ORIGINAL ARTICLE

COMPARATIVE ANALYSIS OF CLINICAL AND LABORATORY CHARACTERISTICS OF MEASLES IN VACCINATED AND UNVACCINATED CHILDREN IN THE POLTAVA REGION (UKRAINE)

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ABSTRACT

The aim: To study the clinical and laboratory characteristics of measles, as well as to compare the course of this disease in vaccinated and unvaccinated children in the Poltava region (Ukraine).

Materials and methods: 104 inpatients with measles were examined: vaccinated (n=27) and unvaccinated (n=77). The patient examination program included: assessment of complaints and anamnestic data obtained by questioning (during admission to hospital treatment, during treatment and after discharge) and detailed analysis of medical records (Form № 003/y), physical examination, general clinical study of peripheral blood.

Statistical processing of the study results was carried out by methods of variation statistics using the program «SPSS 17.0».

Results: The clinical and laboratory picture of measles in the examined patients is typical for this disease. Measles vaccinated children are significantly less likely to have fever (p=0.001) and Koplik's spots (χ^2=3.80, p=0.051), the duration of fever (p=0.001), cough (p=0.000), and the length of hospital stay (p=0.000), as well as 3.0 times less often leukopenia is detected (p=0.043) and 2.0 times less often – acceleration of ESR (p=0.023).

Conclusions: The obtained data raise the question of expanding the explanatory work on the importance of a full course of preventive vaccination among children, as well as increasing the volume of public procurement of necessary drugs to increase public access to free vaccination.

KEY WORDS: measles, vaccination, children

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INTRODUCTION

A global strategic plan for measles and rubella control took place in the world from 2012 to 2020. Its aim was to eliminate measles by 2020 [1]. According to WHO estimated data for the period from 2000 to 2015 measles vaccination reduced the global mortality from this disease by 79 %: from 544000 cases of fatal outcomes in 2000 to 134000 – in 2015. However, the incidence of measles does not lose its relevance and, despite the possibility of effective prevention of this disease through vaccination, more than 20 million people become infected annually [2].

Outbreaks of measles periodically occur in many countries of the world, the main risk factor of which is insufficient immunological protection of the population due to factors such as increased internal and external migration, low vaccination coverage in violation of its schedules and timing, as well as unreasonable medical exemption from measles vaccination [3-7]. Mandatory vaccinal prevention, including measles, using the combined vaccine against measles, mumps and rubella, is regulated in our country by the MoH orders № 551 of 11.08.2014 «On improving the implementation of prophylactic vaccinations in Ukraine» and № 947 of 18.05.2018 «On making amendments to the calendar of prophylactic vaccinations in Ukraine». However, today Ukraine is on the list of 9 countries in the European region endemic for measles and over the past 15 years 80 % of cases of this disease have been reported among Ukrainians [8-9]. In recent years, an increase in the incidence of measles in Ukraine was observed in 2001, 2006 and 2012. [4, 10-11]. The next epidemic outbreak of this disease was recorded in the period 2017-2019, in particular in the Poltava region, which is explained by the relatively low coverage of measles vaccination in the years preceding the rise in the incidence rate [12].

Thus, the study of the clinical and laboratory characteristics of measles, as well as the comparative characteristics of the course of this disease in vaccinated and unvaccinated children, is an urgent scientific and practical task.

THE AIM

The aim of the research is to study the clinical and laboratory characteristics of measles, as well as to compare the course of this disease in vaccinated and unvaccinated children in the Poltava region (Ukraine).

MATERIALS AND METHODS

To achieve this goal 104 patients with measles were examined: girls – 54 (51.9 %), boys – 50 (48.1 %) aged 6 months

Table I. Comparative characteristics of the clinical picture of measles in vaccinated and unvaccinated children

Indicators	Groups of patients with measles		p
	I, n=27, Me (Q1-Q3)	II, n=77, Me (Q1-Q3)	
Red blood cells	4.0 (3.9-4.1)	3.8 (3.6-4.2)	0.199
Hemoglobin	124.0 (118.0-130.0)	120.0 (110.0-128.0)	0.790
Leukocytes	5.2 (4.4-7.0)	5.0 (3.7-7.0)	0.272
ESR	8.0 (5.0-15.0)	16.0 (8.0-22.0)	0.005
Band neutrophils	5.0 (3.0-8.0)	6.0 (3.0-10.0)	0.769
Segmented neutrophils	53.0 (42.0-62.0)	51.0 (45.0-61.0)	0.967
Monocytes	2.0 (2.0-3.0)	6.0 (4.0-8.0)	0.000
Lymphocytes	34.0 (24.0-45.0)	35.0 (24.0-43.0)	0.798

Note. The significance level was obtained using Fisher's exact test and χ2 criterion, depending on the assumptions of the analysis.

