

A case control study of ophthalmia Neonatorum in Kaduna II: Causative agents and their antibiotic sensitivity.

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Summary

Aim:- To identify the causative agents of ophthalmia neonatorum and their antibiotic sensitivity in the hospitals of study.

Patients and methods:- A case-control study of ophthalmia neonatorum was carried out in 6 hospitals in Kaduna metropolis in northern Nigeria. Two hundred cases were matched with two hundred controls.

Results:- The male to female ratio was 1.1:1. The mean age of the patients was 8.9 days, and range was birth to 28 days. The age at the onset of the symptoms was birth to 27 days with a mean of 3.9 days. The most common pathogen isolated in this study was *Staphylococcus aureus*, both in cases (69.7%) and in controls (48%). Only one case of *Neisseria gonorrhoea* was found. Thirteen and four *E. coli* were isolated from cases and control while 7 and 31 *Staphylococcus epidermidis* were isolated from cases and controls respectively. Giemsa staining carried out in only 3 out of the 6 hospitals yielded 9 and 3 isolates of *Chlamydia trachomatis* in cases and controls respectively. The percentage sensitivity of *Staphylococcus aureus* to penicillin, chloramphenicol, tetracycline, erythromycin and gentamicin were 3, 73, 37, 59 and 77 respectively. The corresponding sensitivity of *E. coli* to the above antibiotics was 0, 69, 46, 10 and 62 respectively.

Conclusion:- Most of the cases of ophthalmia neonatorum are mild.

Keywords: *Ophthalmia neonatorum, Gonococcal, Chlamydial, Staphylococcal, Invitro, Sentivity, Antibiotics.*

Résumé

But:- Identifier les agents provocateurs d'ophtalmie néonatorum et leur sensibilité antibiotiques dans les hôpitaux d'étude.

Patients et méthodes:- Une étude de cas de contrôle d'ophtalmie néonatorum a été effectuée dans 6 hôpitaux de la métropole de Kaduna au Nord du Nigeria. Deux cents cas ont été opposés aux deux cents cas de contrôles.

Résultats:- Un rapport sexe masculin-sexe féminin était 1, 1:1. L'âge moyen des patients était 8, 9 jours, et de l'ordre de la naissance au 28 ans. L'âge à la première attaque des symptômes était naissance au 27 jours avec un moyen de 3, 9 jours. La pathogène la plus courante isolée dans cette étude était *staphylococcus aureus*, dans les cas 69, 7% et les contrôles 48% les deux. On a trouvé un seul cas de *neisseria gonorrhoeae*. Treize et quatre *E. coli* ont été isolés chez les cas et les contrôles tandis que 7 et 31 *staphylococcus epidermidis* ont été isolés des cas et des contrôles respectivement. La teinture Giemsa effectuée seulement dans 3 entre les 6 hôpitaux a donné 9 et 3 isolés de *Chlamydia trachomatis* chez les cas et les contrôles respectivement. Le

pourcentage de la sensibilité du *staphylococcus aureus* à la pénicilline, au chloramphénicol, à la tétracycline, à l'érythromycine et gentamicine étaient 3, 73, 37, 59 et 77 respectivement. La sensibilité correspondante de *E. coli* par rapport aux antibiotiques cités ci-dessus était 0, 69, 46, 10, et 62 respectivement.

Conclusion:- La plupart des cas d'ophtalmie néonatorum sont bénins.

Introduction

The conjunctiva is sterile at birth. Being the exposed part of the eye, however, the cornea and conjunctiva are the most frequently infected. The various saprophytic bacteria that are regarded as the most constant normal inhabitants of the conjunctiva are *Corynebacterium xerosis* and *Staphylococcus epidermidis*.¹ The majority of conjunctival infections are bacterial or viral. Fungal infections are rare.¹

The World Health Organisation's definition of ophthalmia neonatorum² is "any conjunctivitis with discharge occurring during the first 28 days of life."

