Intraperitoneal Fluid Collection: CT Characteristics in Determining the Causes

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Purpose: Abdominal CT scans in patients with intraperitoneal fluid were retrospectively studied to identify characteristic features useful for differential diagnosis of various causes.

Materials and Methods: One hundred and seventy patients with intraperitoneal fluid collection were classified as categories of hepatic disease, carcinomatosis, and infectious disease. We analyzed sites of fluid collection, the presence of peritoneal thickening, omental and mesenteric fat infiltration, and lymph node enlargement.

Results: Intraperitoneal fluid was present in subhepatic space, subphrenic space, paracolic gutter, mesentery, and fossa of the gallbladder in decreasing order of frequency. Fluid in the gallbladder fossa was the most frequent in hepatic diseases. The fluid collection in subhepatic and subphrenic space was less frequent in infectious diseases. Peritoneal thickening was noted in infectious diseases, and carcinomatosis. Omental fat infiltration and enlarged lymph nodes were the most frequent in carcinomatosis (58% and 44%, respectively), whereas, mesenteric fat infiltration and enlarged lymph nodes were the most common in infectious diseases (61%, and 26%, respectively).

Conclusion: The location of peritoneal fluid collection showed some lesion specific characteristics, and CT features of fat infiltration and enlarged lymph nodes of peritoneum, omentum, and mesentery were helpful for differential diagnosis between carcinomatosis and infectious diseases.

Index Words: Ascites
Peritoneum, CT
Peritoneum, fluid

INTRODUCTION

Several radiologic modalities are used to assess intraperitoneal lesions associated with ascites, including ultrasonography (US), CT, or MR. The goals of these modalities are to determine the location, amount, and cause of intraperitoneal fluid. CT was proven to be accurate in the evaluation of location or assessment of intraperitoneal fluid amount (1, 2). To date, evaluation of the cause of the site-specific intraperitoneal fluid collection has not been undertaken. Although CT findings such as peritoneal nodules, omental or mesenteric masses, tethered bowel loops, and contrast enhancement or thickened peritoneum may suggest malignancy, peritoneal fluid per se occurring in a variety of intraperitoneal disease usually do not provide a clue to a specific diagnosis (1-5). Can abdominal CT accurately help differentiating intraperitoneal lesions accompanied with fluid? This study attempted to establish lesion-specific CT features of intraperitoneal fluid collection which may be valuable in management of the patients with intraperitoneal fluid.

MATERIALS and METHODS

The study population consisted of 170 patients, 112 men and 58 women ranging in age from 7 to 86 years (mean, 49 years). All patients had taken CT scan, and
the films were evaluated at the department of radiology of Inha Hospital, between January 1992 and September 1994. Final diagnosis included hepatoma (n=46), liver cirrhosis (n=33), carcinomatosis (n=36), infectious disease (n=23), traumatic hemoperitoneum (n=15), pancreatitis (n=12), intestinal obstruction (n=3), and Budd-Chiari syndrome (n=2). The diseases encountered were classified into: 1) hepatic disease, 2) carcinomatosis, or 3) infectious disease. Hepatic diseases included hepatoma and liver cirrhosis. Carcinomatosis included stomach, biliary, pancreatic, ovarian, gallbladder, and rectal cancers in 12, 7, 6, 4, 3, and 2 patients, respectively, and unknown metastatic adenocarcinoma in 2 patients. The diseases of infectious origin included tuberculosis, panperitonitis or abscess with visceral perforation, and diverticulitis in 13, 9, and 1 patients, respectively. The diagnosis was confirmed by operation followed by pathologic examination of the lesions, and peritoneoscope or ultrasound guided biopsy. Clinical data and surgical findings were compiled from the patients' medical records.

