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-

sure being 60/0 and the pulmonary artery pressure 18/6. After closure of the defect the thrill in the pulmonary artery disappeared and the right ventricular pressure dropped to 28/4 with a pulmonary artery pressure of 20/10.

Indications for Surgery

The volume of the shunt has been the indication for surgery, not the presence or absence of symptoms in the patient. Ideally, the shunt should be arrested before the right heart has developed permanent secondary organic changes.

The closure of a proved atrial septal defect can now be regarded in the same light as a persistent ductus; that is, to prevent the ill effects of the shunt on the heart and pulmonary bed. It is quite wrong to wait for the development of symptoms.

In the pre-operative assessment, the presence and volume of the shunt and the level of the pulmonary vascular resistance are all taken into consideration. Shunts of 2:1 or more are considered suitable for surgery, while a raised pulmonary vascular resistance (particularly with a small shunt) makes surgical closure hazardous. The late development of cyanosis as a result of reversal of the shunt is an absolute contra-indication to surgery.

The electrocardiogram must show right ventricular hypertrophy and right axis deviation. Right axis deviation is of some importance, since a tendency to a left axis deviation may suggest an ostium primum defect. In the two ostium primum defects we have encountered, left axis deviation has been present and we do not now operate in such cases.

Cases in failure and those in the older age group should not be excluded provided that the pulmonary vascular resistance is not raised

and the agreed indications are present, but a higher operative risk may have to be accepted. On the other hand, this must be set against the unfavourable natural history of the disease. The average age at death in three published series is as follows: Roesler (1934), 36 years; Welch and Kinney (1940), 33 years; and Burrett and White (1945), 39 years.

FIG. 1.—Sinus venosus, or high defect. These cases are associated with one or more anomalous veins draining into the dilated superior vena cava.

FIG. 3.—An ostium primum defect. It is well defined posteriorly, but the anterior margin is formed by the ventricular septum. The mitral valve is deeply cleft.

FIG. 2.—A, Typical fossa ovalis or ostium secundum defect. There is a well-defined anterior margin. B, Lacework type of ostium secundum defect due to incomplete remnants of the septum primum. C, Large ostium secundum defect. Note how the inferior margin is overlapped by the eustachian valve. There are two apparently anomalous pulmonary veins visible.

Clinical Analysis

This surgical series consists of 49 cases—46 secundum defects, 2 primum defects, and 1 sinus venosus defect. The Table shows the age distribution in relation to symptoms. It will be seen that 18 cases in this series had symptoms.

Age Distribution

Age:	0-5	6-10	11-15	16-20	21-30	31-40	41-50	51-60
No. Symptoms	1	2	8	4	5	0	8	1
	0	1	3	1	4	0	8	1

The sex distribution consists of 12 males and 37 females. The majority of those with symptoms complained of dyspnoea on moderate exertion accompanied by palpitations. Recurrent chest infection was present in four and two had suffered haemoptysis. Frank cardiac failure had been present in five and their ages were 30, 47, 48, 49, and 56. The patient over 56 had been virtually incapacitated for 18 years. This group survived surgery and has done well, except for the patient of 56, who succumbed during surgery. This was due to a heavily calcified pericardium around the inferior vena cava, which made the dissection of this vessel hazardous. After release of the clamp across the inferior vena cava it was found that the calcium had produced disruption of the vessel wall, with uncontrollable haemorrhage. The patients with symptoms were, in the main, over the age of 20, but those with recurrent chest infection were in the younger age group and had been investigated elsewhere for bronchiectasis. There was one further case in failure; this was in a child with an ostium primum defect.

It has been stated that there is retardation of growth in these cases; certainly in our series there were several patients who were quite definitely undersized.

Anaesthesia is to be fully described elsewhere by Dr. E. S. Machell.

Surgical Technique

This type of surgery must be carried out by a team fully trained in this work, and the operating team must be thoroughly integrated with the anaesthetic and nursing teams. All the steps in the

operation must be carefully rehearsed, and each member must know precisely what function he is to serve.

The approach is through the bed of the fourth rib on both sides, with transection of the sternum. The mediastinum is inspected for a left-sided superior vena cava. Rubber slings are placed around the superior and inferior vena cava, so as to occlude these vessels. The defect is then explored digitally through a small incision made in the wall of the right atrium. This exploration should be done systematically to exclude anomalous pulmonary veins and to note the relationship of the eustachian valve to the inferior vena caval opening. The defect is then explored to confirm the diagnosis of ostium secundum defect. The observer, having obtained a clear conception of the interior of the atrium, then withdraws his finger and the atrium is explored digitally by an assistant.

