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INCIDENCE OF HYPERTENSION AFTER PREGNANCY TOXAEMIA

BY

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In spite of an extensive literature, which was reviewed in two previous papers (Gibson, 1954, 1956), there is still some difference of opinion on whether permanent and significant hypertension is a frequent sequel to pregnancy toxæmia in women who enter pregnancy with normal blood pressures; and again about the amount of damage which may be done by a toxæmic pregnancy in a woman already hypertensive. The three major difficulties of assessment are: (1) the difficulty of definition and classification; (2) the fact that few women have had their blood pressures taken before pregnancy started, and it is well known that pressures taken during the second trimester of pregnancy may give unusually low readings; and (3) the fact that, in a normal population, blood pressure varies with age, so that in a follow-up study final blood pressures must be expected to be somewhat higher than initial readings taken some years previously. For all these reasons one of us was about to embark on yet another follow-up study of a small series of cases of pregnancy toxæmia observed a few years ago (Platt, Stewart, and Emery, 1958), but on reading the literature it seemed that the very much larger series of cases observed by Gibson (1954, 1956) (which is referred to in this paper as the Belfast series) was capable of further analysis. This paper is therefore a re-examination, jointly by physician and obstetrician, of the Belfast series.

In this series Gibson took the figure of 140/90 to be the arbitrary dividing line between normal blood pressure and hypertension. If either the systolic or diastolic pressure was below this level the patient was regarded as normotensive. Of 1,420 toxæmic pregnancies in the series, 95% of the women were re-examined an average of four years later. Of these, 63.6% were adjudged, after review, to be cases of pre-eclamptic or eclamptic toxæmia, and 11.7% to be cases of chronic hypertension complicated by pregnancy. 1.9% were classed as chronic renal disease, and 22.8% remained unclassified, this large residue of unclassified cases being due usually to the fact that blood-pressure readings in early pregnancy had not been recorded. Using again the criterion of 140/90, Gibson found that about 30% of patients had hypertension after pre-eclamptic toxæmia. He found that neither the duration of the toxæmia—that is, the length of conservative treatment—nor the severity of the toxæmia had a significant effect on the incidence of hypertension as a sequel; the most important factor was the age at time

of review—49% of women aged 40 to 44 years and 65% of women aged 45 to 49 years were hypertensive on this assessment.

Case Material.—The case records have been divided into two groups: (1) the toxæmic series, consisting of 446 cases in which the blood pressure was found to be below 140/90 during or before the 20th week of pregnancy, and which satisfy the diagnostic criteria of toxæmia (Gibson, 1954); and (2) the hypertensive series, in which the blood pressure was found to be 140/90 or more during or before the 20th week of pregnancy.

Toxæmic Series

The main objects of the re-examination were to compare the initial and later blood pressures of these women with those of a general population of women in the same age groups. For our controls we have taken the population of 1,204 unselected females recorded by Hamilton, Pickering, Fraser Roberts, and Sowry (1954a). For the sake of brevity this is referred to as the London series. It must be noted, however, that our toxæmic series is not strictly comparable with a series of unselected women, because we have arbitrarily excluded anyone with a blood pressure of 140/90 or over, and the London series clearly shows that in the older age groups something approaching a third of all women are likely to have blood pressures higher than this. Table I and Fig. 1 show the systolic pressures and Table II and Fig. 2 the diastolic pressures of the toxæmic series in early pregnancy and again some four years after the pregnancy, set out as percentages and compared with the London series. It will be seen at a glance that the distribution of blood pressures of these women in early pregnancy closely corresponds with the distribution we would expect from the London series, except in the later age group (40–49), where, as we would expect, the exclusion of cases with pressures of over 140/90 significantly alters the distribution. Yet the blood pressures four or so years later are all shifted to the right and no longer conform to the expected distribution of blood pressures in a population of corresponding age. This occurs in spite of the fact that, initially, women with pressures over 140/90 were excluded.

