JOURNAL OF OCULAR PHARMACOLOGY
AND THERAPEUTICS
Volume 16, Number 1, 2000
Mary Ann Liebert, Inc.

Antibiotic Treatment of Orbital Cellulitis: An Analysis of Pathogenic Bacteria and Bacterial Susceptibility

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ABSTRACT

The proper choice of effective antibiotics is a mainstay for the treatment of orbital cellulitis. The lack of native data regarding the microorganism causing the infection and its antibiotic sensitivity prompted us to conduct this study.

We retrospectively collected 29 cases of orbital cellulitis admitted to Chung-Ho Memorial Hospital of Kaohsiung Medical College from January 1994 to September 1998. The effectiveness of antibiotics with bacterial susceptibility was analyzed.

Of the 29 cases, fifteen were male and fourteen female. The patients ranged in age from 7 months to 79 years (mean, 37.6 years). Sinusitis (9 cases, 31.0%) is the most common etiology. Fourteen cases received both medical and surgical treatments. Eighteen cases had purulent discharge from the infection areas sent for culture isolation of the microorganism. The culture positive rate was 50% (9 in 18 cases). The *Staphylococcus aureus* (5 cases) was the most common pathogen. The bacterial susceptibility test showed drug resistance of 100% for penicillin G (seven out of seven cases; 7/7), 100% for ampicillin (10/10), and 0% for amikacin (0/3) and vancomycin (0/7).

Penicillin and ampicillin are not effective for those isolated bacteria. Oxacillin and gentamicin, frequently used in first line treatment, might encounter drug resistance in some cases. Amikacin and vancomycin, without any resistance in bacterial susceptibility tests, could be used in vision-threatening, critical, and intractable cases.

INTRODUCTION

The proper choice of effective antibiotics is a mainstay for the initial treatment of orbital cellulitis. The microorganism causing this disease will shift with time and long-term use of antibiotics. Bacteria may develop drug resistance if the use of antibiotics is not properly controlled. The lack of native data regarding the microorganism causing the infection and its antibiotic sensitivity prompted us to conduct this retrospective study.

MATERIALS AND METHODS

Retrospectively, we collected cases of preseptal and postseptal orbital cellulitis in Kaohsiung Medical College from January 1994 to September 1998. We analyzed the associated disorders related to the infection, the microorganism isolated from the pus or discharge, the bacterial susceptibility, and the antibiotics used orally and intravenously. The pus or discharge used for culture isolation was obtained during surgical interventions, by spontaneous rupture of orbital abscess through cutaneous tissue, or by swabbing the sinus pus in cases of sinusitis. One case had blood culture. Clinical information, including chief complaints, symptoms, signs, laboratory data, ocular examination, CT scan, and duration of the disease was also recorded and analyzed. Therapeutic methods, both medical and surgical, and their duration were reviewed.

To culture aerobic organisms, the samples were sent in trypticase soy broth, and then plated onto EMB agar and blood agar plates. After incubation of 18 to 24 hr, colony types were described. To culture anaerobic organisms, a thioglycolate broth and a second Brucella agar and Columbia agar were used in an anaerobic chamber. Examination of the anaerobic type was done. Fungus was plated into a Sabouraud dextrose agar plate, and was identified by methods of biochemical exams or slide culture.

The antibiotic susceptibility of the cultures that were considered to be the causative agents was examined by the filter paper disc method. The drugs which were collected in our study included ampicillin, penicillin G, augmentin, amoxicillin/calvulanic acid, oxacillin, piperacillin, amikacin, gentamicin, chloramphenicol, vancomycin, cefmetazole, clindamycin, cefotiam, cefazolin, netilmicin, and erythromycin.

RESULTS

A total of 29 patients (32 eyes, 2 recurrent, 1 bilateral), 15 male and 14 female, was collected. The patients ranged in age from 7 months to 79 years (mean 37.6 years). Sinusitis (9 cases, 31.0%) was the most common associated disorder (Table 1), followed by trauma (8 cases, 27.6%). Two cases of sinusitis combined trauma. One case of sinusitis combined dacryocystitis. One case of dacryocystitis was associated with trauma. One case of endophthalmitis was due to trauma. The surgery inducing orbital cellulitis was a silicone sponge explant for retinal detachment.

TABLE 1.
Frequency of Associated Disorders in Orbital Cellulitis

Associated Disorders	No.	%
Sinusitis	9	31.0
Trauma	8	27.6
Dacryocystitis	4	13.8
Hordeolum/chalazion	4	13.8
Unknown	4	13.8
Endophthalmitis	3	10.3
Pharyngitis	1	3.4
Surgery	1	3.4

The most common initial treatment was a combination of gentamicin and cefazolin intravenously (IV) (6 cases, 20.7%), followed by gentamicin and amoxicillin/clavulanic acid (5 cases, 17.2%), and

oxacillin and gentamicin (3 cases, 10.3%) (Table 2). Fifteen cases received medical (antibiotic) treatment alone. Fourteen cases had medical and surgical treatments, which included incision, drainage, enucleation, evisceration, orbitotomy and sinus surgery. The ages of these 14 cases ranged from 2.5 to 79 years, mean 39.6 years. There were 6 males and 8 females. Of these 14 cases receiving operations, twelve had pus samples sent for culture isolation of microorganism; seven had positive results. Two cases that did not have a specimen sent for culture were associated with dacryocystitis in one case and hordeolum in the other.