The incidence, aetiology and relative prevalence of the disease in a community depends on whether a prophylaxis is applied at birth or not, and the prevalence of sexually transmitted disease agents in pregnant women.³ Incidence of 1 - 24 per 100 live births have been reported from various parts of the world.³

Ophthalmia neonatorum can be microbial or chemical in origin. The microbial causes can be broadly subdivided into 2 groups. First is the sexually transmitted disease agents acquired by infants from the mother during the process of parturition. The second group is that of other bacterial ophthalmia neonatorum. *Chlamydia trachomatis* and *Neisseria gonorrhoea* are the most frequently identified and the most intensively studied agents in the first group.³ The reservoir of infection in the microbial type is the pregnant woman with gonococcal or chlamydial infection. The risk of gonococcal and chlamydial ophthalmia neonatorum in the absence of prophylaxis can be estimated from the prevalence of genital infections in pregnant women.

The objective of this study is to determine the causative agents of ophthalmia neonatorum and their invitro sensitivity to antibiotics in Kaduna metropolis.

Materials and methods

Patients were infants aged 0 - 28 days, with their mothers who presented at postnatal clinic, postnatal ward, paediatric out patient or intensive care baby unit of:

1. Kawo Maternal and Child Health Clinic, Kaduna
2. Tudun Wada Maternal and Child Health Clinic, Kaduna
3. Kaduna State General Hospital (Dutse) Tudun Wada, Kaduna

4. Ahmadu Bello University Teaching Hospital, Kaduna (ABUTH)
5. Nigerian Army Reference Hospital, Kaduna (NARHK) and
6. National Eye Centre, Kaduna.

The study was carried out in the above 5 Health facilities located at different areas of the city. Two cases who presented at the National Eye Centre, Kaduna during the period were also included. Hospital (1) and (2) are primary health centres, (3) is a General Hospital, while (4) and (5) are tertiary health facilities. Cases were babies who have conjunctivitis with discharge in one or both eyes within the age of 0 - 28 days. Controls were babies aged 0 - 28 days without conjunctivitis or discharge. The study was carried out over a period of about 3 months from 1st of February to the 27th of April, 1998, when 200 cases had been seen in all the hospitals. The 5 hospitals were covered through twice daily visits to hospitals 1, 2, and 3, and a daily visit to hospitals 4 and 5. The cases were matched with 200 controls. The nature and the objectives of the study were explained to the parent(s) Informed consent of the parent or the Caretaker was sought verbally. Clinical history was obtained and recorded in each case using the questionnaire for the study. This included history of the symptoms such as its duration, previous medication (traditional and orthodox), fever, activity, irritability or lethargy, diarrhoea, vomiting, jaundice, birth weight and gestational age.

Ocular examination was performed to assess the severity of the conjunctivitis. The study was endorsed by the ethical committee of the National Eye Centre, Kaduna. Two conjunctival swabs were taken. One was used to prepare a slide for Gram staining, and the second for antibiotic sensitivity.

Conjunctival scraping was performed at hospitals (1), (2), and (3) only. It was attempted but discontinued at (4) and (5) due to high refusal rates by mothers. The conjunctiva was gently stroked with the blunt edge of a sterile (size 15) scalpel blade. Enough conjunctival epithelial tissue was obtained.

The specimen thus obtained was gently placed over a labeled glass slide. The slide was air dried for 10 minutes and then fixed with absolute methanol for 5 minutes and again air dried.

The slide of fixed conjunctival epithelial cells was stained with Wright Giemsa stain. The slides were viewed and read under the microscope with a magnification of x1000. Intracytoplasmic inclusion bodies of Halberstadter-Prowazek were searched for in the epithelial

cells by carefully going through the slides systematically.