Table II. Comparative characteristics of hemogram indicators for measles in vaccinated and unvaccinated children

Symptoms	Groups of patients with measles		p
	I, n=27, abs. (%)	II, n=77, abs. (%)	
Maculopapular stage rash	24 (88.9)	73 (94.8)	0.372
Conjunctivitis	19 (70.4)	56 (72.7)	0.814
Koplik's spots	11 (40.7)	48 (62.3)	0.051
Dry cough	23 (85.2)	73 (94.8)	0.200
Fever	22 (81.5)	77 (100.0)	0.001

Note. The significance level was obtained using the Mann-Whitney test.

to 16 years, average – 5.7±0.4. All patients were hospitalized in the children's infectious ward of the municipal enterprise «1st city clinical hospital of Poltava city Council» in 2017-2019. Patients' parents gave written consent to the processing of personal data.

The patient examination program included: assessment of complaints and anamnestic data obtained by questioning (during admission to hospital treatment, during treatment and after discharge) and detailed analysis of medical records (Form № 003/y), physical examination, general clinical study of peripheral blood.

Statistical processing of the findings was carried out using the program «SPSS 17.0».

To determine the central trend, the mean value and standard error of the mean value were used – in the sample n>100 or the median (*Me)* with the upper and lower quartiles *(Q1-Q3*) – in the sample n<100. The significance of differences in quantitative results was determined using the Mann-Whitney U-test, qualitative – by analyzing contingency tables using the exact Fisher test and χ^2 criterion depending on the assumptions of the analysis.

For all types of analysis, the differences were considered significant at p <0.05, at p in the range from 0.05 to ≤0.1 a tendency towards significance was marked.

RESULTS

The study found that the overall clinical picture of measles in the examined children was typical for this disease. Thus, a maculopapular stage rash occurred in 97 patients (97.3 %), conjunctivitis in 75 (72.1 %), Koplik's spots in 59 (57.6 %), dry cough in 96 (92.6 %), the average duration of which was 5.6±0.3 days and fever in 99 (95.2 %), the average duration is – 3.1±0.2 days.

General blood counts were as follows:

- erythrocytes from 3.0 to $5.0*10^{12}$/ l, on average – 3.9±0.3;
- hemoglobin from 80.0 to 160.0 g/ l, on average – 120.8±1.2;
- leukocytes from 1.9 to $12.6*10^{9}$/ l, on average 5.5±0.2;
- ESR from 3.0 to 34.0 mm/h, on average 14.3±0.8;
- band neutrophils from 1.0 to 35.0 %, on average 6.9±0.5;
- segmented neutrophils from 15.0 to 78.0 %, on average 51.6±1.3;
- monocytes from от 1.0 to 14.0 %, on average 5.5±0.3;
- lymphocytes from 6.0 to 71.0 %, on average 34.1±1.4.

The data of an individual analysis of hemogram indicators of the examined patients are presented in Fig. 1.

As shown in fig. 1, leukocytosis occurred only in 7.7 % of patients, while leukopenia was 3.5 times more likely (26.9 %), lymphocytosis was 6.7 %, lymphopenia was 5.6 times more likely (37.5 %), monocytosis was 12.0%, and ESR acceleration was 26.0 %, leukocyte shift to the left – 42.3 %. Thus, the most characteristic changes in the hemogram are leukocyte shift to the left, lymphopenia and an acceleration of ESR.

