THE BLOOD-PRESSURE IN ACUTE LOBAR PNEUMONIA

being

A THESIS

Submitted for the Degree of M.D.
in the
University of Edinburgh

by

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ACUTE Lobar Pneumonia, with its general distribution over all ages and classes, is responsible for a high rate of mortality amongst those who are attacked by it. Any means by which the prognosis and treatment of the disease can be improved and made more reliable must be of the highest value.

It is within recent years only that attention has been directed to the importance of the blood-pressure in pneumonia with regard to both prognosis and treatment.

In 1907 Dr. G. A. Gibson made the following statement: "It is undoubtedly true that pneumonia has not such a uniform effect on arterial pressure as is seen in typhoid fever, and the results of many different observers show extreme variations. It may be stated, as a general rule, that the pressure tends to be a little below normal with considerable fluctuations throughout the course of the disease. It has been asserted that there is a sudden fall at the period of the crisis; this, however, has certainly been far from common in my experience. A pressure appreciably below the normal in pneumonia is invariably of evil omen, and any considerable fall bodes disaster. When the arterial pressure, expressed in millimetres of mercury, does not fall below the pulse rate, expressed in/
in beats per minute, the fact may be taken as of excellent augury, while the converse is equally true. From the work of the last few years in my own wards no fact is more certain than this."(1)

Working on the lines suggested by the statement as to the blood-pressure, pulse-rate ratio, Gordon(2) in observations on fifteen cases of pneumonia, found that in no case did death occur when the blood-pressure in millimetres of mercury was higher than the pulse rate in beats per minute, and only one case recovered where the pulse rate was persistently above the blood-pressure. In this case, on the day preceding the crisis, the blood-pressure became above the pulse rate, and thus the prognosis became good.

The observations of Hare(3) serve to confirm the results obtained, and, in company with Gordon, he emphasises the value of the sphygmometer, not only in prognosis, but also as an indicator of a failing heart, which will point to the necessity for stimulative measures long before one could tell from either the quality of the pulse or cardiac sounds.

Goodman and Pitman(4), after the study of fifteen cases of pneumonia, share with Gibson, Gordon, and Hare the opinion that constant attention should be paid to the blood-pressure and its relation to the pulse rate. However, they do not feel that a blood-pressure/

(3) Therapeutic Gazette, 1910, 3rd Ser. 26, p. 387.
(4) Therapeutic Gazette, 1911, 3rd Ser. 27, p. 464.
pressure lower than a pulse rate necessarily means a fatal termination, nor that with a blood-pressure higher than the pulse rate, a favourable result may always be expected. They emphasise the point that "in arterio-sclerosis or nephritis, or in any condition usually associated with an increase in blood-pressure, the patient may have in pneumonia a higher pressure than normal, yet for that individual the pressure is relatively low."

In the present series of cases of acute lobar pneumonia the blood-pressure in millimetres of mercury and the pulse rate in beats per minute have been taken four-hourly during the daytime, at 10 a.m., 2 p.m., 6 p.m., 10 p.m. The reason for not taking them at night is that to ensure accuracy of results it was found the blood-pressure needed to be taken by the same observer on every occasion.

The sphygmometer used has been the Riva-Rocci instrument supplied by Hawksly of London, and the systolic pressure has been read at that point when, after obliteration of the radial pulse at the wrist, it reappears on lessening the pressure in the armlet.

Both the blood-pressure and the pulse rate have been charted as the nearest multiple of five.

On the charts the blood-pressure is shown by dots in red ink, the pulse rate by black dots.

There are two small points to which attention must be paid if accurate readings are to be obtained. The/
The first is that before taking the blood-pressure and pulse rate, the patient should be in as tranquil a frame of mind as possible. This is because it is often found that in a highly nervous patient the excitement connected with the fixing on of the armlet, especially for the first time, raises the blood-pressure and pulse rate also above what is normal for the particular case.

The second precaution to be taken is that the blood-pressure should not be read immediately after an attack of coughing, as this always tends to considerably heighten the pressure reading.

It will be understood that when speaking of simply "blood-pressure" and "pulse rate," by the former is meant its height in millimetres of mercury, and by the latter its rate in beats per minute.
GENERAL OBSERVATIONS.

As a general rule the blood-pressure is found to keep below the average normal level until after the temperature has settled down, after which there is a gradual rise until it reaches the normal height. This applies both to children and adults.

In many of the cases where the blood-pressure was high during the course of the disease it was found that on taking it during convalescence it was still higher; thus showing that although high during the acute stages the blood-pressure was really for these cases subnormal.

It could not be shown that variations in the height of the temperature had any definite effect on the height of the blood-pressure; that is to say, any rise or fall of temperature during the time previous to the crisis had no influence on the blood-pressure chart.(1)

It must be noted, however, that this statement excludes the time of the crisis. It has been stated by various observers(2) that the crisis has no effect on the blood-pressure. By reference to the charts it/

(2) (a) Osler: Practice of Medicine, 6th Ed., p. 177.
it will be found that in the very large majority of cases there was a distinct fall at the time of or immediately after the crisis; and in those cases where the fall in temperature occurred by lysis the same statement is equally true. The fall, however, was never a marked one.

After this preliminary fall the blood-pressure usually begins to steadily rise to its former normal limits. In some of the cases which have been very restless this rise has been delayed somewhat, as if by the general lower tone of the circulatory system the heart obtained longer time for recuperating from the increased strain put upon it by the acute delirium.

In those cases where a higher blood-pressure than normal has obtained during the acute stages of the disease, the crisis or lysis, as the case may be, has been followed by a steady fall down to the normal limits.

Cardiac failure coming on after the crisis is also accompanied by a falling blood-pressure, but, as we shall see later, it is accompanied also by a rising pulse.

The onset of death in a case of pneumonia is not always accompanied by a fall in the blood-pressure.

In the fatal cases, fifteen in number, in nine (Cases No. 14, 15, 17, 23, 26, 27, 29, 24, 32) there was a fall before death occurred, whilst in six (Cases No. 1, 16, 22, 30, 86, 38) there was a rise in the blood-
pressure. The fall before death was usually a sudden one, and the rise was in most cases a sudden one also, so that a sudden rise in blood-pressure is always to be considered with some degree of uneasiness, although a sudden rise is by no means an uncommon occurrence in cases for which no anxiety is felt.

When coming before the crisis, a sudden rise in the blood-pressure in pneumonia has been said to be a warning of a complication; (1) and, further, that acute delirium is often a sequel of a rapid rise in blood-pressure. (2)

Examination of the present series of cases does not allow (except in Case 38) of any definite statement being made on these points, but the following may be noted:

The blood-pressure during delirium and restlessness reached the highest limits that it attained throughout the case. In most cases there was a rise of blood-pressure either immediately before or during the period of delirium, although this rise was in some cases very small.

The one case which endorses the former statements is No. 30, in which the rapid rise of the blood-pressure on one day was followed by delirium on the next. On the day on which delirium set in, however, the pressure fell.

A/

A falling blood-pressure: - A fall in the blood-pressure, as we have already seen, is the common phenomenon about the time of the crisis and before death. In the former it is usually only temporary, although it may in certain cases continue to fall for some time after the crisis, especially in patients who have proved very restless. In such cases the fall is steady and gradual, and causes no anxiety; it is accompanied by a correspondingly steady fall on the part of the pulse rate. When a fall in blood-pressure is accompanied, not by a fall, but by a rise in pulse rate, then, as we shall see later, much more different conclusions are to be drawn.

Although a case in which the blood-pressure is much below normal will undoubtedly be considered as more serious, yet a low blood-pressure in itself is not to be looked upon always with great gravity. Cases of adults in which the blood-pressure has reached 80-90 millimetres of mercury have caused no anxiety, and have made good recoveries.

