Bronchoscopic management of malignant airway obstruction in RIPAS hospital

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Abstract

Lung cancer is the leading cause of cancer deaths in the world. Only about 25% of patients diagnosed with lung cancer are amenable to curative surgery. The majorities are in advances stages of the disease by the time of diagnosis and are open only to palliative treatment. Obstruction of major airways by such tumours occurs in 30% of cases and they often present with symptoms of dypsnoea, stridor, obstructive pneumonia and impending suffocation which can be life threatening. Management of this group of patients can be very challenging and requires emergency relief of the obstruction. We describe two cases of major airway obstruction secondary to advanced malignancies in Brunei Darussalam and discuss the emerging bronchoscopic therapy available to deal with this life threatening condition.

Keywords: airway obstruction, airway stenting, endobronchial tumour, lung cancer

Introduction

Only 20-25% of patients diagnosed with lung cancer are amenable to surgical resection [1]. The majority are in advanced stages of the disease by the time of diagnosis and can only be treated palliatively. Malignant airway obstruction secondary to lung cancers occurred in 30% of cases and can result in incapacitating and life threatening symptoms which requires urgent relieve of airway obstructions [2].

Conventional chemotherapy and radiotherapy have limited roles in the management of acute malignant airway obstruction. Endobronchial therapy such as intraluminal brachytherapy, bronchoscopic laser resection combined with endobronchial stenting has evolved into an effective alternative therapy albeit a palliative option [3]. This form of bronchoscopic therapy has only recently become available in Brunei Darussalam. We report here the first two cases of endobronchial therapy with diathermy tumour resection and airway stenting using Ultraflex self-expanding nitinol stents (Boston Scientific; Natick, MA), in two patients with malignant airway obstruction at RIPAS Hospital.

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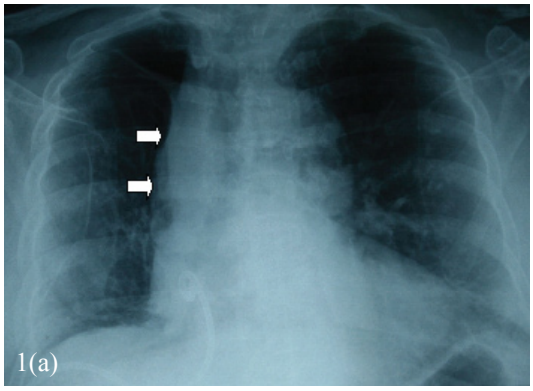
Case Reports

Case 1

In March 2007, a 78-yr old Chinese female with a past medical history of frontal hygroma and dementia, was admitted with to the medical ward with fever and shortness of breath. Routine chest radiograph taken on admission showed a right mediastinal mass lesion (Figure 1a) with right lower lobe lung consolidation. Computed tomography (CT) scan confirmed right paratracheal lymphadenopathy measuring 5 x 3 x 3cm, extending to the level of the carina causing obstruction to both right upper and lower lobe bronchus with complete collapse of the right lower lobe (Figure 1b).

A CT guided FNAC of the right paratracheal mediastinal mass was performed which was complicated by a moderate size pneumothorax. A 12ch pigtail catheter was inserted under radiology guidance but this failed to resolve the pneumothorax and the catheter was kept for several days, resulting in right pleural space infection and empyema.



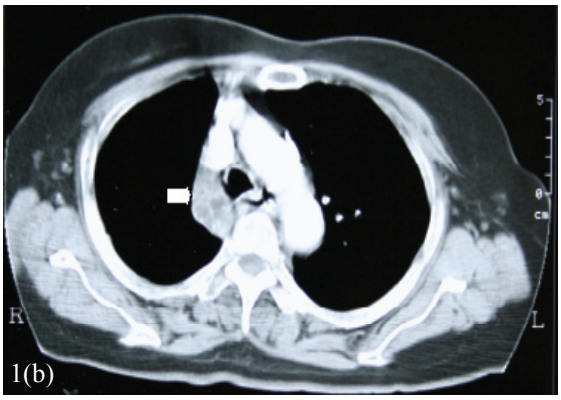
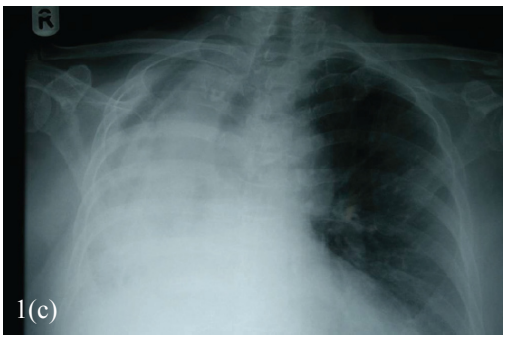


