Pulmonary Embolism-A Mechanical Compression Effect on Lower Limb Deep Venous Thrombosis

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Abbreviation: PE: Pulmonary Thromboembolism; DVT: Deep Vein Thrombosis; FFT: Free Floating Thrombus; CUS: Compression Ultrasonography; CT: Computed Tomography

Introduction

Majority of Pulmonary Thromboembolism (PE) results from clot fragmentation of lower limb Deep Venous Thrombosis (DVT) [1,2]. Non-invasive testing of the lower limb, such as Compression Ultrasonography (CUS), is the gold standard for the routine diagnosis of DVT. Free-Floating Thrombus (FFT) is present in 10-26% of thrombi detected with ultrasound and is often considered being a risk factor for PE in patients with DVT [3]. Few cases in which CUS may have dislodged a blood clot and caused a PE have been reported [4].

We present 3 cases (Table 1) of acute PE following mechanical compression effect on lower limb DVT.

Case 1

An 85 year-old man presented with 4-day history of progressively worsens dyspnea with bilateral lower limb edema. He also had cough productive of purulent sputum and hemoptysis. He denied fever and chest pain. Clinical examination revealed a febrile patient with heart rate of 80/min, respiratory rate of 22/min and SpO2 of 96% breathing on supplemental oxygen of FiO2 50%. Bilateral leg edema was present and lung auscultation revealed widespread coarse crepitations. Cardiovascular and abdominal examination was unremarkable. Chest X-Ray (sitting film) showed bilateral alveolar infiltrates in the mid and lower zones with blunting of the right costophrenic angle. Serial ECG and cardiac enzymes were unremarkable. Blood investigations revealed: NT-proBNP 6488 pg/ml (N<100), Hemoglobin 11 g/dl, White counts 15.7×10(9)/l, Platelet 41×10(9)/L, normal PTT & APTT, CRP 78.9mg/L.

Computed Tomography of the thorax (CT* findings

| Case 1 | Case 2 | Case 3 |
|--------|--------|--------|
| Gender | Male   | Female | Female |
| Age    | 85     | 41     | 54     |
| CUS* and Doppler studies | Floating thrombus in the right external iliac vein and the proximal end of the common femoral vein which was completely thrombolic. | Acute right femoral vein thrombosis | Acute thrombosis in the mid to distal left popliteal vein |
| Onset of PE* | 1 hour after CUS | Immediately after completion of CUS | Immediately after leg massage |
| CT* findings | Acute filling defects in the left main pulmonary artery | Filling defects in the right upper, middle and lower lobar extending to segmental arteries |
| Outcome | Fatal | Discharged well with antiocoagulation |

*N(CNS8.8), Creatinine 174 μmol/L, Protein 58 g/L, Albumin 27 g/L. The Urinary Protein Creatinine ratio was 10.52 g. He was referred to the hematologist and the nephrologist for further evaluation.

The patient improved with intravenous Frusemide and Moxifloxacin. On his 4th day of hospitalization, his right lower limb was noted to be bigger than the left. Empiric parental antiocoagulation was not started as the patient had hemoptysis and thrombocytopenia. An ultrasonography scan (compression ultrasonography with Doppler study) of the right lower limb was performed 6 hours later, unfortunately the patient collapsed suddenly while talking to his relatives 1 hour after the scan. Despite aggressive cardiopulmonary resuscitation the patient remained in asystole. The ultrasonography scan report returned as: Thrombosis of the entire right common femoral vein and floating thrombus in the right external iliac vein and the proximal end of the common femoral vein (Figure 1).

Case 2

A 41 year old Chinese female was hospitalized for suspected right lower limb DVT. Her vital signs were normal and she underwent a lower limb ultrasonography (compression ultrasonography with Doppler study) the next day. In the vascular ultrasonography room, she became acutely tachypneic and SpO2 was 80% on room air just after completion of ultrasonography which confirmed acute right femoral vein thrombosis. She required supplemental oxygen via intranasal cannula at flow rate of 5 L/min to maintain SpO2 above 92% and was transferred to the intensive care unit. She was started immediately with parental heparin and an urgent computed tomography (CT) thorax scan done showed acute filling defects in the left main pulmonary artery.

Case 3

A 54 year old Chinese lady had lower limb aches for a couple of days and went to a parlor for a leg massage. Immediately after the massage, upon standing up, she had acute giddiness, dyspnea, chest tightness and diaphoresis. Her first recorded vital signs taken by the attending paramedics were: blood pressure 77/46 mmHg, pulse rate 100/min and diaphoresis. She required supplemental oxygen via intranasal cannula at flow rate of 5 L/min to maintain SpO2 above 92% and was transferred to the intensive care unit. She was started immediately with parental heparin and an urgent computed tomography (CT) thorax scan performed in the hospital showed acute thrombosis in the mid to distal left popliteal vein and filling defects in the right

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upper, middle and lower lobar extending to segmental arteries respectively. There was also CT evidence of right ventricular strain. Further evaluation for hypercoaguable state and CT abdomen and pelvis scan were normal. The patient was treated with anticoagulants and discharged well.

Discussion

To the best of our knowledge, this is the first report in the medical literature on 3 cases illustrating the detrimental consequence of mechanical compression effect on lower limb DVT.

In the first case, the relative immobilization of an elderly patient due to acute illness and depleting the circulatory fluid in the presence of proteinuria in the Nephrotic range are all risk factors of DVT. The size discrepancy of his lower limbs was noted only after he was treated with diuretics on his 4th day of admission and CUS with Doppler studies was performed within 6 hours of diagnosis. Unfortunately, the patient sustained an acute cardiorespiratory arrest within an hour of the diagnostic test. Although post-mortem was not done, the temporal clinical scenario was consistent with a fatal PE secondary to a floating thrombus in the common femoral vein extending into the iliac vein. The appearance of a FFT on B-mode and color Doppler ultrasonography is impressive as evidenced by the long thrombus ‘floating in’ the venous lumen and surrounded by moving blood, separating it from the wall. The compression test for vein incompressibility and more likely the dynamic test that accelerates venous flow can contribute to the fragmentation of the clot. During limb ultrasonography, compression and dynamic tests should be used cautiously and not repeated unnecessarily. When evident, other criteria like intraluminal echogenicity may be adequate for the diagnosis of DVT.

Conclusions

Majority of pulmonary thromboembolism (PE) results from clot fragmentation of lower limb deep vein thrombosis (DVT). The learning points from these 3 cases are:

1) High index of suspicious of DVT is paramount. Meticulous clinical measurement is required to detect clinical lower limb DVT in patient with bilateral limb edema due to fluid overload state. Earlier diagnosis, the avoidance of excessive pressure of the ultrasound probe, more importantly the omission of dynamic test when a floating clot is detected on compression ultrasonography (CUS) and urgent surgical or endovascular intervention may have prevented the fatal outcome in the first case.

2) Prior to anticoagulation treatment, mechanical compression of the thrombosed vein such as massage, application of compressive stockings or devices, probe compression test for vein incompressibility or dynamic test to accelerate venous flow can contribute to the fragmentation of the clot. During limb ultrasonography, compression and dynamic tests should be used cautiously and not repeated unnecessarily. When evident, other criteria like intraluminal echogenicity may be adequate for the diagnosis of DVT.

3) And therefore one of the pitfalls of CUS is although it is a non-invasive test, it is not absolutely safe.

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