A rapid and precipitous fall in the blood-pressure must always give rise to grave misgivings.

A failing heart is shown by a fall of blood-pressure either sudden or gradual as the case may be.
RELATION OF BLOOD-PRESSURE TO PULSE RATE.

An analysis of the cases of acute lobar pneumonia with their result and the relation which the blood-pressure bore to the pulse rate, will be found following the notes of the cases.

We must here go into this with greater detail.

Taking the fatal cases just, of which the total was seventeen, in five (Cases No. 1, 14, 23, 30, 38) the blood-pressure was consistently above the pulse rate; in five it was consistently below the pulse rate (Cases No. 15, 22, 32, 34, 40). In the remaining seven cases, in six (Cases No. 17, 26, 27, 29, 36, 39) the blood-pressure, although at some time above, became below the pulse rate previous to death, whilst in one (Case No. 16) the blood-pressure became above pulse rate after being below.

In the cases where the blood-pressure was consistently above the pulse rate, and where a fatal result was recorded, the ages were as follows:-

Case No. 1. 65 years.
,, No. 14. 76 years.
,, No. 23. 53 years.
,, No. 30. 65 years.
,, No. 38. 68 years.

all ages, it will be noticed, where some increased height of arterial pressure is to be looked upon as not an abnormal thing.

Case/
Case No. 23 was complicated by the presence of pulmonary tuberculosis, and the outlook, therefore, was very grave.\(^{(1)}\)

In Case 30 there were well-marked sclerotic changes in the arterial walls, and changes of a chronic nature in the kidneys. To this was added a considerable amount of fatty heart changes, so that a slower pulse rate and a higher blood-pressure was only what one would expect.

Case 38 again had definite arterio-sclerosis.

If we take the fatal cases of lobar pneumonia in adults in the prime of life, we see that in them all the blood-pressure was below the pulse rate either consistently or became so before death.

In patients where there was a marked difference between the rate of the pulse and the height of the blood-pressure, the pulse rate being above the blood-pressure, an evident evil prognosis was pointed to (Cases No. 15, 22, 32, 40).

In six of the fatal cases, whilst the blood-pressure was at first above the level of the pulse rate, previous to the termination this position became reversed. The change in positions came about by a gradual rise in pulse rate accompanied usually by a fall; but in one case (29) by a rise in the blood-pressure. The cause of death in these cases was obviously cardiac failure, and the gradual reverse of position whereby/

\(^{(1)}\) Glasgow Medical Journal, May 1911, p. 329.
whereby the pulse rate became above the blood-pressure was evidence of the gradual giving out of the cardiac strength.

Each patient in whom the pulse rate has become and remained higher than the blood-pressure, where previously the reverse was the case, has died.

It cannot be said that a rising blood-pressure is a good sign, or a falling blood-pressure a bad sign - that is, when the blood-pressure is considered alone. But when a falling blood-pressure is associated with a rising pulse rate, or a rising blood-pressure with a quicker rising pulse, then there is a distinct danger signal; and where it has happened that the pulse rate has become above the blood-pressure and remained so, after the opposite position being the case, then a fatal termination to the case has been recorded.

The list of cases show the number of recoveries from pneumonia as twenty-three. Of these, in ten (Cases Nos. 2, 3, 4, 5, 6, 7, 9, 11, 25, 31) the blood-pressure previous to the crisis was consistently below the pulse rate; in seven (Cases Nos. 8, 10, 13, 18, 20, 24, 35) the blood-pressure was all along above the pulse rate; whilst in six (Cases Nos. 12, 19, 21, 28, 33, 37) the blood-pressure was at one time above, at another below, the pulse rate, but, and this point is important, before the crisis and during it the blood-pressure was above the pulse rate. Whatever relation the pulse rate and blood-pressure bore to each other at/
at one time or other, in these six cases the blood-
pressure was always above the pulse rate before, and
remained so during, the occurrence of the crisis.

Amongst the ten cases of recovery where the blood-
pressure was consistently below the pulse rate, there
were six cases under fourteen years of age (Cases Nos. 2, 3, 4, 5, 6, 22). Children naturally have a higher
pulse rate and lower blood-pressure than adults, and
moreover the pulse rate in children is not of the same
importance as in older people. (1) The relationship
of the blood-pressure and pulse rate in a child, there-
fore, is not of any marked value in a disease such as
pneumonia. So that we have four cases of pneumonia
in adults where the blood-pressure previous to the
crisis was consistently below the pulse rate, and where
a good recovery was made.

In none of the cases, however, it may be remarked,
was the difference between the two very emphatic.
Moreover, in all these cases where previous to the
crisis the blood-pressure has been below the pulse rate
and yet a favourable result ensued, it will be seen
that the position has changed during the crisis, so
that during the settlement of the temperature the
blood-pressure has become above the pulse rate.

In the six cases which recovered where the blood-
pressure was at first below, but before the crisis be-
came above the pulse rate, this change was synchronous
with/

(1) British Medical Journal, Dunlop, 1908, Vol. ii.,
p. 367.
with an all-round improvement in the patient's condition. It was a sign that the heart had successfully withstood the strain put upon it by the consolidation of the patient's lung and the general toxic condition.

It may be safely stated in all these six patients that whereas they were all critically ill and the prognosis in each was doubtful, the turning point in their illnesses was marked by the blood-pressure becoming above the pulse rate.
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

Name: [Handwritten]
Age: 65 years
Disease: [Handwritten]
Notes: [Handwritten]
Result: [Handwritten]

Date: [Handwritten]
Time: [Handwritten]

Blood Pressure and Pulse Measurement Graph.
NOTES AND REMARKS ON CASES.

Case 1.- Death.

On admission no history could be obtained as he was in a state of acute delirium and very violent. Temperature 103.8°F., pulse 105 per minute, respirations 36 per minute.
Pneumonia of left lower lobe.
September 20th developed pneumonia of left upper lobe.
At 10 p.m. on September 20th temperature suddenly shot up, respirations became much increased, and he died at 4 a.m. on the 21st.
Treatment: On admission: Brandy ½ oz every four hours.
September 18th: Strychnine 1/60th gr. hypodermically every two hours.
At post-mortem there was slight cardiac hypertrophy.
Remarks: The blood-pressure was consistently above the pulse rate and a fatal result ensued. Taking into account the condition of the cardiac muscle one would be led to expect a higher blood-pressure than normal. It is to be noted that an early rise in the pressure occurred after the administration of the strychnine. There was a rise in blood-pressure previous to the onset of death.
Case 2.- Recovery.

History: Ill for three days with pain in left side of chest, and cough.
On admission: Temperature 101°F., pulse 110 per minute, respirations 22 per minute. Herpes Labialis. Pneumonic patch at apex of left lower lobe.
25.8.12: Consolidation spreading along the great fissure of the lung. Rusty sputum.
27.8.12: Crisis during last night.
Remarks: The pulse rate before the crisis was above the blood-pressure, but immediately after the crisis the pulse rate became below and remained so. During the crisis there was a fall in blood-pressure. Immediately afterwards it rises.

Case 3.- Recovery.

History: For three days has had a cough
On admission: Looks ill. Herpes Labialis. Temperature 100.6°F., pulse 110 per minute, respirations 24 per minute.
Pneumonia of right upper lobe.
Crisis during night of September 1st.
Remarks: Blood-pressure before the crisis is below, but/
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

Date: September 25, 1912

Time: 2:00 PM

Blood Pressure: 150/90

Pulse Rate: 80

Name: [Blank]

Age: 1 year

Disease: [Blank]

Notes: [Blank]

Result: Recovery
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**Notes:**
- Name: Annie Johnson
- Age: 8 years
- Disease: Rheumatism
- Recovery: Improved
but immediately after the crisis becomes above the pulse rate. There is a fall in blood-pressure after the crisis.

