Biochemical properties of group G streptococci isolated from cats and man

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Summary. The biochemical characteristics of group G streptococci isolated from cats were markedly similar to the characteristics of group G streptococci from man. Both cat and human isolates of group G streptococci were also very similar in biochemical characteristics to group A streptococci so that to identify the source of group G streptococci by biochemical reactions is not a reliable procedure. The group G streptococci found in many cats could be pathogenic to man, since their physiological and biological characteristics are very similar to those of group A streptococci.

Introduction

The physiological and biochemical characteristics of streptococci of Lancefield's group G isolated from man are similar to those of group A streptococci from man¹ and the characteristics of group G strains isolated from animals are more varied than those from man. Few studies have compared the biological and physiological characteristics of group G streptococci isolated from animals and man. Krantz and Dunne² isolated group G streptococci from cattle, hogs and a sheep and in their examination of 13 isolates they established that eight fermented lactose, seven mannitol, eight trehalose, and six sorbitol. Hamilton and Stark³ performed biochemical tests on 10 of 70 strains isolated from dairy herds in New York State and reported that all formed acid from glucose, lactose, sucrose and salicin, but did not ferment inulin, mannitol, raffinose, sorbitol or trehalose. Eberhart and Guss⁴ tested 31 isolates from the udders of dairy cattle and noted that all hydrolysed aesculin and fermented lactose, maltose, sucrose and salicin, but not mannitol, inulin, raffinose, sorbitol or trehalose. Clark *et al.*⁵ proposed eight biotypes for their human and bovine isolates based on the fermentation of trehalose, lactose, raffinose and the hydrolysis of aesculin. All their human isolates but only one of 14 bovine isolates fermented trehalose.

Laughton examined 24 isolates of group G streptococci from dogs:⁶ most fermented lactose, sucrose, maltose and salicin, but only 66% fermented trehalose and 30% sorbitol; none produced acid from glycerol, inulin, mannitol or raffinose. The 206 group G streptococcal isolates from dogs examined by Biberstein *et al.*⁷ were of four biotypes: 73.3% fermented

lactose but not trehalose or sorbitol; 18.4% were lactose variable and fermented trehalose but not sorbitol; 7.7% did not ferment any of the three sugars; and one (0.05%) fermented all three.

Tillman *et al.*⁸ found that 11 group G isolates from clinically ill cats fermented lactose but not sorbitol or trehalose. Two other isolates from the throats of normal cats fermented lactose but not sorbitol; one fermented trehalose.

Tagg and Wong⁹ compared the biochemical reactions of group G isolates from man, dogs, cats and cattle and established 12 biotypes based on aesculin hydrolysis (A), and acid production from lactose (L), salicin (S) and trehalose (T); 50% of cat isolates but only 14% from man were AST, 33.3% from cats but none from man were LS, and 16.6% from cats and 16% from man were ALST.

Because biochemical reactions of group G streptococci may be useful in determining the species origin of isolates, we investigated the biochemical profiles of isolates from man and from the throats or vaginas of cats.

Materials and methods

Source of isolates

Sixty-eight group G streptococci were examined. Those of animal origin were isolated from the throats of apparently healthy male and female cats (15) and from the vagina of some of the female cats (16) housed in the University animal care facility. The human isolates (37) were obtained from the Texas Department of Public Health, Austin, Texas, the City of Houston Health Department, and the Clinical Pathology Laboratory at the University of Texas Medical Branch at Galveston. The anatomical site of origin and

information about the health of the patients were not available to the investigators.

Group identification

Group identification was established by the slide co-agglutination method and confirmed by biochemical reactions.

Biochemical determinations

Biochemical tests were performed with the API20 S Streptococcus strips (Analytab Products, NY, USA); the tests determined fermentation, utilisation or the presence of bile-aesculin, mannitol, β -glucosidase, sorbitol, N-acetyl-glucosaminidase, glycerol, β -galactosidase, sorbose, indoxyl-acetate, raffinose, lactose, phosphatase, sucrose, trehalose, arginine, hippurate, leucine aminopeptidase, serine aminopeptidase, pyroglutamic acid, arylamidase and arginine aminopeptidase.

Statistical evaluation of results was by the χ^2 test.

