Community-acquired pneumonia: the dynamics of senior medical students' knowledge

Neumonía adquirida en la comunidad: la dinámica del conocimiento de los estudiantes de medicina senior

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Abstract

Community-acquired pneumonia (CAP) is an acute infectious disease. Inflammation of the lower respiratory system, interstitium, and microvasculature, mainly of bacterial etiology, is a typical pathological sign of this disease. It is one of the leading causes of death from infectious diseases. The survey was conducted within the KNOCAP multicenter research project (the full name of the project "The assessment of students' and physicians' knowledge of community-acquired pneumonia basics"). We have assessed the knowledge and preferences of doctors and 85 senior medical students from Belgorod National Research University majoring in Medicine by surveying them two times – before and after the conduction of educational activities. The first stage of the project was carried out in 2017-2018, the second one – in 2018-2019. Educational activities were held during the educational process (in particular, during Clinical Pharmacology). The greatest difficulties appeared when answering the questions: the choice of the main criterion for the terminating antimicrobial therapy (AMT); the choice of the main diagnostic sign when examining a CAP patient; the choice of the criterion for CAP diagnosis confirmation. This study makes a significant contribution to the development of a practical health care system because it allows both identifying "weak spots" and improving the quality of CAP patients' management tactics. There is a necessity to conduct more studies about this matter since the current health care system is experiencing changes, and new clinical guidelines are published.

Keywords: community-acquired pneumonia, diagnosis, pharmacotherapy, level of knowledge, pharmacoepidemiology, students.

Resumen

La neumonía adquirida en la comunidad (NAC) es una enfermedad infecciosa aguda. La inflamación del sistema respiratorio inferior, el intersticio y la microvasculatura, principalmente de etiología bacteriana, es un signo patológico típico de esta enfermedad. Es una de las principales causas de muerte por enfermedades infecciosas. La encuesta se realizó dentro del proyecto de investigación multicéntrico KNOCAP (el nombre completo del proyecto "La evaluación del conocimiento de los estudiantes y los médicos sobre los aspectos básicos de la neumonía adquirida en la comunidad"). Evaluamos el conocimiento y las preferencias de los médicos y 85 estudiantes de medicina de la Universidad Nacional de Investigación de Belgorod que se especializan en Medicina, encuestándolos dos veces, antes y después de la realización de actividades educativas. La primera etapa del proyecto se llevó a cabo entre 2017-2018, la segunda, entre 2018-2019. Las actividades educativas se llevaron a cabo durante el proceso educativo (en particular, durante el curso de farmacología clínica). La mayor dificultad en responder correctamente fue en las siguientes preguntas: la elección del criterio principal para la terminación de la terapia antimicrobiana (AMT); la elección del signo diagnóstico principal al examinar a un paciente con CAP; la elección del criterio para la confirmación del diagnóstico de CAP. Este estudio contribuye significativamente al desarrollo del sistema práctico de atención médica, ya que permite identificar "puntos débiles" y mejorar la calidad de las prácticas del manejo de los pacientes con CAP. Es necesario realizar más estudios sobre este tema, ya que el sistema de atención médica actual está experimentando cambios y se publican nuevas pautas clínicas.

Palabras clave: neumonía adquirida en la comunidad, diagnóstico, farmacoterapia, nivel de conocimiento, farmacoepidemiología, estudiantes.

Introduction

Community-acquired pneumonia is an acute infectious and socially significant disease. The typical pathological feature of CAP is inflammation of the lower respiratory system, interstitium, and microvasculature, caused mainly by bacteria. However, viruses, fungi, and protozoa can also be an etiological factor.

