

O. Lesieur
R. Lorillard
H. Ha Thi
P. Duffeant
L. Ledain

Unilateral pulmonary oedema complicating mitral regurgitation: diagnosis and demonstration by transoesophageal echocardiography

Received: 31 May 1999
Final revision received: 28 September 1999
Accepted: 20 January 2000

O. Lesieur (✉) · R. Lorillard · H. Ha Thi ·
P. Duffeant · L. Ledain
Réanimation Polyvalente, CH Saint-Louis,
F-17019 La Rochelle, France
e-mail: olivier.lesieur@wanadoo.fr
Fax: + 33-5-46 45 52 85

Abstract One aetiology of unilateral pulmonary oedema is mitral valve disease. We report three cases of right pulmonary oedema caused by acute mitral regurgitation. These reports underline the diagnostic value of transoesophageal echocardiography, which rapidly visualised severe mitral regurgitation with retrograde jet directed toward the right pulmonary veins. Two patients underwent prompt cardiac surgery.

Key words Unilateral pulmonary oedema · Mitral valve regurgitation · Heart failure · Transoesophageal echocardiography

Introduction

Differential diagnosis of unilateral pulmonary opacity includes infection, neoplasm, lung infarction, atelectasis, aspiration, bronchial obstruction and cardiac failure. Unilateral pulmonary oedema is a rare and often misdiagnosed cause of focal lung disease. It may be due to a left-to-right intracardiac shunt, gravitational or re-expansion pulmonary oedema, obstruction to pulmonary venous drainage or mitral valve disease. We report three cases of respiratory failure with right pulmonary oedema due to acute mitral insufficiency. In our reports, multi-plane transoesophageal echocardiography provided diagnostic information and direct visualisation of the mechanism of oedema formation.

Case reports

Case 1

Awaking from sleep with respiratory distress, a healthy 72-year-old man was brought to the emergency room and required intubation. He had a history of mitral valve prolapse with grade 1/4 regurgitation documented by echocardiography in 1987. Physical examination revealed rales on the right lung and a grade 3/6 systolic mur-

mur radiating to the axilla. Blood pressure was 230/120 mmHg. Tracheal suction yielded a clear and frothy fluid. Initial chest radiograph showed an interstitial infiltrate located only in the right lung without cardiac silhouette enlargement (Fig. 1). Electrocardiogram showed sinus tachycardia and left atrial enlargement. His temperature was 37°C. Leukocyte count and C reactive protein (CRP) levels were not elevated. Bronchoscopy showed no extrinsic compression or endobronchial abnormalities. The patient was given diuretics and vasodilators. The ventilator was set in pressure support ventilation. The right-sided infiltrate resolved in 24 h.

On the second day, transthoracic echocardiography revealed a flail posterior leaflet of the mitral valve with grade 3/4 regurgitation and dilatation of the left atrium. Transoesophageal echocardiography by colour Doppler demonstrated a high-velocity regurgitant jet directed at the right pulmonary veins. Pulse wave Doppler confirmed reversal of pulmonary venous flow in the right pulmonary veins. Swan-Ganz catheterisation was performed. Pulmonary capillary wedge pressure (PCWP) measured from the left pulmonary artery showed a mean pressure of 35 mmHg with a back pressure V wave of 45 mmHg. PCWP measured from the right pulmonary artery showed a mean pressure of 35 mmHg with a V wave of 73 mmHg (Fig. 2). Coronary angiography was normal. Left ventriculography confirmed severe mitral regurgitation.

On the third day, the patient underwent surgical replacement of the disrupted valve. Surgery revealed thickening of the mitral valve with areas of fibrosis and rupture of chordae tendinae of both the posterior and anterior leaflets. A prosthetic valve was placed. The postoperative course was uneventful.



