

Short-haul flight: is it a risk to pulmonary embolus?

短途飛行航程：是否有肺栓子的風險？

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Introduction: Pulmonary thromboembolism (PTE) still remains a diagnostic challenge to junior doctors working in emergency departments. Being aware of the condition and its associated risk factors can improve the diagnostic accuracy. Association between passenger travelling long-haul flight and PTE has been well documented; however its association with short-haul flight is very rare and controversial. This case report illustrates the possible linkages between short-haul air travel with the development of classic non-fatal PTE. **Clinical feature:** A young Indian gentleman after travelling four hours on a flight complained of progressive worsening of breathlessness when he arrived at Kuala Lumpur. Clinically he was tachypnoeic and tachycardiac. The electrocardiogram showed T inversion in leads III and aVF, and S wave in lead I. Oligoemia was shown on the chest X-ray and hypoperfused areas were seen on the spiral computed tomographic angiogram. **Treatment:** He was started on unfractionated heparin, switched to low molecular weight heparin, and then warfarin and subsequently admitted to the coronary care unit. **Outcome:** He was discharged well on day 7 after admission with warfarin and medical advice before returning to India. **Conclusion:** Non-fatal PTE is at times difficult to diagnose and requires a high index of suspicion. Its association with healthy passengers of short-haul flight is not well established and this case report illustrates the possibility of linkages. (*Hong Kong j.emerg.med.* 2005;12:99-103)

引言：肺部血栓栓塞仍繼續是在急症室工作，年資較淺醫生診斷的一項挑戰，若能警覺這情況及其相關的風險因素，可改善診斷的準確性。長途飛行旅程的乘客已證實與肺部血栓栓塞有關聯，但與短途飛行的關聯很罕見且具爭議性。本報告顯示短途飛行旅程與形成典型非致命性肺部血栓栓塞的可能聯繫。**臨床特徵：**一名年輕的印度裔男士經過四小時飛行旅程抵達吉隆坡後，申訴呼吸困難及逐漸惡化，臨床上病者出現呼吸急速及心搏過速。心電圖導程 III 及 aVF 顯現 T 波倒向，導程 I 出現 S 波；胸部 X 光造影顯現血量減少並在螺旋電腦掃描血管造影中發覺有血液灌注不足的區域。**治療：**開始時使用未分餾的肝素，其後轉用低分子量肝素，最後再改用華法令阻凝血劑；其後入住心臟治療部。**結果：**住院七天後情況良好，經配予華法令阻凝血劑及醫療忠告後，出院返回印度。**總結：**非致命性肺部血栓栓塞有時很難診斷，需要高度懷疑的警覺性；它與健康的短途飛行旅程乘客的關聯仍未能確立，本報告旨在舉例證明兩者間可能的聯繫。

Keywords: Aircraft, pulmonary embolism, thromboembolism, travel, venous thrombosis

關鍵詞：飛機、肺栓塞、血栓栓塞、旅行、靜脈血栓形成

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Case report

A 37-year-old Indian gentleman attended the emergency department in mid-October 2004 complaining of shortness of breath at rest after arriving at the Kuala Lumpur International Airport from

Calcutta, India. There was no history of cough, haemoptysis, or palpitations. His total flight time took approximately four hours excluding a transit of two hours at the Changi Airport, Singapore before taking another flight to Kuala Lumpur, which lasted for 35 minutes. He did not walk much during the transit and remained seated most of the time. He was also complaining of aching pain over the right calf. He was a businessman on a holiday trip to Kuala Lumpur and never had any medical problem or risk factor for cardiovascular disease. He was a non-alcoholic and denied taking any alcohol before or during the flight. He had no other air or land travelling that lasted for more than an hour over the last two months. He was also an avid jogger. There was no history of trauma or chest pain. There was no family history of thromboembolic disease.

