Case Report

ARDS with Concomitant Pneumomediastinum-Pneumothorax Presenting as Platypnoea-Orthodeoxia Syndrome

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Abstract

Platypnoea-orthodeoxia syndrome (POS) is a rare clinical entity with very few cases reported worldwide. We report a case of a 27-year-old male with a seven-day history of fever, dry cough, and breathlessness; later on, diagnosed to have H1N1 (Swine flu) and acute respiratory distress syndrome. He was put on mechanical ventilation and weaned off in due course. However, he had persistent dyspnoea and desaturation in sitting position that relieved on lying down (platypnoea/orthodeoxia). He was again mechanically ventilated. High resolution computed tomography of chest revealed tension pneumomediastinum and pneumothorax. Computed tomography-guided pigtail drainage of mediastinal air and bilateral intercostal drainage tubes were performed. His symptoms improved immediately. He had no underlying demonstrable cardiac disease. The diagnosis of POS was made due to a high index of clinical suspicion and helped in establishing POS as a presentation of concomitant pneumomediastinum-pneumothorax in this patient. *To the best of our knowledge*, acute respiratory distress syndrome complicated by concomitant pneumomediastinum-pneumothorax as an extra-cardiac cause of POS has not been reported. **[Indian J Chest Dis Allied Sci 2021;63:37-40]**

Key words: Acute respiratory distress syndrome; H1N1; Orthodeoxia-platypnoea; Pneumothorax; Pneumomediastinum

Introduction

Platypnoea (dyspnoea on assumption of an erect posture and relieved by lying down in recumbent posture) and orthodeoxia (worsening of oxygenation in association with platypnoea) is a rare clinical entity. A decrease in oxygenation of PaO_2 >4mmHg on arterial blood gas and/or decrease of oxygen saturation (SpO_2) >5% with pulse oximeter from supine to upright position is called platypnoea-orthodeoxia syndrome (POS). Though the first case of POS was reported by Burchell *et al*, the term platypnoea and orthodeoxia were coined by Altman *et al* and Robin *et al* in patients of hepatic and pulmonary diseases.[1-3] Since then pathophysiology of POS has bewildered clinicians for decades and the precise mechanism remains still elusive. However, underlying cardiac anomaly (intra-cardiac shunting) like atrial septal defect (ASD), patent foramen ovale (PFO), atrial septal aneurysm with extrinsic triggering factors enhancing ventilation-perfusion mismatch leading to worsening of symptoms were more common than an isolated pulmonary (extra-cardiac shunting) cause.[4]

Among extra-cardiac causes, the most common cause is a hepato-pulmonary syndrome where acquired pulmonary arteriovenous fistulae allow requisite right-to-left shunting that is accentuated in the upright position.[5] The reason why shunting is exacerbated in the upright position is unclear. Other reported causes of intra-pulmonary shunting leading to POS include Osler-Weber-Rendu disease and severe cases of parenchymal lung diseases, like emphysema, interstitial lung disease.[6,7] Acute respiratory distress syndrome (ARDS) has been known to cause POS in patients with right-to-left inter-atrial shunt; but not without underlying cardiac anomaly.[8]

We report a rare case of a young patient who developed ARDS following H1N1 infection and had POS secondary to concomitant pneumomediastinum-pneumothorax without any cardiac shunting.

Case Report

A 27-year-old male, a student from Uttar Pradesh (India), with no comorbidities or addictions in the past, presented with a seven-day history of fever, cough, and breathlessness. Fever was high grade, accompanied by intermittent headache, myalgias and retro-orbital pain. He had a non productive cough with irritation in the throat. He complained of progressively increasing breathlessness, which was not associated with paroxysmal nocturnal dyspnoea, orthopnoea, chest tightness, or wheezing. Previously he was diagnosed with lower respiratory tract infection in

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another hospital and started on injectable amoxicillin clavulanate and other supportive treatment before reporting to us. He did not respond to the initial treatment. H1N1 was suspected and the patient was referred to our hospital for further management.

