



## Management of Childhood Seizure in Pediatric Emergency Department

Piero Pavone\*, Silvia Marino, Simona Domenica Marino, Raffaele Falsaperla

Pediatric Emergency Department, University Hospital "Policlinico-Vittorio Emanuele", Italy

### Abstract

Febrile, afebrile seizures and status epilepticus in children are causes of frequent consultations in the Pediatric Emergency Department (PED). The Authors report on the assessment and treatment carried out in a single-center of the PED at the University Hospital of Catania over a three years period.

Five thousand and forty-three children were admitted to the PED: Of these 994 were referred for seizures, 733 of febrile types and 261 with epileptic seizures. After a rapid and progressive procedure of assessment, the children were treated with anticonvulsants, typically Midazolam (Mz): No treatment was carried out in a group of children in whom the febrile seizures had already been remitted at the arrival. Following the administration of Mz, remission was obtained in 315 (87%) and in 241 (92%) of the patients with febrile seizures and epileptic seizures. In 47 (12.9%) of children with febrile status epilepticus and 20 (7.6%) with convulsive status epilepticus it was necessary to apply a second administration of Mz. In 19 and 4 cases, respectively, in those children unresponsive to treatment, Mz was replaced by Levetiracetam. Six children were transferred to Intensive Care for further attempts at treatment.

There are various treatment modalities in children affected by seizures and convulsive status epilepticus and there is no general agreement regarding the schedule and types of drug. In some cases, seizures in children may have a serious effects and it may represent a notable challenge for doctors attending the PED.

**Keywords:** Childhood; Seizures; Treatment; Emergency

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#### \*Correspondence:

Piero Pavone, Department of Pediatrics, AOU Policlinico- Vittorio Emanuele, University of Catania Via S. Sofia, 78, 95123 Catania, Italy,  
E-mail: ppavone@unicat.it

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### Introduction

Seizures in children are one of the most frequent reasons for consultation in the Pediatric Emergency Department (PED). The causes of seizures are numerous and although in children in most cases they have a favorable prognosis, the onset of crises induces a tremendous psychological impact in the parents and caregivers. The causes of neurological consultations in emergency are distinguished into traumatic and non-traumatic cases. The latter group includes infections of the Central Nervous System (CNS) reported in about 1/3 of cases; seizures and status epilepticus; cerebral malformations and anomalies of CNS including vascular, arterial, stroke and sinus venous thrombosis; congenital metabolic errors; hypoglycemia, hyperammonemia, dyselectrolytemia; poisoning with alcohol, drugs, carbon monoxide; and brain tumors [1].

According to Reuter and Brownstein, the most common issues requiring emergency treatment in children were: seizures (febrile, afebrile, status epilepticus), closed head injury, headaches and syncope [1]. García-Peñas and Muñoz-Orduña identify four causes, i.e. headaches, acute non-epileptic paroxysmal episodes, epileptic seizures and febrile convulsions, as nearly 85% of all the visits of pediatric neurological emergencies [2]. Osamura indicates convulsions and disturbances of consciousness as the most frequent neurologic consultations: and the most common request regarded mainly febrile seizures (41.4%) and epileptic seizures (29%) [3].

In this report a three-years' single-center experience on assessment and treatment of children admitted to the Pediatric Emergency Department (PED) affected by febrile seizures and febrile status epilepticus, epileptic seizures and convulsive status epilepticus are reviewed.

### Materials and Methods

During a three-years' period ranging from October 2014 to October 2017, 5043 children were admitted to the University Hospital Policlinico - Vittorio Emanuele of Catania, Italy for general

