Negative results - Pulmonary

Catastrophic haemoptysis during rigid bronchoscopy: a discussion of treatment options to salvage patients during catastrophic haemoptysis at rigid bronchoscopy

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Received 29 April 2003; received in revised form 27 October 2003; accepted 11 November 2003

Abstract

Objective: We report a negative experience of fatal haemorrhage during rigid bronchoscopy when an intrabronchial lesion was biopsied. Despite being prepared for and carrying out emergency sternotomy and clamping the lung hilum, the patient died. Methods: We reviewed mainly non-surgical literature for recommendations for the management of catastrophic bleeding at bronchoscopy. Results: The literature does provide advice for management of ‘massive haemoptysis’ defined as more than 600 ml in 24 h and ‘exsanguinating haemoptysis’ which is at least 1000 ml blood loss at a rate more than 150 ml/h. However there is little in the current surgical literature on the immediate treatment of ‘catastrophic haemoptysis’ which we define as major bleeding from the airway causing an immediate threat to life requiring immediate surgery. Gathering treatment options from various authors we present a suggested protocol for the management of this thoracic surgical emergency. Conclusions: We recommend the initial salvage treatment to be: (1) wedge the rigid bronchoscope into the haemorrhaging bronchus, (2) tamponade the bleeding site with a balloon-tipped vascular catheter, (3) remove the bronchoscope and intubate with a double-lumen tube, (4) undertake emergency definitive surgery. We strongly recommend that a suitable catheter be kept immediately available for this very rare but dangerous complication.

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Keywords: Haemoptysis; Bronchoscopy; Massive; Catastrophic; Balloon

1. Introduction

Recommendations for managing massive haemoptysis are: initial resuscitation; risk-assessment to help determine the level of initial medical care; bronchoscopy and early pulmonary resection in most cases provide the best outcome.

We report a case of fatal haemorrhage during rigid bronchoscopy and biopsy in a 48-year-old female. Despite aggressive resuscitation measures with emergency intubation, immediate sternotomy, clamping the lung hilum, atrial access and internal cardiac massage, the patient died.

This is a case of ‘catastrophic haemoptysis’ defined as major bleeding from the airway causing an immediate threat to life requiring immediate surgery. This has prompted us to review the literature for recommendations for management in such an episode.

2. Materials and methods

A 48-year-old woman was admitted acutely with a 24-h history of haemoptysis, approximately 300 ml in total. Fibre optic bronchoscopy by a chest physician showed the bronchus intermedius to be occluded by blood clot and minor fresh bleeding. For fear of haemorrhage this was not disturbed and no biopsy was taken. Computed tomography of thorax was performed on a 4 slice multidetector CT scanner (Siemens Somatron Volume Zoom) using 2.5 mm collimation every 1.5 mm. One hundred millilitres of
intravenous contrast was given at 3 ml/s, initiating the scan 25 s after the injection started. An intrabronchial mass lesion was found in the distal bronchus intermedius (Fig. 1). There was no suggestion from the CT angiographic appearance that this was a primary vascular anomaly. She was referred for urgent rigid bronchoscopy, the most likely working diagnosis being carcinoid tumour.

Rigid bronchoscopy was undertaken with fully informed consent for emergency lung resection if required. The operation theatre was prepared for emergency sternotomy/thoracotomy if necessary. At rigid bronchoscopy an intrabronchial lesion was seen in the bronchus intermedius covered in blood clot, corresponding with the CT appearance and being consistent with an intrabronchial tumour. Biopsy produced torrential haemorrhage, 500 ml in the first 60 s. The bleeding could not be controlled nor the view maintained with suction and so the bronchoscope was removed to allow emergency intubation while intravenous fluid resuscitation commenced. The bleeding from the airway was so brisk that the anaesthetist had difficulty visualising the larynx despite suction. Cardiac output failed rapidly and external cardiac massage was commenced. A median sternotomy was performed immediately. Despite clamping the right lung hilum, giving aggressive resuscitation with intra-atrial access and performing internal cardiac massage, the patient died.

Post mortem revealed a 1 × 2 cm eroded area in the bronchus intermedius with large calibre arteries lying close to the bronchial surface. Histology showed abnormal dilated, thin-walled vessels close to the luminal surface of the bronchus, but no evidence of tumour, tuberculosis or vasculitis. In conclusion the lesion seen and biopsied at bronchoscopy was probably a vascular malformation of the pulmonary artery, which, even on retrospective review of vessels on a modern contrast CT, was not evident preoperatively. At bronchoscopy it had the appearance of an intraluminal tumour.

