Patent foramen ovale presenting with platypnoea-orthodeoxia syndrome and stroke after multi-organ resection

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SUMMARY
Platypnoea-orthodeoxia syndrome (POS) is defined by oxygen desaturation and dyspnoea in upright position that improves by lying down. It results from a right to left shunt at the intracardiac or intrapulmonary level. A 53-year-old ovarian cancer patient presented with POS that was refractory to oxygen therapy. The symptoms began after an extensive abdominal and pelvic surgery as treatment of her cancer with a complex hospital course. A patent foramen ovale was found with the use of transoesophageal echocardiography. A percutaneous closure was done with positive outcome and dyspnoea disappearance. In this case with its challenging clinical setting, we present a unique clinical scenario of an immediate postoperative POS syndrome. We address the different therapeutic modalities and the need for a multidisciplinary medical approach.

BACKGROUND
Platypnoea refers to a worsening of dyspnoea that occurs in the upright position and improves with recumbency and orthodeoxia refers to arterial oxygen tension drop by more than 5% or 4 mm Hg in the upright position. This could be attributed to intracardiac shunts related to congenital anatomical defects such as patent foramen ovale (PFO), atrial septal defect (ASD) or atrial septal aneurysm with septal fenestrations, with or without elevated right–left gradient. These heart defects are usually accompanied by thoracic or abdominal structural abnormalities in patients presenting with platypnoea-orthodeoxia syndrome (POS). POS could also be caused by pulmonary pathologies where there is ventilation/perfusion mismatch or pulmonary arteriovenous shunting.

POS is considered a rare condition and its true prevalence in the population is not known. Clinically, silent PFO is a term described in the literature for uncomplicated PFO. In a minority of cases, the structural defect is discovered after cerebral ischaemic events.

We present an unusual mechanism of POS mediated by PFO and presented immediately after extensive surgical operation where many abdominal and pelvic organs were removed.

CASE PRESENTATION
A 53-year-old woman known to have operated ovarian cancer with right salpingo-ovariectomy and adjuvant chemotherapy 1 year ago, history of deep vein thrombosis (DVT) on long-term anticoagulation and iron deficiency anaemia. She was hospitalised for a scheduled laparotomy for the treatment of her cancer where she underwent extensive abdominal and pelvic organ resections that included peritomy, splenectomy, hysterectomy, left annexectomy, appendectomy, colectomy, infracolic omentectomy and diaphragm scraping. In the immediate postoperative phase, she presented with abrupt aphasia. On physical examination,
blood pressure was 100/60 mm Hg, heart rate 108 bpm, cardio-
pulmonary auscultation within normal limits, no heart failure
signs, aphasic patient, oxygen saturation 98% on 12 L oxygen
mask on lying position. ECG found normal sinus tachycardia
with no conduction or ischaemic changes. Sodium 137 mmol/L,
potassium 3.8 mmol/L, creatinine 46 µmol/L, glomerular filtra-
tion rate 109 mL/min and haemoglobin 107 g/L.

**INVESTIGATIONS**

Brain CT found left middle cerebral artery territory stroke
(figure 1). The work up showed PFO on transoesophageal echocar-
diography (figure 2), while there were no relevant findings
with transthoracic echocardiography (TTE).

DVT was found on Doppler ultrasound of lower limbs for
which an inferior vena cava filter was implanted due to emboli-
sation of DVT despite therapeutic anticoagulation (figure 3). The
hospital stay was characterised by a refractory hypoxia in the
setting or standing position which did not respond to optiflow or
non-invasive mechanical ventilation, and it disappears on lying
position. The patient was diagnosed with POS syndrome. She
was then transferred to our cardiology department. Afterwards,
heart catheterisation revealed normal right atrial pressure (mean:
6 mm Hg), normal right ventricular pressure (23/8 mm Hg),
normal mean pulmonary capillary wedge pressure (10 mm Hg)
and left atrial pressure (5 mm Hg). Cardiac output was 6.3 L/min
and cardiac index was 3.4 L/min by estimated Fick measurement.
Oximetry showed no significant increase in oxygen saturation in
right-heart chambers.

