images. CT scan also showed main HCC tumor in the right hepatic lobe extending into the IVC and forming a 3×3 cm low-attenuated TT obstructing the IVC, and a 3×4 cm TT in the RA (Fig. 1). However, connections of the TT between the IVC and RA were not clear on CT images.

Magnetic resonance imaging (MRI) (Magnetom 1.0 T, Siemens, Erlangen, Germany) demonstrated the main huge tumor in the right hepatic lobe and scattered daughter nodules were generally low-intense, high-intense, and iso-intense to the liver on T1-weighted (600/15), T2-weighted (2000/90), and proton density (2000/15) images, respectively; however, smaller encapsulated nodules in the main tumor were of different intensities. TT in the IVC (3×3 cm) and RA (3×3 cm) was depicted as the same intensities as those of the main tumor in the right hepatic lobe (Fig. 2). T1-weighted images enhanced with Gd-DTPA (Magnevist, Schering, Berlin, Germany) showed clearer images for tumor margins and irregular internal structures of TT (Fig. 3). MRI offered further detailed information on the tumor

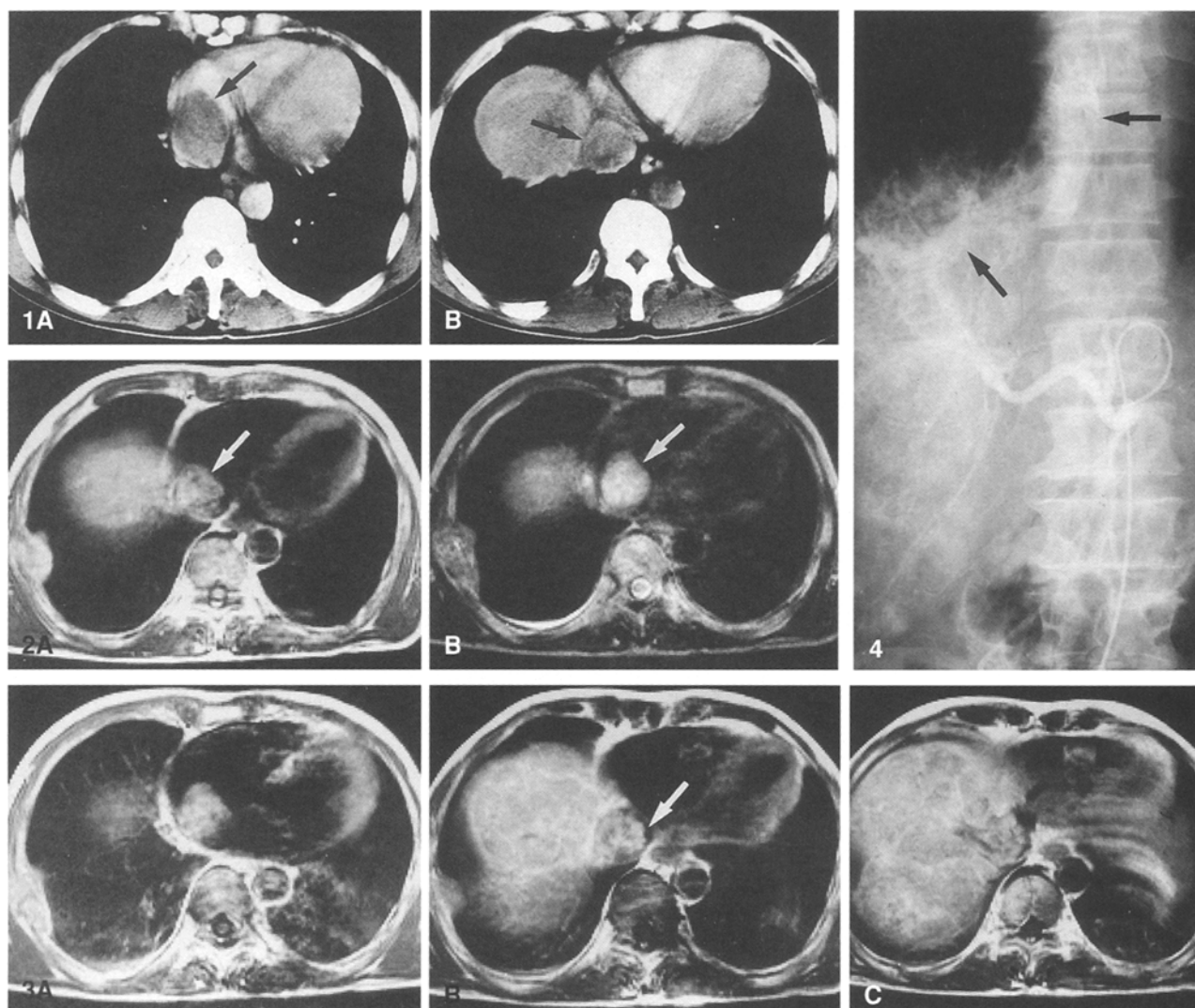


Fig. 1. Enhanced CT scan shows 3 × 4 and 3 × 3 cm low-attenuated TT in the RA (A) and IVC (B), respectively (arrows).

Fig. 2. T1- (A) and (B) T2-weighted MR images of TT in the RA (arrows). The tumor margins and irregular internal structures are demonstrated more clearly than on the CT scan.

Fig. 3. Serial T1-weighted images enhanced with Gd-DTPA at the level of the RA (A), IVC (B), and confluence of the right hepatic vein

involvements as follows: (1) very thin vascular lumens for blood flow shown by flow void effect were observed between the TT and IVC walls; (2) the TT extended continuously from the right hepatic vein through the IVC to the RA; and (3) the margins and inside structures of the leading part of TT in the RA were much clearer than that on CT. Further, MRI for the brain disclosed solitary cerebral metastasis (3 × 4 cm) in the parietooccipital region.

