

Prevalence and antimicrobial susceptibility of *Neisseria gonorrhoeae* isolated from patients in various locations of Kaduna state, Nigeria

¹E. D. Jatau, ¹M. Galadima, ²L. E. Odama and ³J. K. P. Kwaga

¹Department of Microbiology, Ahmadu Bello University, Zaria, Nigeria, ²National Institute for Pharmaceutical Research and Development, Abuja, Nigeria, ³Department of Veterinary Public Health, and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria

Reprint requests to: Dr. M. Galadima, Department of Microbiology, Ahmadu Bello University, Zaria, Nigeria

Abstract

Background/Method: A total of one thousand seven hundred and fifteen (1715) patients, consisting of nine hundred and thirty eight (938) female and seven hundred and seventy seven (777) male patients were screened for *Neisseria gonorrhoeae* infection from seven locations representing the four geographical zones of Kaduna State.

Results: Out of the 1715 patients screened, 275 (16.03%) were found positive for *N. gonorrhoeae* infection. The prevalence rate of *N. gonorrhoeae* infection per location were in Zaria 70 (22.08), Kaduna 32 (21.33%), Pambeguwa 58 (18.35%), Kafanchan 25 (16.66%), Kachia 19 (12.66%), Giwa 31(11.70%), and Soba 34 (10.76%). Results showed that the age group 15-20 years had the highest prevalence of infection (31.05%) followed by the age group 36-40 years and 21-25 years with prevalence of 26.06% and 22.80% respectively. The highest prevalence in males (23.91%) occurred in the age group 36-40 years while the highest prevalence of infection in the female patients (11.18%) was found in the age group 15-20 years. Out of the 275 gonococcal isolates, 225 (81.82%) were resistant to penicillin, 206 (74.91%) to ampicillin, 122(44.36%) to tetracycline, 34(12.36%) isolates to erythromycin, and 16(5.82%) isolates were resistant to gentamicin. All the 275 *N. gonorrhoeae* isolates were sensitive to Ceftriaxone, Cefprozime and Ofloxacin. Out of the 225 penicillin resistant strains of *N. gonorrhoeae* 189 (84%) were positive for beta-lactamase production. The prevalence of beta-lactamase (Penicillinase) producing *N.gonorrhoeae* (PPNG), was statistically significant with $X^2 = 12.25$ which was greater than X^2 t value. Generally there was high prevalence rate of *N.gonorrhoeae* infection in Kaduna State and the

Conclusion: *N. gonorrhoeae* isolates were highly resistant to most commonly used antibiotics in the treatment of gonorrhoea in Kaduna State.

Key words: Gonorrhoea, antibiotic susceptibility, treatment

Introduction

Gonorrhoea is a common disease that has been known since antiquity, which is still a common bacterial infection, caused by *N. gonorrhoeae*, a gram-negative coccus usually found in pairs.^{1,2} Gonorrhoea, a bacterial infection of male and female genital mucosa, has been endemic throughout the world for many centuries and from earliest history to modern days gonococcal urethritis has continued to be a medical problem of serious impact.³

The Centre for Disease Control and Prevention (CDC), Atlanta Georgia, U.S.A. in 1992 reported that in 1991 there was 586, 638 reported cases of gonorrhoea in the U.S.A. The prevalence rates of gonorrhoea and its complications such as urethral stricture, epididymitis, pelvic inflammatory disease (PID), infertility, ophthalmia neonatorum, etc., in urban and rural areas of tropical Africa are alarmingly high.⁴ The world Health Organization Expert Committee on gonococcal infection in 1963 reported an infection rate of 49076 per 100,000 among adult population in Lagos, Nigeria.⁵ That was the highest prevalence rate in the world.

In a study conducted between 1977 and 1981 on 3089 patients attending STD clinic ABUTH, Zaria, a 28.4% prevalence rate of post-pubertal gonorrhoea was reported.⁶ Penicillins have been the drugs of choice for the treatment of gonorrhoea until 1975 when the first cases of penicillinase producing *Neisseria gonorrhoeae* (PPNG) were noted in the Phillippines.⁷ These strains were reported to be spreading throughout the world thereby necessitating radical and expensive changes in the therapy for gonorrhoea.⁸

In Nigeria isolation of seven PPNG strains from patients attending STD clinic Ahmadu Bello University Teaching Hospital Zaria was made in 1983.⁶ In 1987 it was estimated that PPNG comprised 70-80% of gonococcal isolated

in Nigeria.⁹ It was reported¹⁰ that 59 (92.2% of the 64 gonococcal isolates from mjale patients at the special treatment clinic, University College Hospital, Ibadan were PPNG and 5 (7.8%) were non PPNG.

