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Antimicrobial Resistance and Serotypes in the Clinical Isolates of Group B Streptococci

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Background : This study is designed to provide data on the trend of resistance by year of isolation in the clinical isolates of group B streptococci (GBS) during recent eight years and to elucidate the relationship between serotypes and antimicrobial resistance patterns.

Methods : The minimal inhibitory concentrations (MIC) of seven antimicrobial agents and serotypes for 150 strains of GBS isolated from clinical specimens between 1990 and 1997 were investigated.

Results : The resistance rate of 150 clinical isolates of GBS were 20.0% to clindamycin, 16.0% to erythromycin, 4.0% to chloramphenicol, and 95.3% to tetracycline. None was resistant to penicillin, ceftriaxone, or vancomycin. Of the 24 isolates resistant to erythromycin, 20 (83.3%) were resistant to clindamycin. Resistance rates of erythromycin according to serotypes in decreasing order were 69.2% (V), 23.2% (III), and 3.5% (Ib). All serotypes Ia and II were susceptible to erythromycin and clindamycin.

Conclusions : Striking emergence of resistant strains to erythromycin and clindamycin in our clinical isolates of GBS was mainly due to sudden increase of serotype V and III which shows multi-drug resistance phenotype. (Korean J Clin Microbiol 1999;2:64~70)

Key words : Group B streptococci (GBS), Antimicrobial susceptibility, Erythromycin resistance, Clindamycin resistance, Serotype

Group B streptococci (GBS)

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(220-701) 162

[1-6].

GBS penicillin

가

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[7]

tolerance

[8].

Table 1. Activity of antimicrobial agents against 150 clinical isolates of group B streptococci

Antimicrobial agents	MIC (μ g/mL)			Percent		
	MIC50	MIC90	Range	S	I	R
Penicillin G	0.03	0.06	0.008-0.06	100	0	0
Ceftriaxone	0.06	0.06	0.015-0.12	100	0	0
Clindamycin	0.06	8	0.015-256	79.3	0.7	20.0
Erythromycin	0.06	1	0.03- $\geq$ 1024	82.7	1.3	16.0
Chloramphenicol	4	4	2-32	95.3	0.7	4.0
Tetracycline	32	64	0.12-128	4.7	0	95.3
Vancomycin	0.5	1	0.5-1	100	0	0

Abbreviations: S, susceptible; I, intermediate; R, resistant.

Table 2. Antimicrobial resistance rate of group B streptococci according to years

Antimicrobial agents	No.(%) of resistance strain by years							
	1990 (n=7)	1991 (n=5)	1992 (n=12)	1993 (n=3)	1994 (n=13)	1995 (n=6)	1996 (n=50)	1997 (n=54)
Clindamycin	0 (0)	0 (0)	0(0)	0(0)	3(23.1)	2(33.3)	12(24.0)	13(24.1)
Erythromycin	0 (0)	0 (0)	0(0)	0(0)	0(0)	0(0)	13(26.0)	12(22.2)
Chloramphenicol	0 (0)	0 (0)	1(8.3)	1(33.3)	0(0)	0(0)	2(4.0)	2(3.7)
Tetracycline	6(85.7)	5(100)	11(91.7)	3(100)	13(100)	6(100)	49(98.0)	50(92.6)

1990 GBS erythromycin
clindamycin 10%
[7-10] Pearlman [11] erythromycin
clindamycin 16% 15%
가 , 30 1990 3 1998 2
Pfaller [12] -70 GBS
erythromycin 21% . 3
[13] GBS erythromycin 5% 150
clindamycin 13.3% .
GBS NCCLS [19]
가 penicillin G,
erythromycin tetracycline (Sigma Chemical, St. Louis,
Mo. USA), vancomycin (Eli Lilly & Co., Indianapolis, Ind.,
USA), ceftriaxone (Roche, Basle, Switzerland),
chloramphenicol(,), clindamycin (,
) 7 .
[17] erythromycin GBS 30% V
erythromycin 0.008-1024 μ g/mL .
5% Mueller- Hinton agar (Difco, USA) .
가 tryptic soy broth (Difco) 4 mL
[14], GBS McFarland 0.5
V 가 가 Steers replicator (Craft Machine Inc.,
Woodline, Pa., USA) 35 24
[18]. 1990 3 1998 2 8 (Minimal
inhibitory concentration, MIC)
 , 1