On examination, he was conscious, oriented but toxic looking, febrile, tachypnoeic (RR [respiration rate]-32/minute) with use of accessory muscles of respiration. He was desaturating at room air with SpO_2 of 74%. On chest auscultation, he had decreased air entry at bilateral bases and diffuse crackles all over the thorax. Other systemic examination was unremarkable.

The patient was provisionally diagnosed as having viral pneumonia, probably due to H1N1 (due to ongoing outbreak). ARDS was confirmed with arterial blood gas analysis (ABG, PaO_2/FiO_2 - 160) and chest radiograph findings of bilateral infiltrates (Figure 1A). Haemogram showed white blood cells of 2500/mm^3 (neutrophil 76%, lymphocyte 16%, and monocyte 6%) with a platelet count of 1.2 lakh/ mm^3. Liver and kidney function tests were normal. Reverse transcription polymerase chain reaction (RT-PCR) for H1N1 came out to be positive (H1N1 pandemic 2009 strain).

Treatment started with oxygen, oseltamivir (75mg twice a day) and continuous positive airway pressure (CPAP) support. The first two-days were uneventful; but on day 3, he developed increased respiratory distress and was intubated. Transthoracic 2D-echocardiography was normal. Methylprednisolone was started at 1.5 mg/kg/day. On day 5 of intubation, the patient had recording of elevated blood pressure despite complete synchrony with the ventilator. He was treated with nitroglycerine infusion. He also had hypokalemia which was corrected by potassium infusion. Evaluation for young hypertensive with hypokalemia was done; but came to be normal and later hypertension resolved spontaneously. The cause of transient hypertension was not known; but was assumed to be transient autonomic dysfunction.

On day 6 of intubation, ventilator-associated pneumonia was suspected due to high-grade fever and high procalcitonin levels of 7.17 ng/mL (normal range, 0.023-0.028 ng/mL). He was started on empirical antibiotics and later changed according to endotracheal culture sensitivity reports. The patient symptomatically improved and was extubated. However, next day; he developed pain on the left side of the chest and auscultation revealed decreased breath sounds. Chest radiograph revealed a left-sided pneumothorax (Figure 1B). He was started on high flow oxygen with non-invasive ventilation and intercostal drainage (ICD) tube was inserted. The patient improved symptomatically.

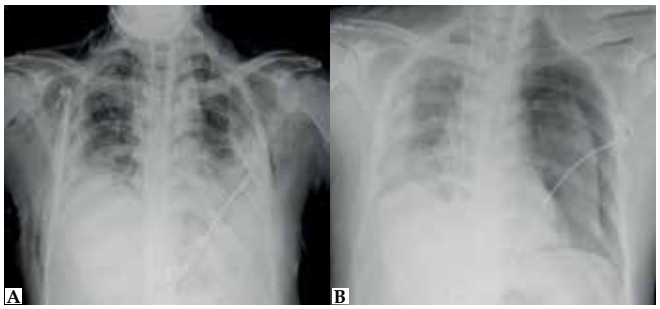

Figure 1. Chest radiograph (postero-anterior view) showing (A) bilateral basal infiltrates and (B) left sided pneumothorax, with collapsed underlying lung border.

On day 18 of hospitalisation, he developed severe breathlessness with platypnoea and orthodeoxia confirmed with arterial blood gas analysis in the supine and upright position (Table). Transthoracic 2D-echocardiography was repeated and intra-cardiac shunting was excluded. Since he was unable to perform Valsalva maneuver and non-availability of transcranial Doppler with agitated saline in our institution, he was provisionally diagnosed to have platypnoea-orthodeoxia syndrome.

