Preoperative Localization of Hepatomas by Sonography with Microbubbles of Carbon Dioxide

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Before liver resection in patients with hepatocellular carcinoma, identification of the segmental location of the tumor(s) and the area to be resected is important [1]. However, localization can be difficult when the tumor is near the border between segments. During surgery, detection of the portal vein to be resected is often complicated by small portal branches arising from the main branch of the anterior or posterior segment [2]. We used sonography with microbubbles of carbon dioxide during percutaneous transhepatic portography to locate the segment of hepatomas before resection.

Technique and Results

The subjects were 12 patients with hepatocellular carcinoma scheduled for resection. All patients had sonography and hepatic arteriography before portography. Informed consent was obtained from all subjects. Percutaneous transhepatic portography was done [2]. A portal branch in the noncancerous area was punctured under sonographic guidance by the Seldinger method. Portography with a 5.5-F catheter was done with vertical and horizontal beams to clarify the ramifications of the intrahepatic portal veins. After the portograms were obtained, the catheter was inserted into the portal branch for injection of microbubbles of carbon dioxide. Two segments were observed: the segment thought to be involved and the adjoining segment. The microbubbles were prepared by vigorous mixing of 10 ml of carbon dioxide, 10 ml of heparinized saline, and 5 ml of the patient's own blood, as previously described [3]. The microbubbles were injected manually through the catheter at the rate of about 2 ml/sec. As a rule, 5–10 ml per segment was sufficient to give a strong and homogenous echo. If the first injection did not give satisfactory results, the volume injected was increased or decreased, as appropriate, and a second injection was given 10 min later. A linear-array electronic scanner (Aloka, SSD-500) was used. The sonograms were recorded on a videotape recorder.

The segment supplied by the portal branch into which the microbubbles were injected was enhanced (Fig. 1). The technique was particularly useful in cases in which detection of the feeding artery on hepatic arteriograms or the tumor-bearing portal branch on portograms was difficult. Microbubbles were injected through the portal branch into the segment thought to be involved. Hepatic tissue of that segment was enhanced, and the tumor was seen in the enhanced segment (Fig. 2). Then microbubbles were injected through the portal branch in the adjacent segment. This segment was enhanced and the absence of the tumor in this segment was apparent. When a tumor is small and the segment of liver involved is strongly enhanced, detection of the tumor is difficult because the hyperechogenicity of the surrounding hepatic tissue obscures the echogenicity of the tumor. This problem can be resolved by use of a different volume of microbubbles; the microbubbles are washed out within 10 min.

During surgery, we found that the location of the tumor identified by this method was correct in all patients. In three of the 12 patients, it was not possible to locate the segment of the tumor by other methods and only this method gave the actual location. Therefore, this method was useful for locating the segment with the tumor.

No abnormal changes in findings such as abdominal pain or fever or laboratory data such as the white blood cell count or liver function tests were found after this procedure in any patient.

Discussion

Advances in medical imaging have made it possible to detect small hepatocellular carcinoma, which sometimes are not seen during hepatic arteriography [4]. Hepatic segmental anatomy and the segmental location of tumors can be investi-
gated by sonography [5] or CT during arterial portography [6]. MR imaging also is useful [7]. However, CT scanning during arterial portography is technically difficult, and results are two-dimensional. MR images show the relationship between tumor(s) and hepatic veins or portal veins, but the segmental location cannot always be decided. It is occasionally difficult to locate the segment of the tumor by these methods. The technique reported here is useful because the tumor is seen as an unenhanced area in an enhanced segment in several projections and because diagnosis of the segmental location of the tumor is accurate (all 12 of our patients). Use of this technique is indicated when it is difficult to locate the tumor by other methods and when limited resection such as segmentectomy or subsegmentectomy is necessary because of impaired liver function. Percutaneous transhepatic portography itself is invasive, but we do it routinely, and this procedure adds about 20 min to the time. During surgery, it is easy to puncture the intrahepatic portal branch. Sonography with microbubbles can be done during surgery the same way marking with blue dye is done [1].

REFERENCES

This article has been cited by:


2. Eldad S. Bialecki, Adrian M. Di Bisceglie. 2005. Diagnosis of hepatocellular carcinoma. *HPB* **7**:1, 26-34. [Crossref]


4. Mark S. Peterson, Richard L. Baron. 2001. Radiologic Diagnosis of Hepatocellular Carcinoma. *Clinics in Liver Disease* **5**:1, 123-144. [Crossref]

5. Doris N. Redhead, Edward Leen. Diagnosis of Liver Metastasis 45-63. [Crossref]

6. TETSUO AKIMOTO, MITSUOMI MATSUMOTO, NORIO MITSUHASHI, TOORU MASHIMO, HIDEO NIIBE. 1997. Evaluation of Effect of Treatment for Invasive Bladder Cancer by Ultrasonography with Intra-arterial Infusion of Carbon Dioxide Microbubbles. *INVESTIGATIVE RADIOLOGY* **32**:7, 396-400. [Crossref]