Figure 1. (a) Chest x-ray showing right mediastinal mass lesion as indicated by the white arrows, which is confirmed on CT scan to be a right paratracheal mass with multiple cystic areas (b).

She underwent video assist-thoracoscopic (VATs) decortication for the right empyema. Although the surgery was successful in resolving the empyema, the whole of her right lung collapsed as a result of the tumour compressing on the right upper and lower lobe bronchi (Figure 1c). A rigid bronchoscopy was carried out and confirmed compression of the right intermediate bronchus to a slit-like opening. This was successfully dilated with a 40mm x 12mm uncovered Ultraflex self-expanding nitinol bronchial stent (Boston Scientific, Natick, MA). Post procedural chest radiograph confirmed expansion of the right lung and the stent can be easily seen on the x-ray. She was subsequently discharged home by the first week of May 2007 and follow-up chest radiograph has confirmed patency of the stent (Figure 1d). Flexible bronchoscopy was performed two weeks after discharge, which showed significant amount of secretion in the stent with in growth of bronchial tissue over the stent (Figure 1e). She was still alive although house bound at her last follow-up in August 2007.



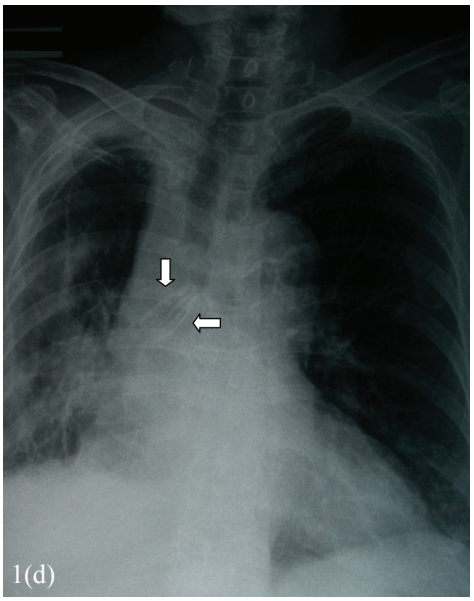


Figure 1. (c) Complete collapse of the right lung following right VATs decortication procedure. Following endobronchial stenting with a 40mm x 12mm Ultraflex self expanding nitinol uncovered stent (white arrows), the right lung is reexpanded (d).

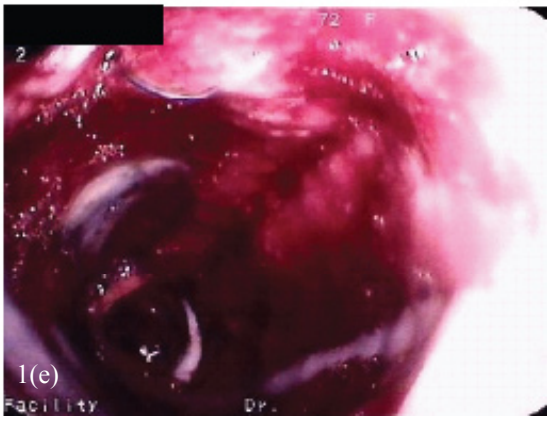
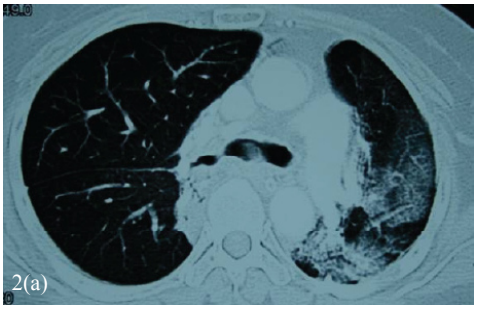


Figure 1(e). In-growth of epithelium over the uncovered Ultraflex nitinol stents with poor clearance of secretion.