Table. Arterial blood gas analysis of the patient in sitting and upright position

ABG Parameters	Supine Position	Upright Position	Upright Position (Post Pigtail and ICD Insertion)
FiO_2	0.60 on CPAP 6 cm H_2O	0.35 on CPAP 6 cm H_2O	0.28 (@2L/min)
pH	7.41	7.37	7.43
PaO_2	75	56	69
SpO_2	95	88	94
$PaCO_2$	37	35	37
HCO_{3-}	23	23	25

Definition of abbreviations: ABG=Arterial blood gas, ICD=Intercostal drainage, FiO_2=Fraction of inspired oxygen, CPAP=Continuous positive airway pressure, PaO_2=Partial pressure of arterial oxygen, SpO_2=Arterial oxygen saturation, $PaCO_2$=Partial pressure of arterial carbon dioxide, HCO_3= bicarbonate

Computed tomography (CT) of the chest revealed surgical emphysema, pneumomediastinum, and bilateral pneumothorax (Figure 2A). CT-guided pigtail catheter for pneumomediastinum, right-sided ICD insertion and repositioning of left ICD were performed. He improved significantly. Repeat CT suggested complete improvement of pneumomediastinum and right-sided pneumothorax and resolution of the subcutaneous emphysema (Figure 2B and 2C). The

pigtail catheter was clamped and removed the next day. Right side ICD was also removed on the third day of insertion. However, the patient developed a left broncho-pleural fistula (BPF). The patient's oxygen requirement reduced and was shifted to nasal prongs at 4 L/hr. The patient was discharged on home oxygen therapy with left-sided ICD *in situ* due to BPF. After two weeks of follow-up, he improved clinically with minimal oxygen requirement at 1 L/hr during activities and maintaining >90% saturation at room air during rest. After one month of discharge, he did not require any supplemental oxygen. CT chest was repeated after three months of discharge showed complete resolution of the pneumothorax and the pneumomediastinum (Figure 2D). Clinically, the patient was asymptomatic with normal physical activity.

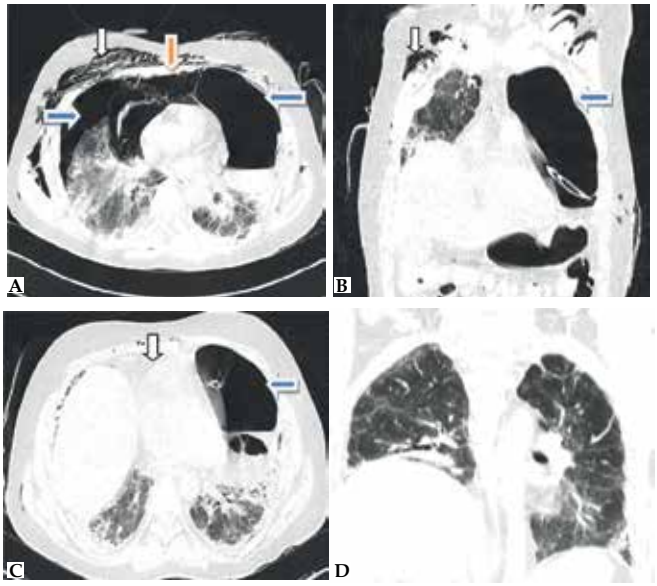

Figure 2. Computed tomography of the chest with lungs window: (A) axial image of day-18 hospitalisation showing subcutaneous emphysema (white arrow), bilateral pneumothorax (blue arrows), and pneumomediastinum (yellow arrow); (B) coronal and (C) axial images after 72 hours of pigtail and intercostals drainage insertions showing significant improvements with the persistence of the left side pneumothorax (blue arrow) and minimal emphysema (white arrow); (D) coronal image showing resolution of air pockets with remnant fibrotic bands at three months of follow-up.

Discussion

In our case, the patient developed acute respiratory distress syndrome following H1N1 infection, complicated with concomitant tension pneumomediastinum-pneumothorax that led to POS without any demonstrable cardiac shunting. POS is a rare clinical entity characterised by dyspnoea and arterial desaturation in the upright posture and relieved in supine posture.

