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Brief Reports

INTRAVENOUS MAGNESIUM AS ACUTE TREATMENT FOR HEADACHES: A PEDIATRIC CASE SERIES

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□ **Abstract—Background: Acute i.v. treatment for pediatric headache varies widely. Objectives: Our aim was to describe our experience with i.v. magnesium for acute treatment of pediatric headache. Methods: We reviewed the electronic medical records of all patients ages 5 to 18 years old treated with a standard dose of i.v. magnesium for headache at our institution from January 2008 to July 2010. Charts were assessed for headache diagnosis, prior medications given, side effects, tolerability, and response to treatment. Individuals were excluded if they had an underlying unstable medical condition or a secondary etiology for headache. Only first encounters were included if the patient had multiple encounters. Results: There were 34 episodes of children who received i.v. magnesium in the emergency department (ED) or hospital. Of these, 14 were excluded because the patients had complex medical conditions (n = 6), they were repeat encounters (n = 7), or known secondary etiology for the headache (n = 1). Of the 20 included charts (range 13–18 years old), 5 had migraine, 4 had tension-type headache, and 11 had status migrainosus. Thirteen were treated in the ED and seven as an inpatient with a standard i.v. dose of magnesium. Ten of thirteen adolescents receiving i.v. magnesium in the ED were admitted for further headache treatment but not for side effects, and three were discharged home. Side effects of treatment included pain (1 of 20), redness (1 of 20), burning (1 of 20), and decreased respiratory rate without change in oxygenation (1 of 20). Conclusions: In our case series, adolescents given i.v. magnesium as an abortive therapy for headache experienced minimal side effects and further studies should evaluate for effectiveness.** © **2014 Elsevier Inc.**

□ **Keywords—pediatric; alternative therapy; headache; pain; CAM; migraine**

INTRODUCTION

Migraine disorders are present in childhood with an increasing prevalence through adolescence (1). When home treatments for an acute migraine fail, children are often referred to the emergency department (ED) for i.v. therapies. Common i.v. therapies used in the ED to abort migraines include anti-dopaminergic nausea medications, such as prochlorperazine and metoclopramide; anticonvulsant medications such as valproic acid; anti-inflammatory medications, such as ketorolac; or i.v. magnesium (2). Magnesium has been implicated in a number of mechanisms that may play a role in the

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pathogenesis of migraines (3). Although i.v. magnesium has been widely used in the pediatric population for the treatment of other childhood illnesses, there is limited clinical evidence regarding its use an abortive therapy for headaches in children (4,5). Our objective was to describe the use of a standard dose of i.v. magnesium for pediatric headache abortive treatment. Additionally, we describe the side effects and clinical response to i.v. magnesium.

METHODS

We performed a retrospective medical record review for all patients ages 5 to 18 years old who received i.v. magnesium in the ED or hospital for a headache diagnosis at our institution from January 2008 to July 2010. The study was approved by our Institutional Review Board. In 2007, our institution began using a standard dose for i.v. magnesium sulfate of 30 mg/kg with a maximum dose of 2000 mg infused over 30 min (1000-mg dose was diluted in 50–100 mL of 5% dextrose water or normal saline) while on cardiorespiratory monitor. Serum magnesium level and, in females, urine pregnancy test were recommended before administration. Intravenous magnesium administration was not recommended if the serum magnesium level was >3 mg/dL (reference range 1.7–2.4 mg/dL). The dose could be repeated in 2 h if the first dose was tolerated and serum magnesium level remained < 3 mg/dL. Individuals were excluded if they had an underlying unstable medical condition or a secondary etiology for headache. Only first encounters were included if the patient had multiple encounters.

We reviewed records for any symptoms specifically identified as side effects related to administration of magnesium. In addition, the following objective measures were reviewed: changes in blood pressure > 15 mm Hg systolic or 10 mm Hg diastolic, heart rate increase or decrease by 20 beats/min, respiratory rate increase or decrease by 6 breaths/min, pulse oxygenation decrease < 92% on room air, and temperature during or after administration for 2 h.

Responders were identified as those with moderate to significant improvement in qualitative or numeric pain scores. Pain improvement was defined as a decrease in pain severity from severe to moderate or less pain or a decrease of 3 points or more on a 0–10 pain rating scale. Additional information collected included other abortive medications given during ED or hospital care, discharge or admission to hospital, headache diagnosis as determined by neurologist review of history and documentation. Fisher's exact test was performed to compare the favorable response to i.v. magnesium among different headache types.

RESULTS

There were 34 episodes of children who received i.v. magnesium in the ED or hospital. Of these, 14 were excluded because the patients had complex medical conditions (n = 6), they were repeat encounters (n = 7), or known secondary etiology for the headache (n = 1). The 20 children meeting inclusion criteria had an average age of 15.7 years (standard deviation 1.7 years; range 13–18 years) and were predominately female (80%) (Table 1). Thirteen (65%) received magnesium in the ED and seven (35%) as an inpatient. Five (25%) had migraine, four (20%) had tension-type headache (TTH), and 11 (55%) had status migrainosus. Median number of medications given before i.v. magnesium was 5 (interquartile range 3–6). Medications given most often before administration of i.v. magnesium were i.v. ketorolac, diphenhydramine, and prochlorperazine or ondansetron given simultaneously with i.v. fluids, commonly followed by i.v. valproic acid. Twelve children had serum magnesium levels obtained before i.v. magnesium administration and levels ranged from 1.5 mg/dL to 2.6 mg/dL (mean 2.01 mg/dL).

No major side effects were noted. Minor side effects included mild transient pain (1 of 20), redness or burning at the injection site (2 of 20), which resolved after infusion and decreased respiratory rate of 9 breaths/min during sleep without change in oxygenation (1 of 20).

Seven (35%) patients showed favorable response, one with migraine, one with TTH, and five with status migrainosus ($p = 0.57$) (Figure 1). None of the patients in our cohort had worsened headache after magnesium administration. Ten of thirteen (77%) children receiving i.v. magnesium in the ED were admitted for further treatment, and three were discharged home. Three (15%) patients received a second dose of i.v. magnesium, with one patient having headache resolution after two doses, another showing minimal response after the first dose and no improvement after the second, and one patient having no response to either dose.

DISCUSSION

We show no serious adverse events and good tolerability with i.v. administration of magnesium for acute treatment

Table 1. Characteristics of Intravenous Magnesium Cases (N = 20)

Age (years), Mean ± SD	15.7 ± 1.7
Female sex, n (%)	16 (80)
ED administration, n (%)	13 (65)
Inpatient administration, n (%)	7 (35)
Migraine, n (%)	5 (25)
Tension-type headache, n (%)	4 (20)
Status migrainosus, n (%)	11 (55)

ED = emergency department; SD = standard deviation.