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TO STUDY INCIDENCE OF MULTI DRUG RESISTANT TUBERCULOSIS IN MUMBAI

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Abstract

Ionized and Rifampicin, the two most potent anti-tuberculosis drugs are rendered ineffective in Multidrug-resistant Tuberculosis (MDR-TB). India, China and Russia contribute to more than 62% of MDR-TB globally. In India, endemic areas like Mumbai are "hotspots" for the dissemination of MDR-TB. The aim of the study was to investigate the incidence of MDR-TB in cases of pulmonary tuberculosis in Mumbai. Total hundred and two clinical isolates

of.Tuberculosiswas tested in the study. Drug susceptibility testing of these strains were carried by Resistance Ratio method to ant tuberculosis drugs namely Ionized, Streptomycin andEthambutol and by absolute concentration method for Rifampicinand Pyrazinamide. In our study highest resistance (46 %) was observed to INH followed by RF (42.16 %), SM (29.41 %) and EMB (25.49 %). While, resistance to Pyrazinamide (PZ) was least (7.8%). MDR TB cases were found to be 41.18%.There was significant difference between resistance pattern of INH and EMB, INH and SM, PZ and EMB, PZ and SM, EMB and RF, PZ and RF. (chi square with Yates correction =8.5, p □0.01).Detection of MDR TB strain would not only eliminate non-essential use of antibiotics, but would also help in the selection of most effective drug regimen and guide therapy in chronic cases.

Keywords

Ionized, Rifampicin MDR-TB, Incident

1. Introduction

Tuberculosis (TB) remains a major health problem in developing nations. Here TB infections are responsible for one in four avoidable adult deaths (Cornwall, 1997). In India about 2 million cases occur every year. In India one person dies every minute due to TB and two persons become sputum positive cases (Singh, 2004). Prevalence of TB in India is fairly high. About 40 % of population is infected and from this pool, cases with clinically active disease continue to develop all the time. The incidence of TB is a function of the extent of infection in the community. This renders the provision of permanent diagnosis and treatment facilities as an absolute necessity (Singh, 2004).

The incidence of the disease is rising yearly; it is 3% per year as per World Health Organization (WHO) projections. It was declared a global health emergency by the World Health Organization (WHO) in 1993 and is still the second leading killer in the world, with an approximate 2 billion people being latently infected (WHO, 2014).

Mycobacterium tuberculosis (M. tuberculosis) has been shown to be not only the greatest scourge of mankind but also adaptable to changing conditions. Only a few years after the introduction of effective chemotherapy, drug resistance began to be reported (Paramasivan, 1998).With the widespread introduction of control programs, drug resistance began to increase, at first only in non-compliant cases. Thereafter, as resistant organisms retain their virulence and

infectivity, the resistant strains have been gradually increasing in the community (Chandrasekaran, 1992).

The most significant emergence has been that of the Multi Drug Resistant (MDR) strains, which is resistant to Ionized (INH) and Rifampicin (RF) with or without being resistant to other drugs (Rosha & Kataria, 2001).The occurrence of Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) has been termed as the first epidemic, and the

resurgence of TB has been termed as the second epidemic and emergence of drug resistant TB as the third epidemic.

Survey conducted by WHO and International Union Against Tuberculosis and Lung Diseases (IUATLD) showed that 1 in 10 cases of TB, harbors resistance to at least one of the currently available anti-tubercular drugs(Rosha & Kataria, 2001).

Past history of inadequate treatment, chronic cases, extensive cavitatory disease, HIV positive status, lower socio-economic status, alcoholism and nosocomial infections have all been implicated as predisposing factors for the development of MDR TB. The treatment of MDR strains is prolonged and expensive with toxic second line drugs (Rosha & Kataria, 2001).

Worldwide prevalence of drug resistant TB is 10% for INH and 1.4% for multiple drugs. But in some geographical "hot spots" over 50% of isolates are resistant to one or more drugs(Chandrasekaran, 1992).In Mumbai, in tertiary care center classical MDR TB values are as high as 51% (Almeida et al., 2003).

