International Journal of Cardiology 287 (2019) 50–52

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Editorial

Serum potassium and glucose levels, and mortality in acute myocardial infarction; fact or myth?

Tadao Aikawa, Toshiyuki Nagai *, Toshihisa Anzai

Department of Cardiovascular Medicine, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Sapporo, Japan

ARTICLE INFO

Article history:
Received 13 March 2019
Accepted 4 April 2019
Available online 8 April 2019

Abnormal serum levels of potassium or glucose are frequently observed in patients with acute myocardial infarction (AMI) [1–3]. There is a "U-shaped" relationship between serum potassium and in-hospital mortality or incidence of ventricular arrhythmias in patients with AMI [1,4]. Notably, a large retrospective cohort study revealed the optimal range of serum potassium levels which showed the lowest risk of in-hospital death and ventricular arrhythmias as 3.5–4.5, 3.0–5.0 mmol/L, respectively, in patients with AMI [1]. In addition, the National Council on Potassium in Clinical Practice recommends maintaining serum potassium levels of at least 4.0 mmol/L to prevent ventricular arrhythmias based on the fact that the risk of early ventricular fibrillation in AMI is dramatically increased in patients who have low potassium levels as <3.9 mmol/L [5]; however, there are no well-designed randomized clinical trials investigating whether potassium replacement can prevent sudden cardiac death or ventricular arrhythmias for patients with AMI. Meanwhile, serum glucose levels also show a "J-shaped" relationship with in-hospital mortality following AMI regardless of the presence of diabetes [2,3]. Although there is no uniform definition of hyperglycemia in patients with AMI, previous studies reported that in-hospital mortality after AMI gradually increases with an elevation in serum glucose levels exceeding 110 to 120 mg/dL in patients without diabetes and exceeding 200 mg/dL in those with diabetes [2]. Spontaneous hypoglycemia (<60 to 70 mg/dL) is also associated with in-hospital mortality after AMI [3].

In the present issue of the International Journal of Cardiology, the Soroka acute myocardial infarction II (SAMI-II) project provides new evidence regarding the associations between serum potassium and glucose levels and in-hospital mortality following AMI [6]. In 12,535 patients who were admitted to the tertiary medical center for AMI, abnormal serum potassium levels (<3.7 or ≥ 4.9 mmol/L) and high glucose levels (≥143 mg/dL) were significantly associated with increased in-hospital mortality after adjusting for the appropriate covariates. Furthermore, the patients with normal serum potassium levels (3.7–4.9 mmol/L) had lower in-hospital mortality even though increasing serum glucose levels. As outlined above, previous studies have reported serum potassium levels have a U-shaped, serum glucose levels have a J-shaped relationship with in-hospital mortality following AMI. Current findings by Plakht et al. further support the complexity of these interactions. It is noteworthy that the in-hospital mortality was the lowest in patients with serum glucose levels of <143 mg/dL and potassium levels of 4.0–4.9 mmol/L. Interestingly, a J-shaped relationship between serum glucose levels and in-hospital mortality was weakened in patients with diabetes compared to those without diabetes, which is in line with the previous report [2]. Fujino, et al. also reported that the highest in-hospital mortality with peak creatinine kinase levels was found in AMI patients accompanied with acute hyperglycemia and no chronic hyperglycemia among the glycemic status [7].

The present study is clinically relevant, but caution should be taken when interpreting their findings because there are several limitations that are worth mentioning. First, the data of serum potassium and glucose levels were retrospectively obtained at an unspecified point during the hospitalization. Previous landmark observational studies demonstrated both admission and mean post-admission levels of potassium [1] and glucose [2] and suggested that their mean post-admission levels could be better for predicting in-hospital mortality after AMI [2]. Second, the medications which can affect serum potassium and glucose levels, such as inhibitors of the renin-angiotensin-aldosterone system and beta blockers (both increasing serum potassium), insulin (decreasing serum glucose and potassium), and other glucose lowering agents were not considered as the covariates for the multivariable models.

The precise underlying mechanisms of abnormal serum potassium and glucose levels in patients with AMI are still under debate. Post-admission pro-inflammatory status following AMI, which can affect serum potassium and glucose levels, is associated with worse outcomes

DOI of original article: https://doi.org/10.1016/j.ijcard.2019.02.031.
* Corresponding author at: Department of Cardiovascular Medicine, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Kita-15, Nishi-7, Kita-ku, Sapporo 060-8638, Japan.
E-mail address: tnagai@huhp.hokudai.ac.jp (T. Nagai).

