Current Practice

RESPIRATORY TRACT DISEASE

Diagnosis and Treatment of Bronchiectasis—I. Diagnosis

JOHN CROFTON,* M.A., M.D.(CANTAB.), F.R.C.P., F.R.C.P.ED.

The term "bronchiectasis" is an anatomical one, indicating a widening of the bronchi. The condition is clinically important only if the bronchi become infected. The important factor predisposing to infection and its sequelae is probably not so much the mere widening of the bronchi as the damage to their walls. Drainage of the bronchial tree is normally ensured partly by ciliary action and partly by the shortening and narrowing of the bronchi on expiration, which tends to convey retained secretions towards the trachea. Damage to the bronchial mucosa, or excess mucus, may interfere with ciliary action, while damage to the bronchial muscle and elastic tissue interferes with the normal bronchial movement. In the upper lobes bronchial damage is less important, as gravity ensures adequate drainage. Bronchiectasis causing major clinical symptoms is therefore usually in the middle or lower lobes.

Diagnosis

The diagnosis of bronchiectasis can be established with certainty only by carrying out a bronchogram. The urgency of doing this will vary with the individual patient. In a young child whose symptoms are not particularly severe it may well be reasonable to wait until the child is older, as a bronchogram in a young child has to be carried out under anaesthetic, and there is a slight risk involved. In an elderly person the clinical evidence may be sufficiently good to excuse the patient the discomforts of a bronchogram. As bronchiectasis is a chronic condition which may need handling over a long period, in most intermediate cases it is wise to establish the diagnosis with certainty and to define the bronchi affected.

In most cases of bronchiectasis strong presumptive evidence of the diagnosis can be obtained from the history and physical signs. The straight chest x-ray film is usually less informative, but of course should always be taken to exclude other diseases. In the following paragraphs the history, physical signs, and radiological appearances of a straightforward case will be described, followed by the differential diagnosis and concluding with a description of the less common presentations of the disease.

History

The typical history of patients with bronchiectasis is one of a cough and sputum dating back to childhood. In most cases bronchiectasis originates in childhood, usually from a severe respiratory illness. A history of the cough having begun following a severe attack of measles, whooping-cough, or pneumonia may be obtained, though not infrequently the severe

illness may have occurred in early infancy and may have been forgotten. In most moderate or severe cases of bronchiectasis the cough is continuous all the year round, although it may be worse in winter. In some the cough may occur only for a week or two following a cold. Usually, in contradistinction to chronic bronchitis, the sputum is purulent most of the time. It may be described as yellow or green, but patients often describe their sputum inaccurately, and it is wise for the practitioner himself to observe the sputum on a number of occasions. In milder cases the quantity of sputum in the day may be only 20 or 30 ml., but in very severe cases may be as much as 500 ml. The sputum may be described as being blood-stained from time to time or there may be a history of larger haemoptyses.

If there is generalized bronchitis as well as bronchiectasis there may be a history of wheeze. The amount of breathlessness depends on the lung damage from the original illness and from subsequent infections and on the degree of chronic bronchitis. There will often be a history of recurrent exacerbations, which necessitate the patient missing work or school. The amount of general ill-health depends on the severity of the condition and the efforts which have been made to control the infection. With the present medical facilities there is often little impairment of general health, except in the most advanced cases. With better oral hygiene and better treatment in this country it is now very unusual to see the classical picture of a patient with vast quantities of foul sputum due to secondary infection with anaerobic organisms.

Physical Signs

The most important physical signs are those in the chest, and consist in localized medium or coarse crepitations, the site depending on the site of the bronchiectasis. The finding of localized coarse crepitations on one occasion is not of great importance, but if they persist or occur at intervals always at the same site this is highly suggestive. In addition there may be evidence of fibrosis, collapse, or secondary pneumonia as a result of the original illness which gave rise to the bronchiectasis, or as a secondary effect of the disease. The general condition of the patient is usually relatively unaffected, but there may be evidence of sinusitis, as infection is often continuous throughout the respiratory tract. Finger-clubbing may occur, usually in moderate or advanced cases.

