MULTIPLE RESISTANT SALMONELLA IN ACCRA, GHANA

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SUMMARY

A total of 115 Salmonella strains isolated during 1998-1999 in Accra, Ghana were examined for drug/multiple drug resistance, using first-line anti-typhoid antibiotics, namely, ampicillin (Am), chloramphenicol (Cm), Tetracycline (Te) and Trimethoprim/sulphamethoxazole (Ts). These organisms were isolated from urine, stool, food, cerebrospinal fluid, blood and other sources. The number of organisms isolated from blood alone was 82(71.3%). Eight serological groups were identified and the most common isolates were groups D (57.4%) and B (33%), with the least found in groups A, G and I.

Forty-four (38.3%) isolates were found to be sensitive to all four antibiotics whilst 71 (61.7%) were resistant to one or more of the antibiotics used. Thirteen (11.3%) of the resistant strains were resistant to only one of the antibiotics, 6 (5.2%) were resistant to two of the antibiotics, 22 (19.1%) were resistant to three of the antibiotics, and 30 (26.1%) were resistant to all four of the antibiotics used. All the organisms were however, sensitive to Ciprofloxacin, and Ceftriaxone and Gentamicin.

These findings indicated that multiple resistant Salmonella are prevalent in Ghana and national surveillance to determine the level of resistance is needed for the nation.

Keywords: Antibiotic susceptibility, multiple resistance, Salmonella

INTRODUCTION

The number of officially recorded cases of human salmonellosis has significantly increased over the past two decades in many countries all over the world[1,2,3]. In Ghana, salmonellosis, especially typhoid fever is of public health concern in urban slums and rural communities where its prevalence is highest in children and young people[4]. This is because older people often seem to possess partial immunity, probably following exposure to frequent sub-clinical infective doses of typhoid bacillus[5]. A review conducted in rural areas of three African countries namely Ghana, Zambia and Kenya in 1994, revealed that incidence of typhoid was much higher in Ghana compared to the rest[3]. This was linked to poor water supply, inadequate sewage disposal and unhygienic conditions.

Treatment of typhoid fever is usually by antibiotics and the drug of choice has been chloramphenicol, a broad-spectrum antibiotic. This drug is inexpensive and has remarkably been effective in the treatment of typhoid fever in the past. However, it has recently been reported to increasingly becoming ineffective in treating typhoid cases[6]. This is very disturbing because it has been reported that about 12-16% of patients die within four weeks of the disease if not well managed[7]. This has led to the recommendation of the use of multi-drug therapy and/or third generation drugs. Multi-drug resistance is, however, now common among these pathogenic microorganisms, which show both *in vivo* as well as *in vitro* resistance to the four first-line antityphoid antibiotics namely, ampicillin, chloramphenicol, tetracycline and trimethoprim-sulphamethoxazole[8, 9, 10,11,11,12].

Quinolone derivatives such as Ciprofloxacin or Pefloxacin and third generation cephalosporins such as Ceftriaxone or Cefotaxin are very effective for treating diseases caused by multi-drug resistant *S. typhi* strains, particularly Ciprofloxacin given by oral route in a 7-day course of therapy[13]. However, these drugs are expensive and out of reach of the poor in the endemic areas, hence, chloramphenicol is still prescribed in many health facilities in Ghana and this has led to the general notion that typhoid is difficult to treat.

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The present study was carried out to evaluate the prevalence of multiple resistant Salmonella in Accra, Ghana during the period August 1998 to July 1999.

MATERIALS AND METHODS

The above study was carried out at the Bacteriology Unit, Noguchi Memorial Institute of Medical Research (NMIMR), University of Ghana, Legon. The isolates of Salmonella from stool, blood, urine, cerebrospinal fluid, food and chicken, were from the Microbiology Department, Korle Bu Teaching Hospital, and the Bacteriology Unit, NMIMR, Legon. The specimens were plated on the appropriate media (MacConkey agar, chocolate agar, blood agar or Dexycholate agar) from Oxoid, (Maryland, USA), depending on the source of the sample and colonies with the characteristics of Salmonella isolated using standard microbiologic methods[14]. Identification of Salmonella from the various sources was done using the following biochemical tests; Triple Sugar Iron (TSI) agar test, Sulphur Indole Motility (SIM) agar test, and Urea agar test, all from Oxoid (Maryland, USA) and the presence of Samonella was confirmed and grouped using Salmonella antesera kit from Denka Seiken Co., Ltd., Japan.

In vitro antibiotic susceptibility against ampicillin (10μg), chloramphenicol (30μg), tetracycline (30μg), and trimethoprim/sulphamethoxazole (1.25/23.75μg) from Britania (Buenos Aires, Argentina) was tested according to the guidelines set by the National Committee for Clinical Laboratory Standards (NCCL)[15].

RESULTS

In all, one hundred and fifteen (115) Salmonella strains were isolated. Table 1 shows the sources and number of Salmonella strains isolated.

Table 1 Number of Salmonella strains isolated

Source of salmonella	Number of salmonella (%)
Blood	82 (71.3)
Food	14 (12.2)
Stool	6 (5.2)
Urine	4 (3.5)
Cerebrospinal fluid	3 (2.6)
Others	6 (5.2)
Total	**115 (100)**

The study serologically identified eight groups of Salmonella, Group D (57.4%). Group B (33%), Group C_1 (3.5%), Group C_2 (1.72%), Group E_1 (1.7%) and Groups A, G and I (0.9%) each.