3. Results of literature survey

It is well known that mortality due to haemoptysis is related to the rate of bleeding, especially when this is over 600 ml in 24 h [1]. This is the basis of the classical definition of ‘massive haemoptysis’.

Following initial resuscitation individuals can be risk-assessed using the rate of bleeding, lung function, co-morbidity, and coagulopathy [2]. This can help to determine the level of medical support and monitoring that is needed such as admission to ITU and the timescale for invasive diagnostic and therapeutic measures. However the unpredictable and recurrent nature of massive haemoptysis means that apparently stable patients can rapidly deteriorate into a life-threatening state [2].

Therapeutic options are: medical management only [3], endobronchial measures, bronchial artery embolisation [2,4], external radiation and surgery. Endobronchial techniques that have had support in the literature are bronchial lavage with iced saline [2], irrigation with vasoconstrictors [2,3,5], topical anticoagulants [3], balloon tamponade [2,6–10], pulmonary separation [2,7,8] and in special circumstances laser ablation [3]. Several studies have compared medical treatment versus early definitive surgery with outcomes of survival and re-bleeding favouring surgery [6–8,11]. The major cause for intra-operative mortality is continued bleeding therefore pulmonary resections are ideally undertaken when patients are not actively bleeding. It is usually not appropriate to wait for this to occur spontaneously.

4. Discussion

Our case report demonstrates the need for widespread awareness of an endobronchial technique to control bleeding of such magnitude that it is likely to be fatal within a few minutes despite the presence of a rigid bronchoscope with suction. The literature fails to specify recommendations for management in such episodes of ‘catastrophic haemoptysis’. This may be because such cases are few in number and are usually fatal before any intervention can occur.

Techniques described for use in massive haemoptysis such as external radiation, and bronchial artery embolisation have no role in emergency salvage procedures. Bronchial irrigation with iced saline, vasoconstrictive agents or anticoagulants would not be helpful since they would be dissipated before reaching the site of haemorrhage.
Laser application would be equally unsuitable in catastrophic haemoptysis.

Catastrophic haemoptysis could be controlled with gauze swabs soaked in vasoconstrictors packed into the bleeding bronchus [2]. The lack of control of swabs that have the potential to become mobile during re-positioning of the patient means they may subsequently endanger life rather than be life-saving.

Tamponade using Fogarty-like catheters passed down the rigid bronchoscope appear to be the best method of achieving control of the bleeding and protection of the contra-lateral lung allowing effective ventilation and resuscitation whilst the patient undergoes definitive surgery. Several authors have used endobronchial balloon tamponade successfully to treat massive or exsanguinating haemoptysis either as definitive treatment or to stabilise the patient prior to surgery [7–10,12]. Most of these reports are not in recent thoracic surgical literature.

Fatal haemoptysis is more commonly caused by asphyxiation than exsanguination because flooding of the alveoli with blood causes irreversible progressive hypoxia [3,4,7]. However in cases of ‘catastrophic haemoptysis’ death from exsanguination is likely to happen rapidly even if ventilation is maintained [8]. Since the major cause for intra-operative mortality is continued bleeding [7,8], techniques of pulmonary separation and unilateral ventilation that do not tamponade or at least block the bleeding lung are not recommended.

Is there a place therefore for techniques of pulmonary separation through double-lumen endotracheal intubation? Attempts to insert a double-lumen tube as the initial life-saving measure may increase morbidity and mortality [7,8]. Difficulty in correct placement, blocking of their lumen by blood and the risk of displacement with loss of lung separation mean a double-lumen tube should not be used a priori for this purpose. Once bleeding is controlled by a tamponade procedure through the rigid bronchoscope, the airways can be suctioned clear of blood, the rigid bronchoscope removed and a double lumen tube placed precisely.

The above discussion assumes that all efforts have already been made to rule out a significant pulmonary vascular abnormality, as biopsy of these is very hazardous. In our patient, modern contrast CT had not shown a vascular abnormality but an intrabronchial mass lesion, which did not contain contrast. Endo et al. [13] have recently reported their experience of treating massive haemoptysis in this Journal and highlighted the role of embolotherapy in patients whose source of bleeding can be proven to be vascular anomaly on initial CT scan or angiography without recourse to hazardous biopsy.

