

## SHORT REPORT

## Respiratory depression in the acute management of seizures

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The incidence of respiratory depression following treatment of prolonged seizures with benzodiazepines is variable in the literature. We retrospectively reviewed the charts of children treated for prolonged seizure over a one year period. Of the 56 seizures treated, 30 received lorazepam, 19 diazepam, and seven both drugs. Twenty two episodes (39%) of prolonged seizure were treated with multiple doses of benzodiazepines. In eight events (14%), there was documented respiratory depression following the administration of one or more doses of benzodiazepine; in six of these, multiple doses were given. The doses used were often at the low end or less than the recommended dose for treatment of status epilepticus. These data support suggestions that multiple doses of benzodiazepines increase the risk of respiratory depression.

Benzodiazepines are routinely used in the management of prolonged seizures. Lorazepam is usually considered the benzodiazepine of choice and has been reported to have less potential for respiratory depression than diazepam.<sup>1-4</sup> In a recent study in adults, however, the rate of respiratory depression following lorazepam was 10.6%.<sup>5</sup> The risk of respiratory

depression with diazepam is unclear but may be as high as 9-20% depending on the route of administration,<sup>1-6</sup> although more recent studies with rectal diazepam gel indicate a lower risk.<sup>7-9</sup>

## METHODS

We reviewed the charts of all patients seen in the emergency room for seizures over a one year period. The records of all children who were treated with benzodiazepines were studied. Respiratory depression was defined as increased  $p_{CO_2}$  on blood gas analysis, notable decrease in respiratory rate, need for positive pressure ventilation, or intubation. The use of pulse oximetry was felt to be unreliable, as all children routinely received oxygen via facemask.

## RESULTS

We identified a total of 40 children, who were treated for 56 prolonged seizures. Eleven children were treated on two to four occasions. One child with severe myoclonic epilepsy of infancy was treated a total of 38 times, often with multiple doses of benzodiazepines, without respiratory depression. Her data were excluded from the analysis.

Thirty episodes were treated with lorazepam only; 18 received a single dose, and 12 received two or more doses.

Table 1 Patient details and benzodiazepine doses

Case	Age (y)	Wt (kg)	Diagnosis	Where treated	Drug	Dose (mg/kg)	Route	Time between doses (min)
1	4	17	Trisomy 22	ER	Lorazepam	0.03	IV	-
2	6	27	First seizure	ER	Diazepam	0.185	IV	-
				ER	Diazepam	0.185	IV	15
3	8	50	Epilepsy	Home	Lorazepam	0.05	SL	-
				ER	Lorazepam	0.1	IV	Unknown*
3	8	51.8	Epilepsy	Home	Lorazepam	0.048	SL	-
				ER	Lorazepam	0.048	SL	~30*
4	1	8	Developmental delay/complicated febrile seizure	ER	Lorazepam	0.06	PR	-
					Lorazepam	0.03	IV	10
					Lorazepam	0.06	PR	4
4	1	8	Developmental delay/complicated febrile seizure	Home	Lorazepam	0.025	PR	-
				ER	Lorazepam	0.05	IV	39
				ER	Lorazepam	0.075	IV	13
5	2.5	11	First unprovoked seizure	ER	Lorazepam	0.1	IV	-
6	9	54	Dandy-Walker/ VP shunt	EMS**	Diazepam	0.09	IV	-
					Lorazepam	0.05	IV	102
					Lorazepam	0.05	IV	5

\*The times were not well documented. In the second event, an approximate time could be inferred from the information given.

\*\* EMS, emergency medical services. Medication provided by paramedical staff en route to hospital.

IV, intravenous; PR, per rectum; SL, sublingual.

Nineteen seizures were managed with diazepam only; 16 with a single dose and three received multiple doses. In seven episodes, children received both lorazepam and diazepam. A total of 22 episodes of prolonged seizure were treated with multiple doses of benzodiazepines.

Problems with respiratory depression were documented in 11 seizures (nine children). Two episodes were unlikely related to medication as they had intracranial haemorrhage requiring neurosurgical management. Two children had respiratory acidosis prior to or at the time the first medication was given; one of these two children deteriorated further following the administration of lorazepam (table 1, case 1). Of the remaining seven events, one child received one dose of lorazepam prior to documentation of respiratory depression, four received two or more doses of lorazepam, one received two doses of diazepam and required intubation, and the last received one dose of diazepam and two doses of lorazepam. Table 1 lists the doses of benzodiazepine. Therefore 8/56 (14%) had documented or worsening respiratory depression following administration of diazepam (1/19), lorazepam (6/30), or both (1/7). In 6/8 events, multiple doses of medication were given prior to documentation of respiratory depression.

## DISCUSSION

These observations raise concerns about the risk of respiratory compromise when using lorazepam in the acute management of seizures. In the emergency room, children often receive more than one dose of benzodiazepine (39% in this study). Most of the children with respiratory depression in this study received doses at the lower end or below the recommended dose of either lorazepam (0.05–0.1 mg/kg) or diazepam (0.5 mg/kg) for status epilepticus, necessitating the use of further medication to stop the seizure. We recognise that the seizures themselves contribute to respiratory depression. In addition, these data are retrospective with no placebo control group. The

data support suggestions, however, that the use of multiple small doses of lorazepam increases the risk of respiratory depression in the management of prolonged seizures.

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