The Gram stained slides were similarly examined for Gram positive or Gram negative bacteria. The swabs for culturing were carefully transferred into a transport medium (Transwab) and taken to the laboratory at the Microbiology Department of National Eye Centre, Kaduna where they were inoculated into blood agar, nutrient agar and Mac Conkey agar. The chocolate Agar plates were incubated in carbon dioxide us-

ing candle extinction Jars to promote the growth of *Neisseria gonorrhoea*. The plates were incubated for 24 to 48 hours at 37°C. All the isolates were identified by standard methods. The major isolated organisms had their antibiotic sensitivity determined by standard disc diffusion technique⁴ using Penicillin, Gentamicin, Ampicillin, Oxacillin, Erythromycin, Chloramphenicol, Septrin, Streptomycin, Tetracycline, Cefotaxim and Kanamycin.

Follow up

Babies were follow up at 72 hours and one week after they were first seen, and finally at the end of the neonatal period. For those recruited at about 3 weeks of age or more, the final visit was at 6 weeks of age. At each visit, the patient was reassessed for persistence, cessation or reduction of discharge. They were also examined with loupe for any complication and necessary measures such as changing or discontinuing the antibiotics was taken. Babies suspected to have gonococcal infection were initially treated with syrup erythromycin estolate and topical 1% chloramphenicol eye ointment. Those suspected to have chlamydial or staphylococcal ophthalmia were initially treated with oral erythromycin estolate and topical chloramphenicol 1% ointment.

The data collected were analysed with the computer using the Data Base Management Software and Statistical Analysis Software (Dbase IV and EPI-Info 6) determined the statistical significance of the findings.

Results

During the 3 months of the study (February to April, 1998), 200 cases were matched with 200 controls. One hundred and seventeen (58.5%) of the cases were delivered at the 5 hospitals, 11 (5.5%) of the cases were delivered in other hospitals 69(35%) were delivered at home, 2 babies were delivered in a chemist shop, and 1 baby delivered in a Church. All except the two seen at the National eye centre were brought to the various hospitals for vaccination.

Table 1 Comparison of isolates from cases of ophthalmia neonatorum and controls with their P-values

Organisms	Isolates from cases	Percentage of total	Isolates from controls	Percentage of total	P-value
Staphylococcus aureus	85	69.7	38	48.1	P<0.01
Escherichia coli	13	10.7	5	6.3	P<0.05
Chlamydia trachomatis	9	7.4	3	3.8	P>0.05
Staphylococcus epidermidis	7	5.7	31	39.8	P<0.01
Beta-haemolytic strept	3	2.5	2	2.5	P>0.05
Klebsiella species	2	1.6	0	0	P>0.05
Pseudomonas species	1	0.8	0	0	P>0.05
Corynebacterium species	1	0.8	0	0	P>0.05
Neisseria gonorrhoea	1	0.8	0	0	P>0.05
Total	122	100%	79	100%	

Distribution of Ophthalmia neonatorum

The age range of the patients was 0 - 28 days with a mean of 8.99 (about 9) days. There were 106 males and 94 females giving a male: female ratio of 1.1:1. The main observable symptom of ophthalmia neonatorum which mother complained about was eye discharge. This was sometimes associated with eye redness or lid swelling.

Table 2 Percentage sensitivity of isolated bacteria from eyes of cases

	Staph. aureus	E.coli	B-haem. Strept.
Penicillin (1.5units)	3	0	0
Ampicillin (25ug)	6	23	0
Streptomycin (25ug)	37	-	-
Chloramphenicol (10ug)	73	69	67
Tetracycline (50ug)	37	46	33
Erythromycin (10ug)	59	10	33
Septrin (25ug)	29	23	33
Oxacillin (5ug)	34	8	33
Cefotaxim (30ug)	86	54	100
Kanamycin (30ug)	78	70	33
Gentamicin (30ug)	77	62	67

