

Implications and Correlations of Invasive Infections Determined by *Streptococcus Pneumoniae* to Children in the Context of SARS-CoV-2 Infection

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Abstract

Background: *Streptococcus pneumoniae* with *Haemophilus influenzae*, *Moraxella catarrhalis*, *Neisseria meningitidis*, *Staphylococcus aureus* and other hemolytic streptococci that have the potential to migrate under certain special and favorable conditions can cause various invasive respiratory infections in children. There is also a temporal and spatial correlation and not only between the invasive pneumococcal disease and the seasonal or permanent circulation of some viral agents –the influenza virus for example, but particularly the current pandemic situation caused by SARS -CoV-2 [1].

Method: This paper aims to outline and examine the implications of the SARS COV 2 pandemic on invasive infections caused by *Streptococcus pneumoniae* in children hospitalized in the "St. John" Children's Emergency Clinical Hospital in Galati, in 2020.

Results: The incidence of invasive pneumococcal diseases in the child is considerably reduced, compared to the previous year of the pandemic, due on the one hand to the protective measures implemented at global, national and local level but also to the implication of internal and external factors.

Conclusion: After a hundred years, mankind is facing a new pandemic, the infection with the SARS-CoV-2 virus that has had and will have an important resonance in the socio-economic field, but also on the pre-existing chronic pathologies as well as on acute invasive infections in children, in this case those caused by *Streptococcus pneumoniae* [2].

Keywords: *Streptococcus Pneumoniae*; SARS-Cov-2; Invasive Infections; Pandemic

Introduction

Invasive infections caused by *Streptococcus pneumoniae* among the pediatric population have represented a rich and topical issue in the last period especially in terms of complications. *Streptococcus pneumoniae* includes over 90 serotypes, but only a small number are pathogenic, namely those with a polysaccharide capsule, which can cause invasive infections [1]. According to the WHO (World Health Organization) data, there are 1.6 million deaths caused by *Streptococcus pneumoniae* diseases worldwide each year, including children up to 5 years of age. In Europe and the U.S. pneumococcus is responsible for about 80% of the bacterial pneumonias [2].

Since the outbreak of the SARS-CoV-2 pandemic in 2020, acute and chronic medical pathologies have undergone a number of modifications, which required the change of the observational and therapeutic management strategy. Coronaviruses (CoV) are a large family of viruses that cause diseases ranging from mild to severe respiratory tract infections, such as Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome [3]. The original epicentre of the coronavirus outbreak was Wuhan, China, where the first case of infection was recorded and the name SARS-CoV-2 comes from the fact that 80% of its genomic sequence is identical to that of the virus which caused the 2002 SARS pandemic. Paediatric patients have been affected in a relatively small percentage ~2%, compared to adults where things are different. Between March and December 2020 there were 2,871,828 confirmed cases of COVID-19 in the U.S. in children, adolescents and young adults aged 0 - 24 years. In Romania, the SARS-CoV-2 infection both in terms of distribution by age group and of a pediatric population category shows statistical reports similar to those in Asia, Europe and America [4].