Radiology

There is no specific finding in the straight chest x-ray film, which may in fact sometimes appear surprisingly normal. The most suggestive finding is of cystic spaces, perhaps 5–10 mm. in diameter, in the part of the lungs where coarse crepitations

* Professor of Respiratory Diseases, University of Edinburgh.

were heard clinically. The cysts may have fluid levels. They are not very common, having been found in only 13% of one large series. It is more usual to find evidence of residua of the original infection which gave rise to the bronchiectasis, such as collapse or fibrosis, or patchy areas of pneumonia. As clinical bronchiectasis may follow primary pulmonary tuberculosis, especially in the middle lobe, evidence of hilar calcification should be sought; and there may be one or more areas of peripheral calcification in the region of the original pulmonary component of the primary complex. Anatomical bronchiectasis is a common complication of post-primary pulmonary tuberculosis, but as this is usually in the upper lobes and well drained it seldom gives rise to subsequent clinical symptoms.

The precise diagnosis of bronchiectasis and the definition of its anatomical location requires a bronchogram. The types of widening of the bronchi demonstrated are usually classified as cylindrical, fusiform, or saccular (cystic), but the differentiation does not have very much importance. What is important its anatomical location require a bronchogram. The types of widened bronchiectatic bronchi but also distortions and irregularities of bronchi elsewhere in the lung. These are frequently present and indicate damage to the bronchi affected. If such damaged bronchi are left behind after surgical resection the patient usually continues to have symptoms. If a left lower-lobe bronchus is affected it is important to pay particular attention to the lingular bronchus. If this is in any way abnormal it is wise, if surgical resection is being attempted, to remove the lingular segment also; otherwise overt bronchiectasis often develops in this segment. Among 165 hospital cases about one-third were bilateral or extensive. The commonest individual sites were the left lower lobe (30%), the right lower lobe (24%), and the middle lobe (21%).

Even if the physical signs and radiological abnormalities on the straight film are present only in one lung, it is most important for the definition of the clinical state, and vital if surgery is being contemplated, that a complete bronchogram of both lungs should be carried out. Unexpected bronchiectasis may be detected in a lung which had been regarded as normal.

Differential Diagnosis

The most important conditions which may give rise to chronic cough and sputum, and which have to be differentiated from bronchiectasis, are chronic bronchitis, pulmonary tuberculosis, and chronic lung abscess. If there is segmental or lobar collapse, or other suggestive radiological signs, carcinoma of the bronchus also has to be considered. An aspirated foreign body or a bronchial adenoma occasionally leads to difficulties in diagnosis.

Chronic bronchitis may complicate bronchiectasis. If there is no bronchiectasis chronic bronchitis usually dates from the time when the patient was in his thirties or forties, rather than back to childhood. Physical signs are less helpful than history, as the patient with bronchiectasis may well have the physical signs of bronchitis and those with bronchitis often have coarse basal crepitations. Major localized changes on the x-ray may suggest the possibility of bronchiectasis.

Pulmonary tuberculosis is differentiated by the appearances on the chest x-ray and by the examination of sputum for tubercle bacilli, which should be sought in all cases in which bronchiectasis is suspected. Anatomical bronchiectasis is common in pulmonary tuberculosis, and may occasionally give rise to residual symptoms due to secondary infection after the tuberculosis has been treated, but usually only if there is residual bronchial stenosis or lower-lobe disease. The diagnosis of chronic lung abscess depends on the demonstration of an abscess cavity on the x-ray; bronchiectasis will often coexist. Very occasionally a bronchopleural fistula associated with an old empyema may give rise to chronic cough and sputum.

In the x-ray a pleural opacity with a fluid level will be found; this has to be differentiated from a lung abscess.

If the radiological appearances are localized, and especially if there is collapse, it will usually be wise as part of the investigation to carry out a bronchoscopy in order to exclude a carcinoma of the bronchus, an aspirated foreign body, or an adenoma.

Less Common Presentations of Bronchiectasis

Haemoptysis.—Blood-streaking of the sputum is quite common in classical bronchiectasis, but every now and then haemoptysis is the only clinical manifestation of the condition. The question of tuberculosis or carcinoma of the bronchus may well arise. The x-ray film will often give an indication of which is the more probable condition, but a bronchogram may well be necessary. Occasionally such a patient presents with a very large haemoptysis. Surprisingly enough, a very severe haemoptysis in bronchiectasis seems most often to derive from a relatively small localized area of disease in a patient who has had a few symptoms previously. Sometimes the patient may appear as an acute emergency, and resection of the source of the bleeding may be necessary if it can be identified. After a haemoptysis of any degree it is most important to carry out a bronchogram in order to localize the bronchiectasis and enable surgical resection to be carried out at any time if it proves to be necessary. The most common site for severe haemoptysis in a relatively asymptomatic case of bronchiectasis is the middle lobe; but occasionally it is in the apex of the lower lobe or in an old area of fibrosis, presumably post-tuberculous, at the apex of the lung.