Case 4.- Recovery.


History: Cough, and pain in left side of chest for two days.

On admission: Temperature $103^\circ F.$, pulse 100 per minute, respirations 52 per minute.

Pneumonia of right lower lobe.

Crisis during morning of September 28th.

Remarks: Another case of pneumonia in a child where the pulse rate is above the blood-pressure. They become at the same level during the crisis, but for some time afterwards the blood-pressure remains below the pulse rate. There is a fall in the blood-pressure during the crisis, after which it gradually rises again.

Case 5.- Recovery.


History: Pain in left side of chest, and cough for two days.

On admission: Temperature $101.8^\circ F.$, pulse 130 per minute, respirations 52 per minute.
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

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Name: Lewis
Age: 14 years
Disease: Febrile Paroxysms
Notes: No significant change in blood pressure or pulse rate.
Recovery: Normal after 3 days.
Pneumonia of left upper lobe.
Pseudo-crisis during night of September 29th; crisis early morning of October 1st.
Remarks: The pulse rate until two days after the crisis was continuously above the blood-pressure; at the pseudo-crisis and at the crisis they became very near each other. There is a fall in the blood-pressure after the crisis.

Case 6.- Recovery.
Lucy Marsden. Age 14 years. Admitted 5.10.12.
History: For three days has had pain in the right side of the chest; cough, rigors.
On admission: Looks very ill. Herpes Labialis. Temperature 102.6°F., pulse 135 per minute, respirations 32 per minute.
Pneumonia of right middle and left upper lobes.
Crisis October 8th.
Treatment: October 6th: Brandy ½ oz. every four hours.
Remarks: A case of double pneumonia in which prior to the crisis the blood-pressure was at a lower level than the pulse rate, the result, however, being a favourable one. During the crisis the blood-pressure made a slight rise and the pulse rate became and remained below.
Case 7.- Recovery.

Thomas Garvey. Age 22 years.

History: September 25th had severe headache and pain in the left side of the chest, also rigors.

Temperature 103° F., pulse 105 per minute, respirations 28 per minute.

Small patch of pneumonia at left apex which gradually spread, and on September 28th whole of left upper lobe was solid.

Crisis during night of October 1st.

Treatment: September 27th he was given tincture of digitalis (mx) and liquor strychnine (mij) every four hours. September 30th: Brandy ½ oz. every four hours, and hypodermics of strychnine (gr. 1/60th) every four hours.

Remarks: A case of young adult in which the blood-pressure remained below the level of the pulse rate up to the crisis, and in which recovery occurred. At the crisis the blood-pressure becomes the higher.

It will be seen that active stimulation was given, and that following this the blood-pressure which had been falling, and the pulse rate which had been rising, steadily became nearer each other on the chart. In view of this, grounds were given for a favourable ending, which, as the result shows, was quite justified.
The crisis was followed by a drop, only a slight one, in the blood-pressure.

Case 8.- Recovery.

History: Pain in the left side of the chest, with cough, for three days.
On admission: Temperature 101.4°F., pulse 90 per minute, respirations 36 per minute.
Pneumonia of apex of left lower lobe
Temperature never reached very high levels, remaining in the region of 100°F., and the patient was fairly comfortable throughout.
Temperature came down by lysis, beginning to drop on the evening of October 9th, and remaining down after the morning of October 11th.
Remarks: Blood-pressure throughout was at normal levels, and remained above the pulse rate. There is a general steady rise of blood-pressure during the period of lysis, but a fall directly after the final settling of the temperature.

Case 9.- Recovery.

History/
**Case 9**

**Lewin's Blood Pressure and Pulse Chart**

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**Name**: Catherine Scally

**Age**: 17 years

**Disease**: Lobar Pneumonia

**Notes**: Result: Recovery
History: "Out of sorts" for four days, diarrhoea, headache, pain in right side of chest.
On admission: Face flushed, tongue furred, abdomen distended.
Temperature 100°F., pulse 120 per minute, respirations 32 per minute.
Pneumonia of right middle lobe.
Widal reaction negative.
Temperature kept up at high limits, tepid sponge being given when it rose above 103°F.
Starting at 6 p.m. on September 26th temperature came down by lysis until it reached and remained normal therefrom, during the evening of September 28th.
Remarks: Before the beginning of the lysis the blood-pressure was at a much lower level than the pulse rate. During the lysis the blood-pressure and pulse rate became more closely related, and on one occasion the pressure is higher than the pulse rate. It is not until after the temperature has finally dropped that the blood-pressure becomes regularly above the pulse rate.

The patient made a good recovery.

There is a drop in the blood-pressure immediately after the final drop in temperature.

Case 10.- Recovery.

History/
LEWIS BLOOD PRESSURE AND PULSE CHART.
History: Pain in the right side of the chest, with a troublesome cough for three days. Is a teetotaller. On admission: Herpes Labialis well marked. Temperature 103°F., pulse 100 per minute, respirations 32 per minute.

Pneumonia of right and left lower lobes. Temperature came down by crisis during the night of October 2nd, but rose again on October 4th to 101°F., remaining up until October 5th at 10 a.m. when it became normal and remained so; the patient making a good recovery.

Treatment: Tincture of digitalis (mx) three times a day.

Remarks: In this, a case of double pneumonia, the pulse rate kept continuously below the blood-pressure range. The blood-pressure throughout remained at a good level.

During both drops in the temperature it will be seen that there is a drop also in the blood-pressure.

Case 11.- Recovery.


History: Severe pain in the left side of the chest for about one week; cough.

On admission: Cyanosis of face; tongue furred; very restless and delirious.

Temperature/
<table>
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<tr>
<th>Case No.</th>
<th>Name</th>
<th>Age</th>
<th>Disease</th>
<th>Notes</th>
<th>Recovery</th>
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<tbody>
<tr>
<td>1</td>
<td>W. M. Cardwell</td>
<td>2/3 years</td>
<td>Leukaemia</td>
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Temperature 101° F., pulse 105 per minute, respirations 36 per minute.

Pneumonia of whole of left lower lobe.

Systolic murmur at apex of heart.

On admission he was given: Brandy ½ oz. every four hours, and strychnine hypodermically (gr. 1/60th) every six hours. Owing to the extreme restlessness it was necessary to give a drachm of paraldehyde.

The temperature came down by lysis beginning at 10 a.m. on August 29th and reaching normal on August 31st. He remained delirious until August 30th, but on this day he became quite rational.

An empyema developed and a rib was resected on September 11th, after which he made an uneventful recovery.

Remarks: Previous to the lysis the pulse rate was above the blood-pressure. During the lysis the two became closer, but not until the final drop in temperature did the blood-pressure become above the pulse rate.

During the lysis the blood-pressure is at a lower level than before; after the lysis it rises.

The variations of temperature previous to the pus being let out of the chest did not affect the blood-pressure, but after the rib resection was performed the blood-pressure steadily rose.

The distance on the chart between the pulse rate and blood-pressure records during the acute stages of the disease was very slight, and in spite of the pressure/
Lewis's Blood Pressure and Pulse Chart.

Name: Henry McDermott
Age: 42 years
Disease: Tuberculosis
Notes: Result: Recovery.

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(Please refer to the chart for detailed blood pressure and pulse readings.)
pressure being below the pulse rate, there was a good recovery.

Case 12.- Recovery.

Henry McDermott. Age 42. Admitted 18.10.12.

History: Three days ago had a rigor; pain in left side of chest. Very much addicted to alcohol.

On admission: Looks very ill. Cyanosis of face; nasal herpes.

Temperature 103.4°F., pulse 110 per minute, respirations 36 per minute.

Pneumonia of left upper and lower, and right lower lobes.