Case 2

In October 2007, a 51-yr old Chinese female with a past medical history of hepatitis B/C, left lower lobectomy for stage 3A non small cell lung cancer (NSCLC) performed in September 2004, was admitted to Ward 19 at RIPAS Hospital with haemoptysis and dyspnoea. Following her initial surgery, she underwent four courses of Mitomycin, Vinblastine, Cisplastin (MVP) chemotherapy. She developed local recurrence of her disease in the mediastinum in December 2005, confirmed on PET scan. She was treated with chemoradiation 50Gy/25# followed by three courses of Cis-diamminedichloroplatinum (CDDP). This was followed by Taxotere for three weeks. She was well until December 2006 when biopsy of a right supraclavicular lymph node confirmed recurrence. She again underwent ten courses of localized radiotherapy for the supraclavicular disease.

CT scan was performed which confirmed recurrence of subcarinal tumour with invasion into the right main bronchus and partially occluding the lumen (Figure 2a). An urgent rigid bronchoscopy was performed on the 23rd October 2007 and endobronchial diathermy resection of the tumour was performed (Figure 2b). However due to excessive bleeding and difficulty in ventilation due to air trapping in the right lung, the procedure was abandoned after resecting only 10% of the tumour.



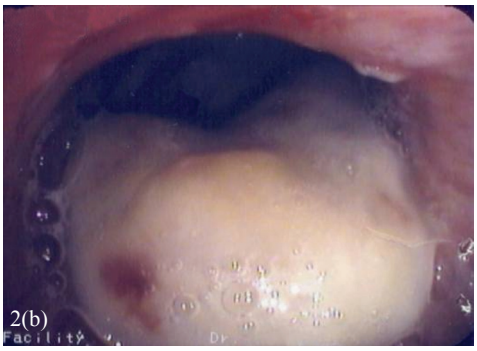
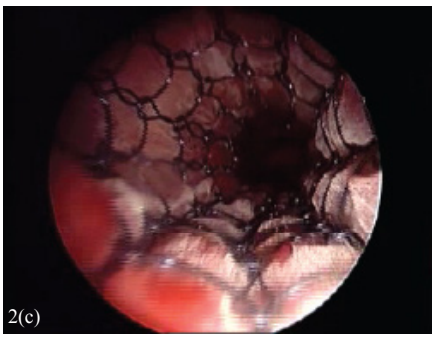


Figure 2. (a) CT scan showing recurrence of subcarina tumour with invasion and near total occlusion of the right main bronchus, (b) regrowth of the tumour 2 weeks after diathermy resection to obstruct about 60% of the right main bronchus lumen.

She again underwent another rigid bronchoscopic resection of the tumour two days later and we were able to remove 80-90% of the tumour. Histology from the first resection confirmed a poorly differentiated metastatic squamous cell carcinoma from her previous NSCLC. Due to the highly malignant nature of the tumour, she underwent 2 other bronchoscopic resections of the tumour during a course of a month and an endobronchial Ultraflex self-expanding covered nitinol stent (60mm x 14mm; [Boston Scientific; Natick, MA]) was inserted into the right main bronchus on the 4th December 2007 (Figure 2c & d). She was extubated the next day and transferred to the general ward a few days later, but died in 2 days later from acute respiratory insufficiency and hypotension.



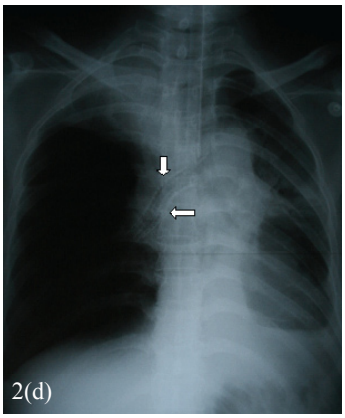


Figure 2. (c) Covered Nitinol selft-expanding stent after deployment into the right main bronchus. (d) Chest x-ray showing a fully expanded covered Ultraflex self-expanding Nitinol stent with full expansion of the right lower lobe.

