In Vitro Antibiotic Susceptibility of Salmonellae

FACELUCIA BARROS, OKSANA M. KORZENIOWSKI, MERLE A. SANDE, KATIA MARTINS, LUIZ CARLOS SANTOS, AND HEONIR ROCHA

Department of Medicine, University of Virginia School of Medicine, Charlottesville, Virginia 22901.*
Department of Medicine, Federal University of Bahia, Salvador, Bahia, Brazil, and Couto Maia Hospital, Salvador, Bahia, Brazil.

Received for publication 27 January 1977

In vitro antibiotic susceptibilities were determined for 101 strains of salmonellae. Resistance to chloramphenicol and ampicillin was low. Cefamandole was active against the majority of strains and deserves further evaluation.

The recent identification of chloramphenicol and multiple drug-resistant salmonella epidemics has generated increased interest in the overall drug sensitivities of these organisms in various localities as well as a search for alternate drug therapy when such resistant strains are identified (4, 5). Cefamandole, a new parenteral cephalosporin prepared by substitution of heterocyclic groups on 7-aminocephalosporanic acid, has been shown to have a marked effect on a small number of strains of Salmonella typhi in vitro. To evaluate the potential usefulness of this antibiotic, 101 strains of salmonella, isolated in Salvador, Brazil, were tested in vitro to a variety of antibiotics currently in use or under investigation.

Strains studied. The 101 strains of salmonella used in our evaluations were isolated from patients at the Hospital Professor Edgard Santos and the Hospital Couto Maia from 1972 to 1975. Both hospitals are referral centers for patients with suspected or proven typhoid fever and other infectious diseases. The salmonella strains were collected randomly in an area where typhoid fever is endemic, and no epidemic outbreak was documented during the period of collection. Serotyping was performed on isolation and reconfirmed prior to antibiotic susceptibility testing. Of 59 strains of group D S. typhi, 53 were recovered from blood, 4 from stools, and 2 from cerebrospinal fluid. Of the remaining 42 "non-typhi" salmonella strains, 22 were recovered from blood, and 20 were isolated from stool, cerebrospinal fluid, urine, or synovial fluid.

Antimicrobial testing. The minimum inhibitory concentration for each drug was determined by serial twofold dilutions in Trypticase soy broth with freshly prepared solutions of chloramphenicol, ampicillin, carbenicillin, tetracycline, tobramycin, gentamicin, cefamandole (Eli Lilly and Co., Indianapolis, Ind.), and BLP-1761 (an ester of hetacillin, Bristol Laboratories, Syracuse, N.Y.). An inoculum of 10⁴ organisms was added to each tube. After 24 h of incubation, samples were taken from all tubes with no visible growth and were plated on Trypticase soy agar to determine minimum bactericidal concentrations. Strains of S. typhi (Fig. 1) were, in general, more susceptible to the antimicrobial agents tested than the "non-typhi" strains (Fig. 2). Cefamandole was the most active drug by weight, with 100% of S. typhi strains inhibited by 1.56 µg/ml or less (Fig. 1a). This is in contrast to other cephalosporins previously tested (1, 2). Ninety-seven percent of S. typhi strains was inhibited by BLP-1761 at a concentration of 3.1 µg/ml as opposed to 90% for ampicillin. Carbenicillin was the least active of the penicillin derivatives.

Chloramphenicol inhibited 97% of S. typhi strains with concentrations of less than 12.5 µg/ml (Fig. 1b). Ninety-three percent of the strains was inhibited by 12.5 µg of tetracycline per ml. Gentamicin and tobramycin had similar activity with 93% of strains inhibited by a concentration of less than 12.5 µg/ml.

In contrast to S. typhi, the "non-typhi" salmonella strains exhibited in vitro resistance of 30 to 40% to most antibiotics tested. Cefamandole and BLP-1761 again appeared to be quite active, each inhibiting 70% of strains with concentrations of 1.6 µg/ml (Fig. 2a).

In this evaluation of 101 strains of salmonella, only a minor emergence of resistant strains to the antibiotics currently utilized in the community was noted. High-level resistance to chloramphenicol and ampicillin remains in the 2 to 3% range, comparable to the data of Finland et al. (2), but much less than the 16 to 33% range reported in other areas not involved in an epidemic of chloramphenicol-resistant strains.
Fig. 1. (a) and (b) show antibiotic susceptibilities of 59 strains of S. typhi.

Fig. 2. (a) and (b) show antibiotic susceptibilities of 42 strains of "non-typhi" salmonellae.
Of note is the emergence of aminoglycoside resistance (7%), which has not been seen by other investigators (1–3). This decreased susceptibility to aminoglycosides is also found in the group of "non-typhi" strains, which showed up to 30% resistance to the maximum achievable serum levels.

LITERATURE CITED