Staphylococcic Infections in Children

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• Over 50 per cent of all staphylococcic infections are hospital-acquired. In 92 per cent of hospital-acquired infection, the organism is resistant to penicillin, and in 74 per cent to tetracycline.

Chloramphenicol, bacitracin, novobiocin and erythromycin are the drugs of choice for therapy. There was good correlation between clinical response and antibiotic therapy selected on the basis of results of organism sensitivity tests done by the agar diffusion technique.

Cross-resistance among the tetracyclines averaged 94 per cent. Erythromycin and magnamycin showed similar pattern.

Mortality in infants less than two months old was 7.8 per cent as compared with 1.1 per cent in older children. Death was related either to pneumonia or to septicemia in the ten fatalities recorded in this series.

THE STARTLING INCREASE in infections due to Staphylococcus pyogenes var. aureus during the last few years is a matter of great concern to all physicians. Epidemics in nurseries for newborn babies[3,4,15,16,18] and operative wound infections[1,14,19] due to this organism are being encountered with alarming frequency and emphasize the need for strict aseptic technique in the care of patients. A single phage type of staphylococcus (52 B/42 E/44 A/81)[2,17] accounts for the majority of these infections. The ability of this organism to adjust to its antibiotic environment is one of the major problems in medicine today. In order to evaluate the gravity of this problem, all cases of staphylococcic infection observed at the Los Angeles Childrens Hospital on which sensitivity tests were made were reviewed.

MATERIAL AND METHOD

This report is based on 55 cases in 1952, 77 in 1954 and 348 in 1956. The age of the children ranged from 2 days to 15 years. Fifty-one per cent were boys and three-fourths were Caucasian.

Sensitivity tests by the agar plate diffusion method were performed only on coagulase-positive strains obtained from clinically ill patients. Ninety-one per cent of the specimens tested were obtained from patients in hospital.

During the years studied there was a sixfold increase in the incidence of staphylococcic infection. Fifty-one per cent could be traced to hospital contact on the wards or to repeated visits to the outpatient department. Chart 1 shows that in these patients, one-third of the infections were in operative wounds. Forty-two per cent of these patients were less than two months of age, a fact which illustrates the hazard of exposure to hospital strains.

The incidence was uniform throughout infancy and childhood. In spite of nursery epidemics due to this organism, only 18.3 per cent of the 480 patients in the cases reviewed were under two months of age. However, infection among the very young was more severe and occasionally accompanied by gangrene and septicemia. Breast abscesses, pyoderma, parotitis and pneumonia were common. Chronic disease such as fibrocystic disease of the pancreas or leukemia predisposed older children to infection with this organism.

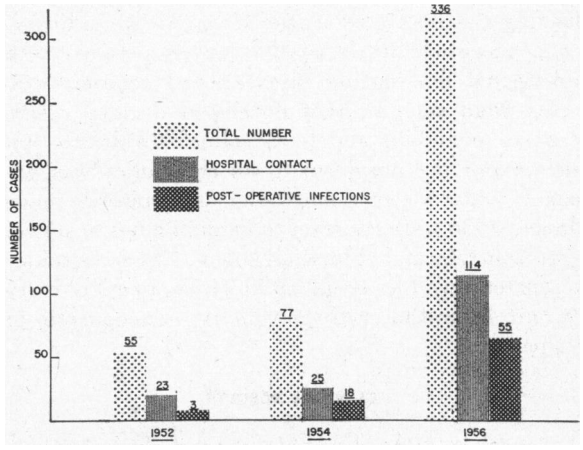

Chart 1.—Fifty-one per cent of the 468 staphylococcic infections originated from contact with hospital strains.