October 19th: Became very delirious, pulse very irregular.

Delirium remained fairly intense up to October 24th during which day he became much quieter.

Crisis occurred during October 25th.

Treatment: October 19th: Brandy ½ oz. every four hours.

October 22nd at mid-night was put on hypodermics of digitalin (gr. 1/100th) every four hours.

Remarks: A case of double pneumonia in an alcoholic patient, in whom there was extreme restlessness and delirium.

There is a marked fall in blood-pressure during the crisis.

There/
There were many changes in the relation of the blood-pressure to the pulse rate. On admission the blood-pressure was above the pulse rate; on the next day it became below. A rise in the height of both then occurred, and sometimes one, sometimes the other, is at the higher level. At no time was there a marked difference between the two levels, the greatest being on the 22nd and 23rd.

On the 22nd digitalin was given, and whether or not it was due to this, at any rate on the morning of October 24th the blood-pressure again became above the pulse rate; and during the crisis on the remained 25th/above.

The restlessness and delirium was not in this case augured by any sudden rise of blood-pressure.

The patient was critically ill, but a not altogether hopeless prognosis was given for the following reasons: - The blood-pressure was never low, and a rise in pulse rate was accompanied, except on one occasion (October 22nd) by a rise in blood-pressure; but mainly because the blood-pressure at times was above the pulse rate, and even when below a very small difference separated them; and just before the crisis the blood-pressure became and remained above the pulse rate.
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**Name**: Smith

**Age**: 27 years

**Disease**: Malaria

**Notes**

**Result**
Case 13.- Recovery.


History: Five days ago had a rigor, pain under right shoulder blade, and cough. Is a teetotaller.

On admission: Herpes on right ear. Temperature 101.6°F. pulse 100 per minute, respirations 40 per minute.

Pneumonia of left lower lobe, and apex of right upper lobe.

On October 20th whole of right upper lobe was solid.

Treatment: Tepid sponge when temperature was above 103 F. At midnight and every four hours he was given a hypodermic of digitalin (gr. 1/100th).

The temperature gradually fell by lysis from the evening of the 24th until the evening of October 27th, when it reached normal.

Remarks: This patient did not give any real anxiety throughout his illness. The blood-pressure was maintained at a high level, and was always well above the pulse rate.

During the lysis there was a fall in the height of the blood-pressure.

Case 14.- Death.


History/
History: Five days ago had a rigor, pain in left side of the chest, worse on coughing. Night sweats and cough for several years; husband died from phthisis.

On admission: Looks very ill, face of dusky hue. Temperature 99°F., pulse 120 per minute, respirations 40 per minute. Sputum rusty and tenaceous. Pulse very irregular.

Pneumonia of left upper lobe, and dullness with tubular breathing at apex of right lower lobe.

On November 2nd temperature rose to 103.2°F.

Died at 3 p.m. November 2nd.

Treatment: On admission put on brandy ½ oz. every four hours. November 2nd, digitalin (gr. 1/100th) and strychnine (gr. 1/60th) hypodermically every two hours.

Post-mortem showed massive pneumonia of the left upper lobe, whilst the physical signs at apex of right lower lobe were due to phthisis.

No macroscopical nephritic changes.

Remarks: The patient only lived twenty hours after admission.

Pneumonia with phthisis as a complication is very fatal. (1)

The blood-pressure was high, but in this connection the age of the patient must be taken into account. Although the blood-pressure was above the pulse/

pulse rate a fatal result ensued. Previous to
death the pulse rate was steadily rising and near-
ing the blood-pressure which did not show any at-
tempt at rising higher.

Case 15.- Death.

History: Had attempted suicide by jumping out of win-
dow on day of admission.
When admitted was quiet. There was extreme bruising
of the right orbit. Distinct generalised icteric
tint.
Temperature 100.4°F., pulse 125 per minute, respira-
tions 30 per minute.
Pneumonia of left lower lobe.
On the night of November 3rd he became very restless
and kept so in spite of sixty grains of choral-
amide.
Treatment: November 4th, Brandy 2 drachms every two
hours; hypodermics of strychnine (gr. 1/60th) with
atropine sulphate (gr. 1/150th) every four hours;
and adrenalin chloride (1 in 1000) mxx by mouth
every four hours.
Died at 7 p.m. on November 4th.
Remarks: Blood-pressure was very much subnormal
throughout. There was a gradual rise for a short
time,
time, but immediately before death a sudden fall from 90 to 70 millimetres of mercury took place. The pulse rate was far above the blood-pressure, the case being hopeless from admission.

Case 16. - Death.


History: For one week has had pain in the right side, rigors and cough. Addicted to alcohol.

On admission: Extremely restless, with marked lividity of face. Sputum rusty. Temperature 101°F., pulse 100 per minute, respirations 40 per minute.

Pneumonia of whole of right lung.

September 28th: Very restless, and trying to get out of bed. Died at 12 noon.

Remarks: From his admission to hospital the patient was in an acutely delirious condition.

During the first day his blood-pressure was markedly subnormal especially considering the man's age, and was below the pulse rate. The two readings previous to death show changes both in the height of the blood-pressure, which rises from 95 to 110 millimetres of mercury, and also in its relation to the pulse rate, which becomes below the pressure. In spite of this the case ends fatally.
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**Name**: Jane Kearns

**Age**: 38 years

**Disease**: Tuberculosis

**Notes**: Result: Death
Case 17.- Death.


History: On October 27th had sudden pain in right side of chest, worse on breathing. Cough, vomiting, and rigors.

On admission: Herpes labialis; rusty sputum. Temperature 102.2°F., pulse 120 per minute, respirations 24 per minute.

Pneumonia of right upper lobe and friction sounds at left base.

On November 3rd pulse was very irregular, and quick (145), heart sounds muffled by respiratory accompaniments.

From November 5th at 2 a.m. when it was 102.8°F. the temperature gradually fell until it reached normal on November 6th at 6 a.m. During the same period the pulse fell from 125 to 100 per minute, and the respirations from 50 to 24 per minute.

On November 3rd was given brandy ½ oz. every four hours, and four-hourly hypodermics of strychnine (gr. 1/60th) with adrenalin chloride (mv. of 1 in 1000). Cold sponged when temperature above 103°F. The stimulants, both the brandy and hypodermics, were discontinued on November 6th.

The temperature never really settled, and on November 10th it became 100°F., and gradually rose until/
until it became 102°-103°F., and remained up at these levels. At the same time the pulse and respiration rate increased. On examination, a fresh small patch of pneumonia was found at the apex of the left lower lobe, which spread until on the 14th November the whole of the left lower lobe became solid. On November 14th she was given brandy ½ oz. every four hours, and hypodermics of strychnine (gr. 1/60th), adrenalin (mv of 1 in 1000) and atropine sulphate (gr. 1/150th) every three hours. Gradually she became weaker and died on November 17th at 11 p.m.

Remarks: An interesting case of pneumonia in the left lower lobe after the occurrence of the crisis of a pneumonia in the right upper lobe.

The range of the blood-pressure kept within fairly small limits, and except on November 2nd did not show either any marked rise or fall.

After the crisis of the first attack there was a slight fall soon followed by a gradual rise which continued up to November 10th - the day on which the temperature again shot up, when a gradual fall begins. A further fall is also seen just previous to death.

There is a marked fall in blood-pressure beginning on November 2nd, which, as will be seen from the chart, is coincident with a rise in pulse rate. On this day the patient received the brandy and hypodermics/
hypodermics, and following on this stimulant treatment a rise of blood-pressure and fall in pulse rate is recorded, so that just before the crisis the two became more closely related. During the crisis the positions are changed, the pulse rate becoming below the blood-pressure.

