

TMSS Medical College Journal (TMCJ)

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Original Article

Antimicrobial Sensitivity Pattern of Salmonella Typhi Isolated from Blood Samples of Enteric Fever Patients at a Tertiary Care Hospital in Bangladesh

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Corresponding Author*Abstract**

Background: Enteric fever is an important multisystem infectious disease caused by *Salmonella typhi*. It is a major public health problem in developing countries including Bangladesh. A changing antimicrobial sensitivity pattern of *Salmonella typhi* and emergence of resistance has increased to a great concern. **Objective:** To investigate the antimicrobial sensitivity pattern of *Salmonella typhi* and selection of appropriate antimicrobial therapy to avoid multidrug-resistance. **Materials and Methods:** This cross-sectional descriptive study was conducted at MH Samorita Hospital and Medical College, Dhaka, Bangladesh from January 2021 to December 2021. Blood culture samples were collected aseptically and cultured in Microbiology laboratory. A total of 100 laboratory reports were collected during this period. Simple random sampling technique was applied for selection of culture positive *Salmonella typhi* patients laboratory reports. Specimens from the blood culture were identified by standard procedures as needed. Antimicrobial sensitivity testing was performed by disk diffusion method according to 'The Clinical Laboratory Standard Institute' guidelines. **Results:** Among the culture positive cases, *Salmonella typhi* was sensitive to ceftriaxone and gentamicin 100% followed by Ceftazidime 99%, Imipenem 98%, Cefixime 93%, Cotrimoxazole 79%, and least sensitive antibiotic was azithromycin 21% and Ciprofloxacin 23%. The incidence rate was high in male 63% and the age group 0-10 years 35%. **Conclusion:** The antimicrobial sensitivity testing showed that the *Salmonella typhi* were highly sensitive (>88%) to most of the drugs used in this study, whereas azithromycin showed only 21% sensitivity. So this study indicates that Ceftriaxone, Gentamicin, Ceftazidime, Imipenem and Cefixime can be used as a first line therapy and Azithromycin, Ciprofloxacin should be avoided for treatment.

Key words: Enteric fever, *Salmonella typhi*, Multidrug resistant, Antimicrobial sensitivity testing.

Introduction

Enteric fever is a febrile illness caused by infection with the Gram-negative bacterium *Salmonella enterica* serovar Typhi (S. Typhi).¹ It is an endemic disease in many developing countries including Bangladesh.² World Health Organization (WHO) estimates the global enteric fever disease burden roughly 21.6 million people annually, resulting in about 223,000 deaths per year.³ The pathogens are transmitted by the faeco oral route with poor hygienic practices resulting in high morbidity and mortality. More than 90% of this

morbidity and mortality occurred in Asia.⁴ Antimicrobial therapy is the mainstay of managing enteric fever. If not treated properly, enteric fever carries a mortality rate of 30 %. Prompt institution of appropriate antimicrobial therapy can reduce the mortality and morbidity of this illness.⁵

Since 1948, chloramphenicol had been the mainstay of treatment of enteric fever until 1972. Then chloramphenicol resistant enteric fever became a problem. Extensive and irrational use of antimicrobial

drugs have led to the emergence and spread of drug-resistance, often referred as multidrug resistance (MDR) in the pathogenic strains of *Salmonella*.⁶ The early emergence of drug resistance among *Salmonella* isolates dates back to late 1980s when the traditional first-line drugs (chloramphenicol, ampicillin and co-trimoxazole) became ineffective due to antibiotic resistance, which compelled clinicians to rely upon fluoroquinolones, especially ciprofloxacin.⁷ Recent global surge in resistance to fluoroquinolones could lead to a disastrous increase in global infectious diseases.⁸ However, several findings suggest the increasing burden of nalidixic acid resistant *S. typhi* (NARST) strains with reduced susceptibilities to fluoroquinolones, which subsequently has led to the introduction of third generation cephalosporins like Cefixime, Ceftazidime, Ceftriaxone and Macrolides like Azithromycin.⁹ But with their increasing usage in clinical settings the resistance against these antibiotics is increasing reported. Multidrug-resistance (MDR) has been emerging rapidly and consistently in enteric fever pathogens driven by selection pressure due to irrational drug therapy. This has resulted in treatment failures leading to extended hospital stay, health complications and leading to rise in morbidity and mortality.¹⁰

The study of antimicrobial sensitivity pattern of *S. typhi* isolates is crucial in prompt and appropriate therapy of enteric fever in prevention and control of the disease. Continual consistent surveillance and monitoring of local antimicrobial resistance trends is a pre-requisite for implementing rational measures and to update the therapeutic guidelines.¹¹

In light of above facts, the present cross sectional descriptive study was under taken to evaluate the antimicrobial sensitivity pattern of *S. typhi* isolated from blood cultures proven enteric fever in a tertiary care hospital in Dhaka, Bangladesh.

