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It's better to be lucky … successful management of an acute endobronchial tumour embolism in the ICU: a case report and review of the literature

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Abstract

Endobronchial tumour embolism is a rare cause of acute central airway obstruction. It is primarily reported during pneumonectomy, and the outcome is frequently fatal. Successful management requires the urgent removal of tumour with rigid or flexible bronchoscopy. We present the case of a 62-year-old woman with poorly differentiated non-small cell lung cancer (NSCLC), referred to our institution for Nd:YAG laser photoresection of endobronchial tumour completely obstructing the right mainstem bronchus (RMSB). Soon after admission, our patient developed critical hypoxemia, rapidly followed by cardiac arrest. Bronchoscopy was urgently performed and revealed a necrotic tumour occluding the left mainstem bronchus (LMSB), with some residual tumour and clot at the RMSB. The tumour acutely obstructing the LMSB was successfully extracted using a foreign body retrieval basket and large flexible biopsy forceps via a large (therapeutic) flexible bronchoscope. Ventilation immediately improved, with the return of a pulse, and the patient was successfully extubated the next day. Pathology of the tumour embolism revealed NSCLC with necrosis and an adherent clot. Here, we review 16 published reports of endobronchial tumour embolism in relation to our case.

Introduction

Endobronchial tumour embolism is a rare cause of acute central airway obstruction. It is primarily reported during pneumonectomy with the obstruction of the contralateral lung, and the outcome is frequently fatal. Successful management requires the urgent removal of the tumour with flexible or rigid bronchoscopy. We present a case of acute endobronchial tumour embolism in an intubated patient, managed successfully with immediate access to flexible therapeutic bronchoscopy tools.

Endobronchial tumour embolism most commonly results from centrally located tumours characterized as polypoid, friable, vascular, or bleeding lesions. Bollen et al. [1] have previously reviewed seven cases of endobronchial tumour embolism reported in the literature between 1966 and 1993 and concluded that rigid bronchoscopy is more effective than flexible bronchoscopy for extracting tumour embolus. PubMed was searched for English and French language reports of endobronchial tumour embolism, and an additional 12 published cases were identified since 1993. Here, we provide an updated literature review in relation to the present case.

Case Report

A 62-year-old female smoker with a recent diagnosis of poorly differentiated non-small cell lung cancer (NSCLC) was referred to our centre for Nd:YAG laser

photoresection of an endobronchial tumour completely obstructing the right mainstem bronchus (RMSB). The left endobronchial tree was normal on initial bronchoscopy performed at the referring hospital (Fig. 1). The patient was intubated prior to ambulance transfer due to hypoxemia.

The chest X-ray on arrival showed complete right lung collapse and an aerated left lung. A few hours after admission, while the patient was being evaluated for her planned therapeutic bronchoscopy procedure, she developed acute sudden shortness of breath with severe hypoxemia. This was rapidly followed by a pulseless electrical activity (PEA) cardiac arrest. Cardiopulmonary resuscitation was initiated. Bag-valve ventilation through the existing endotracheal tube (ETT) was difficult. Suspecting an obstructed or displaced ETT, the patient was re-intubated, but no improvement in ventilation ensued. Bronchoscopy was urgently performed and revealed a necrotic tumour occluding the left mainstem bronchus (LMSB) with ball-valve effect (Fig. 2A). Residual tumour and clot were visualized at the RMSB (Fig. 2B). The bronchoscope was switched to a large ("therapeutic") flexible bronchoscope (FB). The necrotic tumour obstructing the LMSB was successfully extracted, in multiple pieces, using a foreign body retrieval basket and large flexible biopsy forceps (Fig. 2C). This resulted in immediate improvement in ventilation, with the return of a pulse. Debulking of residual RMSB tumour and clot was then performed using the large flexible biopsy forceps (Fig. 2D). Diluted epinephrine (1:10,000) and cold saline were used to control bleeding. Blood and a large amount of secretions were suctioned from the bronchus intermedius, right middle, and lower lobe bronchi at the end of the procedure.

