Omdurman Islamic University Journal (OIUJ)

مجلة جامعة أم درمان الاسلامية

https://journal.oiu.edu.sd/index.php/oiuj

2022; 18(1);166 – 182

https://doi.org/10.52981/oiuj.v18i1.2121

ISSN: 5361-1858

Pattern of Susceptibility Antibiotics against Clinical Isolates of Conjunctivitis from Sudanese Patients in Khartoum State

Nadir Abuzeid [1*], Aya Tarig[1], Afifa Ahmed[1], SaharAbdalla[1], Mayasir Abdelmoum[1] Aymen Mudawe Nurain[2]

[1]*Department of Medical Microbiology, Faculty of Medical laboratory sciences, Omdurman Islamic University.*

[2]*Delta College of Science and Technology, Omdurman, Sudan.*

***Correspondence author:Nadir Abuzeid, Email:** nadirabuzeid@oiu.edu.sd

To cite this article:

Abuzeid , N., Tarig, A., Ahmed, A., Abdalla, S., Abdelmoun, M., & Mudawe Nurain, A. (2022). Pattern of Susceptibility Antibiotics against Clinical Isolates of Conjunctivitis from Sudanese Patients in Khartoum State. Omdurman Islamic University Journal, 18(1), 166-182. https://doi.org/10.52981/oiuj.v18i1.2121.

Abstract

Resistant Antibiotics of bacterial conjunctivitis is a major challenge globally. The study aimed to determine the most common bacterial agents and risk factors, associated with Conjunctivitis among Sudanese patients and the sensitivity of the antibiotics used against isolates bacteria. The study was cross-sectional and carried out in MAKKA and Allwaledin Eye Hospital over three months in 2019. Fifty samples were collected from patients suffer from conjunctivitis by fine swab. Isolates were cultured in different media agar media and biochemical tests were used for identifications. The demographic data was collected by a questionnaire filled by the patient after verbal consent. Antibiotic susceptibility testing was conducted by the disc diffusion method (Kirby-Bauer) was performed as recommended by the CLSI. Staphylococcus aureus (ATCC 25923), Escherichia coli (ATCC 25922), and Pseudomonas aeruginosa (ATCC27853) were used as controls. The positive frequency samples were 38 (76%), and the negative samples were 12(24%). Among the 38 positive samples 19(50%) were females while 19(50%) were males. The difference was not significant P= 0.241) with highly infected age groups (1-10) years old. Our Results detected that Some Isolated bacteria developed

resistance to certain antibiotics, such as Staphylococcus aureus exhibited resistance against Erythromycin 10/15 (66.7%).While Staphylococcus epidermidis resistant against Tetracycline, and Erythromycin 4/4 (100%). Also, *Bacillus spp* revealed resistance against Ceftazidime1/1(100%). *Listeria monocytogenes was* resistant against Ceftazidime and Erythromycin 1/1(100%).On the other hand Pseudomonas aeruginosa, klebsiella pneumonia and klebsiella oxytoca exhibited resistance against Amoxicillin clavulanic acid and Erythromycin. The record data of risk factors conducted by highest frequency include antibiotics (16(36%); P=0.874) and using makeup and viral infection 11(22%); P=0.142) followed by eye surgery, arthritis 6 (12%); P=0.145), diabetes mellitus and hypertension 5(13.2%) ; P=0.654), using the immunosuppressive drug, lens and eye injury 4(8%) ; P=0.654), Smoking (3(6%) ; P=0.961) and heart disease 1(2%) ; P=0.322) associated with conjunctivitis statistically in significant. According to the results, we obtained that the main bacteria that caused conjunctivitis were Staphylococcus aureus and Pseudomonas aeruginosa. The sensitivity test indicated that Ciprofloxacin, Ceftazidime and Gentamycin were the most effective than other drugs used against isolates identified in this study.

Keywords: Conjunctivitis, Bacterial infections, Antibiotic resistance, Risk factors.

