An Address

ON

HEART DISEASE AND PREGNANCY.

DELIVERED TO THE NEWCASTLE-ON-TYNE DIVISION OF THE
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BY

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It is now several years since I first became interested in the subject of heart disease and pregnancy. In the early part of my professional career pregnant women were not supposed to be admitted into the wards of the Newcastle Infirmary, so that my experience was mostly gained in outside consulting practice. Recently greater facilities have been afforded me of studying the problems in a practical manner in the Princess Mary Maternity Hospital with its eighty beds. My desire is to create among the younger members of the profession interest in one of the complications of pregnancy worthy of their attention and well deserving of study. Death in maternity, from whatever cause, is a tragedy of womanhood. The high death rate of women during and shortly after the puerperium is a cause of public uneasiness and calls for abatement, but I do not intend to discuss the subject of septic infection.

Although in the main a physiological state, pregnancy is beset with many possibilities which tend to endanger the life of mother and child. Severe haemorrhage, for example, may occur before or after parturition, from which the patient may apparently recover; yet in many of these women, on auscultating the cardiac area, there will be heard, years afterwards, a soft mitral systolic murmur which was not present before the excessive loss of blood. In other words, as the result of the haemorrhage the heart has remained enlarged, and, being badly nourished, has never quite regained its normal size—a circumstance which will materially affect the course of succeeding pregnancies and increase the risk of the puerperium.

The Condition of the Heart in Pregnancy and the Effect of Pregnancy upon the Heart.

As far back as 1825 Larcher, who was then an interne in the Paris Maternity Hospital, drew attention to the relationship of the two, basing his opinions upon the examination of the heart of 130 patients who had died in the hospital, most of them of puerperal sepsis. It may be taken for granted that in most of the patients the heart had been healthy except so far as it might have been influenced by the puerperal fever. It was his opinion that the human heart becomes normally enlarged during utero-gestation, that it is mainly the left ventricle which is affected, the right heart showing few if any alterations, also that during lactation the heart tends to return to its normal size unless subsequent pregnancies follow each other in rapid succession.

It is possible, as Angus Macdonald,¹ writing in 1878, maintained, that Larcher exaggerated the cardiac condition. On the other hand, it is generally admitted that pregnancy influences the quantity and quality of the blood in the body, and that there is thrown upon the vascular system increased work in order to meet the requirements of the mother and the foetus *in utero*. Larcher's views did not meet with general acceptance even by his own countrymen. One of his strongest opponents, however, was a German, Herman Lohlein, who stated that the average weight of the heart in pregnant women is not greater than that of their non-pregnant sisters. On the whole the consensus of medical opinion is that in pregnancy there is a slight increase in the size and weight of the heart, and my own experience confirms this. The average weight of the female heart between the ages of 20 and 25 years is, according to Peacock, 8½ oz., while in the case of pregnant females it is over 9 oz. In addition to the increased weight of the heart, the blood pressure must be considered. This becomes raised, and is frequently associated, as pregnancy advances, with conditions that are

dangerous. The systole of the ventricle becomes stronger and its contents are discharged under higher pressure. This physiological condition is necessitated by the maternal and foetal requirements. Obstetricians recognize that in abnormal circumstances a rising blood pressure may be the forewarning of eclampsia. At any rate, where the blood pressure rises above 150 mm. of mercury the patient should be watched, carefully dieted, and the emunctory organs maintained in good order. The blood pressure rises and wanes with the pains during the first and second stages of labour, and declines in a normal case three or four days after the confinement.

