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Case Report

External Beam Radiotherapy for Malignant Central Airway Obstruction in a Remote Rural Patient: A Case Study

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Keywords
Carcinoma · Squamous cell · Radiotherapy · Airway obstruction · Community rural · Case report

Abstract
Introduction: Malignant central airway obstruction (MCAO) is a challenging therapeutic scenario, caused by tumour burden which limits airflow within the large airways. Squamous cell carcinoma (SCC) of the lung accounts for 50% of MCAO seen in the setting of non-small cell lung cancer. Here, we present the challenging case of a 63-year-old Indigenous Australian Female rom a remote rural community with background history of metastatic SCC of presumed pulmonary origin, who presented with a 1-week history of dyspnoea, stridor, and hoarse voice. ***Case Presentation:*** A CT chest and neck demonstrated a superior mediastinal mass compressing the trachea to a narrowest diameter of 3 mm. The patient was stabilised in her local health centre, then transferred to our tertiary care facility for further evaluation and management. This stenotic lesion was not amenable to bronchoscopic or surgical intervention but was instead treated successfully with a short course of external beam radiotherapy, to total dose of 25Gy delivered over 10 fractions. The patient had almost complete resolution of respiratory symptoms with no significant radiotherapy related toxicity. ***Conclusion:*** Here, we discuss a challenging case of MCAO in a remote rural Australian patient and demonstrate the utility of external beam radiotherapy in this setting. We also discuss aspects of cancer related healthcare disparities which exist for Indigenous Australians. In doing so, we wish to highlight the need for improved cancer healthcare for such communities.

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Introduction/Background

Malignant central airway obstruction (MCAO) arises as a result of a tumour that limits airflow within the trachea, main stem bronchus, or bronchus intermedius [1]. The most common aetiology for the development of MCAO is direct invasion from an adjacent tumour, often bronchogenic carcinoma [2].

Despite accounting for just 30% of non-small cell lung cancer (NSCLC) overall [3], squamous cell carcinoma (SCC) accounts for more than 50% of MCAO caused by NSCLC [3, 4]. It is estimated that 20–30% of patients with a primary lung cancer will develop a central airway obstruction, and 35% of these patients will die as a consequence of asphyxia, haemoptysis, or post-obstructive pneumonia as a result of airway obstruction [5].

MCAO usually presents with symptoms of breathlessness, wheeze, haemoptysis, or cough. In extreme instances, patients may present with symptoms of impending respiratory arrest. Dyspnoea will typically present when the lumen of the obstructed airway is reduced to 8 mm, and stridor when less than 5 mm [5]. Initial management strategies in MCAO generally include stabilisation of the airway and haemodynamic parameters, followed by definitive treatment – chemotherapy, radiotherapy, or surgery [6].

Various palliative intent treatment strategies have been developed to relieve symptoms of MCAO, and to improve airflow within the blocked airway. Interventional bronchoscopy and laser ablation are methods by which endobronchial obstruction can be relieved in the setting of MCAO. In certain cases, patients may not be candidates for these treatments, and external beam radiotherapy (EBRT) is a potential alternative. Here, we discuss a clinically challenging case of MCAO, that was not amenable to bronchoscopic or surgical intervention for reasons discussed below, and that was instead treated effectively with EBRT.

Case Presentation

Timeline of History prior to Presentation

- Month 0: diagnosis of SCC, presentation with enlarging right supraclavicular mass; needle biopsy demonstrating P-16 negative SCC.
- Month 1–11: treatment with chemo/immunotherapy in the form of pembrolizumab, carboplatin and paclitaxel.
- Month 11: patient presentation to remote rural emergency department with respiratory distress due to MCAO.

Our patient, a 63-year-old Indigenous woman from a remote community in central Australia, presented with a 1-week history of worsening dyspnoea, stridor, and hoarseness. She had good premorbid performance status, indicated by an Eastern Cooperative Oncology Group (ECOG) score of 0.

She had a background oncological diagnosis metastatic SCC, of presumed pulmonary origin. She had been diagnosed approximately 11 months previous, having presented with a right palpable supraclavicular mass. CT imaging revealed multifocal pulmonary lesions with supraclavicular, cervical and mediastinal lymphadenopathy (Fig. 1). Needle biopsy of this supraclavicular lymph node diagnosed a metastatic nonkeratinizing, P-16 negative SCC. She was commenced on chemo-immunotherapy in the form of pembrolizumab, carboplatin, and paclitaxel.

Her comorbidities included type 2 diabetes, dyslipidaemia, and hypertension. She had no smoking history.