Materials and Methods

The blood samples for culture were collected from Microbiology laboratory of MH Samorita Hospital, Dhaka, Bangladesh. A total of 100 laboratory reports were collected during the period of January 2021 to

December 2021. Simple random sampling technique was applied for selection of culture positive *Salmonella typhi* patients laboratory reports. Venous blood samples (10 ml from adults and 5 ml from children) were drawn aseptically by venipuncture from clinically suspected cases of enteric fever before starting any antimicrobial therapy. The specimens were Cultured and antimicrobial sensitivity tests were performed according to standards microbiological techniques. Brain-Heart infusion (BHI) broth was used for culture. Subcultures into blood agar, Mac-Conkeys agar were done as per standard methods. Non-lactose fermenting colonies were identified by biochemical reactions and confirmed by group and type specific *Salmonella* antisera. Antimicrobial sensitivity was performed by Kirby- Bauer Disc- diffusion methods on Muller Hinton agar plates. Antimicrobial disc used in this study were, Amoxicillin, Azithromycin, Cefepime, Cefixime, Ceftazidime, Ceftriaxone, Cefuroxime, Ciprofloxacin, Co-trimoxazole, Gentamicin and Imipenem. Interpretation was done in accordance with the National Committee for Clinical Laboratory Standards (NCCL) and data were entered in Microsoft Excel. This study was approved by ethics Committee of MH Samorita Hospital and Medical College.

Results

In this study total 100 *S. typhi* were obtained by blood culture from the suspected cases of enteric fever. The age of the patients range from 02 to 60 years.

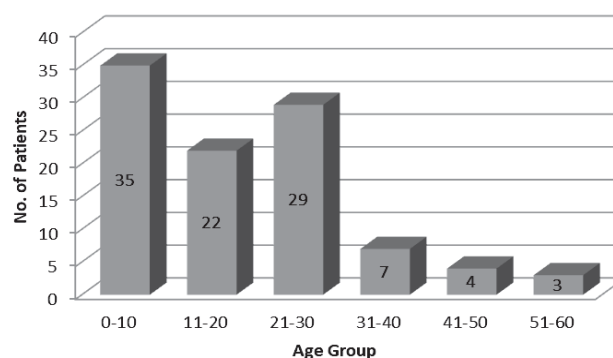


Figure 1. Age wise distribution of *Salmonella typhi*.

Figure 1 Shows the age wise distribution of *Salmonella typhi* isolates. The Majority cases of enteric fever were in 0-10 years age group and least from 51-60 years age groups.

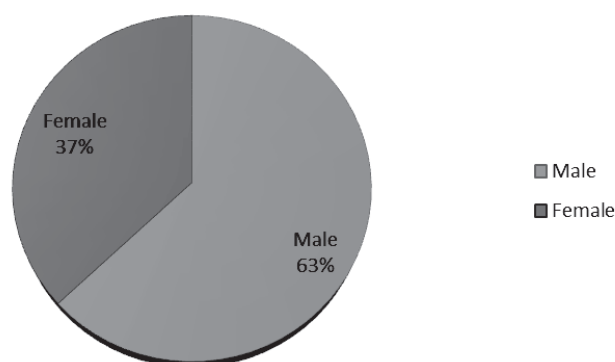


Figure 2. Gender wise distribution of Salmonella typhi.

The gender wise distribution of patients is shown in figure 2, here male were 63% and female were 37%. In this study male preponderance was observed in Enteric fever cases with male: female ratio=1.70:1 for all Salmonella typhi isolates.

