Evaluation of Antimicrobial Resistance of New Cases of Pulmonary Tuberculosis, in Khorasan, Iran

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ABSTRACT

Background: Multi drug-resistant Mycobacterium tuberculosis (MDR-TB) is an infection with a causative bacillus which is resistant to at least two drugs, isoniazid and rifampin. The purpose of this study is to evaluate the prevalence of TB resistance to first-line drugs of newly diagnosed active pulmonary tuberculosis.

Methods: This cross-sectional study was performed on 77 patients with newly diagnosed active pulmonary tuberculosis (according to national protocols of TB). Sputum samples were cultured and antibiogram for isoniazid, rifampin, pyrazinamide, ethambutol, and Streptomycin were performed on the positive cultures.

Results: From 77 patients with TB, 48 cases were positive sputum culture. Antibiogram was done by proportional standard method and all samples were found to be fully sensitive to all first-line TB drugs.

Conclusions: According to the results of this study, the primary resistance was low to the first-line drugs for pulmonary tuberculosis of the samples collected from Khorasan, an east province of Iran. The data showed that in all patients with active pulmonary tuberculosis who were diagnosed with Ziehl–Neelsen stain of sputum, the use of the first-line drugs for tuberculosis treatment is necessary and could be sufficient.


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Introduction

Tuberculosis (TB) is the most common infectious disease of human, as one of the biggest killers of people known in history. Every year, 9 million people suffer from active TB, and about 1.5 million people dies from the disease (1). Ninety percent of these patients belong to the developing countries. According to the World Health Organization (WHO) in 2010, the prevalence of TB is 17 per thousand person and its incidence is 13 per thousand (2). Multi-drug resistant (MDR) TB *, is the result of poor management of TB and is a serious problem in many countries (1). Multi-drug resistant bacilli are resistant to at least two drugs, isoniazid and rifampin (3). WHO has estimated that the number of the new cases of MDR-TB are 440,000 patient in 2009 (4-6). In patients who are initially diagnosed with MDR-TB, a short-term administration of standard therapy does not cure patients, and causes resistance to a wider range of anti-TB drugs (7). There are three types of resistance in tuberculosis, including: 1. Innate resistance † that bacilli are resistant inherently without a history of drug usage. 2. Acquired or secondary resistance caused by improper use of medications and 3. Primary resistance that patients with acquired resistance infect others (8). Tuberculosis in Iran has high incidence, especially in Khorasan province due to its proximity to countries like Afghanistan and immigration from these countries. In patients with MDR-TB, mortality rate and treatment failure and recovery time and treatment costs are high and its control is difficult. So far, many studies have been done in most cases of MDR-TB. However, fewer studies have been done in the case of tuberculosis with primary resistance. Thus we decided to examine the prevalence of primary resistance in newly diagnosed patients with active pulmonary tuberculosis who have not been treated.

Material and method

This is a cross-sectional study which has been done at the Mashhad University of Medical Sciences from 2011 till 2012. Seventy seven patients with proven pulmonary tuberculosis were studied. The sampling method was based on “Purposive Sampling”. The inclusion criteria for confirmed tb cases were based on criteria outlined in the “Protocol of the National Tuberculosis”:(7) 1-At least two positive sputum smears.2- Sputum smear-positive plus a chest X rays compatible with pulmonary tuberculosis. Those who had taken anti tb drugs more than five days were excluded. All patients received a full explanation of the aims and research designs and a written consent was taken from them. Morning sputum samples were obtained from patients. On five milliliter of sputum, 5 ml of caustic soda solution (sodium hydroxide) 4% was added. Then the mixture was vortexed and the resulting mixture was left for 15 minutes under the hood so the natural flora and bacteria that cause pollution have been wiped from the cultivation environment and just only remained Mycobacterium. Then sputum samples were centrifuged at around 3000 rpm for 15 min, then the upper liquid were poured inside the dish which contained phenol 10% and removed from the test. On the lower liquid we poured a few drops of phenol red, as a PH indicator. Then the samples are vortexed and a few drops of 1normal hydrochloric acid were poured on the resulting solution. The PH of the solution is approximately 7 which is the best environment for the growth of mycobacteria then the samples were again has stirred with a vortex. The lid of the Falcons were taken near the fire then with a Pasteur pipette, 3 to 4 drops of the purified liquid were added to the Löwenstein–Jensen culture medium and incubated at 37 ° C obliquely.