Results

Bile-aesculin was hydrolysed by 26.6% of the throat isolates and 31.3% of the vaginal isolates from cats, but by only 5.4% of the human isolates. Mannitol was

utilised by 26.6% of the throat and 6.3% of the vaginal isolates from cats and by 2.7% of the human isolates. β -Glucosidase was present in 13.3% of the throat and 50% of the vaginal isolates from cats ($p < 0.05$). The presence of this enzyme was also significantly greater in the vaginal isolates than in the human isolates (8.1%) ($p < 0.001$) (table I).

Sorbitol was fermented by 20% of the throat isolates and 6.3% of the vaginal isolates from cats but by none of the human isolates. N-acetyl-glucosaminidase was hydrolysed by 6.7% of the throat and 25.0% of the vaginal isolates from cats and by 10.8% of the human isolates. Glycerol was utilised by 6.7% of the cat throat and 2.7% of the human isolates but by none from the cat vagina. None of the strains had β -galactosidase and none fermented sorbose or raffinose.

Indoxyl-acetate was hydrolysed by 20.0% of the cat throat and 12.5% of the cat vaginal isolates but by none from man. Lactose was fermented by 80.0% of the throat and 87.5% of the vaginal isolates from cats. The number of group G streptococci from cats that fermented lactose was significantly greater than the 24.3% of the human isolates that fermented this sugar ($p < 0.001$). Alkaline phosphatase was hydrolysed by 40.0% of the cat throat, 40.5% of the human, and 62.5% of the cat vaginal isolates.

Sucrose was fermented by all 68 group G streptococci. Trehalose was fermented by 60% of isolates from the cat throat and 37.5% from the cat vagina

Table I. Biochemical reactions of animal and human isolates of group G streptococci

Biochemical test	Number (%) of isolates that gave positive reactions			p values
	Cat throat (CT) (n = 15)	Cat vagina (CV) (n = 16)	Human (H) (n = 37)	
Bile-aesculin	4(26.6)	5(31.3)	2(5.4)	
Mannitol	4(26.6)	1(6.3)	1(2.7)	
β -Glucosidase	2(13.3)	8(50)	3(8.1)	CV > CT $p < 0.05$ CV > H $p < 0.001$
Sorbitol	3(20.0)	1(6.3)	0	
N-acetyl-glucosaminidase	1(6.7)	4(25.0)	4(10.8)	
Glycerol utilization	1(6.7)	0	1(2.7)	
β -Galactosidase	0	0	0	
Sorbose	0	0	0	
Indoxyl-acetate	3(20.0)	2(12.5)	0	
Raffinose	0	0	0	
Lactose	12(80.0)	14(87.5)	9(24.3)	CT > H $p < 0.001$ CV > H $p < 0.001$
Phosphatase	6(40.0)	10(62.5)	15(40.5)	
Sucrose	15(100)	16(100)	37(100)	
Trehalose	9(60.0)	6(37.5)	34(91.8)	H > CT $p < 0.01$ H > CV $p < 0.001$
Arginine	15(100)	16(100)	35(94.5)	
Hippurate hydrolysis	0	3(18.8)	0	
Leucine aminopeptidase	9(60.0)	12(75.0)	21(56.8)	
Serine aminopeptidase	9(60.0)	11(68.8)	12(32.4)	CV > H $p < 0.05$ CT + CV > H $p < 0.01$
Pyroglutamic acid arylamidase	4(26.6)	4(25.0)	1(2.7)	
Arginine aminopeptidase	15(100)	16(100)	36(97.3)	

whereas 91.8% of the human isolates fermented this sugar. The proportion of isolates from man that fermented trehalose was significantly greater than the proportion from throats ($p < 0.01$) or vaginas ($p < 0.001$) of cats.

Arginine was utilised by all group G streptococci of cat origin and by 35 (94.5%) of the human isolates. Hippurate was hydrolysed by 18.8% of the vaginal isolates but by none of the throat isolates from cats or the human isolates. Leucine aminopeptidase was detected in 60% of throat isolates and 75% of the

vaginal isolates from cats and in 56.8% of the isolates from man. Serine aminopeptidase was present in 60% of the isolates from cat throats and 68.8% from cat vaginas, but in only 32.4% of the human isolates, a significantly smaller proportion than in cat isolates ($p < 0.01$).

