CLINICAL FORUM

Interventional bronchoscopy for tuberculous tracheobronchial stenosis

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Interventional bronchoscopy for tuberculous tracheobronchial stenosis. S-Y. Low, A. Hsu, P. Eng. ©ERS Journals Ltd 2004.
ABSTRACT: This study investigated the use of interventional bronchoscopic techniques in the management of patients with symptomatic tracheobronchial stenosis from tuberculosis.

The current authors evaluated their experience with interventional bronchoscopic techniques in 21 consecutive patients at the Singapore General Hospital, Singapore, from November 1994 to March 2001. All patients underwent rigid bronchocopy using the Dumon rigid ventilating bronchosope under general anaesthesia. A combination of techniques was used (mechanical or balloon dilatation, Nd-YAG laser and stenting using the Dumon stent).

The mean±SD increase in luminal diameter of the tracheal lesions was from 4.5±2.5 mm pre-procedure to 11.9±1.7 mm post-procedure, whereas that for the mainstem bronchi stenosis was from 2.6±1.0 mm to 8.3±2.4 mm. All patients had immediate relief of symptoms post-intervention. Two patients who presented with acute respiratory failure could be weaned off mechanical ventilation immediately post-procedure. At the end of the study period, 52% (11 out of 21) remained asymptomatic.

Bronchoscopic intervention provided immediate symptomatic relief in all of the studied patients. However, repeated sessions may be required to maintain this improvement. It is concluded that interventional bronchoscopic techniques are useful in the management of patients with tracheobronchial stenosis from tuberculosis.
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Tracheobronchial stenosis due to tuberculosis (TSTB) was first described in 1689 by Richard Morton, an English physician [1]. Despite the decline in pulmonary tuberculosis with the advent of effective chemotherapy, TSTB continues to be under-recognised and often misdiagnosed. Major airway obstruction from luminal stenosis can develop despite adequate anti-tuberculous drug treatment. Surgical treatment has been advocated as the best modality for management of such strictures [2]. However, some patients have long stenotic segments or severe stenosis at two levels, with compromised pulmonary reserve precluding curative surgery [3]. The current authors reviewed their experience with interventional bronchoscopy in the treatment of TSTB.

Materials and methods

A retrospective study of 21 patients with symptomatic TSTB, treated with interventional bronchoscopy at the Singapore General Hospital, Singapore, a tertiary care university-affiliated hospital, was conducted between November 1994 and March 2001. All patients' charts were reviewed and TSTB was diagnosed in all of the patients using flexible bronchoscopy. Active tuberculosis was defined as a positive acid-fast bacilli smear or mycobacterium culture from bronchial aspirate or bronchial biopsy. The rest of the patients had a definite past history of tuberculosis.

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All patients underwent at least one interventional bronchoscopic procedure with Nd-YAG laser (Lasersonics, Division of Heraeus, Milpitas, CA, USA), mechanical or balloon dilatation, and/or stenting. This was performed in the operating room under general anaesthesia using the Dumon rigid ventilatory bronchoscope (Efer, La Ciotat, France). The main anaesthetic agents used were fentanyl (2 µg·kg⁻¹, where the maximum amount used was 50 µg) or alfentanyl (5–20 µg·kg⁻¹) and propofol (2 mg·kg⁻¹). Other agents included atropine (0.6 mg), glycopyrrolate (0.1–0.2 mg), midazolam (1–5 mg) or lorazepam (1 mg). Intubation with the largest fitting rigid bronchoscope was then performed. This was followed by dilatation using progressively larger diameter rigid brochoscopes. The Nd-YAG laser was used sparingly, mainly to resect fibrous bands. The laser was set in the intermittent mode at a power of 40 W and pulse duration of 0.4 s. If stenosis was very severe, balloon dilatation preceded mechanical dilatation. Balloon dilatation was performed using a 7-French 15-mm oesophageal balloon (Microinvasive; Boston Scientific Corporation, Natick, MA, USA), which was inflated with normal saline until resistance was felt. Each inflation cycle was 20 s and this was repeated as necessary. Care was taken not to overinflate the balloon, in order to minimise the risk of airway perforation. The Dumon silicone stent (Axion, Aubaque, France) was the only type of stent used and it was inserted according to the original technique described by DUMON [4].

