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Original Research Article

Comparative study of antibiotic sensitivity pattern of bacterial isolates from ocular infections among patients with and without diabetes mellitus

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ABSTRACT

Purpose of the Study: Antibiotic sensitivity pattern of bacterial isolates varies from place to place and time to time. This study is aimed at determining the sensitivity patterns in our setup. In the era of emerging resistance to antibiotics, there is a need to determine the antibiotic sensitivity pattern of bacterial isolates from ocular infections and to compare the antibiotic sensitivity pattern of bacterial isolates in ocular infections among patients with and without diabetes mellitus.

Objectives of the Study: 1. To determine the antibiotic sensitivity pattern of bacterial isolates in ocular infections. 2. To compare the antibiotic sensitivity pattern of bacterial isolates from ocular infections among patients with and without diabetes mellitus. 3. To study the predisposing factors for development of the multidrug resistant bacteria in ocular infections.

Materials and Methods: It was a hospital based cross-sectional study carried out among the patients presenting to Outpatient department of Hassan Institute of Medical Sciences, Hassan, Karnataka from January 2022 to June 2022. The aims and objectives of the intended study were explained to the subjects and informed written consent was taken. Institutional ethical clearance was obtained. Data was collected as per the proforma sheet.

Results: 110 samples were divided into two groups- Diabetics (Group A) & Non diabetics (Group B). Majority 70(63.6%) of samples sent were from ocular pathology Chronic dacryocystitis. Positivity rate of cultures was 31.8%. Most common isolate in both groups was Staphylococcus aureus. 89% of positive culture patients had history of antibiotic abuse. Highest sensitivity was seen with aminoglycosides and resistance was seen with macrolide like azithromycin and fluroquinolone like ciprofloxacin.

Conclusion: Antibiotic sensitivity and resistance patterns of bacterial isolates in ocular infections was similar in both Diabetics (Group A) and Non diabetics (Group B). Highest sensitivity was seen for Amikacin, Gentamicin and Tobramycin in both groups. Highest resistance was seen for Azithromycin, Amoxicillin clavulanic acid, Ciprofloxacin in both groups.

Multidrug resistance was due to previous history of use of antibiotics, injudicious use of antibiotics for viral, allergic and other conditions, incomplete treatment for ocular infections and extended duration of antibiotic usage.

1. Introduction

Ophthalmic infections are a source of great eye morbidity. Diabetes is a global public-health concern. Frequency and pattern of eye infections in diabetics could be different

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from non-diabetics. In diabetes mellitus, some organisms of the normal flora play a pathogenic role when immune function is compromised, which may result in serious infection. Timely institution of appropriate therapy must be initiated to control the infections and thereby minimize ocular morbidity. If they are not treated promptly, it may lead to sight threatening complications.

Antibiotic sensitivity pattern of bacterial isolates varies from place to place and time to time.[1] This study is aimed at determining the sensitivity patterns in our setup.[2] Various studies show contradicting reports regarding bacterial colonization of ocular tissues in diabetes. Hence the study also aims at studying the colonization with multi drug resistant bacteria in diabetics and non-diabetic individuals

In the era of emerging resistance to antibiotics, there is a need to determine the antibiotic sensitivity pattern of bacterial isolates from ocular infections and to compare the antibiotic sensitivity pattern of bacterial isolates in ocular infections among patients with and without diabetes mellitus.

2. Objectives of the Study

1. To determine the antibiotic sensitivity pattern of bacterial isolates in ocular infections.
2. To compare the antibiotic sensitivity pattern of bacterial isolates from ocular infections among patients with and without diabetes mellitus.
3. To study the predisposing factors for development of the multidrug resistant bacteria in ocular infections.

3. Materials and Methods

It was a hospital based cross sectional study carried out among the patients presenting to Outpatient department of Hassan Institute of Medical Sciences, Hassan, Karnataka from January 2022 to July 2022. The aims and objectives of the intended study were explained to the subjects and informed written consent was taken. Data was collected as per the proforma sheet. Institutional ethical clearance was obtained. Patients of all age groups and gender were divided into 2 groups with diabetes mellitus (Group A) and without diabetes mellitus (Group B). Samples were collected from patients who presented with ocular infections like blepharitis, hordeolum, dacryocystitis, conjunctivitis, keratitis and endophthalmitis. Patients who had not given consent, who were presently on antibiotic therapy at the time of examination and with viral and fungal etiologies were excluded from the study.

