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Case report

Radiotherapy and technetium-99m-labeled red blood cell scintigraphy for hemoptysis from chronic MRSA infection

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ABSTRACT

Aim: To discuss the application of external beam radiotherapy (EBRT) and technetium-99m-labeled red blood cell scintigraphy (LRBCS) in life-threatening hemoptysis from a non-malignant condition.

Materials and methods: This case report presents a patient with persistent hemoptysis secondary to chronic Methicillin-resistant Staphylococcus aureus (MRSA) infection in whom conventional management failed to localize the site of pulmonary bleeding or to provide effective therapy.

Results: EBRT was successfully given for life-threatening hemoptysis with improvement in quality of life for nearly 1 year. LRBCS was used to localize the source of further bleeding and facilitate targeted therapy.

Conclusion: EBRT can be an effective and well-tolerated modality in treating life-threatening hemoptysis refractory to conventional methods. LRBCS is a non-invasive diagnostic tool that can be used to detect the source of pulmonary bleeding.

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1. Case study

A 48-year-old woman with a background of childhood asthma and 30 pack-year smoking history was admitted to hospital with severe bilateral community acquired MRSA pneumonia

that progressed to a right upper lobe lung abscess and empyema. She was treated with intravenous antibiotics but eventually required de-cortication and right upper lobectomy. Over the next few years, she experienced recurrent MRSA pneumonia. Serial chest imaging showed a persistent thick walled right upper lobe cavity and suggestion of mycetoma.

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Fig. 1 – Dose distribution for first EBRT course with (a) axial and (b) coronal slices. Prescription was 17.5 Gy in 5 fractions, given once per week using AP/PA opposed beams with 15° wedges. GTV encompassed the entire right apical cavity and right upper lobe bronchial stump.

Sputum cultures were negative for fungi or mycobacteria. *Aspergillus* precipitins were positive.

Two and a half years after her initial admission, she presented with large volume hemoptysis. Bronchoscopy showed a bronchopleural fistula from the right upper lobe bronchial stump communicating with a blood-filled chronic cavity. Over the next 10 months she had recurrent episodes of large volume hemoptysis requiring repeated admissions. Bronchial artery embolizations were attempted thrice but failed to identify the bleeding point. She was also deemed unsuitable for further surgery.

After an episode of massive life-threatening hemoptysis, palliative external beam radiotherapy (EBRT) was given using five 3.5 Gy fractions, delivered once per week using anterior–posterior parallel opposed fields with 6 and 18 MV photons (Fig. 1). Her hemoptysis did not settle until the fifth fraction. Over the 11 months post-EBRT, she had infrequent small volume hemoptysis and did not require hospital admission.

After further large hemoptysis, technetium-99m-labeled red blood cell scintigraphy (LRBCS) showed the focus of bleeding in the right upper lung zone posteriorly (Fig. 2). High dose focal EBRT was planned for 50 Gy in 25 fractions (Fig. 3). However, after the 19th fraction, she died from a massive bleed from the right apical cavity, confirmed on autopsy.

2. Discussion

Massive hemoptysis is a life-threatening condition and requires urgent evaluation and intervention due to the associated mortality risk.¹ Key diagnostic modalities include bronchoscopy and CT angiography whilst therapeutic management generally involves conservative treatments, bronchial artery embolization or surgery.^{1,2} However, these diagnostic and therapeutic measures may fail to localize and control intermittent hemoptysis, and other modalities need to be employed. This case demonstrates the use of unconventional diagnostic and treatment modalities in the management of non-malignant hemoptysis.

Firstly, EBRT is commonly used for hemoptysis due to lung malignancies but is not generally used for benign conditions due to risk of late effects and secondary malignancy. However, EBRT has been used for treatment of massive hemoptysis associated with aspergilloma or mycetoma when conventional treatment modalities have failed.^{3–5} EBRT for recurrent hemoptysis secondary to chronic MRSA infection has not been previously reported. The fractionation schedule used for the first EBRT course was based on the series by Falkson et al.³ Hemostasis was not achieved as rapidly as they described,

Fig. 2 – LRBCS of the chest was performed using 1 GBq TcO₄ after radiolabeling of autologous red blood cells. The initial planar images up to 4 h showed no bleeding (images not shown). At 24 h post injection, planar views showed no convincing abnormality (a). However, SPECT-CT showed focal red blood cell activity (arrows) in the right upper chest posterolaterally on (b) maximum intensity projection-MIP, (c) axial fused images and (d) coronal fused images.

Fig. 3 – Dose distribution for second EBRT course with (a) axial and (b) coronal views. Dose prescription was planned for 50 Gy in 25 fractions over 5 weeks. A 3D conformal plan was used with beam angles at 180°, 215° and 270° with MLC shaping. GTV encompassed the pulmonary bleeding site as identified on SPECT-CT, allowing focal EBRT.

but this patient had a prolonged period after the initial EBRT with significant improvement in hemoptysis and no hospital admissions. In contrast, she experienced debilitating hemoptysis requiring frequent hospital admissions in the year and a half prior to EBRT. The exact mechanism of radiotherapy-induced hemostasis is unclear, but may be related to both acute and late functional and structural changes in lung vasculature following irradiation.^{3,4} Radiotherapy has been used for abnormal vascular proliferations such as arteriovenous malformations, angiomas and gastric antral vascular ectasia. Its efficacy in these conditions may be related to loss of endothelial cells and prevention of neovascularization.⁶ Whether this applies to chronically inflamed or infected tissues is uncertain.

Secondly, this case shows the advantages of LRBCS in the localization of non-enteric bleeding. LRBCS is less commonly used for pulmonary bleeding and its value in literature is limited to only a few case reports.^{7,8} It has several advantages over conventional diagnostic modalities including non-invasiveness, high sensitivity for slow or intermittent bleeds, high specificity and avoidance of contrast media.⁷ Recent introduction of SPECT-CT may improve the value of this test due to the use of attenuation correction and better anatomical localization gained from co-registered images. For this case, although planar (conventional) imaging was negative, SPECT-CT confirmed a bleeding source. Localization of the pulmonary hemorrhage allowed targeted EBRT.

3. Conclusion

EBRT can be an effective treatment option for non-malignant causes of hemoptysis when other therapeutic modalities fail or are contraindicated. LRBCS is a valuable but underutilized tool for localizing pulmonary bleeding and its role needs to be re-defined in the current era of SPECT-CT.

Conflict of interest

None declared.

Financial disclosures

None declared.

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