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Thyroid Heart Disease was Successfully Treated with Acetazolamide

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Abstract

Introduction: Loop diuretics are currently the first-choice treatment for acutely decompensated HF therapy and for maintaining euvolemia, but the addition of other diuretic agents, such as the carbonic anhydrase inhibitor acetazolamide might be effective for patients with refractory heart failure.

Case: A 35-year-old woman referred from a private hospital came to the emergency unit at Sanjiwani Regional Hospital with complaints of shortness of breath and palpitations, and both legs were swollen. The patient has risk factors for hyperthyroidism and a family history of coronary heart disease. On physical examination, he was conscious of compost mentis with blood pressure 85/50 mmHg, heart rate 79 times/minute, respiratory rate 45 times/minute with saturation 93%, rales (+), oedema in both legs, cold acral; laboratory examination showed TsHs 0.22 uIU/ml, FT4 26.29 pmol/L.

Discussion: Acetazolamide is a carbonic anhydrase inhibitor that reduces proximal tubular sodium reabsorption and may improve diuretic efficiency when added to loop diuretics, thereby potentially facilitating decongestion, was not associated with an increased incidence of adverse events, and associated with a shorter duration of hospital stay.

Conclusion: Acetazolamide is a carbonic anhydrase inhibitor that may improve diuretic efficiency when added to loop diuretics.

Keyword: heart failure, hyperthyroidism, acetazolamide

Introduction

Heart failure is a complex clinical syndrome resulting from structural or functional disorders of ventricular filling or ejection ventricles. The main manifestations of heart failure are shortness of breath and fatigue, which can limit activity, and fluid retention, which causes pulmonary congestion and/or leg oedema [1]. The prevalence of heart failure in Asian countries is generally similar to the figures reported in European countries (1 – 3%), but the Indonesian prevalence rate is reported to be >5%. In Indonesia, the age of heart failure patients is relatively younger compared to Europe and America, accompanied by a more severe clinical appearance. The prevalence of heart failure itself is increasing because patients who experience acute heart damage can progress to chronic heart failure [2].

Thyroid dysfunction is a modifiable risk factor in patients who are at risk of heart failure since even a minor change in circulating TH concentration can adversely affect the CV system. Indeed, overt and subclinical hypo- and hyperthyroidism influence cardiac function via complex mechanisms, which may lead to cardiac dysfunction and heart failure [3,5]. Thyroid hormones (THs) strongly impact the growth,

development, and metabolism of every cell and organ. They also play a critical role in cardiovascular (CV) homeostasis, including the regulation of key processes related to the maintenance of cardiac contractility, electrophysiological functions, and cardiac structure [4,5].

Loop diuretics are currently the first-choice treatment for acutely decompensated HF therapy and for maintaining euvolemia. Repeated administration of loop diuretics often leads to diuretics-associated resistance. Early studies demonstrated that treatment aimed at supplementing or retaining chloride using the carbonic anhydrase inhibitor acetazolamide might be effective for patients with refractory heart failure [6-8]. Here, we present a case of thyroid heart disease treated with acetazolamide as adjuvant diuretic therapy.

Case Report

A 35-year-old woman referred from a private hospital came to the emergency unit at Sanjiwani Regional Hospital with complaints of shortness of breath accompanied by a heavy chest feeling 15 hours before entering the hospital; her chest felt heavy with cold sweat. The patient complained of shortness of breath during light activities; the shortness of breath was also felt at night, causing the patient to wake up due to shortness of breath; the shortness of breath did not decrease with rest. Apart from that, the patient also felt palpitations starting from the beginning of the shortness of breath. The patient also complained that both legs were swollen.

The patient had been hospitalized with complaints of angina two years ago and had been given heart medication previously. The patient was diagnosed with angina and hyperthyroidism, but the patient was not in control and did not take medication regularly. The patient has risk factors for hyperthyroidism and a family history of coronary heart disease.

On physical examination, he was conscious of compost mentis with blood pressure 85/50 mmHg, heart rate 79 times/minute, respiratory rate 45 times/minute with saturation 93%. On physical examination, a murmur wasn't found. Examination of the lungs revealed that the lung sounds had changed to rales at the basal area, and then oedema and cold acral were found in both legs. ECG showed sinus rhythm with a rate of 79 times per minute, normal axis, pulmonary p and mitral p waves, PR interval 0.18 seconds, QRS complex duration 0.08 seconds, with pathological Q in leads V2-V3.

