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Etiology and Antibacterial Susceptibility Pattern of Bacterial Ocular Infections in a Children Hospital in North Jordan (2005-2009)

AL-SHARA MOHAMMAD

Department of Pharmacology, Faculty of Nursing, Irbid National University, Irbid (Jordan).

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ABSTRACT

To identify the etiology of ocular bacterial infections and to assess the *in vitro* susceptibility of these ocular bacterial isolates to commonly used antibiotics. Retrospective analysis of consecutive samples submitted for microbiological evaluation from children aged below 15 years who were clinically diagnosed with ocular infections and were treated at princess Rahmah hospital in North Jordan between January 2005 and December 2009. A total of 284 ocular samples were submitted for microbiological evaluation, of which 154 (54.2%) had positive bacterial growth. The most common bacterial species isolated was *Staphylococcus aureus* (56.6%) followed by *Streptococcus pneumoniae* (14.9%). *Klebsiella sp* (12.9%), *Enterobacter spp* (9.1%), *Pseudomonas* (5.2%) and *Moraxella* (1.3%). The most of gram-positive isolates was susceptible to vancomycin (93.6%) and cefotaxime (84.3%), and gram-negative isolates to ciprofloxacin (77.7%) and tobramycin (48.1%). Over all isolates, ciprofloxacin was the most effective antimicrobial agents with susceptibility rate of 78.0%. Gram-positive cocci were the most frequent bacteria isolated from ocular infections and were sensitive to vancomycin and cefotaxime, while gram-negative isolates were more sensitive to ciprofloxacin and tobramycin.

Key words: Ocular pathogens, Ocular infection, Antimicrobial susceptibility patterns.

INTRODUCTION

Ocular Infections is a common infectious condition that can affect children and both genders. It is most commonly characterized by conjunctival hyperemia (red eye" or "pink eye) and ocular discharge which consequently may results in severe visual loss[1].

The most common bacterial pathogens that cause ocular Infections in children include Staphylococcus species, Haemophilus species, *Streptococcus pneumoniae*, and Moraxella species[2-4]. One prospective study (428 children from southern Israel with a clinical diagnosis of conjunctivitis) found that, in 55% of the children, conjunctivitis was caused by *S pneumoniae*, *H influenzae*, or *M catarrhalis*[5].

Treatment of bacterial ocular Infections is usually take place with empirical broad spectrum antibiotics without waiting for pathogen identification and antibiotic susceptibility tests[6]. However, frequent indiscriminate use of antibiotics results in emerge development of resistance to many commonly used antimicrobials[7-9].

The bacterial pathogens causing acute bacterial infections of the eye and their pattern of antibiotic sensitivity have recently been reported from the UK and the USA[10-12].

Many antimicrobials have been used for the treatment of conjunctivitis includes: penicillin, streptomycin, tetracycline, chloramphenicol, gentamycin, erythromycin, and cloxacillin. Colxacillin was the best drug for staphylococcal while resistance of 30.9% was to chloramphenicol[13]. The etiologies and their antibiotic sensitivities pattern of ocular infections have been gradually changed over the years[13-15].

Little information about etiology and antimicrobial susceptibility pattern of ocular Infections is available in Jordan. Therefore, this study was conducted to assess the causative organisms and antimicrobials susceptibility pattern of ocular infections pathogens isolated from children between January 2005 and December 2009, at Princess Rahmah Hospital in Irbid, Jordan. The importance of this study is to aid clinicians to facilitate the empiric treatment and management of children with symptoms of ocular infections. Moreover, the data would also help authorities to formulate antibacterial prescription policies.

MATERIAL AND METHODS

This retrospective study was conducted on 154 children patients (≤ 15 years of age) with clinically diagnosed of ocular infections, at the Princess Rahmah Hospital in Irbid, Jordan between January 2005 and December 2009. Data of microorganisms and antibacterial susceptibility were obtained from the records of clinical microbiology laboratory which filled in a prepared data sheet**.** The inferior conjunctival sac was swabbed in a single sweep for secretions or discharge with a sterile Dacron swab. Bacteriological specimens were processed and identified with standard cultures. All isolates were tested for their susceptibilities to at least 12 out of 15 antimicrobials using antimicrobials diffusion discs[16]**.** Bacterial sensitivity was tested for the following antimicrobials: amoxicillin-clavulanic acid, ampicillin, cefaclor, cefixime, cephalothin, cotrimoxazole, ciprofloxacin, cefotaxime, gentamicin, oxacillin, piperacillin, tobramycin and vancomycin. Data were analyzed statistically using SPSS (version 15 for Windows) program calculating the frequencies and cross tables.