Table 3. Resistance rate of Group B streptococci according to serotypes

Serotypes	No.	No. (%) of resistant isolates by antimicrobial agents			
		Tetracycline	Clindamycin	Erythromycin	Chloramphenicol
Ia	14	10(71.4)	0(0)	0(0)	0(0)
Ib	57	57(100)	8(14.0)	2(3.5)	0(0)
II	4	4(100)	0(0)	0(0)	0(0)
III	56	55(98.2)	13(23.2)	13(23.2)	6(10.7)
V	13	13(100)	9(69.2)	9(69.2)	0(0)
NT	6	4(66.7)	0(0)	0(0)	0(0)
Total	150	143(95.3)	30(20.0)	24(16.0)	6(4.0)

Abbreviation: NT, Non-typeable.

Enterococcus faecalis ATCC 29212
가
150 GBS
[18]
1.
150 GBS penicillin
G가 0.06 µg/mL, ceftriaxone 0.12 µg/mL,
vancomycin 0.5-1 µg/mL, chloramphenicol 2-32 µg/mL,
tetracycline 0.12-128 µg/mL, clindamycin 0.015-256 µg/mL,
erythromycin 0.03-≥ 1024 µg/mL.
MIC90 penicillin G ceftriaxone 0.06 µg/mL,
erythromycin vancomycin 1 µg/mL,
chloramphenicol, clindamycin tetracycline 4 µg/mL, 8 µg/mL 64 µg/mL. NCCLS Breakpoint
, tetracycline, clindamycin,
erythromycin chloramphenicol 95.3%,
20.0%, 16.0% 4.0%, penicillin, ceftriaxone
vancomycin (Table 1).

2.
GBS
tetracycline chloramphenicol 가
clindamycin 1994
1997 24.0% erythromycin
1995 1996 1997
26.0% 22.2% (Table 2).

3.

Ia II nontypeable (NT) tetracycline
 71.4%, 100% 66.7%
 clindamycin

Table 4. Trend of resistance phenotypes of group B streptococci according to serotypes

Serotypes	Resistance phenotype	No. of isolates by years								No.(%)
		1990	1991	1992	1993	1994	1995	1996	1997	
Ia	No resistance			1			1	2		4(2.7)
	TC ^r	1				1		3	5	10(6.7)
Ib	TC ^r	3	3	8		3	2	14	16	49(32.7)
	TC ^r CL ^r					3	2		1	6(4.0)
	TC ^r CL ^r EM ^r							2		2(1.3)
II	TC ^r		1		1			2		4(2.7)
III	No resistance	1								1(0.6)
	TC ^r	2	1	2	1	5	2	10	11	34(22.7)
	TC ^r CM ^r			1	1			1	1	4(2.7)
	TC ^r CL ^r							2	1	3(2.0)
	TC ^r EM ^r							3	1	4(2.7)
	TC ^r CL ^r EM ^r							5	3	8(5.3)
	TC ^r CL ^r CM ^r								1	1(0.6)
	TC ^r CL ^r CM ^r EM ^r							1		1(0.6)
V	TC ^r							1	3	4(2.7)
	TC ^r CL ^r EM ^r							2	7	9(6.0)
NT	No resistance								2	2(1.3)
	TC ^r					1		3		4(2.7)

Abbreviations: TC, tetracycline; r, resistant; CL, clindamycin; EM, erythromycin; CM, chloramphenicol; NT; non-typeable.

Table 5. Sources and minimal inhibitory concentrations (MICs) of 38 isolates of group B streptococci which shows multi-resistance

