AN ANALYSIS OF EIGHT HUNDRED AND EIGHT CASES OF CHOREA, WITH SPECIAL REFERENCE TO THE CARDIO-VASCULAR MANIFESTATIONS.*

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Some time ago Dr. Thomas suggested to me that it might be of interest to analyze the records of the cases of chorea which had been treated in his department in the Johns Hopkins Hospital Dispensary with reference to the cardio-vascular manifestations. For the most part these cases have been rather carefully studied, each patient, as far as possible, having been sent to the medical department for special notes on the heart. Last fall, accordingly, I undertook this task, which was particularly interesting to me in view of the fact that many of the special notes had been made by myself. I have added to these cases those which have been treated in the hospital wards during the same period, the majority of which I have also been able to study.

My plan was somewhat similar to that which was adopted a few years ago in the study of the cardio-vascular complications and sequels of typhoid fever. It involved: 1. A study of the records of these cases while under treatment. 2. A study of the pathological observations in the fatal cases. 3. An investigation into the present condition of all old patients with whom it was possible to enter into communication.

The amount of time required to go over so large a number of cases made it impossible for me to finish this whole undertaking in time for this session. That which I present consists of a brief summary of the first part of the work, namely, a study of the records of 808 cases of chorea treated in the Johns Hopkins Hospital and Dispensary, with special reference to the condition of heart and vessels.

Number of Cases.—The material amounted to 808 cases, of which 698 were treated in the dispensary and 110 in the wards of the hospital.

Race.—Of these cases, 783, or 96.9 per cent., were white; 25, or 3 per cent. only, were colored. As the proportion of colored patients treated for all diseases in the medical department of the hospital and dispensary amounts to about 12 per cent., it may be seen that these figures go to support the observations of Weir Mitchell and others that chorea is relatively rare in the negro.

Sex.—Two hundred and thirty-two, or 28.7 per cent., of these cases were in males; 576, or 71.2 per cent., were in females; about the usual proportion.

Age.—The following table, arranged by hemi-decades, will show the incidence of chorea according to age:

TABLE SHOWING INCIDENCE OF CHOREA ACCORDING TO AGE.

YEARS.	Cases.	Percentage.
1 to 5	20	2.5
10 to 15	369	46.2
15 to 20	83	10.4
20 and over	20	2.5
Uncertain	10	

It may thus be seen that 84.5 per cent. of the cases were between the age of 5 and 15.

Number of Attacks.—The frequency of relapses and recurrent attacks of chorea is well recognized. In 799 of

these 808 cases good records could be obtained as to the number of attacks. In 499, or 62.4 per cent., the patient was seen in the first attack alone. In 163, or 20.4 per cent., there was a history of two attacks. In 137, or 17.1 per cent., there was a history of three or more attacks.

Incidence of Rheumatism.—A point of special importance, particularly with regard to the occurrence of cardio-vascular manifestations, is the frequency with which rheumatism was observed, or distinctly noted in the history. The atypical and mild character of acute rheumatism in children is familiar. Considering the histories given by the patients or their parents, it was deemed wise for our present purposes, to classify arbitrarily, as acute rheumatism, all those cases in which there was a clear, definite history of pain and tenderness in joints. The patients and their parents and friends were always carefully questioned on this point. Out of 789 cases in which there was a record as to the previous history of the patient, in 171, or 21.6 per cent., a history of rheumatism was obtained.¹ In 618, or 78.3 per cent., there was no history of rheumatism.

Fever.—Observations on the temperature, important though they undoubtedly are, were unfortunately not made in many of the dispensary cases. A discussion of the temperature records in the hospital cases is reserved for the section treating of organic heart lesions.

Heart.—In 118 cases in the dispensary, and in one case in the hospital no note on the heart was recorded. Of the remaining 689 cases, cardiac murmurs were detected in 235, or 40.5 per cent.; they were absent in 345, or 59.4 per cent. In about one-quarter of the instances with abnormal heart sounds, the murmurs were soft systolic souffles, heard at the base alone, or over the whole cardiac area, and unassociated with other modifications of the size or functions of the heart, such as might justify the diagnosis of organic lesion.

In 175, or 25.4 per cent., of the cases in which an examination of the heart was recorded, conditions justifying the diagnosis of organic cardiac disease were found. In 16 more instances the signs were sufficient to warrant a reasonable suspicion that such changes were present. Including these, the proportion of cases with possible organic change would be raised to 27.7 per cent.