This protocol was approved by the Ethics Committee of the ministry of health in Jordan (MOH, REC, 08, 0057).

RESULTS

A total of 284 ocular samples obtained from children clinically diagnosed with ocular infections, was submitted for microbiological evaluation during the study period of 5 years. Of

Table 1: Frequency of isolation of causative organisms of ocular infection in children

Organism	2005	2006	2007	2008	2009	Gender		Total
	N (%)	N (%)	N (%)	N (%)	N (%)	Male (%)	Female (%)	N (%)
Staph. Aurous	10 (45.4)	45.2))14	24 (72.8)	22 (56.4)	17 (58.6)	42	45	87 (56.6)
Streptococcus	4 (18.1)	5 (16.1)	3 (9.1)	5 (12.8)	6 (20.7)	14	9	23 (14.9)
Klebsiella spp	3 (13.6)	5 (16.1)	3 (9.1)	7 (18.0)	2 (6.9)	8	12	20 (12.9)
Enterobacter spp	4 (18.1)	6 (19.4)	2 (6.0)	2 (5.1)	0	4	10	14 (9.1)
Pseudomonas	1 (4.5)	1 (3.2)	0	2 (5.1)	4 (13.8)	6	2	8 (5.2)
Moraxella	0	0	1 (3.0)	1 (2.6)	0	1	1	2 (1.3)
Total	22 (100.0)	31 (100.0)	33 (100.0)	39 (100.0)	29 (100.0)	75	79	154 (100.0)

Table 2: Pattern of susceptibility to various antibiotics in children with ocular infection

Organism	Year	Antimicrobial agent Number of tested isolates (%) susceptible					
		AMC	AMP	CEC	CF	CLT	COT
Gram –positive isolates	2005	4 (50.0)	4 (50.0)	4 (75.0)	4 (75.0)	3 (100.0)	5 (60.0)
	2006	10 (90.0)	4 (50.0)	6 (66.6)	10 (60.0)	3 (33.3)	4 (50.0)
	2007	24 (54.1)	21 (71.4)	16 (50.0)	20 (20.0)	19 (52.6)	21 (38.0)
	2008	20 (80.0)	13 (53.8)	18 (50.0)	12 (0)	13 (84.6)	18 (33.3)
	2009	10 (70.0)	18 (66.6)	13 (69.2)	15 (40.0)	0	19 (47.3)
	2005-2009	68 (69.1)	60 (63.6)	57 (57.8)	61 (31.1)	38 (65.7)	67 (41.7)
Gram –negative isolates	2005	4 (25.0)	6 (33.3)	2 (50.0)	4 (0)	3 (33.3)	4 (50.0)
	2006	7 (28.5)	6 (33.3)	4 (50.0)	4 (75.0)	3 (33.3)	4 (50.0)
	2007	5 (40.0)	4 (25.0)	4 (75.0)	6 (50.0)	4 (25.0)	5 (20.0)
	2008	9 (22.2)	6 (66.6)	6 (33.3)	7 (0)	6 (33.3)	4 (25.0)
	2009	6 (0)	0	2 (0)	2 (0)	0	2 (0)
	2005-2009	31 (22.5)	22 (27.2)	18 (44.4)	23 (26.0)	16 (31.2)	19 (31.5)
All pathogens	2005	8 (37.5)	10 (40.0)	6 (66.6)	8 (37.5)	6 (66.6)	9 (55.5)
	2006	17 (64.7)	10 (40.0)	10 (60.0)	14 (64.2)	6 (33.3)	8 (50.0)
	2007	29 (51.7)	25 (64.0)	20 (55.0)	26 (26.9)	23 (47.8)	26 (34.6)
	2008	29 (62.0)	19 (42.1)	24 (45.8)	19 (0)	19 (68.4)	22 (31.8)
	2009	16 (43.7)	18 (66.6)	15 (60.0)	17 (35.3)	2 (100.0)	21 (42.8)
	2005-2009	99 (54.5)	82 (53.6)	75 (54.6)	84 (29.7)	56 (57.1)	86 (39.5)

Amoxicillin-clavulanic acid (AMC), Ampicillin (AMP), Cefaclor (CEC), Cefixime (CF), Cephalothin (CLT), Ciprofloxacin (CPR), Cotrimoxazole (COT), Cefotaxime (CTX), Gentamicin (GEN), Piprecillin (PIP), Tobramycin (TOB), Vancomycin (VAN).