The CT scanners used were a GE 9800 (GE Medical System, Milwaukee, Wisconsin, USA) and a Shimadzu SCT 2000 T (Kyoto, Japan). Unenhanced and contrast enhanced scans were obtained in all patients, with 5 to 10 mm collimation at intervals of 10 mm, from the diaphragm to iliac crest with axial scans. All patients received 250 cc of oral contrast material (370 mg/ml, Gastrografin diluted 1:40 in water, Schering, Seoul, Korea), and 100-150 ml of intravenous contrast media (iodine 300 mg/ml, iopromide, Schering, Seoul, Korea).

Two radiologists (MYK, CHS) jointly interpreted the CT findings without prior knowledge of the patient's specific diagnosis. CT scans were reviewed and evaluated for the following findings: (a) the locations of peritoneal fluid, such as subphrenic space, subhepatic space, paracolic gutter, fossa of the gallbladder and lesser sac, (b) the CT features suggesting lesional spread pattern, such as peritoneal thickening and lymph nodes (Fig. 1a), omental fat infiltration and lymph nodes (Fig. 1b), mesenteric fat infiltration (Fig. 2a) and lymph nodes (Fig. 2b). Peritoneum was considered to be thickened, if it was twice the normal thickness with or without abnormal enhancement. Although a lymphadenopathy over 10 mm in diameter is generally considered as abnormal, lymph node over 5 mm in diameter was considered to be enlarged for this study in order to include small lymph nodes of peritoneum or omentum. Diagnostic criterion of fat infiltration was linear fibrous densities throughout the omentum and mesentery associated with thickening and indistinctness of vasculature. The diseases thus reviewed were compared in terms of the location of fluid, and involvement of peritoneum, omentum, and mesentery.

The statistical significance was obtained using the chi-square test (or Fisher's exact test where indicated). For statistical analysis, P value less than .05 was considered significant.

RESULTS

The fluid was present in subhepatic space in 132 (78%), subphrenic space in 131 (77%), paracolic gutter in 121 (71%), mesentery in 66 (39%), fossa of the gallbladder in 50 (29%), lesser sac in 17 (10%), retroperitoneum in 15 (9%), and pleural space in 35 (21%) patients. Intraperitoneal fluid of subhepatic and subphrenic space was seen in 85/87%, 81/83%, 61/48% in hepatic disease, carcinomatosis, and infectious disease, respectively. Fluid in paracolic gutter was detected in 75%, 67%, 57% of the hepatic diseases,
Fig. 2. Generalized ascites with tuberculous peritonitis in a 32-year-old woman. a. Contrast enhanced CT scan shows irregular mesenteric fat infiltration with increased linear fibrous densities (arrows). b. CT scan demonstrates mesenteric lymph node (arrow) and irregular mesenteric fat infiltration.

carcinomatosis, and infectious diseases, respectively. Fluid in the mesentery was noted in 44%, 42%, and 39% of the hepatic disease, carcinomatosis, and infectious diseases, respectively. Fluid in the gallbladder fossa was present in 41%, 28%, and 13% of the hepatic diseases, carcinomatosis, and infectious diseases. The frequency of fluid collection in subhepatic space, subphrenic space, and fossa of gallbladder was significantly different among the disease groups (p<0.05) (Fig. 3).

Comparison of spread pattern of the lesions involving peritoneum, omentum, and mesentery is shown in Fig. 4. Peritoneal thickening was detected in 26% and 19% of the infectious diseases and carcinomatosis, respectively. Omental fat infiltration was present in 58%, 38%, and 30% of carcinomatosis, hepatic diseases, and infectious diseases, respectively. Mesenteric fat infiltration was noted in 61%, 42%, and 32% of the infectious disease, carcinomatosis, and hepatic diseases, respectively. Peritoneal lymph nodes were detected in 8% of the carcinomatoses. Omental lymph node was detected in 44% and 13% of the carcinomatoses and infectious diseases. Mesenteric lymph node was noted in 26% and 17% of the infectious diseases and carcinomatosis. Incidences of peritoneal thickening, enlarged omental lymph nodes, presence of mesenteric fat infiltration, and enlarged mesenteric lymph nodes were significantly different among the disease groups (p<0.05).

