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MODERN DIAGNOSTIC MODALITY VERSUS CONVENTIONAL DIAGNOSTICS MODALITY IN DIAGNOSIS OF TUBERCULOSIS IN PAEDIATRICS AGE GROUP IN A TERTIARY CARE INSTITUTE

Paediatrics

Bhavesh Panot — Professor, Department of Paediatrics, Dr G. D. Pol Foundation 's YMTAMC, Kharghar , Navi Mumbai , Maharashtra, India

Jayesh Panot — Assistant Professor, Department of Paediatrics, Rajiv Gandhi Medical College, Kalwa, Thane-400605, Maharashtra, India

Pradnya Jadhav* — Assistant Professor, Department of Community Medicine, Rajiv Gandhi Medical College, Kalwa, Thane-400605, Maharashtra, India*Corresponding Author

Shailesh Gadakh — Consultant Paediatrician,Buldhana Multispeciality Hospital, Buldhana

ABSTRACT

This cross-sectional descriptive study was conducted using the convenience sampling technique on 122 paediatrics patients (females: 65, 53.02%; males: 57, 46,8%) who were admitted in the pediatrics ward of Tertiary Care Centre in Metropolitan city in Western India . 68.9% (n=84)were pulmonary Tb cases & 31.1%(n= 38) were extrapulmonary Tb cases. Among Pulmonary Tb cases ,maximum 31% (n= 26)belong to age group 0-3 years while among the extra-pulmonary Tb cases maximum were reported 47.4%(n= 18) in age group 7-9 years. Xray chest suggestive of MTB was detected in 100%(n=84)cases while 76.3%(n=29) extrapulmonary Tb show X-ray changes. MTB was detected in 42(50%) pulmonary TB cases &in 97.4%(n=37) extrapulmonary Tb was not detected. Mantoux test was positive in 84.5%n=71) pulmonary TBcases& 76.3%(n= 29) extrapulmonary Tb Cases. MTB was detected in 43(51.2%)using CBNAAT . Xray ,ZN staining & CBNAAT diagnostic modalities are better able to diagnose pulmonary TB as opposed to Extra pulmonary TB with Stastical significant difference (P< 0.001) .Sensitivity was highest for x-ray chest(100%) , Montoux test(84.52%), CBNAAT(51.19%) & ZN staining(50%), while specificity was highest for ZN staining & CBNAAT and low for X-ray chest & Montoux test(23.68%)

KEYWORDS

Pulmonary TB , Extra-Pulmonary TB, MTB, CBNAAT

INTRODUCTION

Tuberculosis is a great menace to mankind since ancient times. The genus Mycobacterium was known to originate 150 million years ago. The skeletal deformities of tuberculosis have been demonstrated in Egyptian mummies.[1] But the causative agent of this dreadful disease was not known for longer periods. The discovery of Mycobacterium tuberculosis, the causative agent for tuberculosis was by Robert Koch in 1882 using light microscopy and a special staining technique.[2]

Tuberculosis in young children, a vulnerable population differs from adults in many ways like atypical radiological features, non-specific symptoms, difficulty in obtaining samples, lower bacillary load, absence of a gold standard test for diagnosis and by being commonly extra pulmonary or disseminated at its presentation.[3,4] Tuberculosis can mimic common diseases like pneumonia, generalized bacterial or viral infections, malnutrition and HIV.[5]

In the national programs for control of tuberculosis also, paediatric population remains neglected.[6] This leads to increased morbidity and mortality among children. Children in developing countries have latent tuberculosis most commonly and its progression to active tuberculosis depends on various factors. Age, nutrition, HIV status, contact with a known case of tuberculosis, diseases like measles and pertussis determine the progression of tuberculosis in children.[7] The recent advances in diagnosis and newer drug formulations have not yet reached the paediatric population.[8]

Pulmonary tuberculosis and intra-thoracic lymphadenopathy constitutes 60%-80% of the paediatric cases. Among the extrapulmonary tuberculosis, lymphadenopathy is the most common (67%), followed by central nervous system involvement (13%, pleural (6%), disseminated (5%) and skeletal (4%) TB. Disseminated (miliary) disease and TB meningitis are commonly seen in very young children and/or HIV-infected children.[6]

