ORIGINAL ARTICLE

Epidemiology of Non-Typhoidal Salmonella among patients attending a Tertiary Care Centre in central Kerala

Oommen S, Nair S, Nair K, Pillai S

Department of Microbiology, Pushpagiri Institute of Medical-Sciences and Research Centre, Tiruvalla, Kerala, India

ABSTRACT

Introduction: Non-Typhoidal Salmonella (NTS) species are important food borne pathogens with acute gastroenteritis being the most common clinical manifestation. Certain serovars of Salmonella show a much higher predilection for causing bacteraemia. Though NTS infections are associated with significant morbidity and mortality worldwide; data on NTS in India are limited. **Objectives**: The aim of this study was to describe the prevalence and epidemiology of Non-Typhoidal Salmonella (NTS) in central Kerala, and to compare their sensitivity patterns with typhoidal Salmonella. **Methods**: A retrospective study was done on the blood and stool culture samples received by the microbiology laboratory of a tertiary care centre from January 2012 to August 2014. NTS were isolated and identified using standard bacteriological methods, including serotyping with specific antisera. The geographical distribution, co-morbid conditions and antibiotic sensitivity patterns were analyzed. **Results**: A total of 15 cases of NTS were isolated of which three isolates were associated with bactaeremia. Most common isolates were *S.* Typhimurium and *S.* Enteritidis. We also isolated *S.* Weltreveden from two patients. **Conclusion**: Knowledge of the prevalent of serotypes and their sensitivities would be useful for epidemiological and treatment purposes.

Key words: Non-Typhoidal Salmonella, *Salmonella* Enteritidis, *Salmonella* Typhimurium, *Salmonella* Weltevreden

INTRODUCTION

Infections caused by *Salmonella enterica* ssp. *enterica* can be broadly divided into two groups namely the typhoidal Salmonella which are specific human pathogens of serotypes Typhi and Paratyphi and the Non-Typhoidal Salmonella (NTS), which are primarily transmitted to humans from animals. NTS species are significant food-borne pathogens with a spectrum of disease ranging from the most common clinical presentation of acute self-limited gastroenteritis in healthy individuals to the infrequent presentation of bacteraemia, which occurs in approximately 5% of the patients.[1] Bacteraemia is more often associated with certain serovars of Salmonellae, which differs in different countries.[2,3] An example of this is *Salmonella enterica* var Typhimurium, ST313 which has emerged as a new pathogenic multi-drug resistant clade in sub-Saharan Africa causing epidemics of invasive disease in humans.[4] These epidemics are linked to the emergence of resistance to commonly used antimicrobial drugs.

Access this article online

Quick Response Code:

Website: www.jacmjournal.org

DOI: 10.4103/0972-1282.158780

Moreover, with the increase in life-span and lifestyle associated disorders there is a large population of immunocompromised patients (HIV, malignancy, chemotherapy, steroid therapy, diabetes) and extremes of age (<3 month and >50 years of age) who are vulnerable to invasive NTS infections. Extra-intestinal focal infections (e.g., arthritis, meningitis, pneumonia) occur in 5-10% of those with bacteraemia. The World Health Organization has determined that the NTS are emerging as one of the most important etiological agents of infectious diseases in the world.[5]

NTS is primarily an animal pathogen found worldwide in the gastrointestinal tract of domestic and wild birds, animals, and amphibians. Transmission of NTS to humans is mainly food-borne through consumption of contaminated meat, eggs, and poultry or by contamination of any other food or water by animal or bird excreta. Peaks of infection occur during the rainy season and affects both adults and children.[3] Antibiotic resistance is becoming more common in NTS to all classes of antimicrobials. The presence of extended spectrum beta-lactamase and cephalosporinase (AmpC) has been previously reported.[3] Hence, a review of empiric antibiotics,

Address for correspondence: Dr. Seema Oommen, E-mail: seema.oommen@gmail.com

especially if there is no improvement of the clinical condition of the patient is necessary.