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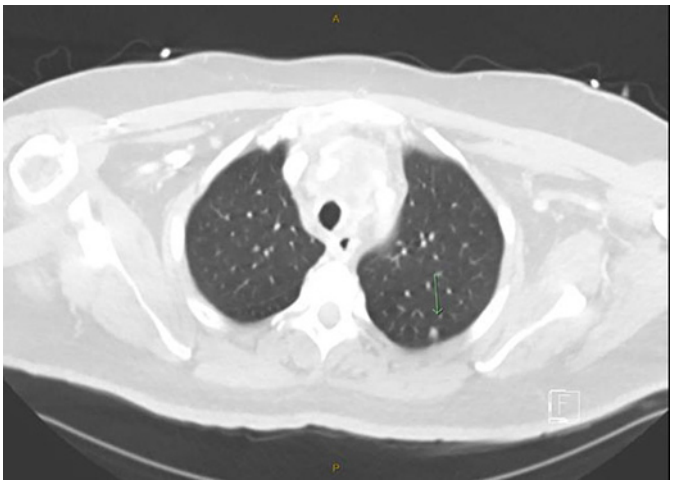

Fig. 1. CT imaging with lung windowing, demonstrating one of several pulmonary lesions identified within the lung parenchyma at diagnosis.

Fig. 2. CT imaging demonstrating tumour encasement of the trachea and the resulting marked reduction in aperture of the airway. The diameter of the airway this narrowest point measured 3 mm.

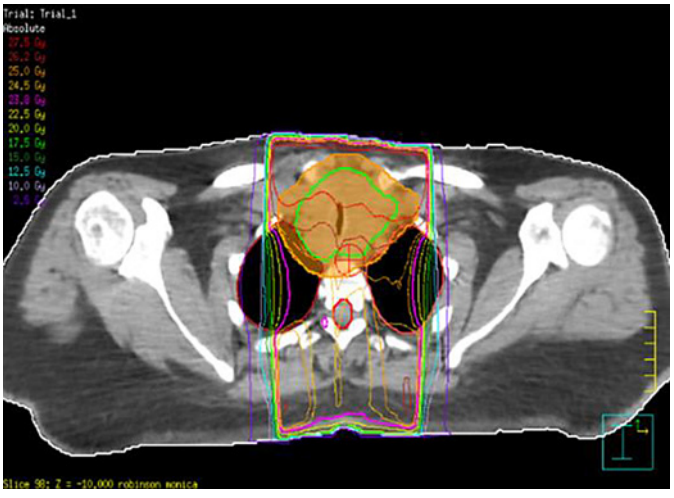

Fig. 3. Radiotherapy plan demonstrating the treatment fields utilised in this case. Here, the CTV included the obstructive tracheal mass, whilst the PTV comprised a 10 mm isotropic expansion of the CTV. Dose to OARs were within departmental guideline constraints. CTV, clinical target volume; PTV, planned target volume; OAR, organs at risk.

Eleven months following this initial diagnosis, the patient developed acute breathlessness and presented at her local healthcare facility. On presentation, she had stridor with significant dyspnoea during prolonged conversation or on minimal exertion. Auscultation of the lungs revealed reduced air entry and a widespread monophonic wheeze. She was hemodynamically stable and maintaining saturations of 98% on room air.

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Given these clinical findings, an urgent CT of the neck and chest was performed, which revealed a superior mediastinal mass, causing high-grade stricture of the trachea, to a narrowest diameter of just 3 mm (Fig. 2). This mass extended around the great vessels, and caused extrinsic pressure on the left brachiocephalic vein, as well as contacting the oesophagus. In light of the concern for impending airway compromise, the patient was started on dexamethasone and nebulised adrenaline. She was urgently referred to our tertiary care facility for further management.

Definitive management options in the form of bronchoscopic or surgical intervention were considered. The case was discussed with the ear, nose and throat, cardiothoracic surgery, and the respiratory services in our centre. The multidisciplinary consensus was that due to the extensive involvement of the trachea and its anatomical location, surgical or bronchoscopic intervention would carry with it a significant risk of morbidity and mortality. These options were explained to the patient, who voiced her priority of returning to her rural community for palliation. With support from her family, the patient opted for treatment with EBRT instead.

The patient was treated with EBRT to a dose of 25Gy in 10 fractions using photons, and a 3D conformal technique. The clinical target volume included the obstructive tracheal mass. The planned target volume used in this case comprised a 10 mm isotropic expansion on the clinical target volume (Fig. 3). Considering the high-grade tracheal stenosis and the risk of impending respiratory crisis, a more fractionated course of radiotherapy was delivered to minimise the risk of airway occlusion. Due to the significant potential for iatrogenic airway obstruction, the patient was closely monitored in our intensive care unit, ensuring that any necessary palliative interventions could be promptly administered in the event of imminent upper airway compromise.