1. Introduction.

Common eye infections include conjunctivitis, often called (pink eye), which affects the membrane that lines the inside of the eyelids and covers the whites of the eye [1]. Conjunctivitis often cause redness, irritation, tearing and itchiness. Discharge from the eye and crusting of the eyelid margin are also common symptoms [2]. It revealed from primary involvement of the conjunctival tissue may episode secondary to other ocular or systemic disease such as gonococcus [3], Chlamydia (Terlinchamp and Duchesne, 2020) and autoimmune disease[4].Conjunctivitis may be due to bacterial, viral, fungal, parasitic or allergic agents that produce conjunctival inflammation [4-6]. It has globally distribution, affecting persons of all ages, races, social demographic and both genders. In the United States, its prevalence in the population ages 1 −74 was 13 in 1,000, according to the National Health Survey conducted [7]. Furthermore, suggestive risk factors reported associated with conjunctivitis include diabetes mellitus [8], Heart disease [9], hypertension[10], arthritis [11],smoking[12], immunosuppressive drug , eye's Injury [13], Surgery [14], Make Up, lens[15]. The major causative agent of bacterial infections were reported in a few studies in Sudan include conjunctivitis is *Streptococcus pneumonia, Haemophilus influenza, Staphylococcus aureus, Neisseria*

gonorrhoeae, Chlamydia trachomatis, Pseudomnas aeruginosa and Moraxella species [15-18].Using antibiotics Treatment with a broad-spectrum topical antibiotic for five to seven days is usually effective. However, growing resistance has been observed among ocular bacteria as with other systemic pathogens. The development of drug resistance by over using of antibiotics for systemic infection as well as overuse of topical antibiotics in the eye in the Sudan [19]. The need for screening and treatment are important to reduce the cost of the socioeconomic impact of conjunctivitis. Accurate diagnosis and appropriate treatment can minimize these costs and the illness. Misdiagnosis of conjunctivitis can add a substantial cost burden and may result in serious impairment of vision. Therefore, the present study aimed to isolate and identify the common bacteria causing conjunctivitis and their antibiotic susceptibility and their risk factors in Khartoum state, Sudan.

2. Materials and Methods:

2.1Study Design

The study was a cross-sectional descriptive study carried out during the period from October to December 2019. Conjunctival swabs were collected from fifty patients attended to Makkah Eye Hospital and Allwaldin Eye Hospital at Khartoum state. The patients' age range from one month to eighty years old, any subject who did not meet inclusion criteria were excluded from study.

2.2 Ethical Consideration

A permission to conduct this study was obtained from Omdurman Islamic University Ethical Committee. A written informed consent form was obtained from study Participants confidentiality after they given them anonymous codes. Demographic data was obtained using specified instructed standardized-interviewer administered face-to-face questionnaire. Regression analysis that revealed combination of history and clinical signs and symptoms has had been done by professional ophthalmologist using calibrated slit lamp bio-microscopy.

2.3Collection Samples and Identification of Isolated Aerobic Bacteria Procedure

Each conjunctival swab was obtained by having the patient look up and wiping a sterile swab moistened with sterile peptone water by rubbing them over the lower conjunctival sac from medial to lateral can thus and back again to the medial canthus very carefully without touching the cornea. Two swabs were collected from each case. One of the two swabs used for direct gram stain, and other swabs was dipped into AMIS transport media. then directly inoculated onto blood agar, MacConkey agar (Hi Media®, India) and chocolate agar then a smear was prepared from each swab. The media were incubated at 37°C for 24-72 hours aerobically and chocolate agar was incubated at 35-37°C for 48 hours in an atmosphere with 5-7%

carbondioxide (CO2). The single pure Colonial identification was studied according to morphology, size, color, edges, haemolysis, on blood agar, side views of colonies and fermentation of lactose on MacConkey agar. Identification of isolated bacteria was based on conventional microbiological methods, these included for Gram positive bacteria, indirect Gram stain, hemolytic activity on 5% sheep blood agar(SBA), 3% catalase reaction test , coagulase reaction(tube method), motility test, CAMP test,1% oxidase test, growth on NaCl 6.5%, 40% Bile esculin hydrolysis, novobiocin disk test, optochin disk test ,bacitracin disk test, and sets of sugars such as 1% of Raffinose, Pyruvate Arginine, Manitol, Arabinose, and Sorbose. For Gram negative bacteria identification was based on indirect Gram stain, colony morphology on blood agar, MacConkey agar, motility test, citrate test, urease test, and oxidase test and reaction on triple sugar iron, hydrogen sulfide production, Indole test.

