Evaluation of Three Imaging Instruments in Dogs with Liver Hematomas: Concise Communication

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Single-gamma emission computerized tomography (ECT) was compared with transmission computerized tomography (TCT) and scintillation-camera imaging (SC) in eight dogs with acute, solitary hematomas in the left liver lobe. The superior performance of TCT was attributed to its inherently better spatial resolution than those of ECT or SC, and to the fact that studies with TCT could be performed during apnea. ECT was more sensitive than SC to small changes in the spatial distribution of radionuclides. In addition, the ECT, by virtue of its sectioning capability, was more sensitive than is SC to differences in radionuclide concentrations at same depth in an organ.

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MATERIALS AND METHOD

Single-gamma emission computerized tomography (ECT) was compared with transmission computerized tomography (TCT) and scintillation-camera (SC) imaging in eight dogs weighing 17–35 kg. Acute solitary hematomas in the left liver lobe were induced by instillation of 20 cc of nonheparinized blood at laparatomy after anesthesia with pentobarbital. This resulted in spherical lesions approximately 2.2 cm in diameter.

Imaging was done within 2 hr after formation of these hematomas. For ECT imaging,* a 3-mCi dose of Tc-99m sulfur colloid was administered intravenously. Each slice with ECT required 5 min. TCT stop-motion imaging† was performed in apnea (20 sec per slice) after administration of succinylcholine (1 mg/kg). There was intermittent artificial respiration between images. Gamma-camera imaging‡ was done following the ECT imaging in several projections using a scintillation camera with low-energy all-purpose collimator (LEAP) and motion-correction device. All images accumulated 500,000 counts and required about 1 min to obtain. Followup examinations with TCT only were obtained at 6–12 days, at which time the animals were killed and an autopsy performed.

Induction of the hematomas at laparotomy and imaging were performed by two of the investigators (MPF/RAP). SC, ECT, and TCT scans were interpreted separately by two different investigators (MKL/LCK), who had no prior knowledge of the experimental filling defects.

RESULTS

All eight of the hematomas measuring approximately 2.0–2.5 cm in diameter were detected by TCT imaging (Figure 1A). Four were demonstrated by ECT (Figure 1B) with the remaining four being questionably positive, either as a filling defect or as a distortion of the left lobe of the liver. Only two of the hematomas could be identified on camera scintiphotos, with an additional two being questionably positive (Table 1). Followup examination with TCT at 6–12 days and subsequent autopsy demonstrated resolution of these hematomas.

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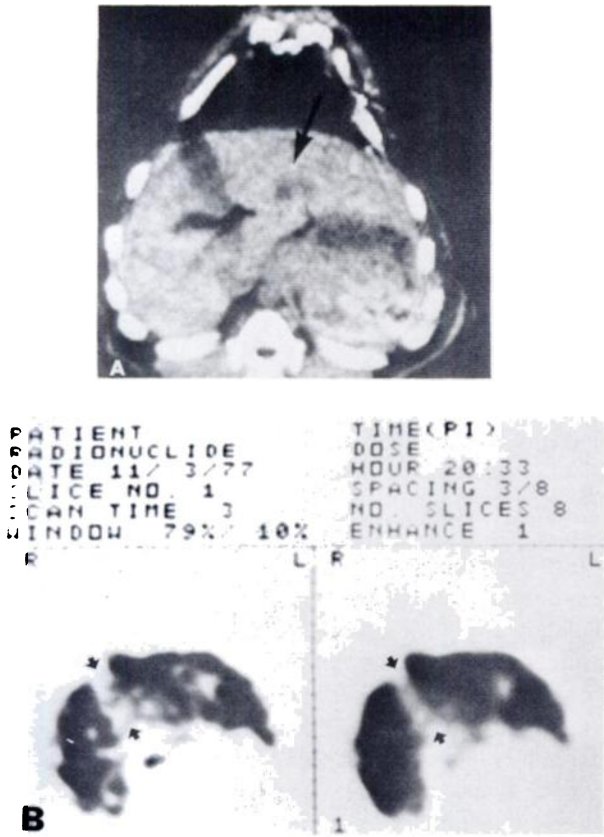

FIG. 1 (A) Hematoma, demonstrated by transmission CT as area of low attenuation within left lobe of liver (arrow). (B) Hematoma within left lobe of liver, visualized by emission (Tc-99m SC) computed tomography. Note location of gallbladder fossa and porta hepatis (arrows). Raw data on left; processed image on right.

TABLE 1. EVALUATION OF LIVER HEMATOMAS IN DOGS WITH THREE IMAGING SYSTEMS

Dog No.	ECT	TCT	SC	Comments
1	±*	+	+	Intrahepatic hematoma
2	+	+	±?	Intrahepatic hematoma
3	±*	+	−	Intrahepatic hematoma
4	±*	+	±?	Intrahepatic hematoma
5	±*	+	+	Subcapsular hematoma
6	+	+	−	Intrahepatic hematoma
7	+	+	−	Intrahepatic hematoma
8	+	+	−	Intrahepatic hematoma

* Distortion of left lobe of liver only.

DISCUSSION

The superior performance of TCT in detecting mass lesions in the liver in this study is attributed to its inherent spatial resolution of 1.5 mm using a slice thickness of 15 mm (*1*). Phantom studies on the radiotracer imaging systems have shown that filling defects 1 cm in diameter surrounded by radioactivity are detected on images from the ECT system. The resolution of the SC is inferior to this, requiring filling defects to be 3 cm in diameter before they are detected on the images (*2*). The slice width of the ECT is 1.25 cm and the distance between the midpoint of the slices was selected to be 0.95 cm (3/8 in.). In addition, studies with TCT could be performed during apnea (20 sec per slice), whereas current technical limitations preclude a motionless condition with the SC or ECT study (*3, 4*). Furthermore, the TCT Hounsfield number for blood is significantly different from that of liver parenchyma (*5–6*).

We do find the ECT to be more sensitive than SC to small changes in the spatial distribution of radionuclides. In addition, the ECT, by virtue of its sectioning capability, is more sensitive to differences in radionuclide concentrations at some depth in the organ than is true for SC. However, the use of a high-resolution collimator instead of a LEAP collimator would improve the performance of the SC somewhat. Furthermore, the multilobulated appearance of the dog's liver (*6*) may have contributed to the inferior performance of the SC as compared with the two tomographic imaging devices.

Until such time as the photon yield in ECT permits a shortening of the examination to a period of apnea, it is apparent that TCT will be the instrument of choice in instances in which density differences are identifiable. In instances in which a study is performed to assess organ function or blood flow, ECT, or SC techniques will continue to be useful.

FOOTNOTES

* Union Carbide Cleon 710 unit
† Acta-Pfizer 0200 FS
‡ Searle Pho Gamma V

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