Intensive Care Unit-Acquired neuromyopathy (ICU-ANM) in children

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Abstract

Intensive care unit acquired neuromyopathy (ICU-ANM) is a common complication occurring in a significant proportion of critically ill patients. Among children, the incidence, risk factors, diagnosis and management strategies of this disease are not well explored. The aim of this study is to investigate the frequency and the risk factors of ICU-ANM in our pediatric ICU (PICU). A retrospective cohort study was conducted at the PICU of a university hospital center in South Tunisia. We identify all patients who presented difficulties in removing the ventilator and having a neuromuscular deficit after awakening. The muscle strength was evaluated by the Medical Research Council scoring system (MRC-SS)). Risk factors for ICU-ANM were analyzed. We observed 5 cases of ICU-ANM with a mean age of 3 years. They have required prolonged mechanical ventilation and developed sepsis with multiple organ dysfunction. Mechanical ventilation (MV) days were higher than 7 days among them. ICU-ANM was suspected in view of difficulties in weaning from MV. A significant motor deficit (MRC < 48) was noticed. The risk factors identified were sepsis (4/5), multiple organ failure (2/5), mechanical ventilation (5/5), corticosteroids (1/5), and hyperglycemia (2/5). Electrophysiological exploration done in one case revealed sensory and motor axonal damage. Spontaneous improvement occurred within several months in only 2 cases and the rest had died.

ICU-ANM among children is associated with increased morbidity and additional cost of therapeutic care. Careful neurologic examination and early electrophysiological investigations are necessary to establish the diagnosis of ICU-ANM.

Mots-clés: Intensive care unit acquired neuromyopathy; pediatric; intensive care unit

RÉSUMÉ

La neuromyopathie acquise en unité de soins intensifs (NMA) est une complication fréquente chez une proportion significative de patients gravement malades. Chez les enfants, l'incidence, les facteurs de risque, le diagnostic et les stratégies de prise en charge de cette maladie ne sont pas bien étudiés.

L'objectif de cette étude est d'étudier la fréquence et les facteurs de risque de la NMA dans notre unité de soins intensifs pédiatriques (USIP). Une étude de cohorte rétrospective a été menée à l'USIP d'un centre hospitalier universitaire du sud de la Tunisie. Nous avons identifié tous les patients qui ont présenté des difficultés à retirer le ventilateur et ayant un déficit neuromusculaire après le réveil. La force musculaire a été évaluée par le Medical Research Council scoring system (MRC-SS). Les facteurs de risque de la NMA en USI ont été analysés. Nous avons observé 5 cas de NMA avec un âge moyen de 3 ans. Ils ont eu besoin d'une ventilation mécanique prolongée et ont développé une septicémie avec de multiples dysfonctionnements d'organes. Le nombre de jours de ventilation mécanique (VM) était supérieur à 7 jours pour chacun d'entre eux. La NMA a été suspectée au vu des difficultés de sevrage de la ventilation mécanique. Un déficit moteur significatif (MRC < 48) a été constaté. Les facteurs de risque identifiés étaient le sepsis (4/5), la défaillance de plusieurs organes (2/5), la ventilation mécanique (5/5), les corticostéroïdes (1/5) et l'hyperglycémie (2/5). L'exploration électrophysiologique réalisée dans un cas a révélé une atteinte axonale sensorielle et motrice. Une amélioration spontanée s'est produite en quelques mois dans seulement 2 cas, les autres étant décédés.

Key words: Neuromyopathie acquise en unité de soins intensifs ; pédiatrie ; unité de soins intensifs

Introduction

Intensive care unit-acquired neuromyopathy (ICU-ANM) is a common condition in critically ill patients who are mechanically ventilated for long periods of time [1]. It is associated with longer stay in intensive care units (ICU) and therefore higher morbidity and mortality. First described in 1892 by Osler as a rapid loss of flesh in prolonged sepsis [2], this disorder was more precisely described after almost a century by Bolton who defined critical illness polyneuropathy (CIP) as muscular weakness and im-

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paired sensitivity, occurring during the stay in ICU, with conservation of the central nervous system [3]. Central nervous system damage as well as peripheral neuromuscular disorders present at the start of intensive care are excluded. The precise pathologic mechanism that causes this disorder is still unclear. While well-recognized complication in adults, the available literature regarding ICU-ANM in children is restricted to small case series [4–6].
A prevalence of about 2% has been reported in severely ill infants in a recent review article, which is less than the prevalence reported in adults. [7].
As a result, infants at risk for developing neuromuscular dysfunction due to critical illness are less likely to be detected, assessed, and provided with appropriate therapies. The aim of this study was to identify the population at risk of developing ICU-ANM among the children admitted to our PICU.

