The Relation
Between
Cardiac and Pulmonary Disease
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The Heart and Lungs are by far the most important organs in the body, being the most essential to life. If, without causing excessive hemorrhage, we remove any of the others, even the brain itself, the animal will continue to live for some, it may be for a considerable, time. But if we remove the Heart or Lungs, or place them in such a condition that they can no longer carry on their respective functions, it instantaneously dies. And yet, they are by no means, the most complex organs of the body. The function of the Heart is merely mechanical, that of propelling the blood through the Lungs and System.
And the sole object of the lungs is to exert a chemical influence on that blood, changing it from venous to arterial. To what then is their importance due? Surely to that fluid which is wholly dependent upon them. But how comes it, that the blood is so all-essential to the vital economy, that the moment its function is arrested, death takes place? It is difficult to conceive how this can be explained, if we believe that the sole function of the blood is to nourish the tissues, and to carry away effete matter. If this were all, its interruption would certainly cause death, but surely not instantaneously.

But another, and far more important function of the blood is the production of Nerve force, which is now generally allowed to be produced by the chemical action which takes place in the change of Arterial into Venous blood. It is the prevailing opinion that this function is performed...
only in the Nerve centres, and that from thence, the Nerve force is distributed throughout the body. But it is more probable, as has been suggested, that this nerve force is generated, not merely in the Nerve centres, but wherever the change of Arterial into Venous blood takes place. The force thus produced, is taken up by the extremities of the different nerves, and after a longer or shorter circuit, is returned to the same point, thus forming a constant circulation of Nerve force in every part of the body.

This Nerve influence, kept up by the circulation of the blood, is absolutely essential to, or may even be said, to constitute, life. The stoppage of the circulation, and consequent interruption to the chemical action, and evolution of Nerve influence, will cause instant extinction of life, in the same manner, as the removal of the metallic plates, from the acid fluid, in the Galvanic battery, instantly stops the evolution of electricity.
I must apologize for having dwelt
so long on this comparatively extraneous
subject, but I considered it necessary,
in order to explain the importance of
that, which it is the object of this
proper to consider.

However we explain it, there
 exposition of properly arterialized
blood, is indispensable to the continuance
of health. And that this is wholly
dependent on the heart and lungs. How
important then are the diseases of either
of these organs, but still important are
their combinations, which occurs but
too frequently, as we wont be led to
expect, when we consider the intimate
relation which exists between the
functions of these organs, and how
dependent the one is on the other.

On entering on the consideration
of this subject, let us first trace the
blood in its passage through the
heart and lungs.
After passing from the venous cavity into the right auricle, and from thence into the right ventricle, the blood is forced by the contraction of the heart, through the pulmonary arteries into the lungs. Here, by the ramification of the capillaries, which surround the air cells, it is brought into contact with the inspired air, by which it is arterialized. It is then collected by the pulmonary veins and conducted by them into the left auricle and ventricle, from which it is propelled through the system.

Thus so long as health is retained, this circulation is kept up with such perfect smoothness and regularity, that we are unconscious of its existence. But should anything occur to interrupt the flow through either organ, it is evident that the other must suffer, giving rise to various unpleasant, painful and dangerous symptoms. Dr. Wardrop says, "If we examine the phenomena of life, every perceptible..."
alteration in the functions of one of these two vital organs, will be observed. When followed by some modification in the functions of the other." And we require to turn our attention, not always to the most prominent symptom, or to the organ apparently most affected, but to the original exciting cause, whether it exist in the heart or lungs. In some cases of heart disease, however, we can do more good by directing our treatment to the lungs, than by attempting to act directly on the heart itself. Thus engage to quote Dr. Latham: "The lungs are the most frequent seat of effusions and congestion, hemorrhage and inflammations, which are the result and concomitants of an unsound heart, and the lungs are the chief scope of medical treatment, from time to time in many cases, and even the sole scope, from first to last, in some, of unsound heart." In many cases of disease of the heart, the most prominent symptoms, and those which first attract the attention,
of the patient, are to found in the lungs. "It would be difficult," says Caltham, "to over-rate, as guides to practice, of the signs which declare themselve, through the medium of the lungs, in every case of unknown heart." How important it is then that we should be thoroughly conversant with the diseases of those organs, and ready to guard against their complication one with another.