Character of the Cardiac Lesions.—The cases in which the diagnosis of organic cardiac disease was made have been divided into three classes, one in which the condition was certain; another in which the existence of organic change was regarded as probable; a third, which has been already mentioned, including 16 cases in which organic lesions were suspected. Taking into consideration those cases only in which organic lesions were deemed probable, 175 in number, there were:

Cases of mitral insufficiency	111
Cases of mitral stenosis	7
Cases of mitral stenosis and insufficiency	39
Cases of mitral and aortic insufficiency	10
Cases of mitral stenosis and aortic insufficiency	1
Cases of double mitral disease and aortic insufficiency	1
Cases of acute endocarditis, probably mitral in character	6

In 20 instances with definitely recognized organic lesions an acute endocarditis was also present. There were 3 cases of acute pericarditis. In 2 instances a diagnosis of adherent pericardium was made in a relapse.

Fatal Cases.—There were 4 fatal cases of chorea in children, and one case in which the patient died during an attack of acute rheumatism which had been associated with a choreic attack. Of the 4 cases of chorea

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1. In some of these cases rheumatic symptoms were observed while the patient was under treatment.

insaniens there were autopsies in two instances. In both of these cases the patient had had rheumatism, one in connection with the fatal attack. In both instances acute endocarditis was found; once, mitral; once, aortic and mitral. Of the two other cases, in one a well-marked endocarditis and pericarditis was recognized *intra vitam*, while in the second, a soft systolic murmur alone was audible over the cardiac area; at the same time, however, high fever and an extremely rapid, irregular pulse justified the diagnosis of an endocarditis. In this case there was no history of rheumatism. In the fifth case, in which death occurred during an attack of acute rheumatism which had followed chorea, there was subacute endocarditis of the mitral and aortic valves as well as an acute pericarditis.

RELATION OF THE CASES WITH CARDIAC INVOLVEMENT
TO RHEUMATISM, TO RECURRENT ATTACKS AND
TO FEBRILE MANIFESTATIONS.

Relation of Rheumatism to Cardiac Involvement.—It was deemed of interest to note the relation of those cases with cardiac involvement to rheumatic complications. The following table shows the proportion of instances in which acute rheumatism occurred among the cases, with and without cardiac involvement:

TABLE SHOWING INCIDENCE OF RHEUMATISM.

	Rheumatism.		No history of rheumatism.	
	Cases.	Per cent.	Cases.	Per cent.
Without cardiac involvement . . .	105	16.9	513	83.
With cardiac involvement	66	38.5	105	61.4

The relatively higher percentage of a history of acute rheumatism in those cases with cardiac involvement might, in part, be due to the fact that a large proportion of these cases were hospital patients whose histories were taken with greater care and accuracy. Looking at the question from another standpoint (Chart 1), however, it was found that:

Of 171 cases with a history of rheumatism, 34.5 per cent. showed organic cardiac lesions.

Of 618 cases with no history of rheumatism, 16.9 per cent. showed organic cardiac lesions.

It is clear, therefore, that cardiac manifestations were more frequent in those patients who had suffered from acute polyarthritis.

Relation of Relapses and Recurrent Attacks to Cardiac Involvement.—The following table bears on the question of the relative frequency of recurrent attacks in cases with and without cardiac lesions:

TABLE ILLUSTRATING FREQUENCY OF RECURRENT ATTACKS IN CASES WITH AND WITHOUT CARDIAC LESIONS.

	Single attack.		Two attacks.		Three or more attacks.	
	Cases.	Pr ct.	Cases.	Pr ct.	Cases.	Pr ct.
Without cardiac involvement	414	65.6	121	19.2	94	14.9
With cardiac involvement	85	50.	42	24.7	43	25.2

If, again, one divide the total number of cases into three groups, those in which there is a record of but one attack, those in which there is a record of two attacks, and those in which there is a record of three or more attacks, and study the percentage of cardiac lesions in each group (Chart 2), the following figures are obtained:

PERCENTAGE OF CARDIAC LESIONS IN CASES WITH SINGLE AND MULTIPLE ATTACKS.

