

Serogroups and antimicrobial susceptibility of non-typhoidal salmonellas in children

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ABSTRACT

Objectives: To update knowledge regarding the pattern of Serogroups and antimicrobial susceptibility of Salmonellas causing gastroenteritis in children at the King Khalid University Hospital in Riyadh, Saudi Arabia during the period of 1st April 1996 to 30th September 1999.

Methods: The case records of 416 children, from whom Salmonella species were isolated from stool cultures between April 1996 and September 1999 were reviewed. The isolates and susceptibility of these Salmonella were carried out accordingly to standard microbiological methods.

Results: During a period of 3 and 1/2 years a total of 412 non-typhoidal Salmonellas were isolated from stool cultures of 416 children who presented to King Khalid University Hospital complaining of gastroenteritis. The majority of these children (70%) belonged to the age

group 0-4 years. Eighty seven percent of the Salmonella isolates were Serogroup D1, B and C1. The Serogroups and antimicrobial susceptibility of these Salmonellas differed from those previously reported from this country and other parts of the world.

Conclusions: Salmonella gastroenteritis is an important clinical condition in infants and children in the Kingdom of Saudi Arabia. Salmonella Serogroups D1, B and C predominate as causative agents of this condition. Most of the salmonella serogroups isolated in this study were highly susceptible to commonly used antimicrobial agents but ampicillin showed a rising resistance pattern. This may make it unsuitable therapy for Salmonella gastroenteritis.

Keywords: Non-typhoidal salmonellas, susceptibility, antimicrobial agents.

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Salmonellas are important pathogens in infants and children.¹ Gastrointestinal infections caused by non-typhoidal salmonellas continue to be a problem of great magnitude in different parts of the world.^{1,2} Salmonella gastroenteritis is generally, a self-limiting disease¹ but a high risk of bacteremia and extra intestinal infections in infants and children has prompted recommendation for antimicrobial treatment in these age groups.² The increase of antimicrobial resistance in Salmonella species has been reported by several authors.^{3,4} The emergence of Salmonella species resistant to chloramphenicol, ampicillin and trimethoprim sulfamethoxazole has made the treatment of salmonellosis difficult.^{5,6} The

incidence of antimicrobial resistance among Salmonella species in different regions of the Kingdom has been documented in previous reports which showed changing patterns of resistance among these species.⁷⁻⁸

Methods. King Khalid University Hospital is a tertiary health care center with an 850-bed capacity, situated in the central region of Saudi Arabia. The case records of 416 children, from whom Salmonella species were isolated from stool between April 1996 and September 1999 were reviewed. Salmonella gastroenteritis in a child was defined as diarrhea,

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vomiting, or both, and positive salmonella culture - other than *Salmonella, paratyphi A, B and C* - from stool. For isolation of *Salmonella* species, the specimens were cultured directly onto xylose lysine deoxycholate (XLD) agar (Difco Laboratories, Deboit, USA) and Selenite F broth (Oxoid, Basingstroke, UK). After overnight incubation, the latter was subcultured onto deoxycholate citrate agar (DCA) (Difco, Laboratories). Non-lactose fermenting, urease and oxidase negative colonies resembling *Salmonella* species were further identified by means of API 20 (Analytical Profile Index, Biomerieux, France). Organisms giving a *Salmonella* profile were serogrouped using specific antisera (Wellcome Diagnostics, Dartford, UK). Antimicrobial susceptibility testing was performed by Stoke's disc comparative diffusion method using *E.coli* (NCTC 10418) as a control organism. In this study the antimicrobial agents used had the same potencies recommended in a previous study.⁹ The minimum inhibitory concentration (MIC) was performed by the E test method (E test, AB, Biodisk Solona Sweden). The breakpoint MIC was defined according to the recommendations of the National Committee for Clinical Laboratory Standards (NCCLS).¹⁰

Results. The majority of our patients (70%) were from the age group 0-4 years; (26%) belong to the age group 0-2 years. The age distribution of our patients is shown in Table 1. Table 2 shows the incidence of salmonella serogroups isolated with 87% of the isolates belonging to Serogroups D1, B and C1. Table 3 shows the resistance pattern of the salmonella serogroups, with all Serogroups showing high susceptibility to chloramphenicol except serogroup C1 and E2. Serogroup E2 isolates were susceptible to all antimicrobial agents tested except chloramphenicol and ampicillin.

Discussion. *Salmonella* infections are common in Saudi Arabia.^{7,8} An increasing incidence of non-typhoidal salmonellosis has been noted throughout the world¹¹ and the same trend can be expected in Saudi Arabia. Another important problem is the increase of antimicrobial resistance in *Salmonella*, as recently reported by several authors.¹²⁻¹⁴ There are only a few published studies of salmonella infections in Saudi Arabia, most focusing on Pediatric patients.⁷⁻⁹ One such study was an attempt to evaluate the susceptibility pattern in different Serogroups of salmonellas.⁹ The majority of our patients (70%) were from the age group 0-4 years; 26% belong to the age group 0-2 years. This is in agreement with reports by other authors^{9,15-17} who found that 72-95% of their patients were derived from this age group. Most of our isolates were Serogroup D1, followed by Serogroup B and C1. A small proportion were Serogroups E1 and E2 and

Table 1 - Age distribution of 416 children with gastroenteritis caused by different *Salmonella* serogroups.