Serotypes	Age (Years)	Sex	Specimen	MIC (µ g/mL)			
				TC	CL	EM	CM
Ib	58	F	Urine	32	2	0.03	2
Ib	29	M	Urine	32	2	0.03	2
Ib	29	M	Urine	32	2	0.06	2
Ib	20	F	Cervix	32	2	0.06	4
Ib	38	M	Prostatic juice	32	2	0.06	4
Ib	30	F	Cervix	64	2	0.06	4
Ib	40	F	Wound	32	8	1	4
Ib	23	F	Cervix	64	256	4	4
III	25	M	Urine	128	0.06	0.03	16
III	33	F	Cervix	64	0.06	0.06	16
III	27	F	Cervix	32	0.06	1	2
III	44	F	Cervix	32	0.06	1	4
III	41	M	Foot	32	0.06	2	2
III	72	F	Wound	32	0.125	2	4
III	24	F	Cervix	64	0.125	0.06	16
III	<1	M	Blood	128	0.125	0.06	32
III	38	F	Cervix	16	1	0.06	4
III	38	F	Cervix	32	1	0.5	4
III	45	F	Cervix	32	2	1	4
III	50	F	Wound	64	4	0.06	16
III	33	F	Cervix	32	4	0.5	2
III	33	F	Cervix	32	8	1	4
III	<1	F	Blood	32	8	1	4
III	46	F	Cervix	32	16	1	2
III	74	F	Urine	32	16	1	4
III	25	F	Cervix	32	16	2	4
III	<1	F	CSF	32	16	2	4
III	28	F	Cervix	32	256	≥ 1024	4
III	28	F	Cervix	64	256	≥ 1024	16
V	44	F	Cervix	64	256	≥ 1024	4
V	24	F	Cervix	64	256	≥ 1024	4
V	27	F	Cervix	64	256	≥ 1024	4
V	29	M	Wound	64	256	≥ 1024	4
V	21	F	Cervix	64	256	≥ 1024	4
V	55	M	Wound	64	256	≥ 1024	4
V	21	F	Cervix	64	256	≥ 1024	4
V	34	M	Wound	64	256	≥ 1024	4
V	42	M	Prostatic juice	64	256	≥ 1024	4

Abbreviations: see table 4.

V, III, Ib 69.2%, 23.2% 10.5% 23.2% 3.5% chloramphenicol
, erythromycin V, III, Ib 69.2%, III 10.7% (6/56)

(Table 3).

4.

150 GBS 7
(4.7%) 가 105
(70.0%) tetracycline 가

25.3% 17 (11.3%) 20 (13.3%) 가
가 1 가

III, V Ib가 21 , 9 8
V, III Ib

69.2%(9/13), 37.5%(21/56) 14.0%(8/57)
Erythromycin 24 20
(83.3%) clindamycin (Table 4).

5.

38 Ib III 1 2
clindamycin MIC가 256 μ g/mL V
9 256 μ g/mL Ib
clindamycin MIC가 256 μ g/mL
erythromycin MIC가 1024 μ g/mL (Table 5).

GBS penicillin 100%

penicillin ,
penicillinase
penicillin [9,20,21].
GBS erythromycin, clindamycin tetracycline

GBS penicillin, ceftriaxone vancomycin
가

100% [6-10]. , erythromycin
1980-1992

5%[6]
[13] 5%,
1.4%[22],
Berkowitz [9] 1990 3.2%, Fernandez
[17] 1992-1996
7.4%, 1992
8%[8], 1991
9%[10]

erythromycin 16% 1997
Pearlman [11] 16%
Clindamycin 20%
0-15%[6-11] . Erythromycin clindamycin

. GBS macrolide
A
[7,23]. GBS macrolide
erythromycin clindamycin MIC가
erythromycin clindamycin
erythromycin MIC가 8-16
 μ g/mL clindamycin
[7,23]. Pearlman [11]
erythromycin 62%가 clindamycin
clindamycin 90% erythromycin
, Tsakris Maniatis[10] erythromycin
2/3 clindamycin
가 가
erythromycin 24
20 가 clindamycin 83.3%,
16.7%
macrolide
tetracycline chloramphenicol
95.3% 4.0% [6] 90% 0%, Betriu
[8] 90% 3%
GBS 25.3% Berkowitz [9]
19%
tetracycline chloramphenicol
가 clindamycin
erythromycin 1994 1996 가
20%
clindamycin erythromycin
가 erythromycin clindamycin
V III 1996
가 V
1995 1996
1997 3 10 가 , 9
가 erythromycin clindamycin
erythromycin clindamycin MIC가 256 μ g/mL
III 56 9
erythromycin clindamycin
2 Ib 57 가
가 erythromycin
clindamycin 1996 2
Erythromycin clindamycin
Ib III 6 4 가
, chloramphenicol
III . 1993
Tsakris Maniatis[10]
GBS erythromycin
[17] erythromycin GBS 30% Fernandez
V

1994;12:111-5.

7. . , 1998:99-114.

