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A complex study of the incidence of *M. pneumoniae*, *M. genitalium* and *M. fermentans* in relatively healthy children and children with lower respiratory tract diseases

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The aim of the study was to investigate the prevalence of different mycoplasmic species (*M. pneumoniae*, *M. genitalium* and *M. fermentans*) in healthy children and children with lower respiratory tract (LRT) infections, and co-infections by these agents. **Methods**. A total of 91 patients with LRT infections (acute bronchitis 39 and pneumonia 52) were investigated. Throat swabs and blood samples of the patients were tested by specific polymerase chain reaction (PCR) and hybridization assays for *M. pneumoniae*, *M. genitalium* and *M. fermentans*. **Results**. The PCR test revealed *M. pneumoniae*, *M. genitalium* and *M. fermentans* DNA in 43/91 (47.3%) hospitalized patients (15 with bronchitis and 28 with pneumonia). In 26 healthy children from the control group, evidence of mycoplasmic infection was obtained in 5 (19.2%). The difference was significant ($p < 0.025$). Infections were detected from throat swabs and blood samples: *M. pneumoniae* in 32.9% (30/91), *M. genitalium* 22% (20/91) and *M. fermentans* 16.5% (15/91). *M. pneumoniae* ($p < 0.025$) and *M. genitalium* ($p < 0.05$) were significantly more often frequent in children with LRT than in the control group. There was no significant difference between the study groups in the rates of acute infection by *M. fermentans* (16.5% in the hospitalized patients *versus* 11.5% in the control subjects). Single infections with one of the test mycoplasmas were observed in 23 (25.3%) of the 91 patients. The most common single infection was *M. pneumoniae* 16.5% (15/91), whereas *M. genitalium* (2.2%, 2/91) and *M. fermentans* (6.6%, 6/91) were found at a lower incidence. Multiple mycoplasmic infections were found in 20 of 91 (22%) patients, double infections being detected in 18/91 (19.8%) and triple infections in 2/91 (2.2%). It is of interest that DNA of all three microorganisms was present in blood samples of 34.1% patients. *M. pneumoniae* infections were found in blood samples of 10/30 (33.3%) patients, *M. genitalium* occurred in 11/20 (55%) and *M. fermentans* in 10/15 (66.7%). In blood samples of patients with LRT diseases, *M. pneumoniae* ($p < 0.01$), *M. genitalium* ($p < 0.001$) and *M. fermentans* ($p < 0.001$) were significantly more frequent that in the control group. **Conclusions**. This study has showed that *M. genitalium*, not only *M. pneumoniae*, may evoke lower respiratory tract infections in children. The significance of *M. fermentans* in the etiology of LRT infections in children is not clear. Evidence of mycoplasma DNA in the blood of children with LRT infections supports the hypothesis that mycoplasmas from mucosa are disseminated to other tissues via blood.

Key words: *M. pneumoniae, M. genitalium, M. fermentans* infection, prevalence, polymerase chain reaction, children

INTRODUCTION

Man is the natural host of *M. pneumoniae, M. genitalium* and *M. fermentans*. All these mycoplasmas are found in human respiratory or urinary tracts as a normal flora (1–6). Recent findings have shown their unusual occurrence in blood, tissues and intracellular persistence, avoiding the immune response

and evoking infections (7, 8). These findings explain why *M. pneumoniae, M. genitalium* and *M. fermentans* can survive in the human body after antibacterial treatment and the clinical recovery of a patient (9, 10).

M. pneumoniae is known to elicit respiratory tract infections. However, recently with the aid of the polymerase chain reaction (PCR) technique *M. pneumoniae* has been shown to occur in urogenital tract and trigger nongonococcal urethritis (5, 11, 12). Only recently weighty proofs have been found that *M. genitalium*, which is a normal microflora in the urinary and sexual system or evokes non-gonococcal urethritis (13–16), can cause respiratory tract infection. When in 1988 for the first time both *M. pneumoniae* and *M. genitalium* were simultaneously isolated in nasopharyngeal specimens (17) from patients with acute respiratory disease, this not only contributed new concepts about the host distribution of *M. genitalium*, but also prompted an important question about the potential pathogenicity of the organism and its relationship with *M. pneumoniae*. Although *M. genitalium* is undoubtedly a separate microorganism species, it has become evident that by its structure, antigenic and molecular properties it is similar to *M. pneumoniae* (18) and that serologically it is difficult to differentiate between these two because of numerous cross-reactions (19). The latest methods such as immunoblotting and PCR allow this differentiation (20). There are only single publications to show that *M. genitalium* alone or with other mycoplasmas can elicit acute LRT infections (21, 22). Over the recent years also there have been reports on *M. fermentans* not only to colonize the upper respiratory tract but also to damage it them (4, 23, 24). However, the literature data on the atypical localization of different mycoplasm species are not numerous and controversial. The pathogenesis and clinical significance of the atypical localization of *M. genitalium* and *M. fermentans* are not yet clear and need further studies. The prevalence and significance of mixed mycoplasmal infections of respiratory tract are unknown.