	Single attack.		Two attacks.		Three or more attacks.	
	Cases.	Pr ct.	Cases.	Pr ct.	Cases.	Pr ct.
Number of cases	499		163		137	
Cardiac lesions	85	17.	42	25.7	43	31.3

The histories of individual cases, moreover, show very clearly in a number of instances, the development of cardiac lesions with relapses and recurrent attacks.

Relation of Fever to the Development of Cardiac Complications.—The temperature, as has been said, was regularly recorded only in hospital cases. In but 1 out of 110 instances was there a complete absence of fever during the attack. In 4 more of these cases it was noted that the temperature was normal during the greater part of the time, the elevations being slight and occasional. In the rest of these cases there were frequent elevations of the temperature above 99 degrees; in the majority, indeed, it remained somewhat above normal during the greater part of the acute attack.

Of particular interest is a comparison of the temperature records of those patients with and without cardiac complications. The following table shows the temperature records in 48 cases without demonstrable cardiac involvement as compared with 59 cases in which organic lesions were detected:

TABLE SHOWING PREVALENCE OF FEVER IN CASES WITH AND WITHOUT CARDIAC INVOLVEMENT.

Temperature	No fever.	99 to 100.	100 to 101.	101 or above.
Cardiac involvement	Cases P. A.	Cases Pr.ct.	Cases Pr.ct.	Cases Pr.ct.
Absent	1	2	19	39.5
Present	0	..	9	15.2
			19	32.2
			31	52.5

If we look now at the question from the standpoint of the percentage of cardiac lesions detected among these

NO RHEUM.	RHEUM.	1 ATTACK	2 ATTACKS	3 OR MORE ATTACKS	NO FEVER	99°-100°	100°-101°	101°+
16.9%	34.5%	17%	25.7%	51.3%	0%	32.1%	44.1%	88.8%

Chart 1.—Percentage of cardiac lesions in cases with and without a history of rheumatism.

Chart 2.—Percentage of cardiac lesions in relation to number of attacks.

Chart 3.—Percentage of cardiac lesions in relation to the degree of fever.

cases when arranged in groups according to the degree of fever present (Chart 3), we obtain the following suggestive table:

TABLE SHOWING PERCENTAGE OF CARDIAC LESIONS RELATIVELY TO THE PRESENCE AND DEGREE OF FEVER.

Temperature	No fever.	99 to 100.	100 to 101.	101 or above.
Cases	28	43	35	
Cardiac lesions	9 (32.1%)	19 (44.1%)	31 (88.8%)	

From the clinical symptoms and the condition of patients returning to the hospital subsequently, there is considerable reason to believe that, in a large proportion of these febrile cases, acute endocardial complications were present. In many patients in whom in one attack there was fever without evidence sufficient to justify a diagnosis of organic cardiac lesion, there was found, on later observation, definite valvular disease.

2. In one of these cases without heart lesion the temperature was doubtless due to an abscess, while in two or three of the cases with cardiac involvement the high temperature was due to complicating rheumatism.

CONCLUSIONS.

A consideration of these cases would suggest that well marked febrile manifestations, without rheumatism, occurring during the course of chorea, especially if they be associated with undue rapidity or irregularity of the pulse, should be regarded as at least strongly suggestive evidence of acute endocarditis. It may of course be possible that such fever is but the index of an infection which lies at the bottom of the choreic manifestations as well as the associated endocarditis. Slight grades of fever were, it is true, observed in almost every case treated in the wards of the hospital. There is nothing, however, in these studies to justify conclusions with regard to the old question as to whether endocarditis in chorea represents a secondary infection or a special localization of an infectious agent which is responsible for the essential manifestations of the disease.

The most important and interesting part of this investigation remains to be carried out, namely, the study of the circulatory conditions in old patients, but it may not be amiss to call attention again to certain points of interest brought out by this preliminary analysis.

1. Of 689 cases of chorea observed at the Johns Hopkins Hospital or Dispensary during one or more attacks, 25.4 per cent. showed evidences of cardiac involvement; such evidence was present in over 50 per cent. of the patients studied in the wards of the hospital.

2. Cardiac involvement occurred with somewhat greater frequency in those cases in which there was a history of acute polyarthritis than where such history was absent.

3. Cardiac involvement was commoner in cases of chorea with frequent recurrences than in those in which there was a history of a single attack.

4. In 110 cases of chorea treated in the wards of the hospital there was fever of a moderate extent in almost every instance.