In most cases, the severity of pneumonia depends on the following factors: the type of pathogen, the consistency of immune response, the morphological features of the inflammatory reaction, and the degree of damage of pulmonary tissue. Despite both the high level of knowledge of the disease pathogenesis and the appearance of new highly effective drugs and the improvement of prevention methods, CAP remains one of the most important socially significant infectious diseases among all population stratums and occupies one of the leading places in the mortality structure of infectious diseases. According to official statistics (Federal Research Institute for Health Organization and Informatics), 591.493 cases of CAP were registered in Russia in 2006, which totalized 4.14% including people over 18 years old (3.44%). The highest incidence of pneumonia among the adults was noted in the Siberian and North-Western Federal Districts (4.18% and 3.69%, respectively), the lowest – in the Central Federal District (3.07%). In 2017, 808.694 children under the age of five died from pneumonia, which is 15% of all children's deaths around the world. The mortality of young and middle-aged people without concomitant diseases is more than 1-3%[1]. In the elderly, both in patients with concomitant diseases (malignant neoplasms, chronic obstructive pulmonary disease, diabetes, kidney and liver diseases, and cardiovascular system diseases) and in patients with severe CAP, the mortality rate reaches 15-30%[2,3]. Hence, the correct initial examination of the patient's severity condition and an immediate and rationally administered pharmacotherapy will contribute to both reducing the level of morbidity and mortality throughout the age groups and decreasing the enormous negative economic impact caused by acute respiratory diseases, including CAP[4].

Therefore, it is extremely important to not only assess the level of basic knowledge of the future health care workers and to identify their "weak spots", but also to carry out the subsequent analysis and correct mistakes with a help of educational activities devoted to CAP patients management. The study aims to determine the dynamics of senior medical students' knowledge in the diagnosis and treatment of CAP before and after educational activities.

Material and Methods

The survey was conducted within the KNOCAP multicenter research project (the full name of the project "The assessment of students' and physicians' knowledge of community-acquired pneumonia basics"). We have assessed the knowledge and preferences of doctors and 85 senior medical students from Belgorod National Research University majoring in Medicine by surveying them two times – before and after the conduction of educational activities. The first stage of the project was carried out in 2017-2018, the second one – in 2018-2019. Educational activities were held during the educational process (in particular, during the course of Clinical pharmacology).

The method of anonymous questioning was used in this study, for which an original questionnaire was developed based on actual clinical guidelines[5-7]. For the correct answer, the respondent was awarded 1 point, for the incorrect answer - 0. The average scores of each respondent, the average scores for individual questions, and the average scores for the entire questionnaire were evaluated. The average completeness rate for the correct, partially correct, and wrong answers was defined as the average level of response completeness (ARC), which is equivalent to the average level of correct answers. For questions that required a mandatory "written" response (questions No. 12 and 13), when none was provided, 0 points were assigned. All information on the questionnaire was entered into an electronic database and processed using the application programs Microsoft Excel, Statistica 10. The McNemar Chi-square test was used to compare the available data, with the help of which the statistical significance of the differences in indicators was assessed, the normality distribution of which was previously determined by using the Kolmogorov-Smirnov test. The statistical significance of the differences was recorded at the level of bilateral $p<0.05$.

This method of knowledge evaluation was specially developed for the "KNOCAP" project and cannot fully reflect the general level of education quality in the university[8-11].

Results and Discussion

At the first stage, 85 medical students were interviewed. Then, after the course of clinical pharmacology and various therapeutic cycles, the same students were re-interviewed. The number of senior medical students in the second stage of the project was 83. The average level of knowledge on questionnaires before educational activities was 43.8%, after – 51.8%. The detailed analysis of individual questions is presented below.

A. The framework of etiology, diagnosis, and prevention of CAP

In the first question, the respondent had to choose the most common pathogen of CAP from the proposed answers. The etiology of CAP is directly related to normal microflora that colonizes the upper respiratory tract. Only a few microorganisms with an increased virulence can cause an inflammatory reaction when entering the lower respiratory tract. Streptococcus pneumonia is such a pathogen and can cause a characteristic inflammatory process in 30-50% of cases. Therefore, pneumococcus is the main causative agent of CAP. At the initial stage of the study, the correct answer was given by 30.6% of respondents, at the second stage – by 33.3% (McNemar χ^2=

0.221, p=0.639), which is an insufficient level of knowledge in this matter. The main mistakes of respondents: 27.6% of respondents indicated another type of streptococcus (S. pyogenes, S. haemoliticus), 19.7% of students chose the genus of staphylococcus (S. aureus and others), 26.3% of students believed that atypical microorganisms most often cause CAP, and the remaining number of respondents (26.4%) chose viruses/fungi/Haemophilus influenza or Enterobacteriaceaeas as the answer.