The aim of the present study was to elucidate the incidence of *M. pneumoniae, M. genitalium* and *M. fermentans* in healthy children and children with respiratory tract infections and to assess the rate of coinfection with these agents.

MATERIALS AND METHODS

In 2001–2002, at the Pediatrics Centre of the Vilnius University Children's Hospital and at the Vilnius University Institute of Immunology a prospective study was performed, which involved 91 patients with infectious diseases of the LRT. Of them, 39 had bronchitis and 52 pneumonia. The control group comprised 20 children that showed no symptoms of respiratory tract diseases. The involvement criteria were as follows: age 0–16 years, symptoms of LRT disease, throat or chest pain, $t \geq 37.5$ °C and at least one concomitant symptom such as general malaise, muscle pain, headache. The clinical and laboratory data were entered into a special questionnaire. Patients that had been treated with non-betalactamic antibiotics during the previous 14 days were excluded from the study.

M. pneumoniae, M. fermentans and *M. genitalium* were determined in throat swabs and blood samples by the methods of PCR and nonradioactive hybridization, using specific primers and probes. Oropharyngeal specimens for PCR investigation were obtained from the posterior oropharynx with cotton swabs. A sample was placed in 2 ml of saline solution, shaken by rotating and kept at 4 °C until further preparation. Prepared samples were kept at –20 °C. Blood samples (2 ml) were taken into vacuum test-tubes with EDTA (K3) (Terumo, Belgium); 200 µl of blood was used for DNA testing with the aid of a K0512 kit for DNA purification from blood (*Fermentas*, Lithuania). The prepared material was kept at –20 °C or 10 µl was used for a PCR test. Specific oligonucleotide primers were used for the different species of mycoplasma (*M. pneumoniae, M. fermentans* and *M. genitalium*). The following nucleotide sequences were chosen: 16S rRNA gene for *M. pneumoniae* and *M. fermentans*, and 140-kDa adhezine gene for *M. genitalium* (25, 26). The PCR sensitivity while determining *M. pneumoniae* DNA was 100 fg. The Southern blot analysis increased the PCR sensitivity up to 1 fg. One fg of DNA on average corresponds to one nucleic acid of the mycoplasma genome.

The data are presented as means with standard deviation or in percentage. The Students's t and chi-square methods were applied to analyse the results. The difference among the groups was regarded as significant, if $p < 0.05$.

RESULTS

A total of 91 patients with lower respiratory tract diseases (acute bronchitis – 39 and pneumonia – 52) were investigated for *M. pneumoniae*, *M. genitalium* and *M. fermentans* infections. The control group consisted of 26 children without LRT infections. The study and the control groups were matched as regards age and sex ($p > 0.05$). By the PCR method, all three mycoplasmas were found in throat swabs and blood samples of 43/91 patients (47.3%). Of the 43 children, 15 were ill with bronchitis and 28 with pneumonia (Fig. 1).

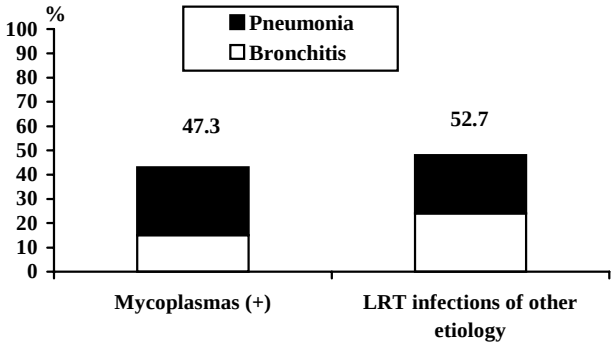

Fig. 1. Rate of mycoplasma infection (*M. pneumoniae, M. genitalium* and *M. fermentans*) in children with lower respiratory tract (LRT) infections (n = 91)

In the control group (n = 26), mycoplasmas were found in 5 children (19.2%). The prevalence of mycoplasmal infections in the control group was statistically reliably lower than in the study group (χ^2 = = 6.56, p < 0.025) (Table 1). *M. pneumoniae* had 1 (3.8%) child, *M. genitalium* – 1 (3.8%), and *M. fermentans* – 3 children (11.5%).