Before the invention of percussion by Auenbrugger, and the still more brilliant discovery by Spennar, we could tell little or nothing about the diseases of the heart during life, and our acquaintance with those of the lungs was very limited. Now however there is no class of diseases, of which our diagnosis is more certain, and our knowledge more extensive. By the help of the stethoscope and percussion, we can tell what lesion has occurred, almost as certainly, as if the organ were laid open before us."
This subject naturally resolves itself into three subdivisions. First—Diseases of the lung commencing at the heart. Second—Those of the heart commencing at the lungs. And third—Those in which both organs are simultaneously affected, by the same exciting cause. The first of these, is the most numerous, as there are few diseases of the lungs, which may not be occasioned by disease of the heart. The second perhaps includes only two morbid conditions. And the third is very limited.

Let us begin with disease of the lung, dependent on some morbid condition of the heart.

The lungs are capable of containing much more air, than is taken in at an ordinary inspiration. So also are they capable of containing a larger amount of blood, than is usually sent to them by the heart. This is taken advantage of, in the economy, to prevent overloading of the heart, when anything
tends to accelerate or obstruct the circulation. Thus, after unusual bodily exertion, which causes venous blood to be returned more rapidly to the heart, than the lungs are capable of arterializing it; the heart instead of retaining the extra blood, and thus becoming engorged, is excited to increased action, and forces it on to the lungs, where it is, as it were, stored till the increased capacity of respiration enables it to become arterialized, and returned to the heart. This overloading of the lungs, is the cause of the disagreeable sensation, when we are said to be out of breath.

This capability of containing a larger amount of blood than usual, M. Harorof names the Pulmonary cardiac function, and a most important one it is, as it saves the heart from what might otherwise be fatal engorgement. But although salutary in general, yet when carried to excess, it is the cause of most of the diseases of the lungs.
arising from the heart.

When there is lesion of the mitral or aortic valve, the blood, prevented from leaving the heart with its accustomed ease, is partly retained in the lungs, and causes congestion of these organs, and the disfigurement commonly attendant on heart disease. This engorgement of long continued, as it generally is, gives rise to other and more serious complications. Its first effect is to cause edema by the exudation of liquor sanguineus, which, being infiltrated into the bronchi and air cells, cells fill them up, and diminish the extent of surface to which air is admitted. It lessens also the capacity of the lungs for containing blood, till they are unable to receive that which is sent to them, except in part kept ealledceed by the auxiliary muscles of respiration. This is a frequent source of asthma, and that of the most severe and fatal kind. Dr. Hope says: "I have never seen a patient suffer..."
suffer such intense and suffocative
agony, as in the variety of (of asthma)
from organic disease of the heart."
The paroxysm generally comes on when
the patient is asleep. Whilst slumber-
ing tranquilly, he starts up and begins
to struggle with violence. This may be
explained by the fact, that to allow
the blood to pass freely through the
lungs, the auxiliary muscles of respira-
tion require to be brought into play, but during
sleep, the stimulus of want of breath being
less felt, the muscles of respiration are
consequently less excited. Inspiration
is the principle force in returning the
blood to the heart, and in cases of
obstructed left side, it requires to be
assisted in the way already mentioned;
but during sleep, the muscles do not
act so forcibly, and the consequence is,
that there is partial stagnation in the
lungs, producing the paroxysm of violent
breathing to relieve them, by forcing the
blood onwards to the heart, which at
the same time is excited to increased action.

Chronic bronchitis is particularly apt to supervene in cases of obstructive disease of the left heart. An habitual state of congestion of the mucous membrane of the bronchi, with some shortness of breath and expectoration, and crepitation in the lower part of the lungs, are the symptoms of this affection. It is frequently to be met with in old persons, and is apt to give rise to peripneumonia thorax, and this again to pneumonic proper.

A case illustrating all these states, is related by Dr. Bristowe. Although there was no actual disease of the mitral valve itself, it was kept from closing by the chordae tendinæ, which were on the stretch thus allowing of regurgitation.

The patient was a Pottery aged fifty six. "He had been ill for about two years, but much worse for three months. His illness had consisted in cough, hoarseness and great dyspnea." The post mortem examination, showed the lungs to be
"Auscultation, conjugated and sparsely expectorated in the greater part of their extent, but carcinized and airleap below. The bronchial tubes were conjugated and contained a large quantity of mucous purulent pleuris. The left ventricle was dilated and hypertrophied, the aortic orifice competent, but the mitral valve modified as above described.

