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"The Ratio between the Pulse rate and the Temperature,
and its significance, in the following diseases".

APPENDICITIS

SCARLET FEVER

ENTERIC FEVER

INFLUENZA

DIPHThERIA

CEREBRAL ABSCESS.

Thesis for the degree of M. D.

by

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"The Ratio between the Pulse rate and the Temperature,
and its significance, in the following diseases."

Appendicitis.

Scarlet Fever.

Enteric Fever.

Influenza.

Diphtheria.

Cerebral Abscess.

In all febrile diseases there is a certain ratio between the pulse rate and the temperature. This ratio varies in different and in the same diseases and these variations are most important as regards Prognosis and Diagnosis.

In discussing such ratios it is necessary to have, if possible, a normal ratio between the pulse rate and the Temperature, from which to form a comparison. The commonly accepted normal ratio in febrile diseases is, that there is an increase of 10 beats per minute in the pulse rate for every degree of fever above the normal. The variations from this normal ratio, as shown in many diseases have led me to the conclusion that there are four different types of ratios.

- A. The Normal Ratio.
- B. An elevation of the Temperature without a corresponding increase in the Pulse rate.
- C. An increase in the pulse rate without a corresponding/

corresponding elevation of the Temperature.

D. An irregular ratio.

To this type belong cases in which the ratio between the Pulse and Temperature does not conform to types A. B. C. or cases in which the ratio varies so often between A. B. and C. as to make them difficult to classify.

I have examined a number of cases of the same disease with the object of showing how many conform to each type of ratio and what is the significance of the different ratios in each disease.

In examining each case there are two important factors which have to be taken into account.

1. The age of the patient.

I have followed this table.

Age	Pulse Rate.
6 - 12 months.	105 - 115 per minute.
2 - 6 years.	90 - 105 " "
7 - 10 "	80 - 90 " "
11 - 14 "	75 - 85 " "

The average pulse rate for the healthy adult is 72 beats per minute.

2. Treatment by drugs which may affect the Temperature or Pulse Rate.

APPENDICITIS.

The result of the examination of twenty-five cases was as follows :-

Class A. "Cases with a pulse Temperature Ratio of the normal type."

There were eight cases, all of which recovered. In five of these there was inflammatory swelling and peri appendicular peritonitis.

In three there was definite abscess formation.

All the cases were operated on, those in which there was abscess formation when the acute symptoms had passed and the abscess had become localized, those in which there was inflammatory swelling at different periods. In the three cases the Temperature was 100°F. on the average at first with a corresponding pulse rate. In the remaining five cases the Pulse Temperature ratio was not constant during the course of illness before operation.

In one of these cases the ratio was of the normal type all the time while the other four showed now and then an irregular ratio though at no time was there a marked variation from the normal. In these cases the temperature was on the average at first 102°F./

102°F.

In all the eight cases the ratio was on the average of the normal type.

Class B. "Cases with a slow pulse compared to the Temperature."

There were eight cases in this class, four of which recovered and four died.

In all the fatal cases there was ^a gangrenous appendix and peritonitis found. In three of these the pulse became rapid shortly before death while the Temperature was subnormal for a time. In the fourth case the temperature remained above normal.

Of the four cases which recovered three were operated on, there being found abscess formation in one case. In two of these cases the pulse was slow the whole time while in the other two cases the pulse was either slow or of the normal type of Ratio.

In one of the fatal cases although the pulse was 68 per minute, the heart was beating at the rate of 154 per minutes. In this case there was a well marked mitral stenosis and a very feeble pulse.

Class C. "Cases with fast pulse compared to the Temperature."

There were nine cases, five of which recovered and/

and four died.

In the four fatal cases there was general Peritonitis. In three of these cases there was a subnormal Temperature at death, in one case it was above normal.

In these cases the pulse rate averaged 140 - 150 per minute.

In the cases that recovered the pulse was not so rapid being never more than 120 per minute, the Temperature being above normal.

CONCLUSIONS.

There is no doubt that the Ratio between the Temperature and Pulse Rate is the most valuable guide as to the treatment and prognosis in every case of appendicitis. Although all the cases have been grouped into the three types of Ratios A. B. and C. difficulty was experienced, as in some of the cases the ratio was irregular for a time. The difficulty is to know when it is right to operate and it is only by examining the Pulse Temperature ratio minutely in addition to the clinical signs that one can foresee the course of any case of appendicitis.

