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Successful thrombolysis of normotensive pulmonary embolism with life-threatening hypoxia in a young man with Klinefelter syndrome

Nuwan Dhanushka Miththinda Jasenthu Kankanamage [1,2] James Gome[1,2]

[1]Deakin University - Warrnambool Campus, Warrnambool, Victoria, Australia
[2]Department of Medicine, South West Healthcare, Warrnambool, Victoria, Australia

Correspondence to
Dr Nuwan Dhanushka Miththinda Jasenthu Kankanamage;
jkndmiththinda@gmail.com

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SUMMARY

Klinefelter syndrome (KS) affects males born with an additional X chromosome giving the genotype 47XXY classically. This syndrome has primary features of infertility and hypogonadism along with other features including a genetically hypercoagulable state. When associated with other risk factors, KS further increases the risk of venous thromboembolism and could result in life-threatening pulmonary embolism (PE). There should be a lower threshold in suspecting PE as a cause of acute respiratory failure in this patient group and thrombolysis should be considered early in normotensive PE with severe hypoxia for best patient outcomes. Furthermore, clinicians should be cautious in managing testosterone therapy in patients with KS and additional thromboembolic risk factors.

BACKGROUND

Klinefelter syndrome (KS) is considered to be the most common sex chromosome disorder. An Australian prevalence study had reported a rate of 223 per 100 000 males, with up to 50% of cases remaining undiagnosed.[1] Affected males have an additional X chromosome leading to poor development of male secondary sexual characteristics. Other than these phenotypic changes, these patients are more prone to cardiovascular, endocrine and psychiatric disorders.[2] KS is also considered to be a genetically hypercoagulable state where affected individuals have been shown to be four times more likely to have venous thromboembolism (VTE).[2] The standardised incidence ratio for VTE is reported to be highest before 30 years of age at 12%.[3] The current hypothesis for this hypercoagulable state is the presence of increased levels of plasminogen activator inhibitor 1 (PAI-1) in KS, related to obesity and low testosterone levels. Despite this, a study by Zitzmann *et al* did not demonstrate a change in PAI-1 levels in patients who are treated with testosterone therapy.[4] Other hypotheses for the hypercoagulable state seen in this patient group include an increase in factor VIII and IX levels due to the genes coding for these factors being located on the X chromosome. A case series of six KS patients with deep venous thrombosis (DVT) has shown elevated factor VIII levels, but this was not significantly different from a control population with VTE.[5]

The Pulmonary Embolism International Thrombolysis Study (PEITHO) trial demonstrated that fibrinolytic therapy in patients with intermediate-severity pulmonary embolism (PE) prevented haemodynamic decompensation but increased the risk of major haemorrhage and stroke.[6] A third of the patients in the PEITHO trial complained of persisting dyspnoea at 3-month follow-up, but over 80% had only low or intermediate probability of persisting or new-onset pulmonary hypertension at echocardiographic follow-up. Based on these data, the latest guidelines for PE by the European Society of Cardiology do not recommend routine thrombolysis for intermediate-risk PE. On the other hand, a small randomised trial of 83 patients suggested that thrombolysis in submassive PE improved the functional capacity at 3 months compared with anticoagulation alone.[7]

Here, we report a case of a young man with KS presenting with submassive PE complicated by pneumomediastinum and pneumopericardium with severe hypoxic respiratory failure prompting successful thrombolysis with good functional outcomes.

CASE PRESENTATION

A young man in his mid-20s with KS presented to the emergency department with fluctuating generalised ill health and worsening shortness of breath for 2 weeks. He had an associated persistent dry cough and mild subjective fevers. He denied any pleuritic chest pain and could not recall any preceding calf tenderness and had no identifiable risk factors for VTE except his father having experienced an unprovoked DVT in the past with a negative thrombophilia screen. The patient had been diagnosed with KS at the age of 18 months with XXYY karyotype while being investigated for developmental delay and has been on testosterone replacement since the age of 15 years with a current testosterone regimen of intramuscular testosterone undecanoate 1000 mg at 3 monthly interval. He was otherwise healthy.

On examination, he was of a lean build with a well-grown beard. He was tachypnoeic (up to 40 breaths/min), tachycardic (up to 140 beats/min), and peripherally and centrally cyanosed. His blood pressure remained stable over 100/60 mm Hg. He had occasional crepitations on bilateral lung fields. His oxygen saturation (SPO_2) on room air was 74% and was promptly commenced on a non-rebreather with improvement of SPO_2 to 85%.

INVESTIGATIONS

Arterial blood gas performed on admission demonstrated type 1 respiratory failure with

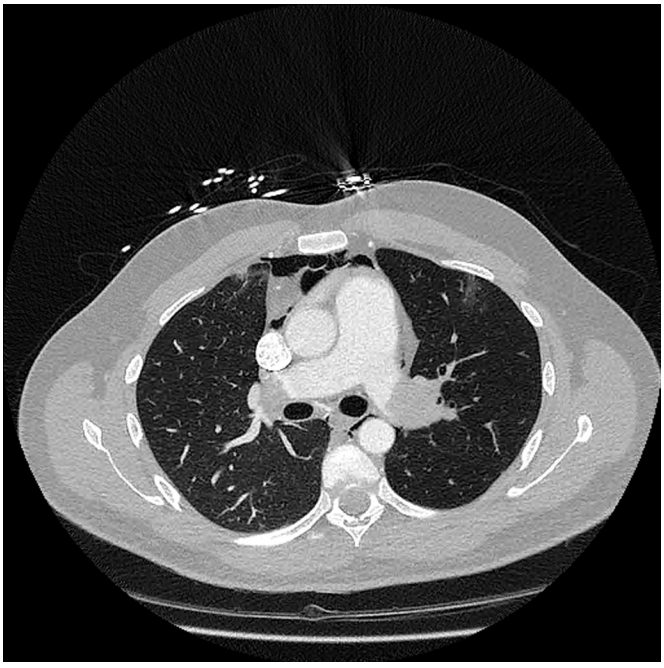

Figure 1 Bilateral pulmonary embolism with pneumomediastinum and pneumopericardium.