Table 1. **Mycoplasmal infection incidence in control children (n = 26)**

Mycoplasma species	Number	%
Unidentified	21	80.8
One agent	5	19.2
M. pneumoniae	1	3.8
M. genitalium	1	3.8
M. fermentans	3	11.5
Multiple infection	0	0

In the study group, *M. pneumoniae* alone or in combination with other mycoplasmas was found in 30/91 (32.9%), *M. genitalium* in 20/91 (22%) and *M. fermentans* in 15/91 (16.5%) (Table 2). The incidence of *M. pneumoniae* was six times, i.e. statistically significantly, higher in LRT patients compared with children from the control group (χ^2 = 6.4, p = 0.025). The incidence of *M. genitalium* was four times higher in LRT patients than in children from the control group, and the difference was statistically significant (χ^2 = 4.3, p < 0.05). The prevalence of *M. fermentans* was nearly the same in the study and in the control groups (Fig. 2).

The place of mycoplasm isolation is shown in Table 3. By the PCR method with hybridization *M. pneumoniae* was found in throat swabs from 20/30 patients (66.7%), in blood from 7/30 (23.3%) and in both from 3/30 patients (10%). *M. genitalium* by the PCR method was isolated from throat swabs for

Table 2. **The incidence of mycoplasmal infections in hospitalized children with lower respiratory tract infections (n = 91)**

Mycoplasma species	Number	%
M. pneumoniae[1]	30	32.9
M. genitalium[1]	20	22
M. fermentans[1]	15	16.5
One agent	23	25.3
M. pneumoniae	15	16.5
M. genitalium	2	2.2
M. fermentans	6	6.6
Multiple infection	20	22
M. pneumoniae + *M. genitalium*	11	12.1
M. genitalium + *M. fermentans*	5	5.5
M. pneumoniae + *M. fermentans*	2	2.2
M. pneumoniae + *M. genitalium* + *M. fermentans*	2	2.2

[1]One agent or in combination with another mycoplasma

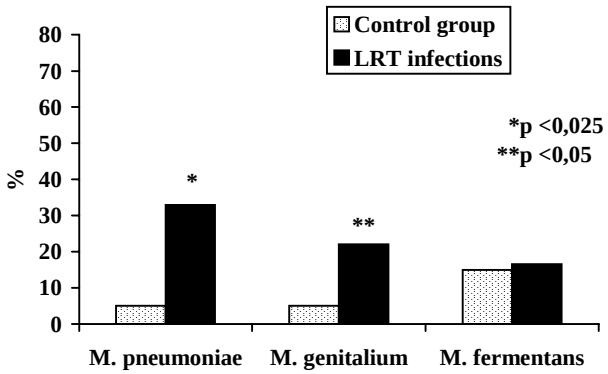

Fig. 2. The incidence *M. pneumoniae*, *M. genitalium* and *M. fermentans* in patients with lower respiratory tract infections and in healthy children

9/20 (45%), from blood for 5/20 (25%) and from both for 6/20 patients (30%). *M. fermentans* was isolated by the PCR method from the throat swabs of 5/15 (33.3%), from the blood of 6/15 (40%) and from both of 4/15 patients (26.7%). In general, the isolation rate of the agents did not depend on the place of their isolation (χ^2 = 6.3, p = 0.18).

Table 3. **Frequency of various mycoplasma species in throat and blood specimens (n = 91)**

Agent	Throat	Blood	Throat and blood	Total
M. pneumoniae	20 (66.7%)	7 (23.3%)	3 (10%)	30
M. genitalium	9 (45%)	5 (25%)	6 (30%)	20
M. fermentans	5 (33.3%)	6 (40%)	4 (26.7%)	15

χ^2 = 6.3, p = 0.18

In total, mycoplasmas were found in the blood of 34.1% (31/91) of patients. *M. genitalium* DNA from throat swabs was isolated of 15 and from the blood of 11 patients; no statistically significant difference between the groups was found (χ^2 = 1.9, p = 0.38). *M. fermentans* DNA was equally frequent in the throat and blood samples (χ^2 = 0.6, p = 0.74), whereas in children with LRT infections *M. pneumoniae* DNA was statistically significantly more frequent in the throat compared with the blood (χ^2 = = 23.7; p = 0.00001) (Fig. 3).