The most favourable cases were those in which
the/

the Ratio was of the normal type. Many cases showed slight irregularities in the Pulse Temperature ratio for a short time. In the cases with inflammatory swelling the initial Temperature was on an average about 102°F. In some of these cases the Pulse and Temperature quickly fell towards the normal together, no immediate operation being necessary. In some the Temperature fell to about 100°F. with a corresponding pulse, these cases then not showing signs of further improvement were operated on with recovery.

In the cases with abscess formation the initial Temperature was not high, the ratio remained of the normal type and in about two days there was slight improvement and the Temperature and Pulse slowly decreased towards the normal.

Judging by these results I think that the Prognosis is very favourable in all cases of the Normal Ratio type in which within or about 36 hours time there is either a quick or slow continued improvement and there is no occasion for immediate operation.

If there is an improvement for one or two days which after that does not continue, the Temperature remaining elevated, an operation is necessary especially/

especially if the pulse shows any sign of increasing in frequency and in these cases the prognosis is not so favourable.

It is a very bad sign to have any marked variation of the Temperature and Pulse from the Normal Ratio, as occurred in some of the cases in Class B and C. For example an elevated Temperature and a slow pulse, or a subnormal Temperature with a slow or fast pulse. If the Temperature becomes as low as 96°F. , the prognosis is exceedingly bad. A marked disparity between the Pulse and Temperature was the sign of gangrene and perforation of the appendix.

The cases in Class B. which recovered were those in which the variation from the Normal Ratio was not very marked being just sufficient to enable them to be classified in Class B.

In all the cases, except the one in which there was Mitral stenosis, the pulse became very rapid shortly before death. The mortality is severe in all cases where the pulse is rapid, over 130 a minute, more so if the Temperature is not much elevated or is subnormal. If the pulse is quick and strong, with an elevated Temperature, as long as the Pulse is not much/

much in excess of that of the Normal Ratio, and not over 120 per minute in adults, the prognosis is more favourable. In all the cases in Class C. which recovered the Pulse was not very rapid neither was there a subnormal Temperature in any.

A marked disparity in Pulse Temperature ratio necessitates immediate operation, but the cases in which the variation of the Pulse Temperature Ratio from the Normal Ratio is slight must be watched carefully for any further variation. I think that in all cases in which the Pulse Temperature Ratio is of an irregular type or of the Class B. and C. type, the Temperature and Pulse should be recorded every two hours as some of the cases belonging to Class B. changed rapidly to Class C. with a fatal termination in 3 - 12 hours, and that the rate of the heart beats per minute should be tested by a stethoscope in all cases with a very slow pulse.

Quotations. Thomson and Miles - Manual of Surgery.

Operation is indicated within twelve hours if from the onset the symptoms assume a grave character. If within 24 hours there is decided improvement especially in the facies and pulse operation may be deferred, but the patient should be kept under continuous/

continuous observation.

If the symptoms and clinical signs show no sign of improvement at the end of 24 or 36 hours the best chance for the patient is to operate.

ENTERIC FEVER.

The result from the examination of twenty-four cases was as follows :-

Class A. "Cases with a Pulse Temperature Ratio of
Normal type."

There were five cases in this class all of which recovered.

In two of these only was the ratio constant during the course of the disease. In the remaining three cases the ratio was on the average of the normal type but varied during the course of the disease, the pulse becoming fast in two of the three cases while the Temperature was high for a time. In the third case the Pulse became quick before and during an attack of Intestinal Haemorrhage and the Temperature became subnormal for a time.

Class B. "Cases with a slow Pulse compared to the
Temperature".

There/

There were fifteen cases in this class. In fourteen the pulse was slow all the time. In the remaining case the Temperature became for a period of a remittent type with its maximum at 8 p.m. and minimum at 8 a.m. During this period the pulse became faster.

Class C. "Cases with a fast Pulse compared to the Temperature."

In this class there were four cases, two of which recovered while two died.

In one of the fatal cases the Ratio at first was of the Normal type till about a week before death when the pulse became fast and remained so. There was no complication in this case.

In the other fatal case the Temperature was very irregular and remittent having its maximum at 6 p.m. or 10 p.m. and minimum at 6 a.m. or 10 a.m., although the Temperature was sometimes elevated in the morning. This case was complicated with Intestinal Haemorrhage.