Robert Koch (1882) demonstrated tubercle bacilli from the grey tubercles of animals lungs hardened with alcohol and stained with methylene blue and caustic potash[9]The acid fast nature of the bacillus was demonstrated by Ehrlich in 1882.[10] Other diagnostic discoveries include X-rays by Wilhelm Konrad Roentgen in 1895, development of the tuberculin skin test by Von Pirquet and Mantoux in 1907-1908 and preparation of PPD by Seebert in 1940. [10,11]

Regional data from the World Health Organization (WHO) in 2007 showed that smear-positive TB in children aged <14 years accounted for 0.6-3.6% of reported cases. [12]

However, because ~95% of cases in children <12 years of age are smear negative, these data underestimate the true burden of TB. In 2010, of the ~1 million estimated cases of TB in children worldwide, 75% occur in the 22 highest burden countries.[13]

In 2015, the world had an estimated 10.4 million new TB cases. Over half of these were among men (5.9 million), and women constituted over a third (3.5 million). Ten per cent of cases were among children.[14]

Laboratory diagnosis of tuberculosis

Ziehl-Neelsen and Acid fast methods of acid fast staining are in routine use nowadays. The tubercle bacilli are seen as thin, long, slender, slightly curved occasionally beaded pink bacilli against a blue background by light microscopy using acid fast staining techniques. The smears are graded according to RNTCP guidelines.[15]In fluorescent microscope, the bacilli appear as slender bright yellow fluorescent rods against a dark background. Fluorescent microscopy increases the sensitivity by 10% when compared with conventional light microscopy.[16]CBNAAT detects M. tuberculosis and rifampicin resistance by amplification of the rifampin resistance determining region (RRDR) of the rpoB gene and subsequent probing of this region for mutations rifampicin resistance[17]Mantoux test is not used to measure immunity but the degree of hypersensitivity to tuberculin antigen. This serves as a poor diagnostic tool as it cannot differentiate between latent tuberculosis infection and active disease. Adenosine deaminase (ADA) is considered to be an excellent surrogate marker in the diagnosis of extrapulmonary TB & mainly used in detecting tubercle bacilli in serosal fluids like pleural effusion (TB pleural effusion), pericardial effusion (TB Pericarditis) and peritoneal fluid (TB peritonitis). The sensitivity of this test for these serosal fluids range from 90-100%. [18]

MATERIALS AND METHODS

This cross-sectional record based hospital study was conducted in which records of patients diagnosed with tuberculosis admitted in paediatric ward during year 2020 & 2021 in a Tertiary care centre in a Metropolitan city in western India using convenient sampling method was analysed maintaining the confidentiality of the patients. All the patients aged 1- 12 yrs diagnosed with tuberculosis were included The data were entered in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and were statistically analyzed using EpiInfo

Version 7.0 (public domain software package from the Centers for Disease Control and Prevention, Atlanta, GA, USA). Continuous data were presented as Mean and Standard Deviation (SD). The 95% Confidence interval (CI) was estimated and stated as: [Mean-(1.96)*Standard Error)] - [Mean+(1.96)*Standard Error)].

RESULTS AND DISCUSSION

In all, there were 122 participants (65 females: 53.2% and 57 males: 46.8%).

Out of 122,68.9%(n=84)werepulmonary TB cases whilen31.1%(n=38) were extrapulmonary TB cases. (Table 1) Among the pulmonary TB cases 31%(n=26) were in age group 0-3 yrs while 27. 4%(n=23) belonged to age group>10ys & above,21.4%(n=18) were in age group 7-9 yrs & 20.2%(n=17)were in age group 4-6 yrs. Among the extrapulmonary TB case,47.4%(n=18) belong to age group 7-9yrs while 23.7%(n=9) belong to age group >10 yrs & above,26.3%(n=10) age group 4-6 yrs & 2.6%(n=1)was in age group 0-3 yrs.(Table 2). Resistance to rifampicin was not detected in any of cases.(Table 3)