Discussion

Patients presenting with large airway obstruction secondary to a malignant tumour are often unwell with symptoms of dypsnoea, stridor, obstructive pneumonia and impending suffocation which can be life threatening as shown by the two cases above [2]. Primary surgical resection and reconstruction of the airway provides the best opportunity for definitive management but however majority of patients present at a very late stage when curative resection is no longer possible. Palliative relief of the obstruction can be achieved with endobronchial therapy which is a fast evolving treatment aimed at achieving a patent airway and improvement of the quality of life for the patient [3].

The essential principles of endobronchial therapy for malignant airway obstruction have been well described by Mathisen and Grillo [4], which are, 1) initial resection of the intraluminal tracheobronchial tumour in order to re-establish airway patency and 2) to maintain airway patency by insertion of a stent to hold the airway open and to inhibit further in-growth of tumour into the lumen.

Bronchoscopic intra-luminal tumour resection can be achieved by several modalities such as mechanical coring out using diathermy probe [5], which was done for our second case, cryotherapy resection [6], photodynamic therapy (PDT) [7] and Nd:YAG laser ablation [8]. The latter three modalities are as yet not available in RIPAS Hospital.

Cryotherapy is a cytotoxic method that spares collagen containing structures [6]. It's mode of action is by direct contact effect with a cryoprobe which freezes and destroys the tumour cells [6]. The probe is usually inserted through the bronchoscope. Three cycles of freezing is usually required, each for about 20-30 seconds with a thawing period in between [6]. It is a safe and cost-effective therapy but does not bring about an immediate relieve of the airway obstruction. The subsequent eschar formation from cellular necrosis may cause obstruction when it finally detaches from the wall [8].

Similarly PDT has also been widely applied for treatment of tracheobronchial tumours. This modality uses a light of certain wavelength to activate light sensitive photochemicals known such as hemato-porphyrins [7]. Clinical PDT is a two-phase process. Phase one involves presensitization of the tumour tissues with photosensitizers which is delivered topically or systemically. Photosensitizers are chosen for their ability to accumulate in the tumour tissues rather than in normal tissues. In phase two, the tumour is exposed to a light of appropriate wavelength, usually delivered through a bronchoscope and will activate photosensitizers in the presence of oxygen to produce free oxygen radicals and other cytotoxic mediators resulting in direct tumour cell injury and vascular shutdown [7]. Recent evidence has also shown the immune and inflammatory responses to play a role in tumour cytotoxicity following PDT [9].

This is a very well proven technique and is a safe and effective therapeutic method for advanced lung cancer with important endobronchial presentation [10]. However, PDT requires complex equipment and the photosensitization of the patient implies increased costs and lengthening of hospitalization. The photo sensitizer may also predispose the patient's skin to light sensitivity resulting in incidence of 8-28% of sunburn [10]. Furthermore, just like cryotherapy, a delayed result is seen rather than an immediate relief of obstruction.

Nd:YAG laser ablation is another modality that is very effective and uses laser to coagulate and vaporise the tumour and provide immediate relieve of the airway obstruction [8]. However unlike diathermy resection which provide a shorter mean interval between resection of 29 days, Nd:YAG laser ablation can achieved a much longer duration between resection of 102 days [8]. This is because with the Nd:YAG laser, there is possibly a cytocide effect deep within the tumour even after resection has been completed [8]. However, cost of the equipment is an issue as well as training of staffs.

There are different types of commercially available airway stents, which can be subdivided into two groups, silicone and metal stents as shown in table one. The silicone stents such as Dumon, and Hood have flexible but fixed shape and have the advantage that they are easily removed and repositioned or changed as many times as possible [11,12]. They are more commonly indicated for the temporary relief of benign airway obstruction such as tracheobronchial malacia or benign strictures where they

can be later removed once the problem has been resolved [13]. Their disadvantages are that they required rigid bronchoscopy for placement and due to their fixed shape, they do not conform well to the anatomy of the airway and can be dislodged just as easily resulting in stent migration [11,12].