Of the two cases that recovered, in one the pulse was fast at first, but slowly decreased to the normal ratio type, while in the other for a period the Pulse and Temperature were of an irregular type, the Temperature/

Temperature being sometimes elevated at night, sometimes not, ^{elevated,} with a Pulse which was not constant in its variations according to the Temperature. This case was complicated by Thrombosis of the Femoral Vein.

CONCLUSIONS.

In the majority of the cases, about 60%, the pulse was slow throughout with uneventful recovery, and these were the most favourable cases. The older the patients the more tendency there was to the pulse being slow.

When the pulse kept slow and the Temperature was not remittent the recovery was rapid. In those cases in which during twenty-four hours the Temperature was remittent, recovery was slower and the Pulse became quicker.

The cases in which the Ratio was of the normal type showed a tendency for the Temperature to remain elevated for a longer period, or for a higher Temperature and increased Pulse rate or some complication later. This is not such a favourable type.

Undoubtedly the cases with a fast pulse are the worst as they are associated with some complication especially/

especially Haemorrhage from the Intestine. In these cases if there is a marked fall or rise of the Temperature the pulse varies to a certain degree not generally in any definitely ratio but remains quick. By far the most definite ratio between the Temperature and Pulse occurs in the cases in which the Pulse is slow throughout the course of the disease.

Quotations. "Clifford Allbutt's System of Medicine."

A small and quick pulse is a bad omen. There is no definite relation between the Pulse and Temperature though often with the rise of Temperature the pulse also increases.

(An extract from an article by Julius Dreschfield).

DIPHThERIA.

The result from the examination of twenty-six cases was as follows :-

Class A. "Cases with Pulse Temperature Ratio of the Normal type."

There were four cases in this class, three of which recovered and one died.

In these cases it was only during the febrile stage that the ratio was of the normal type. Out of the/

the whole series of cases there were twenty-one recoveries and in all these, the Temperatures after it had fallen became subnormal for a long period during which time the pulse varied in frequency in the individual cases, being sometimes slow or fast or sometimes of the normal type of frequency.

In the case that died the ratio at first was of the normal type. After the temperature became subnormal the Pulse was comparatively slow for a long period till it became rapid for a short time and remained so till death, which occurred forty days after the onset of the disease.

Class B. "Cases with a slow Pulse compared to the Temperature."

There were four cases in this class, one being fatal.

In these cases on the average the pulse was slow although in all the ratio at times was very irregular and followed no definite course. In the case that died the Temperature was very variable while the pulse which was fast for a time became slow and death occurred on the third day, the pulse being very slow and the Temperature elevated.

Class C. "Cases with a fast Pulse compared to the Temperature."

There/

There were fourteen cases in this class, two of them being fatal.

In one of the cases which died the Pulse was fast all the time. In the other fatal case it was slow at first and gradually became faster.

Class D. "Cases with an irregular Pulse Temperature Ratio."

There were four cases in this class, one of them being fatal.

In the fatal case the Ratio between the Temperature and the Pulse was irregular and ill-defined.

At the beginning the Temperature was subnormal, then became irregular and elevated. The Pulse which was fast did not vary definitely according to the Temperature. At death the Pulse was moderately fast with an elevated Temperature.

In the three other cases the irregularity was not so marked and not so continuous as in the fatal case.

CONCLUSIONS.

Of the five fatal cases, at death, in three cases the Temperature was subnormal, while in two cases the Temperature was elevated.

In four cases the pulse was fast and in one slow at death.

In/

In all the cases the Pulse Temperature Ratio was variable from day to day, these variations being mostly without any significance. The prognosis was bad in those cases in which there was a marked disparity between the Pulse and Temperature. For example a very slow pulse associated with an elevated temperature, or a very fast pulse and a subnormal Temperature. These cases are generally fatal. A low Temperature such as 96^o F. which occurred in one case, is a very dangerous sign as is also a marked continuous irregularity in the Pulse Temperature Ratio.

Judging by the twenty-one cases which recovered the prognosis is good in all cases as long as the Temperature and Pulse do not vary greatly from the normal type and there is no marked irregularity in the Pulse Temperature Ratio.

Quotations. Holt's Diseases of Children.

