

Management of massive haemoptysis with the rigid bronchoscope and cold saline lavage

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ABSTRACT Twelve successive patients with massive haemoptysis were treated by emergency rigid bronchoscopy and lavage of the bleeding lung with cold saline. All patients stopped bleeding during the procedure and all blood and clot was evacuated from the accessible airways. The bleeding source was localised to a lobe in seven cases, and lateralised in the remaining five patients. Two patients had a second haemorrhage during that hospital stay and cold saline lavage again terminated it. Further therapy, either surgical or medical was based on information obtained during the respite from haemorrhage achieved with this technique. There was no hospital mortality in the series.

The conservative management of haemoptysis is generally successful, but 10-15% of all patients with haemoptysis may bleed to a life-threatening extent.^{1 2} This figure includes patients with limited pulmonary reserve in whom the spillage of moderate amounts of blood into the tracheo-bronchial tree causes critical deterioration in lung function, and those in danger of asphyxiation from the sheer volume of blood aspirated. The various methods of management of life-threatening haemoptysis include drug therapy endoscopic control measures (endobronchial balloon tamponade, topical adrenalin application, and lung isolation with double lumen endotracheal tubes), bronchial artery embolisation techniques, and lung resection. The performance of a pulmonary resection on a patient who is actively bleeding and whose respiratory reserve is unknown is necessarily hazardous. The occurrence of massive haemoptysis in poor risk patients has encouraged the development of non-surgical methods of management. Our experience with emergency rigid bronchoscopy and cold saline lavage in 12 patients with massive haemoptysis forms the basis of this report. No similar experience has been reported.

Patients and methods

During the period August 1978-June 1979 inclusive, 12 patients with massive haemoptysis were treated by the combined Thoracic Surgery and Respiratory Medicine Services of Baragwanath Hospital, Johannesburg. Our definition of massive haemoptysis was the expectoration of more than 600 ml of blood within a 24-hour period after hospital admission. There were 11 men and one woman and all were black or of mixed race and from the poorest socioeconomic background. Eleven of the 12 patients were new cases to our services. The age range was from 28 to 60 years. After a preliminary assessment of the clinical and respiratory state our standard medical regimen for the management of continued haemoptysis was begun. The essentials of this regime were strict bedrest in the semi-sitting position, or posture with the radiologically normal lung uppermost. A controlled humidified oxygen and air mixture was given by face mask and diazepam 5 mg every six hours was commenced. A large bore intravenous cannula was inserted into a peripheral vein and four units of whole blood were grouped and crossmatched. Arterial blood gases were obtained on admission and thereafter if clinical deterioration was suspected. The prothrombin index, platelet count, and blood creatinine, urea and electrolytes were estimated urgently. Good quality chest radiographs (posteroanterior and left lateral views)

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Table 1 *Diagnosis and location of pathology*

| Case | Age (yr) | Sex | Diagnosis | Volume haemoptysis (ml/24hr) | Site of bleeding |
|------|----------|-----|---------------------------|------------------------------|------------------|
| 1 | 51 | M | Bronchiectasis | 1000 | Left upper lobe |
| 2 | 55 | M | Bronchiectasis | 1000 | Right lung |
| 3 | 33 | F | Bronchiectasis | 600 | Right lung |
| 4 | 52 | M | Recurrent pneumonia | 600 | Left lower lobe |
| 5 | 46 | M | Tuberculosis | 600 | Left upper lobe |
| 6 | 28 | M | Bronchiectasis | 1000 | Right upper lobe |
| 7 | 58 | M | Tuberculosis | 600 | Left upper lobe |
| 8 | 39 | M | Tuberculosis | 600 | Left lung |
| 9 | 44 | M | Tuberculosis | 1000 | Left lung |
| 10 | 36 | M | Lung abscess | 1000 | Left lung |
| 11 | 45 | M | Giant pulmonary hamartoma | 900 | Right lower lobe |
| 12 | 29 | M | Bronchiectasis | 1000 | Right upper lobe |

were obtained in the x-ray department as an emergency. All blood coughed up was collected and its volume estimated. Antibiotics were given if the sputum was frankly purulent. If the volume of haemoptysis exceeded 600 ml within 24 hours or less, emergency rigid bronchoscopy and cold saline pulmonary lavage was carried out and suitable preparations for an immediate thoracotomy were made. The diagnosis, the volume of haemoptysis and the localisation of bleeding at endoscopy for each patient are summarised in table 1.

