CONGENITAL CARDIAC DISEASE IN IDENTICAL TWINS.

BY

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The study of rare diseases and rare abnormalities is of more value in throwing light upon pathological or physiological processes than in furnishing guidance for future encounter with the same condition. This principle applies to the study of diseases in the individual, but it applies even more in the case of homogeneous twins, for here the solutions of embryological problems may become apparent, and a means is afforded of investigating the influence of the various factors which control development in childhood. The rôles of nurture and nature in directing character formation have thus been investigated by Galton¹. The occurrence of acquired disease, both physical and psychical, in homogeneous twins has elucidated the close similarity of intimate structure and defence mechanisms possessed by such twins. In this connection, twins suffering from lenteric diarrhœa have been recorded by Cockayne², while asthma occurring in both of a pair has been described by Trousseau³. Cases of congenital abnormalities occurring doubly in twins have been investigated and recorded by Cockayne², who found such abnormalities involving not only gross and intimate structure but mental and metabolic processes also.

The rarity of congenital cardiac abnormalities in twins, and the writer's recent observation of twins suffering from patent ductus arteriosus, have prompted an investigation of cardiac defects occurring in paired offspring, and specially a consideration of the clinical manifestations of patent ductus arteriosus in infants. This paper therefore deals first with congenital cardiac disease in homogeneous twins, an account being given of cases recently observed, and secondly with the symptoms of patent ductus arteriosus. In the latter part other examples of this defect occurring solitarily in single children have been collected for their clinical value, and the syndrome has been described.

CASES OF CONGENITAL CARDIAC DEFECT IN TWINS.

I. Dèbreuil-Chambardel⁴ describes transposition of viscera occurring in one of twins. In weight, size, general appearance, and in the development of varicosities on the legs, these twins were identical, but one of them was discovered to have the apex beat within and below the right nipple, while X-ray confirmed the dextrocardia and showed the liver to be on the left of the abdomen. Although these findings were not conclusive evidence of transposition of the heart, the following embryological considerations make this probable. First, it is known that in double monsters the aorta bifurcates, the left branch passing backward and to the left in the normal manner in the left-sided twin; while

the right branch passes backward and to the right in the right-sided twin. Secondly, in such monsters, transposition of the viscera has been shown by Martinotti and by Lochte to depend upon persistence of the right omphalo-mesenteric vein, and they have found that secondary rotation of the heart is usual but not inevitable. If we regard identical twins as separated double monsters, the application of these principles to such twins becomes apparent. A mirror-image hare-lip, right on one twin and left on the other, strengthens the probability that the transposition of the heart was present in one of the pair.

II. Pezzi and Carugati¹ give an account of adult identical twins both of whom had dextrocardia and probably complete transposition of viscera. While serving in the war one of the twins had a bout of malaria, and a mass in the left hypochondrium was thought to be the spleen, but was found by radiography to be the liver. Further X-ray examination showed the heart and stomach to be on the right, and the liver on the left in both of the twins. Electrocardiography showed a reversed but otherwise normal tracing in lead I; lead II was as a normal lead III, and lead III as a normal lead II.

The interest in this case lies not so much in the presence of similar visceral abnormalities but in the absence of a mirror-image dextrocardia in one twin corresponding with a normally placed heart in the other. For in this case, the external evidence indicated homogeneity in the twins, while the electrocardiographic changes said by Abbott² to be diagnostic of congenital dextrocardia with *situs inversus* were present. Further, the fact that this form of congenital dextrocardia is, unlike that without *situs inversus*, not of clinical significance, suggests that the former abnormality was present in the case of these soldiers.

III. The following cases of patent ductus arteriosus occurring in each of a pair of twins recently came under observation at the Middlesex Hospital. These infants were of the same sex and very similar in general appearance, size and weight. The first was admitted, at the age of 17 days on February 25th, 1929. The child was the second of the pair, and had been a full time breech presentation. There was a history that the child had been coughing for a week and that for three days before admission his condition had been worse. It was also complained that the infant went blue when coughing, and that the feeds were being vomited. On examination the infant was found to be rather emaciated and of greyish complexion. No murmur was heard on auscultation, nor were any other signs of cardio-vascular abnormality detected. The breath-sounds were weak, and fine sibilant rhonchi and râles were heard throughout the lungs. For three days after admission the vomiting continued, and attacks of cyanosis occurred seven or eight times in the day. In these seizures the colour would suddenly turn to greyish blue while the breath was held. No convulsions occurred, and to all appearances the child was moribund. The administration of oxygen, and holding the infant up by the legs, brought these attacks to an end within two or three minutes. After three days the attacks became less frequent, vomiting stopped and the general condition greatly improved; on the eighth day after admission, a more severe attack than ever occurred, the breathing was never properly re-established and death took place

eight hours later. At necropsy the ductus arteriosus was found to be patent so that a probe could easily be passed from the aorta into the pulmonary artery. Evidences of bronchitis and broncho-pneumonia were found in the lungs.