Patients' diabetic status was assessed by blood sugar levels.

Details regarding past use of antibiotics in terms of dose, regimen, misuse of antibiotics for viral, allergic and other nonbacterial infections, incomplete treatment for ocular pathologies, extended duration of therapy was collected and analyzed.

Depending upon tissues infected, samples were sent as described. Swab from lid margin in blepharitis and hordeolum, swab from fornices in conjunctivitis, Scrapings from cornea in corneal ulcer, lipogranulomatous material from chalazion, corneal button from TPK, excised lacrimal sac in chronic dacryocystitis, aqueous and vitreous tap in endophthalmitis.

Collected samples were transported via appropriate transport media and delivered to the bacteriology laboratory and processed. Culture samples were immediately inoculated into 5% sheep blood and McConkey agar plates, as well as the brain heart infusion broth. Blood agar plates were incubated with 5% carbon dioxide. All culture media was incubated at 37°C for at least 48-72 hours, and bacterial colonies were isolated and identified by using standard operative procedures. Antibiotic susceptibility testing was performed on all bacterial isolates using the Kirby-Bauer disc-diffusion technique as per CLSI guidelines. Antibiotic sensitivity and resistance pattern was analyzed & compared among diabetic (Group A) and non-diabetic (Group B) groups. Predisposing factors for development of the multidrug resistant bacteria in ocular infections were analyzed.

Multidrug resistance bacteria was defined as bacteria which are resistance to 2 or more drugs of different groups.

4. Results

Total of 110 samples were collected from various infected ocular tissues.

We divided the samples into 2 groups, Group A with samples from Diabetics and Group B with samples from Non-Diabetics with 55 samples in each group.

Table 1: Case distribution

Group	Cases	Percentage
Group A (DM)	55	50.0
Group B (Non-DM)	55	50.0
Total	110	100.0

70(63.6%) samples sent were of Chronic dacryocystitis.

Out of 55 samples in Diabetics (Group A), 19(34.5%) samples were positive for organisms. Out of 55 samples in non-diabetics (Group B), 16(29.09%) samples were positive for organisms.

9(25.7%) patients used antibiotics previously for ocular diseases. 10(28.5%) patients used antibiotics injudiciously. 7(20%) patients didn't complete the course of antibiotics, 5(14.2%) patients took drugs for long duration than prescribed and 4(11.4%) patients took appropriate treatment.

The most common isolates isolated in Diabetics (Group A) were Staphylococcus aureus in 4(7.2%) patients

Table 2: Samples distribution

Ocular pathology and sample sent	No. of samples
Chronic dacryocystitis- Conjunctival swab	56(50.9%)
Chronic dacryocystitis- Excised lacrimal sac	14(12.7%)
Internal hordeolum-Swab from lid	10(9.09%)
Keratitis- Corneal scraping	10(9.09%)
Conjunctivitis- Conjunctival swab	10(9.09%)
Acute dacryocystitis- Conjunctival swab	03(2.7%)
Corneal button- Excised button	02(1.8%)
Blepharitis- Swab from lid margin	02(1.8%)
Chalazion- Tissue	01(0.9%)
Endophthalmitis- Vitreous tap	01(0.9%)
Total	110(100%)

Table 3: Isolates distribution

Isolates	Group A (DM)	Group B (Non DM)
Acinetobacter species	3(5.4%)	3(5.4%)
Citrobacter freundii	2(3.6%)	0
Diphtheroid	0	2(3.6%)
Enterobacter aerogenes	1(1.8%)	0
Escherichia coli	2(3.6%)	2(3.6%)
Klebsiella pneumoniae	3(5.4%)	1(1.8%)
Pseudomonas aeruginosa	3(5.4%)	1(1.8%)
Staphylococcus aureus	4(7.2%)	7(12.7%)
Enterobacter cloacae	1(1.8%)	0
Total	19(34.5%)	16(29.09%)

Table 4: History of antibiotic usage distribution

Previous use	Injudicious use	Incomplete treatment	Extended duration of treatment	Appropriate treatment
9(25.7%)	10(28.5%)	7(20%)	5(14.2%)	4(11.4%)

followed by Klebsiella pneumoniae 3(5.4%), Pseudomonas aeruginosa 3(5.4%) and Acinetobacter in 3(5.4%) patients. The most common isolates in non diabetics (Group B) were also Staphylococcus aureus in 7(1%) patients followed by Acinetobacter in 3(5.4%) patients.