This study was undertaken to determine the prevalence of *Neisseria gonorrhoeae* and its susceptibility to commonly used antibiotics for the treatment of gonorrhoea in Kaduna State.

Materials and methods

Study area

In this study we zoned Kaduna State into four geographical areas comprising; Zone A: Birnin Gwari, Kaduna, Chukun. Kaduna town was chosen as a representative.

Zone B: Zaria, Giwa and Makarfi. Zaria and Giwa were chosen as representatives.

Zone C: Saminka, Soba and Pambeguwa. Soba and Pambeguwa were chosen as representatives.

Zone D: Kafanchan, Zonkwa and Kachia. Kafanchan and Kachia were chosen.

Study population

This study was carried out between April 1995 and August 1997 on 1715 patients who were present at various clinics at the chosen locations. The population was made up of 938 females and 777 males.

Culture media

Thayer-martin medium - a selective medium for the isolation of pathogenic *Neisseria* was purchased from Oxoid, Unipath, Ltd. U.K. and Stuart's transport medium was purchased from Difco Laboratories, Detroit, Michigan, U.S.A.

Isolation

Endocervical swabs (ECS) and urethral swabs (US) were collected, and processed for the isolation of *Neisseria gonorrhoeae* as described by previous workers.⁶

Sensitivity testing

Pure *Neisseria gonorrhoeae* isolates were subjected to antimicrobial susceptibility test using disc diffusion method.¹¹

Penicillin G, 2.4 mcg, ampicillin 10 mcg, Tetracycline 10 mcg, Erythromycin 5 mcg, Ceftriaxone 0.1mcg, Cefuroxime 10mcg and Ofloxacin 10 mcg were purchased from Oxoid, Unipath U.K. Reference *Neisseria gonorrhoeae* strains were obtained from the WIIO collaborating center for reference and Research in gonococcal, Copenhagen, Denmark. An inoculum of 10^9 c.f.u. per ml of each *N. gonorrhoeae* was made from a 24 hour-growth on chocolate agar plate. The inoculated plates were allowed 15 minutes at room temperature to dry before the antibiotic discs were placed slightly and pressed down. The inverted plates were incubated in an atmosphere of 5% CO₂ at 35°C for 24 hours. The zone of inhibition was measured and interpreted (National Committee on Clinical Laboratory Standards [NCCLS] guidelines).

Minimum inhibitory concentration

The minimum inhibitory concentration (MICs) of penicillin G, Ampicillin, Tetracycline, Erythromycin, Gentamycin, Ceftriaxone, Cefuroxime and Ofloxacin were determined on each *N. gonorrhoeae* isolate using tube dilution method.¹²

Beta-lactamase production

The rapid idometric test¹³ was used in

determining beta-Lactamase production in *N. gonorrhoeae* isolates.

Results

Out of the 1715 patients screened, 275 (16.03%) were found positive for *Neisseria gonorrhoeae* infection. The prevalence per location is shown in table 1. The prevalence per location showed Zaria having the highest rate (22.08%) followed by Kaduna with 21.33%. Prevalence of gonococcal infection among age groups shows that 15-20 years old age group has the highest prevalence of 31.67% followed by 36-40 years old age group with 26.08% prevalence (table 2).

Out of 275 *Neisseria gonorrhoeae* isolates obtained in this study, 225 were resistant to penicillin, 206 were resistant to ampicillin, 122 isolates were resistant to tetracycline, 34 were resistant to erythromycin and 16 isolates were resistant to gentamicin. All the 275 *Neisseria gonorrhoeae* isolates were sensitive to ceftriaxone, cefuroxime and ofloxacin. 189 (84%) of the 225 *Neisseria gonorrhoeae* that were penicillin resistant were positive for beta-lactamase production. The remaining 36 penicillin resistant strains were B-lactamase negative. The results are shown in table 3. The MICs of penicillin and ampicillin against the *Neisseria gonorrhoeae* isolates were higher than 0.125 mcg/ml.

Table 1: Prevalence of *N. gonorrhoeae* Infection in various locations in Kaduna

Location	No. of samples	No. positive	%
Zaria	317	70	22.08
Pambeguwa	316	58	18.35
Giwa	316	37	11.70
Soba	316	34	10.76
Kaduna	150	32	21.33
Kafanchan	150	25	16.66
Kachia	150	19	12.66

Table 2: Distribution of *Neisseria gonorrhoeae* Infection among age groups based on sex and geographic locations