The twin brother of the patient just described was admitted to the Hospital on March 6th, 1929, at the age of 26 days. For several days there had been slight cough, but two days prior to admission the cough became worse and the child began to vomit his feeds. On the day before admission cyanosis after coughing and unduly hurried respirations were observed. On examination the infant looked ill and grey. No murmur or other sign of cardio-vascular defect was observed. Signs of bronchitis were found in the lungs. Attacks in every respect similar to those in the first case were observed in this child at intervals for three days, and improvement resulted from the same treatment. However the attacks recurred on the fifth day after admission and death followed in an attack two days later. At necropsy a patent ductus arteriosus was found exactly like that observed in the other twin. Signs of bronchitis and broncho-pneumonia were also present.

PATENT DUCTUS ARTERIOSUS IN INFANCY.

In view of the pronounced and distinctive clinical manifestations in the twins described above it was thought worth while to collect some other instances of patent ductus arteriosus in infancy. In 1911, E. W. Hall⁹, at the Middlesex Hospital, described three such cases, and gave an account of their clinical course and post-mortem findings. In each instance there were observed at variable intervals spontaneous attacks of apnoea with cyanosis, death occurring as the immediate consequence of a severe or prolonged attack, and in each infant also patency of the ductus arteriosus was the sole abnormality found at necropsy.

The association of variable cyanosis and apnoeic attacks with patency of the ductus arteriosus is exemplified further in the following case. A baby of four weeks was admitted to Great Ormond Street Hospital on account of blueness and difficulty in breathing. These symptoms had been variable and not noticed as a marked feature in the first few days of life. The infant wasted after birth, and four days before admission a diagnosis of broncho-pneumonia had been made in view of the respiratory symptoms. On admission he was a blue baby. There was slight pyrexia, but no definite signs were found in the lungs; the heart was rapid but no murmurs were heard. The variation in the depth of cyanosis was sufficiently great to lead to a tentative diagnosis of patent ductus arteriosus. Just before death, which occurred five days after admission, a few moist sounds were heard at both bases. At autopsy the ductus arteriosus was found to be open and was about a quarter of the bore of the pulmonary artery. There was no other abnormality of the heart, but both lungs showed broncho-pneumonia of the lower lobes.

The similarities between the four single cases described and the author's pair are (1) the absence of physical signs in the cardiovascular system: (2) the presence of patent ductus as a solitary cardiac defect: (3) the occurrence

of attacks of cyanosis with arrest of the breathing, these attacks sometimes ceasing spontaneously, sometimes yielding to oxygen or the injection of cardiac stimulants, and frequently terminated in death.

Some obscurity surrounds the mode of production of cyanosis in these patients. The most likely explanation seems to be a change in the blood supply to the lungs brought about by a reversal of the direction of flow through the patent ductus arteriosus. If blood normally passing from the right ventricle into the pulmonary circuit is deflected through such an abnormal passage into the systemic circulation, progressively increasing cyanosis must follow. Supposing this to be the origin of the cyanosis, it remains to explain the cause of the deflection of blood from the pulmonary to the systemic circuit, and the frequent termination of the attack with resumption of normal conditions.

The most probable causes of increased resistance in the pulmonary circuit are any muscular effort on the part of the child, particularly crying or coughing, and engorgement of the pulmonary capillaries as occurs at the onset of pulmonary infections. A history of cough preceding the onset of cyanotic attacks is found in two of the cases described in this paper, and in these, as in one other case, broncho-pneumonia was found at autopsy. In the remaining three cases no such history was obtainable, nor was any pulmonary lesion discovered post mortem. Assuming reversal of blood-flow in the ductus to be the cause of cyanosis, the same cause in an opposite direction must operate in terminating the attack. This reversal might well be explained by the rise in arterial blood-pressure which accompanies asphyxia.

How it is that no murmur is presented by these patients, while the classical "mill-wheel" murmur is typical of patent ductus arteriosus in the adult, is not clear. It has been suggested that the difference depends upon the anatomical nature of the communication; if the ductus is straight and of uniform bore (as in all the cases here described) no murmur is produced, while a spindle-shaped dilatation of the channel which is not uncommon in the adult may be responsible for the continuous diminuendo and crescendo bruit.

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SUMMARY.

1. Three cases of congenital cardiac defect affecting one or both of twins are described. Two of these are taken from the literature; the third instance in which patency of the ductus arteriosus existed as a solitary cardiac defect in both of the twins is here newly recorded.

2. The clinical course and pathological findings in the author's cases are described, and reference is made to the manifestations observed in other cases of patent ductus arteriosus occurring as a solitary abnormality in infancy.

3. The origin of congenital defects in twins is discussed.

4. The symptoms corresponding to patency of the ductus arteriosus, and the probable mode of production of the syndrome are outlined.

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