The luminal diameters of the airway pre- and post-treatment were visually assessed. Patients were followed-up

within 1 month after discharge and regularly thereafter as per physician's discretion.

Results

Patients' baseline characteristics are summarised in table 1. In the current study, all of the patients had associated parenchymal tuberculous disease, and patients who had active tuberculosis had mycobacterium tuberculosis that was sensitive to first-line drugs. Patients' symptomatology is described in table 2. Two of the studied patients presented with acute respiratory failure. Most of the strictures (50%) were in the left mainstem bronchus (fig. 1). In total, 16 out of the 21 patients (76%) had one stricture each, whereas the other five patients had two strictures each. Of these five patients who had two strictures each, three patients had strictures in the trachea and left mainstem bronchus, whereas the remaining two patients had strictures in the trachea and right mainstem bronchus. The mean±SD luminal diameters of the tracheal and mainstem bronchi strictures were 4.5±2.5 mm and 2.6±1.0 mm, respectively. A total of 11 patients (52%) had stents inserted, of which eight received a single stent and three had two stents. Four patients failed stenting because one stent covered the right upper lobe orifice, and was hence removed, and the other three could not be deployed fully. The mean luminal diameter of the tracheal strictures increased by 164% from 4.5±2.5 mm pre-treatment to 11.9±1.7 mm post-treatment, whereas that of the mainstem bronchi increased by 219% from 2.6±1.0 mm to 8.3±2.4 mm. Two patients who required emergency mechanical ventilation could be extubated immediately post-procedure. All patients achieved immediate symptomatic relief after their bronchoscopic intervention. Final outcomes at the end of the follow-up are shown in table 3. One patient ultimately underwent a left pneumonectomy because of recurrent chest infections, despite
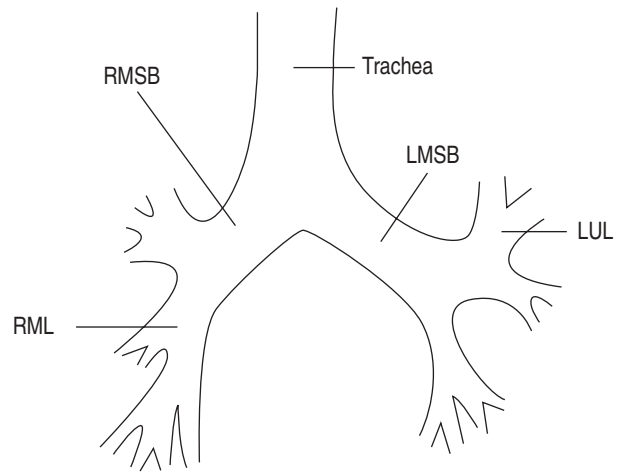

Fig. 1. – Strictures were located in the lung as follows: trachea (n=7); left mainstem bronchus (LMSB; n=13); left upper lobe (LUL; n=1); right middle lobe (RML; n=1); and right mainstem bronchus (RMSB; n=4).

repeated interventional bronchoscopic procedures. Of the remaining 20 patients, 11 were asymptomatic. The median duration of follow-up was 25 months.

Discussion

TSTB is not uncommon. SALKIN *et al.* [5] reported the incidence of TSTB in patients with active pulmonary tuberculosis as 15.5%, whereas SO *et al.* [6] reported their incidence in Hong Kong to be 18%. The impact of treatment with antituberculous chemotherapy and even steroids on the evolution of active tuberculous endobronchitis remains unclear [7–10]. The pathogenesis of this disease is thought to be from direct innoculation of tubercle bacilli into the bronchus [1].

