

Clinical report

Findings of ruptured hepatocellular carcinoma on computed tomography in Thailand

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Background: A spontaneously ruptured hepatocellular carcinoma (HCC) carries an extremely poor prognosis and high mortality. In Thailand, the reported incidence of ruptured HCC was 12.4 % .

Objective: To evaluate the computed tomography (CT) findings of ruptured HCC at King Chulalongkorn Memorial Hospital, Thailand.

Methods: We reviewed the CT findings of 15 patients who were diagnosed as having a ruptured HCC and underwent CT scan of the upper abdomen. Two experienced radiologists analyzed the CT findings regarding the tumor's size, tumor's number, location, hepatic segment involvement, contour protrusion including appearance of the mass and ascites.

Results: The study population consisted of 15 men with mean age of 57.4 years (27-78 years). All cases showed liver cirrhosis. All ruptured tumors were located at the periphery of the liver and had a protruding contour. The maximum diameter of the tumors ranged from 2.8-17.2 cm (mean 7.44 cm). Marginal disruption was seen in 9 cases (60 %). Five cases (33 %) presented with hematoma and high attenuation around the ruptured mass. All cases of ruptured HCC had ascites.

Conclusion: The peripheral location, protruding contour, marginal disruption of the tumor with the background of a cirrhotic liver are highly suggestive of ruptured HCC.

Keywords: Contour protrusion, marginal disruption, ruptured hepatocellular carcinoma, surrounding hematoma.

Hepatocellular carcinoma (HCC) is a primary malignant tumor of the liver arising from hepatic parenchymal cells (hepatocytes), blood vessels or cholangioles within the liver, excluding gallbladder and biliary passages. It accounts for over 90 % of all primary hepatic malignancies and is one of the most frequent tumors with overall poor prognosis [1]. There is a low incidence of HCC in developed countries, but there is an extremely high incidence of HCC in many parts of Africa and Asia. In these developing countries, tumors occur in a younger age group, and correlate strongly with hepatitis B virus infection. The other common causes are hepatitis C, and aflatoxin exposure. In Asia, the incidence of HCC is about 10-20 per 100,000 population, while it is 1-3 per 100,000 population in Australia, North America and Europe

[2]. This difference may be related to the prevalence of chronic hepatitis B virus infection (8-15 % in Asia and Africa, and 8-12 % in Thailand) [3, 4].

Although HCC can present with various symptoms depending on the stage of the disease, hemoperitoneum is a well-known form of HCC presentation. A spontaneously ruptured HCC carries an extremely poor prognosis with high mortality due to hypovolemic shock and renal failure. There is a distinct geographic difference in the reported incidences of this complication. In Asia, the incidence reported was 12.4 % in Thailand [5] and 14.5 % in Hong Kong [6]. Spontaneous rupture was the cause of death in 10 % and 20.4 % of all patients with HCC in Japan and Thailand, respectively [7].

There are a number of reports on findings of ruptured HCC that refer to the incidence, or symptoms or mortality rate. Several reports have showed anatomic changes of ruptured HCC based on computed tomography (CT) in Japan and Korea

[8-13]. However, there has been no report on CT findings of ruptured HCC in the Southeast Asian region. In this report, we review the CT findings of ruptured HCC at King Chulalongkorn Memorial Hospital in Thailand from Jun 01, 2004 - Dec 31, 2005. We investigated the tumor size, number, location, number of hepatic segments involved, contour protrusion, including appearance of the mass, discontinuity of hepatic surface, enhancing pattern of the tumor, and ascites.

Materials and methods

From Jun 01, 2004 - Dec 31, 2005, 402 patients were diagnosed HCC at King Chulalongkorn Memorial Hospital on the basis of CT, angiography, MRI, serum level of alpha-fetoprotein or histopathological study. Ruptured HCC, proved by unclotted blood from abdominal paracentesis, developed in 25 of these cases.