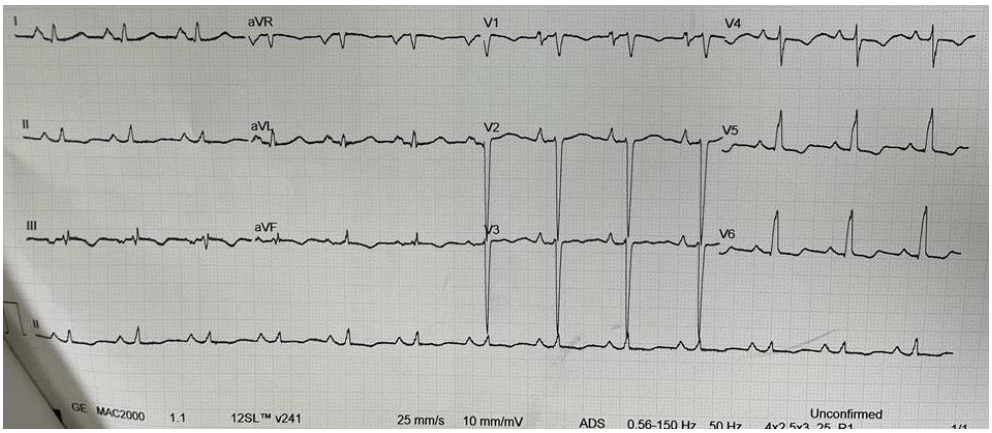


Fig 1. The ECG show Biatrial enlargement

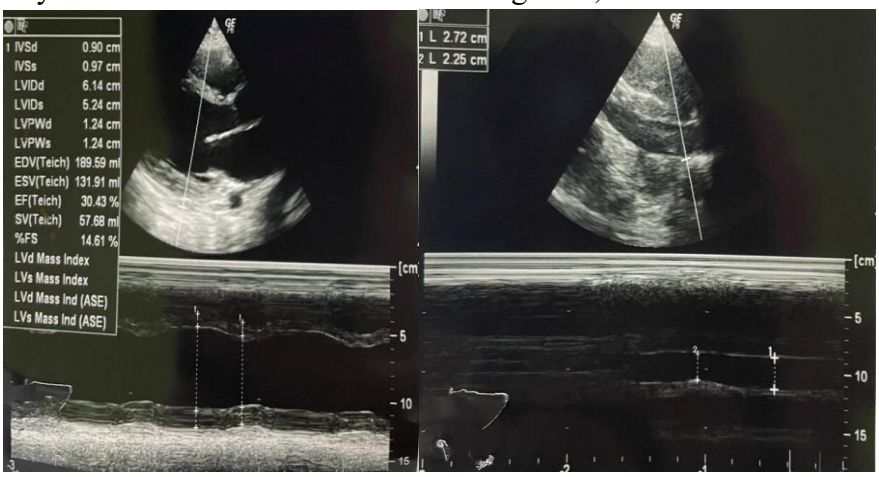
Laboratory examination showed haemoglobin 11.6 g/dL, leukocytes 16,040/uL, hematocrit 36%, erythrocytes 4,620/uL, platelets 127,000/uL, sodium 127 mmol/l, potassium 4.1 mmol/l, chloride 101 mmol/l, urea 89.3 mg /dL, creatinine 1.22 mg/dL, SGPT 113 U/L, SGOT 43 U/L, TsHs 0.22 uIU/ml, FT4 26.29 pmol/L, chest x-ray examination showed cardiomegaly.

Then, the patient was diagnosed with ADHF ec CAD dd thyroid heart disease with cardiogenic shock. After leaving the emergency unit, the patient was treated in the Intensive Cardiac Care Unit/ICCU. The therapy given on the first day of treatment is dobutamine drip 5 mcg/kgbb, furosemide drip 5 mg/hour, clopidogrel 1 x 75 mg, isosorbide dinitrate 5 mg for sublingual chest pain, Ramipril 1 x 2.5 mg, enoxaparin 1 x 0.4 cc SC.