2.4 Susceptibility Pattern of Antibiotics

Considering Clinical Laboratory Standard Institute (CLSI) breakpoints of antibiotic multi -disks (Hi Media®, India) were performed to clinically isolated bacteria using a standard disk diffusion method for drug susceptibility test (DST), and were done on Muller Hinton Agar (Hi Media®, India), with 0.5McFarland turbidity standards. The following antibiotic disks which available with varying concentrations were used for testing, Ciprofloxacin (CIP: 5µg) ceftazidime (CAZ: 30µg), Gentamycin (G: 10µg) Erythromycin (E: 15 µg), Tetracycline (TE: 30 µg), and Amoxicillin/clavulanic acid (AM/CA: 30µg) (Hi Media®, India) for Gram positive and negative bacterial isolates (22). The Zone size Interpretative chart was based on results obtained using Mueller Hinton Agar which records in three categories sensitive, intermediate and resistant as shown in Table 4.

2.5 Quality Control (QC):

Aseptic techniques were strictly observed during samples collection, transportation, processing and storage. All reagents and kits were used according to manufacturer instruction sheet. Biological materials used include 5% sheep blood, rabbit de-fibrigenated plasma, standard strains for quality control, *Staph aureus* ATCC 25923), *Escherichia coli* (ATCC 25922), and *Pseudomonas aeruginosa* (ATCC27853).

2.6 Statistical Analysis:

Data analysis was performed using SPSS version 24 according to study objectives. Descriptive data analysis (Frequency and percentage) on subject demographics were calculated using cross-tabulation and Chi ^{2} to determine P value less than 0.05 indicates significant variation.

3. Result:

3.1 Socio-demographic characteristics of the study participants:

A total of fifty eye swabs specimens (n = 50) were collected randomly from patients with symptoms of conjunctivitis attending the Makkah and Allwaldin Eye Hospital at Khartoum state. The frequency positive isolated samples from cultures were 38 (76%) and negative samples were 12(24%) depicted in (Table 1). Among the positive samples 19(50%) were females while 19(50%) were males. The difference was insignificant (p = 0.241). The total of Gram- positive bacteria isolated was 28 (63.6%), while the total of Gram-negative bacteria was 16 (36.4%), the difference was not significant (p = 0.978). Most samples were pure 34 (89.5%), and the frequency of the mixed samples was 4 (10.5%). Patients enrolled in the study were divided into eight age groups:(0-10) years old, (11-20) years old, (21- 30) years old, (31-40) years old , (41-50) years old , (51-60) years old , (61-70) years old and (71-80) years old. The highest frequency of isolates was 7/50 (18.4%) which was in the age group (0-10 years) followed by the age groups (11-20) years old, (31-40) years old and (61-70) years old which were 6/50(15.8%) while the age group (21-30) years was 5/50 (13.8%).Followed by 4/50(10.5%) for the age group (51-60) years. The age group (41-50) years has lower frequency 3/50(7.9%). The lowest frequency of isolates was 1/50(2.6%) in the age group of (71-80) years. This age frequency was statistically insignificant (p = 0.666) depicted in **(Table 2)**.. The recorded data of risk factors conducted by highest frequency include antibiotics 16(36%); P=0.874) and using makeup and viral infection 11(22%) ; P=0.142) which followed by eye surgery, arthritis 6 (12%); P=0.145), diabetes mellitus and hypertension (5(13.2%) ; P=0.654), using the immunosuppressive drug, lens and eye injury 4(8%) ; P=0.654), smoking (3(6%) ; P=0.961) and heart disease 1(2%) ; P=0.322) associated with conjunctivitis statistically insignificant depicted in **(Table 3)**.

3.2 Conjunctival bacterial isolates: The major organisms isolated were *Staphylococcus aureus* 15 (39.5%). Followed by *Pseudomonas aureginosa* 10 (26.3%), While *klebsiella pneumonia* and S. saprophytic have the same frequency 3(7.9%). Followed by *Staphylococcus epidermidis* and *Streptococcus pneumonia* were 2(5.3%). The lowest Frequency was 1 (2.6%) for each *Kellebsiella oxytoca*, Bacillus cereus and *Listeria monocytogenes* as in showed in(**Figure 1**).

