CASE REPORT

Heart failure in dilated cardiomyopathy mimicking asthma triggered by pneumonia

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SUMMARY

Heart failure is a rare cause of wheezing and may develop into a critical condition in children. Few cases report patients with heart failure, secondary to dilated cardiomyopathy, with high fever. A 23-month-old girl visited the emergency department with high fever, cough, first wheezing episode, chest retraction and tachycardia. The chest X-ray revealed consolidation on the left lower lung field; the cardiothoracic ratio was 60%. She was diagnosed with bronchial asthma triggered by pneumonia, which remained unchanged during four visits. Subsequently, she was diagnosed with heart failure in idiopathic dilated cardiomyopathy and discharged without sequelae. During the first wheezing episode in children with abnormal vital signs, heart failure should be considered in the differential diagnosis, and a chest X-ray should be performed. Additionally, when the cardiothoracic ratio is greater than 50%, 12-lead ECG and echocardiography should be performed. Moreover, cognitive bias should be considered in all emergency care unit situations.

BACKGROUND

In children, wheezing is frequently caused by bronchial asthma and bronchiolitis and occasionally by pneumonia.¹ Heart failure is a rare cause of wheezing¹; this often leads physicians to miss or delay the diagnosis.^{2–4} In addition, when wheezing children present with fever, physicians are likely to consider respiratory infection rather than heart failure as to be the cause. However, heart failure may develop into a critical condition, resulting in serious sequelae and high mortality. Herein, we

report a child with wheezing, who was misdiagnosed with bronchial asthma triggered by pneumonia and was later diagnosed with heart failure secondary to dilated cardiomyopathy.

CASE PRESENTATION

The patient was a 23-month-old girl with no medical history, including wheezing, with the exception of dry skin. She had no family history of sudden death or cardiac diseases; however, her mother had cough-variant asthma.

Eight days before admission, she visited the emergency department of our hospital with a 4-day history of cough and rhinorrhoea and new-onset high fever. On arrival, the following measurements were noted: body weight, 9 kg; respiratory rate, 40 breaths per minute; oxygen saturation, 100% on room air; heart rate, 161 beats per minute and axillary temperature, 38.8°C. Physical examination revealed substernal and intercostal retraction, prolonged expiration, diminished breath sounds and expiratory wheezing over bilateral lungs, regular heart rhythm and no hepatomegaly. Blood tests and chest X-ray were performed to determine the cause of the respiratory distress. An upright posterior–anterior chest X-ray revealed consolidation on the left lower lung field, and the cardiothoracic ratio was 60% (figure 1). Laboratory findings were as follows: white cell count, $14.45 \times 10^9/L$; neutrophil, 80.8% and C reactive protein, 2.5 mg/dL. Her respiratory distress and wheezing improved with salbutamol inhalation and intravenous methylprednisolone administration. Therefore, bronchial asthma was assumed to be the cause of wheezing. She was diagnosed with bronchial asthma, triggered by pneumonia, and discharged after the ceftriaxone infusion for bacterial pneumonia.

Seven days before admission, she revisited the emergency department of our hospital for a follow-up evaluation. Her respiratory status, circulatory status and vital signs were stable. Again, she was diagnosed with the same conditions and discharged with a prescription for amoxicillin and montelukast.

Three days before admission, she revisited the emergency department of our hospital with an exacerbated cough and new-onset high fever. Her respiratory status, circulatory status and vital signs were stable, except for her axillary temperature, which was 39.0°C. She was diagnosed with the same conditions. Following salbutamol inhalation, she temporally had tachypnoea and moderate retraction. The symptoms improved within 1 hour;

Figure 1 Chest X-ray during the first visit to the emergency department shows consolidation on the left lower lung field and the cardiothoracic ratio of 60%.

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Figure 2 Chest X-ray during the fourth visit to the emergency department shows consolidation on the left lower lung field and the cardiothoracic ratio of 62%.

therefore, she was discharged. Subsequently, she had low-grade fever.

