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Pyogenic liver abscess treated by percutaneous catheter drainage: MDCT measurement for treatment outcome

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ABSTRACT

Objective: To analyze multidetector computed tomographic (MDCT) parameters in patients with pyogenic liver abscess (PLA), and to identify which parameters can be predicted percutaneous catheter drainage (PCD) treatment outcome.
Materials and methods: Clinical, laboratory and MDCT findings of 175 patients with PLA who had undergone PCD were retrospectively reviewed. All abscesses shown on MDCT were evaluated for size, margin, attenuation values, location, number of large (>3 cm) abscesses, presence of a cystic component, presence of gas, and the shortest length to the liver capsule. Univariate and multivariate analyses of the MDCT parameters that affect PCD treatment outcome was performed. For continuous data of MDCT parameters (abscess size and the shortest length), we used receiver-operating-characteristic (ROC) curve to determine the optimal cut-off values.
Results: PCD was failed in 32 patients and the overall failure rate was 18.28%. Multivariate analysis revealed that PCD failure was predicted by the presence of gas (odds ratio [OR], 42.67), a large abscess (OR 1.21), low minimal attenuation values (OR 1.02), wide range of attenuation values (OR 1.01), a shorter length to the liver capsule (OR 0.09) and lack of a cystic component (OR 0.09) of the PLA. ROC curve showed that the shortest length less than 0.25 cm and an abscess size greater than 7.3 cm were the optimal cut-off values predicting PCD treatment failure.
Conclusion: Among these MDCT parameters, gas formation within PLA was the most important predictor for PCD failure. Surgical intervention might be considered early in high-risk patients of PCD failure.

1. Introduction

Percutaneous catheter drainage (PCD) guided by sonography or computed tomography (CT) is widely accepted as the therapy of choice for accessible pyogenic liver abscess (PLA), with the expectation that successful imaging-guided drainage will significantly reduce the mortality rate to 2.5% [1]. The advantage of imaging-guided percutaneous drainage over surgery is the marked reductions in invasiveness and cost, lower morbidity, greater feasibility, and no requirement for general anaesthesia [2,3]. However, the imaging-guided drainage procedure still has a 10–15% failure rate [4]. To the best of our knowledge, advanced age, respiratory failure, coagulopathy, and the sonographic appearance of the abscess, such as a large size and multiloculation, may reduce the success of PCD [5,6].

Patients managed with an imaging-guided percutaneous drainage procedure for PLA show a high rate of treatment success, especially when the abscesses are simple, well defined, and unilocular on sonography or CT [7]. However, with increasing experience, attempts are now frequently made to percutaneously drain complex liver abscesses, including multiseptate abscesses, those with poorly defined margins or a predominantly solid appearance, and those containing thick heterogeneous viscid pus. As far as we know, no data are available for a large series of patients that could be used to evaluate the multidetector computed tomography (MDCT) measurement for treatment outcome of PCD therapy in patients with PLA. For this reason, we have reviewed our 6 years of experience in treating 175 patients with PCD and analyzed their clinical parameters and MDCT characteristics in an attempt to identify the predictors associated with both successful and unsuccessful PCD treatment.

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2. Materials and methods

2.1. Patients

This study was conducted retrospectively at a tertiary referral medical centre between January 2009 and March 2010. The study was approved by the institutional review board for human investigations, who waived the requirement for the written informed consent of the patients because patient anonymity was strictly maintained and the study was an observational one. In a search of the institutional database with the International Classification of Diseases, 9th Revision code 572.0, we found 285 patients with a final diagnosis of liver abscess during their hospitalization. PLA was diagnosed if at least one of the following criteria was met: (1) pus was drained with PCD; (2) bacterial pathogens were isolated from a blood culture or abscess culture; and (3) the intrahepatic cavity was resolved after antibiotic and PCD treatments. All patients had undergone an MDCT scan before treatment. In this study, we excluded 110 patients who did not receive PCD therapy in their initial treatment, which included antibiotic treatment only or surgery only. Finally, our study population consisted of 175 patients (103 men and 72 women; mean age = 62 ± 15 years, range = 24–88 years). These patients were divided into two groups. The failure group consisted of those in whom PCD therapy had failed and the non-failure group consisted of patients who experienced successful PCD therapy.

