

Proceedings of the Thoracic Society

The Summer Meeting of the Thoracic Society was held on 6-8 July 1972 in Cardiff. There were 15 short papers, two lectures, and two symposia. Summaries follow.

DOWN UNDER FROM ON TOP

M. R. JOSEPH A scenic tour of Australia as photographed from the cockpit of a Cherokee 180 light aircraft.

The route taken was up the East Coast to Cooktown in the far north, then across to Karumba on the Gulf of Carpentaria, down to Central Old, across to Mount Isa and Alice Springs, up the centre to Darwin, down the West Coast to Perth, and back to Newtown via the South Coast.

MEASUREMENT OF REGIONAL VENTILATION WITH GAMMA CAMERA

Clinical and Physiological Use of the Gamma Camera

D. ACKERY and G. M. STERLING During the past two years the Gamma camera has been used at Southampton to give qualitative information on the distribution of ventilation in patients with various lung disorders. Comparing this with conventional perfusion scanning gives regional ventilation/perfusion relationships. Recently a magnetic tape unit and computer have been attached to the camera, permitting quantitative measurements of xenon wash-in and wash-out.

Studies of regional ventilation have value in several situations including (1) *Diagnosis of pulmonary thromboembolism*. Perfusion scans alone often show patchy defects which might be due to primary lung disease rather than thromboembolism. Ventilation scanning is usually normal in the latter condition but shows scattered defects associated with the perfusion defects in patients with lung disease such as asthma or bronchitis. (2) *Localization of areas of hypoventilation*. Clinical suspicion of an area of underventilated lung can be confirmed by xenon imaging and this, together with identification of regions of gas trapping on wash-out, may help to define a bullous area for resection, particularly if ventilation is unaffected in other parts of the lung. (3) *Assessment of patients for operation*. The likely functional state of the remaining lung after resection for a tumour can be assessed more accurately with combined ventilation and perfusion scanning than with the latter alone. (4) *Regional distribution of ventilation*. Although the spatial resolution of the Gamma camera is poor, it is an improvement over the static systems that have been used previously for xenon physiological studies. It may be used to study the distribution of ventilation up the lung and how

this can vary with ventilatory manoeuvres or be affected by mild lung disease. It is concluded that ventilation imaging with the Gamma camera is a useful and developing technique that has further clinical and physiological application.

⁶⁷GALLIUM SCAN IN DIAGNOSIS OF BRONCHIAL CARCINOMA

W. M. MACLEOD For some years radioisotopes have been used for the location of organs and tissues. The application of specific isotopes in the diagnosis of malignancy has been slower to develop. Numerous elements and compounds have been tried and one that shows promise is ⁶⁷gallium citrate. We have started a study into its possible role in the diagnosis of intrathoracic malignancy, especially various presentations of bronchial carcinoma.

At the start of this study we have chosen three diagnostic problems, the isolated nodular 'tumour', the possible invasion of the mediastinum, and the pleural effusion of unknown aetiology. Our preliminary findings are (1) that primary malignant nodules in the lung can be identified but nodules of small size (e.g., 1 cm diameter) are too small for effective resolution and distinction from the background radiation; (2) for mediastinal lesions the results are disappointing. It is impossible to distinguish mediastinal invasion. The radioactivity of ⁶⁷gallium in the marrow of the vertebrae and the sternum interferes; (3) for malignant deposits which are associated with pleural effusions the deposits can be recognized in spite of the effusion. The fluid itself contains insufficient cell content either to interfere or to be in itself of diagnostic value.

We would emphasize that these results are very preliminary and many facts have yet to be established. We believe that the Society would appreciate this early notification of such work.

USE OF A MOBILE PROFILE LUNG SCANNING DEVICE

J. T. BAKER This apparatus has been developed in the Institute of Nuclear Medicine, The Middlesex Hospital, and its further assessment is being carried out at Sully Hospital in the cardiothoracic centre.

Initially, the resolution of the instrument has been tested in over 50 patients who were at the same time having linear lung scans with a Selo dual-headed scanner. There appeared relatively good correlation between the two instruments, and segmental perfusion defects could be detected on the chart record output of the profile lung scanning device.