5. In a large majority of the cases in which high fever was present there was evidence of cardiac involvement.

6. There is good reason to believe that the presence of fever in otherwise uncomplicated chorea is, in a large proportion of cases, associated with a complicating endocarditis.

CARDIAC HYPERTROPHY AS OBSERVED IN
CHRONIC NEPHRITIS.*

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The frequency of a pronounced hypertrophy of the heart in kidney disease was first pointed out by Bright¹ in 1836. It was exhibited in 23 per cent. of his cases, in most of them affecting the left ventricle, without any cardiac or aortic lesion as a cause. His theory, chemical in nature, considered that an altered condition of the blood either stimulated the heart excessively or else affected the arteries and capillaries in some way to make it more difficult for the heart to drive the blood through to the veins.

G. Johnson² confirmed his findings and adopted the second possibility as an explanation, assuming that the

blood is laden with impurities as a result of the renal disease, and that these poisons stimulate the arterioles to contract by way of the vasomotor nerves and so necessitate an hypertrophy of the left ventricle. His conception assumed the existence of an hypertrophy of the muscular layer of the arterioles and explained only the left ventricular hypertrophy. In 1856 Traube³ advanced a purely physical theory to explain the cardiac hypertrophy which occurs in chronic nephritis. Two factors, he concluded, produce an increased aortic pressure: First, an obliteration of numerous vessels in the contracted cortex or their compression by the inflammatory exudate; second, an increase of the amount of fluid in the arteries as a result of the lessened abstraction of water by the reduced kidney structure. In regard to the first factor, Ludwig and his followers, however, proved that an increased pressure in the renal vessels would not produce any permanent increase of the general arterial pressure (ligature of both renal arteries). As for the second factor, Traube's opponents claimed correctly that in chronic contracted kidney there was no decrease, but always an increase in the amount of water withdrawn from the blood, and in addition a diminished excretion of urine. A resulting plethora is promptly equalized by vaso-dilation and no increase of blood pressure results.

Cohnheim⁴ modified Traube's hypothesis by assuming that despite the resistance in the kidneys the same amount of blood enters the renal arterioles, and as their tonus depends on the amount of urinary substances to be eliminated there must be an abnormal resistance. In 1872 Gull and Sutton⁵ considered that a general arterio-capillary fibrosis was the primary condition, and that both the contraction of the kidney and the hypertrophy of the heart were secondary. Although this hypothesis will explain the condition in the true arterio-sclerotic kidney, it is of no value in interpreting the other forms of renal disease, nor does it account for an hypertrophy of the right ventricle and auricles.

In 1877, Ewald⁶ found hypertrophy of the muscular layer of the systemic arterioles and suggested that the cardiac hypertrophy depended on this widespread change, and that the latter was due to the increased viscosity of the blood with excessive friction in the capillaries. The hypertrophy of the auricles and right ventricle is left unexplained by such an hypothesis, and since an accurate method for estimating the viscosity of the blood has been devised by C. Hirsch and C. Beck,⁷ no constant relation between it and increased blood pressure on the one hand and cardiac hypertrophy on the other has been observed. In 1878 v. Buhl⁸ believed both renal lesion and cardiac hypertrophy to be concomitant results of the inflammatory action on the kidney and heart of some unknown substances. He found myocarditis in 65.7 per cent. of contracted kidneys, and very often a relative narrowing of the aorta. Such cardiac hypertrophy he considered excentric, due to a previous dilatation. His percentages have not been confirmed except in a measure by Debove and Letulle⁹ in 1880. In any event, his theory would not explain the cardiac hypertrophy of other types of renal disease. In 1880 DaCosta and Long-

3. "Über den Zusammenhang v. Herz u. Nieren Krankheiten," Hirschwald, Berlin, 1856.

4. *Allg. Path.*, second edition, vol. II, p. 258.

5. *Med. Chir.*, Trans., vol. IV, p. 1872.

6. *Virchow Arch.*, vol. lxxi.

7. *Münch. med. Wochschr.*, 1900, No. 49.

8. *Deut. Arch. f. klin. Med.*, vol. lxxii; also *Mitt. aus dem path. Inst. z. Münch.*, 1878, p. 38.

9. *Arch. gen. de Med.*, 1880, vol. I, p. 278.

* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. *Guy's Hosp. Rep.*, I, 1836, p. 396; vol. II, pp. 234 and 259.

2. "Diseases of Kidney," second edition, 1856.