Accurate statistics regarding the extent of MDR TB in India are lacking. The problem is serious and not confined to patients who have received ant tuberculosis treatment in the past. Also facilities for ant tuberculosis drug susceptibility testing are scanty and the management options for this disease are expensive and unsatisfactory. While prime need is to ensure, by good management and supervision, that resistance does not occur in the first place, surveillance of drug resistance is essential to determine the current scale and nature of drug resistance problem, as well as to define the current solutions (Nunn & Felten, 1994).Detection of MDR TB strain would not only eliminate non-essential use of antibiotics, but would also help in selection of the most effective drug regimen and guide therapy in chronic cases. This initiation of effective drug therapy would save time & cost to the patient. Also epidemiological implication of detection of MDR TB strains is very significant. If the resistant strains are not tackled properly, they are soon

likely to outnumber the sensitive ones, which get eliminated by the chemotherapeutic agents in due course (Nunn & Felten, 1994).The situation has turned into a pressing demand for drug-susceptibility testing (DST) in order to accomplish drug-resistance surveillance (DRS), and also to develop efficient regimens for appropriate treatment of individual cases (Mitchison, 2005).
Hence interest was aroused to find out the incidence of MDR TB in Mumbai by collecting clinical isolates of M. tuberculosis from tertiary health care center.

2. Material and Methods

Total 102 Clinical isolates of. Tuberculosis along with Standard strain of M tuberculosis H37Rv was tested in the study. They were collected from Department of Microbiology of P.D. Hindu Hospital and Medical Research Centre, Mumbai, India. All the strains were grown in Sterile Lowenstein Jensen Medium (LJM) slants with 2% glycerol (HiMedia laboratories Pvt. Ltd., India). The clinical isolates were defined as M. tuberculosis according to their biochemical characteristics. DST of these strains was carried by Resistance Ratio (RR) method to anti-tuberculosis drugs namely Ionized (INH) (Lapin PharmaceuticalsIndia), Streptomycin (SM) (LupinPharmaceuticals, India), and Ethambutol (EMB) (Lupin Pharmaceuticals, India).Drug concentrations (µg/ml) tested were as follows:(Drug concentrations (µg/ml) shown in bracket were tested for M. tuberculosis H37Rv strain)

- INH: 0. 05, 0.1.0.2, 1.0 and 5.0µg/ml (0.025, 0.05, 0.1 and 0.2µg/ml)
- EMB: 0.5, 1.0, 2.0 and 8.0 µg/ml(0.5, 1, 2 and 8µg/ml)
- SM: 4, 8, 16, 32 and 64µg/ml (1, 2, 4, 8 and 16µg/ml)

RR was the minimum inhibitory concentration of the test strain divided by the minimal inhibitory concentration of standard strain of M. tuberculosis H37Rv. Strain with RR of 8 or more were considered resistant to those drugs. A ratio of 4 was considered suggestive of resistance, while strain with resistance ratio of 2 was considered as susceptible strain.
Further these 102 Clinical isolates of. Tuberculosis along with Standard strain of M tuberculosis H37Rv was tested for Rifampicin (RF) (Lupin Pharmaceuticals, India), and Pyrazinamide (PZ) (Lupin Pharmaceuticals, India), by absolute concentration method (Cannetti et al., 1963).Drug concentrations (µg/ml) tested were as follows:

- PZ: 50, 100 and 200µg/ml

- RF: 1, 2, 4, 8, 16, 32, 40, 64, 128 and 256µg/ml

Inoculated slants were incubated for 4 weeks at 37º C. Growth was defined as 20 colonies or more. Less than 20 isolated colonies were considered as inhibition and test strain was said to be susceptible.