SOURCE OF CULTURE AND RESISTANCE PATTERN

The respiratory tract, the blood and the subcutaneous tissues were the three chief sources of material from which staphylococci grew. Table 1 shows that in comparison with 1952 and 1954 staphylococcic infection appeared somewhat more frequently in postoperative wounds and subcutaneous infections in 1956. Among the hospital-acquired infections,

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TABLE 1.—*Source of Material That Grew Staphylococci on Culture in 480 Cases in 1952, 1954 and 1956, Showing Uniform Increase in Total Number, but Changes in Proportions*

Source	1952 Cases	1952 Per Cent	1954 Cases	1954 Per Cent	1956 Cases	1956 Per Cent
Respiratory tract	25	45.5	28	36.4	156	44.0
Blood	8	14.5	6	7.8	23	6.0
Postoperative wounds	5	9.1	13	16.8	53	15.0
Abscesses	4	7.3	12	15.6	64	20.0
Miscellaneous	13	23.6	18	23.4	52	15.0
Total	55	100	77	100	348	100

92 per cent were resistant to penicillin and 74 per cent to tetracycline (Chart 2). Resistance of the organism to these two drugs was least in the case of patients who had had neither previous contact with hospital strains of staphylococci nor antibiotic therapy before admission. In the latter group the organism was resistant to penicillin in 54 per cent of cases and to tetracycline in 35 per cent. In Chart 3 the comparison of the years 1952, 1954 and 1956 shows a continued high resistance to penicillin. Staphylococcic resistance to chloramphenicol and erythromycin was much less frequent, probably reflecting the restricted usage of these drugs. Resistance was most likely to develop in patients with protracted debilitating disease; and repeated cultures from such sources developed decided resistance to penicillin and tetracycline (Table 2). Resistance of the organism to all antibiotics was unusual; only 5 per cent of the 348 cultures made during 1956 were resistant to penicillin, tetracycline, erythromycin and chloramphenicol. Cross resistance to the tetracyclines occurred in 94.5 per cent of cases (Chart 4) and to erythromycin and magnamycin in 94 per cent.

CLINICAL RESULTS

Sensitivity tests, drug therapy and clinical course were studied in all 480 cases. These were divided into three groups. The first was composed of 326 patients treated with an antibiotic to which the infecting organism was very sensitive; and in this group 86 per cent improved rapidly and were cured. The second group was made up of 80 children who were treated with an antibiotic to which the organism was resistant; 41.5 per cent improved, and in these patients fever persisted longer and recovery was slower. The third group consisted of 74 patients not treated with any antibiotic. In this group the infections were relatively mild, such as postoperative wound infections, pyoderma and subcutaneous abscesses. The recovery rate was 53.5 per cent—a better rate than that for the group with drug-resistant infection treated with antibiotics.

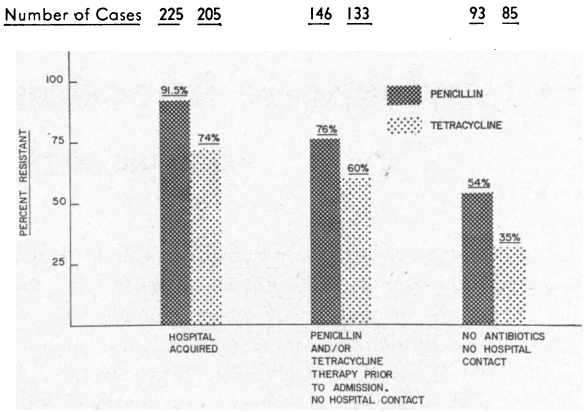

Chart 2.—The resistance to penicillin and tetracycline in three groups of patients: The first group had hospital-acquired infections; the second group is composed of patients treated with antibiotics before admission, and the third group consists of patients with neither hospital exposure nor previous antibiotic therapy.

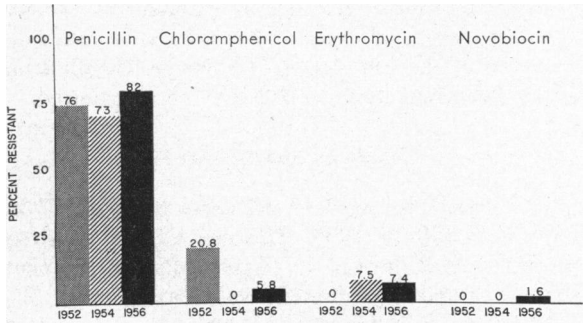

Chart 3.—The changing pattern of resistance of staphylococci to penicillin, chloramphenicol, erythromycin and novobiocin in the years 1952, 1954 and 1956.