Methods and Materials

This paper is a retrospective, comparative and observational study that took place in the laboratory of the "Sf. Ioan" Children's Emergency Clinical Hospital in Galati, focusing on the identification of all strains of Streptococcus pneumoniae in children, isolated from various pathological products. The study took one year to complete (2020) in the context of the COVID-19 pandemic, identifying the cases that were positive for SARS CoV-2 infection in children. The trained medical personnel collected the pathological products under aseptic conditions with sterile materials and instruments, and their transport was carried out quickly, under conditions of biological protection and ensuring the identity of the samples. For the examination and determination of the morphotinctorial characteristics of these strains Gram stained smears were used, subsequently seeding on their culture media, differentiating them according to the type of pathological product collected (nasopharyngeal secretion, laryngotracheal secretion, blood and otic secretion). For the nasopharyngeal, laryngotracheal and otic secretions, the inoculations were performed on blood agar, then the optochin test was performed, identifying suspicious alpha-hemolytic cultures. The blood culture technique was performed for blood using the BACT/ALERT device. The sown media were incubated at 37°C, 24 - 48 hours, under aerobiosis conditions. The identification of streptococcus was carried out on the basis of the biochemical characters observed on the special Muller Hinton agar, and the identification of the species was done with the help of the automatic bacteriology analyzer Vitek 2 COMPACT. Diagnosis of COVID-19 positive patients was performed by detecting the SARS-CoV-2 RNA by PCR testing of a nasopharyngeal swab. Reverse transcriptase polymerase chain reaction (RT-PCR) is considered the "gold standard" method of diagnosing SARS-CoV-2 infection with a specificity and sensitivity of up to 98% [5]. The data obtained from the research of the clinical observation sheets of the hospitalized patients during 2020 were processed using the Microsoft Excel software, being subsequently filtered and sorted according to different criteria.

Results

The comparative and descriptive analysis of the batch analyzed during 2020, regarding the incidence of isolated cases of Streptococcus pneumoniae in hospitalized children, showed a total of 23 isolated strains of different pathological secretions. The most common isolation place of Streptococcus pneumoniae was in the nasal swab, followed by the otic secretion. Compared to 2019, when there were 100 patients diagnosed with Streptococcus pneumoniae, their incidence has greatly decreased in the context of the COVID 19 pandemic. The age group most affected by the invasive infections caused by Streptococcus pneumoniae was the under 5 (20 cases), as the data in the literature confirmed it. This age group also represents a real potential reservoir of this pathogen especially of multiresistant strains. Thus, there is a close epidemiological relationship between the strains that colonize the asymptomatic pediatric population and the strains that generate invasive pneumococcal infections. [6] It should be noted that most cases received as first-line antibiotic therapy a third generation cephalosporin, which was later found in the antibiogram as sensitive, so that their evolution was a favorable one and free of major complications. This low incidence of invasive infections caused by Streptococcus pneumoniae is neither random nor it is based on the implementation of pneumococcal vaccination in the national immunization scheme, but rather due to the appearance of SARS COV-2 infection worldwide. We are thus facing a reversal of the situation against the Streptococcus pneumoniae and the first place goes to the

infection with SARS CoV-2, aspect confirmed within the “Sf. Ioan” Children’s Emergency Clinical Hospital in Galati. In terms of the distribution of cases by sex, there is equality in both situations. A total of 158 cases of COVID-19 were detected in children hospitalized during 2020, compared to 23 cases of invasive streptococcus pneumoniae infections.

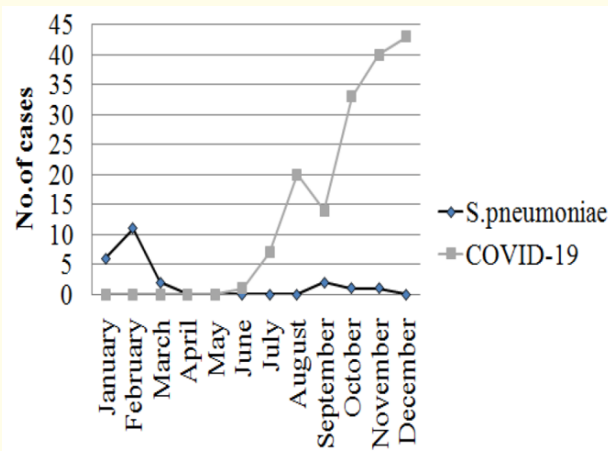


Figure 1: Distribution of SARS CoV-2 infection cases by sex.