On the day of admission, she revisited the emergency department of our hospital with sleep disturbance, vomiting because of the exacerbated cough and poor oral intake. The following measurements were obtained: respiratory rate, 46 breaths per minute; oxygen saturation, 98% on room air; heart rate, 154 beats per minute and axillary temperature, 36.9°C. Physical examination revealed no chest retraction, no wheezing and crackle, a palpable radial artery and a capillary refilling time of less than 2 s. The upright posterior–anterior chest X-ray revealed consolidation on the left lower lung field and the cardiothoracic ratio of 62% (figure 2). Laboratory findings were as follows: white cell count, $16.63 \times 10^9/L$; neutrophil, 65.7%; C reactive protein, 8.0 mg/dL; blood urea nitrogen, 8.8 mg/dL; creatinine, 0.18 mg/dL; aspartate aminotransferase, 31 U/L; lactate dehydrogenase, 325 U/L and creatine kinase, 61 U/L. She was admitted because of poor oral intake because of pneumonia. A ward physician suspected cardiac diseases from her first wheezing episode and cardiomegaly. The 12-lead ECG revealed left ventricular hypertrophy and inverted T wave in precordial leads V4–V6 (figure 3), and the echocardiogram performed by the ward physician revealed dilation of the left atrium and left ventricle. A paediatric cardiologist, consulted by the ward physician, noted gallop rhythm and palpated hepatomegaly, and therefore, performed a second echocardiogram, which revealed

Figure 3 ECG shows left ventricular hypertrophy and inverted T wave in precordial leads V4–V6.

Figure 4 Echocardiogram shows dilation of the left atrium and left ventricle and a left ventricular ejection fraction of 35.6%.

a left ventricular ejection fraction of 35.6%, dilation of the left atrium and left ventricle and moderate mitral regurgitation (figure 4). Her brain natriuretic peptide was 2176 pg/mL. She was diagnosed with heart failure and treated with diuretics and milrinone. On the same day, her respiratory failure worsened. She was intubated and treated with a ventilator, vasoactive agent, vasodilator, diuretic and an ACE inhibitor. She was further diagnosed with idiopathic dilated cardiomyopathy.

OUTCOME AND FOLLOW-UP

She was discharged 37 days after admission without sequelae. Her general condition was good with a left ventricular ejection fraction of 50.6% in the 4-month follow-up after discharge.

DISCUSSION

There are two important clinical issues regarding this patient. First, heart failure should be considered in the differential diagnosis of the first wheezing episode in children, even if they present with high fever. When examining children with wheezing, fever can mislead physicians to prematurely limit the differential diagnosis to respiratory infection. Pneumonia and bronchiolitis are common causes of wheezing with fever,¹ and there are few cases reporting patients with heart failure secondary to dilated cardiomyopathy also having high fever. In addition, patients with heart failure from dilated cardiomyopathy without high fever often experience delayed diagnosis and/or misdiagnosis.^{2–4} Since heart failure itself is not the cause of high fever, a patient with wheezing and high fever may be misdiagnosed with pneumonia, bronchiolitis or bronchial asthma triggered by respiratory infection. Our patient showed mild cardiomegaly on the chest X-ray; however, she was misdiagnosed with heart failure during the four visits to the emergency department. Three reasons misleading to premature closure⁵ in the first visit include: (1) the presence of cardiomegaly as well as consolidation in the X-ray, leading to the pneumonia diagnosis, (2) the cardiothoracic ratio can physiologically be greater than 50% in children⁶ and (3) her wheezing and respiratory distress improved with treatment

Learning points

- ▶ Heart failure should be considered in the differential diagnosis of the first wheezing episode in children, even if they present with high fever.
- ▶ A chest X-ray should be performed during the first wheezing episode when children have abnormal vital signs.
- ▶ 12-Lead ECG and echocardiography should be performed when the chest X-ray reveals the cardiothoracic ratio to be >50%.
- ▶ Clinicians should pay attention to cognitive bias in all emergency care unit situations.

for bronchial asthma. During the third visit, the physician had two cognitive biases: anchoring bias and confirmation bias.⁵ The anchoring bias was that she was previously diagnosed with bronchial asthma, and the confirmation bias was not considering heart failure, despite her exacerbation of respiratory status after inhalation of a beta stimulant. Even if patients have previously been diagnosed with a respiratory disease, when respiratory symptoms worsen or do not improve, heart failure should be considered, and an ECG and echocardiogram should be performed.