The examined patients were divided into groups in order to compare the clinical and laboratory characteristics of measles in vaccinated and unvaccinated patients:

- I – vaccinated patients, n=27, girls – 10 (27.0 %), boys – 17 (63.0 %) aged 6 months to 16 years, *Me*=5,0 (2.0-11.0);

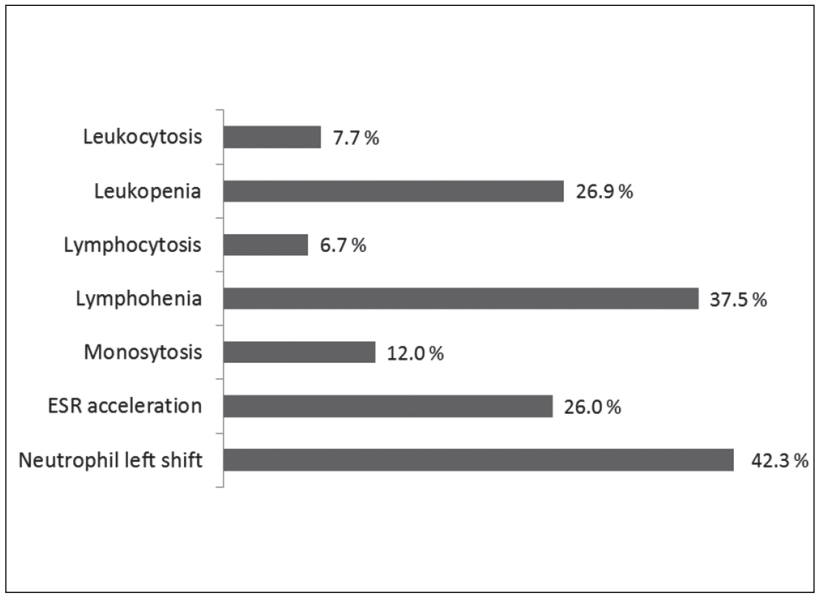

Fig. 1. An individual analysis of hemogram indicators of children with measles

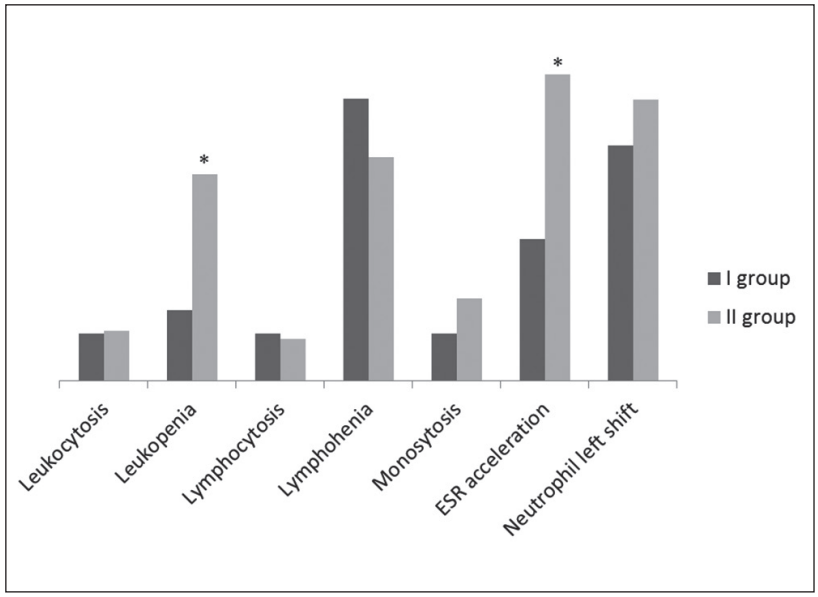

Fig. 2. Individual analysis of hemogram values for measles in vaccinated and unvaccinated children.
Note. – $p<0,05$ (significance level obtained using Fisher's exact test and χ^2 criterion depending on the assumptions of the analysis).

– II – unvaccinated patients, n=77, girls – 44 (57.1 %), boys – 33 (42.9 %) aged 6 months to 16 years, *Me*=4.0 (2.0-8.0).

Taking into account the low number of patients who received the full course of measles immunization (at 12 months and 6 years) – n=3, that made statistical generalization impossible, these patients were assigned to group I.

Comparative characteristics of the clinical picture of measles in patients of groups I and II are presented in table I.

