MIGRAINE AND ITS RELATIONSHIP TO HYPERTENSION*

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Headaches present a common and important group of symptoms in general practice, the accurate diagnosis and treatment of which may be the despair of the practitioner. Until comparatively recently the problem of headache received only scant attention and the mechanisms producing the various types of headaches were poorly understood. The importance of the problem is aptly expressed in the following words: "If one should search for a human ill which has manifested itself most widely during all times and among all people, there can be little doubt headache would achieve this undesirable distinction" (A. H. Riley, cited by Meuller, 1951).

This study was an attempt to give some indication of the incidence in general practice of one common and distressing variety of headache—namely, migraine—and, secondly, to establish a possible relationship between migraine and the later development of hypertension.

Though the condition has been recognized for many centuries it was not until the beginning of the second world war that any real progress was made towards solving the mystery of this distressing complaint. Migraine can scarcely be called a serious condition, but it is nevertheless an incapacitating one; the unfortunate sufferer may lose a considerable number of working days during a year, while the young mother may be quite incapable of performing her normal household duties for several days following an attack. The problem thus assumes an economic importance which presents an additional challenge to the doctor in his management of the many cases which are bound to come his way in normal day-to-day practice.

The material for this study has been drawn from a population of approximately 6,000 comprising the patients of a practice situated on the outskirts of the City of Liverpool, and the observations were made over a period of three years, 1954 to 1957.

Approach to the Problem

The method of approach was as follows. The medical record of every patient in the practice was examined and any reference to migraine or recurrent headaches suggestive of migraine was recorded along with the patient's name, age, and address. A total of 5,785 such records were studied. At the same time, any reference to raised blood-pressure was recorded. These patients were then interviewed, and a detailed history taken, followed by physical examination.

The criteria which had to be satisfied before a diagnosis of migraine was made were based on the definition of von Storch (quoted by Marshall, 1949), who listed the following components in order of diagnostic importance: (1) recurrent headache; (2) associated visual symptoms; (3) temporary gastrointestinal phenomena, usually nausea or vomiting; and (4) a family history of migraine, occasionally an epileptic history.

The first of these components associated with one other was necessary before the diagnosis was considered. According to Marshall the diagnosis could be expressed in order of certainty as follows: (1, 2, 3, 4); (1, 2, 4); (1, 3, 4); (1, 2); (1, 3). It will be noted that von Storch does not stress the unilateral nature of the migraine headache. In this study I have insisted on this feature being present, at least at some stage in the history.

To satisfy a diagnosis of hypertension, a diastolic pressure of not less than 100 mm. Hg was chosen as the basic level (Peel, 1950).

Only cases of hypertension labelled "essential" have been included in the study. In most patients the final reading chosen was the average of several readings taken over a period of at least six months, and in many cases over a period of several years. The patients interviewed were questioned regarding their general health, including past medical history. At the conclusion of the history specific questions were asked regarding the nature of any headache, the questions being based on the criteria already stated. Many patients interviewed already knew they suffered from migraine and were in the habit of attending the surgery at regular intervals for treatment. Likewise, many patients were already aware that their blood-pressure was raised and were accustomed to having it recorded periodically (though during the examination the words "high blood-pressure" were carefully avoided).

Findings

A past or present history of migraine was obtained in 281 patients, giving an incidence of 4.85%. Of these, 221 (78.6%) were female and 60 male. Of these 281 patients, 154 (54.8%) gave a family history of migraine. Likewise, examination of 5,785 medical records revealed 161 cases that satisfied the criteria of hypertension previously stated. Of these 161 cases, 128 (80%) were female and 33 (20%) male. Investigation of these patients revealed that 84 (52%) had a past or present history of migraine. Certain points of criticism are, however, at once apparent, and it would seem appropriate to draw attention to these before proceeding further. The most obvious question concerns the accuracy of these records in giving a true indication of the incidence of migraine and hypertension. Obviously, the records would only reveal those patients who had chosen to complain of their disability, or where the condition was diagnosed by chance. Medical records ignore patients whose attacks of migraine are perhaps so infrequent or of such short duration or so mild that they do not consult a doctor.