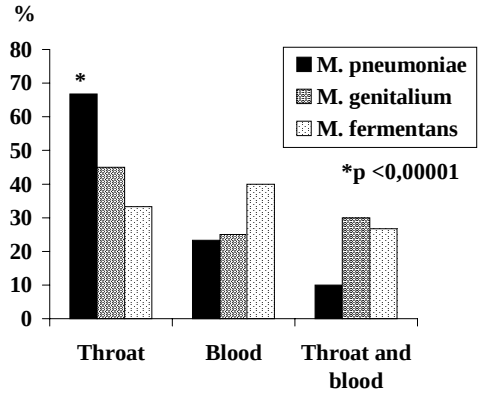

Fig. 3. The rate of *M. pneumoniae*, *M. genitalium* and *M. fermentans* DNA in blood samples and throat swabs

DNA of all three mycoplasmas was isolated from blood samples of LRT patients: *M. pneumoniae* DNA from 10/30 (33.3%), *M. genitalium* from 11/20 (55%) and *M. fermentans* from 10/15 (66.7%) patients (Fig. 4), and their incidence was significantly higher compared with the control group (χ^2 = 7.67, p < < 0.01; χ^2 = 18.79, p < 0.001; χ^2 = 15.98, p < < 0.001, respectively).

One agent was found in 23/91 (25.3%) and multiple mycoplasmal infection in 20/91 patients (22%). *M. pneumoniae* was the most common agent of LRT infection (15/91, 16.5%), followed by *M. fermentans* (6/91, 6.6%) and *M. genitalium* (2/91, 2.2%). Two agents were found in 18/91 (19.8%) and

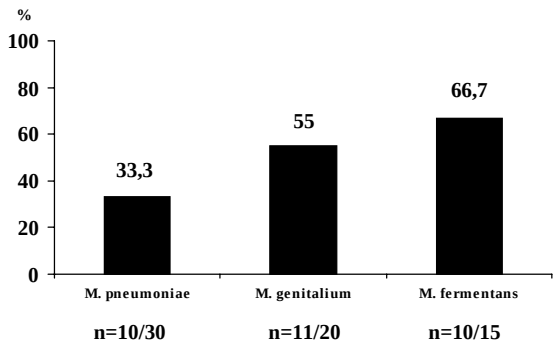

Fig. 4. The rate of *M. pneumoniae, M. genitalium* and *M. fermentans* in blood samples of patients with lower respiratory tract infections

three in 2/91 (2.2%) patients (Fig. 5). In the cases of mixed infection, the most frequent combination was *M. pneumoniae* + *M. genitalium* (12.1%), followed by *M. genitalium* + *M. fermentans* (5.5%) and *M. pneumoniae* + *M. fermentans* (2.2%) (Fig. 6). All three mycoplasmas were detected in 2 (2.2%) patients with LRT diseases.

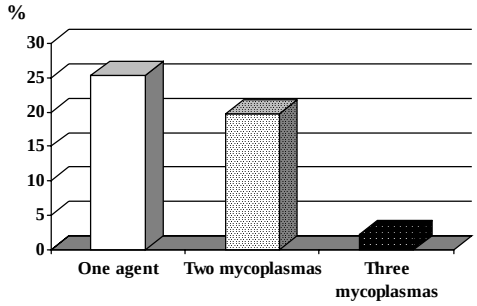

Fig. 5. The rate of multiple mycoplasmal infections in children with LRT infections

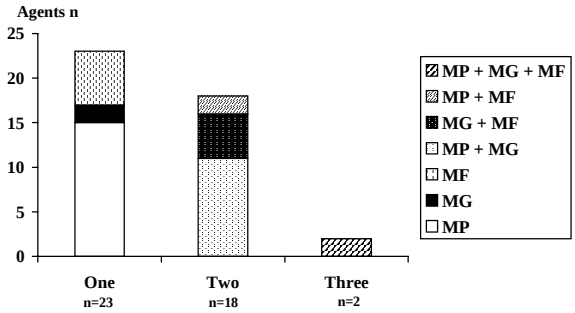

Fig. 6. The number of single and multiple (two and three agents) mycoplasmal infections (MP – *M. pneumoniae*, MG – *M. genitalium*, MF – *M. fermentans*)