Age (yrs)	Zaria		Giwa		Soba		P/Beguwa		Kaduna		K/chian		Kachia		Total Male	Total Female	Total (%)
	M	F	M	F	M	F	M	F	M	F	M	F	M	F			
	15-20	4	1	7	2	9	6	5	6	6	2	0	1	10	1	32	19
21-25	16	7	14	7	10	6	10	7	14	6	11	4	8	0	83	41	547(22.67)
26-30	12	6	6	1	2	1	5	2	2	0	6	2	0	2	33	14	586(8.02)
31-35	6	0	0	0	0	0	9	0	1	1	1	0	2	0	19	1	213(9.39)
36-40	8	0	0	0	0	0	0	3	1	0	2	0	0	0	9	3	46(26.08)
41-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0(0)
46+	5	7	0	1	0	0	2	0	0	0	1	0	4	0	12	8	162(12.34)

Table 3: Penicillinase and non-penicillinase producing isolates from various locations in Kaduna state

Location	No. resistant	No. of PPNG	No. of NPPNG
Zaria	63	47	16
Giwa	26	24	2
Soba	24	24	0
P/eguwa	47	37	10
Kaduna	28	24	4
K/chan	21	18	3
Kachia	16	15	1

PPNG = Penicillinase producing *Neisseria gonorrhoeae*

NPPNG = Non-penicillinase producing *Neisseria gonorrhoeae*

Penicillin had an MIC of 32.0 mcg/ml against 5 isolates. Similarly tetracycline had MIC of 32.0mcg/ml against 3 isolates ceftriaxone, cefuroxime and ofloxacin had the value of 0.125 against all the isolates tested. Generally, the MIC's of most drugs commonly used for the treatment of gonorrhoeae such as penicillin G, ampicillin and tetracycline were high.

Discussion

The findings in this study have shown a prevalence rate (16.03%) of gonococcal infection among the population studied. The prevalence rate of gonococcal infection was significantly higher among male (24.5%) than female (9.08%) patients. The Prevalence of *Neisseria gonorrhoeae* infection was found to be highest in the population screened in Zaria than in those from other locations, although the prevalence rate (22.08%) obtained was lower than 28.0% reported in 1983⁶. The findings, however confirmed the high prevalence rate of gonorrhoeae among the inhabitants of Zaria. The 21.33% prevalence rate for

Kaduna was higher than those reported from both Ibadan and Lagos.¹⁷ The prevalence of *Neisseria gonorrhoeae* infection among different age groups was found to be highest among 15-20 years old age group in which 51 (31.67%) out of 161 patients screened were found positive. This could be due to the sexual activities of the age groups, which decrease with age. The highest prevalence found among the 15-20 years old age group is in agreement with report from the United States of America that people between the ages of 15 to 19 years have the highest prevalence of gonorrhoea.¹⁶

The antimicrobial susceptibility pattern of the isolates showed that most were resistant to those antibiotics that are commonly used in the treatment of gonorrhoea. There were fewer isolates that were resistant to erythromycin and gentamicin than to penicillin, ampicillin and tetracycline. All the *Neisseria gonorrhoeae* isolates were susceptible to ceftriaxone, cefuroxime and ofloxacin. The resistance exhibited by these isolates could be attributed to indiscriminate use of antibiotics and self-medication that results in subtherapeutic dosage, thereby stimulating the development of resistant mutants.¹⁰ Penicillin had MIC of 32.0mcg/ml against five *Neisseria gonorrhoeae* isolates. The high MICs of penicillin, ampicillin and tetracycline confirmed the high level of resistance by the isolates to these antibiotics. Penicillinase (beta-lactamase) production was determined by iodometric method and 189 (84.0%) of the 225 penicillin resistant strains were beta-lactamase positive. The remaining 36 (16%) of the 225 penicillinase resistant isolates were beta-lactamase negative. The high prevalence rate of penicillinase producing *Neisseria gonorrhoeae* (PPNG) found in this study is in agreement an earlier report that PPNG constitutes 70-80% of *N. gonorrhoeae* isolates in Nigeria.¹⁰

The initial report on the epidemiology of PPNG strains showed that there was a spread of these strains from Asia and Africa to all other parts of the world.² The high prevalence rate of PPNG among the patients screened, poses a serious public health problem because the enzyme (beta-lactamase) has been found to be identical to the one found in *Haemophilus influenzae* which is reported to have acquired the resistant-plasmid from other enteric gram negative bacilli.²

Gonorrhoeae has a high prevalent in Kaduna state. The highest prevalence of 31.67% among the 15-20 year old age group is serious medical problem bearing in mind consequences STD could have on a productive age group. The high prevalence rate (84%) of PPNG found in this study could mean high cost of treatment for gonorrhoeae due to treatment failure with commonly used antibiotics that will necessitate the use of more effective but costly quinolones. Public health officials should contain the spread of the resistant strain by carrying out effective monitoring on prevalence and antibiotic susceptibility of *Neisseria gonorrhoeae* isolates.

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