Another important aspect to be noticed is that there is still a detailed temporal and spatial correlation during each month in 2020 between these two entities. Thus, the peak of SARS-COV-2 infection was reached in December 2020 with a number of 43 cases, and for Streptococcus pneumoniae no case was detected in children hospitalized during the period mentioned. As to the SARS-CoV-2 infection, the clinical spectrum ranged from asymptomatic infection, discovered by chance, but also mild forms of the disease to some extremely severe ones that required hospitalization in the intensive care unit. The highest percentage belonged to mild and moderate forms of the disease that did not require prolonged hospitalization. However, the spread of SARS-CoV-2 infection both locally and globally has been impressive. At the opposite pole most cases of Streptococcus pneumoniae were identified at the beginning of the year (January-February-March), when the infection with COVID-19 was in its early stages, and there were no ways of testing and diagnosing suspicious patients.

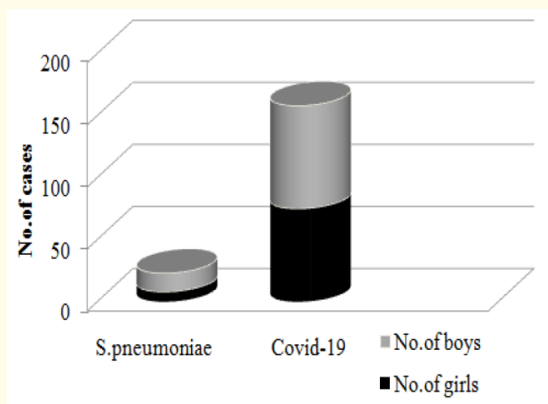


Figure 2: Distribution of SARS CoV-2 and S.pneumoniae infection cases by sex.

Discussions

The invasive infections caused by *Streptococcus pneumoniae* have been one of the main causes of morbidity and mortality in the pediatric population, so interest in this topic in the medical world has been a real challenge [3]. An important step in the evolution of this pathology was the implementation of pneumococcal vaccination in national immunization programmes, which led to a decrease in the incidence of cases. However, the complete disappearance of this pathology was not possible because although they were vaccinated against pneumococcal disease, children still developed the disease, but most likely with another serotype that had not been in the vaccine, either they were incompletely vaccinated or they belonged to certain categories prone to the disease (premature, immunosuppressed, artificially fed children or splenectomies ones) [2]. As to this study, the important and significant decrease in the incidence of pneumococcal infections in the child was due to the current pandemic context of COVID-19, through the implementation of several safety and prevention measures worldwide, but also locally: closure of communities and schools, wearing protective masks including in public spaces, social distance, self-isolation, limitation of travel, but also low number of cases reported in hospital units [7]. Many paediatric patients in the context of minor acute distress have either turned to their GP or treated themselves at home because of various reasons: fear of hospitalization, fear of nosocomial infections and fear of impact or contact with COVID-19 positive patients. Thus, many of them have not been properly diagnosed and treated because of this COVID-19 global pandemic outbreak.

Conclusions

The SARS CoV-2 infection has had and will have a long-term economic, social and medical impact on all age groups, but especially on the pediatric population, since there are not enough studies on this group of patients and no vaccine to provide protection to children under 16 years of age. Thus, the initiation of certain harsh restrictions had a beneficial effect in the medical world, by decreasing the incidence of invasive infections caused by *Streptococcus pneumoniae* and implicitly of short- and long-term complications.

Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

LSM and IP performed the literature search for relevant publications on the topic. LSM and IP writing original draft preparation, AN, OMM and AM supervision and participated in drafting the manuscript and provided critical insight. MPD and CMP supervision. All the authors verified and approved the final version of the manuscript.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. The Hospital Ethics Committee approved this study. Each patient, in this case legal guardians, had to fill in an informed consent for each of the sample collection procedures. Subsequent research was carried out under the conditions agreed upon in this informed consent, which was drawn up in accordance with the current legislation of the World Health Organization and the European Union on research on human subjects in the field of medicine, considering the latest version of the Declaration of Human Rights in Helsinki.

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