Pyroglutamic acid arylamidase was detected in 25% of the vaginal isolates and 26.6% of the throat isolates from cats, but in only 2.7% of the human isolates. Arginine aminopeptidase was present in all isolates from cats and in 97.3% of those from man.

Table II. Biochemical reactions of group G streptococci from animals and man

Authors	Source animal	Number tested	Percentages that gave positive results in tests with					
			BEM	LAC	MAN	SAC	SOR	TRE
Laughton ⁶	Dogs	24	...	M	0	M	30	66
Krantz and Dunne ²	Cattle	13	...	62	54	...	46	...
	Hogs							
Hamilton and Stark ³	Cattle	10	...	100	...	100	...	...
Eberhart and Guss ⁴	Cattle	31	100	100	0	100	0	0
Biberstein <i>et al.</i> ⁷	Dogs	151	...	100	...	...	0	0
	"	38	...	V	...	...	0	100
	"	16	...	0	...	...	0	100
	"	1	...	100	...	...	100	100
Tillman <i>et al.</i> ⁸	Cats	11	...	100	...	...	0	0
	"	1	...	100	...	...	100	0
	"	1	...	100	...	...	0	100
Tagg and Wong ⁹	Man	10	100	100	...	...	...	100
	"	12	100	0	...	...	...	100
	"	9	0	100	...	...	...	100
	"	19	0	0	...	...	...	100
	Dogs	3	100	100	...	...	...	100
	"	12	100	100	...	...	...	0
	"	3	0	100	...	...	...	100
	"	1	100	0	...	...	...	0
	Cats	1	100	100	...	...	...	100
	"	3	100	0	...	...	...	100
	"	2	0	100	...	...	...	0
	Cows	3	100	100	...	...	...	0
Clark <i>et al.</i> ⁵	Man	17	100	100	...	...	...	100
	"	34	100	0	...	...	...	100
	"	11	0	100	...	...	...	100
	"	19	0	0	...	...	...	100
	"	1	100	0	...	...	...	0
	Cows	1	0	100	...	...	...	100
	"	2	100	100	...	...	...	0
	"	8	100	0	...	...	...	0
	"	1	0	100	...	...	...	0
This report	Man	2	100	0	100	100	0	100
	"	1	100	0	0	100	0	100
	"	2	0	100	0	100	0	0
	"	7	0	100	0	100	0	100
	"	24	0	0	0	100	0	100
	"	1	0	0	0	100	0	0
	Cat throats	1	100	0	100	100	0	100
	"	3	100	100	100	100	100	100
	"	3	0	100	0	100	0	100
	"	6	0	100	0	100	0	0
	"	2	0	0	0	100	0	100
	Cat vagina	1	100	100	100	100	100	100
	"	2	100	100	0	100	0	0
	"	3	100	100	0	100	0	100
	"	8	0	100	0	100	0	0
	"	2	0	0	0	100	0	100

..., Not reported.

M, Most (author description); V, variable.

BEM, Bile-aesculin, LAC, lactose, MAN, mannitol, SAC, sucrose, SOR, sorbitol, TRE, trehalose.

Discussion

The reactions obtained with the group G streptococci from cats were similar to the reactions of group A streptococci, except for the results of tests for β -glucosidase, β -galactosidase, indoxyl-acetate hydrolysis and sorbitol and trehalose fermentation. The nephritogenic group G streptococci of animal origin, reported by Duca *et al.*,¹⁰ fermented lactose and sorbitol, but not trehalose. Only four of the cat isolates of group G reported here fermented sorbitol, but all fermented trehalose as well as lactose. The biochemical reactions of nephritogenic group G streptococci were not reported.^{11, 12}

Most of the group G streptococci isolated from cats have physiological and biochemical properties similar to those of group A streptococci; therefore the group G streptococci found in many cats¹³ could be potentially pathogenic for man.

Although the results of the biochemical tests differed between some isolates of group G streptococci from man and cats, clear-cut biotypes could not be established (table II). Table II also summarises the biochemical reactions obtained by several other investigators and their attempt to establish biotypes of group G. To establish the origin of isolates or indicate the possibility of pathogenic potential in man, biotype profile is less useful than some other properties, e.g., multiplication in human blood,^{14, 15} NADase production and the serum opacity reaction,¹⁶ serotype,¹⁷⁻¹⁹ and expression of M protein.^{14, 20-22}

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