The diagnosis of TSTB is usually delayed as chest radiography and flow/volume curves are insensitive [5, 7]. Flexible bronchoscopy remains the most useful modality for diagnosis and assessment if the diagnosis is suspected [11]. Of the 21 patients in the current study, 16 (76%) were female. This predominance in the female sex has also been reported in Japan [2], Hong Kong [7] and Korea [10, 12]. It is postulated that this might be as a result of a narrower bronchus and the fact that females expectorate less, resulting in stasis of sputum containing tuberculous bacilli on the bronchial wall. As in other studies [2], the left mainstem bronchus was the most common site for TSTB in the studied patients. This could be because the left mainstem bronchus is easily compressed by the aortic arch. Lymph node tuberculosis is also more often

Table 1. – Baseline characteristics of the patients

Age yrs	43.2±15.5
Patients n	21
Female	16 (76)
Male	5 (24)
Race	
Chinese	17 (81)
Others	4 (19)
Active tuberculosis	
Received <1 month treatment before intervention	3 (14)
Intervention at the end of drug therapy	6 (29)
Inactive tuberculosis	
Patients n	12 (57)
Length of disease free interval	16.5 (1–40)

Data are presented as mean±SD, n (%) and median (range).

Table 2. – Symptoms at presentation

Symptom	Patients		
	All	Active	Inactive
Patients n	21	9	12
Cough	18 (86)	9 (100)	9 (75)
Dyspnoea	12 (57)	5 (56)	7 (58)
Loss of weight	6 (29)	2 (22)	4 (33)
Fever	5 (24)	1 (11)	4 (33)
Wheeze	4 (19)	4 (44)	0 (0)
Acute respiratory failure requiring mechanical ventilation	2 (9.5)	1 (11)	1 (8)
Duration of symptoms prior to diagnosis months	3 (0.2–48)	4 (0.5–24)	2.5 (0.2–48)

Data are presented as n, n (%) and median (range).

Table 3. – Outcomes based on number of procedures

Procedures[#]	Patients n	Reason for repeat procedures	Patients' final outcome at the end of follow-up
1	14	NA	7 asymptomatic; 2 effort dyspnoea (1 defaulted, 1 considering repeat procedure); 4 chronic cough (2 failed stenting, 2 stents *in situ*); 1 recurrent chest infections (considering surgery)
2	2	Restenosis; stent migration and granulation tissue	1 asymptomatic; 1 recurrent chest infections (defaulted)
3	4	Restenosis and/or stent migration	2 asymptomatic; 1 recurrent chest infections (underwent left pneumonectomy); 1 chronic cough (failed stenting)
5	1	Granulation tissue	1 asymptomatic

NA: not applicable. [#]: n=35.

noted on the left, making the left mainstem bronchus more vulnerable to pathological strictures.

The current patients were not suitable for surgical bronchoplasty as the primary modality of treatment because most had either multiple or long-segment involvement, or inadequate pulmonary reserve. In fact, two patients presented *in extremis* with acute respiratory failure requiring immediate intubation. They were weaned from mechanical ventilation immediately following the procedure. All patients had immediate amelioration of their symptoms and there was no mortality in the current study. In the long term, 52% (11 out of 21) of the patients remained asymptomatic at the end of the follow-up period. Stents were used to reduce the risk of restenosis and were helpful in malacic airways, but repeat procedure was required in 19% (four out of 21) of the patients because of specific stent-related complications [13], including migration (two out of 21), granulation (one out of 21) or both (one out of 21). A major disadvantage of bronchoscopic management is that repeat sessions may be required [14]. This is similar to the study by WAN *et al.* [15], who reported their experience with interventional bronchoscopy in seven patients with TSTB. This illustrates the palliative nature of interventional bronchoscopic techniques for the management of airway stenoses. The current authors still feel that suitable patients should be considered for potentially curative bronchoplasty [16].

Conclusions

Interventional bronchoscopy offers immediate palliation of respiratory symptoms in cases with tracheobronchial stenosis due to tuberculosis. In a select subgroup, this improvement can be as dramatic as liberation from mechanical ventilation. This provides an alternative in the group of patients with severe tracheobronchial stenosis due to tuberculosis who are unsuitable for curative surgical resection.

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