The technique of rigid bronchoscopy in these actively bleeding patients differs in several aspects from the routine. An electrocardiograph was connected to the patient. General anaesthesia was induced, often with the patient propped up on the transport trolley after some preoxygenation. An adult-sized rigid bronchoscope was introduced through the vocal cords into the trachea. A wide bore oesophagoscope sucker was used for speedy evacuation of blood and clot from the major airways. The bronchoscope was then advanced to intubate the main bronchus on the non-bleeding side. Oxygenation was maintained using the Sanders injector device or by inserting an endotracheal tube into the proximal end of the bronchoscope and intermittently insufflating with oxygen. A period of gas exchange then permitted

stabilisation of the patient's condition. The bronchoscope was next introduced into the bronchus on the side of the bleeding and blood and clot were evacuated. Irrigation with normal saline at 4°C in 50 ml aliquots was started. Each 50 ml instillation was sucked out after approximately 30–60 seconds, the normal side was reintubated and gas exchange continued. By alternate intubation both gas exchange and irrigation proceeded apace. As bleeding slowed in response to the cold irrigation, lobar localisation became possible, the appropriate lobar bronchus was then intubated and a local irrigation was carried out. There was a considerable reduction of bleeding after several cold saline instillations. The bronchoscope was then withdrawn into the trachea between irrigation periods, permitting the use of both lungs for gas exchange. The average volume of irrigation fluid was 500 ml per patient (range 300–750 ml), when all apparent bleeding had ceased and all blood and clot had been removed from both lungs a routine examination of the tracheobronchial tree was performed. Washings were collected for bacteriological and cytological examination. General anaesthesia was reversed at this point, the patient was postured thereafter with the pathological lung dependent and our conservative regime was restarted. Table 2 contains a summary of the endoscopic and

Table 2 *Management and results*

| Case | Management | Result |
|------|--|--|
| 1 | Bronchoscopy and cold lavage × 2 | Free of haemoptysis at one year |
| 2 | Bronchoscopy and cold lavage × 2 Extrapleural pneumonectomy | Well one year after operation |
| 3 | Bronchoscopy and cold lavage Extrapleural pneumonectomy | Well one year after operation |
| 4 | Bronchoscopy and cold lavage | Discharged free of haemoptysis at three weeks. Refused operation |
| 5 | Bronchoscopy and cold lavage | Discharged free of haemoptysis on TB chemotherapy |
| 6 | Bronchoscopy and cold lavage | Discharged free of haemoptysis. Refused operation |
| 7 | Bronchoscopy and cold lavage | Discharged free of haemoptysis on TB chemotherapy |
| 8 | Bronchoscopy and cold lavage | Discharged free of haemoptysis on TB chemotherapy |
| 9 | Bronchoscopy and cold lavage | Discharged free of haemoptysis. Refused operation |
| 10 | Bronchoscopy and cold lavage | Discharged free of haemoptysis. Refused operation |
| 11 | Bronchoscopy and cold lavage | Discharged free of haemoptysis. Died three months later in respiratory failure |
| 12 | Bronchoscopy and cold lavage Anterior segmentectomy of right upper lobe | Asymptomatic six months after operation |

operative procedures performed, treatment given, and available follow-up.

Results

All patients stopped bleeding during the endoscopy and lavage, and no patient required emergency thoracotomy. The haemorrhage was shown to be localised to a lobe, segment group or segment in seven patients and lateralisation was possible in the other five patients. A transient sinus bradycardia was observed in one patient during the cold irrigation. Two patients suffered further episodes of massive haemoptysis during the same hospital admission, three days and 10 days after the initial procedure. One of these patients had refused operation, while the second patient had poor respiratory function and was in severe heart failure making any operation extremely hazardous. Both these patients were controlled by a second bronchoscopy and cold saline lavage. Four patients had active tuberculosis. Five patients had bronchiectasis with superimposed fungal or bacterial infections. One patient had a lung abscess and one had a post-aspiration chronic destructive pneumonia. The remaining patient had a giant pulmonary hamartoma. Of the five patients with bronchiectasis, three subsequently had elective pulmonary resections and two refused operation. The remaining patients were treated medically. All patients were discharged from hospital free from haemoptysis.

