Evaluation of magnesium replacement protocol in patients on continuous insulin infusion in the adult ICU: A retrospective analysis

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Introduction

- Abnormal electrolyte levels are encountered frequently in the ICU setting. Deficiencies can range in variety and severity, with hypomagnesemia being known to result in symptoms like, tetany, vertigo, convulsions, and life-threatening cardiac arrhythmias, such as torsades de pointes and supraventricular tachycardia [3].
- Serum magnesium (Mg) is widely controlled via urine excretion, which varies from 0.5 to 70% of the total filtered Mg amount. The reabsorption of filtered magnesium by the kidneys mainly depends on the serum Mg levels. Serum magnesium of ≤ 1.5 mg/dL is widely considered clinical deficiency in the literature [2].
- One of the well-known causes of hypomagnesemia is insulin administration which promotes elevation of magnesium intracellularly in erythrocytes and platelets [1]. Among other causes are gastrointestinal surgeries and magnesium wasting medications, such as aminoglycosides, diuretics and antineoplastics [2].
- It has been hypothesized that slower delivery of magnesium to kidneys prevents its rapid excretion and maintains Mg retention in the serum. However, the clinical benefit of prolonging intravenous Mg supplementation is unclear. A recent study by Ku at al. in hematopoietic cell transplant recipients requiring intravenous Mg repletion did not find any correlation between prolonged Mg infusion and improved serum Mg levels [4].
- Further research is warranted to analyze the benefits of extended intravenous magnesium infusion.

Objectives

- To investigate the impact of the duration of infusion of IV Mg replacement in patients receiving continuous insulin infusion while treated in the adult ICU. This study observed outcomes before and after implementation of the revised electrolyte replacement protocol, which extended IV Mg sulfate infusion duration for 2 mg and 4 mg-dose infusions from 1 and 2 hours to 6 and 8 hours, respectively.

Primary Outcome:

- Mean % serum magnesium levels drawn within 2.0-2.5 mg/dL therapeutic range while on continuous insulin infusion.

Secondary Outcome:

- Duration of time magnesium was retained within the range of 2.0-2.5 mg/dL, within the range of 1.5-2.5 mg/dL and mean magnesium level throughout insulin infusion.

Materials and Methods

Study Design:

- Double-center, retrospective chart review
- Timeframe: January 1, 2018 – June 30, 2019
- Two Cohorts:
  - Pre-protocol change group (shorter infusion duration), *n* = 53
  - Post-protocol change group (longer infusion duration), *n* = 55
- IRB approved
- Outcomes were analyzed using the Mann-Whitney U Test and categorical data was analyzed using Fisher's Exact Test. All tests were two-tailed and a p-value of <0.05 was considered significant.

Inclusion Criteria:

- Age ≥18 y/o
- Patients receiving continuous intravenous insulin infusion
- Patients receiving IV magnesium replacement while on insulin infusion

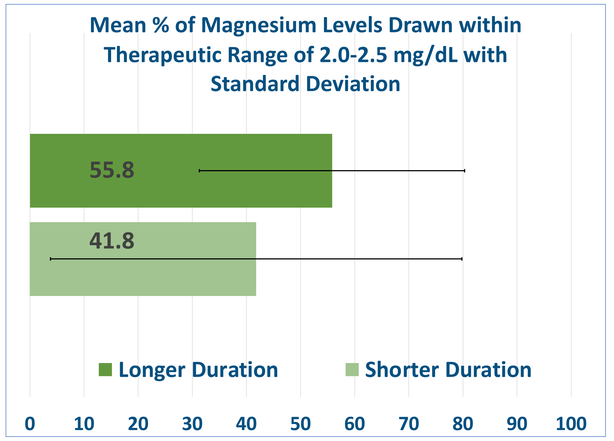
Exclusion Criteria:

- Patients receiving total parenteral nutrition (TPN) while on insulin infusion
- Patients receiving continuous renal replacement therapy (CRRT)
- Patients receiving oral magnesium replacement concomitantly with IV magnesium replacement while on insulin infusion.