More recently, it has been used to study lung perfusion in patients with carcinoma of the bronchus preoperatively, and in other patients with a variety of lung diseases. The measurement by planimetry of areas underlying profile scans of individual lungs has been used to assess unilateral lung function; this is being compared with a simple spirometric method of assessment. Bronchspirometry is being used to validate both these methods although at the moment the study is in an early stage.

The profile lung scanner's use by the bedside has proved more difficult, particularly from the point of view of the interpretation of traces obtained. A study of patients with mitral valve disease while ambulant preoperatively has disclosed a surprising amount of asymmetry of perfusion over both lungs as well as the well recognized diversion of flow from base to apex.

LUNG BLOOD FLOW STUDIES IN PATIENTS WITH KYPHOSCOLIOSIS AND NEUROMUSCULAR WEAKNESS

W. A. LITTLER, S. R. REUBEN, and D. J. LANE The measurement of N_2O uptake in a body plethysmograph provides information on (1) mean pulmonary blood flow; (2) pulmonary artery to capillary flow conduction time. This is the time from pulmonary valve opening, indicated in a high frequency phonocardiogram, to the foot of the capillary flow pulse and is normally 120–180 msec; (3) pulsatility of capillary flow. This is the ratio of peak to mean flow rate and is normally 2.0:1.

Previous work (Reuben, 1970 and 1971) has established a relationship between flow conduction time and mean pulmonary arterial pressure, and between pulsatility of capillary flow and the pulmonary arterial time constant, where the latter is the product of resistance and compliance.

Chronic hypoxia, irrespective of its cause, is associated with pulmonary arterial hypertension. Kyphoscoliosis, and diseases producing neuromuscular weakness or paralysis, restrict ventilation and may lead to anaemia and eventual cor pulmonale.

A total of 18 studies were made on 16 patients, of whom 10 had kyphoscoliosis (7 paralytic and 3 idiopathic) and 6 had neuromuscular weakness or paralysis (5 poliomyelitis, 1 muscular dystrophy). The mean findings were as follows: vital capacity (VC) 1.9 ± 0.9 l. (56% of predicted normal); physiological dead-space (VD/V_T) $49 \pm 11\%$; arterial blood gas tensions for oxygen (P_{aO_2}) 81.33 ± 13.65 torr and for carbon dioxide (P_{aCO_2}) 45.21 ± 8.79 torr; resting heart rate 89 ± 13 min^{-1} ; pulmonary blood flow 3.8 ± 1.5 l. min^{-1} ; flow conduction time 104 ± 23.7 msec; pulsatility index 2.0 ± 0.2 :1.

A close linear correlation was found between the pulmonary artery to capillary flow conduction time and the P_{aO_2} ($r = +0.85$, $P < 0.001$). This probably reflects pulmonary arterial hypertension (Reuben, 1970) secondary to vasoconstriction of the pulmonary arterioles (Morkin *et al.*, 1964). The lowered flow con-

duction time indicates an elevated pulmonary arterial pulse wave velocity and reduced compliance, which offsets the increased pulmonary arterial resistance so that the time constant of the pulmonary arterial system remains uniform. This uniformity of the time constant explains the finding of a normal pulsatility index of capillary flow (Reuben, 1971).

REFERENCES

- Morkin, E., Levine, R., and Fishman, A. P. (1964). *Circulation Research*, 15, 146.
 Reuben, S. R. (1970 and 1971). *Circulation Research*, 27 523 and 29, 40.

ASTHMA DUE TO CHEMICAL DUSTS, VAPOURS AND FUMES

J. PEPYS, C. A. C. PICKERING, and R. DAY The development of safe, reproducible, and acceptable methods for the investigation of asthma due to inorganic and organic chemical agents is described. It entails an occupational-type exposure with the causal agents in the form in which they were encountered and is shown to reproduce the clinical picture in subjects with asthma due to inorganic dusts such as the complex salts of platinum, organic dusts such as piperazine and wood-dusts, fumes such as those of Kynol flux and derived from amino-ethyl ethanalamine, and vapours such as those of tolylene diisocyanate. These agents provoke asthmatic reactions corresponding, in some instances, to the 'immediate', 'late', and dual reactions observed in tests with aqueous extracts in patients allergic to common allergens such as *Aspergillus fumigatus*, *Dermatophagoides spp.*, the house dust allergy, and avian allergens. As in the latter examples, Intal inhibits some of the reactions to the chemical agents. Antibodies against some of the chemical agents are demonstrated.

