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Prevalence of Rifampicin Resistant Mycobacterium tuberculosis among Suspected Pulmonary Tuberculosis Patients in White Nile State, Sudan

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Abstract

Tuberculosis is infectious disease. The study aimed to evaluate the rate of rifampin resistance in pulmonary tuberculosis patients who attended the tuberculosis unit in Kosti Teaching Hospital (Kosti city, White Nile State, Sudan) by using the GeneXpert assay method. This was cross-sectional study carried out during December 2019-December 2020 at Kosti Teaching Hospital. The study included the pulmonary tuberculosis subjects as diagnosed based on was based on past history, clinical features and detection mycobacterium tuberculosis by GeneXpert. In this study, the sputum sample were collected from each individual and immediately processed for detection of Rifampicin resistance by using of GeneXpert. One thousand subjects were involved in this study. In this study, the frequency of rifampicin resistant was 1.2%. Male subjects (23.4) were showed higher rate of sensitivity to rifampicin than females, P=0.041. The rate of rifampicin resistant was significantly higher in subjects aged 41-60 years than other, P>0.05. It is also higher in rural areas residents, relapse subjects, and subjects who are seropositive for HIV, P>>0.05. The study highlighted the rate of rifampicin resistance in White Nile state and provides evidence about the distribution of resistant among gender, residence, and age, which is important for health system as well as in diagnosis and control of infection.

Keywords: M. tuberculosis, Pulmonary Tuberculosis, Rifampin Resistance, GeneXpert

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INTRODUCTION

Tuberculosis (TB) is a global health issue and cause by M. tuberculosis that most often affects lungs leading to pulmonary tuberculosis [1]. This infectious disease is among the 10 leading causes of death worldwide, ranking above HIV/AIDS. In spite of the development in diagnostic methods, availability of free effective treatment, extensive control program, increase in public awareness, TB remains a public thread globally [2]. The Xpert MTB/RIF assay (Xpert assay; Cepheid, Sunnyvale, CA) is a fully automated, cartridge-based, real-time polymerase chain reaction (PCR) assay designed to detect the presence of Mycobacterium tuberculosis (MTB) and rifampin (RIF) resistance within 2 hours [3].

In 2015, it is estimated that there is 10.4 million new cases, of them, 10% were among children and 12% had a human immunodeficiency virus (HIV) co-infection [4]. Globally, there is an estimated 10.0 million people developed TB disease in 2019. The major risk factor s includes poverty, malnutrition, and immunosuppressive therapy [6].

Usually, it affects the lung, but tuberculosis is a multi-system disease with protean manifestation. The principal mode of spread is through the inhalation of infected aerosolized droplets. The most common manifestations of pulmonary tuberculosis include chronic cough, low-grade fever, hemoptysis, night sweats, and weight loss. Pulmonary tuberculosis may lead to many complications such as extensive lung destruction, acute respiratory distress syndrome, and empyema [6].

Early detection of drug resistance is crucial for early treatment of TB [7]. In this study, we aimed to evaluate the rate of rifampin resistance in pulmonary tuberculosis patients who attended the tuberculosis unit in Kosti Teaching Hospital (Kosti city, White Nile State, Sudan) by using the GeneXpert assay method.

MATERIALS AND METHODS

This was cross-sectional study carried out during December 2019-December 2020 at Kosti Teaching Hospital**.** This hospital is locating in the Kosti city (Sudan), and contains TB Unit, where the admitted patients get health services related to Tuberculosis illness. The TB Unit is a referral unit in White Nile state, Sudan. The study approved by the Ethics Review Committees of Kosti Teaching Hospital and followed the instructions of the Declaration of Helsinki. All the study protocol was carried out in accordance with relevant guidelines and regulations of the Ethic committee of Kosti Teaching Hospital. Informed consent was taken from all study participants.

Study participants

The study included the pulmonary tuberculosis subjects as diagnosed based on was based on past history, clinical features and detection mycobacterium tuberculosis by GeneXpert as mentioned previously [8]. Patients were recruited throughout the study duration. Disqualified individuals were excluded. The convenient sampling technique was used to recruit the subjects who were eligible for participation. To assure about the

confidentiality of the information of patients, each subject was given a unique identification number for cording and maintaining of subjects privacy.

Data collection

All subjects were invited to fill a structured questionnaire. The questionnaire captured information includes gender, residence, and age.

Sample collection and analysis

In this study, the sputum sample were collected from each individual and immediately processed for detection of Rifampicin resistance by using of GeneXpert as mentioned formerly [8].

Quality control

Quality check in all working steps was done by different laboratory technician personal to obtain accurate result.