Table 3 Percentage sensitivity of isolated bacteria from eyes of control babies

	Staph. aureus	E.coli
Penicillin (1.5units)	3	0
Ampicillin (25ug)	45	0
Streptomycin (25ug)	55	0
Chloramphenicol (10ug)	70	0
Tetracycline (50ug)	45	50
Erythromycin (10ug)	69	0
Septrin (25ug)	67	25
Oxacillin (5ug)	6	0
Cefatoxim (30ug)	6	0
Kanamycin (30ug)	3	-
Gentamicin (30ug)	76	76

Table 4 Types of eye discharge produced by the major isolated bacteria

Bacteria	Type of eye discharge		
	Purulent % of total isolate	Mucopurulent % of total isolate	Mucoid % of total isolate
Staphylococcus aureus	45	22	33
B-Hemolytic strept.*	100	-	-
E-coli	38	16	46
Staphylococcus epidermidis	43	16	41
Neisseria gonococcus*	100	-	-
Chlamydia trachomatis	44.5	11	44.5

* Only 3 isolates

* Only 1 isolate

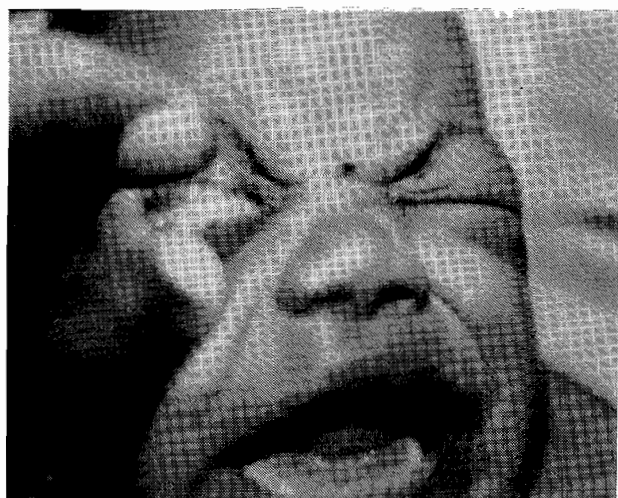


Fig. 1 Staphylococcal ophthalmia neonatorum

Duration of symptoms

Duration of eye discharge ranged from 0 - 21 days with a mean of 5.3 days.

Age at onset

The age of the babies when eye discharge was first noticed ranged from birth to 27 days, with a mean of 3.9 days.

Causative agents of ophthalmia neonatorum

A total of 122 micro-organisms were isolated from cases, consisting of 113 bacteria and 9 *Chlamydia trachomatis*. Gram-staining revealed 96(85%) Gram positive and 17 (15%) Gram negative bacteria. Out of the 200 cases, 111 (55%) had positive isolates, from culture, while 89 (45%) yielded no growth after 48hrs of incubation. One hundred and nine were pure cultures while 2 were mixed growth of 2 bacteria each. The major bacteria isolated were *Staphylococcus aureus* 85 (69.7%) *Escherichia coli* 13 (10.7%), *Chlamydia trachomatis* 9(7.4%), *Staphylococcus epidermidis* 7(5.7%), *Betahaemolytic strept.* 3(2.5%) *Klebsiella species* 2(1.6%), *Pseudomonas species* 1(0.8%), *Neisseria gonorrhoea* 1(0.8%) and *Corynebacterium species* 1(0.8%).

All the micro-organisms isolated in cases and controls and their p-value are shown in table 1.

Out of the 140 patients seen in the 3 hospitals where Giemsa staining was carried out, it showed chlamydial inclusion bodies in 9 patients.

For control babies, a total of 79 isolates were made consisting of 76 bacteria and 3 *Chlamydia trachomatis*. Gram positive bacteria formed 69 (91%) while gram negative bacteria accounted for 7 (9%) of bacterial isolates. These were *Staphylococcus aureus* 38(48.1%) *Staphylococcus epidermidis* 31(39.8%), *Escherichia coli* 5(6.3%), *Chlamydia trachomatis* 3(3.8%) and *Klebsiella species* 2(2.5%) Table 1

There is statistical significance between cases and controls in numbers of *Staph. aureus*, *E.coli* and *Staph. epidermidis* isolated.