4.1. Suggested protocol for managing catastrophic bleeding at rigid bronchoscopy

Our recommendation for control of catastrophic haemorrhage from an identifiable source at rigid bronchoscopy (assuming vascular anomaly has not been evident on contrast CT scan) is as follows:

1. Do not remove the rigid bronchoscope. Wedge the bronchoscope into the bleeding bronchus to achieve at least partial tamponade whilst suctioning blood and ventilating the contra-lateral lung through the side-holes
2. Pass a deflated balloon-tipped vascular catheter [we would propose to use a 7Fr 120 cm length vascular catheter with a 2 cm length 14 mm diameter balloon (supplied by Boston Scientific though they do not recommend it for this use)]. This, or a similar device is now kept with the bronchoscopy equipment] without guide-wire down the lumen of the scope until the balloon lies just distal to the end of the bronchoscope
3. Withdraw the bronchoscope and balloon slowly until the estimated main source of haemorrhage comes into view
4. Inflate the balloon and assess for control of the bleeding with suctioning
5. If control is not attained deflate the balloon and withdraw the bronchoscope and balloon 1 cm, inflate the balloon and reassess
6. Once control is achieved the rigid bronchoscope can be removed whilst carefully leaving the catheter in place
7. A single-lumen or preferably a double-lumen endotra-cheal tube can be passed and the patient positioned for an emergency thoracotomy and lung resection. The double lumen would be a second-line safety measure should the balloon later fail: the tracheal cuff would act as a blocker and the endobronchial cuff would protect the contra-lateral lung.

References


Appendix A. ICVTS on-line discussion

Author: Dr. Sameh Sersar, Mansoura University, Department of Cardiothoracic surgery, Mansoura, Egypt

Date: 04-Jan-2004

Message: I have a few comments. First of all, the definitions of haemoptysis are to be reevaluated. I believe that the amount of haemoptysis should be defined according to the body size index or weight of the pediatric patients (1). I also prefer if this definition includes all patients whatever the age, sex or body weight. The anatomical dead space of the major air way is a major determinant. It equals 2–3 cm/kg body weight. The literature does provide advice for management of massive haemoptysis defined as more than 600 ml in 24 h and exsanguinating haemoptysis which is at least 1000 ml blood loss at a rate more than 150 ml/h. However, there is little in the current surgical literature on the immediate treatment of catastrophic haemoptysis which we define as major bleeding from the airway causing an immediate threat to life requiring immediate surgery. Massive haemoptysis is defined also as expectoration of an amount of blood more than the anatomical dead space (2–3 ml/kg) (2). Haemoptysis was categorized as mild (150 ml/day), large (150 to 400 ml/day), or massive (400 ml/day) for an adult patient – as we understood and for a pediatric series as the authors mentioned. I believe that the amount of haemoptysis should be defined according to the body size index or weight of the pediatric patient. Toker et al. (1) considered 3 consecutive days of hemoptysis of 50 ml for a girl weighing 30 kg to be an indication for endobronchial evaluation. This could be accepted as a sign of life threatening hemoptysis, which could be considered to be 200 ml in a single episode. Toker et al. (1) stated that the amount of hemoptysis was reported to be a significant predictor of death only for patients with congenital heart disease. I do not agree with this statement at all. Otherwise these definitions of haemoptysis are of no clinical or therapeutic value. Their statement means that the treatment of all cases of haemoptysis is the same which I do not believe. They stated that in their study they considered 3 consecutive days of haemoptysis of 50 ml for a girl weighing 30 kg to be an indication for endobronchial evaluation. We do believe that this is a late decision for a significant amount of haemoptysis.

References


Response

Author: Mr. Richard G. Berrisford, Consultant Thoracic Surgeon, Royal Devon and Exeter NHS Trust, Department of Thoracic Surgery, Barrack Road, Exeter EX2 5DW, UK

Date: 09-Jan-2004

Message: Thank you for your comments which highlight the undoubted controversy about definitions of haemoptysis. Linkage to BMI and dead space volume does seem sensible. The main reason for our paper, however, is to specifically highlight the management of a patient who is exsanguinating within minutes – and to alert surgeons to the steps they can take to salvage such a patient.