Physical examination revealed a medium-sized gentleman, tachypnoeic with a respiratory rate of 32 breaths/min, an initial blood pressure of 107/55 mm Hg which remained normotensive, tachycardia at 122 beats/min and regular, an oxygen saturation of 94% on room air, no rub or crackles heard. The examination of the cardiovascular and respiratory systems was unremarkable. Emergent investigations which included electrocardiogram (ECG) showed evidence of sinus tachycardia with T inversion in leads III and aVF, S wave in lead I and partial right bundle branch block (Figure 1). Chest X-ray (CXR) showed evidence of partial oligoemia, mainly in the right lung (Figure 2). His arterial blood gases on room air showed hypoxaemia with type I respiratory failure and respiratory alkalosis with pH 7.52, PO_2 60 mm Hg, PCO_2 19.1 mm Hg, HCO_3^- 20.6 mmol/L and SpO_2 94.7%. His repeated arterial blood gases after the administration of 60% oxygen showed marked improvement with pH 7.46, PO_2 177 mm Hg, PCO_2 20.1 mm Hg, HCO_3^- 18.3 mmol/L and SpO_2 99.6%. His full blood count showed no evidence of thrombocytosis with packed cell volume 0.45 L/L, white cell count $13.6 \times 10^9/L$, platelet $216 \times 10^9/L$ and haemoglobin 15.1 g/dL. His renal profile was within normal limits with urea 3.4 mmol/L, potassium 4.6 mmol/L, sodium 141 mmol/L, chloride 108 mmol/L and creatinine 100 μ mol/L.



Figure 1. ECG showing sinus tachycardia, T inversion in III and partial right bundle branch block.

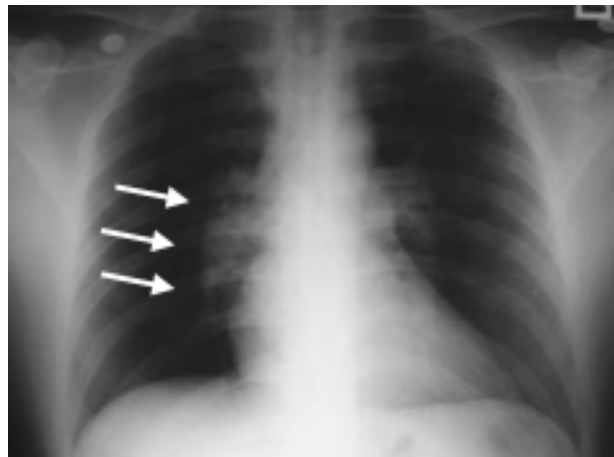


Figure 2. Oligoemia in the right lung (white arrows).

Possible differential diagnoses in his particular case included spontaneous pneumothorax, pneumonia, and pulmonary embolism. However, the clinical examination of the lungs with evidence of good air entry bilaterally, no rub or crackles, no history of fever or cough, and together with the findings on CXR excluded the possibility of pneumothorax and chest infections. Therefore, a diagnosis of pulmonary embolism with high probability was made and he was treated with high flow oxygen by mask at 10 L/min to sustain a SpO_2 of more than 98%, a bolus dose of 5,000 units unfractionated heparin (UFH) followed by UFH infusion of 1,000 units per hour to sustain a satisfactory aPTT of between 50 to 90 seconds as soon as possible, which was later changed to low molecular weight heparin (LMWH) and followed by warfarin.

Pulmonary computed tomographic (CT) angiogram on the day of admission confirmed the presence of hypoperfused areas at multiple sites in the right lung (Figure 3). Echocardiography on the next day showed evidence of dilatation of the right atrium and right ventricle with an ejection fraction of 46%. These investigations confirmed the extensiveness of the pulmonary embolus. Subsequent evaluation by Doppler ultrasound of the lower limbs did not reveal any evidence of deep vein thrombosis. The patient was later transferred to the coronary care unit for continuing care. Protein C investigations of this patient were within normal limits. He was discharged well on day 7 after admission with warfarin (INR 2.2) and medical advice for travelling back to India.

