

The carriage of potentially pathogenic β -haemolytic streptococci (β -HS) in healthy adult inhabitants of Wielkopolska, Poland

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary Background. Acute pharyngitis is a common disease in primary health care patients. Beta-hemolytic streptococci (β -HS) are a frequent etiological agent, while swab culture from the throat and palatine tonsils is the gold standard for diagnosis.

Objectives. The evaluation of the prevalence of potentially pathogenic β -HS carriage in young adult inhabitants of Wielkopolska, Poland.

Material and methods. The study included 205 healthy young adult (18–44 years old) (29.0 ± 6.4) inhabitants ($M = 95$, $F = 110$) of Wielkopolska, Poland. Two swabs were taken from the throat: the first one was used to perform a rapid antigenic diagnostic test (RADT) for group A streptococci (GAS) and the second to grow a conventional culture. If β -HS grew, isolates were serotyped according to Lancefield. In addition, simple demographic and medical data were collected from the subjects. The study was financed from funds granted within the first edition of the “Give a hand” project (Karol Marcinkowski Poznan University of Medical Sciences).

Results. Positive throat cultures were obtained in 15.6% out of 205 persons ($n = 32$). The distribution of β -HS serogroup results was as follows: group C (GCS) – 17 cases (53.1% of cases where β -HS growth was positive), group F (GFS) – 9 cases (28.1%), GAS – 3 people (9.4%) and group G (GGS) – 3 subjects (9.4%). The growth of the discussed bacteria in cultures was moderate or high in 53% of these cases. RADT was positive in 5 cases (but only one person had GAS in throat culture). The positive culture result was significantly more frequent in men (62.5% out of 32 cases with β -HS growth, $p = 0.0460$).

Conclusions. 1. The possibility of β -HS carriage must be taken into account when analysing the results of throat swab cultures. 2. GAS carriage is significantly lower than non-GAS carriage. 3. GCS were the most prevalent among non-GAS. 4. Being male may predispose individuals to β -HS carriage.

Key words: culture, streptococci, carriage, Lancefield, RADT, pharyngitis.

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Background

Pharyngitis is a common problem faced by family doctors in their daily practice. If the bacterial etiology of this syndrome is suspected, swab cultures from the surface of the palatine tonsils and the posterior pharynx are the clinical diagnostic gold standard [1]. This test has potentially significant limitations, such as imperfect sensitivity (depending, among other things, on proper sample collection) and specificity (the impact of asymptomatic carriage).

Objectives

The aim of the study was to assess the prevalence of potentially pathogenic beta-haemolytic streptococci (β -HS) carriage in healthy young adults.

Material and methods

The analysis included 205 healthy inhabitants of Wielkopolska, Poland (95 men and 110 women) aged 18–44 years (29.0 ± 6.4), coming from different backgrounds. The subjects were recruited in Poznan over 12 months – from

1 March 2013 to the end of February 2014. The exclusion factors were as follows: any acute disease, antibiotic treatment in the preceding month, and chronic comorbidities.

At least 12 hours after the last tooth brushing, two swabs were collected from the posterior pharynx and the palatine tonsils in each subject: the first sample was delivered to the microbiology laboratory (transport medium Amies) within 24 hours of collection (Microbiology Laboratory of the Jozef Strus Multispecialty Municipal Hospital in Poznan), the second sample was used immediately after collection to perform a Rapid Antigen Diagnostic Test (RADT) for the qualitative detection of streptococcal group A antigen (OSOM Strep A Test; Sekisui Diagnostics, LLC, San Diego, USA) according to the manufacturer’s instructions. The collection of throat the swab and the performance of the microbiological examination for β -HS was carried out in accordance with the instructions contained in the publicly accessible national recommendations [1]. The growth of β -HS colonies was semi-quantitatively evaluated based on the following principles: scanty growth – within the first quadrant of the plate (+), moderate growth – also within the second quadrant (++), abundant growth – also within the third (\pm fourth) quadrant (+++ or ++++). Group typing according to Lancefield (A, B, C, D, F and G) was performed using SLIDEX® Strepto Plus



(bioMérieux® SA, Marcy-l'Étoile, France) latex agglutination test. In addition, the subjects were asked about demographic data and information about contact with people having pharyngitis in the week preceding the recruitment.