Discussion

The massive spillage of blood into the tracheo-bronchial tree necessitates urgent bronchoscopic localisation of the bleeding site and expeditious treatment either an interim endoscopic control measure or immediate resection of the diseased pulmonary parenchyma.²⁻⁴ The decision to undertake an emergency operation is easily made when bleeding has been localised and controlled and the pulmonary reserve of the patient is known to be adequate for the proposed resection. The medical management of massive, life-threatening haemoptysis may incur a mortality of between 50% and 80%.^{1 5 6} Substantial reduction in mortality with surgical management has been reported by Crocco *et al.*,¹ McCallum *et al.*,³ and Mattox and Guinn.⁷ How-management has been reported by Crocco *et al.*,¹ remains between 22% and 37%.^{1 3 5} The surgical mortality occurs in those patients actively bleeding at the time of operation as defined by

Crocco *et al.*¹ Often excluded from surgical series, but included in medical series and making a large contribution to the high mortality, are those patients suffering from disseminated pulmonary carcinoma, coagulopathies, serious cardiac disease, or severely compromised lung function. Mortality is also high in those patients in whom the localisation of bleeding has not been achieved, and in those refusing operation. Saw *et al.*¹ introduced endobronchial balloon tamponade using the flexible bronchoscope and controlled life-threatening haemoptysis in 10 successive patients. Remy *et al.*⁸ reported on 104 patients with life-threatening haemoptysis managed by bronchial artery embolisation. Forty-seven of their patients were actively bleeding at the time of intervention and control of haemorrhage was achieved in all. Wholey *et al.*⁶ reported control of massive haemorrhage in all five patients managed by bronchial arterial embolisation. Endoscopic control may also be achieved by endobronchial tamponade with a pack or swab, topical application of adrenaline solutions or the separation of bleeding and non-bleeding lungs with a double lumen endotracheal tube.

Although the flexible fiberoptic bronchoscope is the instrument of choice for most cases of haemoptysis, massive life-threatening haemoptysis is best managed with the rigid bronchoscope. The narrow suction channel of the flexible instrument is incapable of evacuating large volumes of blood rapidly and the optical system becomes obscured in the presence of large amounts of endobronchial blood. The rigid instrument excels both as an assured airway and as a conduit for the passage of large suction cannulae. The widespread adoption by many disciplines of flexible bronchoscopy has resulted in fewer applications of the rigid bronchoscope, but training in its use should remain an essential part of thoracic surgery programmes.

Massive haemoptysis was caused by inflammatory disease of the pulmonary parenchyma in 11 of our 12 patients. The pulmonary reserve of the majority of our cases was assessed clinically as marginal or was unknown. All patients were actively bleeding and their lives were in danger. Emergency operation would have carried a considerable mortality. The endoscopic cold saline irrigation technique proved effective and safe. The respite from haemoptysis allowed more accurate clinical and respiratory assessment of the patients and for a definitive diagnosis to be made in all. The patients suitable for pulmonary resections were defined and after bronchography were subjected to elective and where

applicable, lung-sparing pulmonary resection.

Massive bleeding into the tracheobronchial tree is usually from the bronchial arterial system. The injection studies of the bronchial vasculature in inflammatory disease of the pulmonary parenchyma carried out by Cudkowicz⁹ in 1952 and Marchand *et al*¹⁰ in 1950, confirm this observation. Pulmonary arterial branches to inflamed areas of lung are thrombosed and obliterated early on in the inflammatory process. Bronchial arterial vessels enlarge as do "connecting vessels" between the bronchial and pulmonary arterial systems. These thin-walled, enlarging vessels carrying blood at systemic pressure traverse inflamed and necrotic areas of lung, and once breached flood the tracheobronchial tree. Marchand *et al*¹⁰ demonstrated not only increased bronchial arterial blood flow to areas of parenchymal inflammation in the lung, but also increased vascularity of that particular lobe and lung. The success of bronchial artery embolisation techniques in controlling massive haemoptysis corroborates the role of these vessels in life-threatening bleeding. The bronchial arteries contain the vaso-responsive mural musculature, typical of systemic arterial vessels. We believe that vasoconstriction occurs in response to the cold irrigation solution resulting in considerable reduction of blood flow and favouring thrombotic occlusion of the distal breached vessels. Saline irrigation of the lung has been used successfully in various pulmonary disorders, such as fibrocystic disease and alveolar proteinosis. Our technique uses modest volumes of cold irrigation fluid and is clearly a temporary control measure. Blood and clot are evacuated from the lungs, restoring lost function, and a respite from further bleeding is gained in the short term.

The availability of non-surgical methods for the early control of life-threatening haemoptysis should obviate the need for emergency surgical operation under hazardous circumstances. Life-threatening haemorrhage can be temporarily

controlled, restoring clinical stability, and allowing time for the underlying pathology to be defined and the patients' respiratory status to be determined. Resection if indicated can be carried out as a precise and elective procedure and the needless removal of healthy pulmonary tissue can be avoided.

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