X-ray chest, ZN staining and CBNAAT were able to better identify pulmonary TB as opposed to extra-pulmonary TB &The findings were statistically significant The findings of Montoux test were not statistically significant between the pulmonary and extrapulmonary TB. (Table 4)

The sensitivity was highest for x-ray chest(100%) followed by Mantoux test(84.52%), CBNAAT(51.19%) and ZN staining(50%), while the specificity was highest for ZN staining and CBNAAT and low for X-ray chest and Montoux test (23.68% each)(Table 5)

In our study, the proportion of pulmonary tuberculosis was 68.9% (n=84) and extra pulmonary tuberculosis was 38% (n=38). These findings corroborate with previously published studies from USA which reported 75% pulmonary tuberculosis cases and 25% extra pulmonary cases under the age of fifteen years.[19]Studies from Middle East (Iran and Turkey) have reported similar detection rates of pulmonary and extra pulmonary tuberculosis.[20,21]

In our study, the detection rate of rifampicin resistant M.TB among the total n=122 children were found to be n=0. A study in Africa reported the resistance rate among children affected with tuberculosis to be 6.7%.[22]Various studies reported the resistance rate among paediatric tuberculosis to be 0.6% to 2.3 %, similar to our study.[23]

Table 1:Diagnositic classification of TB

Diagnosis	Frequency	Percentage
Pulmonary TB	84	68.9
Extrapulmonary TB	38	31.1
Total	122	100.0

Table 2: Distribution of Patients in different Age group

	0-3years	4-6 years	7-9 years	10 and above	Total
Pulmonary TB	26(31%)	17(20.2%)	18(21.4%)	23(27.4%)	84(100%)
Extra-pulmonary TB	1(2.6%)	10(26.3%)	18(47.4%)	9(23.7%)	38(100%)

Table 3 : Rifampicin Resistance

Rifampicin Resistance		
Detected	0	0
Not Detected	122	100

Table 4: Co-relation between various diagnostic tests and TB diagnosis.

Diagnostic Test	Test Finding	Diagnosis		Chi-square, p-value
		Pulmonary TB	Extra-pulmonary TB	
X-ray chest	Suggestive of TB	84(100%)	29(76.3%)	21.479, 0.0001*
	Not suggestive of TB	0	9(23.7%)	
ZN staining	MTB detected	42(50%)	1(2.6%)	25.722, 0.0001*
	MTB non detected	42(50%)	37(97.4%)	
Montoux test	Positive	71(84.5%)	29(76.3%)	1.193, 0.275
	Negative	13(15.5%	9(23.7%)	
CBNAAT	MTB detected	43(51.2%)	1(2.6%)	27.755, 0.0001*
	MTB non detected	41(48.8%)	37(97.4%)	

*Satistically significant

Table 5: Sensitivity, specificity, Positive predictive value (PPV) and Negative predictive value(NPV) of different diagnostic tests for Pulmonary TB.

Diagnostic test	Sensitivity	Specificity	PPV	NPV
X-ray chest	100%	23.68%	74..34%	100%
ZNstaining	50%	97.40%	97.67%	46.84%
Montoux test	84.52%	23.68%	71%	40.91%
CBNAAT	51.19%	97.37%	97.73%	47.44%

CONCLUSION

This work was done to find out ideal diagnostic methods for diagnosis of tuberculosis among children. Among the methods which were used for the diagnosis of paediatric tuberculosis, conventional methods were advantageous as it could detect more cases which are missed by CBNAAT and ZN staining.

The detection rate of rifampicin resistant tuberculosis among the positive cases was 0.0%. As the rate of drug resistant tuberculosis is in increasing trend among children, it is essential to use a rapid method which detects M.TB and rifampicin resistance simultaneously. Thus, CBNAAT is the best method in the diagnosis of tuberculosis adults but in pediatric age group it does not prove to be the best method as compared with conventional methods.Earlier detection can reduce the death rate among children and prevent the spread of tuberculosis in the community.

Though various advances in diagnosis of tuberculosis,clinical suspicion,clinical presentation ,history of contact and the conventional methods of diagnosing tuberculosis are more conclusive in the the diagnosis of tuberculosis.

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