All subjects who agreed to participate in this study signed an appropriate consent form. The study was approved by the Bioethics Committee of Poznan University of Medical Sciences (Resolution No. 988/13).

Statistical analysis

The test results are expressed as mean and standard deviation (SD). Nominal data are presented as percentages. The comparisons of age and the number of people in households were performed using the U Mann-Whitney test, because data were not consistent with normal distribution (Shapiro-Wilk test). The comparison of categorical variables was carried out using the test for proportion. Data were analyzed with Statistica 10 (StatSoft). The tests were considered statistically significant at $p < 0.05$.

Results

In total, β -HS were grown from the material obtained from 32 patients (15.6%). In 29 cases (14.1%), bacteria belonged to groups other than A by Lancefield (non-GAS), whereas in three patients (1.5%) group A streptococci (GAS) were identified.

The distribution of non-GAS incidence was as follows: serogroup C (GCS) – 17 people (53.1% of positive cultures), group F (GFS) – 9 patients (28.1%), group G (GGS) – 3 individuals (9.4%). Low intensity of growth was observed in 15 cases (46.9% of positive cultures), moderate – in 9 patients (28.1%) and abundant – in 8 of the subjects (25%).

Positive RADT was achieved in 5 cases: in 2 patients with culture growth (1 case of abundant GCS growth and 1 case with scanty GAS growth) and in 3 subjects without β -HS growth.

The analysis of selected variables in terms of their possible association with the identification of β -HS growth is shown in Table 1.

It should be added that none of the subjects had pharyngitis within the following 7 days of swab collection for this analysis (the information was obtained during contact with subjects in order to pass on to them the results of their throat swab cultures).

Discussion

The incidence of the asymptomatic carriage of potentially pathogenic β -HS found in healthy young adult subjects is in the range of that reported by other authors [2–5]. However, in-depth comparative analysis of our results with respect to world literature reveals some significant differences.

Begovac et al. found the presence of β -HS in 6.8% of throat swab cultures from samples taken from 740 people aged 15–44, whereas GAS and non-GAS were observed in a similar proportion of cases [2]. In this study performed in the Croatian population, 2/3rds of non-GAS isolates belonged to group B streptococci (GBS).

Zwart et al. demonstrated GAS in 6.5% and non-GAS in 23.9% out of 510 healthy Dutch people [3] of the same age as in the previously discussed study. Two samples were taken from each subject, one from the throat and one from the palatine tonsils – both were cultured. As a result of this procedure, the number of subjects who manifested β -HS growth increased by 13%. The distribution of representatives of various β -HS serogroups by Lancefield according to Zwart et al. was as follows: GCS – 26.5%, GBS – 23.2%, GAS – 21.3%, GGS – 18% and GFS – 11%.

A study from Sub-Saharan Africa (Gabon) showed that β -HS were cultured in material taken from 7.8% of 333 subjects. GGS, GAS and GCS were 3.6%, 3% and 1.5%, respectively [4]. It should be noted, however, that although these values concerned adults (18–92 years), more detailed information on the distribution of different β -HS serogroups in narrower age groups (including those close to the interval analysed in our study) was not available. β -HS were found in 11 out of 88 (13.4%) asymptomatic subjects (control group) in a study on the prevalence of these bacteria in patients with pharyngitis in India [5]. GAS and GCS were observed in a similar group of people, i.e. in 6 (7.3%) and 5 (6.1%) carriers. The authors did not specify the age of the subjects («appropriately matched for age and sex»), but it is known that there were also children among them.

In summary, these data indicate that the carriage profile of potentially pathogenic β -HS differs significantly depending on two main factors, i.e. the place of testing and the methodology applied. Of course, the first of these factors must be considered as a greatly simplified sum of a number of conditions (e.g. climate, demographic factors, the quality of the health care system, including the availability and wide use of antibiotics) that may affect the studied phenomenon.