Methods

This retrospective cohort study was conducted between January 2021 and December 2021 in the PICU of the pediatric department, Hedi Chaker university hospital in South Tunisia. Children aged 0–14 years admitted for a period of more than 24 h in the PICU were eligible for inclusion. We included critically ill children who presented a neuromuscular disorder and failure to wean from mechanical ventilation during their PICU stay. Exclusion criteria were: pre-existing or current neuromuscular disorder or genetic disorders known to cause neuromuscular weakness. Basic demographic data, primary diagnosis, the total length of time on mechanical ventilation, and length of PICU stay were analyzed. A neurological examination was performed at the time of admission and then daily until recovery and discharge from the PICU.
The muscle strength was assessed by the manual muscle testing method. In each extremity, Medical Research Council (MRC) scoring system evaluates muscle force on a scale from 0 to 5 in three muscle groups of both upper and lower limbs (shoulder abduction, elbow flexors, wrist extensors, hip flexors, knee extensors and foot dorsal flexors), rendering a maximum score of 60. A score of < 48 out of a total score of 60 is used to distinguish patients with ICU-ANM. The clinico-biological data concerning the risk factors have been identified (sepsis, systemic inflammatory response syndrome and multi-organ failure, Corticosteroid administration, use of neuromuscular blocking drugs, hyperglycemia)

Results

Our study included 5 pediatric patients (3 girls and 2 boys) with a mean of age 3 years. All of the reported patients were admitted to the PICU for pathologies involving the vital prognosis (2 cases of severe bronchiolitis, one case of ruptured pulmonary hydatid cyst, one extradural hematoma and one case of Multi-System Inflammatory Syndrome).
ICU-ANM was suspected in view of difficulties in weaning from MV. These patients developed a severe sensory-motor polyneuropathy within an average of 10 days of admission and for more than 7 days of mechanical ventilation. A flaccid and symmetric tetraparesis in the limbs was noticed after awakening and the facial muscles were spared. Significant motor deficit (MRC < 48) was identified. Laboratory investigations of blood and cerebrospinal fluid and spinal magnetic resonance imaging revealed normal results. The risk factors identified were sepsis (4/5), multiple organ failure (2/5), mechanical ventilation (5/5), use of high doses of corticosteroids (1/5), and hyperglycemia (2/5).
The mean number of total days on mechanical ventilation was 12. Neuromuscular blockers were used in 3 cases. An electrophysiological exploration was necessary in one case because of the noncooperation of the young aged child. It revealed sensory and motor axonal damage. The mean number of total LOS in PICU was 15 days with fatal evolution in 3 cases. Spontaneous improvement occurred within several months in only 2 cases.

Discussion

ICU-ANM is an acute clinical weakness that occurs in severely ill patients especially in ICU [6]. Better identification of the pathology probably explains the increasing incidence of the disease. A large number of studies have been carried out to identify critically ill patients at risk for ICU-ANM. The most common risk Factors observed were multi organ failure, sepsis and systemic inflammatory response syndrome. Patients who received high doses of corticosteroids were also exposed to develop ICA-ANM[8]. The role of hyperglycemia is more controversial. Strict control of glycemia seems protective [9]. Immobilization, mechanical ventilation and the use of sedative drugs can play a deleterious role. Experimental data confirm the occurrence of diaphragmatic atrophy following the resting of the respiratory muscles under controlled mechanical ventilation [10]. Difficulties in withdrawing assisted ventilation was the initial sign of ICU-ANM in our cases. Recently, García-Martínez and al had proposed a diagnostic approach to ICU-ANM based on Medical Research Council Sum Score (MRC-SS) and/or ultrasounds used upon patient admission to the ICU [11]. However, the difficulties in conducting electrophysiological studies at the patient's bedside led us to rely on clinical criteria rather than electrophysiological signs. Up to day, there is no curative therapy, but a rapid control of sepsis and multi organ failure, shortening the duration of mechanical ventilation are highly recommended to prevent this neuromuscular disorder. In certain pathologies, the use of corticosteroids is unavoidable, but the pediatrics should keep in mind the possibility of side effects, including neuromuscular disorders and therefore to reduce the dose and the duration of the cure as much as possible. It has been proven that daily application of neuromuscular electrical stimulation effectively prevents histological muscle atrophy [12].

Conclusion

ICU-ANM is becoming a major problem in critically ill patients. We should keep in mind this complication not only for the cost of greater length of stay in ICU but also for the secondary complications (infection, embolism...) and the high risk of mortality. We recommend neurophysiologic testing for early diagnosis of weakness, control of causal factors, and reducing the length of the period of mechanical ventilation.

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