Comparison of CT findings between MDR-TB and XDR-TB

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Aims and objectives

Multidrug-resistant tuberculosis (MDR-TB) is defined as a disease caused by Mycobacterium tuberculosis strains with resistance to at least isoniazid and rifampin. Extensively drug-resistant tuberculosis (XDR-TB) is a life-threatening infection that is resistant to any type of fluoroquinolone and at least one of the three following injectable drugs: amikacin, capreomycin or kanamycin in addition to isoniazid and rifampin\(^1\). According to a World Health Organization (WHO) report, about 3.2% of all new tuberculosis cases are multidrug resistant (MDR).

Comparing with patients with drug-sensitive TB, non-AIDS patients with MDR-TB are younger and have more frequent history of TB treatment and show more cavitary lung lesions on CT\(^2\). Although clinical findings of XDR- and MDR-TB have been widely reported\(^3-6\), to the best of our knowledge, the radiologic comparison of MDR- and XDR-TB has rarely been reported. Thus, the purpose of our study was to evaluate the radiologic findings of MDR- and XDR-TB and to compare the findings with two groups in non-AIDS patients.
Methods and materials

1. Patients

The retrospective study was approved by the institutional review board of our medical institution, for which the requirement for informed consent was waived. From 2008 to March 2014, a computer search was performed to identify all patients with MDR- and XDR-TB who underwent chest CT scans. 107 non-AIDS patients with MDR-TB and 26 non-AIDS patients with XDR-TB were identified by computer searching. Among them, 76 MDR-TB patients and 22 XDR-TB patients were compatible with primary tuberculous infection. Primary tuberculosis was defined as the disease that developed in patients with no history of anti-tuberculous treatment or a history of less than two months of treatment. After exception of the patients with lack of the availability of chest CT scan, 52 MDR-TB and 15 XDR-TB patients were included in this study. All of 67 patients included in this study were HIV-seronegative. The time interval between MDR-TB isolation and the initial chest CT scans ranged from 3 to 67 days (mean interval, 19 days) and interval between XDR-TB isolation and CT ranges from 2 to 55 days (mean interval, 21 days) respectively. The time interval between specimen isolation and CT scan was not statistically different between MDR- and XDR-TB patient groups respectively (p=0.538, by Mann-Whitney U test).

2. Imaging technique and analysis

All examinations were performed with a 4-detector spiral CT scanner (Asteion; Toshiba Medical, Tokyo, Japan) or a 16-section MDCT scanner (Somatom Sensation 16; Siemens Medical Solutions, Erlangen, Germany), using a dedicated chest CT protocol. None of the patients were administered an intravenous injection of contrast medium. Helical scan date were acquired using 16 detector rows and a beam collimation of 3 mm (16 x 3.0 mm), a gantry rotation time of 0.5 s, a section reconstruction thickness of 3.0 to 5.0 mm, an image reconstruction interval of 3.0 mm, and an effective tube current-time product of 200 mAs and 120 kVp.

Chest CT scans were reviewed by one radiologist (K.W.Y.) with 5 years’ experience who had no knowledge of the patients’ clinical information and diagnosis. All the CT images were reviewed at a workstation (HP Z800; Hewlett-Packard Development Company, USA) that had a spatial resolution of 1536 x2048 (PGL21; WIDE, Korea) with the PACS (PiViewSTAR; Infinitt, Seoul, Korea). Both mediastinal (window width, 400 HU; window level, 20 HU) and lung parenchyma (window width, 1,500 HU; window level, -800 HU) window images were available on the PACS systems for analysis. The assessment of pulmonary parenchyme included as follows: tree-in-bud pattern, cavity (presence, number, wall thickness), consolidation, number of involved lobes. The presence or
absence of pleural effusion and mediastinal lymphadenopathy were also assessed. The tree-in-bud pattern was defined as centrilobular branching structures that resemble a budding tree. The cavity was defined as gas-filled or fluid-filled space, seen as a lucency or low attenuated area within pulmonary consolidation or mass. The cavity wall thickness was calculated at largest portion of cavity by electronic measurement on PACS system.

3. Statistical analysis

Statistical analysis was done using SPSS version 17.0 (SPSS, Chicago, IL, USA) and MedCalc version 12.3.0.0 (MedCalc, Mariakerke, Belgium). We compared the quantitative results of univariate analysis and demographic data (sex and age) of patients with MDR- and XDR-TB using the Mann-Whitney U test. Student-t test was used to compare the number of involved lobes, and the number of cavity. The differences of parenchymal abnormalities in two groups were evaluated using by chi-square test or Fisher-exact test. A p-value of <.05 was considered statistically significant.
Results

1. Patients Demographics

The mean age was not significantly different (p=0.875, Student-t test) between the MDR-TB group (mean age, 40.0 years; age range, 14-76) and the XDR-TB group (mean age, 44.4; age range, 21-65). Sex ratio was not significantly different between the two groups (p=0.752, Chi-Square test).

2. CT findings

The CT findings of both primary MDR- and XDR-TB are summarized in Table 1. There was no statistically significant difference between MDR- and XDR-TB in presence and number of cavities, tree-in-bud pattern, number of involved lobes, consolidation, pleural effusion, and lymphadenopathy. The only statistically significant finding was cavity wall thickness. Using by Mann-Whitney U test, cavity wall thickness was thicker in XDR-TB (mean, 11.5 mm) group than MDR-TB (mean, 8.3 mm) group (figure 1, 2).
**Table 1**: Presence of Abnormalities in MDR- and XDR-TB as Depicted on CT Scans

<table>
<thead>
<tr>
<th>CT findings</th>
<th>MDR-TB (n=53)</th>
<th>XDR-TB (n=15)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence</td>
<td>46 (86.8)</td>
<td>13 (86.7)</td>
<td>1.0000</td>
</tr>
<tr>
<td>Number of cavities*</td>
<td>2.9</td>
<td>3.3</td>
<td>0.4545</td>
</tr>
<tr>
<td>Wall thickness*</td>
<td>8.3 mm</td>
<td>11.5 mm</td>
<td>0.0008</td>
</tr>
<tr>
<td>Tree-in-bud sign</td>
<td>49 (92.4)</td>
<td>14 (93.3)</td>
<td>1.0000</td>
</tr>
<tr>
<td>Involved lobes*</td>
<td>2.9</td>
<td>3.3</td>
<td>0.0995</td>
</tr>
<tr>
<td>Consolidation</td>
<td>38 (71.7)</td>
<td>10 (66.7)</td>
<td>0.7532</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>9 (17)</td>
<td>3 (20)</td>
<td>0.7188</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
<td>3 (5.6)</td>
<td>1 (6.7)</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Data are presented as No.(%) of patients unless otherwise specified.

* Mean number

Numbers in parenthesis are percentages. MDR-TB = multidrug-resistant tuberculosis, XDR-TB = extensively drug-resistant tuberculosis.
Fig. 1: Figure 1. Primary extensive-resistant (XDR) tuberculosis in a 51-year-old man. Axial thin-section CT scan shows large cavity in left upper lobe. The largest diameter of cavity wall was 12 mm in size.

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**Fig. 2:** Figure 2. Primary multidrug-resistant (MDR) tuberculosis in a 48-year-old man. Axial thin-section CT scan shows relatively thin walled cavity. The largest diameter of the wall was 7 mm in size.

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Conclusion

In conclusion, the cavity wall is thicker in XDR-TB patient than MDR-TB. This conclusion suggests that the cavity wall thickness reflects the resistance of anti-tuberculous drugs.
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References