The patient did not experience any high-grade toxicities related to EBRT. However, because of the high doses of dexamethasone used, she developed oral candidiasis, which was effectively treated with nystatin. Upon completion of radiotherapy, the patient had almost complete resolution of respiratory symptoms, being comfortable ambulating short distances, and speaking in full sentences without difficulty. Following this, she was discharged home to her community for follow up with her community palliative care team and her primary medical oncologist.

Discussion

The Therapeutic Challenge of SCC

SCC poses a significant therapeutic challenge when compared to other tumour subtypes under the banner of NSCLC, due to a markedly different molecular profile when compared to other subtypes, as well as the lack of targeted therapies for this type of NSCLC [7].

For many patients, first-line treatment regimens will utilise platinum-based chemotherapy and immunotherapy. The introduction of chemo-immunotherapy has been shown in various clinical trials to date to be of benefit in the metastatic Lung SCC setting. The addition of pembrolizumab to either carboplatin/paclitaxel or nab-paclitaxel has been shown to confer an overall survival benefit (median 17.1 vs. 11.6 months) as well as a demonstrable improvement in progression-free survival (median 8.0 vs. 5.1 months) when compared to chemotherapy alone [7, 8]. Despite these improvements in outcomes with the advent of chemo-immunotherapy, disease progression will often eventually occur, and most patients with primary pulmonary malignancy will die because of disease progression, with no current defined guidelines on second-line therapies [7, 9].

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MCAO and Its Management

The management of MCAO can be an extremely challenging clinical scenario, requiring a diverse multidisciplinary team including medical and radiation oncology, anaesthesiology, Ear, Nose and Throat surgery, and interventional pulmonology. Airway obstruction often presents late in the course of such malignancies, and the prognosis is generally short following its development, meaning that surgical intervention is not feasible [10]. Whilst carrying a very poor prognosis, MCAO also results in significant quality of life disturbance [2].

With limited scope for surgical intervention, other palliative measures to reduce symptoms must be considered. These include bronchoscopic interventions such as mechanical debulking, stenting or laser ablation. Bronchoscopic stenting is often considered a safe, and effective treatment for patients with MCAO, immediately relieving the symptoms caused by airway obstruction. Multicentre studies examining the technical success rates of bronchoscopic interventions for MCAO, cite an overall success rate of 93%, and a procedure related death rate of approximately 1% [9]. Despite this success rate, when one considers the risk of general anaesthesia, and a failure rate of approximately 5%, it is important to identify those patients most suitable for interventional bronchoscopy procedures [9].

In the case of our patient, bronchoscopic intervention was considered; however, given the degree of stenosis, as well as the location of the obstruction, it was felt that the procedural risk was too great. Being a vital community leader in a remote Indigenous Community, the patient expressed her wish to return home as of paramount importance to her. As such, with close multidisciplinary cooperation, and respecting the patient's own goals of care, the decision was made not to proceed with bronchoscopic intervention, instead opting for palliative EBRT.

EBRT as a method of palliation carries with it several distinct advantages over other therapeutic procedures such as bronchoscopic intervention in contexts such as the case presented. In this case, we demonstrated that EBRT was a viable, minimally invasive palliative intervention, which yielded favourable results in terms of symptom resolution, as well as having minimal complications or toxicity. Several studies have examined the efficacy of EBRT in the setting of MCAO. In their study examining the efficacy of EBRT in the setting of MCAO, Lee et al. [10] demonstrated that EBRT is a viable option to resolve bronchial obstruction; with 78.9% of patients having symptomatic or radiographic improvement. They also showed that responders to EBRT had a significantly higher survival time than nonresponders to EBRT. They found that this did not give rise to severe complications – again an important point given the palliative nature of this intervention.

EBRT is favoured as a relatively rapid, and noninvasive method of providing palliative intent treatment to patients with MCAO; however, it is an important caveat that EBRT may not immediately improve the symptoms of MCAO, rather symptom resolution will occur in the days and weeks following radiotherapy. The time frame for response can vary widely, with studies suggesting median time for response (defined as radiographic resolution or symptom resolution) between 7 and 24 days [11].

Palliative EBRT also requires a relatively longer duration of treatment when compared to other palliative interventions. Such drawbacks may be overcome with hypofractionation; however, this carries with it an increased risk of treatment-related complications, such as that of iatrogenic airway compromise in this case [9]. Delineation of a defined treatment schedule to balance achieving higher response rates whilst also minimising side effects, is required.