Table I: Antimicrobial sensitivity pattern of Salmonella typhi by kirby-bauer disc diffusion method

Antibiotic	Serotype typhi (N = 100)		
	Sensitive (%)	Intermediate (%)	Resistant (%)
Amoxycillin	81(81)	-	19(19)
Azithromycin	21(21)	1(1)	78(78)
Cefepime	96(96)	4(4)	-
Cefixime	93(93)	3(3)	4(4)
Ceftazidime	99(99)	-	1(1)
Ceftriaxone	100(100)	-	-
Cefuroxime	41(41)	59(59)	-
Ciprofloxacin	23(23)	-	77(77)
Co-trimoxazole	79(79)	13(13)	8(8)
Gentamicin	100(100)	-	-
Imipenem	98(98)	2(2)	-

The antimicrobial sensitivity pattern of *S. typhi* as depicted in Table I, showed very high sensitivity towards Gentamicin and Ceftriaxone (100%) followed by Ceftazidime (99%) and Imipenem (98%). *S. typhi* isolates were least sensitive towards Azithromycin (21%). However, sensitivity to conventional antibiotics like Amoxicillin (81%) and Co-trimoxazole were (79%) respectively. *S. typhi* isolates were mostly resistant to Azithromycin (78%) and Ciprofloxacin (77%).

Discussion

Enteric fever is an endemic disease in the tropic and subtropic regions of the world. It has become a major public health problem in low-to-middle-income countries (LMICs) like Bangladesh. The occurrence of enteric fever was higher in summer month, but now a day it spreads highly among the community in all seasons of the year. The presence of densely populated urban areas with reduced access to safe drinking water and sanitation, lowered socio-economic status, lack of effective surveillance and poor infection control are some of the driving factors for the high endemicity of the diseases in these countries. Poverty and lack of proper health care facilities incite disease burden in Bangladesh.¹² Global burden for Salmonella typhi is 80% seen in the Asian and African countries. Proper sanitation, public health education and vaccination are long term preventive measures that would improve this situation. The emergence of antibiotic resistant strains of bacteria is closely linked to the irrational use of antibiotics.¹³

In the present study 23% of the isolates were susceptible to Ciprofloxacin in disc-diffusion test. This is concurrent with the findings from other studies.¹⁴ It needs higher concentration for disc diffusion test. The requirement for higher concentrations of Ciprofloxacin for the inhibition of *S. typhi* could be due to the overuse of Ciprofloxacin in the treatment of enteric fever and other unrelated infections. Over-the-counter (OTC) availability of antibiotics and incomplete treatment due to many reasons in a developing country like ours may also be the factors contributing to the development of resistance.¹⁵

Our study showed 100% sensitivity of Salmonella typhi against Ceftriaxone and Gentamicin. Similar results were reported from studies done in India, Pakistan and neighboring countries.^{16, 17, 18} Emphasis is laid on the sparing use of this drug. If we do not make any limitation of its use then it became resistant to these first line drugs very soon. *S. typhi* were found to be 21% susceptible towards Azithromycin. The emerging resistant of Azithromycin has also been reported in India.¹⁹ This may be the result of misuse of

Azithromycin that has been propelled due to its oral route of administration, as well as broad-spectrum antimicrobial activity with minimal side effect and interactions.²⁰ Conventional first line drugs are not used for a long period in enteric fever because of the high resistance rate, so they are regaining their sensitivity. From this study we observed that Co-trimoxazole is still a little bit sensitive of *Salmonella typhi* (79%). Now a days Co-trimoxazole is the second cost effective drug used to treat *S. typhi*.²¹

In this study we male were more affected than female and male: female ratio =1.70:1. The highest prevalence rate was observed in children whose age was between 0 to 10 years (37%) due to less development of immune power and poor personal hygiene. Children cannot maintain proper hygiene by themselves. These findings were in agreement with the findings of other studies.^{22, 23, 24}

Conclusion

The findings of the present study indicated that MDR strains prevail in Bangladesh. Co-trimoxazole and Amoxicillin resistant by *Salmonella typhi* were found to be minimal, so these drugs may still have a role in the treatment of enteric fever. However Gentamicin and Ceftriaxone showed cent percent sensitivity followed by Ceftazidime (99%), Imipenem (98%), Cefepime (96%), Cefixime (93%). Hence Cephalosporin groups are the choice of drugs to treat enteric fever. Antibiotics are unnecessarily prescribed for common cold, cough, any febrile illness and diarrhea in Bangladesh. Physicians, therefore should always be aware of the antibiotic sensitivity /resistance profile of the organism for the rational use of antibiotics. Therefore it might be recommended that blood/stool/urine culture should be sent to diagnostic center for characteristics of a particular pathogen before prescribing antibiotics in suspected enteric fever patients to prevent further resistance. Improvement in sanitation and water supply systems has been suggested as a method to control epidemics of enteric fever in Bangladesh as these factors are the tip of the iceberg.

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