Fig. 1 Antero-posterior chest radiograph performed on the day of admission revealing the presence of right-sided pulmonary oedema in case 1

Case 2

A healthy 75-year-old woman had a grade 2/4 mitral regurgitation, known for 2 years. She presented with acute dyspnoea and required intubation. Auscultation revealed rales over the right lung and a loud systolic murmur that radiated to the left axilla. Expectoration was pink and frothy. Her blood pressure was 130/80 mmHg, pulse rate 130 beats/min and temperature 38.2°C. There were no Janeway lesions or Roth spots. Chest radiograph showed a right-sided pulmonary infiltrate. Electrocardiogram revealed sinus tachycardia, left axis deviation and left atrial enlargement. The white blood count was 17,000/mm³ and CRP was 56 mg/l. Sputum gram

stain showed no micro-organisms. Several blood cultures were sampled. Transthoracic echocardiography performed in the emergency room revealed a myxomatous mitral valve with a flail posterior leaflet and grade 4/4 regurgitation. Admitted to the ICU, the patient received parenteral furosemide, nitroglycerine and antibiotics.

Transoesophageal echocardiography and left ventriculography demonstrated a regurgitant jet targeted towards the right pulmonary veins and systolic reversal of flow (pulse wave Doppler) in the right inferior pulmonary vein. Coronary angiography was normal. Right heart catheterisation showed a mean left pulmonary artery pressure of 26 mmHg and a mean right pulmonary artery pressure of 36 mmHg. The mean PCWP on both sides was 18 mmHg with a V wave of 35 mmHg present only in the right lung.

The patient underwent surgical repair of the disrupted valve 24 h after hospital admission. Preoperative blood cultures were all negative. A chest radiograph performed 4 days following surgery showed complete resolution of the right lung opacity.

Case 3

A 90-year-old man was admitted to the emergency room with cough, shortness of breath and abundant clear expectoration. His medical history was significant for mitral insufficiency, coronary artery disease and atrial fibrillation. His blood pressure was 200/110 mmHg. Despite depletive therapy (furosemide, nitroglycerine), cardiac arrest occurred in the coronary care unit. The patient was resuscitated with intubation, ventilation with an inspired concentration of 100% oxygen, intravenous epinephrine and external chest compressions.

On ICU admission, examination revealed rales on the right lung and a systolic murmur radiating to the axilla. His temperature was 37°C. CRP and leukocyte count were not increased. Vital signs were good but the patient was unresponsive to stimulation (Glasgow coma score 3 points). Chest radiograph showed an interstitial infiltrate in the right upper lobe. Transthoracic echocardiography revealed systolic posterior buckling of the mitral valve with

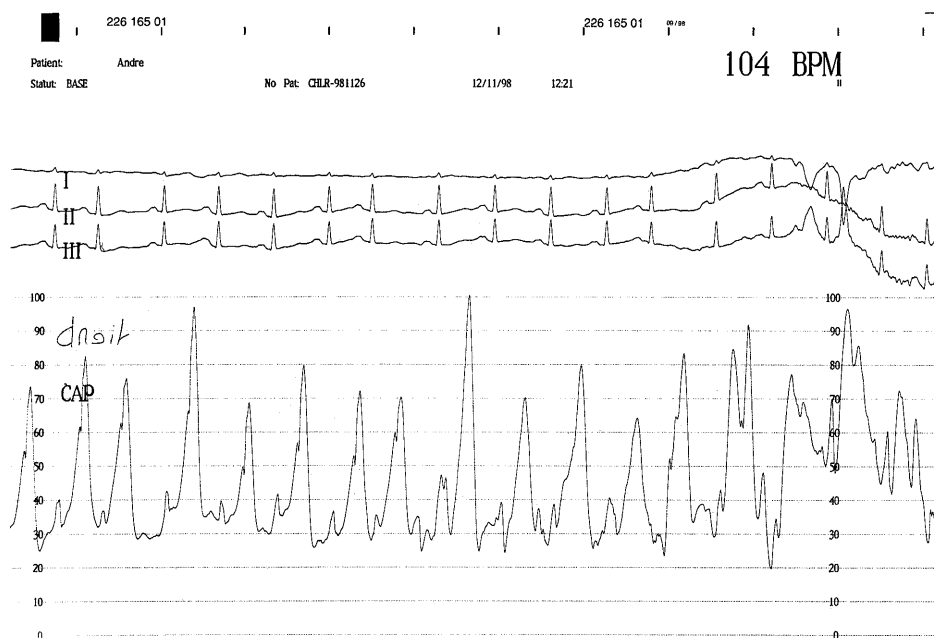


Fig. 2 Catheterisation of the left pulmonary artery in case 1 demonstrating a mean capillary wedge pressure of 35 mmHg with a back pressure V wave of 73 mmHg (CAP capillary wedge pressure)