UNILATERAL BRONCHOPULMONARY LAVAGE IN CHRONIC BRONCHIAL ASTHMA

G. M. KIRK In New Zealand bronchial lavage was introduced by Heath Thompson *et al.*, who reported their bronchoscopic method and results in 1966. Initially it gained few advocates except in a modified form and then mainly in the treatment of status asthmaticus. With the newer technique of unilateral bronchopulmonary lavage one lung is flooded while the other is actively ventilated. This is more suited to the patient with chronic bronchial asthma, who is not responding to other measures and is often requiring large doses of steroids. The anaesthetic technique procedure during the lavage, and results of over 70 lavages, performed by the unilateral method in patients with chronic bronchial asthma, are discussed and compared with 15 lavages performed by the bronchoscopic method. In the author's opinion, the unilateral method

is not only easier and safer but more effective than the bronchoscopic method.

REFERENCE

Thompson, H. T., Pryor, W. J., and Hill, J. (1966). *Thorax*, 21, 557-559.

INVESTIGATION INTO USE OF IPPB IN CHRONIC RESPIRATORY DISEASE

A. THORNTON and C. S. DARKE Ten patients with severe disability from emphysema and chronic bronchitis have been admitted to hospital for 14 days' intensive treatment with intermittent positive pressure breathing. All patients had grade 5 dyspnoea, but their production of sputum varied considerably. The patients underwent a thorough evaluation of respiratory function immediately on admission including estimation of:

timed vital capacity, residual volume, pulmonary nitrogen washout with oxygen, ventilatory response to carbon dioxide, and physiological deadspace to tidal volume ratio, also PaO_2 , Paco_2 , and alveolar-arterial tension difference for oxygen when breathing air and after administration of 100% oxygen for 10 minutes.

The patients received IPPB therapy with air humidified with water for 10 minutes every waking hour for 14 days. No other special medication was offered but the patients were allowed to continue any therapy they were receiving on entry to hospital. The sputum was collected and weighed every 24 hours. At the end of 14 days' therapy the patient's pulmonary function was reassessed.

With one exception all patients said they felt much better on leaving hospital than when they entered. But no significant change was found in any of the tests. Thus it is impossible to state from the evidence that the subjective improvement was a result of intensive IPPB therapy. It might have been a result of hospitalization and individual interest being taken in the patients.

HUMAN PULMONARY DIROFILARIASIS IN QUEENSLAND

D. E. MOORHOUSE, E. W. ABRAHAMS, B. J. STEPHENS, and D. H. MEYERS Histological examination of granulomata from the lungs of four patients from Queensland revealed the presence of a nematode worm which was identified as *Dirofilaria immitis*, the heart worm of dogs.

D. immitis, which is transmitted by a variety of mosquitoes, is known to be widely distributed in Australia, though little is known of its prevalence. Evidence suggests that this may not be an uncommon condition and that the possibility of infection with *D. immitis* should be considered whenever granulomata of unknown aetiology are encountered in the lung. An account of these cases has appeared in the *Medical Journal of Australia*, 1971, 2, 1230-1233.

PLASTIC RECONSTRUCTIVE PROCEDURES

A long-term Review of Dermal Grafts and Bronchial Reconstruction

I. MONK, R. NICKS, R. H. F. BRAIN, and T. J. OTTO A series of patients with various types of non-malignant bronchial strictures was treated surgically between 1953 and 1962. The period of review, therefore, is between 10 and 20 years. Bronchoplastic procedures were carried out on one group of patients, while dermal grafting was employed on another group. This review confirms the suitability of bronchial tissues for plastic reconstructive procedures but reveals that there is some progressive late shrinkage when dermal grafts are used.