In the next question, it was required to indicate the highly efficient methods of CAP prevention used to date. Among the proposed answers including tempering, homeopathic and immunomodulatory therapy, the only correct answer was "vaccination with pneumococcal and influenza vaccine". At the beginning of the study, the correct answer was received from 65.9% of respondents, and after educational activities – from 65.4% (McNemarχ^2=0.018, p=0.895).

According to the authors of the study, the absence of difference can be due to, first, an ambiguous attitude of the respondents to vaccination (12%)[8,9] and, secondly, the beliefs in tempering, immunomodulatory therapy. However, to date, there is only one evidentially based mean against pneumococcus and influenza virus, it is vaccination[7,10].

The next question required to identify the main diagnostic sign of CAP when examining the patient. The correct answer is the syndrome of pulmonary consolidation. There are the following signs of the syndrome: peeling of the affected side when breathing and an increased tactile fremitus during palpation over the same area, dullness of percussion sound, by auscultation – weakening of vesicular breathing over the foci of consolidation, bronchi crackle or crepitation. If there is no consolidation syndrome, the radiological conclusion about pneumonia is unjustified, because a change in the pulmonary pattern without lung tissue infiltration may be a sign of another disease[6,12]. At the initial stage of the study, the correct answer was received from 47.1% of respondents, and at the end of the second stage – from 45.7%. The observed decrease in the frequency of incorrect answers was not statistically significant (McNemar χ^2=0.011, p=0.916).

The diagnosis of a non-severe CAP is based on two examinations. Respondents were proposed to select from the following answers: single-plane radiography, biplane radiography, biochemical blood assay, general blood test, clinical analysis of sputum, microbiological analysis of sputum, and "Not sure". From the listed above, respondents had to choose a general blood test and biplane radiography [7,13]. At the initial stage of the study the correct answer was given by only 30.6% of medical students, and after educational activities – by 56.8%. The observed decrease in the frequency of incorrect answers after educational activities was statistically significant (McNemar χ^2 =6.128, p <0.014).

The next question was – «What makes the diagnosis of pneumonia 'inaccurate/uncertain':

1. lack of temperature and white blood cells;
2. lack of x-ray examination;
3. the absence of pulmonary consolidation syndrome;
4. lack of cough, wheezing in the lungs.

The inaccessibility or absence of radiological confirmation of focal lung infiltration (fluorography or radiography) makes the diagnosis of pneumonia inaccurate/uncertain[14,35].

Before educational activities, the correct answer was given by 29.4% of respondents, and after the training – by 55.6%, a visible increase in the number of correct answers is confirmed by the corresponding statistical analysis (McNemarχ^2 =6, p=0.015).

If CAP treatment has positive dynamics, it is recommended to perform a repeated x-ray examination in 14 days or later[15,16]. At the initial stage of the study, 27.1% of students answered correctly, after educational activities the number increased to 45.7%. The observed increase in the frequency of correct answers was statistically significant (McNemarχ^2 =4.057, p=0.05).