It is after the supervision of pregnancy that many women, hitherto unaware of having experienced any inconvenience in walking or taking gentle exercise, become conscious of a sense of breathlessness on exertion, and since in pregnancy there is usually a tendency for the body weight to increase, for the volume of blood to become greater, and the size of the uterus larger, this raises the question whether there is an increased cardiac output. It is this problem which Stander, Duncan, and Sisson² set themselves the task of investigating. The new physiology, with its carefully-thought-out methods of research and instrumental equipment, has given a fresh impetus to the study of medical problems and has compelled us to approach these in a manner impossible to be done four decades ago. The experimental method was made use of by the research workers just mentioned, dogs, non-pregnant and pregnant, being employed. Six female dogs were carefully trained so that they were completely under control, and were unlikely therefore by movement or otherwise to vitiate the results aimed at. Two of the dogs became pregnant. The results of the experiments are interesting, for the investigators found that of the four non-pregnant animals kept under observation for more than a year the heart output varied very little, also that the "minute volume" had a more constant value than the "systolic output." One circumstance particularly worthy of mention is that during oestrus the cardiac output was increased and therefore resembled in a miniature manner what takes place in pregnancy. These observers found that during gestation the cardiac output kept gradually increasing all through, until shortly before delivery the output had increased 53 per cent., and that after delivery it slowly returned to what might be regarded as the normal. The conclusion was that the cardiac output is increased by one-third to one-half during the later months of pregnancy, and since during the whole period of utero-gestation there is never a fall of the arterial blood pressure, the heart is really called upon to perform a greater amount of work. This raises the question whether this is accomplished by the heart becoming hypertrophied or simply by the organ calling upon its latent reserve. Opinions differ, as I have incidentally stated, in regard to the occurrence of hypertrophy of the left ventricle of the heart, but there is not the least doubt "that some mechanism must be called into play to meet the increased demands of pregnancy." Given a healthy heart and a normal pregnancy, the heart is capable of rising to the occasion, but it is another thing for a woman who has a cardiac valvular lesion and whose myocardial fibres are not typically sound; how will her heart bear the additional strain which pregnancy is likely to impose upon it?

Some Statistics.

Taking the records of the Princess Mary Maternity Hospital for the last three years, I find that 9 pregnant women with heart disease were admitted in 1924; 3 were cases of mitral stenosis, 3 of mitral incompetence, and 1 of aortic regurgitation, while 2 suffered from myocardial weakness. All the patients successfully passed through the process of parturition, and were able to return to their homes. During 1925 the cardiac patients admitted numbered 16; 2 were suffering from mitral stenosis, 6 from mitral incompetence, 3 from aortic regurgitation, and 5 from cardio-valvular defects, not stated, and myocardial feebleness. Three deaths occurred: one woman, the subject of aortic regurgitation, developed anginal pains, and died a few hours after her admission, undelivered; one woman was admitted in a moribund condition with mitral regurgitation, six and a half months pregnant—she died nine and

a half hours after admission, undelivered; another woman, the subject of mitral regurgitation, died a few hours after admission. There were 13 cardiac patients admitted during 1926; 8 suffered from mitral stenosis, 3 from mitral incompetence, and 2 from aortic regurgitation. One patient, a 3-para, aged 37, the subject of mitral stenosis, died ten days after her confinement from pulmonary embolism. Of the 38 patients 13 suffered from mitral stenosis, 12 from mitral regurgitation, and 6 from aortic regurgitation. Four patients (10.6 per cent.) died in the hospital. It is more than likely that in some of the patients tabulated as mitral regurgitation, stenosis was present as well.

As a contrast I will take the number of similar cases admitted into a general hospital—the Western Infirmary of Glasgow. Dr. R. A. Currie of that city has been good enough to send to me, with Professor T. Monro's permission, the number of patients admitted into Professor Monro's wards during the last ten years. The total number for that period is 27. Of these, 7 were cases of mitral stenosis, 7 of mitral regurgitation, 3 of aortic valvular disease, and 6 of auricular fibrillation. Three of the patients died, all of them from mitral stenosis and auricular fibrillation (11.1 per cent.).