Restoration of the Gullet following Extensive Benign Strictures

ROWAN NICKS This paper concerns the replacement of the gullet in rare cases with extensive benign strictures due to various causes, mainly a late sequel of the ingestion of caustics. The following aspects are discussed: the method and technology, the influence of peristalsis and of reflux of upper gastrointestinal juices on the anastomosis and its functioning, the blood supply of jejunal and colonic grafts, and the problem of insufficient length complicating terminal necrosis or exteriorization of the ends.

Treatment of Oesophageal Complications of Systemic Sclerosis

R. H. F. BRAIN The clinical manifestations of 10 patients with systemic sclerosis whose oesophageal complications were managed largely by surgery are reported. Nine of them were found to have a severe ulcerating type of oesophagitis and all had hiatal herniae demonstrable by contrast radiology. In addition, all but two had fibrous strictures.

Their treatment by surgery is viewed with the tentative conclusions that an earlier diagnosis of reflux oesophagitis could be beneficial in leading to successful control by simple hiatal hernia repair. The severity of the oesophagitis is explained with a further suggestion that shortening and stricture formation, when present, should be treated by excision with replacement by jejunum or colon before the cardiopulmonary manifestations of the disease preclude major surgical measures.

The finding of an impaired vagal neurological supply to the oesophagus in the form of a deficiency in Auerbach's cells in two patients is of interest.

Use of Sleeve Resection and Reconstruction of the Bronchi in Pulmonary Surgery

T. J. OTTO Thirty-three patients who have undergone various forms of limited resection or/and reconstruction of the bronchial tree are presented. The reconstruction followed traumatic damage in four instances and in three iatrogenic damage to the bronchi.

Pulmonary resection plus partial resection of the bronchus was carried out for adenoma in 15 cases and in 10 a similar procedure was performed for bronchial carcinoma. In one case removal of a paratracheal cyst necessitated partial reconstruction of the trachea with fascia lata.

Conventional sleeve resection was carried out in 15 cases; there were four cases each of reimplantation of the main or lobar bronchus and suturing or grafting of the trachea. In the remaining 10 cases, various forms of segmental resection of the bronchus and its reconstruction were performed. In restoring the continuity of the bronchus, attention was paid to both preserving a wide lumen and ensuring normal alignment so as not to impair ventilation or hinder drainage of secretions. The techniques of reconstruction are described in detail.

In three cases bronchial fistulae followed the operations; two of these eventually healed. Otherwise there were no complications, and in all cases the pulmonary tissue distal to the reconstruction preserved its function very well.

In cases of bronchial carcinoma the long-term results were comparable with those obtained by lobectomy.

Follow-up studies showed that the reconstructed bronchi healed without evident stricture or deformation.

FACTORS AFFECTING LOCALIZATION OF DISEASE IN THE LUNG

JOHN B. WEST Marked topographical differences in function of the lung have been described during the last few years. The apices of upright lungs are relatively poorly perfused, underventilated, overexpanded, and have higher oxygen tensions and lower carbon dioxide tensions compared with the bases of the lungs. It is probable that the apical localization of adult tuberculosis and the basal origin of the changes in alpha-1 antitrypsin deficiency disease can be attributed in part to these regional differences in function.

Recently we have become interested in the distribution of mechanical stresses within the lung. When parenchymal disease weakens the structure of the lung, it is natural to expect failure to occur first in the regions of greatest mechanical stress. The distribution of gravity-induced stress, strain, and surface pressure has been analysed in a theoretical model using the technique of finite elements. These predictions have been compared with histological measurements on dog lungs fixed *in situ* by freezing. In the upright lung, the stresses are greatest at the apex of the upper lobe. As the lung is inflated from very low volumes to total lung capacity, the stress at the apex first decreases, then increases. This behaviour can be explained by the increasing rigidity of the expanded lung which enables it to resist distortion by its weight. At functional residual capacity, stress at the apex is near its minimum.

These findings are consistent with the observations that the first signs of centrilobular emphysema, the blebs of spontaneous pneumothorax, and the cavities of pulmonary tuberculosis are commonly seen in the upper regions of the lung.