DISCUSSION

At present, PCR is the standard first-choice method used for diagnosis of mycoplasmal infections (27, 28). This method is sensitive (80.6–92%) and highly specific (98%) (29–32). It is more sensitive than the culture and serological methods, such as complement fixation, IgG, IgM, IgA class antibody immunoenzymatic investigations (32, 33). Honda and co-authors (30) showed that the sensitivity of the method depends on the quality of sampling. If taking a swab from the pharynx is accompanied by inadequate scratching of pharynx mucosa, the result may be false-negative because of an insufficient DNA quantity (30). Recently published data indicate that the molecular methods can help to improve the diagnostics of viral infections in patients with LRT infections (34). Since the serological methods are less sensitive and less specific than PCR assay, we used PCR for *M. pneumoniae*, *M. genitalium* and *M. fermentans* detection.

M. pneumoniae is a known pathogen of the respiratory tract, *M. genitalium* is usually isolated from the urogenital tract (13), whereas *M. fermentans* is found as a normal oral and pharyngeal flora, and rather often it is isolated from synovial fluid and blood specimens (18, 36, 37). Studies have revealed a similar structure of *M. pneumoniae* and *M. genitalium*, similar antigenic properties, identical adhesion genes and membrane glycolipids (18, 38). The literature provides only scanty data on the interaction of these agents in human tissues or their prevalence and significance when isolated from non-characteristic places such as respiratory tract or blood.

Using the specific PCR method and hybridization, in throat or blood samples of the healthy children from the control group we found *M. pneumoniae* in 3.8%, *M. genitalium* in 3.8% and *M. fermentans* in 11.5% of cases. Cultures of the specimens from the throat showed that *M. pneumoniae* carriers among healthy subjects comprised 2.5–13.5% (1, 2, 39). *M. pneumoniae* prevalence varied depending on the season of the year. In the control group children the throat swab specimens were MP-negative, possibly because of an insufficient amount of DNA in a swab or an insufficient number of children in the control group. *M. pneumoniae* was found in the blood of only one child after hybridization. This child could be a *M. pneumoniae* carrier after the history of a mycoplasmal infection. Foy (39) isolated *M. pneumoniae* from pharynx swabs of some patients four months following the disease; this agent is found also in the blood of healthy humans (40). Throat swabs showed 3.8% of *M. genitalium* carriers, which is in agreement with the literature data (5%) (22). No *M. genitalium* DNA copies were found in the blood of healthy children. *M. fermentans* was found in the pharynx of 3.8% of healthy children. The literature indicates that *M. fermentans* colonizes the mouth and pharynx of infants; at the age of three years its prevalence reaches 28.6% (4) and in adults 44–54.7% (41, 42). In the control group, *M. fermentans* was found in 7.7% of blood samples, which is in agreement with the data reported in the literature. Choppa and co-authors (43) and Nasralla and co-authors (40) revealed *M. fermentans* in the blood of 2.8–16% of healthy individuals. Our data coincide with the data of other authors and show that healthy children can be carriers of *M. pneumoniae* (3.8%), *M. genitalium* (3.8%) and *M. fermentans* (11.5%).

By the PCR method, all three mycoplasmas were found in 47.3% of children (43/91) with acute LRT infections. *M. pneumoniae* was detected in 32.9% (30/91), *M. genitalium* in 22% (20/91) and *M. fermentans* in 16.5% (15/91); multiple infections were found in 22% (20/91) of patients. *M. pneumoniae* and *M. genitalium* were statistically significantly more frequent in children with LRT infections than in healthy children from the control group. According to literature data, the prevalence of *M. pneumoniae* among hospitalized patients with LRT diseases varies greatly (12.6–61.9%) (31, 44, 45). On average, *M. pneumoniae* is found in 30–40% of hospitalized children with LRT infections (45–47). In hospitalized patients *M. pneumoniae* infection is 2–5-fold more frequent than in outpatients (48). The prevalence of this mycoplasmal infection in outpatients with viral diseases of respiratory tract or with a cold is rather low (2–10.7%) (49–52). In 22% of children with LRT infections, *M. genitalium* was found is throat swabs and blood samples. Literature data on *M. genitalium* infections of respiratory tract are very scarce. Recently two sources have shown the incidence of *M. genitalium* in 21–22.5% of cases, which is in agreement with our results (21, 22). In children with LRT infections the incidence of *M. genitalium* was statistically significantly higher than in children from the control group. Our study confirms the data reported by other authors that *M. genitalium* can evoke LRT infections in children (21, 22).

