In differential diagnosis, too, the transaminase levels may be of help. On several occasions we found it useful in assessing whether severe cardiac pain was due to prolonged angina pectoris or actual infarction, the transaminase results correlating in each case correctly with electrocardiographic findings and subsequent clinical progress.

No diagnostic rise in transaminase levels was detected in two cases of pulmonary infarction, two cases of gall-bladder dysfunction, two cerebral catastrophes, and six cases of pneumonia.

It is of interest that one case of active rheumatic pericarditis (not included in this series) revealed a transiently raised serum transaminase level. This suggests concurrent myocardial damage of a temporary nature, and it will be of interest in the future to ascertain whether serum transaminase levels will help in assessing activity in cases of rheumatic carditis where this is in doubt.

In carrying out these estimations of serum transaminase levels the method of Frankel and Reitman (1957) was found to have several inherent disadvantages regarding cost and technique. These seem to be overcome in the method described by King (1958), and the simpler technique and its cheapness should place it well within the scope of all routine laboratories.

Summary

Serum transaminase estimations in a small number of cases of myocardial infarction are related to clinical, electrocardiographic, and necropsy findings. The test's possible value and advantages in early differential diagnosis and prognosis are discussed.

This series reveals close correlation between peak transaminase levels, size of infarct, and immediate outcome.

Evidence is presented which shows that cases in which transaminase values rise above 250 SGO-T units do not usually recover.

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Rank Precision Industries (B.A.F.) Ltd. has issued a leaflet describing the films and filmstrips on hospital and medical training in the G.B. Film Library. The leaflet lists 44 films and 33 filmstrips which are available from the library. It gives brief details of their length, number of reels or frames, hire rates, and purchase prices. Handbooks containing essential information for the guidance of teachers or film users are supplied with the films and filmstrips. Films are available for either outright purchase or hire; viewing copies will be supplied free of charge on application. Filmstrips are for outright purchase only, but may be previewed under a 14-days "sale or return" approval scheme. Further details from the G.B. Film Library, Aintree Road, Perivale, Greenford, Middlesex.

SCURVY FOLLOWING BILATERAL ADRENALECTOMY

REPORT OF TWO CASES

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During the convalescent period of two patients who had undergone bilateral adrenalectomy and oophorectomy for advanced breast cancer it was noticed that they developed petechial skin haemorrhages on the arms and legs. One of these patients also complained of bleeding gums. A diagnosis of scurvy was made and the vitamin-C saturation test was carried out. In the first patient only 21 mg. of the vitamin appeared in the urine, following an intravenous injection of 1,000 mg. of ascorbic acid, and in the second case only 31 mg. was excreted. The average amount of ascorbic acid excreted during this test in a normal healthy individual varies between 300 and 500 mg.

These findings stimulated us to investigate two other patients in the ward who had recently had their adrenals and ovaries removed, and in both cases the test showed a vitamin-C deficiency. Further patients were investigated and of nine who were subjected to the test similar deficiencies were found in seven. The remaining two patients had been operated upon several months previously; both had progressed well, had good appetites, and had increased in weight, and in them the values were 370 and 570 mg. respectively. The average amount of vitamin C excreted in the seven patients (average age 53 years) in whom the figure was low was 85 mg.

A control series of tests was carried out on nine patients who had recently undergone operations such as radical mastectomy, cholecystectomy, appendicectomy, and colectomy. The average amount of vitamin C excreted by them was 300 mg., their average age being 49 years. None of these patients had been given vitamin C therapeutically.

Although there is some doubt about the reliability of the vitamin-C saturation test, these figures seemed significant and led us to believe that patients who had both adrenals and ovaries removed might be deficient in vitamin C, especially in the early post-operative period.

We record the two case histories of scurvy following bilateral adrenalectomy and oophorectomy, and discuss the possible cause of this, together with the relationship of vitamin C to the adrenal glands.