Among the 25 cases in which ruptured HCC was diagnosed, 15 cases underwent helical CT and were included in this study. All patients were male with a mean age of 57.4 years (range 27-78 years). Symptoms were sudden onset of abdominal pain in 15 cases, abdominal distention in 10 cases, pallor in 13 cases and hypotension in 6 cases. All patients underwent helical CT (Somatom Sensation plus 4 or Somatom Sensation plus 16 Siemens Medical Solution, Germany). The Somatom Sensation plus 4 used a 4mm slice width, 2.5 mm collimator, 12.5 mm feed per rotation and 0.5 sec rotation time, while the Somatom Sensation plus 16 used a 16x1.5 mm collimator, 24.0 mm feed per rotation and 0.5 sec rotation time [14]. In 14 patients, plain scan was done, and then the arterial and portovenous phases were obtained using the bolus tracking technique in which the abdominal aorta threshold was set at 100 Hounfields unit (HU). A 3-4 ml/sec of 100 ml non-ionic contrast medium was injected as bolus, and the images of arteries were obtained 30-35 seconds after injection. The portovenous phases were obtained 65-70 seconds after injection. One patient received only plain CT without post contrast study due to the rising of serum creatinine.

Two experienced radiologists analyzed the CT findings regarding the tumor's size, number, location, number of involved hepatic segments, contour protrusion, marginal disruption and "enucleation sign" which was defined as separation of tumor content from the peripheral enhancing rim together with

intraperitoneal rupture of tumor content into the perihepatic space as seen in the arterial phase [15] including the appearance of the mass and CT number of ascites. Differences in opinion were resolved by consensus.

Definition

Marginal disruption: some part of tumor protrudes beyond the tumor margin itself.

Contour protrusion: the tumor protrudes beyond the original liver contour.

Results

All the cases of ruptured hepatocellular carcinoma developed in a cirrhotic liver. **Table 1** shows the CT findings of the ruptured HCC. All ruptured tumors were located in the periphery of the liver and had protruding contour (**Fig. 1**) seen on both pre- and post contrast studies. The maximum diameter of tumors ranged from 2.8-17.2 cm (mean 7.44 cm). Marginal disruption was seen in 9 cases (60 %) (**Fig. 2**). "Enucleation sign" was noted in 2 cases (13 %) (**Fig. 3**). In 2 cases (13 %), CT images during the venous phase showed extravasation of contrast material (**Fig. 4**). Five cases (33.3 %) had a hematoma with high attenuation adjacent to the ruptured mass, representing a surrounding hemorrhage (**Fig. 4**). Portal vein thrombosis was noted in 8 cases (53.3 %). Ascites developed in all cases of ruptured HCC, the mean Hounfields unit being about 24.3 (7-50 HU) in precontrast study and 25.36 (7-50 HU) in post contrast study. Ten cases (66.6 %) had multiple masses in different hepatic segment. In 11 cases (73.3 %) of the ruptured tumors showed mixed iso- and hypodensity and 4 cases (26.6 %) showed mixed hyper- and hypodensity on precontrast study. In 9 cases (60 %), CT images showed central non-enhancing low attenuation representing central necrosis which was seen in pre- and post contrast studies. All tumors showed moderate contrast enhancement in the arterial phase and washout in the portovenous phase.

Table 1. CT findings of ruptured HCC.

CT findings	Number of cases (%)
Protruding contour	15 (100%)
Marginal disruption	9 (60%)
Central necrosis	9 (60%)
Surrounding hematoma	5 (33.3%)
Extravasation of CM	2 (13%)
Enucleation sign	2 (13%)