M. fermentans is found in the pharynx of healthy individuals and of HIV patients (23%), as well as in HIV patients' bronchoalveolar lavage (25%) (24, 53). In our study, *M. fermentans* was found in 16.5% of children with LRT infections, however, the difference as compared with the control group was not significant. In cases of *M. fermentans* infection, this agent is equally frequent in throat swabs (9/15) and blood samples (10/15). This means that *M. fermentans* is most probably part of the normal microflora or a co-pathogen alongside other mycoplasmas, and its clinical significance in the etiology of LRT infectious diseases is not yet clear.

Recent studies have shown that DNA of *M. pneumoniae*, *M. genitalium* and *M. fermentans* is frequently found in whole blood or peripheral blood monocytes or other cells of patients with chronic fatigue and amyotrophic lateral sclerosis syndromes (37, 54). A case of *M. pneumoniae* DNA occurrence in the blood of acute pneumonia patients was reported (55). Detection of mycoplasmal DNA in the blood of children with LRT infections would be helpful in determining the prevalence of mycoplasmal bacteremia, also it would alleviate the diagnostics of this infection and would improve the control of its treatment. This approach, employing the PCR assay, has been used for diagnosing acute tuberculosis, *S. pneumoniae* infection and controlling the efficiency of its treatment (56). Attempts are in progress to use the PCR method for the diagnosis of LRT infections caused by *Ch. pneumoniae* by examining peripheral blood cells (57, 58).

Nasralla et al. (40) by the PCR method examined 565 patients ill with LNS and fibromyalgia syndrome and found mycoplasmas in the blood of 300 (53.1%) patients. Nicolson et al. (54) examined 28 amyotrophic lateral sclerosis patients and in 83% of blood specimens found mycoplasmal DNA such as *M. fermentans, M. pneumoniae, M. hominis* and *M. penetrans* DNA. Nijs et al. (37) by the PCR method examined 261 chronic fatigue syndrome patients and 36 healthy volunteers; in the blood of 68% (179/261) of patients and in 5.6% ($p < 0.001$) of healthy individuals they found various mycoplasma species (*M. hominis, M. pneumoniae, M. fermentans, M. penetrans*), and multiple infection was observed in 17.2% of patients.

On evaluating the literature data, we tried to detect the DNA of three mycoplasmas in the blood of children with LRT infections. Interestingly, the DNA of all three mycoplasmas was found in blood samples of healthy children (11.5%) and of children with LRT infections (34.1%). In cases of *M. pneumoniae* infection, DNA was isolated from blood samples of 10/30 (33.3%) patients, the numbers for *M. genitalium* and *M. fermentans* infection being 11/20 (55%) and 10/15 (66.7%), respectively. In the blood of children with LRT infectious diseases, *M. pneumoniae* ($\chi^2 = 7.67$; $p < 0.01$), *M. genitalium* ($\chi^2 = 18.79$; $p < 0.001$) and *M. fermentans* ($\chi^2 = 15.98$; $p < 0.001$) were statistically significantly more frequent than for children from the control group. To prove that blood sample examination is efficient in diagnosing *M. pneumoniae* and *M. genitalium* infections, further studies are needed. The great number of patients with mycoplasmic DNA in their blood implies that these bacteria easily find their way to the blood, can survive there for a long time if untreated and can have a role in the pathogenesis of chronic fatigue syndrome and other diseases. Since our knowledge of the role of *M. fermentans* in the pathogenesis of respiratory tract infections is still poor and in the present study the incidence of *M. fermentans* in patients with LRT infections in general did not differ from that in control group, it remains unclear whether *M. fermentans* is a morbid agent, a cofactor, an opportunistic infection or a superinfection.

Mycoplasmic DNA analysis in blood or blood cells can be very valuable in identifying *M. pneumoniae* bacteremia or carriers and evaluating the efficacy of antimycoplasmic treatment. Determination of *M. pneumoniae* DNA in blood by the PCR method would be also valuable for diagnosing LRT infections, in pre-school children in particular, as they fail to cough up sputum. Blood analysis for mycoplasmic DNA could help in escaping false-negative results because of an insufficient amount of DNA when the sampling is accompanied by inadequate scratching of pharyngeal mucosa (30). Further studies are indispensable in order to find whether the agent's DNA in the whole blood or in monocytes can be helpful in diagnosing a mycoplasmal LRT infection.