On the second day of treatment in the intensive care unit, the patient's blood pressure was 130/90 mmHg, pulse rate 130 times/minute, respiratory rate 40 times/minute, and saturation 96% with nasal cannula 4 litres per minute. In addition, the patient experienced episodes of rhythm disturbances in the form of bigemini ventricular extrasystole. The patient was given additional therapy in the form of antiarrhythmics, namely amiodarone 300 mg every 1 hour. After that, the patient was reported to have no more signs of rhythm disturbances in the form of bigemini ventricular extrasystole. Apart from that, the patient also complained of shortness of breath and swelling of the legs. On this day, the dobutamine drip was stopped, and the furosemide drip was increased to 10 mg/hour.

On the third day of treatment in the intensive care unit, the patient still experienced shortness of breath and chest pain that felt like being crushed by a heavy object and cold sweat. The patient's blood pressure on the third day of treatment was 110/70 mmHg, pulse rate 90 times/minute, breathing 30 times per minute. On the same day, the patient had his blood laboratory checked for procalcitonin levels; on this day, the patient was given medication in the form of acetazolamide 1x250 mg.

On the fourth day of treatment in the intensive care unit, the patient's shortness of breath began to decrease. On this day, the patient underwent echocardiography, and the procalcitonin result was 19.54 ng/mL. Echocardiography results are heart chamber dimensions, dilatation of all heart chambers, eccentric LVH, severely decreased LV systolic function (EF 30%), LV diastolic function decreased grade III, normal RV contractility, global hypokinetic, mild MR valve, eRAP: 15 mmHg, pericardium normal. The changes in therapy on the 4th day of treatment were furosemide 10 mg/hour, CaCo3 2x1 tab.



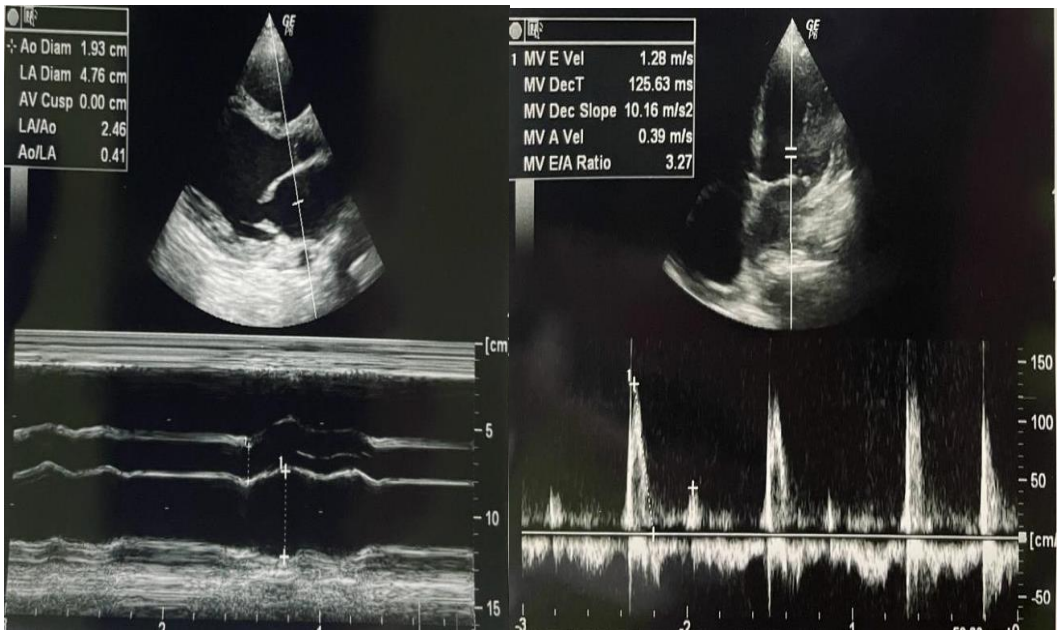


Fig 2. Low Ejection Fraction In PLAX View Of Echocardiography

On the fifth day of treatment in the intensive care unit, the patient's condition began to improve, and the shortness of breath was much reduced, so the dose of furosemide was reduced to 5 mg/hour. On the sixth day of treatment in the intensive care unit, the condition was still much better; there was no shortness of breath, so the dose of furosemide was changed to oral; the patient was also given additional therapy in the form of sacubitril/valsartan 2 x 50 mg.