Statistical assessment

The demographic data and study outcome were assessed by using of SPSS software (Copyright IBM Corp., Armonk, N.Y., USA). Firstly, the study data were coded, entered, validated and analyzed. In order to determine the relationship of Rifampicin resistance with study variables and degree of variation in the rate of Rifampicin resistance between study variables, Pearson Chi-squared test was done. Data are displayed as tables. The Rifampicin resistance was expressed as number and percentage. All cases with the P-values below 0.05 were accepted as statistically significant.

RESULTS

One thousand subjects were involved in this study. In this study, the frequency of rifampicin resistant was 1.2% (Table 1). Male subjects (23.4) were showed higher rate of sensitivity to rifampicin than females, P=0.041 (17). The rate of rifampicin resistant was significantly higher in subjects aged 41-60 years than other, P>0.05. It is also higher in rural areas residents, relapse subjects, and subjects who are seropositive for HIV, P>>0.05 (Table 2).

Table (1): Frequency of rifampicin resistant among TB patient

Rifampicin	Frequency: N (%)
Sensitive	208 (20.8)
Resistant	12 (1.2)
Negative	780 (78)

Table (2): Rate of rifampicin resistant among study participants

Variable		Rifampicin resistant				
		Negative	Sensitive	Resistant	X^2	P value
Gender	Male	449 (75.5)	139(23.4)	7 (1.2)	5.943	0.049
	Female	331(81.7)	79(17)	5(1.2)		
Age	1-20	158(83.2)	30(15.8)	2(1.1)		
	21-40	285(83.2)	112(27.9)	4(1)	25.944	<0.000
	41-60	199(79)	49(19.4)	4(1.6)		
	61-80	138(87.9)	17(10.8)	2(1.3)		
Residence	Urban	528(79.8)	129(19.5)	5(0.8)		
	Rural	252(74.6)	79(23.4)	7(2.1)	5.544	0.061
Case	New	569(78.2)	152(20.9)	7(1)	2952	0.527
	Relapse	157(78.9)	38(19.1)	4(2)		
	Loss of follow-up	54(74)	18(24.7)	1(1.4)		
HIV	Negative	166 (77.6)	46 (21.5)	2 (0.9)	1.966	0.762
	Positive	24 (75)	7 (21.9)	1 (3.1)		
	Unknown	590(78.2)	155(20.6)	9 (1.2)		

Statistical analysis performed by fisher exact test

DISCUSSION

Tuberculosis is infectious disease. The occurrence of drug-resistant TB, particularly rifampicin (RIF) - and multidrug-resistant TB, has critically obstructed progress toward controlling this disease [9]. An estimated 10.0 million people developed active TB in 2018, of which 484,000 cases were affected by MTB with resistance to RIF. However RIF is presently the most effective first-line anti-TB drug, Rifampicin is one of the most effective first-line anti-TB drug that serves as a surrogate marker for the detection of multidrug resistant-tuberculosis (MDR-TB), as > 90% of RIF resistant isolates are also isoniazid-resistant, another potent first-line anti-TB drug [9–11]. Resistance to RIF only and it is largely attributed to nucleotide substitutions in an 81- bp core region of the rpoB gene; however, there is growing resistance to rifampicin, largely due to particular genomic mutations in the rpoB gene of Mycobacterium tuberculosis [13]. The rpoB gene encodes the ß subunit of RNA polymerase, which is involved in chain initiation and elongation [15]. Mutations in the rifampicin resistance determining region (RRDR) of this gene (codons 507–533) are associated with rifampicin resistance [16]. The rising incidence of (MDR-TB) have threatened the global measures to control the TB epidemic and the detection of such resistance at the earliest is essential to limit the spread of the evolving resistance and to initiate optimal therapy [17].

In this study, the overall frequency of RR-TB was (1.2%) among suspected TB patients which is less than other several studies [18-24] but is higher than Elsafi et al study [8]. This variation may be due to variations in sample sizes and geographical area.

Rifampicin sensitivity was lower among females than males, (P <0.05). This is similar to Elsafi et al [8] and Masenga et al study results [25], which may propose a higher level of RR in males. Regarding the proportion of rifampicin resistance pattern among the age group, the highest resistance pattern (33.3 %) was observed in the age group 41-60 compared to other, which is similar to previous study [25] but it is different from local previous study [8].

According to the residence, there was strong relation between RR-TB and residence, which is matched with other study that found geography had positive relationships with the MDR [26].

The present study showed that TB relapse subjects had higher rate RR-TB but it is not significant, which is in line with local previous study [8].

CONCLUSION

The study highlighted the rate of rifampicin resistance in White Nile state and provides evidence about the distribution of resistant among gender, residence, and age, which is important for health system as well as in diagnosis and control of infection.

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