CASE REPORT

Change of Exhaled Acetone Concentration in a Diabetic Patient with Acute Decompensated Heart Failure

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Summary
In heart failure patients, exhaled acetone concentration, a noninvasive biomarker, is increased according to heart failure severity. Moreover, exhaled acetone concentration is also known to be affected by diabetes mellitus. However, there have been no reports on exhaled acetone concentration in heart failure patients with diabetes mellitus. A 77-year old man was admitted to our hospital with acute decompensated heart failure and atrioventricular block. He had controlled diabetes mellitus under insulin treatment with hemoglobin A1c of 6.5%. He underwent treatment of diuretics and permanent pacemaker implantation. His condition improved and he was discharged at Day 12. Due to the heart failure improvement, his levels of exhaled acetone concentration decreased from 1.623 ppm at admission to 0.664 ppm at discharge. This is the first report to reveal a change of exhaled acetone concentration in a diabetic patient with acute decompensated heart failure.

Key words: Breath analysis, Ketone body, Diabetes mellitus

Case Report
A 77-year old man was admitted to our department with dyspnea on effort, and he was diagnosed as having acute decompensated heart failure and atrioventricular block. He had type 2 diabetes mellitus, for which he was receiving insulin treatment, and his hemoglobin A1c was 6.5% (National Glycohemoglobin Standardization Program) on admission. He did not exhibit signs of hyperglycemic crisis including diabetic ketoacidosis, hepatic dysfunction, or acute kidney injury on admission. The patient was initially administered with diuretics and received a temporary pacemaker. A permanent pacemaker was then implanted for the atrioventricular block on Day 5. His heart failure improved and he was discharged on Day 12. Of note, ischemic etiology was excluded by myocardial perfusion scintigraphy, and glucose levels were well-controlled by insulin treatment during hospitalization.

In the clinical course of treatment, brain natriuretic peptide levels, blood glucose levels, and total ketone body levels in the blood, as well as acetone concentration levels in the breath, were measured with written informed consent from the patient after an overnight fast (Figure). We used a breath-sampling bag (Collection Bag; Laboratory for Expiration Biochemistry, Nourishment Metabolism Co., Ltd., Nara, Japan) and a gas chromatograph (GC-8A; Shimadzu Co., Ltd., Kyoto, Japan) to measure the exhaled acetone concentration according to the method described in our previous report.3 The patient consumed a hospital diet with an average total energy count of 1600 kcal/day (60 g protein, 45 g fat, and 270 g carbohydrates). The levels of exhaled acetone concentration decreased with improvement of heart failure. On Day 2 of administration, the patient’s B-type natriuretic peptide level was 183.1 pg/mL, blood glucose level was 80 mg/dL, total ketone body level was 456 μmol/L, and exhaled acetone concentration level was 1.623 ppm. On Day 10, just prior to discharge, his B-type natriuretic peptide level was 14.0 pg/mL, blood glucose level was 106 mg/dL, total ketone body level was 57 μmol/L, and exhaled acetone concentration level was...
Clinical course. Red stars represent exhaled acetone concentration levels. Black circles represent plasma B-type natriuretic peptide (BNP) levels. Gray triangles represent fasting blood glucose levels. Blue cross marks represent levels of blood total ketone bodies. On Day 2, levels of exhaled acetone concentration, BNP, and total ketone bodies increased; these parameters then decreased following heart failure treatment. The patient did not exhibit signs of hyperglycemic crisis including diabetic ketoacidosis.

Discussion

This is the first case report to describe exhaled acetone concentration in a diabetic patient with acute decompensated heart failure. The failing heart relies on ketone bodies as an important energy source and heart failure patients have altered systemic and cardiac ketone body metabolism.1,6) Exhaled acetone concentration is a useful non-invasive biomarker to evaluate heart failure severity.2,3) Anecdotal evidence has shown the decrease of exhaled acetone concentration in the clinical course of acute decompensated heart failure.7) Furthermore, ketone body metabolism also alters in patients with diabetes mellitus.4) Many heart failure patients have diabetes mellitus, which contributes to the worsening of heart failure.8) Previous studies on exhaled acetone concentration in heart failure excluded patients with diabetes mellitus, and there have been no reports about exhaled acetone concentration in heart failure with diabetes mellitus.2,3) Diabetes is the most common cause of elevated blood ketones. Especially in diabetic ketoacidosis, elevated blood ketone bodies are produced under low insulin and high counterregulatory hormone levels.9) However, well-controlled diabetic patients might be comparable to the patients without diabetes mellitus. Our well-controlled diabetic patient presented with an increased exhaled acetone concentration level with a severe state of heart failure on admission. Subsequently, the levels of exhaled acetone concentration decreased after heart failure treatment with improvement. In the limitation of this case report, only one diabetic patient with heart failure showed change of exhaled acetone concentration, and we need further study of many diabetic patient with heart failure to show the usefulness of exhaled acetone concentration. Here we might show the change of exhaled acetone concentration as a noninvasive biomarker to monitor the severity of heart failure in a diabetic patient with acute decompensated heart failure.

Disclosures

Conflicts of interest: None.

References

7. Yokokawa T, Sugano Y, Shimouchi A, et al. A case of acute decompensated heart failure evaluated by series of exhaled acetone concentrations as noninvasive biomarker of heart failure se-