Aminoglycosides like amikacin, gentamicin & tobramycin were sensitive in 23(65.71%),23(65.71%) & 15(42.85%) patients respectively.

Amikacin 23(65.71%) had the highest sensitivity & Azithromycin 17(48.5%) had the highest resistance.

In Diabetics, amikacin 14(40%) & ceftazidime 15(42.86%) were the most sensitive drugs. Azithromycin 7(20%) was the resistant drug.

In non diabetics, amikacin 9(251%) & gentamicin 8(22.85%) were the most sensitive drugs. Azithromycin 10(28.57%) & ciprofloxacin 6(17.14%) were the resistant drugs.

Antibiotic sensitivity of Bacterial isolates in Diabetics (Group A)

1. Staph aureus was more sensitive to vancomycin 4(100%), linezolid 4(100%).
2. Acinetobacter had maximum sensitivity to amikacin (100%), ceftazidime (100%) & gentamycin (100%).
3. Klebsiella pneumoniae had maximum sensitivity to amikacin (100%), ceftazidime (100%) & gentamycin (100%).
4. Pseudomonas aeruginosa had maximum sensitivity to ceftazidime (100%).
5. E. coli had maximum sensitivity to amikacin (100%), ceftazidime (100%), gentamycin (100%), levofloxacin (100%), tobramycin (100%).
6. Enterobacter species had maximum sensitivity to amikacin (100%), ceftazidime (100%), gentamycin (100%) levofloxacin (100%) & tobramycin (100%).
7. Citrobacter freundii had maximum sensitivity to azithromycin (100%), ceftazidime (100%), gentamycin(100%) & tobramycin (100%).

Antibiotic resistance of Bacterial isolates in Diabetics (Group A)

1. Staphylococcus aureus had resistance to azithromycin (50%), ciprofloxacin (50%) & doxycycline (25%).
2. Acinetobacter had resistance to azithromycin (66%) & amoxycillin clavulanic acid (33%)
3. Klebsiella pneumoniae had resistance to ciprofloxacin (33%)
4. Pseudomonas aeruginosa had resistance to amikacin (33%) & gentamycin (33%)
5. E. coli had resistance to azithromycin (50%) & amoxycillin clavulanic acid (50%)
6. Enterobacter species had resistance to azithromycin (100%)
7. Citrobacter freundii had resistance to amoxicillin clavulanic acid (50%)

Antibiotic sensitivity of Bacterial isolates in Non diabetics (Group B)

1. Staph aureus showed sensitivity to vancomycin (85.7%), doxycycline (71.4%).
2. Acinetobacter has maximum sensitivity to amikacin (100%), gentamycin (100%).
3. Klebsiella pneumoniae had maximum sensitivity to amikacin (100%).
4. Pseudomonas aeruginosa had maximum sensitivity to amikacin (100%), ceftazidime (100%), gentamycin (100%), levofloxacin (100%) & tobramycin (100%).
5. E. coli has maximum sensitivity to amikacin (100%), gentamycin (100%) & tobramycin (100%).

Table 5: Ocular pathologies distribution

Isolates	Ocular pathologies							
	Chronic dacryocystitis	Acute dacryocystitis	Internal Hordeolum	Corneal ulcer	Conjunctivitis	Corneal button	Vitreous tap	Total
Acinetobacter species	4(3.6%)			1(0.9%)		1(0.9%)		6(5.2%)
Citrobacter freundii			1(0.9%)				1(0.9%)	2(1.8%)
Diphtheroids	1(0.9%)					1(0.9%)		2(1.8%)
Enterobacter aerogenes	1(0.9%)							1(0.9%)
Escherichia coli	2(1.8%)		2(1.8%)					4(3.6%)
Klebsiella pneumoniae			1(0.9%	1(0.9%)	2(1.8%)			4(3.6%)
Pseudomonas aeruginosa	1(0.9%)	1(0.9%)		2(1.8%)				4(3.6%)
Staphylococcus aureus	7(6.3%)		3(2.7%)		1(0.9%)			11(10%)
Enterobacter cloacae	1(0.9%)							1(0.9%)
Total	17(15.45%)	1(0.9%)	7(6.3%)	4(3.6%)	3(2.7%)	2(1.8%)	1(0.9%)	35(31.8%)