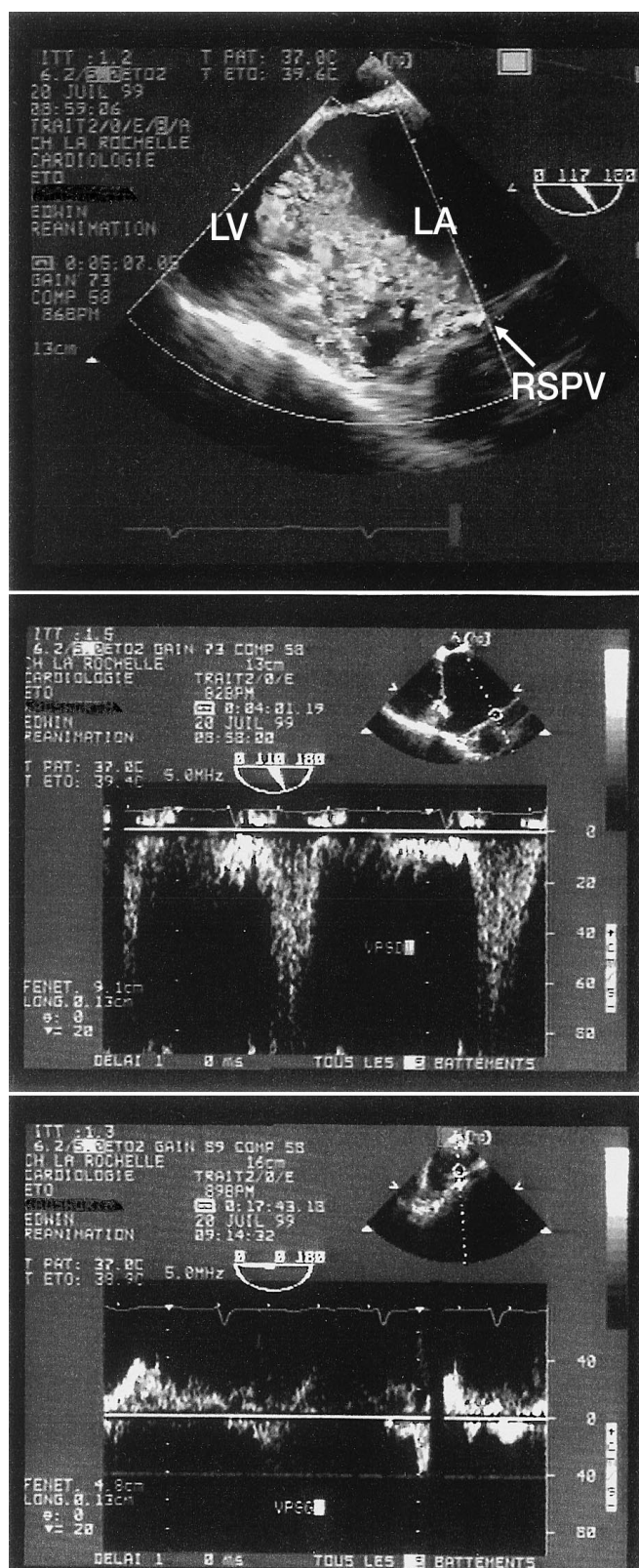


Fig.3 Transgastric incidence by colour Doppler (*upper portion of the panel*) in case 3 showing the regurgitant jet directed to the RSPV. *Middle portion*: pulsed Doppler demonstrating the systolic reversal of flow in the RSPV. *Lower portion*: normal flow (transoesophageal incidence) in the LSPV (LA left atrium, LV left ventricle, RSPV right superior pulmonary vein, LSPV left superior pulmonary vein)

grade 3/4 regurgitation, suggestive of disruption of the leaflet. Transoesophageal echocardiography documented a retrograde jet directed towards the right pulmonary veins and the systolic reversal of flow in the right superior pulmonary vein (Fig.3). The patient remained in a deep coma and unresponsive to pain 7 days after resuscitation. All medications were stopped.