3. Results

Table 3.1: *Initial drug resistance to individual drug*

n=102

Serial No.	Drug under study	Resistant strains	% Resistance	Susceptible strains	% Susceptible
1	SM	30	29.41	72	70.59
2	INH	47	46.07	55	53.92
3	EMB	26	25.49	76	74.51
4	RF	43	42.16	59	57.84
5	PZ	08	7.84	94	92.16

Table exhibits the number of initial drug resistance cases to individual drugs. The cases were compared for resistance to multiple mono resistant sets of two drugs. Significant differences were found between cases resistant for SM v/s INH, SM v/s PZ, INH v/s EMB, INH v/s PZ, EMB v/s RF, EMB v/s PZ, EMB v/s PZ and RF v/s PZ ($p< 0.0001$). While difference between SM v/s EMB, SM v/s RF and INH v/s RF was not significant. [Table 3.1]

Table 3.2: *Initial drug resistance to the combination of drugs*

n=102

Serial No.	Resistance to drug combination	Initial resistance	% Resistance	Highest resistance in drug combination
2	1 drug	07	6.86	INH
4	2 drug	10	9.8	INH+RF
5	3 drug	16	15.69	INH+RF+SM
6	4 drug	16	15.69	INH+RF+SM+EMB
7	5 drug	02	1.96	INH+RF+SM+EMB+PZ

Table exhibits the number of initial drug resistance cases to combination of drugs. In two drug combinations, significant differences were found by applying Fisher Exact probability test, between cases resistant for INH+RF and INH + PZ (FP=0.03) ; INH+RF and INH + PZ (FP=0.007) ,while INH+RF and SM +INH; SM+INH and INH+PZ; SM+INH and PZ+SM were not significant.In three drug combinations, applying Chi square with Yates correction, INH+RF+SM and INH+RF+EMB did not show Statistically Significant difference (P□0.05) while in four drugs combination, INH+RF+SM+EMB and INH+RF +EMB+PZ showed Statistically Significant difference (P<0.01).[Table 3.2]

Table 3.3: *Age wise distribution of MDR strains of M. tuberculosis*

INH	**RF**		**Age in years**					
			14 to23	**24 to33**	**34 to43**	**44 to53**	**54 to63**	**64 &>**
Sensitive	Sensitive	No.	6	14	14	7	7	6
		%	11.10%	25.90%	25.90%	13.00%	13.00%	11.10%
	Resistance	No.	0	0	1	0	0	0
		%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
	Total	No.	6	14	15	7	7	6
		%	10.90%	25.50%	27.30%	12.70%	12.70%	10.90%
Resistance	Sensitive	No.	0	4	1	0		0
		%	0.00%	80.00%	20.00%	0.00%		0.00%
	Resistance	No.	6	18	8	6		4
		%	14.30%	42.90%	19.00%	14.30%		9.50%
	Total	No.	6	22	9	6		4
		%	12.80%	46.80%	19.10%	12.80%		8.50%

Table exhibits age-wise distribution of MDR strains of M. tuberculosis. No significant association was found after applying chi square test between age of patient and MDR strains. (P=0.754)[Table 3.3]

Table 3.4: *Gender wise distribution of resistant strains of M. tuberculosis*

No.	Patients	Ant tuberculosis drugs tested					
		SM (%)	**EMB (%)**	**INH (%)**	**RF (%)**	**PZ (%)**	**INH + RF (%)**
1	Male	**24.6**	**18.03**	**36.07**	**32.8**	**6.6**	**32.8**
2	Female	**36.6**	**36.6**	**60.97**	**56.1**	**9.76**	**53.66**

Table exhibits gender wise distribution of resistant strains of M. tuberculosis. No significant association was found after applying chi square test between patient's gender and resistance to individual drug. (P=0.6997)[Table 3.4]

Table 3.5: *Gender-wise distribution of MDR strains of M. tuberculosis*

INH	RF		Sex		Total
			Female	**Male**	
Sensitive	Sensitive	No.	14	40	54
		%	25.90%	74.10%	100.00%
	Resistance	No.	1	0	1
		%	100.00%	0.00%	100.00%
	Total	No.	15	40	55
		%	27.30%	72.70%	100.00%
Resistance	Sensitive	No.	3	2	5
		%	60.00%	40.00%	100.00%
	Resistance	No.	22	20	42
		%	52.40%	47.60%	100.00%
	Total	No.	25	22	47
		%	53.20%	46.80%	100.00%