Discussion

Prolonged air travel with the associated immobilisation is a risk factor for venous thromboembolism (VTE) and the occurrence of pulmonary thromboembolism (PTE), being called the "economy class syndrome" under these circumstances. In 1946, Homans first referred to flights as a possible risk factor for VTE, reporting an episode of venous thrombosis in a doctor after a 14-hour flight.¹ In 1977, Symington and Stack used, for the first time, the term "economy class syndrome", implying the pathogenic role of stasis

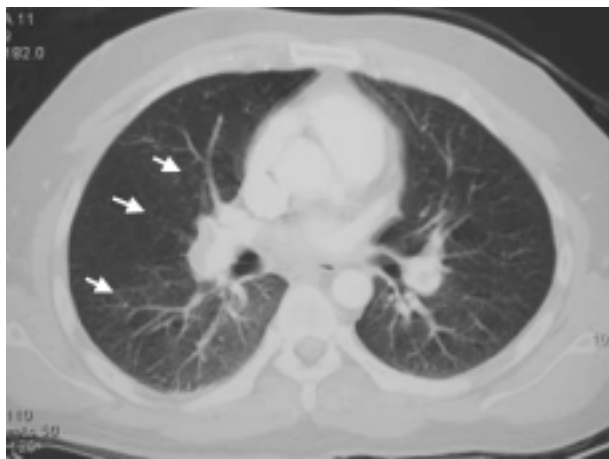


Figure 3. Multiple hypoperfused areas in the patient's right lung shown in the CT pulmonary angiogram (white arrows).

during long flights in restricted seats especially those of the economy class.² Defining prolonged air travel is still controversial despite several studies having been done all over the world. Schwarz et al found that travelling more than eight hours or longer doubled the risk for isolated muscle calf venous thrombosis and was associated with well established risk factors for VTE.³ In their study, the patients also had existing risk factors for VTE.³ Pérez-Rodríguez et al found that travelling more than six hours in a flight had an incidence of 0.39 VTE per million passengers.⁴ The greater the distance travelled by air, the higher the risk for the development of non-fatal PTE, in particular long-haul flights of more than eight hours. This was shown by an observational study carried out over a ten-year period at the arrival hall of Charles de Gaulle airport in Paris, the risk of severe PTE being 150 times higher in passengers travelling more than 5,000 km compared to those travelling less than 5,000 km.⁵

It is well known that venous stasis can be a precipitating cause of VTE, particularly in bedridden and hospitalised patients.⁶ However, is there evidence that apparently healthy individuals may be at increased risk when confined to tight quarters, as during air travel or in an automobile, and dehydration and thrombocytosis may further predispose to episodes of VTE? For many decades, flights have been considered a risk factor for VTE, but researchers still puzzle on the actual precipitants. Interestingly, this patient only had a total of 4.5 hours flight time and did not have any risk factor for the development of VTE prior to this incidence. Is a 4.5 hours flight journey considered to be long? Is it true that the "economy class syndrome" is a real risk or just media hype? Malaysia receives nearly 10 to 12 million tourists per year since 1990 and they are on a rising trend. This is also true in most Asian countries whereby tourism is a major industry and tourism is related closely with air travel. Most travellers have medium to long distance flight journeys. This case report may be only one in a million but it does pose a risk because PTE is a life-threatening event if not being taken seriously or misdiagnosis occurs. This case is a classic example on how PTE may present, but when looking back on the history of this unfortunate gentleman, one would puzzle because no

other risk factor can be established except for the 4-hour total flight journey.

Diagnosing PTE still remains a medical challenge despite advances in medical technology. The good old 'medical instinct' based on history, clinical examination, and basic emergent investigations, is still very much relevant in diagnosing PTE. In this case report, the diagnosis of PTE was based on the clinical examination and simple investigations. Spiral CT pulmonary angiogram was only done to confirm the clinical suspicion and to complete the investigations. Despite being non-invasive and having a sensitivity of more than 95% or higher for segmental or larger PTE,^{7,8} this investigation is still not widely available in most developing countries. Therefore, at the end, 'clinical examination' still remains the best tool.