Table 2: Pattern of susceptibility to various antibiotics in children with ocular infection

Organism	Year	Antimicrobial agent Number of tested isolates (%) susceptible					
		CPR	CTX	GEN	PIP	TOB	VAN
Gram –positive isolates	2005	10 (60.0)	4 (100.0)	9 (44.4)	10 (30.0)	8 (87.5)	3 (66.6)
	2006	15 (40.0)	6 (83.3)	7 (57.1)	17 (35.3)	15 (86.6)	5 (80.0)
	2007	20 (95.0)	25 (88.0)	26 (69.2)	5 (80.0)	10 (70.0)	12 (100.0)
	2008	11 (81.8)	13 (76.9)	25 (52.0)	0	10 (70.0)	20 (95.0)
	2009	17 (100.0)	3 (66.6)	14 (71.4)	6 (100.0)	12 (41.6)	7 (100.0)
	2005-2009	73 (78.0)	51 (84.3)	81 (60.4)	38 (50.0)	55 (70.9)	47 (93.6)
Gram –negative isolates	2005	4 (50.0)	7 (14.2)	8 (12.5)	6 (50.0)	4 (25.0)	2 (50.0)
	2006	6 (33.3)	10 (30.0)	8 (62.5)	9 (33.3)	8 (37.5)	2 (50.0)
	2007	5 (100.0)	6 (66.6)	4 (100.0)	0	3 (100.0)	1 (0)
	2008	10 (100.0)	9 (66.6)	12 (33.3)	0	6 (33.3)	8 (12.5)
	2009	2 (100.0)	4 (50.0)	6 (66.6)	4 (50.0)	6 (66.6)	4 (0)
	2005-2009	27 (77.7)	36 (44.4)	38 (36.8)	19 (42.1)	27 (48.1)	17 (17.6)
All isolates	2005	14 (57.1)	11 (45.4)	17 (29.4)	16 (37.5)	12 (66.6)	5 (60.0)
	2006	21 (38.1)	16 (50.0)	15 (33.3)	26 (34.6)	23 (69.5)	7 (71.4)
	2007	25 (96.0)	31 (83.8)	30 (73.3)	5 (80.0)	13 (76.9)	13 (92.3)
	2008	21 (90.4)	22 (72.7)	37 (45.9)	0	16 (56.2)	28 (71.4)
	2009	19 (100.0)	7 (57.1)	20 (70.0)	10 (80.0)	18 (50.0)	11 (63.6)
	2005-2009	100 (78.0)	87 (67.8)	119 (52.9)	57 (47.3)	82 (63.4)	64 (73.4)

Amoxicillin-clavulanic acid (AMC), Ampicillin (AMP), Cefaclor (CEC), Cefixime (CF), Cephalothin (CLT), Ciprofloxacin (CPR), Cotrimoxazole (COT), Cefotaxime (CTX), Gentamicin (GEN), Piprecillin (PIP), Tobramycin (TOB), Vancomycin (VAN).

the 284 ocular specimens subjected to cultures, 154 (54.2%) had bacterial growth.

The predominant bacterial species isolated was *Staphylococcus aureus* (56.6%) followed by *Streptococcus pneumoniae* (14.9%). *Klebsiella sp* (12.9%), *E. coli* (9.1%), *Pseudomonas* (5.2%) and *Moraxella* (1.3%) (Table 1).

Over all isolates, ciprofloxacin was the most effective antimicrobial agent with susceptibility rate of 78.0%. The most of gram-positive isolates were susceptible to vancomycin (93.6%) followed by cefotaxime (84.3%), ciprofloxacin (78.0%), tobramycin (70.9%), amoxicillin-clavulanic acid (69.1%), cephalothin (65.7%), ampicillin (63.6%) and gentamicin (60.4%). The gram-negative organisms were susceptible in highest percentage to ciprofloxacin (77.7%) followed by tobramycin (48.1%) and cefotaxime (44.4%). The antimicrobial susceptibility of conjunctivitis isolates for 12 selected antimicrobial agents used in this study are summarized in (Table 2).

Of twelve of tested antimicrobials, ciprofloxacin had the highest susceptibility rate (78.0%) for all tested isolates, followed by vancomycin (73.4%). Whereas, cefixime showed the lowest susceptibility rate of 29.7% (Table 2).

