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# A Study of Antibiotic Susceptibility Pattern of *Salmonella typhi* and *Salmonella paratyphi* A

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**A B S T R A C T**

Typhoid fever is a systemic infection caused by *Salmonella enterica* subspecies *enterica* serovar Typhi. A very similar but often less severe disease is caused by S. *paratyphi* A, B and sometimes C. Enteric fever is endemic in all parts of India. *S. typhi* and *S. paratyphi* A are the predominant types of *Salmonella* responsible of enteric fever in India. An antibiogram is the result of a laboratory testing for the sensitivity of an isolated bacterial strain to different antibiotics. A descriptive study was conducted at the Department of Microbiology, Sri Siddhartha Medical College and Research centre, Tumkur from January 2015 to December 2016. A total of 292 isolates were studied. Antibiotic sensitivity was observed on Muller –Hinton agar plates by Kirby-Bauer disc diffusion methods according to National Committee for Clinical Laboratory (NCCL) guidelines. The male to female ratio was 2.3: 1. More cases are reported among males compared to females probably as a result of increased exposure to infection. Antibiotic susceptibility/resistance profile is also found to be similar in these two agents. In the recent days a change towards increased isolation of *S. paratyphi* A has been observed in many places. This can be explained by two hypothesis: 1. Increased vaccination against Typhoid fever and 2. Increased interest among the microbiologists. Both *S. typhi* and *S. paratyphi* A has similar distribution rate (54% and 46%). Present study represents amoxycillin and clavulinic acid, ceftriaxone, cefotaxime and amikacin are the drug of choice for typhoid fever.

## Introduction

Typhoid fever is a systemic infection caused by *Salmonella enterica* subspecies *enterica* serovar Typhi. A very similar but often less severe disease is caused by *S. paratyphi* A, B and sometimes C. *S. typhi*, a highly adapted human-specific pathogen that evolved about 50,000 years ago, has remarkable mechanisms for persistence in its host (Pegues *et al.*, 2005). Enteric fever continues to be a major public health problem, especially in the developing countries of the tropics (Gautam *et al.*, 2002).

It is an important cause of morbidity and mortality with an estimated 33 million cases worldwide (Kumar *et al.*, 2008) and an estimated 600,000 deaths annually (Gautam *et al.*, 2002). Enteric fever is endemic in all parts of India. *S. typhi* and *S. paratyphi* A are the predominant types of *Salmonella* responsible of enteric fever in India (Gautam *et al.*, 2002).

Chloramphenicol was first introduced in 1948 as effective antibiotic in the treatment of enteric fever and was the undisputed drug of choice until the mid 1970's (Lakshmi *et al.,* 2006). An antibiogram is the result of a laboratory testing for the sensitivity of an isolated bacterial strain to different antibiotics. The susceptibility or resistance patterns to selected antimicrobial drugs can be a very valuable screen for epidemiological investigations. Because of mutation and/or plasmid acquisition such patterns cannot be regarded as definitive. Nevertheless, patterns such as ACSSuT (Ampicillin, chloramphenicol, streptomycin, sulphon-amides and tetracycline) for *S. typhimurium*. (Venkatesh *et al.,* 2013; Das and Bhattacharya, 2006).

## Materials and Methods

A descriptive study was conducted at the Department of Microbiology, Sri Siddhartha Medical College and Research centre, Tumkur from January 2015 to December 2016. A total of 292 isolates were studied. Patients attending the outpatient department (OPD) or admitted at Sri Siddhartha Hospital who are clinically suspected as enteric fever cases formed the source for the material of the study. Venous blood was collected under aseptic precautions from these patients. 5 ml from children and 10 ml from adults respectively were collected for blood culture. Non *Salmonella* species isolated from blood cultures and patients below one year of age were not included. Antibiotic sensitivity was observed on Muller–Hinton agar plates by Kirbey-Bauer disc diffusion methods according to National Committee for Clinical Laboratory (NCCL) guidelines (Bauer *et al.,* 1966; National Committee for clinica laboratory standards performance standards for antimicrobial susceptibility testing NCCLS, 2002). In this study following antibiotics were included: Ampicillin, Amoxycillin and Clavulinic acid, Ceftriaxone, Cefotaxime, Chlorampenicol, Ciprofloxacin, Co-trimoxazole, Amikacin and Nalidixic acid. Data collected was entered in Microsoft excel 2007 and analysed using Epi Info 3.4.3. Descriptive statistics such as proportion, mean and SD were used.