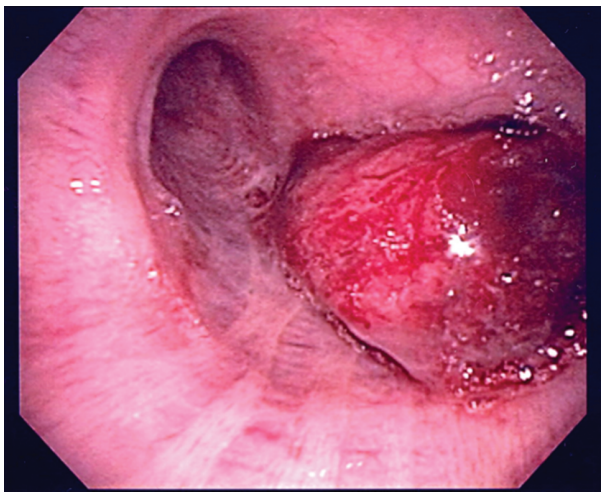

Figure 1. Initial bronchoscopy: bulky and vascular endobronchial tumour completely obstructing the right mainstem bronchus.

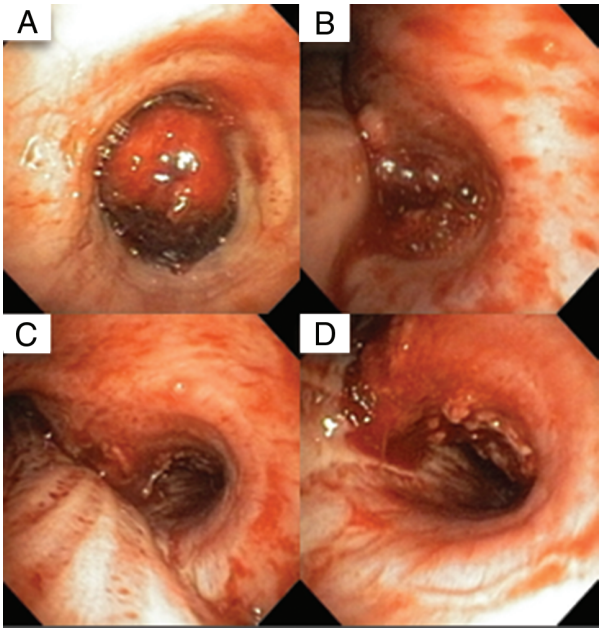

Figure 2. Flexible bronchoscopy immediately following re-intubation revealed a tumour obstructing the left mainstem bronchus (LMSB) with ball-valve effect (A) and residual tumour and clot at the right mainstem bronchus (RMSB) (B). View from main carina after urgent flexible bronchoscopy with extraction of LMSB endobronchial tumour embolism (C); minimal residual tumour at RMSB (D)

The patient was successfully extubated the following day and received external beam radiation before being discharged home. Pathology of the tumour embolus revealed NSCLC with necrosis and an adherent clot.

Discussion

Endobronchial tumour embolism resulting in complete obstruction of the contralateral mainstem bronchus (MSB) is a rare and often fatal event [1]. Byard [2] recently recommended that the phrase "tumor fragmentation with airway impaction" replace endobronchial tumour embolism as the term embolism refers specifically to obstruction within the blood stream and not the airway. However, the majority of published cases in the literature use the latter term. Embley and Fairbairn [3] used the term endobronchial tumour *migration* instead of embolism in their 2008 case report. Case reports of tumour embolisms since 2008 have not cited their paper, suggesting the practical necessity of continuing to use the term embolism (in addition to adopting a more precise descriptor) to facilitate identification of cases in the literature.

The majority of cases of endobronchial tumour embolism describe obstruction of a MSB by emboli that become dislocated from an endobronchial tumour within the contralateral MSB (Table 1). Tumour embolism lodging

Table 1. Review of the literature on acute endobronchial tumour embolism.