**DIFFERENTIAL DIAGNOSIS**

High index of suspicion is required to bring it up to deferential
diagnosis. The evaluation needs to correlate between dyspnoea
and upright posture. Patients can present with POS without
underlying cardiac causes. However, similar right-to-left commu-
nication can be found in the form of pulmonary arteriovenous
malformation or severe ventilation perfusion mismatching.6 This
association is also observed in cases of chronic liver disease in
the presence of hepatopulmonary syndrome where worsening
of oxygen desaturation is observed on standing position.7 In our
case, the aetiology of POS was a right-to-left shunt at the cardiac
level with no associated extra-cardiac causes.

**TREATMENT**

After multidisciplinary team discussion, percutaneous foramen
ovale closure was decided to be the strategy of choice for her
refractory hypoxia with no other underlying aetiology and to
prevent stroke recurrence. The evidence on the effects of PFO
closure for the treatment hypoxia is limited to case reports;
however, it is promising. Hypoxia was found to improve imme-
diately following PFO closure.8

Our patient was transferred to the catheterisation laboratory
where foramen ovale closure was performed using Amplatzer
septal occluder (size: 35 mm) (figure 4). The procedure was
under general anaesthesia and was guided by transoesophageal
echocardiography (TOE) (figure 5). In postprocedural period,
TTE showed interatrial prosthesis located in place with no
residual shunt along with small pericardial effusion (figure 6).

**OUTCOME AND FOLLOW-UP**

The hypoxia subsided postoperatively and subsequent 3 months
follow-up revealed positive outcomes with no hypoxia episodes.
DISCUSSION

Platypnoea orthopnoea syndrome related hypoxia occurs in upright and setting positions and resolves when lying down. As described in our case, it does not respond to oxygen therapy. The underlying pathophysiology could be related to cardiac causes represented by intracardiac shunts, for example, PFO, ASD and ASD with fenestrations or to pulmonary causes represented by pulmonary parenchymal ventilation/perfusion mismatch, and pulmonary arteriovenous shunts.

PFO is a congenital heart defect that present in 25% of autopsies and a minority of patients with this heart defect present with stroke; however, 40% of patients with cryptogenic stroke found to have PFO suggesting its involvement by paradoxical embolism rather than being an incidental finding. While PFO patients may present with stroke, it is more less frequent that they present with POS with an incidence rate of 2%. In most cases of POS caused by heart defects, an additional pathology or a thoracoabdominal anatomical abnormality coexist leading to right-to-left shunt even in the absence of persistent high right-heart pressures. Such pathological conditions include aortoc systemic, pericardial effusion, pneumonia, paralysis of the right hemidiaphragm, kyphoscoliosis and obstructive or restrictive pulmonary diseases. The presence of PFO only without an associated pathology mostly would not present with positional hypoxia due to the fact that the left atrial pressure is higher than the right atrial pressure preventing right-to-left shunt. In fact, the presence of an associated pathology leads to interatrial septal displacement which found to be a critical factor in the development of POS. The occurrence of septal displacement leads to a change in the atrial position that puts the atrial defect directly at the level of blood flow entrance from the inferior vena cava. This displacement becomes more marked in the upright position, which explains why the oxygen desaturation is related to orthostatism.

The first event in our case was a stroke that necessitated inferior vena cava filter placement due to anticoagulation contraindication and the high risk of venous thromboembolism in postoperative period. Assuming that thrombi crossed the PFO, this means there is a right-to-left shunt consolidating the diagnosis of POS. Many precipitating factors in patients with POS and PFO were described in the literature as mentioned above; however, post extensive abdominal organs resection have not been reported previously. Nevertheless, the most probable theory in our case is that resection of several abdominopelvic organs has led to a change in volume distribution with less organs accommodating blood and more volume returning to right-heart chambers with an associated septal displacement favouring right-to-left shunt even in the absence of persistent high right-heart pressures.

The use of relevant diagnostic tools confirms the presence of PFO. PFO percutaneous closure has proven to be a safe and successful treatment for patients with POS, with rapid symptom relief and low complication rates. Our patient showed immediate positive outcome with dyspnoea disappearance in post-procedural period. Three-month follow-up showed neither recurrence of dyspnoea nor cerebrovascular events.

CONCLUSION

A previously silent PFO presented with stroke and POS after extensive abdominal organs resection in a 53-year-old cancer patient. This was managed with percutaneous device closure with positive outcome in 3-month follow-up.

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Learning points

► High index of suspicion is essential to reach rare diagnoses.
► Multidisciplinary medical approach is a key for good clinical outcomes.
► Medical interventions could be the triggering event that uncover undiagnosed clinical conditions.
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