The sensitivity of isolated bacteria from babies with ophthalmia neonatorum and control babies were tested. The percentage sensitivity of *Staphylococcus auerus* to penicillin, chloramphenicol, tetracycline, erythromycin and gentamicin were 3, 73, 37, 59 and 77 respectively. The corresponding sensitivity of *E. coli* to the above antibiotics was 0, 69, 46, 10 and 62 respectively. Tables 2 and 3.

The micro-organisms isolated were analysed with respect to low maternal social status, age of the baby at the time of onset of the discharge and history of vaginal discharge in mother. The types of eye discharge are shown in Table 4 and Fig. 1.

Purulent eye discharge resulted from 45% of infection by *Staphylococcus aureus*, 100% of *Beta haemolytic streptococcus*, 38% of infection by *E. coli* 44.5% of *Chlamydia trachomatis* and 43% of infection by *Staphylococcus epidermidis*. The only case of *Neisseria gonorrhoeal* infection had purulent discharge. Mucopurulent discharge resulted from 22% of *Staphylococcus aureus* infection, 16% each of *E.coli* and *Staphylococcus epidermidis* infections as well as 11% of chlamydial infection. Thirty three percent

of *Staphylococcus aureus* infection resulted in mucoid discharge, while 46% of *E.coli*, 41% of *Staphylococcus epidermidis* and 44.5% of chlamydial infection had mucoid discharge.

Maternal vaginal discharge

Maternal vaginal discharge was associated with 32% of *Staphylococcus aureus*, 77% of *E.coli* and the only neisseria gonococcal infection. In 2 out of 4(50%) of purely chlamydia infection there was positive history of maternal vaginal discharge.

Low maternal social status

Twenty eight percent (28%) of *Staphylococcus aureus* infection, 23% of *E. coli*, 100% of infection by *Klebsiella species* and 44% chlamydial infection were associated with low maternal social status.

Age of onset

The age of onset of *Staphylococcus aureus* ophthalmia ranged from birth to 27 days. However, most infections occurred within the first few days of birth. Twenty nine percent occurred at birth and within the first 3 days of life 65% had manifested. Seventy two percent and 95% of infection had manifested by the first and second week respectively. The mean age of onset was 4 days.

The mean age of onset of *E.coli* ophthalmia was 2.3 days and the range was from birth to 14 days. Onset of chlamydial ophthalmia ranged from birth to 14 days with a mean of 3.5days.

Previous medication

In 50 babies some form of medication had been administered prior to presentation. Eye drops or ointments procured without prescription, in most cases, accounted for 31 (62%) of these. Sixteen patients did not know the name of the eye drops, while 12 and 3 patients applied chloramphenicol and gentamicin eye drops respectively. Systemic antibiotics were administered in 7 cases. These were the cases admitted in hospitals for other systemic illnesses including neonatal jaundice, neonatal sepsis, impetigo etc. In 11 patients breast milk was applied to the eye while traditional eye medicine was applied in one baby.

Follow up

A total of 134 patients came for follow-up. Most (70%) of the follow-up visits were made at one week after the first assessment of the baby. Only 21(16%) came for follow up at 4weeks after first assessment. One baby had persistent conjunctivitis and was found to have a blocked nasolacrimal passage and therefore referred for treatment at the National Eye Centre, Kaduna. The baby with gonococcal ophthalmia neonatorum was one of the 2 cases who presented at National Eye Centre but mother absconded after two days of hospitalization when eye discharge had markedly reduced. A premature baby died on admission in a paediatric ward.

Complication

No corneal complication was recorded in any of the cases.