Polyflex is a newer self expanding thin wall silicone based stents made of polyester mesh covered with silicone [14]. It is more flexible than the Dumon and Hood and can also be folded into a much more compact size and hence can be delivered via a catheter. Like the other two silicone stents, Polyflex stents can be easily removed and repositioned. However, because of its smooth surface, stent migration has been reported to occur in 100% of cases, particularly in cases of benign tracheobronchial stenosis [14]. For treatment of malignant strictures, polyflex stent has been proven to be more promising [15].

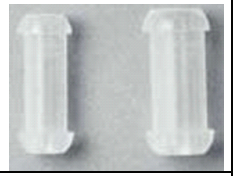
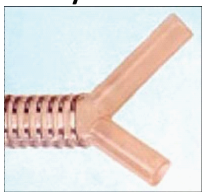
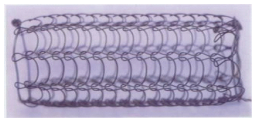
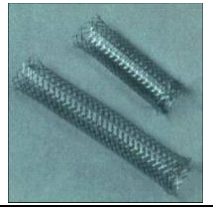
The self-expanding metal stents (Ultraflex and Wallstent) however are available in sterilised prepacked 8F catheter sheath where they are tightly compressed around the catheter [16]. Hence they can be easily delivered via a flexible bronchoscope with fluoroscopic control under local anaesthetic agents. Their flexibility and radial force provided by the struts conforms better to the airway [16]. They come in either uncovered or covered with silicone rubber or polyurethane coating. Uncovered self expanding metal stents are commonly used as in case one for airway obstruction secondary to extrinsic compression by malignancy. They have the advantage of preserving patency of lobar branches as well as mucociliary clearance. Uncovered stents are eventually incorporated within the airway wall with neoepithelization within 3 to 6 weeks after insertion as shown in Figure 1e [17].

Covered self-expanding metal stents however are indicated for treatment of malignant strictures where there is in-growth of tumour into the tracheobronchial lumen [16]. However about 1cm of either ends of the covered stents are bare and hence neoepithelization can occurred at these sites. Self-expanding metal stents have the disadvantages that they are permanent once neoepithelization occurs and removal is extremely difficult, if not impossible [17]. Adjustment is only possible during the early stages prior to full deployment but once the stents are fully expanded, it is difficult to adjust and fluoroscopy is required during placement in most cases.

The complications related to airways stents shown in Table 1, are increased sputum secretion and retention, obstruction of stents from sputum or in-growth of granulation tissue, stent migration particularly with silicon stents and erosion of airways due to excessive radial force of an oversized self-expanding metal [11, 13-16, 18]. However, in cases where endobronchial stents are inserted for malignant airway obstruction such as with both our cases, complications may not arise as most patients succumbed to their malignant disease before.

In conclusion, endobronchial airway stenting is safe and effective in providing immediate albeit palliative relief from malignant major airway obstruction. Because of their poor prognosis, most patients succumbed to their malignant disease before any major complications arise from insertion of these stents.

Table 1. Types of commercially available airway stents.

	Silicon Stents			Self Expanding Stents		
Stent Type	**Dumon** 	**Hood** 	**Dynamic** 	**Polyflex** 	**Ultraflex** 	**Wallstent** 
Manufacturer	Novatech	Hood Corp	Rush Inc.	Rush Inc.	Boston Scientific	Boston Scientific
Construction	Molded silicon rubber	Molded silicon rubber	Silicone with anterolateal steel struts	Polyester mesh covered with silicone	Single strand woven nitilol With/without silicone coating	Woven cobalt/chrome alloy monofilament coated with silicone
Size (mm)	9 x 20 – 18 x 70 + Y	6 x 13 – 18 x 70 + Y	13, 15, 17 (trachea)	6 x 20 – 22 x 80	8 x 20 – 20 x 80	8 x 20 – 24 x 60
Advantages	Easily adjustable and removable, can be repositioned and changed as many times as required. no ingrowth and no reaction of the airway mucosa.			Compressible nature means small delivery catheter. Can be delivered via flexible bronchoscopy with radiological control, hence easily deployed under light sedation and local anaesthetic. Radial tension ensures stable position with minimal migration. Uncovered stents allow also ventilation of lobar bronchi through the interstices of the metal mesh.		
Disadvantages	Rigid fixed shape. Need for rigid bronchoscopy placement. Smaller inner diameter hence can be easily occluded by thick secretions. Potential for dislodgement and distortion.			Difficult to remove once fully deployed except polyflex stent. Ingrowth of tissue in uncovered stents may lead to future obstruction. Sputum retention due to disturbance in ciliary clearance especially in covered stent. Covered stent may obstruct lobar bronchii. Can cause compression necrosis if over distended.		