Accurate figures relating to the incidence of migraine are difficult to obtain. Grimes (1931), in a survey of 15,000 patients in general practice in America, estimated the incidence as 8%. More recently, in a review of migraine, the incidence is quoted as 10% of the population (*J. Amer. med. Ass.*, 1955). Fry (1955-6), in his practice of 5,000 patients, has recorded 145 cases over a period of five years, giving an incidence of 3.5%. The finding that 281 (4.85%) patients satisfied the criteria of migraine compared favourably with that of Fry and also with the incidence reported by Lennox (1941) and Leyton (1954). With regard to the estimate of Grimes it is possible that, with the more accurate and detailed methods of investigation which are now employed, many of his cases might be found to have a definite pathological basis for their headaches. American workers—for example, von Storch—do not

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appear to stress the hemicranial nature of migraine and tend to accept as their definition a history of recurrent headaches with either scotomata or gastro-intestinal disturbance or both. This definition would probably tend to allow of a somewhat higher incidence than if the unilateral feature were insisted on in the diagnosis. Confusion between migraine and psychogenic headache is possible, though as a rule the latter is of longer duration and there is no aura.

The finding that 84 (52%) of the 161 patients with hypertension gave a past or present history of migraine would appear almost incredibly high, and the impression was gained that if this proportion were a true one the association between migraine and hypertension would almost certainly have been more widely reported on and more definite conclusions on the subject would already have been reached. Obviously, in this instance the medical records were giving an erroneous impression. Patients complaining of headache are more likely to have their blood-pressure recorded than are patients with other complaints. The symptomless hypertensive is under-represented in such medical records.

It was therefore decided to carry out an analysis of 150 cases of migraine in patients over the age of 30 and to compare them with 150 controls of the same age and sex distribution chosen at random, who gave no history in any way suggestive of migraine. In this way it would be possible to determine whether patients with migraine had blood-pressure above the average for the population. In both groups of patients the following data were recorded: sex, age, and blood-pressure. In the group of patients with migraine the following additional data were recorded: age at onset and severity. The fact that blood-pressure can be influenced by certain well-recognized conditions—for example, renal disorders, endocrine disorders, pregnancy, etc.—has been borne in mind and any doubtful cases have been excluded from the study.

Presentation of Data

Analysis of 150 Cases of Migraine (Aged 30 and Over)

Sex Distribution.—Males 38, females 112. The ratio of females to males of 3 to 1 is influenced by several factors: (a) It is generally recognized that females are more free to consult a doctor, especially at surgeries. This trend is revealed in Table I, which shows the total attendance at morning and evening surgeries at the

TABLE I.—*Relationship Between Sex Incidence of Migraine and Total Attendance at Surgery During a Four-weeks Period*

	Total Attendances	History of Migraine	Test of Significance
Female ..	1,094	112	} $\chi^2 = 8.87$ $n = 1$ $P = 0.01$
Male ..	703	38	

practice concerned in this investigation during a typical four-weeks period in winter. (b) The frequent association between migraine and menstruation, which, in view of its regularity, will almost certainly sooner or later send the patient to seek medical advice. (c) The conclusion that more women consult a doctor because their headaches are frequently more severe, of longer duration, and are more often accompanied by nausea and vomiting (Lennox, 1941).

Age Distribution (Table II).—The age distribution is very similar in males and females, with a decreasing incidence towards the middle age. It is generally

TABLE II.—*Age Distribution*

Age	Males	Females
30-39	17	43
40-49	9	37
50-59	9	24
60+	3	8
Mean age	44.2 years	44.2 years

recognized that migraine tends to disappear in middle age. In women this decline often follows the menopause (Lennox, 1941), but in others the menopause coincides with an intensification of the headaches (Roberts, 1955).

Age at Onset (Table III).—Migraine may develop at any age, but the onset is usually in childhood or adolescence, with a tendency to become less frequent with age (Friedman, 1951). In childhood recurrent attacks of vomiting without headache may precede the fully developed migraine attack. However, no age

TABLE III.—*Age at Onset*

Age	Males	Females
10-19	9	39
20-29	13	46
30-39	10	16
40-49	6	10
50-59	—	1
Mean age at onset ..	27.9 years	24.5 years

group is exempt, and migraine may not appear until past middle age (Leyton, 1954). That author maintains that migraine which begins late in life tends to increase in frequency and severity rather than decrease with advancing age. The finding of a mean age of onset of 27.9 years for males and 24.5 years for females could in some measure be due to the fact that all these patients were 30 years or older and therefore their memories for age at onset might be less sharp than in younger patients.