	Clinical setting		Tumour characteristics		Intervention(s) and outcome	
Reference	Age/ Sex	Intraoperative? If yes, ETT type(s)	Histological cancer type and gross appearance*	Tumour location† and site of embolization	Successful extraction of tumour embolus?	Successful outcome?
Annamalai et al. [4]	21F	Yes; SLT	Leiomyosarcoma Mobile, pedunculated	LUL bronchus → main carina	Yes; bronchotomy allowed tumour extraction	Yes
Barat et al. [5]	55M	Yes (manipulation of MSB); SLT	Carcinosarcoma Friable	Bifurcation of LMSB → larynx (below VC)	Yes; Magil clamp used to remove tumour in the larynx below the vocal cords	No; patient died hours after intervention
Markowicz et al. [8]	65F	Yes; SLT with a small separate lumen containing bronchial blocker (Univent)	Hamartochondroma N/A	LUL bronchus → RMSB	Yes; RB and aspiration catheter (unable to remove with FB and forceps)	Yes
Pathi et al. [11]	76F	Yes; SLT	Carcinosarcoma N/A	LUL and LMSB → RMSB	Yes; RB and biopsy forceps	No; cardiac arrest (coexisting CV disease)
Bollen et al. [1]	71M	Yes; SLT	Carcinosarcoma Highly vascularized lesion, fixed as a plug	LUL bronchus → RMSB	No; could not remove with FB. Unable to reach the carina through bronchial stump	No
Fox et al. [15]	58M	Yes (during palpation of the lesion); SLT	NSCLC (SCC, poorly differentiated) N/A	Main carina → unknown (LMSB suspected)	No; could not find the embolus so patient kept alive on CPB	Yes; patient coughed up tumour 18 h post-operatively
Verstraeten et al. [10]	70M	Yes; DLT replaced with SLT	NSCLC (Adenocarcinoma) N/A	Bronchus intermedius → LMSB	Yes; RB using a gripping device	Yes
Chadha et al. [9]	50F	Yes; DLT replaced with SLT at the end of surgery	Carcinoid Fleshy mass	RMSB → LMSB	Yes; flexible forceps through FB	Yes
Lee et al. [16]	59M	Yes; DLT replaced with SLT	NSCLC (pleiomorphic carcinoma) Soft, sticky, easily compressible	Distal LMSB → RMSB	Yes; bronchotomy (through bronchial stump) with curved long forceps under FB vision Initially unsuccessful with suctioning and FB with basket because mass too soft	Yes

Table 1. Continued

	Clinical setting		Tumour characteristics		Intervention(s) and outcome	
Reference	Age/ Sex	Intraoperative? If yes, ETT type(s)	Histological cancer type and gross appearance*	Tumour location† and site of embolization	Successful extraction of tumour embolus?	Successful outcome?
Janseen et al. [14]	68F	Yes; SLT	Renal carcinoma metastasis Polypoid tumour	LMSB → RMSB	No; bronchoscope could not aspirate the tumour with suction	No
Heydorn et al. [17]	36M	Yes; SLT	NSCLC (SCC, invasive) Large friable, bleeding	RMSB → LMSB	No; failed aspiration through the stump	No
Vuckovick et al. [18]	61M	Yes; DLT	NSCLC (LCNEC); Necrotic, smooth	RMB → LMB	No; could not remove with FB	No
Petrella et al. [7]	47M	No; during post-chemotherapy period	NSCLC (adenocarcinoma) Blood clots, brown tissue	LUL → LMSB	Yes; RB with grasping forceps Initially unsuccessful using FB with continuous suction	Yes
Schenk et al. [13]	22F	No; during diagnostic bronchoscopy with 8mm ETT with supplemental oxygen	Metastatic pelvic chondrosarcoma Necrotic, smooth	RUL occluding RMSB → LMSB	Yes; biopsy forceps through FB	Yes
Tan et al. [6]	63M	No; on the ward	NSCLC (adenocarcinoma) Necrotic	RUL → LMSB	No, patient died before intervention	No
Embley et al. [3]	59M	No; on the way to bronchoscopy suite	NSCLC (poorly differentiated); necrotic	LMSB → unknown (suspected RMB)	Yes; patient coughed up tumour before bronchoscopy	Yes

***Gross description of the endobronchial tumour or tumour embolus as described by the authors.**

†Anatomic location of the tumour prior to embolization.

CPB, cardiopulmonary bypass; CV, cardiovascular; DLT, double-lumen tube (Carlens), NSCLC, non-small cell lung cancer; ETT, endotracheal tube; FB, flexible (fibre optic) bronchoscopy; LCNEC, large cell neuroendocrine carcinoma; LLL, left lower lobe; LUL, left upper lobe; MSB, mainstem bronchus (R right, L left); RB, rigid bronchoscopy; RUL, right upper lobe; SCC, squamous cell carcinoma; SLT, Single-lumen tube; VC, vocal cords.

between the tracheal carina and a single-lumen ETT during pneumonectomy has also been found to result in obstruction of the contralateral MSB in addition to the ETT [4]. A tumour embolus has been found to travel as proximally as the subglottic region of the trachea [5,6] and to occur in ipsilateral airways whereby an embolus originating from an LUL tumour caused the sudden occlusion of the LMSB and LLL [7]. Endobronchial tumour embolism has been reported to impede exhalation from the affected lung via a ball-valve effect [5,8,9]. This has been supported by the observation of dynamic hyperinflation of the obstructed lung and intermittent separation of the embolic mass from the bronchial wall with positive pressure. Tension pneumothorax in the context of a tumour embolism has been attributed to dynamic hyperinflation; however, insertion of a chest tube in this setting does not result in clinical improvement [9,10].