3.3 Pattern Susceptibility of Bacterial Isolates to Antibiotics:

Regarding antimicrobial sensitivity revealed that Staphylococcus aureus species are highly sensitive to Ciprofloxacin 14/15(93.3%), followed by Gentamycin 13/15(86.7%), Also, 10/15(66.7%) sensitive to Amoxicillin clavulanic acid, followed by Tetracycline and Ceftazidim 8/15(53.3%). However, detection of resistance against Erythromycin 10/15(66.7%). Also, Staphylococcus epidermidis showed sensitive to each Ciprofloxacin, Amoxicillin clavulanic acid, Ceftazidime and Gentamycin 4/4(100%), and show high resistance against Tetracycline and Erythromycin 0/4(0%). Stapylococcus saprophyticus sensitive to Ciprofloxacin, Ceftazidime and Gentamycin 3/3 (100%), and resistance just against Erythromycin 1/3 (33.3%). Bacillus cereus sensitive to Ciprofloxacin, Gentamycin, Tetracycline and Amoxicillin clavulanic 1/1 (100%), and resistance against Ceftazidime 1/1(100%), also intermediate to Erythromycin 1/1(100%). Streptococcus pneumonia sensitive to Gentamycin, Tetracycline and Amoxicillin clavulanic 2/2(100%) also sensitive to Erythromycin, Ciprofloxacin and Ceftazidime 1/2 (50%), and resistance against Ceftazidime and Erythromycin 1/2 (50%), and intermediate to Ciprofloxacin 1/2 (50%). Listeria monocytogens show sensitive to Gentamycin, Tetracycline and Amoxicillin clavulanic 1/1 (100%), and resistance to Erythromycin and Ceftazidime 1/1 (100%), and intermediate to Ciprofloxacin 1/1 (100%). Pseudomonas aeruginosa showed highly sensitive to Gentamycin, Tetracycline and Ciprofloxacin 12/12(100%), followed by Ceftazidime 11/12 (91.7%), and resistance against Amoxicillin clavulanic 12/12 (100%) and Erythromycin 8/12 (66.7%). Klebsiella pneumonia showed highly sensitive to Gentamycin 3/3 (100%), followed by Ciprofloxacin and Tetracycline 2/3 (66.7%), and highly resistance against Amoxicillin clavulanic and Erythromycin 3/3(100%), followed by Ceftazidime 2/3(66.7%). Klebsiella oxytoca sensitive to Gentamycin, Tetracycline, Ciprofloxacin and Ceftazidime1/1(100%). And resistance against Amoxicillin clavulanic and Erythromycin 1/1(100%).The result showed highest susceptibility antibiotics were recorded for both Gram positive and negative bacteria as following Gentamycin 37(97.3), ciprofloxacin 36(97.6%),Ceftazidime 28(73.7), Amoxicillin+clavulanic 21(55.2%), Tetracycline 20(52.6%) and Erythromycin 10(26.3) ascendingly. All the results data were illustrated in (Table 4).

Table-1Characteristic of bacteria associated with conjunctivitis in MAKKAH and Allwaldin Eye hospital in Khartoum state.

Item	**Growth Bacteria**	**no-growth**	**Total**	
According to identification	Number (Percentage)	Number (Percentage)	Number (Percentage)	
	38(76)	12(24)	50(100)	
Gram positive	28(63.6)	0(0)	28((56)	0.978
Gram negative	16(36.4%)	0(0)	16(32)	
Pure culture	34(89.5)	0(0)	34(68)	0.754
Mixed culture	4(10.5)	0(0)	4(8)	

Table-2 Demographic data associated with conjunctivitis in MAKKAH and Allwaldin Eye hospital in Khartoum state.

Item	Growth Bacteria	no-growth	Total	P
According to identification	Number(Percentage)	Number(Percentage)	Number(Percentage	
According to sex				
Male	19 (73.1)	7 (26.9)	26(52)	0.241
Female	19(79.1)	5(20.8)	24(48)	
According to age				
0-10 years	7(18.4)	5(41.7)	12(24)	0.666
11-20	6(15.8)	2(16.7)	8(16)	
21-30	5(13.2%)	0(0)	5(10)	
31-40	6(15.8)	2(16.7)	8(16)	
41-50	3(7.9)	0(0)	3(6)	
51-60	4(10.5)	1(8.3)	5(10)	
61-70	6(15.8)	2(16.7)	8(16)	
71-80	1(2.6)	0(0)	1(2)	

Table-3 Relative risk factors associated with conjunctivitis in MAKKAH and Allwaldin Eye hospital in Khartoum state.