In the year 2012, Kerala experienced a wake-up call after a youth died of food-poisoning due to consumption of chicken meat. Though the pathogen involved in the disease was not identified, the unhygienic practices adopted in local restaurants and hotels were exposed by the health authorities leading to a massive shutdown of eateries not maintaining the minimum standard of hygiene. The contribution of NTS to diarrhoeal illness in Kerala is poorly described. The geographical distribution of NTS, their antibiotic susceptibility profiles or the serotypes prevalent in the state are not documented. This may also be due to the fact that the most common manifestation is a mild self-limiting gastroenteritis, and hence only about 25% of affected people seek medical attention.[6] Consequently surveillance data collected by health department underestimate the true burden of the disease. To the best of our knowledge, this study is the first in the central part of Kerala in which predominant serotypes were enumerated.

A good understanding of the epidemiology of this neglected disease will open new avenues for public health strategies to prevent infections and interrupt transmission and also for the development of vaccines. Thus, this study was carried out with the aim to study the prevalence of the circulating serotypes of NTS in the districts of Kottayam, Alleppey and Pathanamthitta in central Kerala, their geographic distribution and clinical and antimicrobial profiles.

MATERIALS AND METHODS

A retrospective study was done on the blood and stool culture samples received by the microbiology laboratory at Pushpagiri Medical College Hospital, Tiruvalla, Kerala, India from January 2012 to August 2014. NTS were isolated and identified using standard bacteriological methods.[7] The isolates were confirmed as Salmonella species by agglutination with group specific Salmonella polyvalent O (A-G) antisera (Denka Seiken, Japan). NTS was diagnosed after excluding the serotypes Typhi and Paratyphi A by testing with O9 and O2 *Salmonella* antisera. Isolates which agglutinated with O4 antisera along with other isolates agglutinating only with polyvalent O Salmonella antisera were subjected to serotyping at Central Research Institute, Kasauli. Antibiotic sensitivity was determined by using Kirby-Bauer disc diffusion in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines of that year.[8] Modified zone diameters as per CLSI guidelines were used to interpret resistance to Ciprofloxacin. The following antibiotics were tested Ampicillin (10 μg), Ceftriaxone (30 μg), Chloramphenicol (30 μg), Tetracycline (30 μg), Co-trimoxazole (23.75/1.25 μg), Nalidixic acid (30 μg), Ciprofloxacin (5 μg), and Azithromycin (15 μg). Geographic distribution, demographic variables, co-morbid conditions and antibiotic sensitivity patterns were analyzed.

RESULTS

A total of 15 cases were identified during the study period of which three cases were associated with bacteraemia [Table 1]. There were 26 isolates of *Salmonella* Typhi and 37 *Salmonella* Paratyphi A during this period.

DISCUSSION

The true burden of NTS causing disease in India is unclear. In high-income countries, NTS predominantly causes a self-limiting diarrhoeal illness in healthy individuals; bloodstream or focal infection is rare and mainly happens in individuals with specific risk factors.[3]

During our study period, a total of 15 NTS isolates were identified of which three cases were associated with bactaeraemia. Of this one patient was 18 months old and the other two above 60 years of age. *Salmonella* Enteritidis was the agent causing invasive disease in two of these patients while *Salmonella* Typhimurium was isolated in one 62-year-old patient who expired due to the disease.

The overall trend was a higher incidence in females (66%) with male to female ratio 1:2 [Table 2]. Though all age groups were affected, 60% of the population was above 60 years of age suggesting waning immunity as a likely reason for the manifestation of NTS necessitating hospitalization. Observation of an increased risk for NTS bacteraemia with advancing age is also likely due to a higher prevalence of co-morbid illnesses in the older age group that predisposes to the risk of bacteraemia.[9,10] Diabetes mellitus was the single most important co-morbid condition associated with disease in our study (7/15-40%).

