Objective: To identify the pattern of drug-susceptibility of newly diagnosed pulmonary tuberculosis patients in Riyadh, we conducted a study on all Mycobacterium tuberculosis positive-culture patients admitted to Sahari Chest Hospital from January 1994 to April 1995.

Methods: Demographic data, antituberculous therapy and drug-susceptibility testing results of each patient were reviewed from patients’ hospital records. The samples were cultured on Lowenstein-Jensen media and drug susceptibility was tested by Bactec 12B (Middlebrook 7H12) media against selected antituberculous drugs

Results: Drug susceptibility was performed on 362 (91%) of the sputum positive-cultures. The overall initial resistance rate (1 or more drugs) was 12.4%. Initial.

Correspondence to: Dr. Nasser Al-Hamdan, Field Epidemiology Training Program, P.O. Box 6344, Riyadh 11442, Saudi Arabia
resistance was more common with a single drug (9.4%), followed by two drugs (2.3%) and then three drugs (0.3%). Resistance to isoniazid was most common (10.4%), followed by streptomycin (2.7%), rifampicin (1.9%) and ethambutol (0.6%). Single isoniazid resistance was 60%, followed by two drugs: streptomycin and isoniazid (13.3%).

**Conclusion and Recommendations:** Resistance to multiple drugs is not yet a significant problem in Riyadh. A continuous monitoring of drug resistance is important for planning and assessing the national TB control program. Timely and complete reporting is essential to identify the problem as and when it begins.

**Key Words:** TB, drug susceptibility, Saudi Arabia

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**INTRODUCTION**

Drug resistance to tuberculosis is a serious threat to national TB programs throughout the world, particularly in developing countries.¹ It is a public health problem in the western and southern regions of Saudi Arabia.²³ Primary resistance occurs as a result of acquiring an infectious strain from another patient who has developed resistance due to inadequate antituberculous treatment. Some of the few published reports on antituberculous drug-susceptibility patterns in different parts of Saudi Arabia,²⁵ were concerned with the pattern of drug susceptibility among pulmonary tuberculosis patients in the Riyadh region.⁶⁷ Monitoring drug resistance rates will provide a continuous evaluation of the effectiveness of local control efforts and determine the appropriateness of the currently recommended initial TB treatment regimen for the area. We present the results on the pattern of antituberculous drugs among newly diagnosed pulmonary tuberculosis patients at Sahari Chest Hospital in Riyadh.

**MATERIAL AND METHODS**

The study was conducted at the 150-bed Sahari Chest Hospital, which is the main referral chest hospital in the Riyadh region. Between January 1994 and April 1995, all patients from Sahari Chest Hospital newly diagnosed as having pulmonary tuberculosis with a positive sputum culture and no past history of antituberculous therapy were enrolled. Information on age, nationality, drug sensitivity and resistance to Mycobacterium tuberculosis was extracted from the patient’s hospital records. The resistance reported for tubercle bacilli isolated from these cases was considered as initial resistance according to World Health Organization (WHO) recommendations.⁸

Drug-culture and susceptibility testing were processed at Riyadh Central Laboratory. The samples were cultured on Lowenstein-Jensen media and drug susceptibility was tested by Bactec 12B (Middlebrook 7H12) media against streptomycin, isoniazid, rifampicin and ethambutol. Data were analyzed by Epi-Info software version 5.02.

**RESULTS**

During the period of investigation, 362 isolates containing Mycobacterium tuberculosis were identified. Of these, 121 (33.4%) isolates were from Saudis and 241 (66.6%) were from non-Saudis. The highest percentages of isolates among non-Saudis were from Indians, Filipinos and Bangladeshis (Table 1). The age range for Saudis was from 12 to 85 years (mean = 40.5), and for non-Saudis from 14 to
72 (mean = 33.2). The number of non-Saudi cases exceeded the number of Saudi cases in the age group 20-49, while for the other age groups the number of cases in Saudis was higher (Figure 1). The overall initial resistance rate to antituberculous drugs was 12.4%. Thirty-four (9.4%) isolates were resistant to a single drug, 10 (2.8%) to two drugs and 1 (0.3%) to three drugs (Table 2). Initial drug resistance to isoniazid was the most frequent (10.5%), followed by streptomycin (2.8%), rifampicin (1.9%) and ethambutol (0.6%) (Table 1). Single isoniazid resistance was the most common pattern of resistance (60%), followed by two drugs, streptomycin and isoniazid (13.3%) (Table 2).