Severity of Attacks (Table IV).—The one female in category 1 is probably an underestimate, since patients with such infrequent attacks would be less likely to complain of their headaches. The majority of patients fall into categories 2 and 3. Table V reveals a tendency towards greater severity and higher blood-pressure as the duration of the migraine increases. A possible explanation which might influence the data is that, apart from any relationship between migraine and

TABLE IV.—*Severity of Attacks*

Severity	Males	Females
Category 1	—	1
" 2	17	27
" 3	16	78
" 4	4	6
Mean	2.6	2.8

1 = Attacks less than once every 6 months. 2 = Attacks more frequent than once every 6 months. 3 = Attacks more frequent than once a month. 4 = Attacks more frequent than once a week.

TABLE V.—*Relationship Between Severity, Duration of Migraine, and Level of Blood-pressure in 80 Females Aged 30 to 49*

Duration of Migraine	Average Severity	Average Diastolic B.P.
0-5 years	2.7	81.0
6-9 "	2.4	82.1
10-14 "	2.7	86.9
15-19 "	2.9	80.0
20-24 "	2.8	80.3
25-29 "	3.0	90.0
30 and over	3.0	90.0

blood-pressure, the higher levels of blood-pressure could be the effect of age. The average severity among this group is 2.8—that is, roughly one attack a month.

Comparison Between Blood-pressures of 150 Migraine Patients and Blood-pressures of 150 Controls Matched for Age and Sex

Significance.—Age for age, the difference between the mean systolic pressures (Table VI) and between the mean diastolic pressures (Table VII) of the migraine

and non-migraine groups is around 10 mm. To simplify calculation, tests of significance were applied to pooled data (Table VIII). As the observed difference between the systolic means is five times the standard error it is highly significant. Since the observed difference between the diastolic means is six times the standard error the result is highly significant. Thus there appears to be a significant difference between the blood-pressure levels of migraine and non-migraine patients.

TABLE VI.—Systolic Blood-pressures of Male and Female

Systolic Blood Pressure (mm. Hg)	Patients Aged 30-49		Patients Aged 50+	
	Migraine	Controls	Migraine	Controls
110-	1	7	1	1
120-	26	34	1	2
130-	31	38	3	1
140-	24	16	8	30
150-	7	4	5	12
160-	8	0	8	3
170-	5	0	8	2
180-	2	0	4	0
190-	1	0	4	0
200-	1	—	2	0
Totals ..	106	99	44	51
Mean ..	138.87 mm.	129.1 mm.	159.77 mm.	144.41 mm.

TABLE VII.—Diastolic Blood-pressure of Male and Female Patients

Diastolic Blood Pressure (mm. Hg)	Patients Aged 30-49		Patients Aged 50+	
	Migraine	Controls	Migraine	Controls
60-	6	11	0	0
70-	24	42	2	4
80-	39	38	11	18
90-	23	8	4	29
100-	8	0	18	0
110-	4	0	9	0
120-	2	0	0	0
Totals ..	106	99	44	51
Mean ..	84.11 mm.	76.37 mm.	95.68 mm.	85.98 mm.

TABLE VIII.—Results of Tests of Significance

Patients	Systolic		Diastolic	
	Mean	S.D.	Mean	S.D.
150 migraine	144.86	20.47	87.5	12.69
150 controls	134.26	12.06	79.63	8.36
S.E. of diff.	±1.94		±1.25	

TABLE IX.—Relationship of Migraine to Hypertension in 300 Patients

Systolic					Diastolic					
B.P.	No. of People	No. with History of Migraine	Incidence of Migraine	Test of Significance	B.P.	No. of People	No. with History of Migraine	Incidence of Migraine	Test of Significance	
Patients Aged 40-49										
110-	2	0	0/32=0% 1/40=2.5% 4/41=9.8%	$\chi^2 = 4.61$ $n = 2$ $P = 0.10$	70-	48	0	0/48=0%	$\chi^2 = 4.0$ $n = 2$ $P = 0.15$	
120-	30	0			80-	50	4	4/50=8%		
130-	40	1			90-	15	1	1/15=6.7%		
140-	34	3								
150-	7	1								
Total	113	5	5/113=4.4%	Not significant	Total	113	5	5/113=4.4%	Not significant	
Patients Aged 50 and Over										
120-	6	1	2/82=2.4%	$\chi^2 = 29.38$ $n = 2$ $P < 0.001$	70-	21	1	1/66=1.5%	$\chi^2 = 26.2$ $n = 2$ $P < 0.001$	
130-	24	0			80-	45	0			
140-	52	1			90-	73	10	19/94=20.2%		
150-	45	9	16/73=20.6%		100-	21	9			
160-	26	6			110-	20	8	12/27=44.4%		
170-	2	1			120-	6	3			
180-	13	5	14/32=43.8%		130-	1	1			
190-	4	2								
200-	15	7								
Total	187	32	32/187=17.1%	Significant	Total	187	32	32/187=17.1%	Significant	