## Results and Discussion

Enteric fever continues to be a public health related problem in all the developing countries. Failure to supply safe drinking water and unhygienic eating habits in the population are mainly responsible for persistence of enteric fever. The male to female ratio was 2.3:1. More cases are reported among males compared to females probably as a result of increased exposure to infection. Generally gender has no role in the Enteric fever distribution. Salmonella Typhi was the main agent of enteric fever till now. In the recent days a change towards increased isolation of *S. paratyphi* A has been observed in many places. This can be explained by two hypothesis-1. Increased vaccination against Typhoid fever and 2. Increased interest among the microbiologists. Both *S. typhi* and *S. paratyphi* A has similar distribution rate (54% and 46%).

Antibiotic susceptibility/resistance profile is also found to be similar in these two agents. The present study found that Enteric fever *Salmonellae* have regained susceptibility to the drugs to which they had become resistant earlier such as Ampicillin, Chloromycetin and Co-trimoxazole. Nalidixic acid resistant *Salmonella typhi* are being increasingly isolated in recent years. But all these isolates are found to be susceptible to Ciprofloxacin by disc diffusion and by MIC detection. This difference in the susceptibility pattern between Nalidixic acid and Ciprofloxacin resistance needs to be further evaluated so that an optimum screening method is implemented (Table 1–6 and Fig. 1).

**Table.1** Distribution of *Salmonella* isolates

| Sl. No. | Isolate | No. | % |
|---|---|---|---|
| 1. | *Salmonella typhi* | 160 | 54.8 |
| 2 | ***Salmonella paratyphi* A** | 132 | 45.2 |

**Table.2** Isolate and sex distribution

| Sl. No. | Isolate | No. of patients | | Total (%) |
|---|---|---|---|---|
| | | Male (%) | Female (%) | |
| 1 | *Salmonella typhi* | 113 (55.7) | 47 (52.8) | 160 (54.8) |
| 2 | *Salmonella paratyphi* A | 90 (44.3) | 42 (47.2) | 132 (45.2) |
| | Total | 203 (100) | 89 (100) | 292 (100) |

**Table.3** Age and sex distribution of *Salmonella* isolates

| Sl. No. | Age group | No. of patients | | Total (%) |
|---|---|---|---|---|
| | | Male (%) | Female (%) | |
| 1 | 1–10 | 31 (15.3) | 24 (27) | 55 (18.8) |
| 2 | 11–20 | 89 (43.8) | 31 (34.8) | 120 (41.1) |
| 3 | 21–30 | 74 (36.4) | 29 (32.6) | 103 (35.3) |
| 4 | 31–40 | 4 (2) | 2 (2.2) | 6 (2.1) |
| 5 | 41–50 | 4 (2) | 3 (3.4) | 7 (2.4) |
| 6 | 51–60 | 1 (0.5) | 0 | 1 (0.3) |
| 7 | > 60 | 0 | 0 | 0 |
| | Total | 203 (100) | 89 (100) | 292 (100) |

**Table.4** Seasonal distribution of *Salmonella* isolates

| Sl. No. | Month | *S. typhi* | *S. paratyphi* A | Total Number (%) |
|---|---|---|---|---|
| 1 | January | 3 | 4 | 7 (2.4) |
| 2 | February | 8 | 3 | 11 (3.8) |
| 3 | March | 18 | 9 | 27 (9.2) |
| 4 | April | 14 | 8 | 22 (7.5) |
| 5 | May | 3 | 7 | 10 (3.4) |
| 6 | June | 9 | 2 | 11 (3.8) |
| 7 | July | 20 | 18 | 38 (13) |
| 8 | August | 17 | 36 | 53 (18.2) |
| 9 | September | 18 | 14 | 32 (11) |
| 10 | October | 13 | 9 | 22 (7.5) |
| 11 | November | 14 | 13 | 27 (9.2) |
| 12 | December | 23 | 9 | 32 (11) |
| | Total | 160 | 132 | 292 (100) |