In the worst cases the heart becomes rapid and feeble. Pneumo-gastric paralysis may come on any time, seldom earlier than the end of the second week. This is shown by a slow pulse which is weak, compressible and often irregular.

Allhutt's System of Medicine.

Diphtheria/

Diphtheria is not a very febrile disease and the slighter forms are more febrile than the severer.

In bad cases the Temperature is depressed and about 97° - 98° F. In the most malignant cases a Temperature of 96° F. in the Rectum has been observed.

OSLER.

A slow pulse is a more common indication of danger than a rapid one. At the same time that the pulse is slow the Temperature sinks and death ensues with all the symptoms of collapse.

SCARLET FEVER.

The result from the examination of twenty-seven ^{was} cases as follows :-

Class A. "Cases with a Pulse Temperature Ratio of the Normal type."

There were five cases in this class all of which recovered.

In these cases the Temperature while elevated had a corresponding pulse. After the Temperature had become normal the Pulse varied from time to time being faster or slower without much apparent cause and with no ill effect.

Class B. /

Class B. "Cases with a slow pulse compared to the
Temperature".

There were five cases in this class. In two of these the pulse was slow throughout while in the rest the ratio varied though the pulse was slow on the average.

Class C. "Cases with a fast pulse compared to the
Temperature".

There were thirteen cases in this class. In all the pulse was fast while the Temperature was elevated.

Class D. "Cases in which the Pulse Temperature
Ratio is of an irregular type."

In this class there were four cases which were difficult to classify, the pulse being either slow or fast or of the normal type often irrespective of the Temperature.

CONCLUSIONS.

As none of the cases were fatal it is impossible for me to draw conclusions concerning the Pulse Temperature Ratio in the worst cases.

In the majority of the cases the Pulse was fast and remained so as long as the Temperature was elevated. In none of the cases was the Pulse very rapid. The cases conforming to classes A. B. and D. were about /

about equal in number. The Pulse was slow in a larger number of cases than I expected. As all the cases recovered, the prognosis in cases like these is undoubtedly very good.

Quotations. Osler.

"The Pulse presents the ordinary febrile characters.

In the malignant form the Pulse is very rapid and feeble."

INFLUENZA.

The result from examination of twenty-eight cases was as follows :-

Class A. "Cases with a Pulse Temperature Ratio of the Normal type."

Three cases. In none of these cases was the Temperature at any time very high though in one case it was irregular. The Pulse varied according to the Temperature.

Class B. "Cases with a slow Pulse compared to the Temperature."

There were eighteen cases in this class. These cases were either of the common influenza type with/

with no pulmonary signs on auscultation or of the pulmonary type of Influenza in which in the posterior parts of the lungs plenty of sibilant rhonchi and rales of a sharp sticky nature peculiar to the disease, can be heard on auscultation. In the cases with no pulmonary signs, ^{the} maximum temperature averaged 103°F with a pulse of about 90 per minute. In the pulmonary type of cases which occurred in men of 30 - 45 years of age, the temperature on the average reached 103°F . with a corresponding pulse of 84 per minute. In this type of influenza the temperature was a longer time in becoming normal than in the common type in which the Temperature mostly fell rapidly in 1-3 days time. In all the cases the pulse remained slow and became slower after the Temperature had fallen, becoming in one case 40 per minute which it remained for a considerable time.

Class C. "Cases with a fast Pulse compared to the Temperature".

There were seven cases in this class.

Two of these cases occurred in children and were of a broncho-pneumonia type.

In one case the physical signs were of a pneumonic character without consolidation of the lung.

The/

The physical signs in the one lung which was affected developed into a condition like basal Phthisis and could only be distinguished by the different type of Temperature and examination of the sputum.

One case of the Pneumonia type, occurred in a man of about 60 years of age who had pre-existing valvular disease of the heart with an irregular Pulse.

In another case in which there was slight fever, the pulse though not very rapid, was of high tension.

In the sixth case the Pulse rate varied, being either fast or of the normal rate while the Temperature was of an irregular type.

The seventh case was one of the gastric type of influenza, it was

a mild case with slight fever, sickness and diarrhoea which soon recovered.

CONCLUSIONS.

In the majority of cases the Pulse was slow compared to the Temperature. This is of diagnostic value in the cases of the common influenza type with no physical signs in the lungs, also in the pulmonary type of influenza.