Case 1

A housewife aged 37 was admitted to hospital on June 17, 1958. Nine months earlier she had noticed a swelling in the left breast which had ulcerated through the skin. She complained of loss of energy, tiredness, and poor appetite. On examination she had a foul-smelling, fungating cancer of the left breast, with an infected carcinomatous ulcer in the left axilla. She was pale and listless, with oedema of the legs and sacrum. A blood count showed a haemoglobin level of 22%, and 16,600 white blood cells, of which 95%

were polymorphonuclears. *X*-ray examination of the chest revealed secondary carcinomatous deposits in the mediastinum and ribs.

Following a blood transfusion a right adrenalectomy and bilateral oophorectomy was carried out on June 19. The left adrenal gland was removed two weeks later. Her general condition improved after the second operation, but some days later she developed a temperature, and pus from an infected haematoma began to discharge from the wound in the right loin. Culture of the pus from the breast and

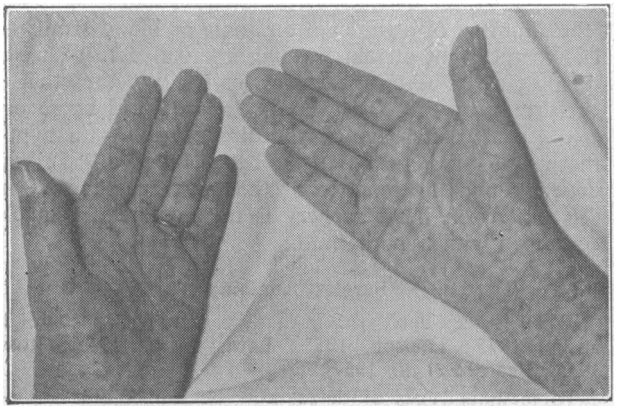

FIG. 1.—Case 1. Petechial haemorrhages of scurvy on the hands following bilateral adrenalectomy.

the loin showed a heavy growth of *Staphylococcus aureus*, sensitive to chlortetracycline and erythromycin.

On the eleventh post-operative day she developed purpuric spots on the hands (Fig. 1), arms, and abdomen, together with sore bleeding gums. At this time she was taking a normal well-balanced diet. A blood count showed a haemoglobin level of 72%, white cells 18,600 with 95% polymorphs, platelets 210,000, and a bleeding-time of 6½ minutes. A diagnosis of scurvy was made, and the vitamin C saturation test revealed a marked vitamin-C deficiency, there being only 21 mg. of ascorbic acid excreted in the urine.

She was given 300 mg. of ascorbic acid daily by mouth, and the rash eventually disappeared. Following a course of deep *x*-ray therapy to the ulcerating breast, which had become a little smaller and cleaner, she was sent home on August 8.

Case 2

A housewife aged 62 was admitted to hospital on June 28, 1958, having had a radical mastectomy in January, 1957, for an anaplastic round-celled carcinoma of the left breast. She had developed secondary carcinomatous deposits in the skin

FIG. 2.—Case 2. Subcutaneous haemorrhages of scurvy on the thigh following bilateral adrenalectomy.

of the right chest wall, and an *x*-ray examination showed lung deposits and a pleural effusion. Her haemoglobin level on admission was 82%.

On June 30 a left adrenalectomy and bilateral oophorectomy was carried out. The liver was found to contain extensive deposits of secondary growth. The adrenal gland was infiltrated with carcinoma, and this was confirmed on histological examination. Ten days later a right adrenalectomy was performed, but a week later her right loin wound became infected following the discharge of a haematoma. She also developed multiple bedsores, which became infected. At this stage she was being given a high-protein diet, but was reluctant to eat.

Culture of the pus in the wound revealed a growth of *Staph. aureus*, which was insensitive to all antibiotics except novobiocin, which was given in doses of 250 mg. six-hourly for five days.