Discussion

A retrograde blood flow directed to the posterior left atrial wall (the position of the pulmonary veins) is a frequent echographic finding in severe mitral regurgitation. The vector of retrograde blood flow across an incompetent mitral valve may be selectively directed towards the right pulmonary venous system [1]. The mechanism of unilateral right-sided pulmonary oedema is related to the reversal of flow in the right pulmonary veins during ventricular systole. As the regurgitant jet targets the right superior pulmonary vein, oedema localises preferentially in the right upper lobe. To our knowledge, 15 cases of this rare condition have been reported in 30 years (Table 1). Eleven of the 15 had pulmonary infiltrate predominantly located in the right upper lobe. In the majority of these reports, the problem was initially misdiagnosed as a more common cause of focal lung disease, including pneumonia, aspiration, pulmonary embolism and neoplasm. The cardiac origin of the unilateral pulmonary opacity was finally supported by cardiac catheterisation [2, 3, 4, 5, 6], transthoracic echocardiography [4, 7, 8] or autopsy findings [4].

More recently, transoesophageal echocardiography has proved useful in determining the mechanism of oedema formation [9, 10, 11]. Roach et al. visualised reversal of flow in both the pulmonary veins by pulse wave Doppler [9]. They detected differential gradients between the right and left pulmonary venous systems, indicating a much higher hydrostatic pressure in the right pulmonary veins. Colour Doppler confirmed that the regurgitant jet was directed towards the right pulmonary veins. Dexter et al. positioned the pulsed wave Doppler in both the superior and inferior right pulmonary veins and visualised the systolic flow from mitral regurgitation into the right superior pulmonary vein [10]. Rice et al. reported an unusual case of left upper lobe oedema secondary to mitral regurgitation, underlining the diagnostic value of transoesophageal echocardiography [11].

Table 1 Right-sided pulmonary oedema associated with mitral regurgitation. Case reports

Author/year	Case	Clinical circumstance/ distribution of oedema	Evaluation	Outcome
Bahl 1971	1	Myocardial infarction/ right upper lobe	– Cardiac catheterization	Surgical replacement
Gamsu 1981	1	Myocardial infarction/ right upper lobe	– Catheter in the right upper lobe pulmonary artery	Medical therapy
Kusumi 1984	1	Left ventricular failure/ right lung	– Cardiac catheterization	Surgical replacement
Keren 1986	1	Myocardial infarction/ right lung	– Cardiac catheterization	Death
Gurney 1989	n° 1	Left ventricular failure/ right upper lobe	– Transthoracic echocardiography	Death
	n° 2	Left ventricular failure/ right upper lobe	– Transthoracic echocardiography	Medical therapy
	n° 3	Myocardial infarction/ right upper lobe	– Transthoracic echocardiography	Surgical replacement
			– differential right- and left-sided catheterization of pulmonary arteries	
	n° 4	Left ventricular failure/ right upper lobe	– Cardiac catheterization	Death
Roach 1993	1	Left ventricular failure/ right upper lobe	– transthoracic echocardiography	Medical therapy
			– Cardiac catheterization	
			– transthoracic echocardiography	
			– transesophageal echocardiography	
Goerre 1994	n° 1	Dyspnea and orthopnea/ right upper lobe	– Transthoracic echocardiography	Medical therapy
	n° 2	Cough and dyspnea/ right upper lobe	– Transthoracic echocardiography	Medical therapy
Alarcon 1995	n° 1	Cough and dyspnea/ right upper lobe	– Transthoracic echocardiography	Medical therapy
	n° 2 & 3	Cough and dyspnea right upper & middle lobe	– Transthoracic echocardiography	Medical therapy
Dexter 1997	1	Cough and hemoptysis/ right upper lobe	– Cardiac catheterization	Surgical replacement
			– transesophageal echocardiography	