| Age Group (Years) | Salmonella serogroups | | | | | | Total |
|-------------------|-----------------------|----|----|----|----|------|-------|
| | B | C1 | D1 | E1 | E2 | Spp. | |
| 0-2 | 41 | 28 | 21 | 6 | 5 | 9 | 110 |
| 3-4 | 53 | 48 | 59 | 6 | 0 | 13 | 179 |
| 5-6 | 11 | 8 | 20 | 1 | 0 | 6 | 46 |
| 7-8 | 9 | 8 | 11 | 0 | 0 | 4 | 32 |
| 9-10 | 8 | 2 | 9 | 0 | 0 | 2 | 21 |
| 11-12 | 3 | 2 | 8 | 0 | 1 | 1 | 11 |
| 13-14 | 1 | 3 | 8 | 0 | 0 | 1 | 13 |

Table 2 - Incidence of salmonella serogroups isolated from children with gastroenteritis (Total 412).

| Salmonella serogroup | Number identified | Percentage |
|----------------------|-------------------|------------|
| Serogroup D1 | 136 | 33 |
| Serogroup B | 126 | 30 |
| Serogroup C1 | 99 | 24 |
| Salmonella spp. | 32 | 8 |
| Serogroup E1 | 13 | 3 |
| Serogroup E2 | 6 | 2 |
| Total | 412 | 100 |

Table 3 - Resistance pattern of the 412 *Salmonella* Serogroups to different antimicrobial agents.

| Agent | Salmonella serogroups (% resistance) | | | | | |
|---|--------------------------------------|-------|-------|------|-------|------|
| | B | C1 | D1 | Spp. | E1 | E2 |
| Ampicillin | 63% | 61% | 20.5% | 51% | 45.5% | 100% |
| Cotrimoxazole | 4% | 2% | 1% | 0% | 0% | 0% |
| Chloramphenicol | 1% | 49.5% | 13.5% | 6% | 0% | 16% |
| Gentamicin | 21% | 33% | 1% | 0% | 9% | 0% |
| FOX | 0% | 101% | 5% | 3% | 0% | 0% |
| CPL | 0% | 20% | 12% | 9% | 0% | 0% |
| Nalidixic Acid | 32% | 33% | 3% | 3% | 0% | 0% |
| CRO | 23% | 29% | 0% | 9% | 0% | 0% |
| CIP | 0% | 1% | 0% | 19% | 0% | 0% |
| Trimethoprim | 29% | 45% | 51% | 0% | 18% | 0% |
| FOX - Cefoxatin; CPL - Cephalexin; CRO - Ceftriaxone; CIP - Ciprofloxacin | | | | | | |

other non-serogroupable *Salmonellas*. This distribution is different from those shown in previous reports from this country^{9,18} but similar to that from Malaysia.¹⁹ A study from Taiwan showed a different pattern of distribution, in which the majority of isolates were Serogroup B.¹³ Unlike our study, a survey of 33 salmonella isolates from Jeddah showed results that differ from ours.⁸ This difference in distribution of salmonella serogroups in these 2 cities from the same geographical area may be due to the cosmopolitan nature of the population of Jeddah, as suggested in a previous study.²⁰ Chowdhury et al²¹ reported high resistance to the following antimicrobial agents chloramphenicol (75%), cotrimoxazole (60%), gentamicin (24%) for non-typhoid salmonellas isolated from children with diarrhea admitted to a Pediatric hospital in Riyadh. These isolates were probably selected-out due to unrestricted sales and injudicious use of antimicrobial agents in the 1970's in this part of the world. Gosling and Kassimi,⁸ showed that resistance to cotrimoxazole and chloramphenicol ranged between 9% and 22%. Lee et al¹⁹ from Malaysia reported a similar resistance pattern to cotrimoxazole and chloramphenicol ranging between (9-10%). In contrast, 95% of our salmonella isolates were sensitive to cotrimoxazole and 85% were susceptible to chloramphenicol except Serogroup C1, which showed 50% susceptibility to chloramphenicol. This low resistance to cotrimoxazole and chloramphenicol of most of our *Salmonella* serogroups may be explained by the fact that all medical staff in our hospital and related hospitals, including Pediatricians, are now aware of the need to restrict antimicrobial agents use. Such restriction is mainly advised in patients with salmonella gastroenteritis. This study shows a high resistance of salmonella organisms to ampicillin. Fifty percent of all Serogroups were resistant to ampicillin, except Serogroup D1, which showed 20% resistance. In contrast, a previous study by Kambal et al⁹ showed higher resistance to this agent, (70%). Another study from Jeddah, in the Western region of Saudi Arabia showed resistance to ampicillin to be 23%.⁸ These studies revealed that resistance to this agent was increasing faster in Saudi Arabia. This may be explained by the widespread use of this agent for treatment of other infections such as respiratory tract infections. The high resistance of our isolates to ampicillin makes this agent unsuitable for empirical therapy of salmonellosis in this country. This has been confirmed by many authors from South East Asia.⁵⁻⁶ Yang et al reported that 43% of group B *Salmonella* were resistant to ampicillin.²² The fluoroquinolones, including Ciprofloxacin (CIP) and Norfloxacin (NOR), have shown high activity against most of the Serogroups of salmonella.⁶ This makes them suitable therapy for *Salmonella* gastroenteritis.

There has been concern regarding the safety of fluoroquinolones in children, due to reported toxicity, involving developing cartilages in young animals. However, these agents should be used with caution in children until their toxicity has been explicitly excluded. As far as we know, there are no previous studies on activity of (Cefoxatin) FOX, (Ceftriaxone) CRO or NOR on salmonella isolates from this part of the world. Our study shows FOX and CRO to be highly active against salmonella species.

Salmonella gastroenteritis is an important clinical condition in infants and children in the Kingdom of Saudi Arabia. *Salmonella* Serogroups D1, B and C predominate as causative agents of this condition. There can be invasive complications following salmonella gastroenteritis. The majority of the salmonella serogroups isolated in this study were highly susceptible to commonly used antimicrobial agents but ampicillin shows a rising resistance pattern. This may make it unsuitable therapy for *Salmonella* gastroenteritis.

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