Discussion

Acute decompensated heart failure can be defined as the sudden or gradual onset of signs or symptoms of heart failure that require an unscheduled office visit, emergency room visit, or hospitalization. In addition to primary deposition, worsening pulmonary and systemic congestion due to increased right and left heart-filling pressures is an almost universal finding in ADHF. One of the typical symptoms of heart failure is signs of congestive and/or peripheral hypoperfusion that require different therapy.

Congestive signs in the form of acute pulmonary oedema are related to pulmonary congestion. Clinical criteria include shortness of breath (on exertion, on lying flat or at rest, exercise intolerance), respiratory failure (hypoxia-hypercapnia), tachypnea >25 breaths/minute, and on lung examination you hear rhonchi or rales. This condition was found in the patient in this case. The patient complained of shortness of breath during light activities; the shortness of breath was also felt at night, causing the patient to wake up due to shortness of breath; the shortness of breath did not decrease with rest with a breathing frequency of 45 times/minute and rales were heard in the area pulmonary basal. Another congestive sign that can be found in heart failure patients is oedema of both legs, which is also found in this patient. The patient also experienced signs of tissue hypoperfusion or shock, such as hypotension (85/50 mmHg) with cold acral [9].

The patient, in this case, had been diagnosed with hyperthyroidism but was never controlled and did not take medication regularly. Usually, hyperthyroidism is characterized by low TSH levels associated with

increased free T4 (FT4) [10]. This patient had a TsHs value of 0.22 uIU/ml and FT4 26.29 pmol/L. One of the non-ischemic etiologies of heart failure is endocrine factors such as hyperthyroidism [1]. Thyroid hormones affect myocardial contractility, total peripheral resistance and heart rate. They enhance myocardial contractility by upregulating calcium handling and myosin heavy chain isoforms and stimulating the beta-adrenergic system. Hyperthyroidism has been shown to incite arrhythmias, vascular changes, and myocardial remodelling. These changes can decrease cardiac output and promote the development of heart failure [10,11,12].

Given the central role of volume expansion in the pathogenesis of congestion, diuretic agents are among the cornerstones of treatments for HF. In the current clinical practice, intravenous diuretics are fundamental for treating AHF, with about 90% of hospitalized AHF patients receiving diuretics to reduce fluid retention and improve oxygenation [13]. The main effect of administering diuretics is to lower blood pressure and ventricular preload. In addition, in patients with left heart failure, giving diuretics will help reduce heart swelling so that pumping is more efficient. Several groups of diuretics can be used, namely the thiazide group and loop diuretics. Thiazides work by inhibiting sodium and chloride reabsorption.

Meanwhile, loop diuretics work by inhibiting the Na-K-Cl transporter in the loop of Henle so that the reabsorption of these minerals is reduced. Loop diuretic drugs bind very easily to plasma proteins, so these drugs are less filtered in the glomerulus [2,14]. In this case, the loop diuretic agent given to the patient was a furosemide drip of 5 mg/hour.

However, on the 3rd day of treatment, the patient had not improved and still complained of shortness of breath. Then, the patient was given additional diuretic therapy of acetazolamide 1x250 mg. Acetazolamide is a carbonic anhydrase inhibitor that reduces proximal tubular sodium reabsorption and may improve diuretic efficiency when added to loop diuretics, potentially facilitating decongestion. Results from an observational study and a small, prospective, randomized trial suggest that the addition of acetazolamide (at a dose of 500 mg administered intravenously once daily) to intravenous loop-diuretic therapy increased urinary sodium excretion, which is an objective metric of diuretic efficiency in patients with acute decompensated heart failure [15].