The pulse gradually dropped and the blood-pressure gradually rose until the onset of the second attack when the pulse rate became increased and the pressure steadily fell until on November 11th the pulse rate again became above the blood-pressure.

On November 14th stimulants were repeated, and the effect of them on the blood-pressure is seen in a slow rise until the day previous to death when it again fell.

In this case, with a blood-pressure below the pulse rate, a fatal result ensued. In the first attack having got safely over her crisis, and the blood-pressure having become above the pulse rate, one might, if there had been no second attack, have reasonably looked for recovery, in spite of the fact of the blood-pressure having been below the pulse rate. This case goes to show very clearly that a rising pulse rate and a falling blood-pressure is a certain danger signal, and that whilst from the blood-pressure alone no indications can be accepted, yet taken in its relationship to the pulse rate valuable deductions as to the progress of the case may be drawn.

The/
**NAME**
Harry Wood

**AGE**
16 years

**DISEASE**
Lobar Pneumonia

**Notes**
Result: Recovery

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**LEWIS’S BLOOD PRESSURE AND PULSE CHART.**

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The effect of the stimulant treatment on both the pulse rate and blood-pressure is to be noted.

Case 18. - Recovery.


History: Pain in the left side of the chest, and cough for about a week.

On admission: Temperature 102.4°F., pulse 110 per minute, respirations 32 per minute.

Pneumonia of left lower lobe. Systolic bruit at cardiac apex.

Crisis during night of July 19th.

Remarks: The patient came into hospital too late for the pulse rate and blood-pressure ratio to be of much practical value, as the crisis occurred on the night of admission.

Two points may be noted - (1) that just before the crisis the blood-pressure became above the pulse rate and the patient made a good recovery; and (2) that immediately after the crisis there was a fall in the height of the blood-pressure after which it steadily rises again.
Case 19. - Recovery.

History: Ill for three days with pain in the right side of the chest, and cough. Moderate alcohol drinker.
On admission: Cyanosis of face, alae nasi working.
Temperature 101° F., pulse 115 per minute, respirations 44 per minute.
Pneumonia of right lower lobe.
Crisis 6-10 p.m. November 6th.
Remarks: Crisis on day after admission to hospital.
On day of admission blood-pressure is below pulse rate, but immediately previous to the crisis it becomes above the pulse rate.
Directly after the crisis there is a slight fall in the blood-pressure.

Case 20. - Recovery.

History: For three days has had cough and pain in left side of the chest.
On admission: Looks ill. Temperature 101.6° F., pulse 110 per minute, respirations 36 per minute.
Pneumonia of left lower lobe.
Temperature/
Temperature remained up until morning of 5th December when it came down to normal by crisis.

December 6th: Temperature rose again and remained up till morning of the 8th, when it reached and remained normal, patient making a good recovery.

Remarks: For the first two days in hospital the pulse rate and blood-pressure were at the same level, but on the day before the crisis the blood-pressure becomes above the pulse rate.

When the temperature went up again after the crisis, there was a marked fall in blood-pressure and rise in pulse rate, so that at one reading the pressure was below the pulse rate, but soon a more favourable state of things came about, and the patient made an excellent recovery.

Case 21. - Recovery.


History: November 22nd had a rigor and pain all over the body. November 23rd cough and pain in the right side of the chest.

On admission: Colour good, alas nasi working. Marked dyspnoea and a catchy cough. Sputum rusty.

Temperature 103.6°F., pulse 120 per minute, respirations 44 per minute.

Pneumonia of right lower lobe.

November 29th: Quite delirious and restless, and in the/
the evening became quite maniacal, so that it was necessary to put him into the restraining jacket. November 30th: Slept for several hours, but was very restless on awakening. Temperature right down to normal at 2 a.m. December 1st: Quite rational. Treatment: A four-hourly stimulant mixture containing sulphuric ether and ammonium carbonate. On November 29th he was given two, and on November 30th one, hypodermic of morphia (gr. $\frac{1}{4}$), and several thirty-grain doses of chloralamide, in an attempt to quieten him. Remarks: An extremely restless and maniacal patient. On day of admittance blood-pressure was a little below the pulse rate, but on the second day it rises above the pulse rate and remains so. A favourable prognosis was therefore given, and a good recovery was made. After the crisis there is a slight fall in the blood-pressure, and as in other restless cases the fall continues for a time; the blood-pressure does not rise again so soon after the crisis as in quiet patients.
Case 22. - Death.


History: July 20th operation for right mastoid suppuration performed under chloroform anaesthesia. After the operation she was fairly well except for persistent remittent temperature up to July 27th when she had a rigor and complained of pain in the right side of the chest.

On examination there was lobar pneumonia of both right and left lower lobes.

Temperature 104°F., pulse 140 per minute, respirations 48 per minute.

Treatment: Brandy $\frac{1}{2}$ oz. every four hours. Hypodermics of strychnine (gr. 1/60th) every two hours.

Died at 6 p.m. July 28th.

Remarks: Death occurred quickly after the appearance of the pneumonia. The blood-pressure was low and very far beneath the pulse rate. A steady rise in both occurred before death, the difference between the two, however, being maintained.

Case 23. - Death.


History: Complaint of "weakness".

On/
On admission: Temperature 102°F., pulse 160 per minute, respirations 46 per minute.

Pneumonia of right lower lobe. Pulse very irregular and heart sounds weak.

December 10th: Pulse still very irregular.

December 11th: Is looking blue, and not taking her food so well. Temperature down to 99°F.

December 13th: Whole of right lung solid.

Treatment: December 9th: Brandy ½ oz. every four hours.

December 12th at 10 a.m.: Hypodermics of strychnine (gr. 1/60th) every four hours, whilst at 10 p.m. five minims of adrenalin chloride (1 in 1000) were added to the strychnine and the two given two-hourly.

Died on December 14th at 3 p.m.

Remarks: The blood-pressure was during the first three days well above the pulse rate, but on the fourth day the pulse rate, as the result of a steady rise, became much nearer the level of the blood-pressure. At all except one reading, however, the blood-pressure kept just higher than the pulse rate. Death occurs in spite of this, but in an old woman such as this patient was, a gradual rise of pulse rate to the height of the blood-pressure must be taken as a bad sign.
Case 24. - Recovery.

Alice Hingley. Age 47. Admitted 7.12.12.

History: Four days ago had a rigor, and pain in the right side of the chest, with a cough.

On admission: Herpes labialis. Temperature 101.2°F, pulse 100 per minute, respirations 28 per minute.

Pneumonia of right lower lobe.

December 11th: Restless but fairly comfortable.

December 12th: Whole of right lung dull now; temperature falling; crisis this evening.

Treatment: December 11th: Brandy ½ oz. every four hours.

Remarks: Throughout the course of the illness the blood-pressure remained at a much higher level than the pulse rate.

The blood-pressure was high, but the normal blood-pressure of the patient taken just before her discharge from hospital was 160 millimetres of mercury, so that during the first three days her blood-pressure was subnormal for her.

During the fall in temperature on December 12th there was a rise in the pressure and another rise immediately after the crisis.
LEWIS: BLOOD PRESSURE AND PULSE CHART.

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December

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Name

Arnie Brown

Age

6 yrs

Disease

Left Pneumonia

Result

.2.0 c.c.

Notes
Case 25. - Recovery.


History: Two days ago had sudden pain in chest and abdomen, and feverishness.

On admission: Temperature 101.6°F., pulse 120 per minute, respirations 48 per minute.

Pneumonia of right lower lobe.

December 10th: Crisis 6-10 p.m.

Remarks: As in all our cases of pneumonia in children the blood-pressure was below the pulse rate during the pre-critical stages with no untoward result.

After the crisis there was a fall in blood-pressure.

Case 26. - Death.


History: December 1st: Had pain in the left side of the chest, and rigors.