NSCLC currently make up the majority of the histopathological tumour types reported to cause endobronchial tumour embolism. The most frequently reported subtypes include adenocarcinoma (three cases), carcinosarcoma (three cases), undifferentiated (three cases), and squamous cell carcinoma (two cases). This contrasts with the review of seven cases between 1966 and 1993 by Bollen et al. [1] where the majority of tumours were squamous cell carcinoma. The overrepresentation of carcinosarcoma, a poorly differentiated NSCLC with sarcoma-like differentiation occurring in <1% of lung malignancies [1,5,11], likely reflects its more common presentation as a central, intrabronchial mass [12] akin to squamous cell carcinoma. Two cases of tumour embolism from metastatic genitourinary cancers (pelvic chondrosarcoma and renal carcinoma) have been described [13,14] .

Most reported cases of endobronchial tumour embolism occurred as a result of surgical manipulation during pneumonectomy [1,4,5,8,9,11,14–18]. Several investigators have stated that endobronchial tumour embolism is underreported in the surgical literature [1,11]. While endobronchial tumour embolism is frequently catastrophic and fatal, the majority of cases in the literature document patient survival, likely reflecting a degree of reporting bias.

Surgical reports of endobronchial tumour embolism frequently advocate the use of double-lumen tubes (DLT). DLT were introduced by Carlens in 1949 for single-lung ventilation during pneumonectomy to protect the nonoperative lung from tumour fragment migration [1,5,14,17]. To achieve single-lung ventilation in a patient with localized tracheal narrowing preventing the insertion of a DLT, Markowicz et al. [8] used an ETT with a separate lumen 8–10 cm distal to the ETT tip containing an inflatable endobronchial blocker. Tumour embolism occurred after the bronchial blocker was retracted to facilitate suturing of the bronchial stump. Similarly, there have been reports of endobronchial embolism occurring during DLT extubation or exchange to a conventional ETT [9,10,18]. These cases are attributed to tumour fragmentation intraoperatively that is initially confined between the stapling line of the bronchial stump and the cuff of the DLT. Upon deflation of the cuff, the fragment migrates into the contralateral MSB, causing obstruction [10,18]. In contrast, Lee et al. [16] described embolisms occurring during pneumonectomy without deflation of the DLT bronchial cuff. The authors speculated that partial dislocation of the bronchial cuff by surgical manipulation around the hila may have contributed to the embolism [16].

Detection of tumour fragments during pneumonectomy is essential to prevent tumour embolism because this tissue can be removed in a controlled setting with forceps [10]. Routine systematic FB inspection through both lumens of the DLT [9], performed prior to closing the bronchus post-pneumonectomy, has been proposed to confirm patency of the airways [1]. Markowicz et al. [8] argued that inspection of the airways should be performed *after* bronchial suturing in order to detect tumour fragments that may enter the airway during suturing.

There are only a few reported cases of endobronchial tumour embolism occurring outside a surgical setting. A single case of tumour embolism in a patient admitted to a medical ward has been reported; the patient developed acute stridor and respiratory distress with failure to ventilate within minutes of intubation and cardiac arrest [6]. Successful extraction of tumour embolus is reported most commonly using rigid bronchoscopy, with few reports of patient survival using flexible bronchoscopy. Successful extraction using FB with forceps has been reported in only two cases [9,13].

Failure to extract the embolus has been attributed to tumour properties: Bollen et al. [1] noted that the tumour was tightly fixed as a plug in the bronchus; Lee et al. [16] were unable to remove an embolus using a basket or suctioning because it was too soft; friable tumour may prevent grasping with forceps [8]. Large tumour fragment size has also been reported to impede extraction [18]. The lack of success with FB may be attributable to the limitation of the available instruments [7,8,10,16]. Lee et al. [16] describe removing tumour embolus through the bronchial stump using curved long forceps under FB guidance.

Successful management requires a high index of suspicion and immediate availability of FB or RB. In the present case, the acute critical event occurred on a weekday afternoon, assessing patients at the bedside (rounds) while the patient was being evaluated by the IP physician planning her therapeutic bronchoscopy procedure. A large FB with large biospy forceps and foreign body retrieval basket were available within minutes. We believe a good dose of luck and immediate availability of a large flexible bronchoscope

with the necessary instruments as well as a coordinated team effort lead to a successful outcome in this patient.

Disclosure Statements

No conflict of interest declared.
Appropriate written informed consent was obtained for publication of this case report and accompanying images.

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