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The harmful effects of calcium overload on cardiovascular and overall mortality in critical-ill patients

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Objectives: Calcium abnormalities, whether high or low, commonly occur in critically ill patients and strongly affect a patient's outcome. We aimed to assess the clinical impact of calcium status on the mortality of critically ill patients.

Methods: We constructed our database to identify all adult patients who were admitted to two intensive care units (ICUs) from January 2002 to December 2018. The patients who had available serum total calcium (tCa) and albumin at the time of ICU admission were included. In this study, ionized calcium (iCa) was calculated using the formula; calculated iCa (c-iCa) = 0.9 + (0.55 * total calcium – 0.3 * albumin).

Results: A total of 1,936 patients were divided into four groups based on c-iCa and tCa status; true and hidden hypercalcemia, normocalcemia, and true hypocalcemia. The true hypercalcemia group was defined as having an elevated c-iCa with elevated tCa. The hidden hypercalcemia group was defined as elevated c-iCa with low or normal tCa. True and hidden hypercalcemia groups showed worse in-hospital mortality than that of normocalcemia. After cox regression analysis, true hypercalcemia groups showed an increased hazard ratio of 1.990 (95% CI, 1.374 - 2.882, p<0.001) for overall mortality. In terms of cardiovascular death, hidden and true hypercalcemia groups also showed increased risks; HR 1.693 (95% CI, 1.083 – 2.648, p=0.021) and 3.381 (95% CI, 1.777 – 6.432, p<0.001), respectively. Contrarily, true hypocalcemia did not increase the risk for overall and cardiovascular death.

Conclusions:

We observed that excess calcium status could be an important risk factor for overall mortality. Especially, in terms of cardiovascular outcomes, even hidden hypercalcemia also increased the risk of death. Therefore, we need to pay attention to calcium status including not only true hypercalcemia but also hidden hypercalcemia in critically ill patients.