On admission: Looks ill, delirious. Temperature 101°F., pulse 95 per minute, respirations 24 per minute.

Pneumonia of left lower lobe.

For the next five days he was very restless, up to December 9th, when he became exhausted and quiet.

On/
On the evening of December 11th the crisis occurred, and the temperature remained down until the morning of December 16th. Whilst the temperature was down he was more comfortable and quiet. On December 16th temperature shot up to 102°F, and he became restless again; it remained up until the morning of December 18th, when it reached normal, and then gradually fell to subnormal limits.

During this period of high temperature he had retention of urine, but no fresh physical signs in the chest. Widal reaction was negative. Pulse became very weak and irregular, and he died at 12 p.m. December 21st.

Treatment: December 4th: Morphia necessary for restlessness. December 5th: Brandy ½ oz. four-hourly. December 16th: Hypodermics every four hours of strychnine (gr. 1/60th) with atropine sulphate (gr. 1/150th).

Remarks: The patient was very delirious, and at times maniacal. Before the second rise of temperature and reappearance of delirium the blood-pressure had kept up at a good level. On the first fall of temperature (December 11th) the blood-pressure dropped slightly, but rose again the day afterwards.

On December 15th the blood-pressure began to fall, and synchronous with this there was a gradual rise of the pulse rate. On the 16th the position of/
of the two became reversed. Previous to this date the blood-pressure had maintained a range higher than that of the pulse rate, but a gradual fall in the pressure, with a corresponding rise in the pulse rate, brought them closer to each other, and on December 16th the pulse rate became above the blood-pressure. The pressure became further below the pulse rate on the 17th, but on the 18th there was a rise of the former whilst the latter showed a fall, with the result that for about sixteen hours (10 p.m. December 18th to 2 p.m. December 19th) the blood-pressure was above the pulse rate. Once more, however, the pulse became the higher, and remained so until death.

The explanation of this reversal of the positions of the blood-pressure and pulse rate may be taken as due to the failure of the heart following pneumonia, where great cardiac strain was caused owing to the extreme delirium and second rise of temperature.

The gradual approach of the blood-pressure and pulse rate by a rise in the former and a fall in the latter, shows the gradual loss of strength of the heart muscle. Stimulants failed to reverse the ratio, although there certainly was a slight period in which the pulse rate was below the blood-pressure after the free use of strychnine.
Case 27. - Death.


On admission was very delirious, and no history could be obtained. Face cyanosed. Temperature 103.4°F, pulse 80 per minute, respirations 44 per minute.

Pneumonia of right lower lobe.

December 16th: Still very restless; temperature keeping up. Died at 8 p.m.

Treatment: On admission received a stimulant mixture of sulphuric spirits of ether, and ammonium carbonate.

December 16th: Brandy ½ oz. every four hours.

Remarks: The patient, an old man, only lived for twenty-one hours after admission, being very restless the whole time until just before death. On admission the blood-pressure stood at 135 millimetres of mercury and pulse at 80 beats per minute, but a rapid fall in the blood-pressure and a rise in the pulse rate reversed the position, and before death the pulse rate was above the blood-pressure.

A rapidly falling blood-pressure with a rising pulse rate is a sure sign of cardiac failure.
Case 28. - Recovery.


History: December 13th 1912 fell off a wall, and since then he has had pain in the left side of the chest. He indulges freely in alcohol.

On admission: Looks very ill, dyspnoea. Temperature 98°F., pulse 130 per minute, respirations 36 per minute.

Fractures of 9th and 10th ribs on left side, and over this area some pleural friction can be made out.

December 17th at 6 p.m.: Temperature went up to 101.6°F., pulse 150 per minute, respirations 40 per minute; he became delirious, and examination of the chest showed pneumonic consolidation of the left lower lobe. For the following two days he was very seriously ill.

December 20th was a little better.

December 23rd temperature dropped to normal at 6 a.m., and kept there until 6 p.m. when it rose again. It remained up until 6 p.m. on the 25th, when it once more reached normal, and thenceforth remained so. On this second drop the respirations also became less, which was not the case on the first fall in the temperature.

Treatment: December 17th: Brandy ½ oz. every four hours.
December 19th: Hypodermics of strychnine (gr.1/60th), digitalin/
44.

digitalin (gr. 1/100th), and atropin (gr. 1/150th), every three hours.

Remarks: A typical lobar pneumonia following a fracture of the ribs.

During the first three days of his illness the patient was very ill. The blood-pressure during that period, previous to the final drop in the temperature, remained up at a good height, and at times was well above the normal.

On the first two days (December 18th and 19th) the pulse rate was above the blood-pressure. On the third day (December 20th) the blood-pressure is at the same at first and then at a higher level than the pulse; the change in position occurring through a fall of pulse rate and a rise of blood-pressure.

It will be seen that with the first fall of temperature (December 23rd) there is no change in the height of the blood-pressure, but following on the rise of temperature there was a fall in blood-pressure and rise in pulse, so that the two became more closely related, but still kept the position of pressure above pulse (December 24th).

At the second and final drop in temperature (this was probably the true crisis, as respiration also became slower, which it did not do on the first fall), there was a fall in the blood-pressure which continued to fall until it reached normal limits.

Whilst the pressure was below the pulse (December/
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

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<th>Time (min)</th>
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<td>Jan 23</td>
<td>230</td>
</tr>
<tr>
<td>Jan 24</td>
<td>240</td>
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</tbody>
</table>

Name: M. Lewis Gross
Age: 58 yrs
Disease: Left Pneumonia
Notes: Request Death
November 18th and 19th), the patient was extremely ill; on December 20th the blood-pressure became above the pulse rate, and this was signalised by a general all-round improvement in the case. The blood-pressure remained above the pulse rate, and no real anxiety was, during this period, felt with regard to the patient.

Case 29. - Death.


History: For one week has had pain in the right side of the chest, cough and rigors. Left off work three days before admission to hospital. Is a heavy drinker.

On admission: Sputum rusty; temperature 103°F., pulse 100 per minute, respirations 36 per minute.

Pneumonia of right upper lobe.

Temperature remained around 103°F., never varying except within very small limits.

Up to December 23rd he remained fairly comfortable, but then the pulse became quicker, and he was a little delirious.

December 24th: Pulse became thready and rapid. Death occurred at 2 a.m. on December 25th.

Treatment: December 21st: Brandy ½ oz. every four hours. Tepid sponge when temperature above 103°F. December/
ber 23rd: Strychnine (gr. 1/60th) hypodermically every four hours to which on the morning of December 24th digitalin (gr. 1/100th) was added and given two-hourly.

Remarks: The blood-pressure kept up until thirty-two hours before death, when it began to drop. Before death there was a precipitous fall from 135 millimetres of mercury to 95.

On the second day after admission the pulse rate began a steady rise. At first the blood-pressure kept the same distance above the pulse rate by a similar steady rise, until the evening before the day of death when a fall in the blood-pressure produced a change in the position, the pulse rate becoming above the pressure and remaining so until death.

Case 30. - Death.


History: For some days has had pain in the left side of the chest, cough and rigors.

On admission: Feeble old man. Temperature 103°F., pulse 85 per minute, respirations 35 per minute. Pulse extremely irregular and impossible to be sure of accuracy in counting it. Heart also very irregular and difficult to count. Vessel coats thickened.

Pneumonia/
Pneumonia of left lower lobe.

December 24th: Pulse became more irregular.

December 25th: Delirious and kept so, on and off, until death.

December 28th: Had pseudo-crisis during the morning; temperature up in the evening to 101°F.; down again to normal, December 29th, when pulse again very irregular, and death took place at 8 p.m.

Treatment: December 23rd: Brandy ½ oz. every four hours.