As can be seen in the table I, fever was significantly less frequently observed in patients of group I – in 22 (81.5 %) versus 77 (100.0 %) in group II (p=0.001), and also, with a tendency towards significance, Koplik's spots – 11 (40.7 %) and 48 (62.3 %) respectively (χ^2=3.80, p=0.051). By the frequency of other symptoms, there was no difference between the compared groups.

It should be noted that the fever in patients of group I lasted less than in II – from 0 to 6 days, *Me*=1.0 (1.0-4.0), while in II – from 1 to 7, *Me*=3.0 (1.0-5.0), p=0.001, the duration of cough in groups I and II was from 0 to 7 days, *Me*=3.0 (3.0-5.0) and from 0 to 14 days *Me*=6.0 (5.0-8.0) respectively, p=0.000.

Comparative characteristics of patients hemogram parameters of groups I and II are presented in table II.

As can be seen from the data in table II, in the hemogram of the examined patients, a significant difference between the I and II comparison groups was observed exclusively by the indicator of monocytes: 2.0 (2.0-3.0) % versus 6.0 (4.0-8.0) %, p=0.000, which, however, did not exceed the upper limit of normal. Other indicators were not statistically different and did not go beyond the reference values.

Then an individual comparative analysis of the hemogram data of the examined patients was carried out. The analysis revealed that significant differences in the comparison groups were observed in the frequency of registration of leukopenia and acceleration of ESR. So, in

group I leukopenia was detected in 3 (11.1 %) patients, which was almost 3.0 less than in group II – in 25 (32.5 %), p=0.043, and acceleration of ESR – 2.0 times less often, 6 (22.2 %) and 37 (48.1 %) respectively, p=0.023. There was no difference in the frequency of registration of other indicators: leukocytosis – 2 (7.4 %) and 6 (7.8 %), p=1.0, left shift of the leukocyte formula – 10 (37.0 %) and 34 (44.2 %), p=0.652, monocytosis – 2 (7.4 %) and 10 (13.0 %), p=0.727, lymphocytosis – 2 (7.4 %) and 5 (6.5 %), p=1.0, lymphopenia – 12 (44.4 %) and 27 (35.1 %), p=0.386, respectively (Fig. 2).

When comparing the duration of inpatient treatment, it was also found that in patients of group I it was from 3 to 7 days, *Me*=5.0 (3.0-5.0), while patients of group II needed longer treatment and observation in a hospital – from 3 to 10 days, *Me*=7.0 (5.0-7.0), p=0,000.

DISCUSSION

As a result of our study we indicate a more severe clinical course of measles in unvaccinated children and more serious changes in laboratory parameters, which consistent with data from the scientific literature [13-15]. An increase in the length of stay in hospital was also established, which creates a significant burden on the health care system of Ukraine.

It is well known that to prevent measles outbreaks, the number of immunized people should be at least 95% [1-2]. According to official data, that the increase in the incidence of measles in the Poltava region and in Ukraine as a whole was preceded by years with a rather low coverage of the population with vaccination against this disease [4,8,12]. So, a relatively high percentage of vaccinated children in the Poltava region was observed only in 2012 and had a constant downward trend in subsequent years. During the period from 2013 to 2018, the absolute number of cases of measles registered in this region among children under 17 years old increased 13.6 times, and among adults - 24 times [12]. This disappointing situation is a consequence of the insufficient level of immunization among children, and also indicates the need for additional vaccination among adults.

However, with the joint actions of all healthcare professionals and the public, as well as appropriate financial support, in Ukraine and, in particular, in the Poltava region, there are conditions for high-quality preventive and anti-epidemic measures against measles, which meet an important strategic task related to the global elimination of this disease.

The obtained data raise the question of expanding the explanatory work on the importance of a full course of preventive vaccination among children, as well as increasing the volume of public procurement of necessary drugs to increase public access to free vaccination.

CONCLUSIONS

1. The clinical picture of measles and laboratory data in the examined patients are typical for this disease (maculopapular staged rash – 97.3 %, conjunctivitis – 72.1 %, Koplik's spots – 57.6%, dry cough – 92.6 %, fever – 95.2 %, leukocytosis – 7.7 %, leukopenia – 26.9 %, lymphocytosis – 6.7 %, lymphopenia – 37.5 %, monocytosis – 12.0 %, acceleration of ESR – 26.0%, leukocyte shift to the left – 42.3 %).
2. Measles vaccinated children are significantly less likely to have fever (p=0.001) and Koplik's spots (χ^2=3.80, p=0.051), the duration of fever (p=0.001), cough (p=0.000), and the length of hospital stay (p=0.000), as well as 3.0 times less often leukopenia is detected (p=0.043) and 2.0 times less often – acceleration of ESR (p=0.023).
3. The obtained data raise the question of expanding the explanatory work on the importance of a full course of preventive vaccination among children, as well as increasing the volume of public procurement of necessary drugs to increase public access to free vaccination.