Cancer Healthcare for Remote Rural Indigenous Australians

It is widely accepted that access to primary healthcare is a crucial part in improving health outcomes. Many residents of Australia's rural and remote communities experience poorer health outcomes compared with many of their metropolitan counterparts [12]. Looking at

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cancer generally, Indigenous Australian Populations (referring to those of Aboriginal or Torres Strait islander descent), when compared to nonindigenous populations, are more likely to be diagnosed at advanced stages of malignancy, often with comorbidities that are extremely complex [13].

Statistics presented by the *Australian Institute of Health and Welfare* show that Indigenous Australians are 2.1 times more likely to be diagnosed with lung cancer and are 1.8 times as likely to die from lung cancer generally when compared to nonindigenous populations. Overall, 26% of cancer deaths in Indigenous Australian populations are attributable to lung cancer [14].

Similar trends are also seen in data collected with respect to remoteness and access to healthcare. According to government figures, currently around 1 in 7 indigenous Australians (15.4%) live in areas that are classified as "remote" or "very remote." When considering those populations considered "remote," the age standardised mortality rate for lung cancer in Indigenous Australian populations is again significantly higher when compared to nonindigenous populations [14].

Much of the marked health disparities observed between these groups stem from barriers to access. Barriers to accessing health services for Indigenous Australians are numerous, with historical racism, cultural insensitivity and a lack of available services being some of the major impediments. One of the most pertinent of these barriers is the lack of access to services to those living in remote areas. Our patient in this instance was a community leader from an extremely remote indigenous community, with the closest tertiary healthcare facility, and primary oncology service being located more than 1,000 km away.

When one considers such barriers to access, it is then unsurprising that patients from such communities will present at a more advanced stage in their malignancy. Many strategies to improve access to healthcare have been implemented to address the stark disparities in healthcare access for Indigenous Australian Populations. One such strategy has been the development of national framework which aims to increase access and improve participation of Indigenous populations in healthcare. The Australian Department of Health and Aged Care, in conjunction with Indigenous community leaders, in 2021 developed "*The National Aboriginal and Torres Strait Islander Health Plan 2021–2031*." Part of this framework describes increasing the access to healthcare for those populations living in remote rural locations, as well as providing a culturally sensitive healthcare system, which respects indigenous values [15].

When one considers cases such as that presented above, the value of such strategy is most pertinent. For those remote rural Indigenous Australians, having access to cancer related healthcare is vital to earlier detection and treatment. However, the healthcare that is delivered must be done so in a culturally sensitive manner to ensure continued engagement, as well as delivering appropriate and timely care.

Conclusion

We present the case of an Indigenous Australian Patient, who presented with impending respiratory compromise as a result of MCAO secondary to SCC of the lung. Given the location of the airway obstruction, surgical or bronchoscopic intervention was not feasible. The patient was instead treated effectively with palliative, short course EBRT, and had complete post-treatment symptom resolution without significant toxicity. Here, we discuss a challenging case of MCAO and highlight the utility of EBRT as an effective and minimally invasive method of palliation in cases where immediate intervention is not available.

Given the patient in this case was an Indigenous Australian, presenting with an extremely advanced malignancy, we also briefly discuss aspects of cancer related healthcare for Indigenous Australian populations living in remote rural communities, and the barriers that exist precluding their access to healthcare. The CARE Checklist for medical case reports has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000542104).

Statement of Ethics

Written informed consent is obtained from all patients for participation in clinical research at the time of consent for Radiotherapy in our healthcare facility. This includes for publication of this case report and any accompanying images. Ethical approval is not required for this study in accordance with local guidelines.

Conflict of Interest Statement

The authors declare no conflict of interest.

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Author Contributions

Dr. Eoin Collins, corresponding author, drafted the initial manuscript, collected, and analysed the data, reviewed, and edited the manuscript. Dr. Druva Mitra assisted with patient management, gathered clinical information, and contributed to the drafting of the case description. Dr. Scott Carruthers provided critical revisions for intellectual content, assisted with data analysis, and contributed to manuscript writing and approved the final version for submission. All authors have read and approved the final manuscript.

Data Availability Statement

The data supporting the findings of this case report are available within the article and its supplementary materials. Due to the sensitive nature of the patient-related data, additional details are not publicly available to ensure patient confidentiality. Anonymised data may be available from the corresponding author upon reasonable request and subject to the approval of the appropriate Ethics Committee.

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