DISCUSSION

This current study provides information regarding the most common bacteria isolated from ocular specimens which was *Staphylococcus aureus* (56.6%) followed by *Streptococcus pneumoniae* (14.9%). These results are in agreement with other studies that reported *S. aureus* as the most common bacteria isolated from children with ocular infection[2-4,17]. While, *Streptococcus pneumonia* was the predominant agent of conjunctivitis followed by other microorganisms[5]. Though *Staphylococci* and *Streptococci* along with other bacteria like *Pseudomonas*, *Moraxella* are part of the normal flora of the conjunctiva, under appropriate conditions they cause infections[18-19]. Among gram-negative bacilli, the most common pathogen was *Klebsiella spp* (12.9%) followed by *Enterobacter spp* (9.1%) *Pseudomonas spp*. (5.2%) and *Moraxella* (1.3%). The gram-negative bacilli, Klebsiella spp., Enterobacter spp., etc., are found in soil and sewage and are opportunistic pathogens causing ocular infection when the host defenses are low[20].

Sensitivity and resistance based on *in vitro* testing may not reflect true clinical resistance and response to an antibiotic because of the host factors and penetration of the drug.

In this study, vancomycin, cefotaxime and ciprofloxacin revealed a higher efficacy against gram-positive isolates compared with other antibacterial agents. Similar finding was reported for susceptibility pattern of conjuntivitis *S. aureus* isolates to vancomycin and ciprofloxacin[21-22]**.** Whereas, cefixime and cotrimoxazole showed the lower efficacy rate against gram-positive isolates.

However, gram-negative isolates showed high susceptibility rate to ciprofloxacin, while vancomycin showed the lowest efficacy. In addition, this study reveled that ciprofloxacin had a higher efficacy against both gram-positive and gram-negative isolates compared with other antibacterial agents. These findings for ciprofloxacin suggest that the behavior of these pathogens in our setting is the same as that reported in the international literature[23-25].

Susceptibility rate of gram-negative isolates to all tested antimicrobial agents was lower than that of gram-positive isolates. This my due to over use of these antimicrobial agents in treatment of infection due to gram-negative bacteria[26]. The relationship between antibiotic use and resistance is complex. Improper selection of antibiotics, inadequate dosing and poor compliance to therapy may play as important a role in increasing resistance as their overuse[21].

Medical literature has shown an increase in the incidence of antibiotic-resistant bacterial strains. Several cofactors have been implicated, among which the frequent use of antimicrobial agents is highlighted[7-9].

CONCLUSION

Ocular infection in children is mainly caused by *Staphylococcus aureus* organisms, which develop resistance to commonly used antimicrobials. This emergence of multiple drug resistance call for judicious antibiotic use to avoiding the development of further resistance to available agents for ocular infection. Its also calls for a continuous monitoring and reviewing of antimicrobial policy in the hospital and the country at large. The information provided in this study would also aid the clinician in formulating rationale-based decisions in the antibiotic treatment of bacterial ocular infections that cause major public health problems.

Moreover, the data would also help authorities to formulate antimicrobial prescription policies.