Item	Growth Bacteria	no-growth	Total	P
	Number(Percentage)	Number(Percentage)	Number(Percentage	
According to risk				
Diabetes Mellitus	5(13.2)	33(86.8)	5(10)	0.654
Heart Disease	1(2.6)	0(0)	1(2)	0.322
Hypertension	5(13.2%)	0(0)	5(10)	0.322
Arthritis	6(15.8)	0(0)	6(12)	0.145
Viral infection	11(28.9)	0(0)	11(22)	0.410
Smoking	3(7.9)	0(0)	3 (6)	0.961
Immunosuppressive Drug	4(10.5)	0(0)	4(8)	0.825
Eye Injury	4(10.5)	0(0)	4(8)	0.825
Eye Surgery	6 (15.8)	0(0)	6(12)	0.145
Eye Make Up	11 (28.9)	0(0)	11(22)	0.142
Using lens	4(10.5)	0(0)	4(8)	0.825
Using Antibiotics	18(47.4)	0(0)	16(36)	0.874

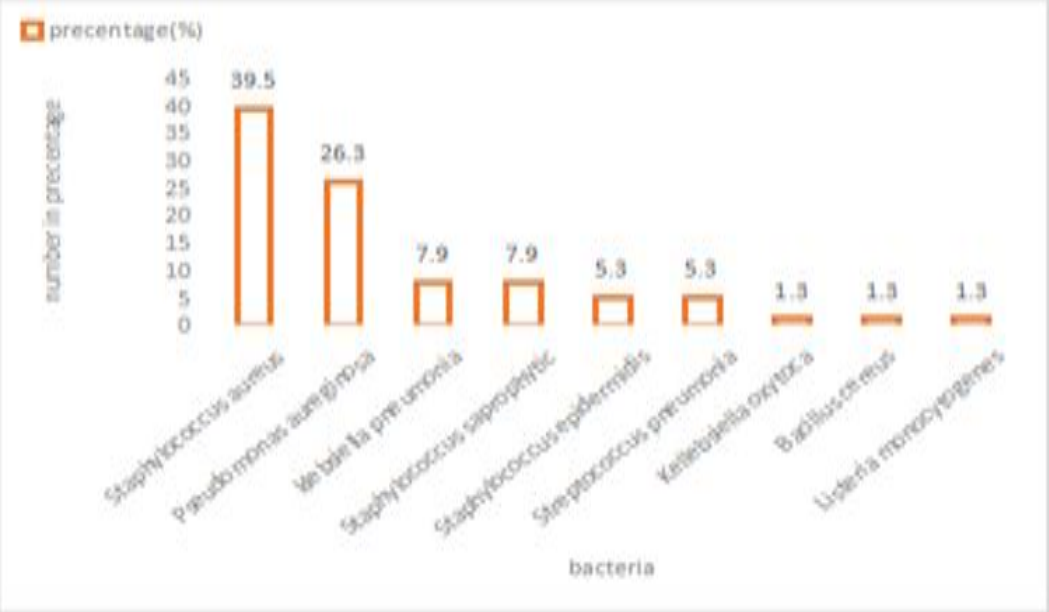

Figure (1): bacterial species isolated from patients suffer from conjunctivitis

Table -4 Pattern of Susceptibility Antibiotics against Clinical Isolates of Conjunctivitis among Sudanese Patients in Khartoum State

Antibiotics			CIP			CAZ			G			ER			TE			AM+CA		
Criteria			S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Inhibition zone in (MM)			21	16-20	15	21	18-20	17	15	13-14	12	23	14-22	13	15	12-14	11	18	14-17	13
GRAMPOSITIVE BACTERIA	*Staphylococcus aureus*	15	14	0	1	8	3	4	13	0	2	5	0	10	8	1	6	10	0	5
	Staphylococcus epidermidis	2	4	0	0	4	0	0	2	0	0	0	0	4	0	0	4	4	0	0
	Stapylococcus saprophyticus	3	3	0	0	3	0	0	3	0	0	2	0	1	3	0	0	3	0	0
	Bacillus cereus	1	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	0	0
	Streptococcus pneumoniae	2	1	1	0	1	0	1	2	0	0	1	0	1	2	0	0	2	0	0
	Listeria monocytogenes	1	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	1	0	0
	TOTAL	24	2396	28.3	14.1	1666.6	312.5	729.1	2395.8	00	28.3	833.3	14.2	1770.8	1575	14.1	1038.5	2187.5	00	519.2
GRAMNEGATIVE BACTERIA	*Pseudomonas aeruginosa*	10	10	0	0	10	0	1	10	0	0	2	2	8	2	0	0	0	0	2
	Klebsiella oxytoca	1	1	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1
	Klebsiella pneumonia	3	2	0	1	13	0	2	3	0	0	0	0	3	2	0	1	0	0	3
	TOTAL	14	13	0	2	12	0	3	14	0	0	2	2	12	5	0	1	0	0	6
ALL	*TOTAL*	38	3694.7	00	37.8	2873.7	00	1026.3	3797.3	00	205.2	1026.3	410.5	2876.3	2052.6	00	1128.9	2155.2	00	1128.9