8. Betriu C, Gomez M, Sanchez A, Cruceyra A, Romero J, Picazo JJ. Antibiotic resistance and penicillin tolerance in clinical isolates of group B streptococci. *J Antimicrob Agents Chemother* 1994;38:2183-6.

9. Berkowitz K, Regan JA, Greenberg E. Antibiotic resistance patterns of group B streptococci in pregnant women. *J Clin Microbiol* 1990;28:5-7.

10. Tsakris A and Maniatis AN. Inducible type of erythromycin resistance among group B streptococci isolated in Greece. *J Antimicrob Chemother* 1993;31:177-8.

11. Pearlman MD, Pierson CL, Faix RG. Frequent resistance of clinical group B streptococci isolates to clindamycin and erythromycin. *Obstet Gynecol* 1998;92:258-61.

12. Pfaller MA, Jones RN, Marshall SA, Edmond ME, Wenzel RP et al. Nosocomial streptococcal blood stream infections in the SCOPE program: species occurrence and antimicrobial resistance. *Diagn Microbiol Infect Dis* 1997;29:259-63.

13. Uh Y, Jang IH, Yoon KJ, Lee CH, Kwon JY, Kim MC. Colonization rates and serotypes of group B streptococci isolated from pregnant women in a Korean tertiary hospital. *Eur J Clin Microbiol Infect Dis* 1997;16:753-6.

14. Chong Y, Lee K, Kwon OH, Nahm CH, Murai T, Inazumi Y. Trend of isolation and serotypes of group B streptococci in Korea. *Yonsei Med J* 1993;34:78-83.

15. Campbell JR, Baker CJ, Edwards MS. Influence of serotype of group B streptococci on C3 degradation. *Infect Immun* 1992;60:4558-62.

16. Schuchat A. Epidemiology of group B streptococcal disease in the United States: shifting paradigms. *Clin Microbiol Rev* 1998;11:497-513.

17. Fernandez M, Hickman ME, Baker CJ. Antimicrobial susceptibilities of group B streptococci isolated between 1992 and 1996 from patients with bacteremia or meningitis. *Antimicrob Agents Chemother* 1998;42:1517-8.

18. , , . Group B streptococci 1998;18:386-90.

19. National Committee for Clinical Laboratory Standards. Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically. M7-A3. National Committee for Clinical Laboratory Standards; Villanova, Pa., 1997.

20. Buu-Ho A, Le Bouguenec C, Horaud T. High-level chromosomal gentamicin resistance in *Streptococcus agalactiae* (group B). *Antimicrob Agents Chemother* 1990;34:985-8.

1. Baker CJ, Edwards MS. Group B streptococcal infections. In: Remington J, Klein JO, eds. *Infectious diseases of the fetus and newborn infant*. 4th ed. Philadelphia: WB Saunders, 1995;980-1054.

2. Liang ST, Lau SP, Chan SH, Fok TF, Murai T, Kaneko Y. Perinatal colonization of group B *Streptococcus*-an epidemiological study in a Chinese population. *Aust NZ Obstet Gynaecol* 1986;26:138-41.

3. Møller M, Thomsen AC, Borch K, Dineson K, Zdravkovic M. Rupture of fetal membranes and premature delivery associated with group B streptococci in urine of pregnant women. *Lancet* 1984;ii:69-70.

4. Regan JA, Chao S, James LS. Premature rupture of membranes, preterm delivery and group B streptococcal colonization of mothers. *Am J Obstet Gynecol* 1981;141:184-6.

5. Yancey MK, Duff P, Clark P, Kurtzer T, Frentzen BR, Kubilis P. Peripartum infection associated with vaginal group B streptococcal colonization. *Obstet Gynecol* 1994;84:816-9.

6. , , . *Streptococcus pyogenes* *Streptococcus agalactiae* .

21. Gardner SE, Yow MD, Leeds LJ, Thompson PK, Mason EO Jr, Clark DJ. *Failure of penicillin to eradicate group B streptococcal colonization in the pregnant woman. Am J Obstet Gynecol* 1979;135:1062-5.
22. Traub WH and Leonhard B. *Comparative susceptibility of clinical group A, B, C, F, and G β -hemolytic streptococcal isolates to 24 antimicrobial drugs. Chemotherapy* 1997;43:10-20.
23. : , 1997:123-35.