There is a general feeling that, apart from myocardial failure, mitral stenosis is the cardiac lesion which gives rise to the greatest danger in pregnancy, both during and after parturition. In mitral stenosis there is the possibility of auricular fibrillation and its accompaniment—diminished heart output. H. R. Schmidt,³ dealing with the subject of heart failure in pregnancy, reminds us that many patients are unconscious of the fact that they are the subjects of heart trouble until after parturition. Baisch examined 200 patients. He found that 50 per cent. of the women remained well, 45 per cent. suffered from failure of compensation, and that 5 per cent. died. Schmidt reported 38 cases of heart failure in 10,027 patients (0.38 per cent.): 5 of these died in hospital during the puerperium, and 5 within a year and a half after parturition. Of 12 patients with mitral stenosis, 6 died immediately after labour, the most serious cases being those with signs of myocardial degeneration, attended by irregularity of the pulse and stasis of the circulation. In heart disease and pregnancy we have to remember that the function of the heart is less deranged by the mechanical conditions incidental to pregnancy than by the consequences of decompensation—that is to say, failure of compensation where there is a valvular lesion. Failure of compensation may occur even in the early months of pregnancy and be the result of inability on the part of the heart to deal with the increasing volume of blood, so that in consequence of embarrassment of the organ the question of the advisability of terminating the pregnancy may have to be considered.

It is difficult to obtain statistics of large numbers, for, after all, the cases are comparatively few, varying from 0.38 per cent. in Schmidt's experience to 1.06 per cent. in G. A. Wagner's; and while we cannot but admit that heart disease in pregnancy is a serious complication, yet here again, as to its seriousness, reliable information is scanty. Wagner's cases numbered 80 in 8,000 pregnant women: 14 of these 80 women died directly or indirectly of heart lesions, but in 12 of these 18 women pregnancy had to be terminated as they were showing such signs of failure of cardiac compensation as cyanosis, dyspnoea, small radial pulse, tachycardia, and prostration. In many of the cardiac patients treated in the Princess Mary Maternity Hospital the second stage of labour has been rapidly gone through, sometimes occupying not more than five minutes, so that, owing to the comparatively rapid emptying of the uterus and the fall in the abdominal pressure, there is a rush of blood to the splanchnic vessels, with the possibility of fatal cardiac failure, such as has been known to occur shortly after surgical removal of a large ovarian cyst.

Heart Disease and Marriage.

Since heart disease may become a serious complication of pregnancy, we are occasionally consulted as to whether women who are its subjects should marry and thereby incur the risk of pregnancy, with its attendant dangers. There

will always be a certain number of married women who do not become pregnant, but in the circumstances of a normal married life there is the possibility. Our experience is that while a cardiac patient may pass successfully through two or three pregnancies and be little the worse for the event, yet with each succeeding pregnancy the heart becomes less and less able to bear the strain—it dilates, and its musculature becomes less efficient. There is always the tendency, too, for the pulmonary circulation to become embarrassed, especially where the lesion affects the mitral orifice. When a single woman has already suffered from hæmoptysis and dyspnoea, these circumstances of themselves should be a reason for the discouragement of marriage. Professor Peter of Paris was of the opinion, in view of the pulmonary complications which were likely to arise, that women with heart disease should not marry, but one of his contemporaries, Professor Jacoud, regarding the statement as too sweeping, maintained that at any rate many women could pass successfully through three pregnancies, including one or two miscarriages, without their health becoming seriously impaired. When, therefore, our advice is asked, we must carefully consider the condition of the heart, the presence or absence of dilatation of the organ, also the regularity and rapidity of its beat, the history of hæmoptysis and dyspnoea, as well as the social and economic status of the patient and her prospects. Irregularity of the heart's action is one of the main dangers to pregnant women. It was the sudden death of a young expectant mother during parturition which led Sir James Mackenzie, when a general practitioner in Burnley, to study more assiduously diseases of the heart. The real danger of heart disease in pregnancy, he too thought, was not so much the existence of a particular valve lesion as the condition of the myocardium. Mackenzie regarded breathlessness and pain as indications of failure of the heart to respond effectively to effort, and he added that these are really not heart symptoms at all, but are produced outside the heart, in the lungs and nervous system.⁴

The Danger of Pregnancy to a Woman with Damaged Heart.

Apart from the effects of previous endocarditis caused by rheumatic fever, intracardiac conditions may arise during pregnancy which may render the organ incapable of carrying the patient through parturition and the puerperium. Although cardiac irregularity was the predominant feature in the Burnley patient just alluded to, it became clear to Mackenzie that there must be various types of irregularity, and that all are not equally dangerous. It is common knowledge that some women with irregularity of the heart's action can pass through the processes of parturition with apparently no ill effects, while in the case of others life is seriously endangered or suddenly brought to a close.