December 25th: Strychnine (gr. 1/60th), digitalin (gr. 1/100th) hypodermically every four hours.

Remarks: At the post-mortem examination of this case extensive fatty changes were present in the heart, which, no doubt, accounted for its arrhythmia. Both kidneys were very small and showed macroscopic changes of a chronic interstitial nature.

Considering the patient's age and the changes in the vessels and kidneys, the blood-pressure height of 135 millimetres of mercury which obtained on admittance was by no means high. A gradual steady fall of blood-pressure set in from the second day until the day previous to death.

On the day of death there was a sudden jump in the blood-pressure from 110 to 140 millimetres of mercury.

The pulse rate was consistently below the blood-pressure, but along with the fall in the latter there was a slow rise in the former, so that before death/
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

Date

Time

3/7/36

J. Paul.

Pulse

240...230

M"m.

180

A"1o.

120

60

0
death the two records became very near each other on the chart.

The slow fall in pressure and rise in pulse rate pointed to the gradual cardiac failure.

Case 31. - Recovery.

History: Severe pain in the left side of the chest, and a cough for a few days. Is six months pregnant.
On admission: Healthy-looking girl; covered with scabies.
Temperature 100.6°F., pulse 130 per minute, respirations 28 per minute.
Pneumonia of left lower lobe.
Crisis during early morning of January 3rd.
Treatment: Brandy, two drachms every two hours.
Remarks: The blood-pressure was low throughout. At the crisis there was a marked fall in the height of the pressure, after which it gradually rose again.

Until the crisis the pulse rate was well above the blood-pressure. At the crisis the beats per minute of the pulse were the same as the height of the blood-pressure in millimetres of mercury, but not until a few hours after the crisis did the blood-pressure become above the pulse rate. In spite/
spite of the condition of the chart there was an excellent recovery.

Case 32. - Death.


History: December 31st 1912 she became "light-headed," had pain in the left side of her chest, with a cough. One month ago was confined.

On admission: Looked very ill, lips and face cyanosed, continuous catchy cough with tenacious blood-stained sputum.

Temperature 101.2°F., pulse 130 per minute, respirations 44 per minute. Pulse irregular.

Pneumonia of left lower lobe.

On January 5th at 2 p.m. temperature dropped by crisis. She remained very ill, with irregular pulse, until January 6th when she showed a decided improvement, and slept well for the first time.

January 7th: Lips very blue, and respirations increased. At 2 p.m. became quite pulseless and cold, and semi-conscious. She rallied, however, and improved until January 9th when she had another relapse, became cold and pulseless, and died at 1.30 p.m. evidently from cardiac failure.

Treatment: January 3rd: Brandy $\frac{1}{2}$ oz. every four hours.

January 4th: Strychnine (gr. 1/60th), digitalin (gr./
(gr. 1/100th) hypodermically every three hours, increased to every two hours on January 7th. January 8th: Hypodermics given every six hours, and a mixture of digitalis, ammonium carbonate and squills every four hours.

Remarks: Death was caused by cardiac failure after the occurrence of the crisis.

The blood-pressure remained at about 100 millimetres of mercury, but there was a fall immediately after the crisis and a more distinct fall just before death.

There was also a fall in blood-pressure on the evening of January 6th, and it was on January 7th that she had her first attack of cardiac failure. It is to be noted that the fall in blood-pressure on this occasion was accompanied by a rise in pulse rate, unlike the crisis where there was an accompanying fall in the pulse.

The blood-pressure slowly rose to its former level until January 9th when a sudden fall was followed by death.

The blood-pressure is far below the pulse rate throughout, a danger signal which proved well founded.
Case 33. - Recovery.


History: For two days had had a cough, and pain in the right side of the chest.

On admission: Face very flushed.

Temperature 101.8°F., pulse 120 per minute, respirations 40 per minute.

Pneumonia of right upper and lower lobes.

January 19th: Pulse feeble, sleeping fairly well.

January 20th: Pulse poor.

January 21st: Temperature dropped by lysis during 20th and 21st.

Treatment: January 17th: Brandy, two drachms every two hours. January 18th: Hypodermics of strychnine (gr. 1/60th), and atropin (gr. 1/100th) every eight hours, increased on January 19th to every four hours.

Remarks: The blood-pressure was subnormal in this case.

During the lysis there was a slight rise in its height, but immediately after the temperature had reached normal there was a fall (January 21st, 10 p.m.). For the first three days the blood-pressure was mostly below the pulse rate, but there was no great difference between them.

At the beginning of lysis (January 20th) there was a fall in pulse rate and a rise in blood-pressure/
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

Case 84

Date 2

Time 7:00 AM

Blood Pressure

Name John Gray

Age 40 years

Disease Acute Lobar Pneumonia etc.

Result Death

Right Arm

Left Arm

100
sure, so that the latter became higher than the former, and remained so.

It may be taken as a good sign that although the pulse rate was above the blood-pressure, yet, in a woman of these years, very little distance separated the two. Also the pressure rose above the pulse at the onset of the lysis.

Case 34. - Death.


History: For a week has had pain in the right side of the chest; cough, and severe shortness of breath. Feet have been swollen at night-time, and eyes puffy in morning.

On admission: Is pale and anaemic, with cyanosis of lips. Temperature 98.4°F, pulse 118 per minute, respirations 30 per minute.

Loud diastolic aortic murmur, and systolic mitral.

Urine: specific gravity 1010; Albumen and casts .

Pleural friction over left lower lobe.

January 8th: Temperature shot up to 101°F, pulse 140 per minute.

Pneumonia of left lower lobe.

Became delirious and restless, and died at 2 p.m. on January 9th.

Treatment/
Treatment: On admission was put on a diuretic mixture with purgation. January 8th: Brandy \( \frac{1}{2} \) oz. every four hours, and hypodermics of digitalin (gr. 1/100th) every four hours.

Remarks: This was evidently a case of valvular heart disease with nephritis, who two days after admission developed a lobar pneumonia, and died the day following.

The blood-pressure was higher in the right arm (125 mm Hg) than in the left (95 mm Hg). Beyond the aortic murmur no signs of aneurism could be found, and, unfortunately, permission for a post-mortem could not be obtained.

Previous to death there was a fall in blood-pressure in both arms, the fall in the left arm being 5 mm Hg more than in the right arm.

The pulse rate was above the level of both blood-pressure readings, and was above all the time from the onset of the pneumonia.

As will be seen, the blood-pressure taken on admission to hospital was 150 millimetres of mercury in the right arm, 110 millimetres in the left. With the onset of the pneumonia there was a considerable fall in both readings, but especially in that of the right arm, the same thing occurring before death.

Case/
Case 35. - Recovery.


History: Was well until thirty-six hours before admission, when he had pain in abdomen and head, and felt generally ill. Indulges freely in alcohol.

On admission: Face flushed, rambling and excitable in his talk.

Temperature 103°F., pulse 125 per minute, respirations 36 per minute.

Pneumonia of left upper and lower lobes.

February 7th: Very delirious. Temperature dropping.
February 8th: Temperature normal last night, but is up again this morning.

February 9th: Crisis during last night. Still strange in manner, but less restless.

Treatment: February 4th: Brandy one drachm every two hours. February 7th: Brandy two drachms every two hours.

Remarks: The blood-pressure after the first twelve hours was above the pulse rate, before this it was just below. When once above, it remained so, and a good recovery was effected.

During the 6th and 7th February there was a gradual fall both in pressure and pulse, there being at the same time a slow fall in temperature.

The blood-pressure fell immediately after the true/
true crisis (February 8th, night), but quickly rose again.

Case 36. - Death.