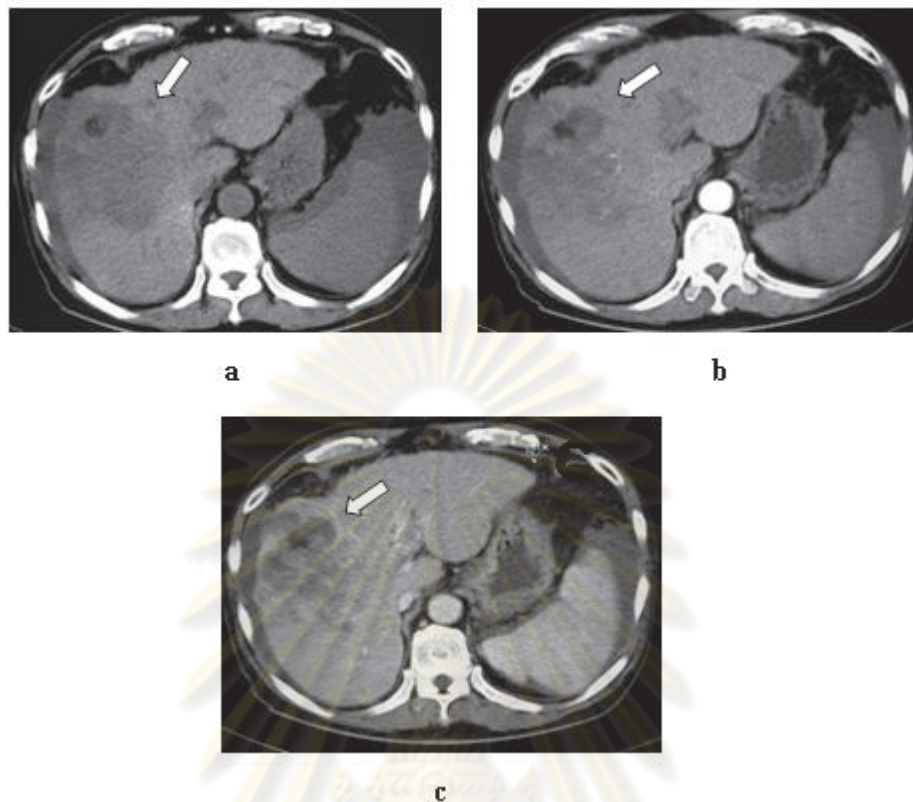


Fig. 1 A 64-year-old man with ruptured HCC. The CT scan shows a heterogeneous hypodense mass in the right hepatic lobe protruding beyond the original liver contour (arrow) as seen in the precontrast image (a), arterial phase image (b), and venous phase image (c)

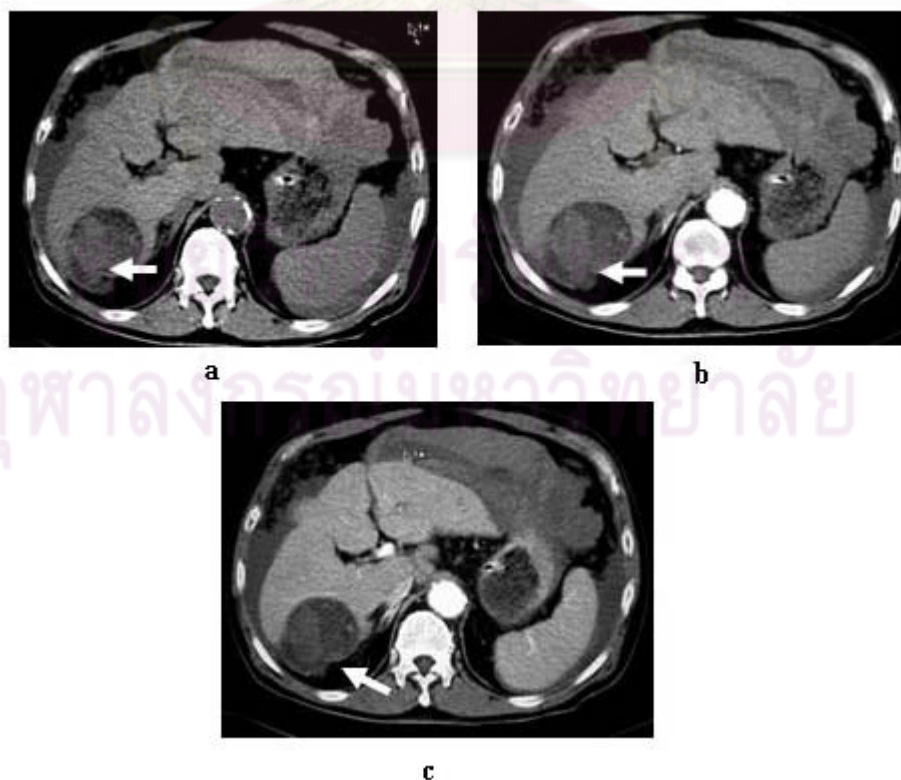


Fig. 2 A 70-year-old man with ruptured HCC. The CT scan shows a protruded mass with marginal disruption (arrow) at segment VI of the right hepatic lobe seen in the precontrast image (a), arterial phase image (b) and portovenous phase image (c).