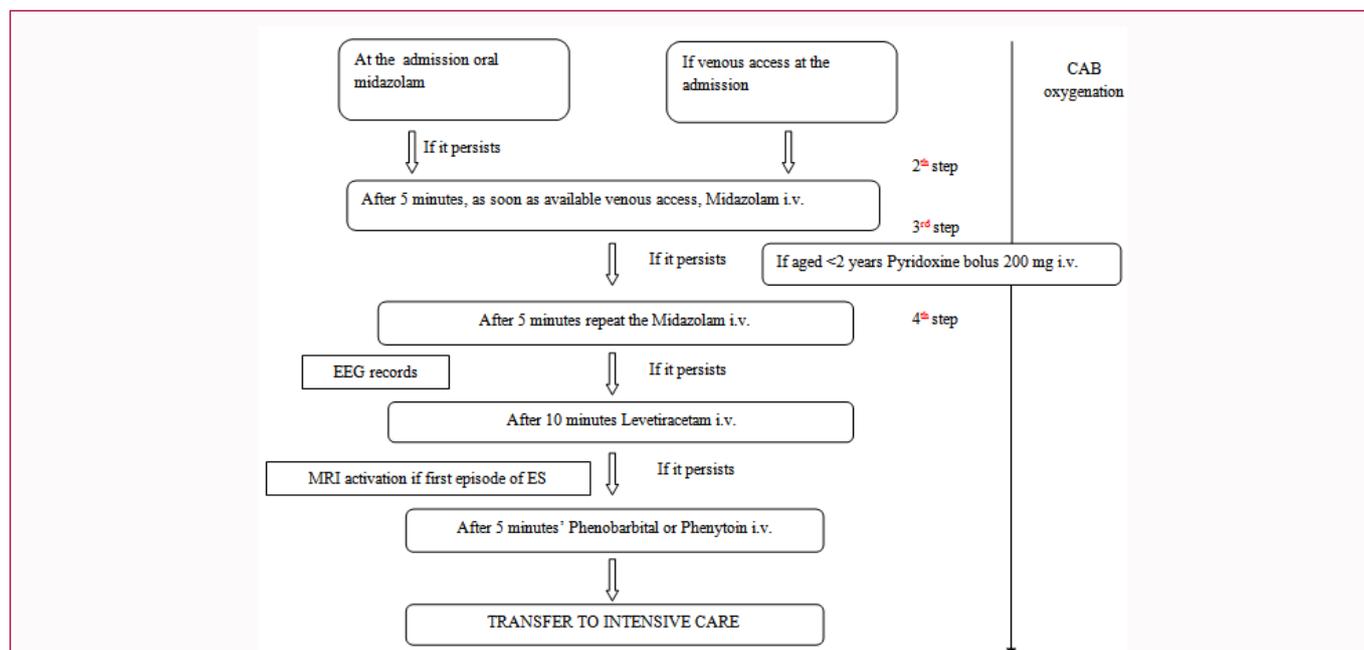


Figure 1:

clinical and neurological problems.

Catania is a Metropolitan City, the second largest in Sicily, with 1,115,310 inhabitants. The University Hospital is a referral center of this area for neurological problems in children. At the PED during this period of years, children with various neurologic problems including headache, seizures, trauma, vertigo and syncope and, with less frequency, other disorders such as anxiety crises, affective spasms, acute confusional states, facial palsy were admitted and examined.

Among the 5,043 children, 994 (19.7%) presented for consultation regarding seizure: 733 (73.7%) were febrile and 261 (26.2%) afebrile seizure types and almost all with generalized tonic-clonic seizures. On arrival of the convulsing child, assessment and treatment was started immediately with rapid, progressive procedures: neurologic evaluation of the clinical signs, including the Glasgow coma scale, intravenous access for blood laboratory findings and prompt treatment, stabilization (airways, breathing, circulation) of the functional activity following the cardiac, respiratory rate, body temperature, blood pressure, Chest compression-Airway maintenance-Breathing (CAB) sequence, focused history with the parent’s information regarding duration of the seizure activity, development status, drug used, pre-hospital management. ECG, EEG monitoring and TC were performed in accordance with the clinical requests [4-6]. Buccal administration of Midazolam (Mz) was started with the dosage and the route reported in Tables 1,2. In the children with status epilepticus after 5 minutes by the administration of Mz, without arrest of seizures, the treatment was followed up according to the scheme reported in Figure 1.

**Results**

In 371 (50.6%) children with febrile seizure, treatment was not performed at the PED since the seizures had already been remitted on arrival; a further 362 (49.3%) needed treatment and this was started with MZ, among these 315 (87%) reached remission shortly after MZ buccal treatment while the other 47 (12.9%) were treated according to the algorithm reported in the Figure 1 with these results: remission was obtained in 26 (55.3%) children after the second step; in 19

Table 1:

MIDAZOLAM DOSAGE
0.05-0.01 mg/kg i.v. or i.m. max 3 mg (slowly for respiratory depression)
0.2-0.8 mg/kg intranasal
0.5 mg/kg rectal max 15 mg

Table 2:

AGE	Dosage	Label Color
From 3 to 6 months In the hospital	2.5 mg	yellow
>6 months to <1 year	2.5 mg	yellow
1 to <5 years	5 mg	blue
5 years to <10 years	7.5 mg	violet
10 years to <18 years	10 mg	orange

(40.4%) after the third step and in 2 (4.2%) it was necessary to transfer the children to the Pediatric Intensive Care Unit (PICU).

Children with epileptic seizures were registered in 261 (26%) cases: among these the response was obtained in 241 children (92%) by buccal Mz, but no response after the first treatment was reported in 20 (7.6%) children; in 12 (60%) it was necessary to apply a second step treatment and in 4 (20%) the third step of treatment. In the remaining 4 (20%) transfer to the PICU became necessary (Table 3).