Abbreviations: CIP=ciprofloxacin , CAZ= ceftazidime, , G=gentamicin, ER=Erythromycin TE= tetracycline, and A/C = **Amoxicillin /clavulanic acid, MM=Millimeters, S = Sensitive, I =Intermediate, R= Resistance**

4. Discussion

The diagnosis of infectious conjunctivitis can be difficult. Clinical ambiguity exists between the viral and bacterial and the allergic forms, which can confound diagnosis[20]. Bacterial conjunctivitis in Sudan is common as a primary event or a secondary infection following a viral illness such as a cold [18].

In the present study, bacterial conjunctivitis was found to be 76% which is much closed to the fact that infectious conjunctivitis is mainly bacterial or viral, with approximately 78% to 80% of cases being bacterial in origin in Nigeria and New York city [21, 22], also estimated near frequencies (69.2 % and 60% respectively) while one researcher [23-26] reported higher results [92.7%]. In contrast, lower results had been recorded by others [24-26]. In the present study revealed that, both females and males were equal in the positive growth with insignificant difference while some previous workers found a high prevalence of the disease in male patients [27]. It can be justified by that gender variation may vary on a region-to-region basis.

The highest infected age group was (0-10years) with (24%) which agrees with the previous study in Sudan. An oppositely previous study in Pakistan found that conjunctivitis was more common among the elderly (61-70 years) with conjunctivitis is very common in young persons (34.4%) and gradually disappears at puberty [28]. In the present study, the Gram-positive bacteria (63.6%) were higher in number than Gram-negative bacteria and this fact was reported in many studies as it considered as major normal flora.

The negative growth culture may be due to viral or fastidious bacteria like Chalymdia trachomatis which required selective or allergic to detect them. The present study, the major organisms isolated were Staphylococcus aureus was rated 15(39.5%) Followed by Pseudomonas aureginosa 10(26.3%). However, our study lacking Haemophilus influenza, may be due to the vaccination program in Sudan includes vaccination with Haemophilus influenzae type b (Hib) conjugate vaccine until the second year of children's life. The recorded data of risk factors conducted by highest frequency include antibiotics16(36%); P=0.874) and using makeup and viral infection (11(22%) ; P=0.142) which followed by eye surgery, arthritis 6 (12%); P=0.145), diabetes mellitus and hypertension (5(13.2%); P= 0.654), using the immunosuppressive drug, lens and eye injury 4(8%) ; P=0.654), Smoking 3(6%) ; P=0.961) and heart disease 1(2%); P=0.322) associated with conjunctivitis statistically in significant as the risk factor was controversial in previous studies [16, 29, 30] and needed more further study to confirm it.

Our findings indicated that the maximum antibiotic sensitivity isolates was against Gentamicin 37(94.7%) followed by Ciprofloxacin 36 (89.5%), Ceftazidime 28(73.7%) and Amoxicillin/clavulanic acid 21(55.2%) and Tetracycline 20(52.6%), and Erythromycin 10(26.3%). One study reported that all bacterial isolates were susceptible to Ciprofloxacin and Gentamicin (19). The present study exerted that the maximum resistance was against Erythromycin 28(76.3%) followed by 11(28%) for both Amoxacilin/clavulanic acid and Tetracycline which was similarly reported in previous study [31, 32], This may be due to prolonged use of antibiotics and common practice of self-medication in Sudan. However, we had some limitations. Firstly, it was a cross-sectional study conducted in a single hospital, and we are not sure whether our results can be generalized to larger population groups. Furthermore, the sample size was small and we did not have sensitivity results from all the isolated microorganisms. We suggest performing more investigations regarding antibiotic susceptibility patterns of pathogens implicated in acute bacterial conjunctivitis in children in our region with the collaboration of more hospitals and assessing more antibiotics in the antibiogram, especially of newer quinolones, to prepare more precise local guidelines for empirical therapy.