Table exhibits gender wise distribution of MDR strains of M. tuberculosis. No significant association found after applying chi square test betweenpatient's genderadd strains of M. tuberculosis,(P=0.607)[Table 3.5]

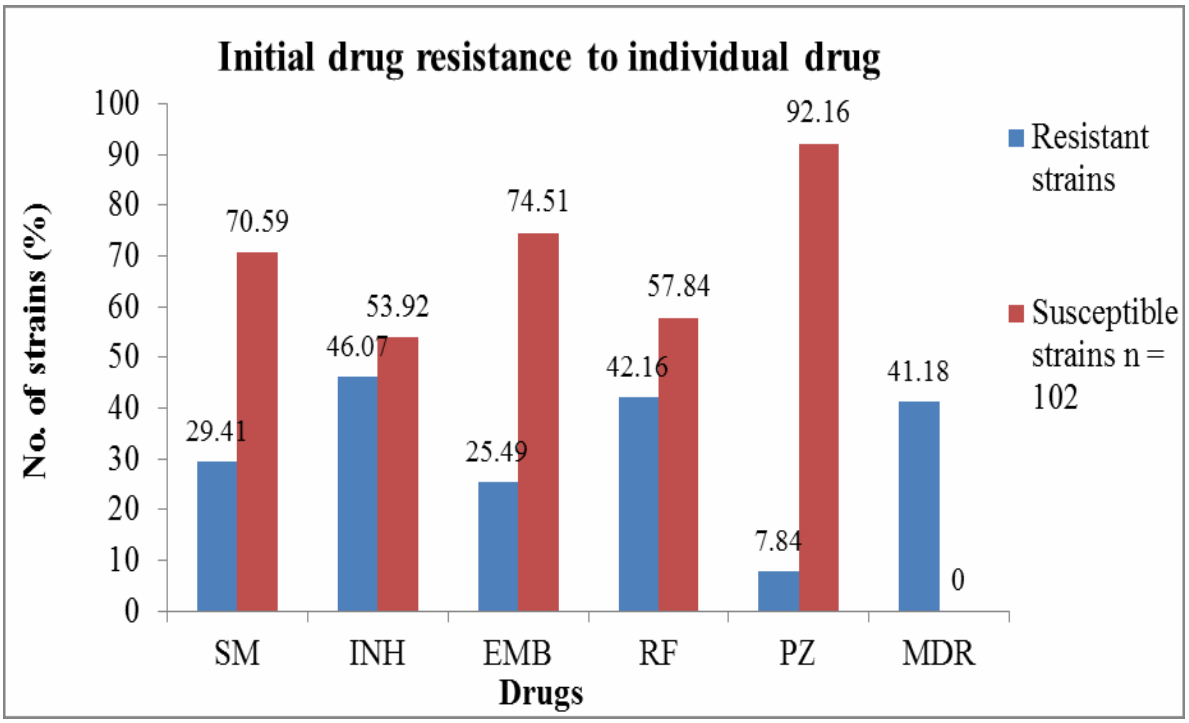

Figure 1: *Initial drug resistance to individual drug*

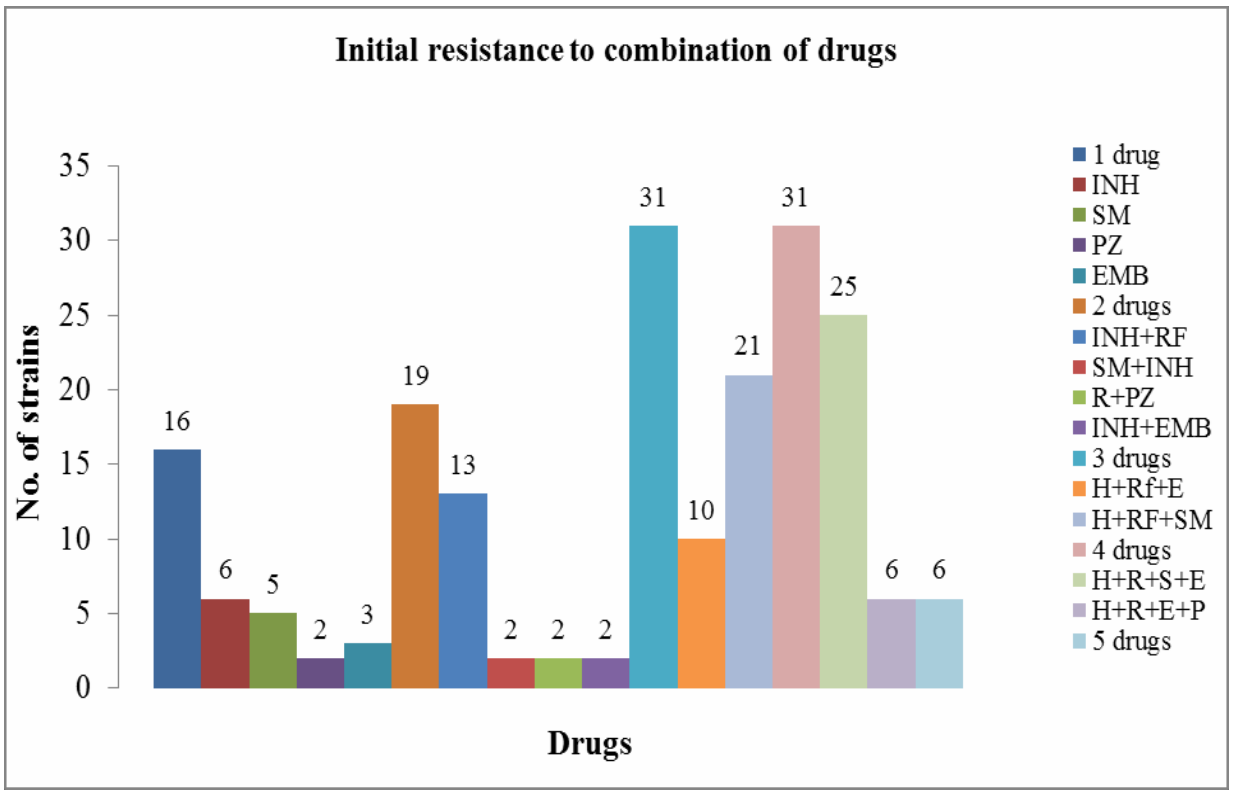

Figure 2: *Initial resistance to combination of drugs*

4. Discussion

In the present study DST of clinical isolates of M. tuberculosis was carried out against ant tuberculosis drugs namely INH, EMB, SM, RF and PZ. We chose the model resistance of M. tuberculosis H37Rv strain as a control. Resistance is defined as a decrease in the sensitivity of sufficient degree to be reasonably certain that the strain concerned is different from a sample of wild strains of human type that have never come in contact with the drug. (Michelson, 1968) The Resistance Ratio method and Absolute Concentration method using M. tuberculosis H37Rv strain as standard control would satisfy all these criteria in determining resistance.

Total 102 clinical isolates of M. tuberculosis were collected from Microbiology Department of P.D. Hindu Hospital and Medical Research center, a tertiary Health care center. Isolates were tested for susceptibility to INH, EMB and SM by Resistance Ratio method and to RF and PZ by Absolute Concentration method.

Drug resistance in clinical practice is classified into primary, secondary or acquired. Combination of primary and secondary resistance is called as initial drug resistance which refers to patients who are either primarily infected with drug resistant organisms or have acquired drug resistance to chemotherapy. An estimate of drug resistance is extremely important in the epidemiology and control of TB. DRSis considered a useful tool to assess the effective functioning of the TB control program. They provide valuable indications for monitoring the quality of chemotherapy applied to community. Also to monitor the TB treatment program(Nunn & Felten, 1994).