Table 1: Isolation of various NTS from blood and faeces

NTS isolates	Total cases (*n* = 15) (%)	Blood isolates	Stool isolates
Salmonella Typhimurium	9 (60)	1	9
Salmonella Enteritidis	4 (27)	2	2
Salmonella Weltevreden	2 (13)	Nil	2

NTS: Non-Typhoidal Salmonella

Table 2: Demographic and epidemiological characteristics of patients with NTS

Demographic and epidemiological features	Total cases (*n* = 15) (%)
Age (years)	
<20	02 (13.3)
21-40	02 (13.3)
41-60	02 (13.3)
>60	09 (60)
Sex	
Males	05 (33.3)
Females	10 (66.6)
Month	
January-April	04 (27)
May-August	08 (53)
September-December	03 (20)
Districts	
Alleppey	*Salmonella* Enteritidis (04/04)
	Salmonella Typhimurium (02/09)
Pathanamthitta	*S.* Typhimurium (06/09)
	S. Weltevreden (01/02)
Kottayam	*S.* Typhimurium (01/09)
	S. Weltevreden (01/02)
Diabetes mellitus	07 (47)
Renal dysfunction	01 (7)
Liver dysfunction	Nil
Steroid therapy	02 (13)
Psychiatric manifestation	01 (7)
Outcome	
Cured	14/15
Expired	1/15 (*Salmonella* Typhimurium bacteraemia)

NTS: Non-Typhoidal *Salmonella*

This finding was consistent with the study conducted by Leibovici *et al.* in 1993.[11]

Isolation increased during May to August (8/15-53%), which are traditionally considered as the rainy season in Kerala suggesting increased chances of contamination of food and water. This association of NTS infection with rainfall was reported by Haddock and Malilay in 1983.[12] *S.* Enteritidis was solely located in the Alleppey district (4/4) while *S.* Typhimurium (6/9) was concentrated more in the Pathanamthitta district with a few isolates from Alleppey and Kottayam districts. The most common serotypes of NTS (2011) in the USA were *S.* Typhimurium (22%), followed by *S.* Enteritidis (18%) and South Newport (10%).[13] Indian studies have also reported *S.* Typhimurium and *S.* Enteritidis as 57-67% of the total Salmonella isolates.[14] *Salmonella* Weltevreden is gaining importance as a significant pathogen causing non-typhoidal salmonellosis globally. Though this serovar was found to be responsible for <4% of the total human salmonellosis in India before 1970, it constituted 29.1% of Salmonella infections in 1972.[15] Two cases (13%) of *S.* Weltevreden 3,{10}{15}: r:z_6 were obtained in our study. Recent reports of this

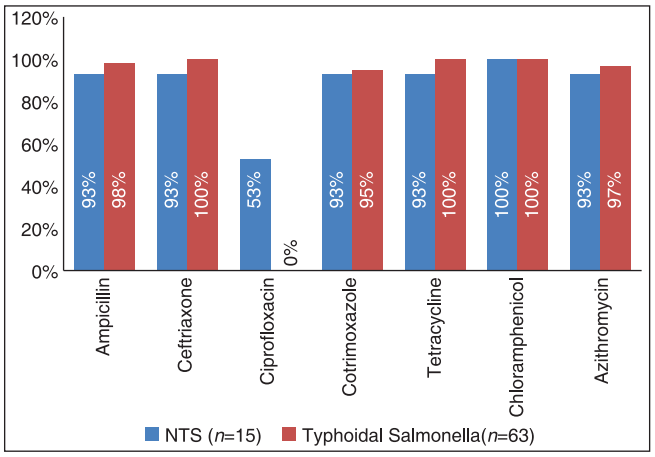

Figure 1: Comparison of sensitivity of typhoidal and non-typhoidal *Salmonella*

organism causing disease have been documented from the state of Karnataka.[16]

Antibiotic sensitivity [Figure 1] was comparable for all antibiotics except Ciprofloxacin in NTS which was higher than typhoidal Salmonella isolated from our hospital during the same period. Of the 15 isolates obtained, one isolate of *S.* Typhimurium from Pathanamthitta district was a multi-drug resistant NTS and a extended spectrum beta-lactamase producer (CTX-M like extended-spectrum beta-lactamase). This isolate caused gastroenteritis in a 63-year-old who underwent hospitalization with oral rehydration therapy and successful treatment with Azithromycin. Isolation of multi-drug resistant Salmonellae poses a threat of spread in the environment and a possibility of encountering more such cases in the future in clinical practice with limited treatment options.