Serological and PCR analyses show that mixed respiratory tract infection occurs in 5% to 48% of patients. Most often concomitantly are found viruses (influenza A or B and RSV) and S. *pneumoniae* or viruses and *M. pneumoniae*, *Ch. pneumoniae* or *S. pneumoniae* together with *M. pneumoniae*, or several mycoplasma species (21, 50, 59–65). The increase in the cases of *M. pneumoniae* coincides with the epidemic periods (50). Therefore Layani-Milon et al. (50) suggest that a viral infection can be accompanied by *M. pneumoniae* superinfection, which appears either at the early (in the first three days) or late stage of the disease when epitelium restoration takes place in the respiratory tract.

Recently, attempts have been made to elucidate the frequency of respiratory tract diseases provoked by different mycoplasma species. However, in the literature, reports on testing for the simultaneous presence of several mycoplasmas in patients with infectious diseases of respiratory tract are very scarce. Kraft et al. (23), by the PCR method, found *M. pneumoniae* in the bronchial biopsies or lavage material of 55% (10/18) of asthma patients and only in 9.1% (1/11) of controls ($p = 0.02$). Interestingly, for all patients the culture and serological tests for *M. pneumoniae* were negative. Besides, for 38.9% (7/18) of asthma patients *M. genitalium* and *M. fermentans* were isolated from bronchial biopsies or bronchoalveolar lavage by the PCR method. In the control group ($n = 11$), one case of *M. genitalium* and one case of *M. fermentan*s were found (23). Our data show that in children with LRT infection various mycoplasma species are found in throat swabs and blood samples. de Barbeyrac et al. (11) of 75 hospitalized patients with lung infiltration (of them 55 with HIV and 20 without HIV) from bronchial lavage samples by the PCR method determined *M. pneumoniae* and *M. genitalium* infection in 9.3% (7/75); of them, mixed *M. pneumoniae* and *M. genitalium* infection was found in 4% (3/75), and in culture these bacteria did not grow. Although the role of mycoplasmas in the etiology and pathogenesis of bronchial asthma is not yet clear, studies show that they might be important in bronchial asthma pathogenesis. Combined *M. pneumoniae* and *M. genitalium* infection was established in the synovial fluid of a pneumonia patient who developed also polyarthritis (18). Lu et al. (21) in 1999 studied 231 children with respiratory tract infections, and by the PCR technique *M. pneumoniae* was found in throat

swabs in 30.7% of cases and *M. genitalium* in 22.5%; 5.2% of patients developed *M. pneumoniae* and *M. genitalium* co-infection (21). In our data, in children with LRT infections multiple mycoplasmal infection was found in 20 patients (22%); two agents were determined in 18/91 (19.8%) and three in 2/91 (2.2%) cases. Among children with LRT infectious diseases, *M. pneumoniae* + *M. fermentans* co-infection was found in 12.1%, *M. genitalium* + *M fermentans* in 5.5%, *M. pneumoniae* + *M. fermentans* in 2.2%, and all three agents were found in two patients.

Thus, the results of the current study show that *M. pneumoniae* and *M. genitalium* pathogens were found significantly more often in children with lower respiratory tract infections than in healthy controls. The incidence of *M. fermentans* in children with LRT infections did not differ from the control group. All three mycoplasmas were found not only in the throat swab specimens but also in the blood of the children with LRT infections. Occurrence of mycoplasmas in the blood of children with LRT diseases confirms the hypothesis that mycoplasmas from mucous membranes are transferred into other tissues by blood. Our study is in support of the literature data showing that combined mycoplasmic infections have a role in the etiology and pathogenesis of the lower respiratory tract diseases in children.

CONCLUSIONS

1. This study has shown that *M. genitalium,* not only *M. pneumoniae,* can be the agent of lower respiratory tract infections in children.

2. The role of *M. fermentans* in the etiology of LRT infections in children is not yet clear.

3. Multiple mycoplasmic infections (22%) might be present in children with lower LRT infections.

4. The occurrence of mycoplasmic DNA in the blood of children with infectious diseases of the lower respiratory tract confirms the hypothesis that mycoplasmas from mucous membranes are transferred into other tissues via blood.