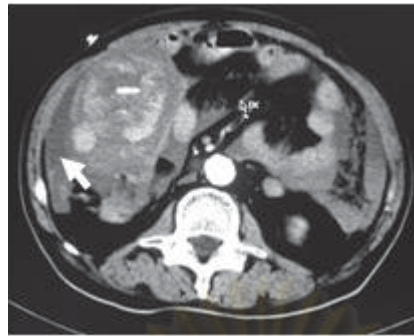


Fig. 3 A 78-year-old man with ruptured HCC. The arterial phase CT scan shows a protruded mass with separation of tumor content (arrow) from the peripheral enhancing rim “enucleation sign” in segment VI of right hepatic lobe.

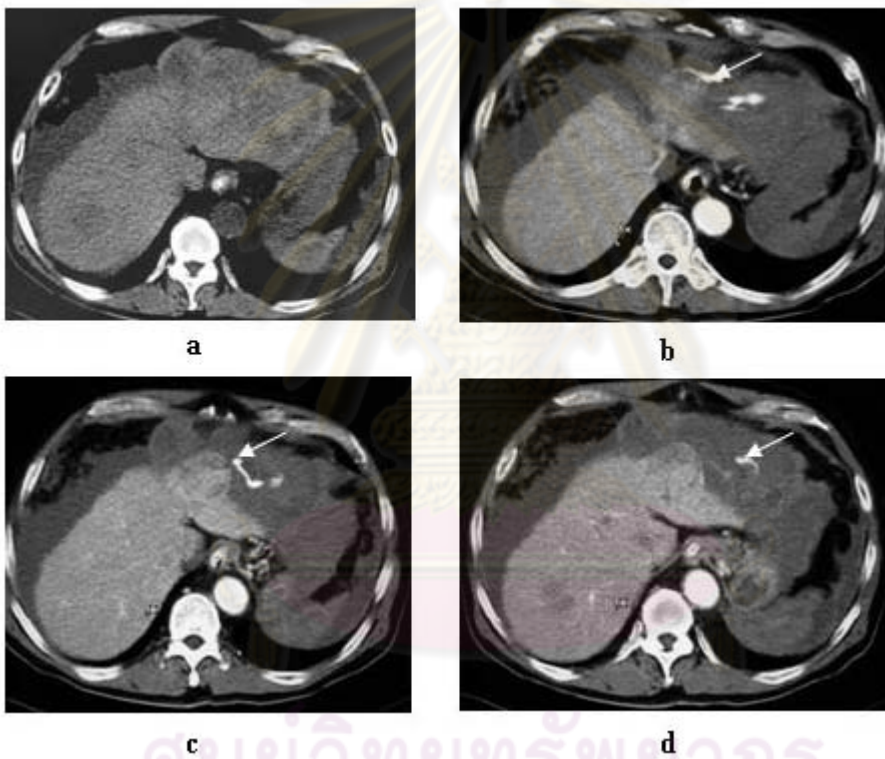


Fig. 4 A 70-year-old man with ruptured HCC. The precontrast CT (a) shows a heterogeneous isodensity mass with protruding contour at segment II of the left hepatic lobe. The late arterial phase (b, c and d) shows extravasation of contrast material from this mass.