Recurrent Pleurisy or Pneumonia.—Every now and then a patient presents who after upper respiratory infection has recurrent pleuritic pain, dry pleurisy, pneumonia, or a small pleural effusion. In such cases a bronchogram often demonstrates a local area of bronchiectasis at the site affected.

Bronchial Obstruction.—Very gross bronchiectasis may occur owing to infection beyond a chronic bronchial obstruction such as that due to bronchial adenoma or an inhaled foreign body. The patient may have recurrent febrile incidents or haemoptysis. The amount of sputum is variable, depending on the degree of bronchial obstruction. There is usually radiological evidence of collapse, or at least gross opacity, in the area affected which should lead to the diagnosis being made by bronchoscopy.

Hypogammaglobulinaemia.—This reduces the patient's resistance to bacterial infection. Affected children often have recurrent respiratory infections, which may give rise to bronchiectasis. In any case of bronchiectasis, especially in a child, it is worth while checking the serum proteins.

Mucoviscidosis (Fibrocystic Disease of the Pancreas).—In mucoviscidosis, besides abnormalities in other organs the sputum is unusually viscid and abnormal, so that chronic respiratory infection, especially with staphylococci, is common. This usually consists in a septic bronchitis, but bronchiectasis may well supervene. The estimation in the sweat of the sodium and chloride concentration, which is above normal in this condition, is a useful screening test which should be carried out in all children with bronchiectasis, and may be worth while in adults also.

Asthmatic Pulmonary Eosinophilia.—In this condition patients with asthmatic symptoms and a blood eosinophilia may develop recurrent pneumonic shadows in different parts of the lung, often accompanied by fever. The condition occurs particularly in middle-aged people, often women, and about half of the cases are due to hypersensitivity to *Aspergillus fumigatus*. A bronchogram often reveals bronchiectasis at the site of the recurrent pulmonary infiltrations.

Dextrocardia.—About 20% of all patients who have dextrocardia and transposition of the viscera also have bronchiectasis.

The site of the bronchiectasis varies, and the condition may be due to a congenital abnormality of the bronchi.

Brain Abscess and Empyema.—Although brain abscess was a classical cause of death in bronchiectasis, it is now less commonly seen, presumably owing to better treatment of the disease. It is usually seen in a patient with well-established

moderate or severe bronchiectasis. Most cases of empyema, when they complicate bronchiectasis, do so in fairly well established moderate or severe cases.

(This article will conclude next week with a discussion on the treatment and prevention of bronchiectasis.)

ANY QUESTIONS?

We publish below a selection of questions and answers of general interest.

Coronary Disease and High Altitudes

Q.—Is it advisable for persons who have had a coronary thrombosis in the past to travel by air or to stay on holiday at a high altitude?

A.—Oxygen is readily taken up or released from haemoglobin for small changes in oxygen tension below about 60 mm. Hg (steep part of the oxygen dissociation curve) but is in more stable combination at higher oxygen tensions (flat part of the oxygen dissociation curve). This means that the saturation of arterial blood with oxygen falls relatively little until the ambient oxygen tension has dropped from the normal level of about 94 mm. Hg to below 60 mm. Hg.

The cabin pressures of most aeroplanes are maintained at or above 565 mm. Hg, which is equivalent to an altitude of 8,000 ft. (2,438 m.). At an atmospheric pressure of 565 mm. Hg the partial pressure of oxygen is therefore only 118 instead of the normal 149 mm. Hg prevailing at sea-level, and the oxygen tension of the alveolar air (fully saturated with water vapour) is only 70 instead of 100 mm. Hg. However, assuming a normal alveolar-arterial gradient for oxygen, the arterial blood will still be nearly 90% saturated at this level of oxygen tension. This altitude does not therefore lead to significant tissue hypoxia under resting conditions, although dyspnoea will be appreciated by healthy persons on hurrying until acclimatized.

At an altitude of 12,000 ft. (3,657 m.) with an atmospheric pressure reduced to only 430 mm. Hg the oxygen tension of alveolar air will be 51 mm. Hg. The arterial oxygen saturation will be down to about 82%, and rapid ascents even to this altitude have been associated with the development of pulmonary oedema, particularly when exercise has been attempted soon after arriving. At 15,000 ft. (4,572 m.) the arterial oxygen saturation will be only 65%, because at this range of altitude small decrements in atmospheric pressure give rise to considerable decrements in blood-oxygen saturation.