Aetiologically, POS are of three types: intra-cardiac, extra-cardiac, and combined cardiac-pulmonary syndrome.[9] The intra-cardiac type occurs usually in the setting of a right-to-left cardiac defects; while the most common site for the extra-cardiac shunt is the lung. The pulmonary shunt can be anatomic (*e.g.*, pulmonary arteriovenous malformation, hepato-pulmonary syndrome) or physiologic (*e.g.*, parenchymal lung diseases). Anatomic type causes increased blood flow in the dependent part due to gravity in the upright posture leading to shunting of blood with worsening of the hypoxemia and dyspnoea.[10,11]

Parenchymal lung diseases with preferential involvement of lung bases can occasionally present as POS, through severe ventilation/perfusion (V/Q) mismatch. ARDS similarly can present as POS.[12] Due to the development of numerous pneumatocoeles secondary to necrotising pneumonia in these types of patients, V/Q mismatch is seen. Also, in the upright posture, the right ventricular preload is reduced causing decreased output to pulmonary arteries. This causes alveolar pressure to exceed pulmonary arterial and venous pressures at the lung apex resulting in dead space (zone I phenomenon).[2] In our patient due to such physiological shunting in the upright posture, there was increased dead space (ventilated; but under-perfused) segments of basal lungs causing tachypnoea. The tachypnoea would further augment the air trapping, further augmenting the alveolar pressure and leads to a vicious circle of POS. These chains of events reversed in the supine posture when pulmonary arterial perfusion pressure increased in zone I of the lungs causing decreased dead space, decreased respiratory rate, and greater time for gas mixing in the lung with a more uniform distribution.[13]

The third type of POS is seen in lung resection where multiple mechanisms act, such as reduction of pulmonary vascular bed area, chronic hypoxaemia leading to an increase in pulmonary vascular resistance and reduction in the right ventricular compliance, and post-pneumonectomy fluid overload in operated hemithorax leading to increased right ventricular afterload.[14]

Pneumomediastinum and pneumothorax can occur as rare complications of ARDS leading to increased pulmonary vascular resistance and right ventricular afterload, and reduction in right ventricular compliance.[15] These haemodynamic changes may lead to right-to-left inter-atrial shunt due to the increase in the right atrial pressure resulting in transient pressure gradient. In our patient, the trilogy of pneumomediastinum, pneumothorax, and ARDS could have contributed POS.

Platypnoea-orthodeoxia syndrome is a diagnostic challenge since few cases have been reported in the medical literature. The diagnosis involves a multi-disciplinary approach involving clinical suspicion along with demonstration of right-to-left shunt by any one of four modalities: transoesophageal echocardiogram with bubble study, technetium-99m-labeled macro-aggregated albumin scan, pulmonary arteriography or right heart catheterisation.[16] However, in a resource-limited setting as in our country, diagnosis involves a high index of suspicion supported with ancillary available investigations. The sensitivity and specificity for TTE for the diagnosing PFO are 88% and 98%, respectively. The positive likelihood ratio is 45.3 and the negative likelihood ratio is 0.12.[17] Our case was diagnosed on the basis of concomitant clinical findings and other ancillary investigations confirming the clinical suspicion of POS. Treatment of POS is aimed at the treatment of the primary cause, which in most cases leads to resolution of the symptoms as evidenced from our case.

In conclusion, platypnoea-orthodeoxia syndrome is mainly a clinical diagnosis, should be suspected in cases of unexplained dyspnoea. Not all cases of ARDS develop POS. However, ARDS complicated by other structural or functional abnormalities like the presence of either pneumothorax, pneumomediastinum, or both should be evaluated as an extra-cardiac cause of POS. POS may be a factor for difficult weaning in ARDS patients. The early intervention after review of the possible aetiopathogenesis of POS results in resolution of symptoms, and thus, confirming the diagnosis

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