2.2. Methods

In a retrospective review, performed independently by two authors, the medical records of patients with PLA were examined for age, sex, clinical presentation, underlying disease, and laboratory data at initial emergency department presentation, morbidity, mortality, and hospital stay. The aetiology was defined as cryptogenic if no causative lesion could be demonstrated. Each patient received abdominal MDCT before beginning therapy. All the included patients were treated with an antibiotic (most commonly ceftriaxone) plus PCD. The antibiotic doses were subsequently adjusted according to the results of blood or abscess cultures. In our hospital setting, PCD was performed regularly on abscesses with diameters greater than 3 cm unless the location of abscess made it too difficult to drain. Each abscesses with diameters greater than 3 cm was placed at least one catheter; and if indicated, we inserted two drainage tubes if diameter of the abscess is larger than 6 cm. Patients underwent PCD in which a 8.5-Fr, 10-Fr, or 12-Fr pigtail catheter was placed into the largest abscess locule with the modified Seldinger technique by two expert radiologists with 5–14 years of experience. The size selection of drainage tubes is determined by the experienced radiologists at the time of drainage procedure. The length of drainage catheter traversing through unaffected liver was regularly recorded. The pus aspirated initially by PCD was sent for microbiological analysis and the amount was routinely recorded. In each drainage procedure, the abscess cavities were followed by ultrasound within 3 days. Failed PCD therapy was defined as death or decline in the patient's clinical condition that required an additional procedure, such as surgical drainage or resection, during the same hospital stay. A secondary procedure was defined as either a revision of the PCD with a larger catheter or a repeated PCD of other abscess cavities. The secondary procedure was categorized as successful PCD if no further surgery was needed or death occurred. The reasons for a secondary procedure were recorded as: (1) catheter blockage; (2) catheter dislodgement; and (3) the development of a new abscess. Mortality was defined as death during hospitalization. Morbidities included metastatic infection, acute renal failure, acute respiratory failure, septic shock, hepatic failure, pleural effusion, empyema, upper gastrointestinal bleeding, and an episode of coronary artery disease during the same hospitalization.

2.3. MDCT scan for liver abscesses

At our institution, the MDCT protocol for the suspected liver abnormality was designed as follows. Unenhanced MDCT scans are routinely performed without any prior oral administration of water or contrast material (CM). Two phases (arterial and portal venous phases) are then obtained after the intravenous administration of 90 mL of CM (iodine concentration 350 mg/mL; Omnipaque, GE Healthcare, Norway) at a rate of 2.5–3.0 mL/s using a power injector, followed by a saline chaser. Venous access is provided with a 20- or 22-gauge cubital needle. The scan delay for the arterial-phase images is defined with bolus tracking, with a circular region of interest (ROI) positioned at the level of the abdominal aorta, and a predefined 120-Hounsfield unit (HU) enhancement threshold level is set to trigger the data acquisition. The portal venous phase is scanned 40 s after the initiation of the arterial phase MDCT scan.

We use the following image parameters for MDCT scanning and reconstruction: beam collimation of 0.5 mm, slice thickness of 5 mm, pitch 1.5, tube voltage set at 120 kV, and the maximum tube current limited to 230 mA using dose modulation. The scanning range is from the hepatic dome to the iliac crest. Coronal reformatted images are routinely obtained. All the MDCT images are reviewed on dedicated Picture Archiving and Communication System (PACS) workstations.

2.4. Reviewing the MDCT images

The patient names and identifying record numbers were electronically removed from all images for each MDCT examination before the cases were loaded onto a workstation for review. The MDCT images were individually reviewed by two radiologists, who were blinded to the PCD failure and all other clinical laboratory data, although the radiologists knew that all the patients had a final diagnosis of liver abscess. Discrepancies between the two radiologists' evaluations were resolved with further consensus readings. For this assessment, we recorded the characteristics of the liver abscesses on portal-venous-phase MDCT images as follows: (1) size (cm); (2) maximum, minimum, and mean abscess attenuation values (HU); (3) location of the abscess; (4) total number of abscesses larger than 3 cm; (5) total number of abscesses; (6) presence of gas; (7) presence of a cystic component; (8) the shortest length to the liver capsule; (9) the margin of the abscess (well defined or ill defined); and (10) the septum (single or multiple).

Size: The size of the abscess was defined as the longest diameter of the largest abscess.

Attenuation values: Attenuation values measurements were made on a commercially available workstation (Extended Brilliance Workspace, Philips Healthcare) using PACS. The maximum, minimum, and mean attenuation values were measured for the areas with ROI cursors that were placed over the lesion (Fig. 1) in the portal venous phase. The ROI in each section was drawn by hand along the edge of the liver abscess, based on visual inspection. The ROI areas were multiplied by the mean attenuation values in each section, and these values were summed to calculate the total attenuation values. The total attenuation values were then divided by the sum of the ROI areas to calculate the final mean attenuation values of the abscess. In our experience, we noted less than 5% intra-observer variability for this type of assessment.

Example:

Section 1: Mean = M1, Area = A1
Section 2: Mean = M2, Area = A2