In his monograph on hypertension Janeway (1913) called attention to the not infrequent occurrence of migraine headaches during early life in persons who later had hypertension and "hypertensive headaches." He described the headache as: "One which appears on awakening or wakes the patient in the early morning hours, has its greatest intensity before arising, and passes away either immediately after breakfast, or during the course of the morning, to reappear in the same manner day after day for considerable periods. The intensity of the pain and its location have varied somewhat, the most severe being similar to bad migraine, and in a few cases it is attended by nausea and vomiting." Gardner *et al.* (1940) found that four-fifths of 100 hypertensive patients gave a history of past or present attacks of migraine, contrasted with 15% in the control group. Of the total registrations at the Mayo Clinic, migraine was five times as frequent in hypertensive patients as in those in whom hypertension was not recorded. Atkins (1955) reported that 6 out of 24 patients with migraine had significant hypertension as judged by a mean resting diastolic pressure of over 100 mm. Hg. Of these, four were over 50 years of age, while the youngest was 39. Among 26 control cases only two had significant hypertension.

Until a definite cause for essential hypertension has been established any opinion regarding a possible relationship to migraine must remain nothing more than supposition. Certain facts are, however, already recognized which lend support to a possible association between the two conditions.

1. A family history is common in both conditions. "Studies of the family histories of patients with hypertension have shown a hereditary factor in 76 to 80% of cases" and that "evidence is compatible with the hypothesis that essential hypertension is a hereditary disease conveyed as a Mendelian dominant with a rate of expression of more than 90%" (Platt, 1947).

2. The personality structure of the two disorders has several points in common. Both conditions present evidence of suppressed emotional conflict. According to Ayman (1948) the early symptoms of hypertension are frequently those of psychoneurosis. Emotional stress often seems to precede the onset of hypertension, and anxiety bears a close relationship to the aggravation of existing symptoms in hypertension. Weiss *et al.* (1950) discussed the importance of emotional factors in hypertension and stressed the resemblance to migraine. They believed there was an intimate relationship between the personality structure of the two disorders.

3. Essentially the same mechanism is operative in producing the headache associated with hypertension as in the migraine headache—namely, dilatation and distension of the cranial arteries (Sutherland and Wolff, 1940; Schumacher and Wolff, 1941), though it must be admitted, however, that headache is an unpredictable factor in hypertension.

Any association between migraine and hypertension may be pure chance, since both are common conditions. A patient complaining of recurrent headaches is more likely to have his blood-pressure recorded, and therefore hypertension is more likely to be discovered. The term "essential hypertension" can be used correctly only after known causes of hypertension have been excluded. It is possible, even in the light of our present knowledge, that we may be dealing really with a number of different disorders, which may explain why patients react in different ways to the condition. If, indeed, a common denominator does exist between migraine and hypertension, the solution to this intriguing problem must,

at least for the time being, remain unanswered. Though both migraine and hypertension are common conditions and must therefore frequently meet, the impression was gained that the association between the two conditions was more than one of chance.

Summary and Conclusions

The medical records of 5,785 patients in one general practice have been examined for a history of migraine. The incidence has been estimated as 4.85%. Of these patients, 54.8% gave a family history of migraine.

Patients with migraine were found to have a higher blood-pressure than the average for the population.

In patients over the age of 50 there was a clear and possibly direct correlation between migraine and essential hypertension. The incidence of migraine rose as the level of blood-pressure increased.

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"The Council wish that more [old people's] homes could be encouraged to allow residents to furnish their own room, or to bring articles of furniture where they must still share a bedroom. Living conditions must be improved. Administrative expediency seems to transcend the happiness of each resident when this subject is raised. Many committees and officials insist that residents prefer modern matching furniture to their own belongings. This may be the reaction if emphasis is put on how much nicer the new home and furniture looks, and many residents would be diffident, in such an atmosphere, of disagreeing and asking for their own possibly well-worn belongings. Only recently the secretary of Methodist Homes for the Aged was quoted as saying: 'We like our residents to have their own private room and they are allowed to bring in their own furniture.' The Methodists have 14 homes with 400 residents, and their experience covers a number of years. Their attitude of mind could be copied with advantage by many other homes." (*Annual Report for the year ending March 31, 1959*, National Old People's Welfare Council.)