It should be noted that this method of setting out the results appears to dispose of two of the difficulties encountered in this kind of study. In the first place, age is accounted for because the women are being

FIG. 1.—Distribution of systolic pressures in women before and after a toxæmic pregnancy compared with an unselected series of women of similar age. ○—○=Initial pressure. ○—○=London series. ●—●=Follow-up.

compared with a population of their own age group; for instance, a woman who was 27 during her pregnancy will be in the age group 30-39 when her blood pressure four or five years later is recorded. In the second place, the reliability of the blood pressure during early

TABLE II

Age	Total Cases		Diastolic Pressures								
			40 45	50 55	60 65	70 75	80 85	90 95	100 105	110 115	120 125
Under 20	16 0	Initial pressure			7	7	2				
		Follow-up pressure			0	0	0				
		Initial pressure %			44	44	12.5				
		Follow-up pressure %			0	0	0				
		London series %		4	27	52	18				
20-29	277 182	Initial pressure	2	6	67	122	70	10	0	0	
		Follow-up pressure			7	57	87	26	4		1
		Initial pressure %	1	2	24	44	25	4			
		Follow-up pressure %			4	31	48	14	2		1
		London series %		1	18	49	25	8			
30-39	133 189	Initial pressure		2	15	62	44	10			
		Follow-up pressure			7	44	71	42	22	3	
		Initial pressure %									
		Follow-up pressure %		1.5	11	47	33	7.5			
		London series %			4	23	38	22	12	2	
40-49	20 74	Initial pressure			2	9	8	1			
		Follow-up pressure				4	24	20	19	5	2
		Initial pressure %									
		Follow-up pressure %			10	45	40	5			
		London series %				5	32	27	26	7	3
50-59	1	Initial pressure									
		Follow-up pressure									
		Initial pressure %									
		Follow-up pressure %									
		London series %		0.5	6	29	37	17	5	4	1
50-59	1	Follow-up pressure					1				

TABLE I.—Systolic Pressures

Age	Total Cases		80 85	90 95	100 105	110 115	120 125	130 135	140 145	150 155	160 165	170 175	180 185	190 195	200 205	210 215
Under 20	16 0	Initial pressure			4	3	4	4	1							
		Follow-up pressure			0	0	0	0	0							
		Initial pressure %			25	19	25	25	6							
		Follow-up pressure %			0	0	0	0	0							
		London series %		2	13	45	29	11	0							
20-29	277 182	Initial pressure	1	1	30	91	95	55	4							
		Follow-up pressure			2	25	75	40	23					2	1	1
		Initial pressure %			11	33	34	20	1.4							
		Follow-up pressure %	0.4	0.4	1	14	41	22	13	4	3			1	0.5	0.5
		London series %		2	11	33	23	19	12	0.6						
30-39	133 189	Initial pressure	1	5	12	30	54	24	7							
		Follow-up pressure			4	25	57	24	32							
		Initial pressure %			9	23	41	18	5							
		Follow-up pressure %		4	2	13	30	13	17							
		London series %		1	12	25	22.5	18	12						0.5	
40-49	20 74	Initial pressure	0	0	1	6	8	5								
		Follow-up pressure				5	8	9	23	8	9	6	3	2		1
		Initial pressure %				30	40	25								
		Follow-up pressure %				7	11	12	31	11	12	8	4	3		1
		London series %		1	6	18	18	17	17	14	4	1	3	1	0.5	0.5
50-59	1	Follow-up pressure							1							

pregnancy seems to be established, because if unusually low readings were being encountered, giving a falsely low baseline, they would not compare so accurately (in the younger age groups) with the London series. The average duration of pregnancy at which the initial blood pressure was recorded was 15 weeks, and, as a further

FIG. 2.—Same as Fig. 1, but diastolic pressures. Key as Fig. 1.

initial figure was 120/76 and the follow-up figure 135/84. In the 40-49 age group the initial figure was 121/76 and the follow-up figure 148/93.