PaO_2 of 52 mm Hg. ECG showed tachycardia with S1-Q3-T3 pattern. An urgent CT pulmonary angiogram (CTPA) was performed on high suspicion of PE. This demonstrated a completely occluded left main pulmonary artery with a large embolus and another embolus in the right main pulmonary artery extending into the right middle and lower lobe arteries extensively and to the upper lobe arteries to a lesser extent. CTPA further demonstrated pneumomediastinum and pneumopericardium (figure 1). Closer evaluation of his CTPA revealed alveolar rupture leading to pneumomediastinum and pneumopericardium which was attributed to barotrauma from the persistent dry cough.

Bedside echocardiogram demonstrated ballooning of the right ventricle, suggestive of significant pulmonary hypertension and his troponin I was elevated at 162 ng/L (<21 ng/L).

TREATMENT

He was at high risk according to the simplified PE severity index with a 30-day mortality prediction of 8.9%. Due to the high oxygen requirement and severity of clot burden with persistent tachycardia and right ventricular strain, it was decided to thrombolyse him. He received intravenous alteplase 10 mg loading followed by a 90 mg infusion. His saturation improved gradually over a 6-hour period up to 100% on room air. He received therapeutic dose subcutaneous enoxaparin for 7 days following thrombolysis and was changed to oral apixaban 5 mg two times per day for life-long therapy on discharge.

OUTCOME AND FOLLOW-UP

His testosterone level was 25.4 nmol/L (normal range 10–35 nmol/L). This was 9 weeks after his regular testosterone undecanoate therapy. He was noted to be polycythaemic with a haemoglobin level of 209 g/L and haematocrit of 0.63. The elevated erythropoietin level at 42 mIU/mL (normal range 5–25 mIU/mL) suggests secondary polycythaemia. His haemoglobin level and haematocrit improved to 152 g/L and 0.45, respectively, at the time of discharge. A thrombophilia screen was negative for any secondary causes including JAK2 mutation, antiphospholipid antibodies, anti nuclear antibody, extractable nuclear antigen, vasculitis screening, homocysteine level and prothrombotic gene mutations.

On follow-up at 3 months, he had returned to his baseline functional capacity and his repeat echocardiogram showed complete resolution of right ventricular strain with normal cardiac function. In the long-term management of his testosterone replacement therapy, it was decided to recommence his testosterone only when the serum testosterone level falls below 10 nmol/L.

DISCUSSION

Our patient had multiple risk factors for VTE. KS is known to increase the risk of VTE. He had a family history of unprovoked DVT, although the thrombophilia screening for both him and his father could not identify a hereditary cause. His polycythaemia could have predisposed him to VTE and was likely multifactorial from hypoxia, dehydration and testosterone therapy. The fact that he tolerated an SPO_2 down to 74% in the community was remarkable and we postulate that the secondary polycythaemic response may have allowed him to tolerate such severe hypoxia. Although he was not hypotensive, severe hypoxic respiratory failure with signs of right ventricular strain prompted the decision for thrombolysis. Current guidance for PE thrombolysis mostly depends on failed haemodynamics and suggests close monitoring and consideration of rescue thrombolysis for cases like our patient.[8] Several researchers have highlighted the need for thrombolysis in severe hypoxic respiratory failure with preserved haemodynamics.[9 10] Percutaneous catheter-directed therapy is currently recommended for haemodynamically unstable PE with contraindications for thrombolysis.[8] As our patient did not have any contraindications for thrombolysis, this was not considered. Our patient clearly improved with thrombolysis with normalisation of his oxygenation from SPO_2 of 74%–100% within hours and his full recovery without any evidence of pulmonary hypertension speaks to the dramatic improvement achieved with this therapy. Polycythaemia is one of the most common side effects of testosterone therapy.[11] Regardless of this, a systematic review of six randomised trials and five observational studies failed to show an association between testosterone therapy and thromboembolism.[12] Despite this, provided the multiple risk factors our patient had for VTE, it was decided to minimise

Learning points

- Clinicians should be cognisant about the hypercoagulable state of Klinefelter syndrome, especially when the patient has other risk factors for venous thromboembolism (VTE).
- We propose that clinicians use a cautious and closely supervised approach to testosterone replacement therapy in patients with other risk factors for VTE.
- Clinicians should be aware of the current limitations for thrombolysis recommendations in pulmonary embolism (PE) which entirely depend on haemodynamic instability, and should carefully explore the need for thrombolysis in normotensive PE with refractory hypoxic respiratory failure on a case-by-case basis, which in our case led to optimum patient outcomes both in the short and long term.

any risk testosterone-related polycythaemia could cause by targeting his testosterone therapy towards the lower limit of normal.

Twitter Nuwan Dhanushka Miththinda Jasenthu Kankanamage @jkndmiththinda

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ORCID iD

Nuwan Dhanushka Miththinda Jasenthu Kankanamage http://orcid.org/0000-0001-7497-1676

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