REFERENCES

1. Alexandrakis, G., Alfonso, E. C., Miller, D. Shifting trends in bacterial keratitis in South Florida and emerging resistance to fluoroquinolones. *Ophthalmology*, **107**:1497-502 (2000)
2. Arrfa, R. C., Grayson's diseases of the cornea, 4th ed. St Louis: Mosby-Year Book, 1997:138.
3. Gigliotti, F., Williams, W. T., Hayden, F. G., *et al.* Etiology of acute conjunctivitis in children. *J Pediatr*, **98**:531–536 (1981).
4. Weiss A, Brinser J. H, Nazar-Stewart V. Acute conjunctivitis in childhood. *J Pediatr*, **122**: 10-14 (1993)
5. Buznach, N., Dagan, R., Greenberg, D. Clinical and bacterial characteristics of acute bacterial conjunctivitis in children in the antibiotic resistance era. *Pediatr Infect Dis J*, **24**: 823–828 (2005).
6. Maria Regina Chalita, Ana Luisa Hofling-Lima, Augusto Paranhos, Pulo Schor, Rubens Belfort. Shifting Trends in Invitro Antibiotic Susceptibilities for common ocular isolates during a period of 15 years. *Am J Ophthalmol,* **137**: 43-51 (2004).
7. Kunimoto, D.Y., Sharma, S., Garg, P., Rao, G. N. Invitro susceptibility of bacterial keratitis pathogens to ciprofloxacin. Emerging Resistance. *Ophthalmology*, **106**: 80-5 (1999).
8. Goldstein, M. H., Kowalski, R. P., Gordon, Y. J. Emerging fluoroquinolone resistance in bacterial keratitis. *Ophthalmology*, **106**: 1313-8 (1999).
9. Garg, P., Sharma, S., Rao, G. N. Ciprofloxacin resistant *Pseudomonas* Keratitis. *Ophthalmology*, **106**: 1319-423 (1999).
10. Brook, I. Anaerobic and aerobic bacterial flora of acute conjunctivitis in children. *Arch Ophthalmol*, **98**: 833-5 (1980).
11. Seal, D. V., Barrett, S. P., McGill, J. I. Aetiology and treatment of acute bacterial infection of the external eye. *Br J Ophthalmol*, **66**: 357-60 (1982).
12. Manmeet Singh and Rajneesh Saxena. *Orient. J. Chem,* **27**(1): 185-190 (2011).
13. Mahajan, V. M. Acute bacterial infections of the eye: their aetiology and treatment. *Br J Ophthalmol*, **67**: 191-4 (1983).
14. Block, S.L., Hedrick, J., Tyler, R. Smith, A., Findlay, R., Keegan, E., and Stroman, D. Increasing Bacterial Resistance in Pediatric Acute Conjunctivitis (1997–1998). *Antimicrob. Age. Chemother*, 1650–1654 (2000).
15. Bodor, F. F., Marchant, C. D., Shurin, P. A., and Barankamp, S. J. Bacterial etiology of conjunctivitis-otitis media syndrome. *Pediatrics*, **76**: 26–28 (1985).
16. Bauer, A. W., Kirby, W. M. M., Sherris, J. C., Turck, M. Antibiotic susceptibility testing by a standardized simple disc method. *Am J Clin Pathol*, **45**: 493 (1960).
17. Maurer, P. P., Zbinden, R., Kaufmann, C., Thiel, M.A. Antibiotic susceptibilities of bacteria isolated from ophthalmic specimens between 1984 and 2005 in Zurich, Switzerland. *Klin Monatsbl Augenheilkd*; **224** :240-3 (2007).
18. Speaker, M. G., Milch, F. A., Shah, M. K., Eisner, W., Kreiswirth, B. N. Role of external bacterial flora in the pathogenesis of acute

postoperative endophthalmitis. *Ophthalmology*, **98**: 39-49 1991).

19. Walker, B., Claoue, C.M. Incidence of conjunctival colonization by bacteria capable of causing postoperative endophthalmitis. *J R Soc Med*, **79**: 520-1 (1986).
20. Sihota, R., Tandon, R., editors. Parsons' Diseases of the Eye. 20th ed. New Delhi: Elsevier; 2007. p. 423-69.
21. Ly, CN. M., Pham, J. N., Badenoch, P. R., Bell, S. M., Hawkins, G., Rafferty, D. L., McClellan, K. A. Bacteria commonly isolated from keratitis specimens retain antibiotic susceptibility to fluoroquinolones and gentamicin plus cephalothin. *Clin Experiment Ophthalmol*, **34**: 44-50 (2006).
22. Bharathi. M., Ramakrishnan, R., Shivakumar, C., Meenakshi, R., and Lionalraj. D. Etiology and antibacterial susceptibility pattern of community-acquired bacterial ocular infections in a tertiary eye care hospital in south India. *IJO*, **58**: 497-507(2010).
23. Jensen, H. G., Felix, C. In vitro antibiotic susceptibilities of ocular isolates in North and South America. In Vitro Antibiotic Testing Group. *Cornea*, **17**: 79-87 (1998).
24. Arantes, T. E., Castro, C. M., Cavalcanti, R. F., Severo, M. S., Diniz Mde, F., Urtiga, R. W. Conjunctival bacterial flora after topical use of ciprofloxacin and gatifloxacin in cataract surgery. *Arq Bras Oftalmol*, **71**:191-6 (2008).
25. Arantes, T. E., Cavalcanti, R. F., Diniz Mde, F., Severo, M. S., Lins Neto, J., Castro, C. M. Conjunctival bacterial flora and antibiotic resistance pattern in patients undergoing cataract surgery. *Arq Bras Oftalmol.*; **69**: 33-6. (2006).
26. Al-Shara, M. Etiology and Antimicrobial Susceptibility Pattern of Bacterial Conjunctivitis in Children at Princess Rhamah Hospital in Jordan. *The New Iraqi Journal of Medicine*, **6**: 17-20 (2010).