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*MDR-TB
†Natural Resistance

Of the third day onwards, we investigated the environment for fast growing mycobacteria. After that the cultivation environments were investigated to find MTB, every week (Figure1) antibiogram test by “propotional method” for isoniazid, rifampin, pyrazinamide, ethambutol, and Streptomycin was performed.

Data analysis

Descriptive statistical analyses were used for the data (including demographics, clinical, and results related to antibiogram test). Data were analysed using SPSS the results are given in percentages. To calculate the resistance in new cases, the number of resistant cultures with corresponding drug susceptibility tests (DST) results in these patients was divided by the total number of cultures with corresponding DST results from new cases.

Result

Of 77 patients with tuberculosis, 37 (48.1%) were males. Their median age was 51.18±23.54 years. Fifty-four (70.1%) were Iranian people and 23(29.9%) were Afghan. Sputum culture was positive in 48 patients. Mann-Whitney test showed that there is no correlation between the severities of sputum smear and culture results. Table 1 and 2 show Frequency distribution of demographic factors, clinical characteristics, severity of positive sputum smear and other factors affecting tuberculosis in two groups. The group with positive sputum culture and the group negative sputum culture were evaluated. In patients with negative sputum cultures, 55.2% were males and in patients with positive sputum culture 43.8% were males. All patients with positive cultures were fully sensitive to all 5 first TB drugs including isoniazid, rifampin, ethambutol, Streptomycin and pyrazinamide.

Discussion

With the introduction of the first anti-TB drugs in the world, drug resistance has also increased consequently. Rifampin began in the 70s of the twentieth century and subsequently, multidrug-resistant tuberculosis expanded rapidly (7). With the spread of AIDS in the world, MDR-TB also increased (9). In a study in Switzerland over 3 years, 45 patients who were resistant to one or more first-line drugs were studied. The authors identified quantitative levels and genetic mechanisms of resistance in cases who were drug-resistant clinically. They found that some strains categorized as resistant to isoniazid, ethambutol or Streptomycin by standard laboratory procedures of in vitro drug susceptibility testing may still respond to a treatment regimen that includes these agents (10).

In a study from Iran, in patients with smear - positive TB, treatment was started initially. If at the end of the second phase of treatment the smears were positive, sputum samples were cultured and antibiogram was done. In their study, of 260 patients with newly diagnosed TB, only two patients were smear positive at the end of treatment. When culture results were prepared, it was found that only one patient was resistant to isoniazid and rifampin. Similar to our study, the prevalence of drug resistance was low in their study (11).
In a Moldova research, it was concluded that because initial sputum samples are taken after initiation of therapy, their usefulness for case management or surveillance is compromising, and inappropriate treatment can lead to increased antimicrobial resistance (12). In a study from Tehran, a new case of resistant TB bacilli in the MDR cases was introduced which was resistant to all drugs (TDR)

‡ and showed that, there is some risk of spreading of TDR-TB in Asia.(13) In a study of Kenya (Nairobi), the resistance pattern of pulmonary tuberculosis was studied. They concluded that resistance to isoniazid, which is a first line drug, can lead to MDR-TB unless control programs carried out carefully (14). In another study from Iran, the resistance of mycobacteria to drugs and the risk factors for resistance were investigated. They concluded that the young age of patients and the onset of high rates of resistance to MDR-TB maybe a sign of a new transmission. Therefore, close observation is necessary for successful control of tuberculosis (15). In India, the rate of resistance was higher in those who did not receive appropriate treatment, where as in patients who did not receive any medication, the resistance rate was low (16). In all of studies which reviewed above, the secondary resistance, were investigated.

