

Endoparasitoses in hospitalised paediatric patients with pulmonary disease

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Summary

Faeces examination of hospitalised paediatric patients with respiratory diseases (recurrent and chronic bronchitis, bronchial asthma, contact with TBC, active TBC, rhinopharyngitis, bronchitis, pneumonia, cystic fibrosis, fluidothorax, pleuropneumonia) revealed the total prevalence of endoparasites of 19.85 %, out of which the prevalence of helminth was 7.35 %. Following genera, or species were represented *Ascaris lumbricoides*, *Trichuris trichuria*, *Hymenolepis* spp., *Enterobius vermicularis*. The total prevalence of protozoa was 12.50 % in the following representation: *Cryptosporidium* spp., *Entamoeba* spp., *Isoospora* spp., *Giardia* spp. Out of helminthoses the greatest representation was in *Ascaris lumbricoides* 4.41 %, and out of protozoa *Cryptosporidium* spp. 6.62 %. In paediatric patients the increased levels of IgE antibodies were found for individual age groups as well as higher values of eosinophiles (Eo > 5 %), lymphocytes (Lym > 56 %), and C-reactive protein (CRP > 8 mg.l⁻¹). Statistically significantly (P < 0.05) higher level (above the reference values) of IgE, Eo, Lym were found in the patients with helminthoses.

Key words: endoparasitosis; helminths; protozoa; bronchial and pulmonary infections of children; prevalence; epidemiology

Introduction

Worldwide spread intestinal parasitic infections belong among the most serious health problems in humans in tropical and subtropical regions. Under our climatic-geographical regions it concerns especially people with weak socio-economic standard living in the environment with low hygiene (personal and also environmental). In Slovakia it is most pronouncedly manifested in the Romany settlements and communities (Juriš *et al.*, 2012). The causes of the worsened health status also lie in the absence

of drinking water and sewerage system, bad housing, missing infrastructure, unhealthy feeding, bad personal hygiene, and neglected communal hygiene. In the children living in such conditions there is higher incidence of infectious diseases conditioned by the environmental risks. In general, it can be stated that the health status of the children living in the environment of lower hygienic standard is worse compared to the majority population in Slovakia (Rimárová, 2010). Intestinal parasitism is regarding the health of an individual often connected with the manifestation of allergic reactions and immunodeficient states, especially in paediatric patients within the lowest age group (1 – 5 years). Children suffering from various respiratory diseases connected with immunodeficient status are often positive to some opportune helminth infections (Kalu *et al.*, 2013). Larval stages of tissue helminthoses of the genera *Ascaris* and *Toxocara* after migration through the pulmonary tissue within entero-hepato-pulmonary migration can cause so-called eosinophilic pneumonitis. The clinical picture of the acute phase is accompanied with fever, asthmatic attacks of cough. In 30 % of infected patients, there are pulmonary infiltrates, slight hepatopathy, lymphadenopathy and urticaria. In the blood picture there is leucocytosis, eosinophilia ranges from 10 to 90 %; as well, immunoglobulins above all, of the class IgE and IgG could be elevated (Beneš *et al.*, 2009).

The goal of the study was the ovoscopic diagnostics of endoparasitic infections (protozoa and helminths) in hospitalised paediatric patients.

Material and methods

In our study in total 272 paediatric patients were examined coprologically (147 boys and 125 girls) from the Šrobár Institute of paediatric tuberculosis and respiratory diseases in Dolný Smokovec with pulmonary disease of infectious

Table 1a Prevalence (P %) of protozoa and helminths in paediatric patients with infection disease of the lower airways

Parasites	(No. 272)	P %
Protozoa and helminths	54	19.85
Protozoa	34	12.50
Helminths	20	7.35
Negative samples	218	-

No. – number of samples

Table 1b Prevalence (P %) of protozoa and helminths in different age groups of paediatric patients with infection disease of the lower airways