We can also examine the data in another way. Table IV shows the actual mean gain in pressure of the toxæmic women compared with the gain in pressure which would be expected in women of the same age after the passage of four to five years (as calculated from the London series). In each case the gain in pressure far exceeds the expected gain. It is greater in

the older groups, but this may not indicate a greater risk, because a gain of 10 mm. diastolic pressure in a woman of 20 is probably equivalent to a gain of 15 mm. in a woman of 40 (see later).

As a result of this examination of the Belfast data there seems to us to be little doubt that, as a statistical finding, pregnancy toxæmia causes an increase in blood pressure which is quite beyond anything which can be explained by the mere passage of time. As to the individual, there are of course a large number of cases in which no significant rise of blood pressure occurs at all, and hypertension of a degree likely to affect seriously the expectation of life is very rare. Only 17 of these 446 women were left with a diastolic pressure of 105 or over, and several of these had initial pressures which were at the upper limit for inclusion in the toxæmic series—for example, pressures of 135/90.

Some of the women had had another pregnancy between the initial (early pregnancy) blood pressure and the follow-up study. In some instances the second pregnancy had also been toxæmic. To save breaking down the material into a number of small

groups we have included these, taking no account of the second pregnancy. In most cases there is no obvious difference between those who had one and those who had two pregnancies. One extreme case is that of a girl of 18 whose blood pressure at the 18th week of her second pregnancy was 130/80. This rose to 165/110 during the toxæmia. When seen four years later, after another intervening toxæmic pregnancy, her pressure was 190/115.

From Table III and Fig. 3 it will be seen that the mean initial blood pressure in the 20-29 age group was 119/74, and the follow-up blood pressure 130/81. In the 30-39 age group the initial figure was 120/76 and the follow-up figure 135/84. In the 40-49 age group the initial figure was 121/76 and the follow-up figure 148/93.

FIG. 3.—Mean blood pressures (systolic and diastolic) of women before and after a toxæmic pregnancy compared with mean blood pressures of an unselected series of women of similar age. Key as Fig. 1.

FIG. 3.—Mean blood pressures (systolic and diastolic) of women before and after a toxæmic pregnancy compared with mean blood pressures of an unselected series of women of similar age. Key as Fig. 1.

TABLE IV.—Actual and Expected Gains in Mean Blood Pressures by an Increase in Age of Four to Five Years

Initial Age	Actual		Expected	
	Systolic	Diastolic	Systolic	Diastolic
Under 20	10.6	8.8	2.0	2.0
20-29	12.1	9.1	2.5	2.0
30-39	20.5	13.2	4.0	2.5
40-49	31.3	17.3	5.0	3.0

Hypertensive Series

This series of 92 cases (95 cases, with 3 deaths) includes all those women whose initial blood pressure at the 20th week of pregnancy or before was 140/90 or more. The average duration of pregnancy at which the initial blood pressure was taken was again the 15th week: again we made a check to see if unusually low readings were being obtained because of the pregnancy, but we found that the 34 cases in which the initial blood pressure was recorded at the 13th week or before gave an average diastolic pressure only 3 mm. higher than the average for the whole series of 92 cases. This was probably of no significance.

TABLE III.—Mean Blood Pressures

Age		Systolic	Diastolic
Under 20	Initial	120	63
	Final	(None)	(None)
	London series ..	116	70
20-29	Initial	119	74
	Final	130	81
	London series ..	120	75
30-39	Initial	120	76
	Final	135	84
	London series ..	124	80
40-49	Initial	121	76
	Final	148	93
	London series ..	134	83

It was of course impossible to compare this selected series of hypertensive women with any normal population, and we therefore converted their blood pressures into scores adjusted for age according to the method of Hamilton, Pickering, Fraser Roberts, and Sowry (1954b). By this method any blood pressure can be converted into a corresponding pressure at the age of 60, so that pressures at all ages can be compared. For instance, at the age of 35 the average diastolic pressure for a woman is 80. If her diastolic pressure is in fact 100, or 20 mm. above the average, she scores, not +20, but +25, because, owing to the curve for age, her blood pressure at 60 will probably be 25 mm. above average. A woman of 20 with a diastolic pressure of 100 would, however, score +55 on the same scale, whereas a woman of 45 with a diastolic pressure of 100 would score only +15. This seemed to us to be the only way of trying to make a comparison between the starting pressures of these hypertensive women and their blood pressures recorded about four years later.