In our study highest resistance (46%) was observed to INH followed by RF (42.16%), SM (29.41%) and EMB (25.49%). While resistance to PZ was least (7.8%) There was significant difference between resistance pattern of INH and EMB, INH and SM, PZ and EMB, PZ and SM, EMB and RF, PZ and RF. (chi square with Yates correction =8.5, p □0.01). Our study clearly indicates a fairly high incidence of initial ant tuberculosis drug resistance. The level of drug resistance observed in present study is similar to other surveys, conducted in India in recent past (Hemvani et al., 2001; Trivedi, 1988).

In initial surveys on resistance to ant tuberculosis drugs in India conducted in 1968 –1969 by ICMR, the results showed primary resistance level of about 15% to INH, 12% to SM and 6 % for both the agents. While secondary drug resistance levels were higher at approximately 25 % to INH, 23% to SM and 16 % for both the agents (ICMR, 1968; ICMR, 1969).

The prevalence of primary ant tuberculosis drug resistance in Gujarat, as studied between 1983 to 1986 was found to be significantly high, especially for INH (13.9%) and SM (7.4%). Primary RF and PZ resistance was not detected in any strain. While among treatment failure and relapse cases, resistance was high to INH (55.8%), SM (26.9%) and RF (37.3%) (Trivedi, 1988).In 1992, some authors reported resistance to INH, 10%, SM, 7.6%, RF, 3 % and EMB, 2.6% for newly diagnosed TB cases attending Chest hospital in Jaipur (Chandrasekaran, 1992). According to WHO report the incidence of initial drug resistance in India in 1990 was 12.2 % for INH, 1.8% for RF and SM. While for EMB no resistance was seen(WHO, 1993)

In 2000, some authors observed highest resistance (16.67%) to INH and SM in primary drug category. While in old cases highest resistance was observed to RF (70.59%), followed by INH (61.76%), SM (51.52%) and EMB (39.39%)(Mather et al., 2000). In 2001, some authors reported resistance to INH, 54.2% followed by to SM, 41.5%, PZ, 50%, RF, 25%, EMB, 22% and Thio-acetazone. 6.5%.(Hemvani et al., 2001)In some studies in Gujarat, in previously treated TB patients, reported highest resistance to INH (7.5%), followed by SM (1.4%), RF (0.97%) and EMB (0.4%) in single drug category(Shah et al., 2002). In 2002, studies reported that resistance to INH; either alone or in combination with another drug, was highest (27.4%) or for SM resistance was 23%(Vijay et al., 2002).

The study, in 2006reported initial drug susceptibility profile among new TB patients in new smear positive cases. Total 84.7% of the strains were fully susceptible to the drugs under study while 15.3% of the strains were resistant to at least one drug. Resistance to SM was found to be 4.6%, INH, 5.3%, RF, 0.2%,in new smear negative cases, total 86.9% of the strains were fully susceptible to the drugs under study while 13.1% of the strains were resistant to at least one drug. Resistance to SM was found to be 6.8% and for INH, 2.3% (Santha et al., 2006).

Studies of drug resistant TB are of great epidemiological interest. They provide valuable indications for monitoring the quality of chemotherapy applied to community and to monitor the TB treatment program. High level of drug resistance reflects irregular use of these drugs in the area over several years. Inadequate and irregular ant tuberculosis therapy is not very uncommon feature in India and that will result in further escalation of multiple drug resistant TB cases that in turn will add to the transmission chain. Levels of drug resistance and its trends vary from place to place and serve as an epidemiological indicator to assess the extent of resistant bacteria transmission in the community. Main limitation of our study is that we had information only on

patients reporting to tertiary health care center. An assessment of the magnitude of multiple drug resistant TB is not very well described globally and data remains scantier for India. In view of this we have presented data on analyzing resistance pattern of clinical isolates of M. tuberculosis to combination of ant tuberculosis drugs.We observed that overall 1.96% strains of M. tuberculosis showed resistance to all five drugs under study, while 50.0% Strains were susceptible to all the five drugs.