A. The basics of CAP pharmacotherapy

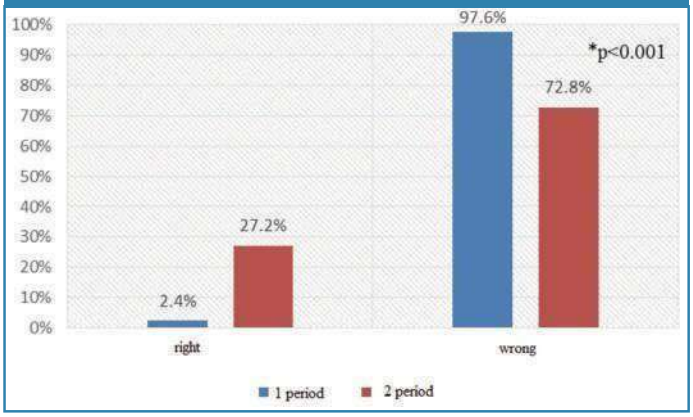
In the next question, it was necessary to indicate the possible reasons for delaying the onset of antimicrobial therapy (AMT). According to both the available clinical guidelines[6] and the draft of new clinical guidelines[7], there are no reasons for the delay of AMT with a confirmed diagnosis of CAP[17,18]. The initial level of correct answers totaled 64.7% and reached 69.1% at the second stage. Disregard of the increase, the observed decrease in the frequency of incorrect answers was not statistically significant (McNamar χ^2 =0.455, p=0.501).

A stable normalization of body temperature over 48-72 hours, combined with both a positive clinical picture and the absence of signs of clinical instability, is a key criterion for terminating AMT for a non-severe CAP[7,19]. The level of correct answer before and after educational activities totaled 42.4% and 46.9%, respectively (McNemarχ^2=0.391, p=0.532).

The next question was devoted to the question of "sequential therapy" for CAP. This type of therapy presumes two-stage administration of antimicrobial drugs: the use of parenteral form and the transition to oral form administration right after the stabilization of the patient's condition, normalization of body temperature, and the improvement of CAP clinical picture[6,20,21]. The initial level of the correct answer was 57.6% and increased to 67.9% after education activities were conducted. The observed increase in the frequency of correct answers was not statistically significant (McNemar χ^2=1.613, p=0.205).

In the next question, it was necessary to indicate typical mistakes in the initial AMT for a non-severe CAP. The following antimicrobial drugs (AMD) options were offered to the respondent: ampicillin + oxacillin («Ampiox»), ciprofloxacin, cefazolin, ampicillin per os, respiratory fluoroquinolones in patients without risk factors. According to the clinical guidelines[6,7], all options refer to an erroneous strategy in a non-severe CAP patients' management[22,23]. Initially, only 2.4% of the respondents answered correctly, and after the educational activities were conducted, the level of correct answers grew up to 27.2% (Figure 1). The observed decrease in the frequency of incorrect answers was statistically significant (McNemar χ^2= 35.438, p <0.001).

Figure 1. The dynamics of responses to the question about typical errors in an initial AMT for a non-severe CAP



The other questions required a "written" response. In the first question, it was necessary to indicate the optimal starting therapy for a non-severe CAP in both patients with neither risk factors nor concomitant diseases (diabetes, chronic renal insufficiency, congestive heart failure, chronic obstructive pulmonary disease (COPD), chronic alcoholism, cachexia, drug addiction, liver cirrhosis) and/or patients who had been taking systemic antimicrobial drugs (AMD) in the last 3 months for more than 2 days. Drugs of choice are amoxicillin or macrolides when suspected of "atypical" etiology of the disease (S. pneumoniae and M. pneumoniae)[6,24]. At the initial stage of the study the correct answer was received from only 3.5% of medical students, and after the conduction of educational activities, the rate increased to 39.5% (Figure 2). The observed decrease in the frequency of incorrect answers after educational activities was statistically significant (McNemar χ^2 =11.796, p <0.001).

The following question required to indicate the optimal starting therapy for a non-severe CAP in both patients with either risk factors or concomitant diseases and/or patients who had been taking systemic AMD in the last 3 months for more than 2 days. It is recommended to prescribe tablets forms of AMD to such patients, but the therapy strategy in these patients is different because the probability of the etiological role of gram-negative flora increases[6,25-27]. Combined AMD could be used as initial therapy: amoxicillin + clavulanic acid, if "atypical" microflora is suspected a combination of β-lactam and macrolide may be prescribed[28-30]. An alternative to combined therapy is the administration of respiratory fluoroquinolones (levofloxacin, moxifloxacin, hemifloxacin)[6,31,32] or, according to the draft of new clinical guidelines – oral cephalosporins (cefditoren)[7,33,34,36]. At the initial stage of the study, the correct answer was given by only 2.4% of medical students, and after the educational activities were conducted their number increased to 27.2% (Figure 3). The observed decrease in the frequency of incorrect answers after educational activities was statistically significant (McNemar χ^2=4.056, p=0.045).