The carriage of potentially pathogenic β -HS has two practical meanings. First, carriers can be a source of infec-

Table 1. The evaluation of selected parameters in patients with positive and negative throat swab culture assessed for the presence of β -HS ($n = 205$)

Variable	Results of throat swab culture		<i>p</i>
	Positive culture ($n = 32$)	Negative culture ($n = 173$)*	
Men	20 (62.5%)	75 (43.4%)	0.0460
Age (years): mean \pm SD; median	27.9 \pm 5.9; 25	29.3 \pm 6.4; 27	0.2306
Number of people in household	3.1 \pm 1.4	3.1 \pm 1.3	0.8013
More than 2 people in household	18 (56.3%)	113* (65.7%)	0.3056
More than 3 people in household	15 (46.9%)	66* (38.4%)	0.3666
More than 4 people in household	5 (15.6%)	17* (9.9%)	0.3353
Children at home	9 (28.1%)	66 (38.2%)	0.2797
Contact with patients with pharyngitis	7 (21.9%)	49 (28.3%)	0.5932
Place of residence – town	26 (81.3%)	147 (85.0%)	0.4526

* One subject did not give the number of people in household.

tion for other people in their environment. Although clinically significant consequences of such a scenario are rather rare [6], it cannot be ruled out that β -HS transmission to patients with comorbidities has greater health consequences. β -HS (including non-GAS) are recognized etiological agents of many serious infections [7, 8]. Secondly, a positive result of throat swab culture in patients with pharyngitis does not allow to unambiguously distinguish the contributory role of the identified streptococcus from the situation in which clinical symptoms may be associated with a viral infection that occurred in the carrier of the bacteria [1, 3, 9].

However, as *S. pyogenes* is a common etiologic agent of pharyngitis, for which antibiotic therapy is justified [1, 6, 10], an important observation is that GAS carriage with abundant culture growth (which in the context of symptoms would be interpreted as clinically relevant) was found only in 1 patient (0.5%).

Non-GAS microorganisms, which are more often identified in this study, may be a source of major interpretation problems and decisions taken in the diagnostic process. In half of these cases (53%), the growth of these bacteria in the culture was moderate or abundant. The intensity of growth, although it has no absolute value in the differentiation of the causal participation of potential pathogens in evoking symptoms of pharyngitis, is an important factor in the analysis of a positive culture swab [3].

Had a more severe viral infection occurred in β -HS carriers in our study, for those with positive culture results it would have probably entailed unnecessary antibiotic therapy in at least a half of the cases. Given that, and the well-known tendency to overuse antibiotics in common upper respiratory tract infections [11, 12], it is clear that the imperfect specificity of the diagnostic gold standard in pharyngitis (throat swab culture) is the inevitable cost of using this valuable diagnostic tool.

The diagnostic effectiveness of RADT in the identification of GAS carriers should also be commented on. In this

study, the sensitivity and predictive value of a positive test result were 33.3% (1/3) and 20% (1/5), respectively. These values, although based on a small number of samples, fit well with the existing knowledge on the subject [1, 6, 10] and confirm questionable usefulness of RADT in detecting the presence of GAS with a low probability of infection.

It is not explained why being male turned out to be a factor predisposing subjects to β -HS carriage. In our opinion, this may result from worse oral hygiene in men [13] or smoking. Unfortunately, no information was collected in this respect when collecting data, hence the causes and possible significance of this conclusion are not known and require further research.

This study has some limitations, which include: the evaluation of an arbitrarily selected age group, getting only some demographic and medical data, the clear dominance of residents of the city in the study population (over 80% of the subjects), and the inclusion in the analysis of only healthy persons without additional significant diseases (this may affect the incidence of potentially pathogenic β -HS carriage). Despite this, we believe that it can be a source of useful knowledge for practitioners.

Conclusions

1. The possibility of carrying potentially pathogenic β -HS must be taken into account in evaluating the results of throat swab culture.
2. GAS carriage in healthy young adults is significantly less common than non-GAS carriage.
3. Carriage was most frequently caused by GCS.
4. Being male was the only identified factor associated with β -HS carriage.

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Conflicts of interest: The authors declare no conflicts of interest.

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