Table 6: Antibiotic susceptibility distribution

Antibiotics	Sensitive	Resistant
Amikacin (Ak)	23	1
Amoxycillin Clavulanic acid (AMC)	10	9
Azithromycin (AZM)	11	17
Ceftazidime (Ca)(CAZ)	18	5
Ciprofloxacin (CIP)	6	9
Ceftriaxone (Ci)(CTR)	3	5
Doxycycline (DX)	9	4
Gentamicin(G)	23	2
Linezolid(L)	11	
Ofloxacin (OFX)	1	
Tobramycin (TB)(TOB)	15	2
Vancomycin (VA)	10	

Table 7: Antibiotic susceptibility in Diabetics (Group A)

Diabetics (Group A)			
Antibiotics	**Sensitive**	**Resistance**	**Total**
Amikacin (Ak)	14	1	15
Amoxycillin Clavulanic acid (AMC)	7	4	11
Azithromycin (AZM)	7	7	14
Ceftazidime (Ca)(CAZ)	15		15
Ciprofloxacin (CIP)	4	3	7
Ceftriaxone (Ci)(CTR)	2	2	4
Doxycycline (DX)	4	2	6
Gentamicin(G)	15	1	16
Linezolid(L)	4		4
Tobramycin (TB)(TOB)	10		10
Vancomycin (VA)	4		4

Table 8: Antibiotic susceptibility in non diabetics (Group B)

Non diabetics (Group B)			
Antibiotics	**Sensitive**	**Resistance**	**Total**
Amikacin (Ak)	9		9
Amoxycillin Clavulanic acid (AMC)	3	5	8
Azithromycin (AZM)	4	10	14
Ceftazidime (Ca)(CAZ)	3	5	8
Ciprofloxacin (CIP)	2	6	8
Ceftriaxone (Ci)(CTR)	1	3	4
Doxycycline (DX)	5	2	7
Gentamicin(G)	8	1	9
Linezolid(L)	7		7
Ofloxacin (OFX)		1	1
Tobramycin (TB)(TOB)	5	2	7

Antibiotic resistance of bacterial isolates in non diabetics (Group B)

1. Staph aureus had resistance to azithromycin (85.7%) & ciprofloxacin (71.4%).
2. Acinetobacter had resistance to ceftazidime (100%), amoxycillin clavulanic acid (66%) & tobramycin (66%).
3. Klebsiella pneumoniae had resistance to azithromycin (100%), ceftriaxone (100%) & gentamycin (100%).
4. Pseudomonas aeruginosa had resistance to amoxycillin clavulanic acid (100%) & Azithromycin (100%).
5. E. coli had resistance to amoxycillin clavulanic acid (50%), azithromycin (50%), ceftazidime (50%) & ceftriaxone (50%).

5. Discussion

We compared the antibiotic sensitivity between Diabetics (Group A) & Non-Diabetics (Group B) presenting with ocular infections.

In our study, the rate of positive culture in Diabetics (Group A) 19(34.54%) was significantly higher than in Non-diabetics (Group B) 16(29.09%) which corelates with study done by Adam M et al. [3]

Gram positive cocci like Staph aureus, Gram negative bacilli like Pseudomonas aeruginosa, Enterobacter aerogenes, Acinetobacter, E. coli, Citrobacter freundii, Enterobacter cloacae, Klebsiella pneumoniae were isolated.

Most common isolates in Diabetics (Group A) and Non diabetics (Group B) was Staphylococcus aureus which corelates with the study done by Adam et al. [3]

In all positive isolates, resistance was seen. The reason being majority of them (89%) had inappropriate use of anibiotics. Hence majority of patients had resistance.