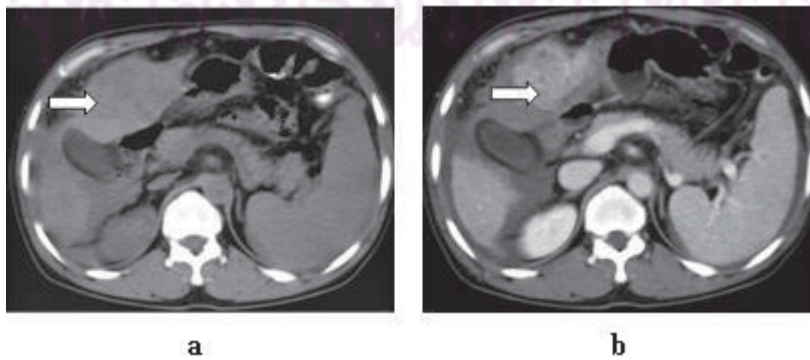


Fig. 5 A 50-year-old man with ruptured HCC. The precontrast CT scan (a) shows a heterogeneous hypodensity mass at segment IV of left hepatic lobe with surrounding high density area (arrow). In the portovenous phase (b) the surrounding high density area shows relatively low attenuation compared to the enhancing mass (flip-flop phenomenon) representing surrounding hematoma.

Discussion

The mechanism of rupture of HCC is poorly understood. Destruction of a feeding artery could cause rupture of a HCC. A feeding artery might rupture in conjunction with the development of ascites. Ascites in the space between the liver and the parietal peritoneum might cause separation of these structures, leading to the tearing of adherent surfaces or rupture of an adjacent artery. The tumor which protrudes beyond the original liver contour is more likely to rupture than one surrounded by normal parenchymal.

Typically, HCC has a hypervascular pattern and its necrosis or vascular invasion with obstruction of venous flow can lead to intraperitoneal hemorrhage. Ruptured HCC is usually fatal, especially in patients with underlying liver cirrhosis who may have severe coagulation defects. Surgical treatment or transcatheter arterial embolization is difficult and has not been successful in the vast majority of cases. Owing to high mortality, prompt and accurate diagnosis including emergency treatment is indispensable. Therefore, imaging plays a significant role in the diagnosis and management of this potentially lethal phenomenon.

Kanematsu et al. [12] reported that increased tumor size and extent of the extrahepatic protrusion are associated with an increased risk for ruptured HCC. This study showed that all ruptured tumors were located in the peripheral area and showed protruding contour. A new finding is called "marginal disruption" defined as some part of the tumor protruding beyond the tumor margin itself. It was seen in 9 cases (60 %). These findings were seen in both pre and post contrast studies including in a single patient who underwent only precontrast CT scan.

Nine cases (60 %) of ruptured HCC showed a central necrosis on both pre and post contrast studies. In 2005, Polat et al. [15] showed necrotic tumor center with fluid collection due to hemoperitoneum in the periphery of the liver which was helpful in diagnosing ruptured HCC.

In 1991, Pombo et al. [10] assumed that intraperitoneal high attenuation clots were more evident close to the tumor suggesting that the tumor was the origin of the hemorrhage. Our study showed evidence of surrounding hematoma seen in 5 cases (33.3 %).

In 2001, a previous study by Illuis Castells et al. [15] reported that the most characteristic findings on

CT scan are the presence of extravasation of contrast material as a sign of active bleeding or the presence of a disruption of the wall of a peripherally or subcapsular located mass. This finding was seen in only 2 cases (13 %) in our study.

In 2001, B G Choi et al. reported the "enucleation sign" which could be specific for ruptured HCC, but we found this in only 2 cases (13 %).

Limitation of this study was that some of the ruptured hepatoma patients were excluded from this study because no CT scan was available.

Conclusion

In cirrhosis of the liver, a peripheral mass showing central necrosis, protruding contour and marginal disruption on CT scan are highly suggestive of ruptured HCC. These findings seen with a surrounding hematoma and/or extravasation of contrast material and/or enucleation sign are more specific for ruptured HCC.

Ruptured HCC is usually fatal. Because of the high mortality rate, prompt and accurate diagnosis is important. Furthermore, the presentation of hemoperitoneum is not specific for ruptured hepatoma.

The authors have no conflict of interest to declare.

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