Epsom salts and the unorthodox journey of a mineral from a natural saline spring

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Central Message

Salutary effects are produced by intraoperative administration of magnesium sulfate in the prevention of arrhythmias after congenital heart surgery.

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Magnesium was discovered serendipitously by a farmer in 1618 in the Surrey market town bearing its name, located southwest of London.¹ Initially recognized for its healing properties and characterized as heptahydrate magnesium sulfate, it is now widely used in many areas, including medicine, agriculture, food preparation, metallurgy, and the aircraft and automotive industries, among many others.

Magnesium is a ubiquitous cation essential for muscle, cardiovascular, and bone health. It is the second most common intracellular electrolyte, thereby playing an essential role in the homeostasis of hundreds of catalytic enzymes. Among these, blocking calcium influx into myocardial cells, inhibiting acetylcholine release from motor nerve terminals, and inhibiting histamine release from mast cells have particular beneficial effects in preventing arrhythmias after cardiac surgery.²

In this issue of the *Journal*, He and colleagues³ have published their retrospective observational study analyzing the effects of intraoperative magnesium sulfate administration in the prevention of postoperative arrhythmias in children undergoing heart surgery in a 9-year period. This single-institution experience represents the largest cohort and case mix study to date. This group has previously published on the salutary effects of intraoperative magnesium in the prevention of junctional ectopic tachycardia.⁴ With the same cohort of patients, the current study of He and colleagues³ expands into other types of arrhythmias, including heart block. This is controversial, because heart block develops most often after surgical trauma and is unlikely to be affected by intraoperative magnesium administration.

As have others before them,⁵ He and colleagues³ note that postoperative arrhythmias arise in as many as one-third of children, and their occurrence prolongs cardiac intensive care and hospital stays, leading to potential worse clinical outcomes. Intraoperative use of magnesium decreased the incidence of all individual types of arrhythmias, occurring in isolation or in combination. Interestingly,

there was no observed benefit with increased doses of magnesium. Magnesium is not the panacea for the prevention of all postoperative arrhythmias, but its effect in reducing the burden of occurrence is clear.

The effects of magnesium administration have been shown before, but the proper timing of administration is unclear. He and colleagues³ chose to administer magnesium in the cardiopulmonary circuit after removal of aortic cross-clamp during warming. This is a natural choice, because the myocardium is reperfused with oxygen-rich blood, thereby lessening the effects of ischemia.

A shortcoming of the study is that even though the population was properly matched, with equal distributions of measured baseline covariates, retrospective propensity-score matching cannot draw a firm causal relationship between intraoperative magnesium and arrhythmia prevention the way that a randomized controlled trial would. Furthermore, the omission of less common arrhythmias, such as wide-complex atrial arrhythmias with bundle branch block or those occurring and lasting less than 1 minute, may have obscured the true incidence of all arrhythmia types. Although intuitively there is a higher likelihood of occurrence of any arrhythmia with higher complexity and adjusted risk for each surgical procedure, this was not the case in the study of He and colleagues.³ Perhaps this was related to their use of an outdated risk assessment tool,

such as the ARISTOTLE score, which lumps procedures differently than the current STAT score, potentially confounding the generalization of the results.

Administration of magnesium sulfate has many applications, but none are closer to the heart than the intracellular stabilization of electrolytes of the myocardial cells. From its humble beginnings of healing ulcers to its ubiquitous use to date, magnesium sulfate has had an unconventional odyssey during 4 centuries of use, to say the least.

References

1. Wacker WE. *Magnesium and Man: A Commonwealth Fund book*. Cambridge (MA): Harvard University press; 1980.
2. Iwazumi T. Molecular mechanism of muscle contraction. *Physiol Chem Phys Med NMR*. 1989;21:187-219.
3. He D, Aggarwal N, Zurakowski D, Jonas RA, Berul CI, Hanumanthaiah S, et al. Lower risk of postoperative arrhythmias in congenital heart surgery following intraoperative administration of magnesium. *J Thorac Cardiovasc Surg*. 2018;156:763-70.
4. He D, Sznycer-Taub N, Cheng Y, McCarter R, Jonas RA, Hanumanthaiah S, et al. Magnesium lowers the incidence of postoperative junctional ectopic tachycardia in congenital heart surgical patients: is there a relationship to surgical procedure complexity? *Pediatr Cardiol*. 2015;36:1179-85.
5. Manrique AM, Arroyo M, Lin Y, El Khoudary SR, Colvin E, Lichtenstein S, et al. Magnesium supplementation during cardiopulmonary bypass to prevent junctional ectopic tachycardia after pediatric cardiac surgery: a randomized controlled study. *J Thorac Cardiovasc Surg*. 2010;139:162-9.e2.