Recent advances in cardiology have confirmed the views, more than once expressed, that life is mainly threatened by myocardial conditions, and in these are included changes in the sino-auricular node, auriculo-ventricular node, and the bundle of His. Such secondary effects as pulmonary congestion and right-sided cardiac dilatation are also of importance. I need only briefly mention the two special nodes of tissue, the sino-auricular node close to the base of the auricles, also the auriculo-ventricular with the bundle of His running down in the myocardium and dividing into two branches, one for each of the ventricles. The impulse to rhythmic cardiac contraction originates in the tissue of the sino-auricular node, and is transmitted by the muscular fibre of the auricular walls to the auriculo-ventricular node, and therefrom by the bundle of His to the ventricular walls. The heart is supplied by branches of the vagus and the sympathetic system of nerves; branches of both of these reach the sino-auricular node, also the auriculo-ventricular, while the substance of the cardiac muscle is capable of originating beats of its own. When through disease the sino-auricular node ceases to function the auricles pass into a condition of fibrillation, but the ventricles still continue to beat at a rate and with a rhythm special to themselves. One of the results of alteration in the rhythmic discharge of impulses from myogenic and cardiac nervous mechanisms is the occurrence of extra-systoles or of tachycardia. The

former may be traced to defaults in (1) auricles, (2) auriculo-ventricular node, or (3) the bundle of His and its branches. An extra-systole is but a single contraction due to the impulse which produces it being discharged earlier than those normally emerging from the sino-auricular node. On the other hand, what is meant by "heart-block" is an irregularity of rhythm due to some defect in the auriculo-ventricular node, or the bundle of His, whereby impulses from the sino-auricular node are not conveyed to the ventricles, and as a consequence the ventricles commence to beat spontaneously.

Cardiac Lesions Separately Considered.

The cardiac lesions met with in women are mostly mitral stenosis and regurgitation—especially the former. It is the effects and the associates of this lesion which obstetricians find play such a harmful part in the later months of pregnancy, also during the second stage of labour and afterwards. As the end of term approaches, the uterus has risen high up in the abdominal cavity, the movements of the diaphragm are impeded, for the midrib cannot contract so well as formerly, and as a consequence there occurs increased venous pressure towards the heart, with circulation stasis, attended by cyanosis and a degree of dyspnoea. The flow of blood through the right heart is delayed. In mitral stenosis in a non-pregnant woman there is usually dilatation of the left auricle and an overfilling of the pulmonary capillaries, followed by compensatory changes in the right heart. That such occur similarly in pregnant women is shown by the fairly free haemoptysis observed in many women prior to the onset of labour. When the breath is held in inspiration during the expulsive stage of labour, and the abdominal and uterine muscular contractions are strong, and when it almost seems as if the right heart could hardly empty itself, relief is brought to the overdistended organ by impulses carried centralwards by the vagus from the overfilled auricles through acceleration of the cardiac beat. The impulses referred to induce, as Bainbridge experimentally demonstrated, cardiac quickening, either by reducing the tone of the cardio-inhibitory mechanism, or by throwing the cardio-accelerator nerve centres into action. By means of this cardiac reflex there is not the least doubt that much maternal suffering and impending danger are averted.

A similar remark applies to mitral regurgitation. Instead of having, however, a small left ventricle, as in cases of uncomplicated mitral stenosis, this chamber is hypertrophied and dilated. The condition enables the heart to cope with the increased quantity of blood poured into it during diastole, so that in pregnancy, given a heart in which compensation is well established, the patient may pass fairly comfortably through the ordeal of parturition; but if, on the other hand, the mitral reflux is fairly free, there will be a degree of backward pressure towards the lungs with inefficient emptying of the right heart, so that the secondary effects come to resemble those met with in mitral stenosis.