Second, a chest X-ray should be performed during the first wheezing episode in children with abnormal vital signs. Furthermore, when the chest X-ray reveals the cardiothoracic ratio greater than 50%, 12-lead ECG and echocardiography should be performed. While one report recommended that all children should undergo a chest X-ray during the first wheezing episode,⁷ the *Textbook of Pediatric Emergency Medicine* does not recommend chest X-ray examination for all children.¹ The predictors of abnormal chest X-ray findings in children experiencing their first wheezing episode are as follows: absence of family history of asthma, elevated temperature, the presence of localised wheezing or localised rales,⁸ respiratory rate greater than 60 breaths per minute, heart rate greater than 160 beats per minute, localised decreased breath sounds before treatment and localised wheezing after treatment.⁹ In the present case, high fever and tachycardia warranted the chest X-ray. Although the cardiothoracic ratio can be greater than 50% without cardiac disease in children, cardiomegaly on chest X-rays has a specificity of 92.3% and a positive likelihood ratio of 7.6 for cardiomegaly in echocardiograms.¹⁰ Therefore, 12-lead ECG and echocardiography should be performed to evaluate cardiac diseases. Chest X-rays of patients with dilated cardiomyopathy often reveal

cardiomegaly,^{11–13} and the 12-lead ECG is seldom normal.¹³ Furthermore, echocardiography should be performed in the emergency department when wheezing does not improve after treatment with a bronchodilator.¹⁴ Inter-rater reliability between paediatric emergency physicians and paediatric cardiologists for the detection of left ventricular dysfunction is high.¹⁵ In our case, because the chest X-ray revealed cardiomegaly, we should have performed 12-lead ECG and echocardiography.

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REFERENCES

- 1 Kathy NS, Richard GB. *Textbook of pediatric emergency medicine*. 7th edn. Philadelphia, PA: Wolters Kluwer, 2016.
- 2 Thammasitboon S, Thammasitboon S, Singhal G, et al. Diagnosing diagnostic error. *Curr Probl Pediatr Adolesc Health Care* 2013;43:227–31.
- 3 Sivitz A, Nagdev A. Heart failure secondary to dilated cardiomyopathy: a role for emergency physician bedside ultrasonography. *Pediatr Emerg Care* 2012;28:163–6.
- 4 Singhi SC, Mathew JL, Kumar RM, et al. Clinical pearls in pediatric cardiology. *Indian J Pediatr* 2011;78:1273–80.
- 5 Croskerry P. Achieving quality in clinical decision making: cognitive strategies and detection of bias. *Acad Emerg Med* 2002;9:1184–204.
- 6 Robert MK, Bonita FS, Joseph WSG, et al. *Nelson textbook of pediatrics*. 20th edn. Amsterdam, the Netherlands: Elsevier, 2016.
- 7 Walsh-Kelly CM, Kim MK, Hennes HM. Chest radiography in the initial episode of bronchospasm in children: can clinical variables predict pathologic findings? *Ann Emerg Med* 1996;28:391–5.
- 8 Roback MG, Dreitlein DA. Chest radiograph in the evaluation of first time wheezing episodes: review of current clinical practice and efficacy. *Pediatr Emerg Care* 1998;14:181–4.
- 9 Gershel JC, Goldman HS, Stein RE, et al. The usefulness of chest radiographs in first asthma attacks. *N Engl J Med* 1983;309:336–9.
- 10 Satou GM, Lacro RV, Chung T, et al. Heart size on chest x-ray as a predictor of cardiac enlargement by echocardiography in children. *Pediatr Cardiol* 2001;22:218–22.
- 11 Jefferies JL, Towbin JA. Dilated cardiomyopathy. *Lancet* 2010;375:752–62.
- 12 Myung KP. *Park's pediatric cardiology for practitioners*. 6th edn. Philadelphia PA: Saunders, an imprint of Elsevier Inc, 2014.
- 13 Dec GW, Fuster V. Idiopathic dilated cardiomyopathy. *N Engl J Med* 1994;331:1564–75.
- 14 Pershad J, Chin T. Early detection of cardiac disease masquerading as acute bronchospasm: The role of bedside limited echocardiography by the emergency physician. *Pediatr Emerg Care* 2003;19:e1–e3.
- 15 Longjohn M, Wan J, Joshi V, et al. Point-of-care echocardiography by pediatric emergency physicians. *Pediatr Emerg Care* 2011;27:693–6.

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