Baseline Characteristics

	Shorter Infusion (*n* = 53)	Longer Infusion (*n* = 55)	P-value
Age (years), mean (SD)	56 (13.8)	57 (18.0)	0.38
Gender (male), *n* (%)	31 (58.5)	31 (56.4)	0.85
Race (Caucasian), *n* (%)	30 (56.6)	34 (61.8)	0.70
Weight (kg), mean (SD)	92 (21.6)	94 (31.9)	0.71
Height (cm), mean (SD)	170 (13.0)	171 (10.0)	0.96
BMI (kg/m^2), mean (SD)	32 (8.8)	34 (14.1)	0.95
SrCr (mg/dL), mean (SD)	0.9 (0.3)	1.3 (1.2)	0.02*
LOS (days), mean (SD)	9 (5.3)	14 (10.3)	0.005*

Results

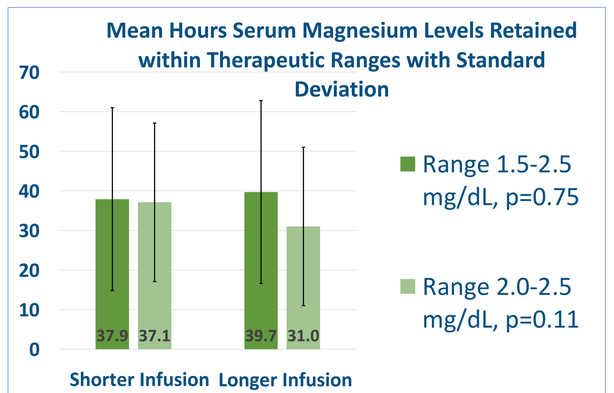


Primary Outcome:

- Mean percentage of Mg levels drawn within the range of 2.0-2.5 mg/dL during continuous insulin infusion. In the pre-protocol phase (shorter infusion) and post-protocol phase (longer infusion) these outcomes were found to be 41.8% ± 38.0% and 55.8% ± 24.5% (p-value = 0.02*), respectively.

Secondary Outcomes:

- Mean time Mg levels held within 1.5-2.5 mg/dL range: 37.9 hrs ± 23.0 hrs (shorter infusion group) and 39.7 hrs ± 23.1 hrs (longer infusion group) (p-value = 0.75).
- Mean time Mg levels held within 2.0-2.5 mg/dL range: 37.1 hrs ± 23.1 hrs (shorter infusion group) and 31.0 hrs ± 20.0 hrs (longer infusion group) (p-value = 0.11).
- Mean Mg levels throughout insulin infusion: 2.0 mg/dL ± 0.3 mg/dL (shorter infusion group) and 2.1 mg/dL ± 0.2 mg/dL (longer infusion group) (p-value = 0.01*).



Conclusions

- Our findings suggest that longer duration of intravenous Mg supplementation may correlate with a higher percentage of serum Mg levels retained within the desired therapeutic range of 2.0-2.5 mg/dL (p-value = 0.02*).
- However, the post-protocol change cohort (longer infusion group) appeared to have included patients with higher serum creatinine levels in general (mean SrCr = 1.3, SD = 1.2), while the pre-protocol change cohort's mean ScCr was 0.9, SD = 0.3, which may have contributed to the fact that serum Mg levels were noticed to have been charted within 2.0-2.5 mg/dL range in the post-protocol change group more often.
- Our research did not demonstrate any statistically significant difference between the time Mg was retained with the technical therapeutic range of 1.5-2.5 mg/dL (p-value = 0.75) or the desired therapeutic range of 2.0-2.5 mg/dL (p-value = 0.11) between the two intravenous Mg infusion durations.
- It is worth noting that limitations to this study include variability in the frequency of charted magnesium levels at bedside, the retrospective nature of the study as well as small sample size.

References

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Disclosures & Contacts

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