In our study, isolates were isolated from ocular pathologies like chronic dacryocystitis acute dacryocystitis, internal hordeolum, corneal ulcer, conjunctivitis, post TPK corneal button & vitreous tap.

The most common organism isolated in chronic dacryocystitis was Staph aureus 7(20%). Out of 17(48.57%) samples isolated from chronic dacryocystitis, 10(58.82%) isolates were Gram negative bacteria & 7(41.17%) were gram negative bacteria. This suggests that Gram negative bacteria were associated with lacrimal duct obstruction which corelates with the study done by S Hoshi et al. [4]

Staph aureus was isolated in 3(8.57%) cases of Internal hordeolum which suggests that Staph aureus was the normal flora inhabiting lid margin as stated by Keshav et al. [5]

Out of 35 isolates, Gram negative isolates were 24(68.5%). Among them, 20(83.3%) Gram negative bacilli & only one Gram negative cocci 4(16.6%) was isolated. Gram positive cocci Staphylococcus aureus 11(31.4%) was isolated and no Gram-positive bacilli were isolated which contradicts the retrospective study conducted by Hayashi Y et al[6] who compared isolates from the conjunctival sac bacterial flora prior to cataract surgery and identified differences of isolates and resistance to antimicrobial agents

In present study, amikacin 23(65.71%), gentamicin 23(65.71%), ceftazidime 18(51.4%) & tobramycin 15(42.85%) had more sensitivity. Azithromycin 17(48.57%) & ciprofloxacin 9(25.71%) had more resistance.

In Diabetics (Group A), gentamicin 15(42.85%), amikacin 14(40%), ceftazidime 15(42.85%) & tobramycin 10(28.57%) had maximum sensitivity. Azithromycin 7(20%) had maximum resistance.

In non-diabetics (Group B), amikacin 9(25.71%) & gentamicin 8(22.85%) had maximum sensitivity. Azithromycin 10(28.57%) & ciprofloxacin 6(17.14) had maximum resistance. This infers that antibiotic sensitivity and resistance patterns in Diabetics (Group A) and Non diabetics (Group B) did not show any significant difference.

In present study, the antibiotic sensitivity of bacteria isolated in patients in Diabetics (Group A) showed following observations. In staphylococcus aureus maximum sensitivity was seen with Linezolid (100%) & vancomycin (100%) & resistance was seen with Azithromycin (50%), Ciprofloxacin (50%) & Doxycycline (25%).

Table 9: Antibiotic sensitivity in diabetics (Group A)

	Ak	AMC	AZM	CAZ	CIP	CTR	DX	G	LE	L	TOB	VA
Staphylococcus aureus	1(25%)	1(25%)	1(25%)		2(50%)	1(25%)	3(75%)	1(25%)		4(100%)		4(100%)
Acinetobacter	3(100%)	2(66%)	1(33%)	3(100%)	1(33%)	2(66%)		3(100%)	2(66%)		2(66%)	
Klebsiella pneumoniae	3(100%)	2(66%)	2(66%)	3(100%)				3(100%)	1(33%)		2(66%)	
Pseudomonas aeruginosa	2(66%)			3(100%)	1(33%)			2(66%)	2(66%)			
Escherichia coli	2(100%)	1(50%)	1(50%)	2(100%)			1(50%)	2(100%)	2(100%)		2(100%)	
Enterobacter aerogenes	1(100%)			1(100%)				1(100%)	1(100%)		1(100%)	
Enterobacter cloacae	1(100%)			1(100%)				1(100%)	1(100%)		1(100%)	
Citrobacter freundii	1(50%)	1(50%)	2(100%)	2(100%)				2(100%)	1(50%)		2(100%)	

Table 10: Antibiotic resistance in Diabetics (Group A)

	Ak	AMC	AZM	CAZ	CIP	CTR	DX	G	LE	L	TOB	VA
Staphylococcus aureus			2(50%)		2(50%)		1(25%)					
Acinetobacter		1(33%)	2(66%)									
Klebsiella pneumoniae					1(33%)							
Pseudomonas aeruginosa	1(33%)							1(33%)				
Escherichia coli		1(50%)	1(50%)									
Enterobacter aerogenes			1(100%)									
Enterobacter cloacae		1(100%)	1(100%)				1(100%)					
Citrobacter freundii		1(50%)										