(Supported by NASA grant NGL 05-009-109 and NIH grant He 13687-02.)

COUGH, SPUTUM, AND BRONCHIAL CLEARANCE

S. W. CLARKE and J. GARETH JONES The healthy tracheobronchial tree is cleansed efficiently by mucociliary clearance. When this is impaired the reserve mechanism, cough, is utilized. While the dynamics of cough are well known, the way in which air flow shears sputum from the bronchial walls is undefined.

We used an *in vitro* system of airways lined with sputum or sputum-like synthetic polymers to study this. We found two-phase gas-liquid interaction takes place between the airstream and sputum at high linear velocities of flow. This interaction depends on the thickness of the sputum layer and the viscoelastic properties of the sputum in a complex way. Our results explain why simple reduction in sputum viscosity may not be advantageous in the clinical situation.

WHY DO NEW GUINEA HIGHLANDERS HAVE LARGE LUNGS?

J. E. COTES The lung volume, adjusted to a standard age and height, of Europeans is systematically larger than that of almost all other ethnic groups for whom data are available. Thus the finding by Woolcock and her colleagues (1970) of European-size lungs in New Guinea highlanders living at the relatively low altitude of 1,500 m is unlikely to reflect genetic factors; it is also unlikely to be due solely to altitude. Data obtained under the auspices of the International Biological Programme (Cotes, 1971) suggest an alternative explanation.

REFERENCES

- Woolcock, A. J., Blackburn, C. R. B., Freeman, M. H., Zylstra, W. and Spring, S. R. (1970). *American Review of Respiratory Diseases*, 102, 575.
Cotes, J. E. (1971). *Thorax*, 26, 490.

SCANNING ELECTRON MICROSCOPY OF LUNG WASHINGS

A. J. SALSBUURY The scanning electron microscope allows the study of the surface of specimens at resolutions of up to 20 m μ using biological material. Results are much more satisfactory with tissues composed of individual cells, as cell margins are difficult to identify in solid tissues using the scanning electron microscope. For this reason, the bulk of microscopy in the human has been performed on blood.

The paper describes, in a preliminary fashion, an attempt to overcome the problem with human lung tissue. Small pieces of fresh human lung, usually from biopsy material, are mixed in a buffer solution.

The pieces of lung are then removed and the cell suspension is prepared for examination under the scanning electron microscope.

Some normal cellular components of the lung can be identified with relative ease. Lung washings in cases of carcinoma, Hodgkin's disease, asbestosis, fibrosing alveolitis, and mesothelioma have also been examined. The full interpretation of results is still in progress.

ASPIRATION BIOPSY OF LUNG LESIONS UNDER X-RAY CONTROL - INITIAL AND FINAL HISTOLOGICAL CORRELATION

R. DICK At the London Chest Hospital between January 1971 and February 1972, a total of 88 patients had aspiration biopsies of localized opacities in the lung or chest wall. We are concerned in this talk with those 38 of the 88 who had a final diagnosis confirmed by an 'open' procedure. In 36 patients the procedure was a thoracotomy, in one other mediastinoscopy, and in another necropsy. In 66% both pre- and post-operative histology agreed definitely on whether the lesion was benign or malignant. The aspiration biopsies were performed by one radiologist and were almost without exception seen by one pathologist.

The technique of the radiological procedure is described, and its merits are discussed under the following headings: (1) the type and size of lesions biopsied; (2) the number diagnosed as benign or malignant; (3) the operative result; (4) the correlation of cell type pre- and post-operatively; and (5) the complications of the procedure.

RELATION BETWEEN INHALED PARTICLES, FIBROSING ALVEOLITIS, AND LUNG CANCER

T. G. VILLAR Our interest in granulomatous diseases of the lungs caused by inhaled particles has shown us that there is a sharp increase in the incidence of lung cancer in patients with these diseases. This is particularly so in vineyard sprayers, in patients exposed to insecticides containing DDT crystals, in workers in polyvinyl plastics industries, in people exposed to hair sprays, etc. The problem whether the resulting fibrosing alveolitis or the foreign matter in the lung is responsible for this greater incidence in lung cancer is discussed. This seems particularly important in the case of polyvinylpyridine which is being used in the prevention of silicosis; here our findings seem to agree with recent experimental work.