Discussion

Although the age at onset ranged from birth to 27 days, most of the patients presented within the first few days of life. This agrees with the findings of previous workers.^{5,6} The mean age at onset in this study was 8.9 days. This is within the age range previously found by other workers^{7,8} who found 5 - 14 days, 1 - 13 days and 1 - 7 days for chlamydial, gonococcal and staphylococcal ophthalmia neonatorum respectively. The mean age at onset for the various isolated micro organisms in this study are 4 days, 5 days and 2.3 days for staphylococcal, chlamydial and *E.coli* ophthalmia neonatorum. The only case of gonococcal ophthalmia neonatorum found in this study was noticed at the age of 2 days. These findings are comparable to those of other workers,^{3,7,8} but in variance with Ugboode's⁵ findings in Zaria.

The duration of symptoms of ophthalmia in this study ranged from 1 - 21 days. The effect of previous medication on duration of symptom is not clear since 50% of patients with positive bacterial isolates have applied some eye medication and 50% have not.

Staphylococcus epidermidis, which is often regarded to be commensal and non pathogenic, has been found to be responsible for 5.7% of the cases in this study, 71% of which were unilateral. Other workers^{6,9} have documented the pathogenic role of *Staphylococcus epidermidis*. Involvement of *Escherichia coli* in aetiology of ophthalmia neonatorum has been similarly well documented.^{6,9,10}

Out of the 200 conjunctival swabs processed from cases, 113 bacteria were isolated. Eighty five (69.5%) of these were *Staphylococcus aureus*. *Staphylococcus aureus* appears to be playing an increasing role in the aetiology of ophthalmia neonatorum in developing countries. *Neisseria gonorrhoea*, which was often quoted to be among the most common cause of ophthalmia neonatorum in these communities³ is less frequently isolated in recent studies. Amoni¹¹ in his investigation of acute purulent conjunctivitis in Nigerian children found *Staphylococcus aureus* and *Neisseria gonorrhoea* as the most common pathogens responsible. Sixteen neonates formed part of the study. In Port Harcourt, Ibe et al¹² found *Staphylococcus aureus* as the most common isolate in neonatal eye infections. As found in the present study, only 1 case of gonococcal infection was found. Blankson and his colleague¹³ found *Staphylococcus aureus* to be the most common isolate in special care baby unit of the teaching hospital, Enugu. In Lagos, Iroha⁶ found *Staphylococcus aureus* to be the most common (37.4%) isolate from conjunctival swabs of neonates, no single case of *Neisseria gonorrhoea* was found. Findings of the above workers and that of Ernest et al¹⁴ in which conjunctival specimens were immediately inoculated into the culture media lend more support to the relative absence of *Neisseria gonorrhoea* in the present study which arguably could be attributed to the loss of the delicate bacteria (*Neisseria gonorrhoea*) on transit despite the use of transport medium.

Ugboode's findings⁵ also support the increasing role of *Staphylococcus aureus* in ophthalmia neonatorum development. In developed countries, *Staphylococcus aureus* is also being increasingly implicated in the aetiology of ophthalmia neonatorum as found by many workers.^{6,15}

Escherichia coli was isolated in 13 (10.72%) and *Staphylococcus epidermidis* in 7(5.7%) of the patients in the present study.

In the study by Iroha et al⁶ the 2 bacteria above formed 7.6% and 12% of the isolates respectively.

Chlamydia trachomatis was isolated in 9(7.4%) patients. This does not represent the real rate of occurrence of chlamydial ophthalmia neonatorum since only 3 out of the 5 hospitals participated due to high refusal rate for conjunctival scraping in the 2 remaining hospitals. A total of 112 patients seen in the above 3 hospitals were those who had conjunctival scraping performed. Isolation rate of *Chlamydia trachomatis* could have been higher if all the 200 cases were investigated.