**Discussion**

Seizures and epileptic status are dangerous conditions that call for immediate action. It is well known that rapid and precocious arrest of seizures are of extreme relevance, since the longer the time of seizures the more severe are the cerebral damages [7-9]. Seizures are defined stereotyped manifestations due to excessive synchronous abnormal electric activity of neurons in the cortical cortex. Febrile seizures, both simple and complex or, as it has been also called, “typical and atypical” are the most common types of seizures in children. They affect 2% to 5% of the general childhood population generally with a favorable prognosis [10]. Epileptic seizures are classified into focal, generalized, and unknown onset; each one distinguished into several sub-groups

Table 3:

Patients at PED admission.	Number	Mz treatment	Results
<b>General disorders</b>	<b>5043</b>		
<b>Seizures</b>	994 (19.7%)		
<b>Febrile seizure</b>	733 (73.7%)		
No treatment	371 (50.6%)	---	Spontaneous resolution
Mz treatment	362 (49.3%)	315 (87%)	Remission shortly after treatment
<b>Febrile seizures lasting &gt;5 min</b>		47 (12.9%)	26 (55.3) remissions after 2 <sup>nd</sup> step
			19 (40.4%) remissions after 3 <sup>rd</sup> step
			2 (4.2%) PICU – 1 exitus
<b>Epilepticus seizure</b>	261(26%)	241 (92%)	Remission after treatment
<b>Convulsive status epilepticus</b>		20 (7.6%)	12 (60%) remissions after 2 <sup>nd</sup> step
			4 (20%) remissions after 3 <sup>rd</sup> step
			4 (20%) PICU – 3 exitus

[11-13]. Convulsive Status Epileptic (CSE) has been traditionally defined as 30 minutes duration of a continuous generalized tonic-clonic seizures or recurrent tonic-clonic seizures without recovery of consciousness between each seizure. Recently a more restricted time of convulsive duration has been taken into consideration and according to the new terminology CSE has been defined as a seizure lasting at least 5 minutes or more. The new definition of CSE is based on the consideration that the natural history of typical generalized convulsive seizures tends to solve spontaneously in a short period of time, usually between 3-5 minutes, whereas seizures with longer duration require pharmacological treatment to arrest them [5,14-16]. Diazepam and Midazolam have been largely used in the acute treatment of convulsing children. In the last years treatment with Midazolam has been largely applied and advised in acute convulsant children. Midazolam has an ultra short action and it may be applied by several routes including intravenous, intramuscular, buccal, intranasal and rectal. The effect is usually reached after 2-3 minutes and its half-life lasts for 45-60 minutes. Moreover, side effects are uncommon in children and are usually mild, consisting of nausea, vomiting, coughing, euphoria, and even hallucination. McMullant et al [17]. In a large meta-analysis comparing Midazolam versus Diazepam report on a greater efficacy of the first drug in arresting the crises using any variety of administration (RR 1.52, 95% CL 1.27-1.82). In the acute convulsing children admitted to our PED and affected by febrile seizure or by epileptic seizure, the arrest of the crises was obtained rapidly, within a few minutes in most of the cases. In the group of children presenting respectively febrile status epilepticus and convulsive status epilepticus the treatment was started as usual with Midazolam at the normal dosage followed by repeat administration of the same drug with the same dosage, thereby obtaining an arrest of the crisis in 55.3% and 60% of the children, respectively. After the third stage of treatment the children were submitted for EEG in order to clarify the subtypes of convulsive status epilepticus focal or generalized, since in the relapsing convulsive seizure, the EEG has shown to have a great relevance as a predictive diagnostic factor [18]. In children resistant to a repeated dose of Mz we have followed the indications of Dalziel et al [19]. Who showed that Levetiracetam has potentially greater advantages compared to Phenytoin, since it may be given as a 5 minutes' infusion by the intravenous route with less risk of serious adverse effects. Following Levetiracetam treatment, arrest of crises were obtained in 19 and in 4 children, respectively, affected by febrile status epilepticus and

convulsive status epilepticus unresponsive to the previous treatment [20]. Two children belonging to the group of febrile status epilepticus and 4 of the group of convulsive status epilepticus were transferred to PICU to proceed with the treatment. In one of the first group and three of the second, the course was lethal.

## Conclusion

In conclusion the results reached in convulsing children with anticonvulsant drugs (and with Midazolam in particular) may be considered quite good, including the children with febrile status epilepticus and convulsive status epilepticus. However, even if notable progress has been already reached in the last years, in the group of children with severe seizures the treatment may be ineffective causing a serious life-threatening and a relevant challenge in the PED.

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