REFERENCES

1. Global measles and rubella strategic plan: 2012-2020. World Health Organization. 2012, 42 p.
2. Fact sheets. Measles. World Health Organization 2018. http://www.who.int/ru/news-room/fact-sheets/detail/measles [date access 03.08.2020]
3. Bayalieva M.M., Smelikov Ya.A. Diagnostika i lechenie kori u detejv period epidemicheskoj vspyshki v 2014-2015 gody [Diagnostic and treatment of measle in children during an outbreak in 2014-2015]. Universum: medicina i farmakologiya. 2015;12(23). (In Russian).
4. Chumachenko T.O., Yemetc M.A. Vplyv vakcynoprofilaktyky koru na epidemichnu sytuaciyu v sviti ta Ukrayini [Effect of measles vaccination for epidemic situation in the world and in Ukraine]. Profilaktychna medytsyna. 2013;1–2(20):30–35. (In Ukrainian).
5. Duru C.O., Peterside O., Adeyemi O.O. A 5 year review of childhood measles at the Niger Delta University Teaching Hospital, Bayelsa state, Nigeria. J. Med. Sci. 2014;5(4):78–86.
6. Getahun M., Beyene B., Ademe A. et al. Epidemiology of laboratory confirmed measles virus cases in Amhara Regional State of Ethiopia, 2004–2014. BMC Infect. Dis. 2016;16:133.
7. Goodson J.L., Seward J.F. Measles 50 years after use of measles vaccine. Infect Dis Clin North Am. 2015;29(4):725–743.
8. Daragan G.M., Krushinska T.Yu., Stepanskiy D.O. et al. Aktual`ni pytannya vakcynaciyi ta epidemiologichnogo naglyadu za korom ta krasnuxoyu v Ukrayini [Topical issues of vaccination and epidemiological surveillance over measles and rubella in Ukraine]. Medicni perspektivi. 2018;23(1):38–43. (In Ukrainian).
9. Volianska L.A. Epidemichni realiyi koru v Ternopil`s`kij oblasti [Epidemic realities of measles in the Ternopil region]. Aktual'naya Infektologiya. 2016;2(11):98–103. (In Ukrainian).
10. Marusik U.I. Kir u ditej [Measles in children]. Aktual'naya Infektologiya. 2017;5:129–133. doi: 10.22141/2312-413x.5.3.2017.109855 (In Ukrainian).
11. Yemets M.A. Epidemichna sytuaciya shhodo koru ta krasnuxy v Ukrayini [Epidemic situation in relation to measles and rubella in Ukraine]. Infektsiini khvoroby. 2014;3:95–97. (In Ukrainian)
12. Sizova L.M. Analiz zabolevaemosti kor`yu v Poltavskoj oblasti [Analysis of measles incidence in the Poltava region]. J.Clin.Exp Med.Res., 2018;6(3):323–329. doi: 10.21272/jcemr.2018.6(3):323–329 (In Russian).

13. Nikiforov A.Yu., Kostyukova T.L., Nagaeva S.Y. et al. Kor' u rebenka: klinicheskij sluchaj [Measles in the child: clinical case]. Voprosy sovremennoj pediatrii.2019;18(5):369-373. doi: 10.15690/vsp.v18i5.2061. (In Russian).
14. Cherry J.D., Zahn M. Clinical characteristics of measles in previously vaccinated and unvaccinated patients in California. Clin Infect Dis. 2018;67(9):1315-1319. doi: 10.1093/cid/ciy286.
15. Mitchell P., Turner N., Jennings L., Dong H. Previous vaccination modifies both the clinical disease and immunological features in children with measles. Journal of Primary Health Care, 2013;5(2):93-98.

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The Authors declare no conflict of interest

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