15.69% strains showed resistance to three drug combinations. In this category maximum resistance was seen to INH, RF and SM combination. (10.78%), followed by INH, RF EMB combination (4.9%).9.8% strains showed resistance to two drugs combination. Highest resistance was observed for INH and RF combination (6.88%), followed by INH and SM (0.98%) and RF and PZ (0.98%).6.86% strains showedrésistance toat least one drug. There was a statistically significant observation between INH plus RF and RF plus; and INH plus RF and INH plus PZ; INHplusRFplusSMplusEMB and INHplusRFplusEMBplusPZcombination. High percentage of MDR strains were observed in the study (41.2 %.)Following studies mentioned below give the magnitude of multiple drug resistance in India.

Some studies, reported among 132 patients who were identified as being resistant to two drugs initially, the proportions of resistance to EMB and INH combination and SM and INH combination were the highest that is 40.9% and 34.9%, respectively. 25 cases who had been found resistant initially to three anti-tubercular drugs, out of them 8 cases (32%) were resistant to three drugs that is SM, EMB and ETH combination and 6 cases (24%) to SM, INH and EMB combination (Krishnaswamy et al., 1984).

Some studies reported in two-drug combination, in primary drug resistance, 3.33% strains resistant to SM and INH combination, 0.7 % strains resistant to INH and EMB combination while 1.07% showed resistant to INH and Thiacatazone combination. In three-drug combination 0.88% strains showed resistance to SM, INH and EMB combination. While in treatment failure and relapse cases, 44.2% strains resistant to INH and RF combination, 3.4% strains resistant to SM and RF combination, 47.1% strains resistant to INH, SM and RF combination. Acquired multidrug resistance in North Arcot in 1988-1989 was 6%, while in 1999, it was 69%(Datta, Radhamani, & Slvaraj, 1993; Trivedi, 1988).In Recur in 1999, it was observed 100%. (Agrawal & Shah, 2002)

Some studies reported high resistance, 20 to 25% to drug combinations. They estimated 23.3% strains that were resistant to at least one drug. In two drugs combination category, in all combinations INH was present. INH and RF combination resistant strains were more in the study (8.1%). In three, four and five drug combinations this study reported 19.4% strains resistant. Simultaneous resistance for INH and PZ was 11.9% and for INH and SM 11.5% while lowest resistance to INH and EMB (5.1%) combination. In three and four drugs combinations, 19.4 % strains were resistant. While 12 % strains were susceptible to all the drugs under study (Hemvani et al., 2001). While study in 2000, reported higher resistance to drug combination. In all the combinations INH was present. In two drugs combination, INH and RF combination showed highest drug resistance (38.24%) followed by INH and SM (30.30%), while 24. 24% strains were resistant to INH and EMB combination. In three drugs combination, for INH, SM and RF combination and for SM, EMB and RF combination, resistance was seen for 21.21% strains. In four drugs combination 6.06% strains showed resistance (Mathur et al., 2000).

Some authors studied 482 previously treated pulmonary tuberculosis patients and reported that resistance to INH and INH plus RIF was 12.86% and 15.77%, respectively. This retrospective study regarding drug-resistance patterns among treatment-failure tuberculosis cases has generated valuable information in the context of the drug-resistant tuberculosis situation in India. Resistance observed in this study was 42.5%. A high degree (14%) of MDR-TB was observed among these patients. These patients claimed to have ant tuberculosis therapy without improvement; however, 151 (57.5%) isolates were sensitive to all four first-line drugs (INH, RIF, SM and EMB) that were tested (Agrawal & Shah, 2002). The 2003 study, reported 25% strains of M. tuberculosis resistant to SM, INH, EMB and RF combinations, while 15% strains showed resistance to SM, INH and RF combination. Study showed similar results as our study with reference to percentage of MDR strains (51%)(Almeida et al., 2003).

Some studies reported resistance to INH and INH plus RF was 20.18% and 16%, respectively. While other, showed 2% MDR strains in old cases while in new cases 0.14%. They reported 0.2% and 0.5% resistance to INH and SM combination in new cases and previously treated patients. While in three drugs combination, resistance was observed for SM, INH & EMB, and SM, RF & EMB and INH, RF & EMB and INH, RF & SM (0.14%) in new cases. 2.5% cases were resistant for 4-drug combination (INH, RF, EMB and SM combination) in previously treated patients(Anuradha et al., 2006; Dam et al., 2005).