John Hare. Age 22 years: Admitted 8.2.13.
History: On February 1st had bleeding from right ear; pain on both sides of the chest; no rigor.
On admission: Looks very ill, face livid with cyanosis of lips and nose.
Temperature 101.6°F., pulse 130 per minute, respirations 64 per minute.
Pneumonia of right upper and left lower lobes.
February 9th and 10th: Temperature gradually rose to limits of 103°F., etc.
February 10th: Very delirious, very cyanosed. Died 9 p.m.
Treatment: February 8th: On admission two drachms of brandy every two hours, and tepid sponging if temperature above 103°F. February 9th: 10 p.m.: Hypodermics of strychnine (gr. 1/60th) every four hours. February 10th: 12 noon: Oxygen; strychnine every two hours.
Remarks: A very extensive area of lung was involved, and the patient was very seriously ill on admission. The blood-pressure was high for a patient twenty-two years of age.
It fell until seven hours before death, and at the last reading there was a sudden rise from 135 millimetres of mercury to 160.

For the first sixteen hours the pulse rate was below the blood-pressure, but after this the pulse gradually rose, and stood at a higher level than the pressure. This remained the position until just previous to death, when the sudden rise of pressure caused the pulse rate to become the lower of the two.

The bad prognosis, pointed to by the pulse rate rising above the blood-pressure, was fully justified, death occurring at 9 p.m. on February 10th in spite of free stimulation and administration of oxygen.

**Case 37. - Recovery.**


History: Two days ago felt "a stitching pain" in the right side of his chest.

On admission: Very extensive labial and nasal herpes; alae nasi working.

Temperature 102.4°F., pulse 115 per minute, respirations 42 per minute.

Pneumonia of right and left lower lobes.

Temperature remained at 102°-103°F. until evening of February/
LEWIS'S BLOOD PRESSURE AND PULSE CHART.

**Date:** 6/16/19

**Time:** P.M.

**Blood Pressure:**
- Systolic: 170mm Hg
- Diastolic: 100mm Hg

**Pulse:** 90 beats per minute

**Notes:**
- **Name:** John Comar
- **Age:** 69 years
- **Disease:** Lobar Pneumonia
- **Diagnosis:** Death
February 2nd, when it began to drop, and from the morning of February 3rd kept at 100.6°F. until the night of February 5th when the crisis occurred.

**Remarks:** On day of admission the pulse rate was above the blood-pressure. A steady fall in the former resulted, on the second day, in a change of the position. On February 3rd and 4th pulse and blood-pressure both rose, and on February 4th they were at exactly the same level, but at no time did the pulse rate become above the blood-pressure.

Following the crisis there was a distinct fall in the blood-pressure.

---

**Case 38. - Death.**


**History:** Day before admission to hospital began to shiver, and felt short of breath.

On admission: Temperature 103°F., pulse 105 per minute, respirations 36 per minute.

Pneumonia of right lower lobe. Arterial coats thickened.

February 17th: Face became very cyanosed, and left lower lobe also solid. Died at 12 midnight.

**Treatment:** On admission given sulphuric spirits of ether and ammonium carbonate. February 17th: Brandy two drachms every two hours.

**Remarks:**
Remarks: The blood-pressure for a man of the patient's age and condition of arterial walls, was low for the first three days, and although above the pulse rate, a good prognosis was not warranted. This is the one case which supports the statement that a sudden rise in blood-pressure means a complication.\(^{(1)}\) The sudden rise on February 17th is synchronous with evidence of pneumonia in the opposite lung.

---

Case 39. - Death.


History: February 19th: Rigors, and pains in the right side of the chest; cough and vomiting. Is a hard drinker.

On admission: Nasal herpes. Temperature \(102^\circ\text{F.}\), pulse 120 per minute, respirations 36 per minute.

Pneumonia of left upper and right middle lobes.

Temperature fell down to \(100^\circ\text{F.}\) on morning after admission.

February 24th at 2 p.m.: Temperature dropped from \(99^\circ\text{F.}\) to \(97^\circ\text{F.}\); became very collapsed and blue; died at 4 p.m. February 24th.

Treatment: On admission: Brandy, two drachms, every two/

two hours. February 24th: strychnine hypodermically (gr. 1/60th) every two hours.

Remarks: A case of pneumonia in an alcoholic patient in whom a sudden fall in temperature is associated with a fatal collapse.

Before death there was a marked fall in the blood-pressure.

Up to the evening of the day previous to death the pulse rate was below the blood-pressure, but at 10 a.m. the reading showed that the pulse rate had risen and the pressure fallen, so that the blood-pressure became below the pulse rate.

This change in the positions was followed by a sudden collapse, warning of some disaster being given by the pulse rising above the blood-pressure.

Case 40. - Death.

Job Broadhead. Age 64. Admitted 23.2.13.
History: Fourteen days ago fell down and hurt right side, and has had pain in right side of chest ever since.

On admission: Temperature 100.8°F., pulse 110 per minute, respirations 36 per minute. Arterial coats calcified.

Pneumonia of right upper lobe.

Treatment: On admission: Brandy, two drachms, every two/
two hours. At 10 p.m. February 23rd: Strychnine (gr. 1/60th) hypodermically every three hours. Died at 12 midnight.
Remarks: The patient only lived eight hours after admission.

The blood-pressure was much below normal, and far below the pulse rate. The prognosis given by this most unfavourable position was quickly justified.
SUMMARY OF CASES.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age</th>
<th>Relation of Blood-Pressure to Pulse Rate</th>
<th>Result.</th>
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</tr>
<tr>
<td>2</td>
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<td>Recovery</td>
</tr>
<tr>
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</tr>
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</tr>
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<tr>
<td>40</td>
<td>64</td>
<td>Below</td>
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</table>

SUMMARY/
SUMMARY.

IN my opinion the result of the observations carried out in the series of cases described in the thesis, fully proves the great importance of a regular and careful estimation of the blood-pressure during the progress of a case of lobar pneumonia.

Whilst my results do not altogether agree with those obtained by some of the observers on the same subject, they no less emphatically point to the value of the sphygmometer both as a prognostic agent and a therapeutic indicator.

I find that the crisis is practically always followed by a slight fall in the blood-pressure, although such a fall may be quite temporary.

If the blood-pressure in millimetres of mercury is above the pulse rate in beats per minute, it is by no means certain that a recovery will result.

But if we exclude patients in the higher ranges of life, and those in whom, owing to arterial or nephritic disease, we expect a hyper normal pressure, then, as a general rule, we may say that when the blood-pressure in millimetres of mercury is above the pulse rate in beats per minute, a favourable termination to the case may be expected.

On/
On the other hand, when the blood-pressure is below the pulse rate, this is not to be regarded as an infallible warning of death. In children certainly this is not true, and in many other cases recovery has followed in spite of the above position being recorded.

But when the blood-pressure in millimetres of mercury is far below the beats per minute of the pulse, then a very hopeless outlook is foreboded.

I would especially lay stress on observing the variations in the relation of the blood-pressure to the pulse rate during the illness: and with regard to this the following rules may be laid down: - That a rising pulse rate accompanied by a falling or stationary blood-pressure; or a falling blood-pressure with a rising or stationary pulse, is to be looked upon with gravity as a sign of impending cardiac failure.

In other words, it must be looked upon as serious when the blood-pressure which at first is above, begins to come closer to the pulse rate; and if the original position becomes changed then very grave danger is indicated.

This fact is fully borne out by many cases in the present series.

The converse is equally true - i.e., that where the blood pressure is at first below but later becomes nearer and finally above, the pulse rate, a hopeful view may be taken.

It follows that if the sphygmometer readings point/
point to impending or threatened cardiac failure, steps will be taken to stimulate the heart. In this way, then, the regular recording of the blood-pressure and the comparison of its height with the rate of the pulse, will indicate the necessity or otherwise of therapeutic measures of cardiac stimulation.