The anaesthetist acts as the timekeeper and times the occlusion of the superior and inferior venae cavae. After 20 seconds the aorta is cross-clamped and neostigmine is injected proximal to the clamp in order to perfuse the coronary circulation. A transverse sinus clamp is then applied across the pulmonary artery and the aorta as low down as possible and the right atrium is opened widely. Any blood remaining is sucked out and a careful survey of the anatomy made. A stitch is then placed through the lower end of the defect and another is placed in the upper end, after which the intervening defect is closed with a running suture. There are often lacework remnants of septum primum across the defect, and these are incorporated in the suture. The needle must pick up the limbus of the fossa ovalis. A further one or two additional interrupted sutures are placed. Before closure of the defect, to exclude air from the left atrium, the anaesthetist inflates the lungs in order to force blood from the left atrium and to expel any trapped air. To exclude air from the right atrium the inferior vena caval snare is released to fill this chamber with blood. A clamp is then placed across the atrial incision, while the transverse sinus clamp is slowly released. The superior vena cava can then be released. At this stage the operator proceeds with closure of the atrial wall, while another member of the team watches the heart for arrhythmias and the coronary arteries for air embolus. If ventricular fibrillation occurs, the member at the table opposite the surgeon massages the heart while the atrial closure is completed.

Most of the cases have had a period of atrial fibrillation during hypothermia. Every case except one has reverted to sinus rhythm before leaving the theatre. One remained in atrial fibrillation but was restored to sinus rhythm two weeks later with quinidine.

Bilateral drainage tubes are inserted up to the base of both pleural cavities and connected to underwater drainage.

Post-operative complications have been few, and are to be discussed by Dr. Machell elsewhere.

Deaths

In this series of 49 cases there have been four deaths. The deaths occurred in the first 10 cases and there have been none in those following. Hypothermia alone has not been primarily responsible for any deaths, and we consider it to be a safe procedure.

The first death was in a woman of 44 and was an early case in the series. She should not have been operated on, and this was a case of bad selection. She had severe symptoms and a high pulmonary resistance with a small shunt. In the light of present knowledge she would not be accepted for surgery.

The second death was due to a technical error. This was during the closure of a low defect in association with a large eustachian valve, and, while the dangers of this combination were well known to us, this case occurred early in our experience, and was further complicated by associated anomalous venous drainage. The edge of the eustachian valve was mistaken for the lower edge of the defect and incor-

porated in the suture. This deviates the inferior vena caval blood into the left atrium. The mistake was not appreciated at the time, and the patient succumbed.

The third case was that of a woman of 56 whose death from haemorrhage has been recorded above. The fourth was that of a child of 12, in whom an attempt was made to close an ostium primum defect. She developed complete heart-block and succumbed in 36 hours. While it is technically possible to close primum defects under hypothermia, the limited time available does not allow adequate margins of safety; but Kirklin *et al.* (1955) have shown that these defects can be closed successfully by inserting a prothesis, using the heart-lung machine.

Follow-up

At the follow-up all survivors were symptomatically well and all the defects have been assessed by our cardiologist, Dr. R. V. Gibson, as being closed, except in one case in which he thinks there may still be a small shunt. This shunt must certainly be small, as the child has improved and has grown remarkably in six months. This child is to be re-catheterized. We have not routinely recatheterized our post-operative cases unless there was the slightest doubt clinically that the defect was completely closed. The three cases catheterized post-operatively have shown no residual shunt.

Summary

A series of 49 cases of atrial septal defects have been closed under hypothermia by surface cooling. Two of the defects were of the ostium primum variety, one a sinus venosus defect, the remaining 46 being ostium secundum defects. There were four deaths among the first 10 cases and none in the last 39 cases.

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The W.H.O. Expert Committee on Malaria at its meeting in Lisbon in September last reviewed the role of antimalarial drugs in world-wide malaria eradication, especially in the later stages of the campaign. If malaria eradication among stable populations in towns or villages was comparatively easy, it became very difficult among nomads—for instance, Bedouin or Amazon-Indian tribes and migrant workers, or groups of people usually dispersed, such as labourers, woodcutters, or fishermen, who lived in tents or temporary shelters. One possible way to protect these groups from malaria appeared to be medicated salt (Pinotti's method). Common household salt was mixed with antimalarial drugs and became a part of the normal diet of people exposed to malaria. This method had been tried out for several years in Brazil, and soon would be applied to more than a million people in that country. Experimental trials had been carried out in the United States under W.H.O. sponsorship, and the application of this method in the field was planned in several other countries. In some parts of Africa experiments were well under way in order to assess possibilities of using Pinotti's method, while more general experiments connected with the distribution of drugs were being attempted almost everywhere in that continent.