https://doi.org/10.1016/j.ijcard.2019.04.013

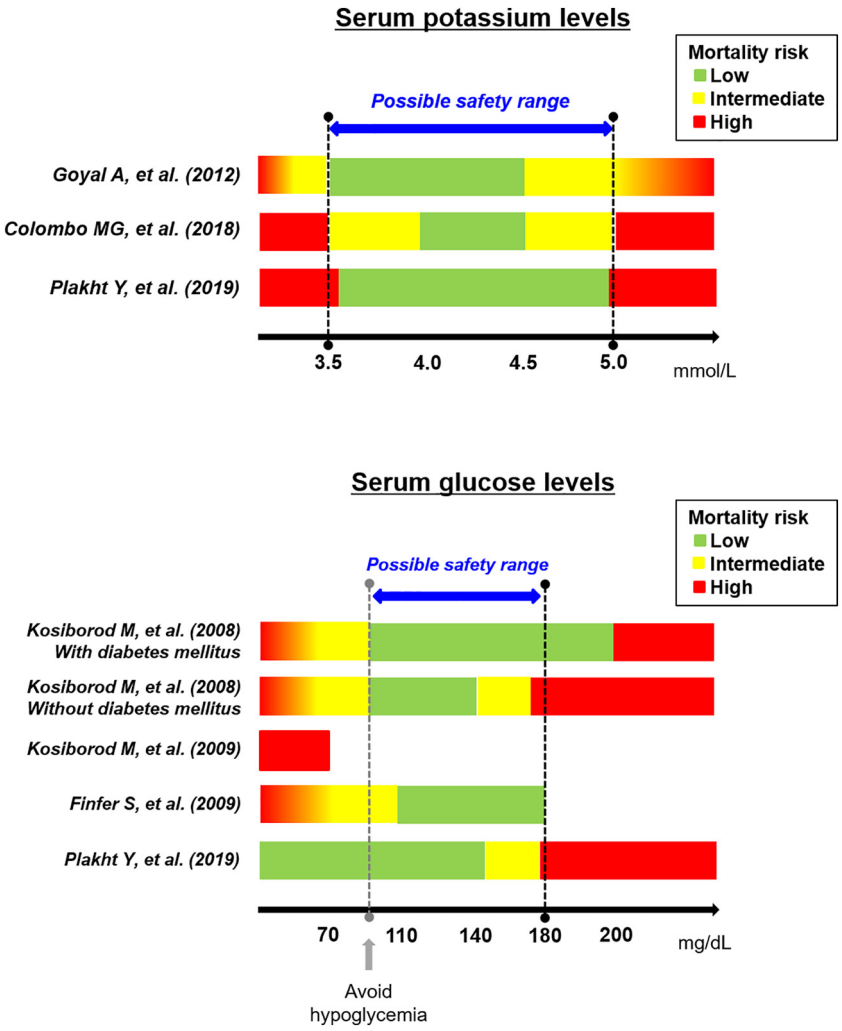

Fig. 1. Possible safety range of serum potassium and glucose levels for mortality risk in patients with AMI according to previous and current reports.

per se [8]. Therefore, abnormal serum potassium or glucose levels after AMI may only reflect disease severity or comorbidities, such as recognized or unrecognized diabetes, renal insufficiency, sepsis, or cardiogenic shock. Moreover, whether aggressive medical therapy to correct abnormal levels of serum potassium and glucose can improve outcome after AMI was not noted in the current report [6]. The Normoglycemia in Intensive Care Evaluation-Survival Using Glucose Algorithm Regulation (NICE-SUGAR) trial reported that intensive serum glucose control targeting 81 to 108 mg/dL significantly increased mortality in patients who admitted to an intensive care unit compared to that targeting ≤180 mg/dL [9]. In addition, intensive serum glucose control has a risk of hypoglycemia, which may be harmful following AMI [2]. Consistently, the glucose-insulin-potassium infusion therapy failed to decrease mortality in patients with AMI [10].

In summary, the work by Plakht et al. should be congratulated for adding new evidence on the interaction between in-hospital mortality after AMI and serum potassium and glucose levels. Given the lack of conclusive evidence of aggressive control of serum potassium and glucose levels in patients with AMI, it is reasonable to avoid significant hypokalemia (<3.5 mmol/L), hyperkalemia (≥5.0 mmol/L), hyperglycemia (>180 mg/dL) and hypoglycemia based on the present report [6], and others [1–5,9] (Fig. 1). Further well-designed prospective interventional studies are needed to determine whether intensive control of serum potassium and glucose levels leads to better outcomes in patients with AMI.

Conflicts of interest

None.

Funding

None.

References

[1] A. Goyal, J.A. Spertus, K. Gosch, et al., Serum potassium levels and mortality in acute myocardial infarction, JAMA 307 (2012) 157–164.
[2] M. Kosiborod, S.E. Inzucchi, H.M. Krumholz, et al., Glucometrics in patients hospitalized with acute myocardial infarction: defining the optimal outcomes-based measure of risk, Circulation 117 (2008) 1018–1027.
[3] M. Kosiborod, S.E. Inzucchi, A. Goyal, et al., Relationship between spontaneous and iatrogenic hypoglycemia and mortality in patients hospitalized with acute myocardial infarction, JAMA 301 (2009) 1556–1564.
[4] M.G. Colombo, I. Kirchberger, U. Amann, et al., Association of serum potassium concentration with mortality and ventricular arrhythmias in patients with acute myocardial infarction: a systematic review and meta-analysis, Eur. J. Prev. Cardiol. 25 (2018) 576–595.
[5] J.N. Cohn, P.R. Kowey, P.K. Whelton, et al., New guidelines for potassium replacement in clinical practice: a contemporary review by the National Council on Potassium in Clinical Practice, Arch. Intern. Med. 160 (2000) 2429–2436.
[6] Y. Plakht, H. Gilutz, A. Shiyovich, The association of concomitant serum potassium and glucose levels and in-hospital mortality in patients with acute myocardial infarction (AMI). Soroka acute myocardial infarction II (SAMI-II) project, Int. J. Cardiol. (2019).

[7] M. Fujino, M. Ishihara, S. Honda, et al., Impact of acute and chronic hyperglycemia on in-hospital outcomes of patients with acute myocardial infarction, Am. J. Cardiol. 114 (2014) 1789–1793.
[8] T. Anzai, T. Yoshikawa, H. Shiraki, et al., C-reactive protein as a predictor of infarct expansion and cardiac rupture after a first Q-wave acute myocardial infarction, Circulation 96 (1997) 778–784.
[9] S. Finfer, D.R. Chittock, S.Y. Su, et al., Intensive versus conventional glucose control in critically ill patients, N. Engl. J. Med. 360 (2009) 1283–1297.
[10] S.R. Mehta, S. Yusuf, R. Diaz, et al., Effect of glucose-insulin-potassium infusion on mortality in patients with acute ST-segment elevation myocardial infarction: the CREATE-ECLA randomized controlled trial, JAMA 293 (2005) 437–446.