Age group	Examined samples (No. 272)	Protozoa		Helminths	
		Positive (No. 34)	P %	Positive (No. 20)	P %
1 – 5 years	57	5	8.77	7	12.28
6 – 10 years	110	8	7.27	8	7.27
11 – 16 years	105	21	20.00	5	4.76

and non-infectious etiology. In the population studied there were 15 children of Romany origin. The analysis was carried out in three age groups: group 1 – 5 years (57 patients), group 6 – 10 years (110 patients), group 11 – 16 years (105 patients). The copro-ovoscopic concentration set *Paraprep L – Faecal Parasite Concentrator* (Diamondial, France) with subsequent microscopy were used for coprological examination of the presence of oocysts and ova in samples. The blood and sera of the children examined were processed by the standard laboratory procedures. The values of immunological and haematological findings were compared with the reference values in children according to the diagnostic laboratory Labmed. Statistical evaluation of the results was carried out using the x-test (significance level $\alpha = 0.05$) by the statistical programme SPSS.

Results

Children faeces examination revealed the total prevalence of endoparasitoses of 19.85 %, out of which helminth infections were 7.35 % (see Table 1a). The total prevalence of protozoa occurrence was 12.50 % in representation of

Cryptosporidium spp., *Entamoeba* spp., *Isospora* spp. and *Giardia* spp. The highest prevalence of protozoal infections was in the children of the age group of 11 – 16 years – 20 %, and helminth infections in those of the age group of 1 – 5 years – 12.28 % (see Table 1b).

From the table 2 it follows that out of the helminths in faeces samples following species were represented: *Ascaris lumbricoides*, *Trichuris trichuria*, *Hymenolepis* spp., *Enterobius vermicularis*. *A. lumbricoides* had the highest representation of helminthoses (4.41 %) and *Cryptosporidium* spp. of protozooses (6.62 %) (see Table 2).

In the paediatric patients observed the clinical units of the respiratory tract were represented, from simple rhinopharyngitis to more serious inflammatory diseases of lungs and pleura. It is interesting that at serious pleuropneumonia and fluidothorax in two patients there was no other except for positive ovoscopic finding of *A. lumbricoides* eggs in faeces (see Table 3).

Serological examination in paediatric patients revealed the increased levels of reference values of IgE antibodies (IgE > 15, > 60, > 90, > 200 IU/l, for individual age groups), eosinophils (Eo > 5 %), lymphocytes (Lym > 56 %), and C-reactive protein (CRP > 8mg/l⁻¹). These findings are

Table 2. Representation of protozoa and helminths in positive faecal samples of hospitalised paediatric patients

Parasites	Positive samples (No. 54/272)	Prevalence P %
<i>Cryptosporidium</i> spp.	18	6.62
<i>Entamoeba</i> spp.	8	2.94
<i>Isospora</i> spp.	2	0.74
<i>Giardia</i> spp.	9	3.30
<i>Ascaris lumbricoides</i>	12	4.41
<i>Trichuris trichuria</i>	3	1.10
<i>Hymenolepis</i> spp.	5	1.84
<i>Enterobius vermicularis</i>	2	0.74

in agreement with coprological findings of eggs (see Table 3 and 4). Statistically significant differences (χ^2 , $P < 0.05$) were found in the levels of eosinophils (Eo) and lymphocytes (Lym) that were increased above the reference values in the patients positive and negative to hemintheses. The increased levels of IgE were statistically significantly higher in the patients positive to helmintheses (in 40 % positive patients and 20 % negative ones). The increased levels of Eo were in 45 % positive patients and in 23 % negative ones. As well, the increased levels of Lym were recorded in 40 % positive patients and in 31 % negative ones (see Table 4).

personal hygiene. The groups of children population living under conditions of lower socio-economical standard belong to the most endangered. The faecal pollution of the environment represents for such patients a significant health risk, because contaminated environment with cysts (e.g. *Gardia* spp., *T. gondii* and oocysts *Cryptosporidium* spp.), or helminth eggs (*Ascaris* spp., *Toxocara* spp., *Hymenolepis* spp.) often becomes the source of parasitic infections (Rudohradská *et al.*, 2012). Under the environmental conditions the developmental stages of endoparasites are resistant against routinely used disinfectant preparations (Ondrašovič *et al.*, 2002).