In a study of neonatal conjunctivitis in Ilorin, Ernest et al¹⁴ found 36 (30.25%) cases of Chlamydial ophthalmia out of 119 cases. Each of *Staphylococcus aureus* and *Staphylococcus epidermidis* was responsible for 15.13% of the cases. Similarly, in his more recent series of 112 babies in Ilorin, Kolade¹⁶ found 36 babies (32.1%) to have chlamydial neonatal conjunctivitis, while each of *Staphylococcus aureus* and *Staphylococcus epidermidis* was responsible for 13.5% of the infections.

Staphylococcus aureus was the most common (48%) pathogen isolated from control eyes with *Staphylococcus epidermidis* forming 39.8%. The high percentage of *Staphylococcus aureus* in normal (control) eyes is surprising. However, there is a significant difference between the values in cases (85) and controls (38). Other workers^{5, 9} found *Staphylococcus aureus* in the eyes control babies.

Significantly, more *Staphylococcus epidermidis* was isolated in control eyes than in cases as expected since it is regarded to be a normal skin commensal. Other commensals such as *Corynebacterium species* were not found in control eyes in this study. It is surprising that the only *Corynebacterium species* isolated was from a symptomatic eye, but since no other organism was found with it, it was regarded to be responsible for the infection.

Antibiotic sensitivity of the major pathogens isolated was tested. Tables 2 and 3. *Staphylococcus aureus* was found to be only minimally sensitive to penicillin (3%) and ampicillin (6%) respectively. This high rate of resistance coupled with the findings of other workers¹⁰ who found sensitivity (33%) of *Neisseria gonorrhoea* to penicillin implies that penicillin should not be the drug of choice for treatment of ophthalmia neonatorum in this environment. This is consistent with findings of other workers.⁷

Many workers^{5,6} have also found high resistance rate of *Staphylococcus aureus* to penicillin and ampicillin. Seventy three percent (73%), 37% and 59% of *Staphylococcus aureus* were sensitive to chloramphenicol, tetracycline and erythromycin respectively. Despite widespread use of chloramphenicol both as eye and systemic preparations, it was still found to be fairly effective in staphylococcal infection in this study. This finding is in contrast to the findings of other workers^{5,6} who found 33% and 28% sensitivity in their isolates and 100% sensitivity to erythromycin.

The finding of 86% and 75% sensitivity of

Staphylococcus aureus to cefotaxim and gentamicin respectively in this study indicate that they may be the drugs of choice for treatment of ophthalmia neonatorum instead of penicillin in this environment. Considering the high cost and relative scarcity of Cefotaxim, however, the present study indicates that gentamicin is the first drug of choice for treatment of ophthalmia neonatorum. Contrary to these findings however, Ugbo⁵ and Iroha⁶ found only 50% and 32% sensitivity to gentamicin respectively.

The gram negative bacterium mainly found in this study (*Escherichia coli*) was 70% and 60% sensitive to kanamycin and gentamicin respectively. It was also sensitive to chloramphenicol (69%), tetracycline (46%) and cefotaxim (54%). Clinical response of *Chlamydia trachomatis* to erythromycin and chloramphenicol eye ointment was assessed and found to be 88%.

Conclusion

This study show that ophthalmia neonatorum is common in this community. The relative absence of *Neisseria gonorrhoea* in this study and the seemingly mild course of the disease found does not imply that ophthalmia neonatorum is always a benign or self limiting disease.

1. Considering cost and availability, the drug of first choice for treatment of ophthalmia neonatorum indicated by this study is gentamicin or chloramphenicol eye drop for mild cases and systemic gentamicin and topical chloramphenicol for severe cases.
2. Introduction of eye prophylaxis with povidone-iodine since it is devoid of the dreaded side-effects of silver nitrate. Traditional birth attendants should be taught how to apply eye prophylaxis when taking delivery at home.
3. Health education of parents to avoid application of harmful traditional eye medicine. Provision of affordable treatment facilities for sexually transmitted diseases, especially for pregnant women.
4. Health education by nurses and primary health workers in antenatal clinic should include causes and prevention of ophthalmia neonatorum, including need to treat vaginal discharge in pregnancy.

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