In our patients, case 1 had no fever and expectorated frothy fluid. On initial chest radiograph, the familiar “butterfly” pattern was missing its left wing. Nevertheless, the right-sided opacity resolved in 24 h with depleitive therapy. Transthoracic echocardiography confirmed the suspected cardiac origin of the respiratory distress. Transoesophageal echocardiography provided direct visualisation of the retrograde flow targeted at the right pulmonary veins. Cardiac catheterisation of the right and left pulmonary arteries demonstrated that the back pressure V waves were larger in the right lung (73 mmHg) compared with those in the left lung

(45 mmHg). The patient underwent valve replacement on the third day after admission. Knowledge of the pathophysiological mechanisms associated with mitral regurgitation, previous reports and case 1 alerted us and facilitated the diagnosis and management of unilateral pulmonary oedema in case 2. Promptly evaluated, our second patient underwent cardiac surgery very quickly, as compared with case one. In case 3, old age and post-ischaemic brain damage advised against surgical repair of the disrupted valve.

Our three cases were encountered in an 8-month period, suggesting that this condition may be more com-

mon than previously estimated. Schnyder et al. retrospectively reviewed the chest radiographs of 131 patients with severe mitral regurgitation [12]. Radiograph signs of oedema were present in 117. In 12 of 117 oedemas, pulmonary infiltrate involved predominantly the right upper lobe.

Acute mitral regurgitation should be suspected whenever focal pulmonary infiltrate develops in a patient with known or suspected mitral valve disease.

Transthoracic echocardiography performed without delay may confirm the cardiac origin of respiratory distress. Transoesophageal echocardiography provides morphological analysis of the disrupted valve and helps physicians in understanding the unilateral distribution of pulmonary oedema. Cardiac catheterisation remains essential to demonstrate the asymmetrically elevated capillary wedge pressure.

References

1. Miyatake K, Nimura Y, Sakakibara H, et al. (1982) Localisation and direction of mitral regurgitant flow in mitral orifice studied with combined use of ultrasonic pulsed Doppler technique and two dimensional echocardiography. *Br Heart J* 48: 449–458
2. Bahl OP, Oliver GC, Rockoff SD, Parker BM (1971) Localised unilateral pulmonary oedema: an unusual presentation of left ventricular failure. *Chest* 60: 277–280
3. Gamsu G, Peters DR, Hess D, et al. (1981) Isolated right upper lobe pulmonary oedema. *West J Med* 135: 151–154
4. Gurney JW, Goodman LR (1989) Pulmonary oedema localised to the right upper lobe accompanying mitral regurgitation. *Radiology* 171: 397–399
5. Keren A, Tzivoni D, Gottlieb S, Benhorin J, Stern S (1986) Unilateral pulmonary oedema complicating acute myocardial infarction. *Am J Cardiol* 57: 182–183
6. Kusumi RK, Walker SS, Fulkerson PK, Henthorn RW, Fass KJ (1984) Unilateral pulmonary oedema associated with left ventricular failure. *Heart Lung* 13: 263–266
7. Goerre S, Kuhn M, Ratti R, Dubach P, Reinhart WH (1994) Localised pulmonary oedema in the right upper lobe. An important differential diagnostic hint for acute mitral insufficiency. *Schweiz Rundsch Med Prax* 83: 1207–1210
8. Alarcon JJ, Guembe P, De Miguel E, Gordillo I, Abellas A (1995) Localized right upper lobe edema. *Chest* 107: 274–276
9. Roach JM, Stajduhar KC, Torrington KG (1993) Right upper lobe pulmonary oedema caused by acute mitral regurgitation. Diagnosis by transoesophageal echocardiography. *Chest* 103: 1286–1288
10. Dexter EU, Snider JM, Gordon EEI, Richenbacher WE (1997) Lobar pulmonary oedema due to mitral regurgitation : diagnosis by echocardiography. *J Card Surg* 12: 412–415
11. Rice J, Roth SL, Rossoff LJ (1998) An unusual case of left upper lobe pulmonary edema. *Chest* 114: 328–330
12. Schnyder PA, Sarraj AM, Duvoisin BE, Kapenberger L (1993) Pulmonary edema associated with mitral regurgitation: prevalence of predominant involvement of the right upper lobe. *AJR Am J Roentgenol* 161: 33–36