Table 3 Respiratory diagnoses in examined children

Diagnosis	Number of children	P %
Recurrent and chronic bronchitis	109	40.07
Bronchial asthma	77	28.31
Contact with TBC	34	12.50
Active TBC	27	9.93
Rhinopharyngitis recurrent	9	3.31
Acute bronchitis	8	2.94
Pneumonia	5	1.84
Cystic fibrosis	1	0.37
Fluidothorax	1	0.37
Pleuropneumonia	1	0.37
Total	272	100.00

Discussion

According to Chaudhry *et al.* (2004) in children older than 2 years the prevalence of parasitoses decreases with increasing age. This follows also from our results, when the prevalence of helmintheses in our patients decreased, however, in protozoal infections the increase was recorded in older patients. Kalu *et al.* (2013) recorded the highest occurrence of nematodes in the age group of 6 – 8 years. O'Harhay *et al.* (2010) observed in *A. lumbricoides* and *T. trichuria* very similar course with the increase of prevalence from childhood to adolescent age, and decreasing trend in adulthood.

In our children examined the prevalence of intestinal nematodes with increasing age decreased. The reason can be in the higher immune response in older children as well as in their intentional acquiring hygienic habits including

Paediatric patients with weakened immune system are susceptible to various infections of the respiratory system. The cause could be in the great amount of serotypes of viruses and bacteria. Helminths often belong among the opportune pathogens that attack the organisms of patients with serious respiratory disease (Shuji *et al.*, 2006). Königová *et al.* (2010) found in paediatric patients at the age of 9 months up to 16 years with acute or chronic respiratory and gastrointestinal infection the occurrence of *A. lumbricoides* and *T. trichuria*. The highest intensity of infection was in the children at the age of 3–5 years living in bad hygienic conditions. The most common clinical manifestations in patients included anaemia in combination with bronchopneumonia, colitis and gastritis. The highest correlation between parasitic load and level of eosinophils, haemoglobin, and total iron was found in the children at the age of 2 years. The authors suppose that analysis of

Table 4 Levels of IgE, Eo, Lym, CRP in individual groups of paediatric patients with respiratory disease and infected with protozoa, or helminths

Group of patients	Number	IgE> No.	χ test (P)*	Eo> No.	χ test (P)*	Lym> No.	χ test (P)*	IgE + Eo> No.	CRP> No.	χ test (P)*
Inf. with protozoa	34	7	0.825	8	0.737	6	0.061	15	8	0.185
Inf. with helminths	20	8	0.044	9	0.028	8	0.012	17	4	0.003
Inf. with protozoa and helminths	54	15	0.257	17	0.192	14	0.315	32	12	0.682
Negative samples	218	45	0.257	50	0.192	72	0.315	95	43	0.682

Reference values

IgE 1 – 12 months of age <15 IU/l; 2 – 5 years of age < 60 IU/l; 6 – 9 years of age < 90 IU/l; 10 – 15 years of age < 200 IU/l
Eo 1 – 5 %

Lym year of age 44 – 56 %; 3 – 6 years of age 40 – 52 %; 7 – 12 years of age 36 – 50 %

CRP month – 15 years of age < 3 mg/l; > 15 years of age < 8 mg/l

* χ test, P value ($P < 0.05$), level of significance ($\alpha=0,05$). Statistical significance of differences of increased levels of IgE, Eo, and Lym between patients with positive and negative ovoscopic findings for protozoa or helminths

laboratory parameters and clinical manifestations could contribute to specification of the diagnostics of parasitoses in children.