Angiography was performed for further diagnosis and treatment. A common hepatic arteriogram showed huge hypervascular tumors in the right hepatic lobe. On the late phase of the arteriogram, TT in the right hepatic vein, IVC, and RA were delineated as numerous minute vessels, so-called "thread and streaks" sign [1] (Fig. 4). Portogram via the superior mesenteric artery showed no demonstration of the right portal vein system other than the thin right posterior portal vein branches.

into the IVC (C) show the continuous connection of TT from the right hepatic vein through the IVC up to the RA. Very thin vascular lumens for blood flow are shown by flow void effect between the TT and IVC walls (arrow).

Fig. 4. At the late arterial phase of common hepatic arteriography, TT in the right hepatic vein, IVC, and RA are delineated as "thread and streaks" sign (arrows).

Lipiodol (10 ml) emulsified with carcinostatics was infused from the proper hepatic artery for treatment. Plain CT 8 days after lipiodolization showed partial Lipiodol accumulations in the main tumor, and no accumulation in the daughter nodules and TT in the IVC and RA.

Discussion

HCC tends to involve vascular structures, such as the portal vein, hepatic vein, IVC, RA, pulmonary artery, and renal vein. Horiike et al. reviewed the articles and described that the incidences of HCC involvement to

the portal vein, hepatic vein, and IVC accounted for 70.8–80.8, 13.3–53.3, and 10.8–13.3%, respectively [2]. The incidence of TT in the RA was also low at 0.5–7.0% [3–5]. In the literature, the incidence of extrahepatic metastases was 48–66%, in which the lung, lymph nodes, and direct involvement to the peritoneum or diaphragm accounted for 44.1–58.3, 34.9–58.3, and 17.7–27.7%, respectively [3, 4]. The incidence of brain metastasis is reported to be much lower at 0.4–2.4% [4, 6]. Although HCC with TT in the IVC and RA significantly tends to be accompanied by lung metastasis [5], no article evaluating relationships between TT in the IVC and/or cardiac cavities and brain metastasis was available.

Possible clinical symptoms in the presence of metastatic cardiac tumors includes intractable heart failure, arrhythmia, cardiomegaly, pericardial effusion, and superior vena cava syndrome [7]. Furthermore, in case of mobile mass formation in the cardiac cavities, ball valve thrombus syndrome presenting cardiac murmurs, respiratory distress, syncope, and/or shock may happen [4, 8]. However, TT in the RA continuously extends from the liver tumor through the IVC at a high incidence of 84–90% [4, 9] and also has invasions to the cardiac muscles, which might lead to minor mobility of TT in the RA, and ball valve thrombus syndrome hardly take place [5]. When the IVC is occluded by TT, secondary Budd-Chiari syndrome may occur [10, 11]. The symptoms of Budd-Chiari syndrome frequently mimic those of severe liver cirrhosis, leading to difficult differentiation between them. However, when dilatations of the superficial veins of the chest and/or abdomen or edema in the lower extremities develop rapidly, the possibility of secondary Budd-Chiari syndrome due to TT in the IVC should be considered.

CT depicted TT in the IVC and RA as a low-attenuated tumor. However, in respect of tumor margins, internal structures, connections from the liver tumor, and vascular lumens between the TT and IVC wall, MRI was superior to CT in our case. Moreover, MRI can offer optional slices to elucidate the extent of TT and relationships with the liver tumor even without using contrast medium, that is, MRI may be the first choice for tumors in the cardiac cavities including TT of HCC [12–15]. Furthermore, pulse-gated MRI is reported to be useful for clearer imaging of tumors in the cardiac cavities [12, 14–16]. However, as TT in the RA frequently has minor mobilities against heart beats as was mentioned earlier, pulse-gated MRI may not be always necessary.

The TT in our case was delineated as “thread and streaks” sign from the right hepatic vein via IVC through RA on angiography, and we considered it as diagnostic evidence [1]. CT scan 8 days after lipiodolization via the hepatic artery depicted no retention in TT in the IVC and RA, which corresponds to the fact that transcatheter arterial embolization (TAE) with lipiodol-

ization is not always effective for extracapsular invasions, TT, and/or daughter nodules in HCC. However, there are some articles reporting the usefulness of TAE for TT [18, 19]. Although Nakamura et al. [20] described a case of HCC developing pulmonary embolism presumably due to fragmentation of necrotized TT of HCC after TAE.

Some recent reports emphasize the use of echocardiography for TT in the cardiac cavities [2, 15, 20–22]. Compared to CT or MRI, echocardiography is useful for observation of mobilities of not only TT but also cardiac muscles and valves in relationship to TT. The IVC and RA should be checked even on abdominal ultrasonography for HCC-suspicious patients, because they can be readily visualized.

HCC patients with TT in the IVC and cardiac cavities usually die of complications due to growth of main tumors or hepatic failure than of complications due to TT. Even in the presence of ball valve thrombus syndrome and/or Budd-Chiari syndrome, there may not be any aggressive treatments other than conservative treatments, because such cases are frequently critical due to the advanced stage of HCC in the liver. Only when primary liver tumors are controllable, surgical resection of TT in the IVC or cardiac cavities may be indicated [21, 22]. There are some articles reporting sudden death due to circulatory failure because of TT of HCC, which should alert us to be cautious for such status [23, 24].

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