In aortic regurgitation it is the left ventricle which claims our attention. Whatever may be the degree of blood pressure during quiescence before the onset of labour pains, the subsequent uterine contractions and those of the abdominal muscles induce a rise of the general arterial tension, and while Marey taught that increase of arterial pressure is followed by slowing of the pulse, this can hardly be said to be quite true of events occurring in the second stage of labour. As already mentioned, during the expulsive stage of labour the breathing is suspended in the inspiratory phase, and this, in conjunction with the muscular contractions, causes an increased flow of venous blood to the right heart. It is then that the Bainbridge reflex comes into play and, by accelerating the pulse rate, tends to maintain the output per beat of the left ventricle at its normal value. Nature has thus provided against serious overdistension of the heart by quickening the pulse and shortening the diastolic period. More and not less blood will thus be expelled from the left ventricle, and the circulation through the coronary arteries, which is the essential requirement, will be maintained. This is probably the explanation of how patients who are the subjects of aortic

regurgitation pass through pregnancy and parturition with less risk than might be expected. In aortic incompetence the left ventricle is hypertrophied and dilated, so that the heart of a pregnant woman accommodates itself to the increased inflow and acts in accordance with Starling's "Law of the heart," whereby the energy set free by the cardiac muscular fibres when they contract varies in proportion to their muscular length. When, therefore, in aortic regurgitation with hypertrophied left ventricle the elongated muscular fibres contract they liberate more energy, there is greater endocardiac pressure, the aortic valves open earlier, the period of expulsion is probably lengthened, and the pulse quickened.

Time will not permit me now to deal with the development of heart affections after the menopause, yet probably related to child-bearing.

Treatment.

The treatment of the pregnant woman with heart disease resolves itself into treatment during pregnancy, parturition, and the lying-in period. If the cardiac lesion is well compensated, and there is no embarrassment of breathing—if, in a word, the patient differs in no respect from a healthy woman similarly circumstanced, then all that is necessary is to keep her under observation, diet her, regulate her exercise, and keep the emunctory organs in good condition. If the blood pressure remains in harmony with that of the average of healthy women, the chances are that the patient will pass through pregnancy and the puerperium without risk. The cases which make us anxious are those in which towards the end of pregnancy the pulse becomes rapid, feeble, flickering, or irregular, but even for such patients much can be done by keeping them in bed and giving digitalis in increasing doses if required. The first stage of labour, if not unduly prolonged, may not be more oppressive than in other patients, although the accoucheur must be on the lookout for signs of fatigue. It is the second stage which calls for careful attention on the part of the obstetrician, so that he may shorten it by the application of the forceps, if there are signs of fatigue or of cardiac failure; or if there is difficulty of breathing, that he may administer oxygen and give hypodermically strophanthin, digitaline, or strychnine, and on the expulsion of the placenta see that abdominal pressure with the hand is maintained. The anxiety of the accoucheur is considerably relieved once parturition has been successfully passed through, but, during the lying-in period, cardiac patients, particularly those with mitral stenosis, require watching for a week or two.

It is desirable that the women of the working classes, particularly those who are the subjects of heart disease, should, if they become pregnant, report themselves at an ante-natal clinic, and, before the end of term, enter a maternity hospital, where, under the supervision of a resident medical officer, eventualities of all kinds may be anticipated and dealt with. I can speak most encouragingly of the good results which have accrued from following out this recommendation. In a general way, even women who are believed to be healthy would benefit, where circumstances permit of it, by reporting themselves at an ante-natal clinic one month before the expected termination of their pregnancy. Where there is no clinic or maternity hospital close at hand a woman who is the subject of heart disease should certainly see her own doctor shortly after she believes herself to be pregnant, and obtain from him advice as to what her line of life should be, what she ought and what she ought not to do; for if her condition, cardiac and general, is such as to cause anxiety and is likely to be attended by risk to her own life, the doctor might, by keeping her at rest at home and treating her with heart tonics, help to carry her safely through her confinement; or—and this might often be better—arrange for her admission into a maternity hospital, where she would have the prescribed rest and medical attention. A pregnant woman with heart disease need not wait until "quickening" takes place before reporting herself to a doctor.

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