DISCUSSION

Our study showed an overall resistance rate of 12.4% to initial antituberculous drugs. Other studies on antituberculous drug resistance in Riyadh region showed rates between 11.2% and 13.2%. These figures are lower than those reported in the Taif region (22.6%) and Giza region (44%). Higher rates have been reported from Turkey (35.5%), Egypt (34%) and India (26%). Our results also showed an overall increase in the rate of antituberculous resistance among Saudis from 10.1% in 1979 to 12.4% in 1995. This small increase may be attributed to an improvement in case findings as well as diagnostic tools. Although several published reports in Saudi Arabia have shown a high rate of resistance to isoniazid and streptomycin (Table 3), our results showed a decrease in resistance. This may be explained by the sudden change in expatriate population in 1990 (just before the Gulf war), as well as an introduction of effective short-course chemotherapy. Non-Saudis in Saudi Arabia come mainly from developing countries and are of working age, which explains their higher number compared with Saudis in the age group 20-49. In addition, a single isoniazid resistance was a more common pattern of resistance. Another study in Riyadh reported the same findings. This may be attributed to a widespread use of isoniazid as a basic drug in all initial treatment regimen therapy of tuberculosis, as well as poor compliance of the patients. Another study in Saudi Arabia has suggested using four and six-month regimens of rifampicin and pyrazinamide to overcome this problem.

Single drug resistance was a more common pattern than multiple drug resistance in Saudi Arabia.

To overcome the problem of initial resistance to isoniazid we suggest a six month regimen: a combination of isoniazid, rifampicin, pyrazinamide and streptomycin or ethambutol in the first two months, followed by isoniazid and rifampicin in the last four months, as recommended by WHO.

Figure 1: Distribution of pulmonary TB cases by age among Saudis and non-Saudis, Sahari Chest Hospital, Riyadh, January 1994 – April 1995

In conclusion, resistance to either a single drug or multiple drugs is not yet a significant problem in Riyadh. A continuous monitoring of drug resistance is important for the planning and assessment of the national TB control program. Furthermore, timely and complete reporting is essential to identify the problem when at its onset; therefore, it is essential to establish computerized antituberculous drug sensitivity surveillance system in...
Table 1: Antituberculous resistance pattern among patients admitted with pulmonary tuberculosis to Sahari Chest Hospital, Riyadh, Saudi Arabia, January 1994 to April 1995

| Nationality | Isolates | Streptomycin | Isoniazid | Rifampicin | Ethambutol |
|-------------|----------|--------------|-----------|------------|------------|
|             | No.      | %            | No.       | %          | No.        | %          |
| Saudis      | 121      | 33.4         | 3         | 2.5        | 8          | 6.6        |
|             |          |              |           |            | 4          | 3.3        |
| Non-Saudis  | 241      | 66.6         | 7         | 2.9        | 30         | 12.4       |
|             |          |              |           |            | 3          | 1.2        |
|             |          |              |           |            | 2          | 0.8        |
| Indian      | 61       | 25.2         | 2         | 3.3        | 5          | 8.2        |
|             |          |              |           |            | 0          | -          |
|             |          |              |           |            | 0          | -          |
| Filipino    | 43       | 18.3         | 2         | 4.7        | 8          | 19.0       |
|             |          |              |           |            | 0          | -          |
|             |          |              |           |            | 0          | -          |
| Bangladeshi | 42       | 17.1         | 1         | 2.4        | 8          | 19.0       |
|             |          |              |           |            | 0          | -          |
|             |          |              |           |            | 0          | -          |
| Sri Lankan  | 22       | 9.1          | 1         | 4.5        | 2          | 9.1        |
|             |          |              |           |            | 0          | -          |
|             |          |              |           |            | 0          | -          |
| Egyptian    | 21       | 9.1          | 1         | 4.8        | 1          | 4.8        |
|             |          |              |           |            | 1          | 4.8        |
| Indonesian  | 9        | 4.1          | 0         | 0          | 2          | 22.2       |
|             |          |              |           |            | 0          | -          |
|             |          |              |           |            | 1          | 11.0       |
| Others      | 43       | 18.8         | 0         | 0          | 4          | 9.3        |
|             |          |              |           |            | 2          | 4.6        |
|             |          |              |           |            | 0          | -          |
| Total       | 362      | 100          | 10        | 2.8        | 38         | 10.5       |
|             |          |              | 7         | 1.9        | 2          | 0.6        |