5. Conclusion:

This study shed light on the importance of antibiotic susceptibility patterns of pathogens implicated in acute bacterial conjunctivitis in children. the main bacteria cause conjunctivitis were Staphylococcus aureus and Pseudomonas aeruginosa. Sensitivity test indicated that Ciprofloxacin, Ceftazidime and Gentamycin were the most effective than other drugs used against isolates identified in this study.

6. Declarations

Ethical approval and consent to participate

applicable

Consent for publication

applicable

Availability of data and material

The dataset generated during this study are available from the corresponding author on reasonable request.

Competing interests

None declared

Funding

No funding

Acknowledgment

We are grateful to all those who participated in this study, namely, the staff of Faculty of Medical laboratory sciences,Omdurman Islamic University, Makkah Eye Hospital and Allwaldin Eye Hospital at Khartoum state.

Supplementary Materials

Ethical clearance letter

Abbreviations

A/C = Amoxicillin/Clavulanic acid.

ATCC = American Type Culture Collection.

CAZ = Ceftazidime.

CIP = Ciprofloxacin.

CLSI = Clinical Laboratory Standard Institute

DST = Drug Susceptibility Test

ER = Erythromycin.

G = Gentamicin.

I = Intermediate.

MM = Millimeters.

R = Resistance.

S = Sensitive.

TE = Tetracycline.

QC = Quality Control

Authors Contribution

N.A,conceptualized the research idea; N.A.designed the study; A.T, A.A, S.A, M.A undertook articles searching, articles assessment, and data extraction; N.A undertook data analysis. All authors interpreted the results and drafted the manuscript. All authors revised and approved the final manuscript and all of them agree to be accounted for the accuracy and integrity of all aspects of the work.

References:

[1] Pippin MM, Le JK. Bacterial Conjunctivitis. StatPearls. Treasure Island (FL)2020.

[2] Palanisamy S, Mathews AD, Murthy SI. A cute bilateral conjunctivitis with nasooral involvement: A rare manifestation of tuberculosis. Indian J Ophthalmol. 2020;68(4):639-40.

[3] Belga S, Gratrix J, Smyczek P, Bertholet L, Read R, Roelofs K, et al. Gonococcal Conjunctivitis in Adults: Case Report and Retrospective Review of Cases in Alberta, Canada, 2000-2016. Sex Transm Dis. 2019;46(1):47-51.

[4] Zhang S, Hu Q, Deng Z, Hu S, Liu F, Yu S, et al. Transmissibility of acute haemorrhagic conjunctivitis in small-scale outbreaks in Hunan Province, China. Sci Rep. 2020;10(1):119.

[5] Baab S, Le PH, Kinzer EE. Allergic Conjunctivitis. StatPearls. Treasure Island (FL)2020.

[6] Bencharki Y, Bouzouba T, Tamym B, Berraho A. [Viral conjunctivitis due to molluscum contagiosum in a young immunocompetent woman]. J Fr Ophtalmol. 2020.

[7] Treister AD, Kraff-Cooper C, Lio PA. Risk Factors for Dupilumab-Associated Conjunctivitis in Patients With Atopic Dermatitis. JAMA Dermatol. 2018;154(10):1208-11.

[8]. Kruse A, Thomsen RW, Hundborg HH, Knudsen LL, Sorensen HT, Schonheyder HC. Diabetes and risk of acute infectious conjunctivitis--a population-based case-control study. Diabet Med. 2006;23(4):393-7.

[9] Kole E, Pugliese A, Cunha BA. Meningococcal conjunctivitis. Heart Lung. 1992;21(1):94-7.

[10] Tsai CY, Huo AP, Chou CT, Wu TH, Tsai YY. Hepatitis, cholangitis, pulmonary hypertension, digital gangrene, and conjunctivitis sicca in a woman with anticentromere antibodies. Eur J Intern Med. 2006;17(5):360-2.

[11] Lacoste MG, Cargnelutti DE, Tamashiro H, Di Genaro MS. Reactive arthritis with conjunctivitis, urethritis and diarrhea in a child: immunological study of potential bacterial trigger. Clin Exp Rheumatol. 2008;26(2):381-2.

[12]. Dogan U, Agca S. Investigation of possible risk factors in the development of seasonal allergic conjunctivitis. Int J Ophthalmol. 2018;11(9):1508-13.

[13] Hazin R, Elia CJ, Putruss M, Bazzi A. Optic nerve injury in a patient with chronic allergic conjunctivitis. Case Rep Neurol Med. 2014;2014:928486.