Some authors reported initial drug susceptibility profile among new TB patients in new smear positive cases. For SM and RF combination 0.1%, SM and INH combination 3.4%, INH and RF combination 0.8%, SM, INH and RF combination 0.9% resistance was observed. MDR strains were found to be 1.7%. In new smear negative cases, SM and INH combination 3.6%, SM, INH and RF combination 0.4% resistance was observed. MDR strains were found to be 0.4%.Drug susceptibility profile among category II patients, SM and INH combination 7.7%, INH and RF combination 7.2% and SM, INH and RF combination 4.5% resistance was observed. MDR strains were found to be 11.7% (Santa et al., 2006). The estimate of drug resistance to combination of drugs is comparable in our study to other surveys in India. The differences, if any have to be evaluated further on the basis of sample size, methodology and interpretation of results. In our study, in most of the combinations INH was present. Same observations were made in the most of the above-mentioned studies. We detected M. tuberculosis strains resistant to RF, were also resistant to INH. Some authors reported same observations.Thus initial resistance to INH, the drug that is included in all the ant tuberculosis regimens, seems to provide the basis for the emergence of the RF resistance (Siddiqi et al., 1981).

Drug resistance levels among patients treated under TB control program are not available in many settings. Studies on global drug resistance levels have been based on point prevalence from a representative sample of patients. Levels among previously treated patients have been reported only from number of tertiary cases or specialized institutions. Incidence of drug resistance appears to be higher in the present study and one of the reasons could be the difference in TB patients selected. Most of the above studies had subjected the isolates from the fresh untreated cases, while in our study more than 40% of the patients did not give the history of the previous TB infection or the treatment. The possibility of concealing the history of treatment cannot be ruled out among the so-called untreated cases at our end.

Main limitation of our study is that we had information only on patients reporting to tertiary health care center. India has a large private sector and large proportions of patients approach them for treatment. In the absence of countrywide data, we are extrapolating the data obtained from our study area, which is in conformity with those reported from.

5. Conclusion

DST should be conducted and treatment modified only for those patients who do not respond to treatment at the end of three months. This could facilitate the early detection of MDR TB and reduce the number of cases requiring culture and DST, providing maximum benefit in resource limited settings. The acquisition of infection with drug resistant forms could also be the other factor for the higher drug resistance prevalence in the present series. The difference in the methodology of drug sensitivity testing is one of the theoretical arguments.

In present study, no association was found between initial drug resistance and age or sex of patients, which is similar to findings of other studies (Trivedi, 1988). Thus, Drug susceptibility pattern in our study showed highest resistance to INH, followed by RF, SM and EMB. Resistance to PZ was the least. Significantly high numbers of MDR strains were seen in the study (41.2%).We observed that overall 1.96% strains of M. tuberculosis showed resistance to all five drugs under study, while 50.0% strains were susceptible to all the five drugs. 15.69% strains showed resistance to three drug combinations. In this category maximum resistance was seen to INH, RF and SM combination, followed by INH, RF EMB combination.9.8% strains showed resistance to two drugs combination. Highest resistance was observed for INH and RF combination, followed by INH and SM and RF and PZ 6.86% strains showed resistance to at least one drug. Following conclusions can be drawn from the study.Initial drug resistance for INH and RF was high for M. tuberculosis strains collected from tertiary health care center. The high percentage of MDR strains of M. tuberculosis was observed from this center. Significantly high resistance was observed to drug combinations. The evidence available shows that drug-resistant tuberculosis is present, mainly as a result of poor clinical and control practices.

From the study, it is difficult to generalize the incidence of MDR TB in normal population as the samples were collected from tertiary health care center. But still the data shows that there are higher cases of MDR TB cases. No significant correlation of MDR strains in males and females and age wise distribution was found in the study. Further, the large sample size is needed to generalize any statement to normal population regarding drug resistance. This kind of surveys, would detect the MDR TB in population, eliminate non-essential use of antibiotics, and help in the selection of most effective drug regimen and guide therapy in chronic cases.

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