‡ totally drug-resistant [TDR] or super extensively drug-resistant [XDR]

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Table 2. Frequency distribution of demographic characteristics and influencing factors of TB by sputum culture results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sputum culture results</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>21(43.8%)</td>
<td>16(35.2%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>51.94±23.60</td>
<td>49.93±23.79</td>
</tr>
<tr>
<td>Weight (Kilo Grams)</td>
<td>52.31±6.18</td>
<td>51.93±7.73</td>
</tr>
<tr>
<td>Iranian nationality</td>
<td>35(72.9%)</td>
<td>19(65.5%)</td>
</tr>
<tr>
<td>Marital status (single)</td>
<td>16(33.3%)</td>
<td>8(27.6%)</td>
</tr>
<tr>
<td>HIV-positive</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Prison</td>
<td>5(10.4%)</td>
<td>3(10.3%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>6(12.5%)</td>
<td>1(3.4%)</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2(4.2%)</td>
<td>2(6.9%)</td>
</tr>
<tr>
<td>Steroid</td>
<td>4(8.3%)</td>
<td>1(3.4%)</td>
</tr>
<tr>
<td>History of contact with tuberculosis</td>
<td>17(35.4%)</td>
<td>17(58.6%)</td>
</tr>
<tr>
<td>Exposed to sunlight</td>
<td>36(75.0%)</td>
<td>19(65.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>48(100.0%)</td>
<td>29(100.0%)</td>
</tr>
</tbody>
</table>
As mentioned in the Moldova study, most studies regarding drug resistance were after initiation of therapy. In our study, unlike above studies, patients were studied before beginning of treatment. Our goal was to find cases of drug resistance resulting from contact with TB patients who had MDR-TB. Thirty-four patients had a history of contact with tuberculosis (Table 2). Our results showed that primary resistant TB is low. (N = 0).

The reasons for the low prevalence of primary resistance in our study could be as following: 1- Careful monitoring of patients and appropriate management of patients, by provincial health care system through Directly Observed Treatment Short-course strategy (DOTS) that has resulted in decreased incidence of tuberculosis in Iran (17). 2- Patients with MDR-TB were referred to more equipped centers. 3- Very low incidence of secondary resistance, as in the other studies carried out in Iran (13). The limitations of our study were the small number of patients and the fact that, patients were not followed after starting of treatment.

**Conclusion**

Our study shows that given the low incidence of primary resistant TB, short-term treatment strategy under direct observation is essential to prevent secondary resistance. Additionally starting treatment with first-line drugs (i.e., rifampin, isoniazid, ethambutol, pyrazinamide) is appropriate for newly diagnosed cases of pulmonary tuberculosis.

<table>
<thead>
<tr>
<th>Clinical signs</th>
<th>Sputum culture results</th>
<th>Test result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Coughing for more than two weeks</td>
<td>47(97.9%)</td>
<td>26(89.7%)</td>
</tr>
<tr>
<td>Productive cough</td>
<td>34(70.8%)</td>
<td>23(79.3%)</td>
</tr>
<tr>
<td>Chest pain</td>
<td>11(22.9%)</td>
<td>4(13.8%)</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>22(45.8%)</td>
<td>15(51.7%)</td>
</tr>
<tr>
<td>Hemoptyisis</td>
<td>4(8.3%)</td>
<td>517.2%</td>
</tr>
<tr>
<td>Fever</td>
<td>25(52.1%)</td>
<td>21(72.4%)</td>
</tr>
<tr>
<td>Weight loss</td>
<td>42(87.5%)</td>
<td>26(89.7%)</td>
</tr>
<tr>
<td>Weakness</td>
<td>36(75.0%)</td>
<td>21(72.4%)</td>
</tr>
<tr>
<td>Night sweat</td>
<td>34(70.8%)</td>
<td>19(65.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>48(100.0%)</td>
<td>29(100.0%)</td>
</tr>
</tbody>
</table>

![Figure 1: Sputum culture in Lovnshtayn-Johnson medium for M-TB](image)
Acknowledgment

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Conflict of interest

None declared conflicts of interest.

References