In the research of Mullens et al., patients with acute decompensated heart failure showed that acetazolamide, a diuretic agent blocking proximal tubular sodium reabsorption, added to loop-diuretic therapy led to more and faster decongestion and was associated with a shorter duration of hospital stay. The benefit of acetazolamide treatment regarding decongestion was maintained at discharge, with a higher percentage of patients discharged from the hospital without residual congestion (difference vs. placebo, 16.3 percentage points) [15]. The attainment of successful decongestion (euvolemia) has a class I recommendation from the European and American guidelines for diagnosing and treating heart failure [1,16]. In addition, adding acetazolamide to loop-diuretic therapy was not associated with an increased incidence of adverse events, and the higher incidence of successful decongestion was associated with a shorter duration of hospital stay [15].

Conclusion

Typical signs and symptoms of ADHF are signs of peripheral tissue congestion and/or hypoperfusion.

Many factors can cause heart failure, one of which is hormonal factors such as hyperthyroidism. Diuretic agents are among the cornerstones of treatments for HF. Acetazolamide is a carbonic anhydrase inhibitor that may improve diuretic efficiency when added to loop diuretics, potentially facilitating decongestion and shortening hospital stays.

Reference

1. Heidenreich et al. AHA/ACC/HFSA Guideline for managing Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022;145:e895–e1032. doi: 10.1161/CIR.0000000000001063.
2. Hasanah et al. Pedoman Tatalaksana Gagal Jantung. Perhimpunan Dokter Spesialis Kardiovaskuler Indonesia. 2023
3. Pasqualetti G, Niccolai F, Calsolaro V et al. (2017) Relationship between thyroid dysfunction and heart failure in older people. J Clin Gerontol Geriatr 65(3):184–191
4. Jabbar A, Pingitore A, Pearce SH, Zaman A, Iervasi G, Razvi S (2017) Thyroid hormones and cardiovascular disease. Nat Rev Cardiol 14(1):39–55
5. Moneim et al. Relationship of thyroid dysfunction with cardiovascular diseases: updated review on heart failure progression. Hormones;2020. https://doi.org/10.1007/s42000-020-00208-8
6. Verbrugge, F. H., Dupont, M., Steels, P., Grieten, L., Swennen, Q., Tang, W. H. W. and Mullens, W. (2014). The kidney in congestive heart failure: 'are natriuresis, sodium, and diuretics really the good, the bad and the ugly?' *Eur J Heart Fail*, 16: 133-142.
7. ter Maaten, J. M., Valente, M. A., Damman, K., Hillege, H. L., Navis, G. and Voors, A. A. (2015). Diuretic response in acute heart failure: pathophysiology, evaluation, and therapy. *Nat Rev Cardiol*, 12: 184-192.
8. Grodin, J. L. (2016). Pharmacologic approaches to electrolyte abnormalities in heart failure. *Curr Heart Fail Rep*, 13: 181-189.
9. Taha, M. & Elbaih, A. Pathophysiology and management of different types of shock. Narayana Medical Journal Volume-6 | Issue-1 | January-June 2017
10. Khan, R., et al. Thyroid and Cardiovascular Disease: A Focused Review on the Impact of Hyperthyroidism in Heart Failure. Cardiol Res. 2020;11(2):68-75
11. Ojamaa K, Kenessey A, Klein I. Thyroid hormone regulation of phospholamban phosphorylation in the rat heart Endocrinology. 2000;141(6):2139-2144
12. Shenoy R, Klein I, Ojamaa K. Differential regulation of SR calcium transporters by thyroid hormone in rat atria and ventricles. Am J Physiol Heart Circ Physiol. 2001;281(4):H1690-1696.
13. Huang, Y. et al. Comparison of Different Furosemide Regimens in the Treatment of Acute Heart Failure: A Meta-Analysis. Computational and Mathematical Methods in Medicine Volume 2022, Article ID 4627826, 8 pages https://doi.org/10.1155/2022/4627826
14. Nurkhalis dan Adista, JR. Manifestasi Klinis dan Tatalaksana Gagal Jantung. J. Ked. N. Med | VOL. 3 | NO. 3 | September 2020
15. Mullens, W et al. Acetazolamide in Acute Decompensated Heart Failure with Volume Overload. n engl j med 387;13 nejm.org september 29, 2022.
16. McDonagh TA, Metra M, Adamo M, et al. 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J 2021;42:3599-726.