LUNG CANCER IN NEW ZEALAND: RELATION TO ETHNIC GROUP AND COUNTRY OF BIRTH

J. BORRIE Between 1957 and 1965 the Regional Thoracic Surgical Unit in Auckland, Wellington, Christchurch, and Dunedin pooled all their lung cancer data. This paper presents the findings and reveals a picture of lung cancer as it affects a smogless,

cigarette-smoking island population in the South Pacific Ocean. The study shows lung cancer incidence in Maori and white populations, sex by age, male and female, the country of birth of the whites, their smoking habits, occupations, symptoms, site incidence, basis of diagnosis, treatment, causes of death, length of survival, and various cross studies computer-aided.

This study confirms that U.K. immigrants are more at risk than New Zealand-born people, and indicates that Maori women seem more at risk than their men folk.

PULMONARY FUNCTION IN BRONCHIAL CARCINOMA: THE EFFECTS OF LUNG RESECTION

J. S. LEGGE and K. N. V. PALMER Bronchial carcinoma is the commonest malignant neoplasm in males. Surgical resection offers the best prospect of cure but there is an appreciable mortality and morbidity from respiratory insufficiency.

The dynamic and static lung volumes, arterial blood gas tensions, and transfer factor were measured in 330 patients with histologically proved bronchial carcinoma. Three-quarters had airways obstruction and lung hyperinflation; transfer factor and arterial oxygen tension were reduced in over 60%, and nearly 10% also had hypercapnia. Airway obstruction occurred predominantly in smokers, but reduction in transfer factor and changes in the blood gas tensions did not differ between smokers and non-smokers. Cardiorespiratory response to exercise was measured in 65 patients. Abnormalities which were those seen in obstructive bronchitis occurred commonly in the smokers.

Of the 330 patients, 225 had thoracotomy and 172 had lung resection (lobectomy or pneumonectomy). Lobectomy led to a loss in lung volume of 15% and pneumonectomy to 30%. Airway obstruction, hypoxaemia, and the physiological dead-space/tidal volume ratio on exercise improved after pneumonectomy but to a lesser extent after lobectomy. Eleven patients died within a month of operation or respiratory insufficiency and two required immediate post-operative tracheostomy. These had preoperatively more severe airways obstruction and lung hyperinflation, higher physiological dead-space/tidal volume ratios on exercise, and some degree of hypercapnia. These tests are considered to be of most value in assessing the ability of the patient to withstand the operation.

CORONARY ARTERY SURGERY

DENTON A. COOLEY Rapid progress in the surgical treatment of coronary artery disease has been more spectacular than in any other aspect of cardiovascular disease.

Emphasis is now placed upon a *direct* approach to the occluded coronary vessel, reattachment of the anomalous coronary and repair or replacement for complications which may result from myocardial infarctions. This report reviews the selection of

patients for surgical treatment, the technique of surgical repair employed, and the results in saphenous vein bypass (approximately 1,200 patients), ventricular aneurysm (130 patients), mitral valve replacement, and other conditions related to coronary disease.

Selective coronary arteriographs using cineangiography must be performed in each patient showing all 'three' major coronary branches. Use of surgical endarterectomy for the total or near total coronary obstruction has extended the scope of revascularization procedures. Best results have been achieved in patients with angina pectoris who have minimal evidence of left ventricular decompensation. We have used liberal indications for revascularization, however, which accounts for an overall mortality of 9%. Factors which influence risk and mortality are

reviewed, and the place for cardiac transplantation in the advanced or terminal patient is considered.

FUTURE MEETINGS

Spring Meeting 1973

Royal College of Physicians, London
One-day meeting on Friday, 2 March
Joint Meeting with the Breathing Club
on Saturday, 3 March

Summer Meeting 1973

Nottingham
Joint Meeting with the BTTA
Wednesday, 11 July to Saturday 14 July.