In this class of cases there is a more definite ratio between the Temperature and Pulse than in all the /

the other cases. The only Pneumonic type of case which did not conform to Class B. was that in which there was a cardiac lesion and this accounted for the irregular and fast pulse. Typical cases of Class B. occurred only in adults.

In a very small majority was the ratio of the normal type, the prognosis in these cases being as favourable as in the cases with a slow pulse.

All the cases recovered, those in which the Pulse was rapid requiring the longest time.

In all the cases occurring in children the pulse was rapid. As nearly all the cases with a fast pulse, examined were of a different nature it is impossible to draw general conclusions from them but the prognosis in them was much less favourable than in the other types of the disease.

Quotations. Allbutt's System of Medicine.

The most distinguishing characteristic of the pulse was that for the severity of the illness it seldom underwent any proportionate acceleration.

CEREBRAL ABSCESS.

The result from the examination of sixteen cases was as follows :-

Class A. "Cases with a Pulse Temperature Ratio of the Normal type." There were no cases in this class.

Class B. "Cases with a slow Pulse compared to the Temperature".

There were twelve cases in this class. In all these cases save one there was a history of middle ear disease. In eleven cases an operation was performed with one recovery. At the time of operation the pulse was slow in all the cases with a subnormal Temperature in six cases and a Temperature above normal in five cases. The pulse rate was slightly slower in the cases with the subnormal Temperature than in those with Temperature above the normal. The Pulse rate varied from 44 - 64 beats per minute in the most typical cases, and in the cases with elevated temperature, the temperature was on the average 101° - 102° F.

In two cases the Temperature was above normal during the whole course of the illness. In one case the Temperature which was of a fluctuating character remained/

remained above normal till near death when it became subnormal. In this latter case on post mortem examination a condition of septic meningitis was found although the diagnosis was, before operation, cerebral abscess.

The case in which no operation was performed was one of chronic abscess in the motor area. In this case there were repeated rigors for a long time with an elevated Temperature and a slow Pulse with no other clinical signs or symptoms. This was succeeded by a type of Jacksonian convulsions in the one side of the face and the arm and leg on the same side. The condition gradually became worse, the one side of the body becoming paralysed. The course of the case lasted about $6\frac{1}{2}$ months, and the diagnosis of chronic abscess was made by Professor Clifford Allbutt. The only other possibility was that it was a case of glioma of the brain substance. Unfortunately no post mortem was obtained.

Class C. "Cases in which the Pulse was fast compared to the Temperature!"

In one case the Temperature was above normal with a fast pulse the whole time. On post mortem an/

an extra dural abscess was found.

In the other case occurring in a child of $4\frac{1}{2}$ months of age the pulse which at first was not very quick became very rapid towards death.

Class D. "Cases with an irregular Pulse Temperature Ratio."

There were two cases in this class.

In none was the irregularity very marked. The Temperature remained slightly above or below normal with a pulse which on the average was slow.

In one the Pulse was slow at death, in the other very rapid.

CONCLUSIONS.

In about 87% of the cases the Pulse was slow often very markedly, as in the case with the Pulse of 44 beats per minute. Unless stated otherwise the abscess found on post mortem examination was in the Temporo sphenoidal lobe of the Brain. In seven of the cases the Pulse remained slow throughout the disease till death.

From examination of these cases I conclude that in all cases with a history of middle ear disease a slow pulse especially a very slow one, is diagnostic of an intra-cerebral abscess. The degree of Temperature/
ature/

Temperature is not such a constant sign as it was above the normal in some cases although in the majority it was subnormal.

In the cases with an irregular Pulse Temperature Ratio the diagnosis is more difficult, the pulse rate being the most important of the two.

In the cases with a rapid Pulse the diagnosis is in favour of an extra dural lesion with definite local abscess formation, or of meningitis.

In all cases the prognosis is very bad, there being only one recovery in these series of cases.

In all cases with a slow pulse and subnormal Temperature I would examine the urine for albumen as in uraemia, the clinical signs and symptoms might simulate those of cerebral abscess so closely as to make a definite diagnosis very difficult.

Quotation. "Miles and Thomson - Manual of Surgery."

In the initiatory stage of cerebral abscess which may last from twelve hours to two or three days, the Temperature and pulse rate are somewhat higher than normal.

When the abscess is fully formed the temperature falls and becomes as a rule persistently subnormal, the pulse being slow and full 40 - 60 per minute.