Critical Illness Polyneuropathy in Children with Infectious Diseases

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Abstract. Our goal was to establish electrophysiological features of critical illness polyneuropathy in children with infectious diseases.

Materials and Methods: We evaluated peripheral nervous system involvement in 67 critically ill children, admitted in ICU with different types of infectious diseases (viral encephalitis, meningoencephalitis, meningitis, acute gastroenteritis). Age of the group varied from 4 months to 17 years. All patients underwent conduction studies and neurological investigation. Sensory and motor fibers of *n. ulnaris et n. medianus*, motor fibers of *n. Tibialis* and sensory fibers of *n. Suralis* were tested. Lowering of the amplitudes, conduction velocity slowing and asymmetry were accounted for the motor and sensory fibers.

Results: In 47 cases (n=71) diagnosis of critical illness polyneuropathy (CIP) was established. Lesions mostly involved lower limbs nerves. According to our data, severe course of CIP was seen in 40% of all cases. Average time of CIP onset in children was 5-7 days from the beginning of mechanical ventilation.

Conclusions: Critical illness polyneuropathy in children with infectious diseases is a severe condition which may lead to the disability of the patients. Average time of its onset is the 5-7 days from the beginning of the mechanical ventilation in 71% of the patients. More often sensory and motor fibers of lower limbs nerves are affected. Conduction studies is a valuable tool in diagnostic process in establishing the critical illness polyneuropathy in children with infectious diseases.

Keywords: Critical illness, critical illness polyneuropathy, children, electromyography.

Acquired critical illness polyneuropathy (CIP) is a serious, severe condition which may occur in the intensive care units (ICU) in patients of all ages and all kinds of underlying disease [1]. If appeared, ICU may severely disrupt treatment process, prolong rehabilitation and significantly lowering patient's quality of life [2]. Mortality is high, severe bilateral phrenic nerve involvement with diaphragm paralysis are reported [3]. CIP is the axonal polyneuropathy by its nature, which explains all these malign features, comparing with demyelinating diseases [4,5].

Characteristics and general features of CIP in adults are well-known and thoroughly described; although, there are very rare reports considering it in pediatric population, especially in children with underlying infectious diseases. Thus, our goal was to establish electrophysiological features of critical illness polyneuropathy in children with infectious diseases.

MATERIALS AND METHODS

We evaluated peripheral nervous system involvement in 67 critically ill children, admitted in ICU of tertiary center with different types of infectious diseases (viral encephalitis (n=21), meningoencephalitis (n=16), meningitis (n=20), acute gastroenteritis (n=10)). Age of the group varied from 4 months to 17 years. Length of ventilation varied from 5 to 40 days, average length - 7±2.7 days.

All patients underwent conduction studies and neurological investigation. Neiro-MVP device (Neurosoft, Russia) was implemented. Sensory and motor fibers of *n. ulnaris et n. medianus*, motor fibers of *n. Tibialis* and sensory fibers of *n. Suralis* were tested according to generally accepted protocols. Lowering of the amplitudes, conduction velocity slowing and asymmetry were accounted for the motor and sensory fibers. We evaluated only the aforementioned nerves, as easiest target with a good comparative database in other studies, thus we did not evaluated phrenic nerve or proximal nerves, like femoral nerve etc.

Conduction studies were performed on a 5-7 day of admittance in the ICU unit. Criteria of CIP were in accordance with [2] and were as follows: typical clinical pattern (flaccid tetraparesis, inability to breath without ventilation support, amount of sensory nerve action potentials (SNAPs) lowered below 80% of lower level of normal parameters, more than 2 changed/pathologic SNAPs, conduction velocity inside the normal values, more than 2 changed/pathologic compound muscle action potentials (CMAPs). 20 healthy children of the comparable age (average 9±2 years, 12 boys, 8 girls) underwent the same conduction studies, normative data was obtained.

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Table 1: Conduction Velocity Parameters in Children with Critical Illness Polyneuropathy & in Control Group

Critical illness CMAPs					Critical illness SNAPs		
	n.ulnaris	***n.medianus***	***n.Peroneus***	***n.Tibialis***	***n.Ulnaris***	***n.medianus***	***n.Suralis***
Amplitude, mV	3.3±2,4	3.98±3.0	0.81±0.7	6.65±3.1	7.11±4.9	4.23±2.1	11.5±4.6
CV, m\s	53.11±18.0	62.3±21.4	46,6±21.2	49.9±18.3	54.7±14.7	51.4±12.6	57.3±10,2
Normal CMAPs					**Normal SNAPs**		
	n.ulnaris	***n.medianus***	***n.Peroneus***	***n.Tibialis***	***n.Ulnaris***	***n.medianus***	***n.Suralis***
Amplitude, mV	10.1±2,1	10.8±1.9	5.4±1.9	11.7±3.6	37.2±3.11	41.54±3.6	18±7.13
CV, m\s	58.4±2.1	64.5±31.8	51.2±9.4	51.4±11.1	61.8±5.7	64.21±1.6	52.21±5.4

As our goal was not to evaluate myopathic changes during this study, needle EMG was not performed.

Statistical analysis included descriptive and comparative statistics.

RESULTS AND DISCUSSION

In 47 cases (n=71) diagnosis of critical illness polyneuropathy (CIP) was established according to before mentioned criteria [2]. Lesions mostly involved lower limbs nerves. According to our data, severe course of CIP was seen in 40% of all cases. Average time of CIP onset in children was 5-7 days from the beginning of mechanical ventilation. Parameters of CMAPs and SNAPs of the children with CIP and in the controls are summarized in the Table **1**.

As we can see from the data obtained, our results for controls are close to the recently published in a huge number (more than 1500) of healthy children [6]. Also significant ($p<0.0001$) differences are seen between the CIP and controls on the peroneal motor nerve CMAPs amplitudes and ulnar and medial nerves SNAPs. There were no lethal cases, general length of in-ward stay in ICU was 14±4.3 days and stay in general neurology pediatric department after the discharge from ICU was 10±5.7 days. 30% of the patients (n=20) still had symptoms of CIP at the time of discharge. Average time of weaning in the CIP group was 31% longer, than in the children without CIP.

According to some reports [7,8] CIP is present in 58% of the adults spent 4-7 days on ventilation. As it was being pointed out, data in pediatric population may vary between reports, as different underlying conditions may lead to the critical illness, thus different pathologic changes will affect peripheral nerves [9]. Our group was affected in 71% of the cases. In some other study of CIP in children authors reports 32.4% frequency of it their group of children with conduction studies performed more than after 7 days of ventilation; they confirm axonal pattern of polyneuropathy [9]. Such a huge difference of CIP frequency may reflect more severe and rapid affection of the peripheral nervous system in children with infectious process, which may contribute to the nerve damage by itself. Shubham *et al*. (2019) provide even higher frequency of CIP in their group of children aged 1-15 years (90.6%), and supports axonal nature of this condition [11]. In their group, septic changes were apparent and they also come to the conclusion that infectious process significantly adding to the nerve damage in CIP.

In addition, we established that more often and severe lesions observed in longer nerves, i.e. nerves of the legs. This may reflect their bigger dependency on axonal transportation, than relatively short nerves of the hands.

CONCLUSIONS

Critical illness polyneuropathy in children with infectious diseases is a severe condition which may lead to the disability of the patients. Average time of its onset is the 5-7 days from the beginning of the mechanical ventilation in 71% of the patients. More often sensory and motor fibers of lower limbs nerves are affected. Conduction studies is a valuable tool in diagnostic process in establishing the critical illness polyneuropathy in children with infectious diseases.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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