References

1. Sioris T, Jarvenpaa R, Kuukasjarvi P, Helin H, Saarelainen S, Tarkka M 2003. Comparison of computed tomography and systematic lymph node dissection in determining TNM and stage in non-small cell lung cancer. Eur J Cardiothorac Surg 23:403-408.

2. Ginsberg RJ, Vokes EE, and Ruben A 1997. Non-small cell lung cancer. DeVita VT, Hellman S, and Rosenberg SA. Cancer principles and practice of oncology 5th ed, Philadelphia: Lippincott-Raven. 858-911.

3. Wood DE 2002. Management of malignant tracheobronchial obstruction. Surg Clin North Am 82:621-642.

4. Mathisen DJ, Grillo HC 1989. Endoscopic relief of malignant airway obstruction. Ann Thorac Surg 48:469-473.

5. Stephens KE, Jr., Wood DE 2000. Bronchoscopic management of central airway obstruction. J Thorac Cardiovasc Surg 119:289-296.

6. Bertoletti L, Elleuch R, Kaczmarek D, Jean-Francois R, Vergnon JM 2006. Bronchoscopic Cryotherapy Treatment of Isolated Endoluminal Typical Carcinoid Tumor Chest 130:1405-1411.

7. Moghissi K 2004. Role of bronchoscopic photodynamic therapy in lung cancer management. Curr Opin Pulm Med 10:256-260.

8. Cavaliere S, Foccoli P, Toninelli C, Venuta F, La Face B 1996. Endoscopic treatment of malignant airway obstructions in 2008 patients. Chest 110:1536-1542.

9. Dougherty TJ 2002. An update on photodynamic therapy applications. J Clin Laser Med Surg 20:3-7.

10. Moghissi K, Dixon K 2003. Is bronchoscopic photodynamic therapy a therapeutic option in lung cancer? Eur Respir J 22:535-541.

11. Dumon JF 1990. A dedicated tracheobronchial stent. Chest 97:328-332.

12. Bolliger CT, Probst R, Tschopp K, Soler M, Perruchoud AP 1993. Silicone stents in the management of inoperable tracheobronchial stenoses. Indications and limitations. Chest 104:1653-1659.

13. Martinez-Ballarin JI, az-Jimenez JP, Castro MJ, Moya JA 1996. Silicone stents in the management of benign tracheobronchial stenoses. Tolerance and early results in 63 patients. Chest 109:626-629.

14. Gildea TR, Murthy SC, Sahoo D, Mason DP, Mehta AC 2006. Performance of a self-expanding silicone stent in palliation of benign airway conditions. Chest 130:1419-1423.

15. Wassermann K, Koch A, Muller-Ehmsen J, Reuter M, Michel O, Eckel HE 1997. Clinical and laboratory evaluation of a new thin-walled self-expanding tracheobronchial silicone stent: progress and pitfalls. J Thorac Cardiovasc Surg 114:527-534.

16. Saad CP, Murthy S, Krizmanich G, Mehta AC 2003. Self-expandable metallic airway stents and flexible bronchoscopy: long-term outcomes analysis. Chest 124:1993-1999.

17. Dasgupta A, Dolmatch BL, bi-Saleh WJ, Mathur PN, Mehta AC 1998. Self-expandable metallic airway stent insertion employing flexible bronchoscopy: preliminary results. Chest 114:106-109.

18. Miyazawa T, Yamakido M, Ikeda S, Furukawa K, Takiguchi Y, Tada H, Shirakusa T 2000. Implantation of ultraflex nitinol stents in malignant tracheobronchial stenoses. Chest 118:959-965.