On the tenth post-operative day she developed purpuric spots and haemorrhages on the hands, arms, and legs (Fig. 2). The gums appeared normal, but she was edentulous. A blood count showed a haemoglobin level of 71%, white cells 13,300 with 94% polymorphs, platelets 47,000, and a bleeding-time of 3½ minutes. A vitamin-C saturation test was carried out and 31 mg. of ascorbic acid was excreted.

She was given 300 mg. of vitamin C daily and the purpuric spots diminished in number, but did not disappear as in Case 1. Although her wounds became cleaner and began to heal, her general condition deteriorated and she died on August 1.

Discussion

It is possible for most vitamins, an exception being vitamin C, to be synthesized in the body, and we depend entirely on extraneous sources for our essential requirements of it. It can be stored to a limited extent in the body, and this is said to occur mainly in the adrenal cortex, pituitary body, corpus luteum, and lens. Investigations have shown that the guinea-pig behaves in a similar way to man and cannot synthesize the vitamin, whereas the rat, dog, and mouse are able to do so. The site of this synthesis is not known, but it may be in the adrenals, as Dumm and Ralli (1949) observed that the ascorbic acid excretion by rats after bilateral adrenalectomy fell to low values. On the other hand, the synthesis is not entirely dependent on the adrenals, as adrenalectomized dogs and rats can be maintained on a vitamin-C-free diet.

A great deal of experimental work has been carried out to determine the relationship between ascorbic acid and the adrenal cortical hormones. In animals, following stress or the administration of corticotrophic hormones, the increased secretion of adrenocortical hormones is associated with a rapid decrease in the amount of ascorbic acid and cholesterol in the adrenal gland. There appears to be considerable doubt about the relation of vitamin C to the synthesis of the adrenocortical steroids. In persons dying after continuous stress the enlarged adrenals were found to contain about 50% less than the normal amount of ascorbic acid and cholesterol (Uotila and Pekkarinen, 1951).

That ascorbic acid is not essential for the actual synthesis of the hormones is seen in scorbutic animals, when cortical hormones are elaborated in the absence of the vitamin. On the other hand, when the adrenals are removed from guinea-pigs, and vitamin C is withheld, the animals die rapidly (Clayton and Prunty, 1953). In classical cases of scurvy in man, the typical findings of eosinopenia and increased 17-ketosteroid excretion are noted after corticotrophin therapy and are not changed after vitamin C administration. After saturation with vitamin C there is a marked increase in urinary ascorbic acid following treatment with corticotrophin.

The effect of corticoid release on ascorbic acid excretion in man is described by Stefanini and Rosenthal (1950) and by Holley and McLester (1951). In each case two male patients with rheumatoid arthritis were treated with cortico-

trophin for periods of six months. In all four patients symptoms of scurvy developed which responded to vitamin C. Holley and McLester have suggested that ascorbic acid plays the part of a reducing mechanism in the production of the steroid hormones. In order to conserve the ascorbic acid content of the adrenal cortex, the body is apparently able to deplete other structures. Corticotrophin therapy reduces the stores of ascorbic acid in the adrenal cortex, and prolonged administration produces a deficiency and symptoms of scurvy.

Kayahan (1952) states that following the taking of large doses of vitamin C by mouth in man, there is an increased corticoid but decreased 17-ketosteroid excretion in the urine, indicating a direct action on the adrenal cortex.

Finally it has been shown that ascorbic acid is used up more rapidly when infection is present.

Summary and Conclusion

The adrenal cortex is the main storage depot of vitamin C in man.

The release of cortical hormones is associated with an increased excretion of ascorbic acid and a reduction of the ascorbic acid content in the gland itself.

Large oral doses of vitamin C appear to increase corticoid but decrease 17-ketosteroid excretion in the urine, indicating a direct action on the adrenal cortex.

It is open to discussion whether or not vitamin C is concerned with the actual synthesis of the adrenocortical steroids, but it is suggested that the power of the adrenal cortex to secrete the hormones is dependent on the presence of ascorbic acid.