The increased levels of reference values of IgE, Eo, Lym, CRP could direct attention to the diagnostics of some species of tissue helminthoses (*Ascaris*, *Toxocara*, *Ancylostoma*, *Necator*, *Strongyloides*) in pulmonary tissue at their entero-hepato-pulmonary migration, because they can cause so-called eosinophilic pneumonitis. The high levels of total IgE antibodies connected with ascariasis limit the evidence supporting of this test in diagnostics of allergy. The diagnostic significance at some tissue helminthoses at the syndrome *larva migrans*, or others is also ascribed to the changes in the value of C-reactive protein (Kinčeková *et al.*, 2008).

Several studies have dealt with the serum concentration of IgE in the patients infected with helminths or protozoa. The increased concentration of IgE antibodies was found especially in the patients with helminth infections (Di Prisco *et al.*, 1993; Perlmann *et al.*, 1994). Immunoglobulin E (IgE) is present in the serum in trace amounts under physiological condition, and has very short half-life (2.5 days). Occasionally, there are increased levels of IgE also at some protozoal infections (giardiasis). The levels of total serum IgE could be increased in case of atopic diseases, tumorous diseases, immunodeficient states, viral infections, which was also confirmed by our study. Concentration of IgE is also influenced by age, sex, race, socio-economical conditions, and it could differ in various countries. Therefore, our observed groups of paediatric patients were selected from the comparable socio-economical environment. The value of total IgE in the serum of children infected with *G. intestinalis* and *E. vermicularis* was significantly higher compared to the control group of healthy children (Kennedy, 2000).

Eosinophilia is very frequent reaction of a host to helminth invasion, but it is rare in protozoal infections. The high levels of eosinophils can be in the patients with trichinellosis, ascariasis, filariasis, schistosomiasis, toxocarosis and fasciolidosis. In the developed countries parasitoses affect mostly children with immuno-deficient status, suffering from chronic, infectious, allergic, and autoimmune diseases (Hagel *et al.*, 1993). Eosinophilia (up to 80 %) is found especially during acute phase of infection with helminths, in chronic phase of infection there is its gradual decrease (Kolářová, 2010).

Hassanein *et al.* (2013) studied the prevalence of endoparasitoses in children with acute lymphatic leukaemia and compared it with the prevalence in the control group of immunocompetent children. The incidence of parasitic infections in leukaemic children was by 30 % higher (by 20 % higher incidence of protozoal infections, and by 10 % higher incidence of helminth infections). This can be caused by the fact that intestinal helminths induce the immune response of Th-2 type. The Th2 immune response can have a key role at influencing the seriousness of acute disease (e.g. pulmonary) during infection with helminths. The immune response of a host to helminth infection cor-

relates with production of interleukins IL-4, IL-5, IL-9, IL-10, and IL-13. The humoral immune response to parasites on that account can support infection with *Mycobacterium tuberculosis*. Positive regulation of Th2 response, including eosinophilia and hyperglobulinemia IgE induced by helminth infection can suppress production of Th1 of immune reaction that is important for fight against intra-cellular pathogens, such as e.g. *M. tuberculosis* (Demirci *et al.*, 2002; Kaji *et al.*, 2007; Dvorožňáková, 2012).

In immunocompromised people the seriousness and manifestations of some parasitic diseases can be altered. Infection with helminths (*A. lumbricoides*, *A. duodenale*, *T. trichuria*) are most widespread, especially in developing countries in the children suffering from malnutrition, infections and deficiency diseases (WHO, 2005; Vincent, 2005). Protozoal infections cause high morbidity in children, and as opportune infections in HIV/AIDS, and in immunosuppressed patients. In consequence of it the patients suffer from recurrent serious diarrhoeic states that can be fatal. *C. parvum*, *G. intestinalis*, *E. histolytica* are the most frequent agents of the diarrhoea.

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