DISCUSSION

The major role of CT is not only to make the diagnosis of intraperitoneal fluid collection but also to identify the cause of ascitic fluid. Hepatic ascites associated with mass or cirrhosis is often advanced and clinically evident before the onset of intraperitoneal fluid. Therefore, it is important to differentiate the peritoneal seeding of carcinoma from benign process such as infectious or inflammatory condition. Although various CT features have been used to differentiate malignant from benign ascites (1-3), these findings are less specific for differential diagnosis of peritoneal lesions (5-9).

The location of intraperitoneal fluid highly correlates with the volume, peritoneal pressure, position of the patient, region of origin, rate of fluid accumulation, presence of adhesions, density of the fluid, forces of gravity, negative subdiaphragmatic pressure, and peritoneal reflections (2, 4, 10). In our study, common sites of the fluid collection were subphrenic space, subhepatic space, and paracolic gutter, and these results suggested that the locations of intraperitoneal fluid were mainly depended on patient’s position and gravity.

There are some lesion specific characteristics in the locations of intraperitoneal fluid. The fluid of the gallbladder fossa was most commonly seen in hepatic diseases. Increased portal pressure might have caused this fluid collection probably secondary to the edema of the gallbladder brought about by disturbance of the drainage of cystic vein into the portal venous system (11). Tsujimoto et al. (12) reported that gallbladder wall thickening is a useful sign of benign ascites; patients with liver cirrhosis showed the gallbladder wall with >4 mm thickness. In infectious diseases, abnormal fluid appeared to spare the subhepatic or subphrenic space probably due to the interference of natural fluid flow by intraperitoneal adhesion or fibrous septation. In carcinomatosis, the common site of intraperitoneal fluid may be subjected to increased incidence of metastasis, as tumor seeding depends on the natural flow of ascites within the peritoneal recesses (10, 13). Buy et al. (14) found that the common sites of
peritoneal thickening or enhancement are detected in most cases with malignant transudates. However, fluid in the greater and lesser sacs to be due to malignant diseases, whereas fluid collection was primarily seen in the greater sac and not in the lesser omental bursae in the cases with benign transudates. However, fluid in the lesser sac is not considered a differential feature of malignant or benign ascites, because a wide range of diseases show fluid in the lesser sac (16). In our study, 21 percent of intraperitoneal lesions with fluid were associated with pleural effusion. Pleural effusion may reflect direct tumor invasion, pleural tuberculosis, or pleuropertitoneal communication. Peritoneal scintigraphy following intraperitoneal administration of Tc-99m sulfur colloid may identify the source of the effusion; if activity is demonstrated in the pleural space, this indicates the presence of a pleuropertitoneal communication (17). A sudden pleural effusion is also a common sequela of pulmonary embolism associated with malignancy (18).

The peritoneum, omentum, and mesentery are commonly involved by various intraperitoneal diseases. Peritoneal thickening or enhancement are detected in peritoneal carcinomatosis, mesothelioma, and tuberculosis (5, 12). Fat infiltration in the omentum reflects invasion of tumor, edema, fibrosis, infectious or inflammatory processes (7, 8). In this study, peritoneal thickening was detected in the infectious diseases and carcinomatosis, and omental fat infiltration was seen in carcinomatosis, hepatic disease, and infectious or inflammatory disease in decreasing order of frequency.

Carcinomatosis, hepatic disease, and infectious or inflammatory disease in decreasing order of frequency. The intraperitoneal fluid was present in subhepatic space, subphrenic space, paracolic gutter, mesentery, and fossa of gallbladder in decreasing order of frequency. The fluid collection in subphrenic and subhepatic space were less frequent in infectious diseases. Fluid in gallbladder fossa was most frequent in hepatic diseases.