The antibiotic susceptibility tests showed that, 44(38.3%) were susceptible to all four antibiotics and the remaining 71 (61.7%) of the 115 Salmonella strains were resistant to one or more of the first-line anti-typhoid antibiotics (Table 2).

Table 2 Susceptibility patterns of Salmonella isolated (n=71).

Resistance pattern	Total number of resistant strains (%)
AmCmTeTs	30 (42.3)
AmCmTe	1 (1.4)
AmTeTs	17 (23.9)
CmTeTs	4 (5.6)
AmTs	1 (1.4)
CmTe	1 (1.4)
TeTs	4 (5.6)
Am	4 (5.6)
Te	9 (12.7)
Total	**71 (100)**

Am=Ampicillin Cm=Chloramphenicol
Te= Tetracycline Ts = Trimethoprim/Sulphamethoxazole

Of these resistant isolates, 6(5.2%) were resistant to two antibiotics, 22 (19.1%) were resistant to three antibiotics whilst 30 (26.1%) were resistant to all four antibiotics. Interestingly, 4 (3.5%) were resistant to ampicillin alone, 9 (7.8%) were resistant to tetracycline alone but none was resistant to chloramphenicol or trimethoprim/sulphamethoxazole alone.

DISCUSSION

There is an increase in the prevalence of salmonellosis in most rural tropical areas and urban slums probably due to HIV, malnutrition, sickle cell anaemia, G6PD-deficiency[3,16], nematodiasis and schistosomiasis[16]. Most of these clinical conditions impair mononuclear cells, hence susceptibility to Salmonella bacteraemia. The high incidence of such infectious diseases has resulted in the acquired bacterial resistance in isolates of even healthy persons and from patients with community-acquired infections[17].

The present study confirms the presence of multi-drug resistant strains (MRS) of Salmonella in Ghana[12,26]. In the study, 60% of the 115 Salmonella species isolated, during a 12 month period, were resistant to one or more of the four first-line anti-typhoid antibiotics, with 70% of these being multi-drug resistant strains. Thus, the multi-drug resistant strains form 45.2% of the total number of organisms investigated. This is similar to the percentage reported from the Indian sub-continent[9], known for its extremely high levels of multi-drug resistant *Salmonella*. These findings have grave implications for antibiotic therapy in Ghana as the resistance is to the inexpensive first-line antibiotics.

No single strain of Salmonella was found to be resistant to chloramphenicol or trimethoprim/sulphamethoxazole alone with the rest being susceptible, and this corroborates investigations by other workers, who indicated no single strain of Salmonella being resistant to chloramphenicol alone[9]. The organisms that were found to be resistant to chloramphenicol and/or trimethoprim-sulphamethoxazole were always resistant to ampicillin and/or tetracycline but never vice versa. All the resistant Salmonella strains in this study were resistant to ampicillin and/or tetracycline, and therefore treatment with chloramphenicol and/or trimethoprim-sulphamethoxazole cannot be relied on to eliminate these pathogens. Fortunately, all the isolates were susceptible to ciprofloxacin, ceftriaxone and gentamicin.

The appearance of such antibiotic-resistant strains of Salmonella is closely linked to antibiotics use for the treatment of human infection and in poultry farming, which provides selective pressure favouring resistant strains[18,19]. It is therefore not surprising that, the drugs most commonly affected by bacterial resistance in Ghana and many other developing countries are generally the inexpensive and popular broad-spectrum antibiotics such as the four used in this study.

The spread of these resistant organisms may be traced to socio-economic and behavioural antecedents contributing to the escalating resistance to antibiotics worldwide. This may result from the misuse of antibiotics by either the physicians in clinical practice, the unskilled practitioners, or by the public, sub-optimal use and poor quality of antibiotics, all of which may bring about resistance[20]. The resistance may however appear rapidly or slowly, depending on the organism concerned, the volume and type of antibiotics used, and the method of application[18]. Unfortunately, precise data on antibiotic use in Ghana and many other countries are not available but consumption appears to be rising on a worldwide scale. This is not surprising since in Ghana antibiotics are easily obtained as over-the-counter drug, in spite of laws and regulations to the contrary which specify their sale only on prescription.

The use of antimicrobial drugs in animals for growth promotion has also led to selection of resistant strains of pathogens, which may be transmitted to humans through food[1,2,21,22]. A typical example involves the emergence and spread of drug-resistant salmonellae from antibiotics used in animals during the 1960s[23], with the subsequent transmission of these salmonellae to man resulting in many human infections. A study conducted in Accra revealed that, imported and locally produced chicken are a potential source of multiple-antibiotic-resistant enteropathogenic bacteria[24]. Richmond[25] reported in 1972 that, sewage and surface waters contribute to the distribution and circulation of resistant organisms. These sources represent a natural medium in which R-plasmid transfer can occur under certain physical, chemical or biological condition and transferred to food and drinking water, leading to recycling to man and animals. It is therefore not surprising that, as much as 11(79%) of the Salmonella isolated from food for this study, were resistant to one or more of the antibiotics used.

The results of this study would suggest that, control measures be tackled through multisectoral methods and not only be dependent on the health sector. Thus, the unnecessarily frequent use of antibiotics must be curbed whilst prompt diagnosis and antibiotic therapy for patients and proper management of asymptomatic carriers be practiced. The provision of potable drinking water and 21st century sewage disposal practices as well as health education must be intensified to help control the disease.

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