CONCLUSION

A comprehensive epidemiological study of invasive and diarrheal Non-Typhoidal Salmonella, with an assessment of the possible methods of transmission is urgently needed. Reporting of cases to the district health authorities must be made mandatory by all hospitals so that the burden of the disease and spread of serovars are identified. The potential value of investigation of the reservoirs and risk factors for exposure and transmission will provide informed approaches to the epidemiologists for preventive measures such as vaccines, improved hygiene, sanitation, improved nutrition and control measures during outbreaks.

REFERENCES

1. Hohmann EL. Nontyphoidal salmonellosis. Clin Infect Dis 2001;32:263-9.

2. Kiratisin P. Bacteraemia due to non-typhoidal *Salmonella* in Thailand: Clinical and microbiological analysis. Trans R Soc Trop Med Hyg 2008;102:384-8.
3. Gordon MA, Graham SM, Walsh AL, Wilson L, Phiri A, Molyneux E, *et al.* Epidemics of invasive *Salmonella enterica* serovar *enteritidis* and *S. enterica* serovar *typhimurium* infection associated with multidrug resistance among adults and children in Malawi. Clin Infect Dis 2008;46:963-9.
4. Feasey NA, Dougan G, Kingsley RA, Heyderman RS, Gordon MA. Invasive non-typhoidal *Salmonella* disease: An emerging and neglected tropical disease in Africa. Lancet 2012;379:2489-99.
5. World Health Organisation. Emerging Food Borne Diseases. Fact Sheet No. 124; 2002.
6. Majowicz SE, Edge VL, Fazil A, McNab WB, Doré KA, Sockett PN, *et al.* Estimating the under-reporting rate for infectious gastrointestinal illness in Ontario. Can J Public Health 2005;96:178-81.
7. Old DC. *Salmonella*. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie and McCartney Practical Medial Microbiology. 14th ed., Ch. 22. New York: Churchill Livingstone; 1996. p. 405-12.
8. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; 20th informational supplement. Vol. 32. Wayne, PA: Clinical and Laboratory Standards Institute (CLSI). M100-S22; 2014.
9. Rodríguez M, de Diego I, Martínez N, Rosario Rodicio M, Carmen Mendoza M. Nontyphoidal *Salmonella* causing focal infections in patients admitted at a Spanish general hospital during an 11-year period (1991-2001). Int J Med Microbiol 2006;296:211-22.
10. Shimoni Z, Pitlik S, Leibovici L, Samra Z, Konigsberger H, Drucker M, *et al.* Nontyphoid *Salmonella* bacteremia: Age-related differences in clinical presentation, bacteriology, and outcome. Clin Infect Dis 1999;28:822-7.
11. Leibovici L, Pitlik SD, Konisberger H, Drucker M. Bloodstream infections in patients older than eighty years. Age Ageing 1993;22:431-42.
12. Haddock RL, Malilay J. The possible role of rainfall in spreading *Salmonella* on Guam. J Diarrhoeal Dis Res 1986;4:229-32.
13. Vijaya D, Janakiram K, Mohan JV, Sharma A. *Salmonella enteritidis* causing gastroenteritis — A case report. J Clin Diagn Res 2012;6:727-8.
14. Basu S, Sood LR. *Salmonella weltevreden*: A sero-type of increasing public health importance in India. Trop Geogr Med 1975;27:387-94.
15. Kumar Y, Sharma A, Sehgal R, Kumar S. Distribution trends of *Salmonella* serovars in India (2001-2005). Trans R Soc Trop Med Hyg 2009;103:390-4.
16. Antony B, Dias M, Shetty AK, Rekha B. Food poisoning due to *Salmonella enterica* serotype *weltevreden* in Mangalore. Indian J Med Microbiol 2009;27:257-8.

How to cite this article: Oommen S, Nair S, Nair K, Pillai S. Epidemiology of Non-Typhoidal Salmonella among patients attending a Tertiary Care Centre in central Kerala. J Acad Clin Microbiol 2015;17:12-5.

Source of Support: Central research Institute, Kasauli. **Conflict of Interest:** None declared.