TABLE 2.
Frequency of Common Initial Antibiotic Treatment Mode

Initial Antibiotic Treatment	No.	(%)
Cefazolin & gentamicin	6	20.7
Amoxicillin/clavulanic acid & gentamicin	5	17.2
Oxacillin & gentamicin	3	10.3
Oxacillin & netilmicin	2	6.9
Ampicillin/sulbactam & netilmicin	2	6.9
Cefotiam & gentamicin	2	6.9
Cefotiam & amikacin	1	3.4
Cefazolin & amikacin	1	3.4
Cefazolin & netilmicin	1	3.4
Cefopirin & gentamicin	1	3.4
Cefazidime & gentamicin	1	3.4
Amoxicillin/clavulanic acid & netilmicin	1	3.4
Piperacillin & amikacin	1	3.4
Oxacillin	1	3.4
Cephradim	1	3.4

Eighteen cases had samples of purulent materials sent for bacterial culture and bacterial susceptibility. The culture positive rate was 50% (9 in 18 cases). One case had a mixed infection of *Staphylococcus aureus* and *Citrobacter freudii*. A total of ten strains of bacteria was obtained. *Staphylococcus aureus* (5 cases, 50%) had the highest incidence, followed by *Staphylococcus epidermidis* (2 cases, 20%), *Pseudomonas aeruginosa* (one case), *Enterobacter sukazukii* (one case), and *Citrobacter freudii* (one case) (Table 3).

TABLE 3.
Frequency of Pathogens Causing Orbital Cellulitis

Bacteria Isolated	No.	(%)
Staphylococcus aureus	5	50
Staphylococcus epidermidis	2	20
Pseudomonas aeruginosa	1	10
Enterobacter sukazukii	1	10
Citrobacter freudii	1	10

One case had a mixed infection of *S. aureus* and *C. freudii*.

The resistance rate was defined as the numbers of strains having results of resistance in the filter paper disc method divided by the numbers of bacterial strains tested with each drug. Since this was a retrospective study lasting 45 months, not every strain of isolated bacteria could be tested with all the same antibiotics (Table 4). Each strain of bacteria was tested by a different group of antibiotics which were used in the bacterial susceptibility tests performed in different periods. Therefore, no statistical comparison of the resistance rate among the antibiotics could be made. The bacterial susceptibility test (Table 4) showed drug resistance of 100% (seven out of seven cases; 7/7) to penicillin G, 100% (10/10) to ampicillin, 71.4% (5/7) to erythromycin, 28.6% (2/7) to oxacillin, 11% (1/9) to gentamicin, and 0% to netilmicin (0/10), vancomycin (0/7), cefazolin (0/7), and amikacin (0/3) (Table 4).

TABLE 4.
Drug Susceptibility Test

Drug	Resistance Rate	(%)
Ampicillin	10/10	100
Penicillin G	7/7	100
Erythromycin	5/7	71.4
Piperacillin	5/10	50
Chloramphenicol	3/10	30
Oxacillin	2/7	28.6
Cefmetazole	2/9	22.2
Ampicillin/sulbactam	1/5	20
Amoxicillin/clavulanic acid	2/10	20
Clindamycin	1/7	14.3
Gentamicin	1/9	11.1
Cefotiam	1/10	10
Amikacin	0/3	0
Cefazolin	0/7	0
Vancomycin	0/7	0
Netilmicin	0/10	0

DISCUSSION

In this study, the most common associated disorders predisposing orbital cellulitis is sinusitis (31.3%) as previously reported (1-7). The second most is trauma. However, trauma may be linked to other predisposing disorders, such as dacryocystitis, sinusitis, or endophthalmitis. Some other factors not included in this series are odontogenic infection, otitis media, leukemia, varicella virus infection, systemic infection, and debilitating disorders (5-7).

Most therapeutic regimens in this study were a combination of aminoglycosides and penicillins or cephalosporins. The bactericidal action of aminoglycosides is inhibition of protein biosynthesis by interfering with the proper attachment of messenger RNA to ribosome. The bactericidal actions of penicillins and cephalosporins are similar by inhibiting bacterial cell wall synthesis. The bactericidal actions of these two combined categories of antibiotics are different, so the combination regimens aim at a possibility of drug synergism and a broad-spectrum covering since any delay of the control of orbital cellulitis might result in irreversible visual loss or life-threatening carvenous sinus thrombosis. However, in some cases, drainage of the abscess is mandatory to the cure of the infection, although the isolated bacteria are susceptible to the antibiotics.

The successful treatment for orbital cellulitis depends on the effect of the antibiotics and the penetrating ability of the antibiotics into the infection area. In cases of abscess formation, adequate drainage is helpful. In our series, the most common isolated bacterial pathogen, *Staphylococcus aureus*,

is not unusual when compared with previous reports (1-5). Another frequently isolated bacteria is the *Streptococcal* organism (2). *Haemophilus influenzae* is rare in the era of the vaccination for *Haemophilus influenzae* type B (2). The bacterial susceptibility test of these bacteria showed that penicillin and ampicillin are not effective for these isolated bacteria. Oxacillin and gentamicin, which are frequently used in the first line treatment, might encounter drug resistance in some cases. Amikacin, cefazolin, netilmicin and vancomycin without any resistance in bacterial susceptibility tests could be used in vision-threatening, critical, and intractable cases.

The samples of pus sent for culture were mostly from cases receiving surgical intervention. These cases were usually intractable to medical therapy alone. In these cases, we had a profile of the bacterial pathogens and their bacterial susceptibility. This could be valuable information for choosing antibiotics to treat intractable cases of orbital cellulitis.

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Received: April 27, 1999
Accepted for Publication: July 20, 1999

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