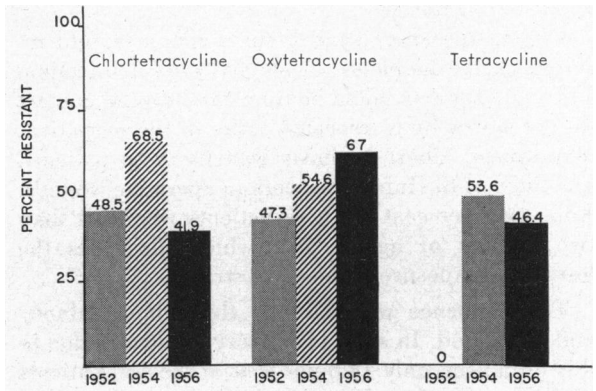

Chart 4.—The changing pattern of staphylococcic resistance to tetracycline with 94.5 per cent cross-resistance.

In contrast to cases of infection with other organisms, clinical relapse was common. Premature cessation of therapy was the most frequent cause; and three to six weeks of therapy was often necessary to cure systemic infections such as pneumonia, osteomyelitis and septicemia. In the severe cases at

TABLE 2.—*Increasing Resistance of Staphylococci to Various Antibiotics with Repetitive Cultures from the Same Source*

Name of Antibiotic	First Culture Total Resist.		Second Culture Total Resist.		Third Culture Total Resist.		Fourth Culture Total Resist.	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Penicillin	179	85	38	95	15	100	3	100
Tetracycline	181	56	40	77.6	15	87	3	100
Erythromycin	183	3.3	36	13.8	12	25	3	67
Chloramphenicol	175	5.1	38	14.5	15	6.7	3	67

least two and sometimes three drugs to which the organism was sensitive were used. Chloramphenicol together with erythromycin or bacitracin were the drugs most frequently used. With this plan of therapy only two of the 23 infants with pneumonia and empyema died in 1956; and in one of these the correct diagnosis was not made and the infant did not receive adequate antibiotic therapy. Death was invariably associated with either septicemia or pneumonia (Table 3). Six of the ten deaths from primary staphylococcic infection happened in infants less than two months of age; and in four of these cases the infection was acquired in the hospital. The mortality rate in this group under two months of age was 7.8 per cent, as compared with a rate of 1.1 per cent in older children.

Infections associated with chronic illness were difficult to treat. Among children with diseases such as leukemia, malignant growth or fibrocystic of the pancreas, 49 died with associated staphylococcic infection. These patients died in spite of the use of antibiotics to which the infecting strains of staphylococci were sensitive.

TABLE 3.—*Pathological Diagnosis in Ten Patients in Whom Staphylococcic Infection Was the Cause of Death*

	No. Cases
Septicemia	2
Subacute bacterial endocarditis	2
Pneumonia, empyema, and pyopneumothorax	2
Pneumonia, empyema, and congenital heart disease	2
Meningitis	1
Pneumonia, empyema, and pericarditis	1

DISCUSSION

The resistance to antibiotics of staphylococci in any community is determined by the local use of antibiotics.[9,10,11,12,21] Penicillin and tetracycline are the two antibiotics most frequently prescribed. Chloramphenicol has not been extensively used since its hematologic toxicity was widely reported in 1952. This, undoubtedly, is the reason for the low resistance rate to chloramphenicol of staphylococci cultured in our community. The low incidence of resistance to erythromycin, novobiocin and bacitracin can also be so ascribed. It is imperative that physicians restrict the use of antibiotics to patients with specific bacterial infection.[6] It is wise not to use antibiotics in the treatment of mild respiratory infections[7] or as prophylactic medication in surgical procedures.[5] Weinstein[20] suggested that prophylactic administration of antibiotics for measles is unwarranted, and Lepper[13] arrived at the same conclusion with respect to patients subjected to tracheotomy. Finland[8] obtained similar results in a study on premature infants. Since many of these infections are acquired through hospital contact, it is vitally important to reduce such contacts to a minimum. Newborn infants are particularly subject to infection and should be discharged from the nursery as soon as possible. Elective surgical procedures in infants should be delayed whenever possible, and strict adherence to aseptic technique with gown, mask and hand-washing are mandatory for every physician working with small infants.

Sensitivity tests are of great value when performed by the disc method in a reliable laboratory. The clinical results reported here clearly demonstrate that patients receiving antibiotics to which their infecting organism was sensitive improved more rapidly than children treated with drugs to which the organism was resistant. In fact the data presented suggested that therapy with a resistant drug delays clinical improvement.

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