The variations from case to case in this series are enormously greater than those in the toxæmic series. Some women with quite high blood pressures seem to be completely unaffected by the pregnancy—in fact, the follow-up pressure may even be lower than the initial one. In other cases extreme rises of pressure are found; for instance, from 140/90 in a woman of 42, to 220/140 five years later. Until we know more about the factors concerned in the development and progression of hypertension, it is somewhat doubtful whether the comparison made here has much validity, but, for what it is worth, the average score for starting systolic pressure was +51; at the follow-up this had increased by 17. The score for the initial diastolic pressure was +25, and this had increased by 8 at the follow-up examination. Translating this back into real blood pressures—for instance, in a woman aged 40—an initial pressure of about 165/100 would be converted into one of 180/110; as the effect of age is eliminated this would seem to be a significant increase attributable entirely to the pregnancy, but again let us remark that fluctuations between individuals are extreme, and there is comparatively little correlation between the height of the starting pressure and the gain of pressure which may be anticipated.

Comment

Although we believe that this paper brings to light some facts about the late prognosis of pregnancy toxæmia which have not been previously shown so clearly, it has to be admitted that the evidence could be challenged on at least two points. The first is that the initial pressure and the follow-up pressure were in most cases not recorded by the same person. If this were a serious source of inaccuracy we do not think the records would show such a clear similarity between the initial pressures and the pressures recorded in the London series for the same age groups; neither do we think that it would show such a regular shift to the right in the follow-up pressures of all age groups. The second point is that we have used as our controls the records of blood pressures from an unselected population—that is, the London series. The ideal control would have been a series of women who had passed through a non-toxæmic pregnancy.

Summary and Conclusions

Further consideration of a previously recorded series of 446 cases of pre-eclamptic toxæmia in women whose blood pressure early in pregnancy was normal clearly

shows that their mean blood pressures approximately four years after the toxæmic pregnancy are much higher than the mean pressures which would be expected in an unselected population of women of similar age. Nevertheless, severe hypertension is a rare sequel of toxæmic pregnancy in a woman previously normotensive. Similarly, in women who had toxæmic pregnancies superimposed on hypertension the rise of blood pressure on re-examination was more than could be accounted for by an increase of age of approximately four to five years.

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ISCHAEMIC ELECTROCARDIOGRAMS IN SYMPTOMLESS MEN

WITH A NOTE ON THE SERUM LIPOPROTEINS

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Much reliance is placed on the electrocardiogram (E.C.G.) in the diagnosis of ischaemic heart disease, especially in cases where the pain is atypical. Most physicians would be prepared to disregard a normal tracing in a patient with a classical history of effort pain or with clinical manifestations of myocardial infarction; but when these features are equivocal their interpretation is apt to be influenced by the electrocardiographic findings. While this approach is usually justified, the wording of some requests for electrocardiography ("Chest pain . . . ? evidence of ischaemia") at least conveys the impression that the tracing is to be used as a diagnostic arbiter, on the thesis that chest pain with an abnormal E.C.G. is necessarily cardiac pain. It should, however, be remembered that coronary artery disease is commonly found at necropsy when there have been no referable symptoms during life, and it is therefore debatable whether electrocardiographic evidence of myocardial ischaemia can invariably be equated with clinical manifestations. Hence, to assess the reliability of the E.C.G. in diagnosis it is important to know how often an ischaemic tracing may be a chance finding.

The literature contains several reports of such tracings being recorded in subjects without chest pain. The significance of many of these series is questionable, either because cases of hypertension or valvular disease (which produce similar electrocardiographic abnormalities) were included, or because insufficient leads were recorded. Using full leads in clinically healthy subjects, Wosika *et al.* (1950) noted ischaemic tracings in 21% of people over 80, and Acheson (1957) noted them in 10% of R.A.F. personnel aged between 19 and 54.