Omental fat infiltration in liver cirrhosis seems to be due to the edema possibly caused by portal hypertension, interfering omental vein drainage into the portal system via superior mesenteric and splenic veins. Mesenteric fat infiltration is seen in metastatic diseases, inflammatory lesions, and mesenteric vascular diseases (8). In this study, mesenteric fat infiltration was noted most commonly in the infectious diseases, followed by carcinomatosis and hepatic diseases.

Most peritoneal solid masses are secondary tumors in overwhelming majority (7). In this study, enlarged peritoneal lymph nodes were present in carcinomatosis, but not in infectious disease. The classic omental cake due to replacement of the omental fat by tumor results in thick, confluent soft tissue masses closely adherent to the anterior surface of the transverse colon (8). Omental lymph nodes in our cases were most prominent in carcinomatosis. Mesenteric lymph nodes were more common in infectious disease than in carcinomatosis. Hulnick et al. (19) reviewed 27 patients with abdominal tuberculosis and reported that there was a tendency for lymphadenopathy to be prominent in peripancreatic and mesenteric compartments. Lymph nodes in carcinomatosis were evenly distributed in the peritoneum, omentum, and mesentery, whereas in infectious diseases, they tended to be confined between mesenteries. Lymph nodes in peritoneum and omentum virtually ensured the diagnosis of carcinomatosis; however, mesenteric lymph nodes highly suggested infectious cause.

Although CT features are considered to have potential for differentiating various diseases associated with intraperitoneal fluid, they are not sufficiently specific to obviate pathologic confirmation. However, the location of intraperitoneal fluid, and lesional involvement of peritoneum, omentum, and mesentery may be helpful for the differential diagnosis of intraperitoneal lesions with ascites.
In conclusion, several findings regarding peritoneal fluid collection appear to be helpful for specific diagnosis of intraperitoneal lesions. In hepatic diseases, fluid in gallbladder fossa was more frequent, and less commonly involved peritoneum, omentum, and mesentery. In carcinomatosis, the fluid showed a diffuse pattern in the peritoneal cavity. This contrasts with infectious processes where fluid tended to spare subphrenic and subhepatic spaces. Omental fat infiltration and lymph node enlargement were frequently observed in carcinomatosis, whereas, mesentric fat infiltration and lymph node enlargement were most commonly associated with infectious diseases.

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복수를 동반한 복강내 병변: 원인에 따른 CT소견

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목 적: 복수를 동반한 다양한 병변들의 감별 진단은 임상적으로 중요한 의의가 있으며, 저자들은 복부 CT 소견을 후향적으로 분석함으로써 감별에 유용한 특징적 소견을 알아보고자 한다.

대상 및 방법: 복수가 있었던 170 예의 복강내 병변을 간성 질환, 악성종양 전이(carcinomatosis), 염증성 질환으로 대별하였다. CT 상 각 병변에 따른 복수의 분포 위치를 비교하였고, 복막 비후, 대망과 장간막의 지방침습, 복막, 대망, 장간막에 동반된 임파절 비대 소견을 분석하였다.

결 과: 복수의 분포를 분석한 결과, 간하, 횡격막하의 빈도가 가장 높았으며, 대장주위구, 장간막, 담낭와의 빈도순으로 나타났다. 담낭와 복수는 간성 질환에서 빈도가 가장 높았으며, 간하와 횡격막하의 복수는 염증성 병변에서 상대적으로 낮은 빈도를 보았다. 복막 비후는 염증성 병변과 악성종양 전이에서 동반되었으며, 대망의 지방조직 침습과 임파절 비대는 악성종양 전이에서 가장 높은 빈도를 보인 반면 (각각 58%, 44%), 장간막의 지방조직 침습과 임파절 비대는 염증성 병변에서 가장 높게 나타났다 (각각 61%, 26%).

결 론: 복수의 분포는 병변에 따른 위치별 특성이 있으며, CT상 복막, 대망, 장간막의 지방조직 침습과 임파절 비대 소견은 악성종양 전이와, 염증성 병변의 감별진단에서 유용한 것으로 사료된다.