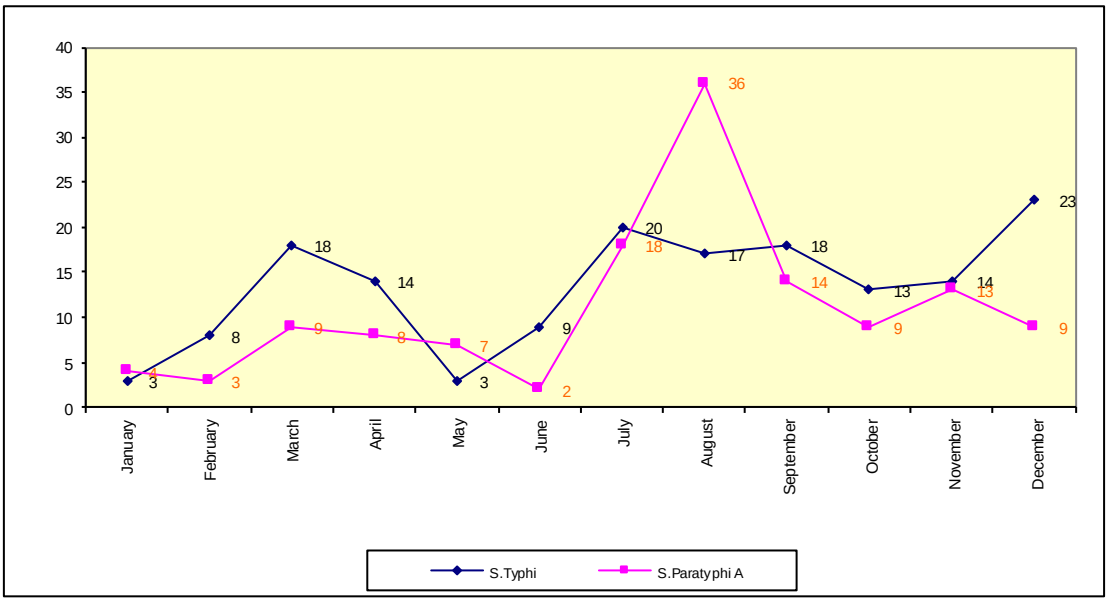
**Table.5** Antibiotic susceptibility pattern of *S. typhi* by disc diffusion method (N=160)

| Sl. No. | Antibiotic | Sensitive n (%) | Intermediate n (%) | Resistant n (%) |
|---|---|---|---|---|
| 1 | Ampicillin | 148 (92.5) | 1 (0.6) | 11 (6.9) |
| 2 | Amoxycillin & Clavulinic acid | 160 (100) | 0 | 0 |
| 3 | Ceftriaxone | 160 (100) | 0 | 0 |
| 4 | Cefotaxime | 160 (100) | 0 | 0 |
| 5 | Chloramphenicol | 154 (96.3) | 2 (1.2) | 4 (2.5) |
| 6 | Ciprofloxacin | 158 (98.8) | 0 | 2 (1.2) |
| 7 | Co-trimoxazole | 158 (98.8) | 0 | 2 (1.2) |
| 8 | Amikacin | 160 (100) | 0 | 0 |
| 9 | Nalidixic acid | 19 (11.9) | 13 (8.1) | 128 (80) |

**Table.6** Antibiotic susceptibility pattern of *S. paratyphi* A by disc diffusion method (N=132)

| Sl. No. | Antibiotic | Sensitive n (%) | Intermediate n (%) | Resistant n (%) |
|---|---|---|---|---|
| 1 | Ampicillin | 128 (97) | 1 (0.7) | 3 (2.3) |
| 2 | Amoxycillin & Clavulinic acid | 130 (98.5) | 0 | 2 (1.5) |
| 3 | Ceftriaxone | 132 (100) | 0 | 0 |
| 4 | Cefotaxime | 132 (100) | 0 | 0 |
| 5 | Chloramphenicol | 129 (97.7) | 0 | 3 (2.3) |
| 6 | Ciprofloxacin | 130 (98.5) | 0 | 2 (1.5) |
| 7 | Co-trimoxazole | 130 (98.5) | 0 | 2 (1.5) |
| 8 | Amikacin | 132 (100) | 0 | 0 |
| 9 | Nalidixic acid | 14 (10.6) | 4 (3) | 114 (86.4) |

**Fig.1** Seasonal distribution of *Salmonella* isolates



Typhoid fever is a major public health problem in this area. Present study represents amoxycillin and clavulinic acid, ceftriaxone, cefotaxime and amikacin are the drug of choice for typhoid fever.

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