Altitudes of up to 5,000 ft. (1,524 m.) permit virtually normal arterial oxygen saturations. At 5,000 ft. the barometric pressure will be about 540 mm. Hg, the alveolar oxygen tension about 74 mm. Hg, and the arterial oxygen saturation about 94%.

The answer to the question, then, is that it is obviously inadvisable for patients with coronary artery disease to expose themselves

unnecessarily to reduced ambient oxygen tensions, because even a small reduction in the amount of oxygen available to an area of myocardium with a critically low blood flow can be dangerous. Specifically, air travel in pressurized planes where exertion is impossible probably imposes a negligible risk for most patients who have had a coronary thrombosis, but a man who develops anginal pain on mild exertion should be advised to take oxygen during the trip or, better, to go by sea.

A holiday at an altitude beyond about 3,000 ft. (914 m.) is a different matter. Hypoxia is more sustained and exertion will exacerbate its effects. Moreover, the situ-

ation is an avoidable one and so should be advised against.

"Binocular" Spectacles

Q.—Are spectacles with an adjustable focus (like "binoculars") made and in what cases are they of value?

A.—Spectacle "binoculars" are obtainable and give some magnification for distance (e.g., the Sportscope with a magnification of $\times 3$). The field of view is somewhat restricted, but they might be of value in helping the partially sighted person to enjoy a theatre or some sporting events.

Notes and Comments

Autotransfusion.—Drs. L. S. CHEN, J. M. CONNAN, J. S. HSU, and C. H. HUNG (Changhua Christian Hospital, Changhua, Formosa, China) write: In reply to a question on autotransfusion ("Any Questions?" 25 December 1965, p. 1533) your expert stated that this was rarely performed. The availability of blood and comparative rarity of acute ectopic gestation no doubt account for this. In this hospital it is used fairly frequently for ectopic gestation, and we find that it not only eliminates the dangers of incompatibility and hepatitis but it allows earlier operation even before donor blood is available, and a more economical return to a normal haemoglobin (100 ml. of blood costs about £2). In 16 cases a total of 14,600 ml. of autotransfusion was given, while the donor blood for these cases amounted to only 5,100 ml.

Last year of 28 cases of ectopic pregnancy 16 fresh cases had autotransfusion, and the largest amount of blood transfused was 1,600 ml. We use mechanical suction directly into the bottle of citrate, and filter the blood only through the drip chamber, thus eliminating the time-consuming process of first filtering through gauze. It is then possible to begin autotransfusion within 10 minutes of starting the operation. The amount of unusable clot is estimated and replaced by donor blood after autotransfusion.

We have also used autotransfusion in a clean case with post-operative haemorrhage into the peritoneal cavity. The surgeons here have used it for a child with ruptured liver with dramatic effect. Naturally, the greatest worry is contamination, especially in cases of trauma, and we have twice been exercised about the wisdom of using blood for an ectopic when a simple follicular cyst of considerable size has ruptured during operation. In neither of these cases was there any noticeable ill-effect.

Protection from Trichlorethylene.—Dr. A. PATON (Dudley Road Hospital, Birmingham 18)

writes: I have lately seen two patients in whom exposure to trichlorethylene was considered as a possible cause for their symptoms. Having therefore had to look up the literature on my own account, I would like to supplement the rather meagre description of the signs of poisoning given by your Expert ("Any Questions?" 19 February, p. 471). Three organs besides the brain seem particularly susceptible—namely, the liver, the heart, and the kidneys. Jaundice and hepatic failure due to acute hepatic necrosis and cardiac arrhythmias from myocardial toxicity have long been recognized. In fact sudden death during trichlorethylene anaesthesia has been attributed to ventricular fibrillation. Less well known is a renal syndrome which mimics acute nephritis (as in the two patients referred to above) and which may progress to anuria.¹ It is perhaps as well to remember that if the patient dies histological evidence of poisoning may be minimal, so that an occupational history may be the only evidence.

OUR EXPERT replies: The case to which Dr. Paton refers¹ relates to quite exceptional exposure. The man concerned worked for two hours at least in a badly ventilated room using trichlorethylene to remove excess asphalt from tiles which he was laying and also to clean his hands. Most chlorinated hydrocarbon solvents can affect the liver and kidneys, but trichlorethylene rarely does so.

REFERENCE

- ¹ Gutch, C. F., Tomhave, W. G., and Stevens, S. C., *Ann. intern. Med.*, 1965, 63, 128.

Correction

We regret that in the article by Dr. E. Posner on industrial chest disease (26 February, p. 525) the name of Dr. A. I. G. McLaughlin was misspelled.