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KOMPLEKSINIS *M. pneumoniae, M. genitalium IR M. fermentans* PAPLITIMO TARP SANTIKINAI SVEIKŲ VAIKŲ IR SERGANČIŲJŲ APATINIŲ KVĖPAVIMO TAKŲ LIGOMIS TYRIMAS

S a n t r a u k a

Darbo tikslas – nustatyti *M. pneumoniae, M. genitalium* ir *M. fermentans* paplitimą tarp sveikų vaikų (sergančių ne kvėpavimo takų infekcinėmis ligomis) ir vaikų, sergančių apatinių kvėpavimo takų infekcinėmis ligomis, bei įvertinti šių sukėlėjų koinfekcijos dažnį.

Metodika. Ištyrėme 91 ligonį, sergantį apatinių kvėpavimo takų infekcinėmis (KTI) ligomis (ūminiu bronchitu – 39, pneumonija – 52). *M. pneumoniae, M. genitalium* ir *M. fermentans* ryklės ir kraujo mėginiuose buvo tiriamos panaudojant specifinę polimerazės grandininę reakciją (PGR) ir hibridizaciją.

Rezultatai. Mikoplazminė infekcija (*M. pneumoniae, M. genitalium* ir *M. fermentans*) PGR metodu ryklės ir kraujo mėginiuose nustatyta 47,3% (43 iš 91) ligonių (15 sirgo bronchitu ir 28 – pneumonija). Sveikų vaikų kontrolinėje grupėje (n = 26) šios mikoplazmos aptiktos 5 (19,2%) atvejais. Vaikų, sergančių apatinių kvėpavimo takų infekcinėmis ligomis, tirtuose ryklės ir kraujo pavyzdžiuose *M. pneumoniae* viena ar su kitomis mikoplazmomis buvo 32,9% (30 iš 91), *M. genitalium* – 22% (20 iš 91) ir *M. fermentans* – 16,5% (15 iš 91). Ligoniams, sergantiems apatinių KTI ligomis, *M. pneumoniae* ($p < 0,025$) ir *M genitalium* ($p < 0,05$) nustatyta reikšmingai dažniau negu kontrolinės grupės vaikams. *M. fermentans* paplitimas kvė-

pavimo takuose, sergant apatinių kvėpavimo takų infekcija, reikšmingai nesiskyrė nuo sveikų vaikų kontrolinės grupės (16,5% hospitalizuotiems vaikams ir 11,5% kontrolinėje grupėje). Vienas sukėlėjas nustatytas 23 ligoniams (25,3%) iš 91. *M. pneumoniae* buvo dažniausias vienas KTI sukėlėjas (15 iš 91, 16,5%), kitos mikoplazmos, kaip vienintelis sukėlėjas, išskirtos rečiau: *M. genitalium* – 2 iš 91 (2,2%) ir *M. fermentans* – 6 iš 91 (6,6%) ligoniams. Mišri mikoplazminė infekcija nustatyta 22% ligonių (20 iš 91), du sukėlėjai identifikuoti 18 iš 91 (19,8%) ligonių ir trys – 2 iš 91 (2,2%). Pažymėtina, kad visų trijų mikoplazmų DNR išskirta iš 34,1% sergančiųjų apatinių kvėpavimo takų infekcijomis kraujo mėginių. *M. pneumoniae* DNR išskirta iš kraujo mėginių 10 iš 30 (33,3%) ligonių, *M. genitalium* – 11 iš 20 (55%) ir *M. fermentans* – 10 iš 15 (66,7%) ligonių. Vaikų, sirgusių apatinių KTI ligomis, kraujyje *M. pneumoniae,* ($p < 0,01$) *M. genitalium* ($p < 0,001$) *ir M. fermentans* ($p < 0,001$) nustatyta reikšmingai dažniau negu kontrolinės grupės vaikams.

Išvados. *M. pneumoniae* ir *M. genitalium* yra vaikų ūminių apatinių kvėpavimo takų infekcinių ligų sukėlėjai. *M. fermentans* reikšmė šių ligų etiologijoje nėra aiški. Vaikai, sergantys apatinių kvėpavimo takų infekcinėmis ligomis, gali turėti mišrią mikoplazminę infekciją. Mikoplazmų DNR aptikimas vaikų, sergančių KTI, kraujyje patvirtina hipotezę, kad mikoplazmos nuo gleivinių į kitus audinius patenka per kraują.

Raktažodžiai: *M. pneumoniae, M. genitalium, M. fermentans* infekcija, paplitimas, polimerazės grandininė reakcija, vaikai