Table 11: Antibiotic sensitivity in non-diabetics (Group B)

	Ak	AMC	AZM	CAZ	CIP	CTR	DX	G	LE	L	TOB	VA
Staphylococcus aureus	2(28.5%)		1(14.2%)	1(14.2%)	2(28.5%)	1(14.2%)	5(71.4%)	2(28.5%)			1(14.2%)	6(85.7%)
Acinetobacter	3(100%)	2(66%)	2(66%)					3(100%)	1(33%)		1(33%)	
Klebsiella pneumoniae	1(100%)											
Pseudomonas aeruginosa	1(100%)			1(100%)				1(100%)	1(100%)		1(100%)	
Escherichia coli	2(100%)	1(50%)	1(50%)	1(50%)				2(100%)	1(50%)		2(100%)	

Table 12: Antibiotic resistance in non-diabetics (Group B)

	Ak	AMC	AZM	CAZ	CIP	CTR	DX	G	LE	L	TOB	VA
Staphylococcus aureus		1(14.2%)	6(85.7%)		5(71.4%)	1(14.2%)	2(28.5%)					
Acinetobacter		2(66%)	1(33%)	3(100%)							2(66%)	
Klebsiella pneumoniae			1(100%)	1(100%)		1(100%)		1(100%)				
Pseudomonas aeruginosa		1(100%)	1(100%)									
Escherichia coli		1(50%)	1(50%)	1(50%)	1(50%)	1(50%)						

Acinetobacter had maximum sensitivity to Amikacin (100%), Ceftazidime (100%) & Gentamycin (100%) & resistance was seen with Azithromycin (66%) & amoxycillin clavulanic acid (33%)

Klebsiella pneumoniae had maximum sensitivity to Amikacin (100%), Ceftazidime (100%) & Gentamycin (100%) & resistance seen with Ciprofloxacin (33%)

Pseudomonas aeruginosa had maximum sensitivity to Ceftazidime (100%) & resistance to amikacin (33%) & gentamycin (33%)

E. coli had maximum sensitivity to amikacin (100%), ceftazidime (100%), gentamycin (100%), Levofloxacin (100%), tobramycin (100%) & resistance to azithromycin (50%) & amoxycillin clavulanic acid (50%)

Enterobacter species had maximum sensitivity to Amikacin (100%), ceftazidime (100%), gentamycin (100%) levofloxacin (100%) & tobramycin (100%) & resistance to azithromycin (100%)

In non-diabetics (Group B), antibiotic sensitivity showed following observations- Staph aureus showed sensitivity to vancomycin (85.7%), doxycycline (71.4%) & resistance to azithromycin (85.7%) & ciprofloxacin (71.4%)

Klebsiella pneumoniae had maximum sensitivity to amikacin (100%) & resistance to azithromycin (100%), ceftriaxone (100%) & gentamycin (100%)

Pseudomonas aeruginosa had maximum sensitivity to amikacin (100%), ceftazidime (100%) gentamycin (100%), levofloxacin (100%) & tobramycin (100%) & resistance to amoxycillin clavulanic acid (100%) & azithromycin(100%)

E. coli has maximum sensitivity to amikacin (100%), gentamycin (100%) & tobramycin (100%) & resistance to amoxycillin clavulanic acid (50%), azithromycin (50%), ceftazidime (50%) & ceftriaxone (50%).

Acinetobacter has maximum sensitivity to amikacin (100%), gentamycin (100%) & resistance to ceftazidime (100%), amoxycillin clavulanic acid (66%) & tobramycin (66%)

6. Conclusion

Antibiotic sensitivity and resistance patterns of bacterial isolates in ocular infections was similar in both Diabetics (Group A) and Non diabetics (Group B). Highest sensitivity was seen for Amikacin, Gentamicin and Tobramycin in both groups. Highest resistance was seen for Azithromycin, Amoxicillin clavulanic acid and Ciprofloxacin in both groups.

Multidrug resistance was due to previous history of use of antibiotics, injudicious use of antibiotics for viral, allergic and other conditions, incomplete treatment for ocular infections and extended duration of antibiotic usage.

7. Source of Funding

None.

8. Conflict of Interest

None.

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