In the cases of scurvy described here it is significant that infection was present in each case, and also in another patient with a low ascorbic acid excretion. Infection was not recorded in any other case which had undergone bilateral adrenalectomy. The presence of infection is believed to cause vitamin C to be utilized more rapidly, and thus deplete the limited reserves. We believe that patients who have their adrenal glands and ovaries removed tend to have a lowered reserve of the vitamin immediately after the operation. This belief is based on the finding of a low vitamin excretion in seven patients following adrenalectomy and oophorectomy, and comparing these values with a group of patients who were recovering from other types of operation.

We suggest that these cases should receive an adequate intake of ascorbic acid if they are not to develop deficiency symptoms.

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The National Council of the National Deaf Children's Society held its first meeting on October 18. The constituent societies are the former Deaf Children's Society, which has amended its constitution to become a national organization, and the following affiliated regional associations: the Herefordshire and Worcestershire Association for Parents of the Deaf; the East of Scotland, the Hertfordshire, the Oxford and Districts Regions; the N.-E. and N.-W. Deaf Children's Associations; and the South Wales Parents' Association for Deaf Children. The Society's address is: 1, Macklin Street, Drury Lane, London, W.C.2.

SURGERY OF ATRIAL SEPTAL DEFECTS

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The shunting of significant amounts of blood from the left to the right atrium through a septal defect should in most cases be corrected surgically. Whether this is performed by the closed method, as devised by Gross *et al.*, or by suture under the direct vision with hypothermia, as first practised by Lewis *et al.* (1955), will depend upon the practice of the individual clinic. In this unit open heart surgery is the method of choice, combined with hypothermia.

Surgical Anatomy

This has been dealt with in many communications (Rokitansky, 1875; Hudson, 1955; Lewis *et al.*, 1955; Ross, 1956; Bedford *et al.*, 1957).

Three main types of defect may be found, and any of these may be associated with anomalous pulmonary venous drainage: (1) The high defect, or sinus venosus type, is always associated with some anomaly of pulmonary venous drainage. There is no postero-superior margin, and the upper portion lies within the mouth of the superior vena cava (Fig. 1). (2) The fossa ovalis or ostium secundum defect. These are well-defined anteriorly, and there are a number of variations as seen in Fig. 2, A, B, and C. (3) The ostium primum defects. The anterior margin of the defect in these cases is formed by the ventricular septum. These ostium primum defects are associated with other anomalies, particularly a cleft mitral valve, producing mitral regurgitation, but the tricuspid valve and the upper portion of the ventricular septum may be deficient (Fig. 3).

Clinical Findings and Catheter Studies

Excellent clinical descriptions of the conditions are available (Kjellberg *et al.*, 1955; Wood, 1956; Bedford *et al.*, 1957; and many others). In the uncomplicated cases with a low pulmonary vascular resistance the findings are those that would be expected when many litres of blood escape from the left to the right atrium and pass through the right heart and pulmonary bed. The right ventricle is overactive and the increased blood flow gives rise to a pulmonary systolic murmur audible along the left sternal edge. There may be a thrill associated with the murmur. Characteristically, the second sound is widely split and fixed. In most cases a tricuspid diastolic flow murmur is audible on inspiration. This, like the pulmonary systolic murmur, is due to the torrent of blood flowing through the right heart. The radiograph shows the characteristic findings of an enlarged right atrium and pulmonary artery with varying degrees of pulmonary plethora and in association with a small aorta. In the secundum type the electrocardiogram shows right ventricular hypertrophy and a partial right bundle-branch block type of pattern.

All cases have been subjected to cardiac catheterization with the object of confirming the clinical diagnosis and of determining the pulmonary resistance and the magnitude of the shunt. This has sometimes been useful in determining whether anomalous pulmonary venous drainage is present. A gradient across the pulmonary valve does not necessarily mean that there is associated pulmonary valve stenosis, because a significant gradient can be produced by a large flow across a normal valve. In one case there was a considerable gradient across the valve, the right ventricle pres-