Table 2: Pattern of initial antituberculous resistance among 362 patients admitted with pulmonary tuberculosis to Sahari Chest Hospital, Riyadh, Saudi Arabia, January 1994 to April 1995

| Resistant To Drugs | Resistant | % all patients (N=362) | % all resistant (N=45) | Total (%) |
|--------------------|-----------|------------------------|------------------------|-----------|
| 1 drug STM         | STM       | 4                      | 1.1                    | 8.9       |
|                    | INH       | 27                     | 7.4                    | 60        |
|                    | RIF       | 3                      | 0.8                    | 6.7       |
|                    | ETH       | 0                      |                        |           |
|                    |           |                        |                        | 34 (9.4)  |
| 2 drugs STM INH    | STM       | 6                      | 1.7                    | 13.3      |
|                    | INH       | 27                     | 7.4                    | 60        |
|                    | RIF       | 3                      | 0.8                    | 6.7       |
|                    | ETH       | 1                      | 0.3                    | 2.2       |
|                    |           |                        |                        | 10 (2.8)  |
| 3 drugs INH RIF ETH| INH       | 1                      | 0.3                    | 2.2       |
|                    | RIF       | 15                     | 4.2                    | 100       |
|                    | ETH       | 15                     | 4.2                    | 100       |
|                    |           |                        |                        | 45 (12.4) |

STM = Streptomycin, INH = Isoniazid, RIF = Rifampicin, ETH = Ethambutol

Table 3: Resistance to antituberculous drugs by region (Riyadh, Gizan and Taif) among pulmonary tuberculosis patients, Saudi Arabia

| Region          | Streptomycin | % of drug resistance | Isoniazid | Rifampicin | Ethambutol | % of resistance |
|-----------------|--------------|-----------------------|-----------|------------|------------|----------------|
| Riyadh*         |              | 9.7                   | 3.6       | ND         | ND         | 13.2           |
| 1979            |              | 13                    | 5.2       | ND         | ND         | 13.2           |
| 1980            |              | 10                    | 3.4       | ND         | ND         | 13.2           |
| 1981            |              | 16.8                  | 4.4       | ND         | ND         | 13.2           |
| Gizan†          |              | 5                     | 10        | 3          | 0          | 44             |
| 1983-84         |              | 16                    | 6.5       | 15         | 4          | 22.6           |
| Taif‡           |              |                      |           |            |            |                |
| June 1986 – May 1988 | 16 | 6.5 | 15 | 4 | 22.6 | 2 |
| Riyadh§         |              | 5.1                   | 19.4      | 9.7        | NC         | 21.3           |
| Dec 1986 - June 1988 | 16 | 6.5 | 15 | 4 | 22.6 | 2 |
| Riyadh*         |              | 2.8                   | 10.5      | 1.9        | 0.6        | 12.4           |

*Sahari Chest Hospital including pulmonary and extra-pulmonary
†Taif Chest Hospital
‡Taif Chest Hospital
§Sahari and King Khalid Hospitals (including pulmonary and extra-pulmonary), ND = no data, NC = not calculated

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both the Sahari Chest Hospital (SCH) and Riyadh Central Laboratory (RCL). The data should be used to determine the morbidity rates, trends and demographic characteristics of the TB patients in the area. The results should also be periodically reported to the primary care providers, local health departments and the TB control program staff. This will provide the health authorities with an important indication of the effectiveness of TB treatment regimens and subsequently improve the TB control program.

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REFERENCES

1. Nunn P, Felten M. Surveillance of resistance to antituberculosis drugs in developing countries. Tubercle Lung Dis 1994;75:163-7.
2. Jarallah JS, Elias AK, Al-Hajjaj MS. High rate of rifampicin resistance of Mycobacterium tuberculosis in the Taif region of Saudi Arabia. Tubercle 1992; 73:113-6.
3. Schiott CR, Engbaek HC, Vergmann. Incidence of drug resistance among isolates of Mycobacterium tuberculosis recovered in the Giza area, Saudi Arabia. Saudi Med J 1985; 6:375-8.
4. Zaman R. Tuberculosis in Saudi Arabia: initial and secondary drug resistance among endogenous and non-endogenous populations. Tubercle 1991;72:51-5.
5. Zaman R. Mycobacterium infections in Jed- dah: a retrospective study. Med Sci Res 1988; 16:117-18.
6. Al-Orainey IO. Resistance to standard antituberculous drugs in Saudi Arabia. Saudi Med J 1986;7:363-8.
7. Al-Orainey IO, Saeed ES, El-Kassimi FA. Resistance to antituberculous drugs in Riyadh, Saudi Arabia. Tubercle 1989;70:207-10.
8. Vareldzis BP, Grotos J, de Kantor J. Drug-resistance tuberculosis: laboratory issues. World Health Organization recommendation. Tubercle 1994;75:1-7.
9. Tahaoglu K, Kizkin T, Tor M. High initial and acquired drug resistance in pulmonary tuberculosis in Turkey. Tubercle 1994;75:324-8.
10. Al-Orainey IO. Effect of initial isoniazid resistance on response to chemotherapy of tuberculosis: A review of clinical trials. Ann Saudi Med 1991;11:3-8.
11. World Health Organization. WHO Tuberculosis Programme: Framework for effective tuberculosis control. Geneva: World Health Organization 1994; Publication WHO/TB/94.179.