[14] Francis IC, Lawless MA. Bilateral giant papillary conjunctivitis related to glaucoma drainage surgery blebs. Cornea. 1994;13(5):469.

[15] Li Y, Huang C, Yang X, Zhang X. Ofloxacin laden microemulsion contact lens to treat conjunctivitis. J Biomater Sci Polym Ed. 2020:1-14.

[16] Ahmed AaH, B Profile of Bacterial Conjunctivitis in Sudan. Sch J App Med Sci. 2016;4(48):1217-12211.

[17] Almajeed AAA, Bushara E, Omer NeT, Ibrahim OM, Ibrahem GMJJBP. Non Chlamydial Acute Bacterial Conjunctivitis in Sudanese Children. 2015;6(253):2.

[18] Alrasheed SH, Naidoo KS, Clarke-Farr PCJAV, Health E. Prevalence of visual impairment and refractive error in school-aged children in South Darfur State of Sudan. 2016;75(1):1-9.

[19] Sahu DN, Thomson S, Salam A, Morton G, Hodgkins P. Neonatal methicillin resistant Staphylococcus aureus conjunctivitis. Br J Ophthalmol. 2006;90(6):794-5.

[20] Ahmed OB, Hamdan EMJSJAMS. Profile of bacterial conjunctivitis in Sudan. 2016;4(4B):1217-21.

[21] Morrow GL AR. Conjunctivitis. American family physician. 1998;57(4):735-46

[22] Olatunji F FA, Ayanniyi A, Akanbi A. Nongonococcal bacterial agents of conjunctivitis and their antibiotic susceptibility patterns in Ilorin. Nigeria Afr J Med Med Sci. 2007;36(3):243-7.

[23] Adebayo A PJ, McCormick SA, Shah MK,Huerto RS, Yu G, Milman TS. . hifting trends in in vitro antibiotic susceptibilities for common bacterial conjunctival isolates in the last decade at the New York Eye and Ear Infirmary. Graefe's Archive for Clinical and Experimental Ophthalmology,. 2011;249(1):111-9.

[24] Abdullah FE KM, Waheed S; . Pakistan journal of medical sciences, 2013;29(1):81. Current pattern of antibiotic resistance of clinical isolates among conjunctival swabs. Pakistan journal of medical sciences. 2013;29(1):81.

[25] Michael A BJT. The Etiology and Antibiogram of Bacterial Causes of Conjunctivitis among Patients Attending the Eye Clinic at Rugarama Hospital in South Western Uganda. An International Journal, . 2014;2014(6):378-83.

[26] Okesola A SA. Microbiological profile of bacterial conjunctivitis in Ibadan, Nigeria. Annals of Ibadan postgraduate medicine, . 2010;8(1):20-4.

[27] Blanco C NMX. Antibiotic Susceptibility of Staphylococci Isolates from Patients with Chronic Conjunctivitis: Including Associated Factors and Clinical Evaluation. Journal of Ocular Pharmacology and Therapeutics,. 2013;29(9):803-8.

[28] Khan M KN, Saeed N, Gulab A, Nazeer A; . A study of 530 cases of vernal conjunctivitis from the North West Frontier Province of Pakistan. Pakistan J Ophthalmol. 1986;2(4):111-4. .

[29] Balasopoulou A KP, Pagoulatos D, Plotas P, Makri OE, Georgakopoulos CD, et al. . Alpha molecular epidemiological analysis of adenoviruses from excess conjunctivitis cases. BMC Ophthalmol. 2017;17(1):51.

]30] Mataftsi A KS, Papagianni E, Tsonona V, Mavridou E, Ziakas N, et al. . Eye Contact Lens. Management of Bacterial Conjunctivitis in Children-Preferred Practice Pattern in Northern Greece. 2018;44(1):S373-S4.

[31] Hedberg K RT, Soler JT, White KE, Hedberg CW, Osterholm MT, et al. . Outbreak of erythromycin-resistant staphylococcal conjunctivitis in a newborn nursery. Pediatr Infect Dis J. 1990;9(4):268-73.

[32] Sthapit P TN, Marasini S, Khoju U, Thapa G;. Bacterial conjunctivitis and use of antibiotics in Dhulikhel Hospital-Kathmandu University Hospital. Kathmandu University Medical Journal. 2012;9(2):69-72. .