VTE is a multifactorial disease resulting from the interaction between genetic and environmental risk factors. The former includes abnormalities causing inherited thrombophilia, such as deficiency of the naturally occurring anticoagulant proteins antithrombin, protein C, protein S and the gain-of-function mutations in genes encoding coagulation factor V prothrombin.⁹ The initial protein C investigations of this patient were within normal limits. It was quite unfortunate that the series of investigations to look into the genetic precipitants of VTE in this gentleman, especially protein S or thrombin abnormalities, had not been done fully due to logistical and financial constraints. However, whatever the outcome of the investigations, he might still require aggressive treatment towards the PTE.

This case report also highlighted the use of UFH as the mainstay of treatment before switching to LMWH. UFH has been proven to be the primary pharmacological agent in the treatment of non-fatal pulmonary embolism or pulmonary embolism without evidence of cardiorespiratory collapse. UFH is also cheaper compared to LMWH. However, it requires stringent monitoring of the aPTT in order to ascertain the beneficial anticoagulant effect (aPTT of 1.5 to 2.5 times the "normal" value) and to avoid major bleeding episodes and heparin-induced thrombocytopenia.

Although LMWH has been shown to be as safe and as effective as UFH, its financial implications still remain a burden to some developing countries.¹⁰ This patient did not require the use of thrombolytic agent such as streptokinase because there was no evidence of refractory hypoxaemia or cardiorespiratory collapse. The use of such thrombolytic agent may be considered if the patient progresses to cardiorespiratory instability. The role of streptokinase or other thrombolytic agent in submassive pulmonary embolus with evidence of dilatation of the right atrium and right ventricle is still controversial¹¹ because of the possibility of more harm to the patient. There was also no major study advocating the use of such agents in case of non-fatal or submassive pulmonary embolus.

The true frequency of these problems (VTE and PTE associated with air travel) remains unknown and controversial. VTE has been suggested to be up to four times likely to develop within two to four weeks of a flight (hazard period) and the incidence of PTE is greater among passengers travelling more than 10,000 km. Furthermore, the risk is highest within two weeks of a long-haul flight.¹² Episodes of deep vein thrombosis (DVT) can arise without any symptoms.¹² Less than half of the patients with symptomless DVT will develop symptoms, and only a few of those go on to develop a clinically detectable pulmonary embolus.¹³ Forbes et al demonstrated that power Doppler ultrasonography (USG) had a sensitivity of 100% and a specificity of 79% in detecting isolated calf DVT.¹⁴ However, accuracy is operator-dependent. In this case, the Doppler USG was negative. There should be a plan to repeat the ultrasound of the lower limbs, as the initial USG may not be able to pick up the thrombosis in the calf veins. Despite the negative finding, it did not change the acute management of this patient. Pulmonary CT angiogram was done as a confirmatory investigation, because this investigation had been proven at par or even better than ventilation-perfusion scan for the diagnosis of PTE.¹⁵

This case report illustrates the importance of putting basic clinical examination and basic emergent investigations as the primary tools in diagnosing pulmonary embolism. This is the beauty of being an

emergency care doctor where diagnostic challenge must be faced and encountered within a short window period of time whereby accurate acute medical management will result in the best outcome in terms of morbidity and mortality.

Conclusion

Diagnosing PTE remains a medical challenge. This case report would like to demonstrate that basic focussed clinical examination together with basic emergent investigations and a high index of suspicion are still essential despite the availability of current technological advances in medicine. This case report puts forward that air travel, whether short-haul or long-haul flight, may be the precipitant in the development of VTE and subsequently PTE. One must be aware of the risk factors of VTE and PTE in order not to miss the diagnosis.

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