Figure 2. The dynamics of responses to the question about an initial therapy for a non-severe CAP in patients with neither risk factors nor concomitant diseases

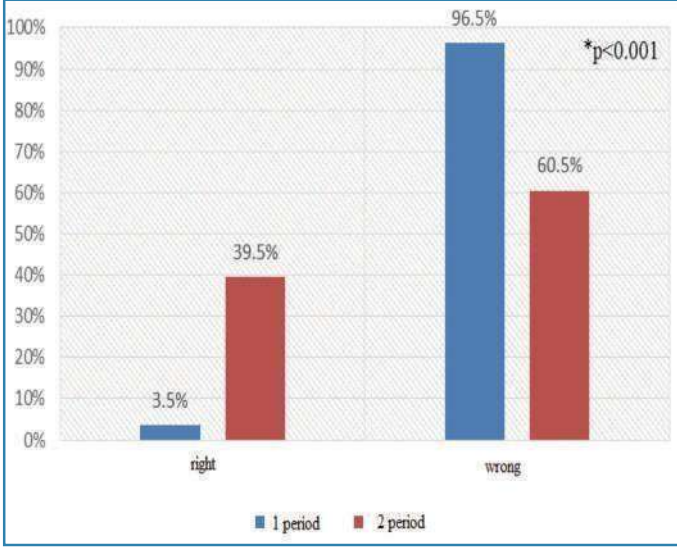
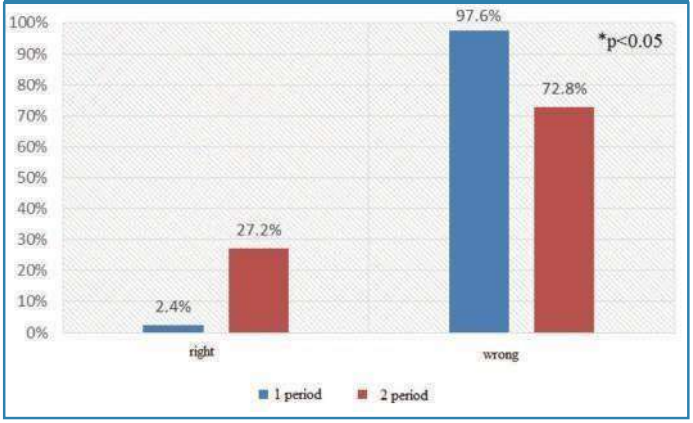


Figure 3. The dynamics of responses to the question about an initial therapy for a non-severe CAP in patients with risk factors and concomitant diseases



Conclusion

The results of the study are ambiguous: on the one hand, there is a statistically significant increase in the level of knowledge as per individual questionnaire questions (mainly questions related to CAP pharmacotherapy), which indicates the value of educational activities. On the other hand, there are still some questions where the level of correct answers did not change after the conduction of educational activities. The

lowest increase in the number of correct answers was noted in the following questions: highly efficient method of CAP prevention; the choice of both the main criterion for terminating AMT and the criterion confirming the diagnosis of CAP; the main diagnostic sign of CAP when examining the patient. According to the authors, an insufficient level of knowledge shown in the study is associated with the limited duration of educational activities during the curriculum. To cover the CAP patients' management tactics in details it is recommended to increase the number of academic hours in the related disciplines: therapy, pulmonology, and clinical pharmacology. Moreover, it is necessary to emphasize that due to the healthcare system optimization, according to the authors, modern medical students experience the lack of hours devoted to practical lessons. This may be the reason for their incomplete knowledge of some fundamental issues of CAP patients' management.

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