When pneumonic supervenes on a habitual state of this kind, it generally proves rapidly fatal; for as C. Watson says, "in their ordinary condition, the patient have just enough and no more of respiratory apparatus in an effective state, whereby to subsist; and when a fresh part of it, is rapidly rendered solid and useless, they rapidly perish."

Pleurisy and hydrothorax may be caused by the evacuation being poured into the pleura. No permanent good is to be obtained in hydrothorax, its arising by tapping as it is sure
Pulmonary hemorrhage with hemoptysis is a very frequent accompaniment of heart disease, caused by the congestion we have been speaking of. Next to phthisis, disease of the heart is the most frequent cause of hemoptysis. The hemorrhage occurs, according to the experience of Dr. Malthe, not from the mucous membrane, but from the parenchyma of the lung, which gives way molecularly. What are the causes of this hemorrhage? Clerc and others consider it to be owing to hypertrophy of the right ventricle. This Dr. Watson denies ever to be the case and says that "the statement is as little supported by reason, as it is by the result of general experience." That the hypertrophy would not suffice for the production of hemoptysis, even if it did often exist, and that "the direct effect of any obstacle to the free passage of..."
the blood in the right chamber of the heart, would be to gorge the liver
and the system of the aencia ports, and to prevent the lungs from receiving
their due proportion of blood.

But although it be true, that
obstruction in the right chamber of the
heart will not produce congestion in the
lungs; yet if an obstruction be situated
within the lung, then those parts which
are still pervious, will necessarily become
congested. Perhaps I may be allowed
to introduce a rough diagram to enable
one to explain my meaning.

Suppose it to represent one
of the pulmonary arteries
with its ramifications. If
one of the branches, (1) were
becoming impervious by an occlusion,
as shown at (4) it is evident, that,
even in the normal state of the heart,
the force of the blood through (2 & 3)
must be considerably increased. But
by the difficulty to the circulation, the
right ventricle is hypertrophied, in order to overcome the obstacle. If its increased force acted only on the obstruction, it would do no harm; but it acts as forcibly on (2+3) as on (1) and they being free, the force is carried to the minute vessels and capillaries, which, unable to withstand the increased pressure, give way and the blood is extravasated. Of course, I am only supposing a case, as I have had no opportunity for making practical investigations on the subject; but may not this explain the hemorrhage which takes place in pneumonia? The exudation, by pressing on the vessels, may act as the obstructing agent. It is said that pulmonary hemorrhage is not often found associated with disease of the right chamber of the heart, but this may be explained by the fact, that the causes producing the hypertrophy are usually temporary and, on their disappearance, the
Heart regains its natural dimensions.

There can be no doubt that pulmonary hemorrhage, and pulmonary lesions of all kinds, are much more frequently associated with disease of the left side of the heart. And this is to be expected, owing to the greater number of lesions which will give rise to them. But the cause here is simply that of mechanical obstruction. The force of the heart can never influence directly on the pulmonary vessels; but, we can suppose, that, in the case of mitral insufficiency, the impulse will be carried backwards through the auricle and pulmonary vein, into the lungs, which, to say the least, is not very probable.

The lesions of the left side of the heart, which may give rise to pulmonary hemorrhage, are mitral insufficiency, mitral obstruction, aortic obstruction, dilatation, and softening. All of
these act in the same way by mechanically obstructing the return of blood from the lungs.

Pulmonary apoplexy is very frequently associated with heart disease. Dr. Watson concludes, that the relation can only be secondary, and describes it as an accident of hemorrhage. "The blood," says he, "is suddenly poured into one of the larger bronchi, causing great difficulty, and in the compulsory efforts to breathe, it is forced backwards into the ultimate bronchi, with such force as in some cases even to rupture the tissue of the lungs. In others it is firmly impacted, forming the round compressed masses, found in the lungs after death. This is a very plausible theory, and accounts for the trouble in some instances; but it can cause it only when, as he says, the
Blood is forced suddenly into one of the larger bronchi, and this, according to Dr. Walche, is seldom the case, indeed never happened in this experience. But why may asphyxia not occur from hypertrophy of the right ventricle, in the way I have described? We have the force of the heart there acting as vir recta, and ramming it home, as it were, without the necessity of any paroxysm of dyspnoea. This agrees also with the theory of Andral, that the sanguine affinor takes place in the alveolar cell. If slowly, as with it may cause the uncircumscribed variety, by gradually passing from one lobule to another, becoming less dense as it recedes from the point at which the force is exerted.

Pulmonary apoplectic may occur as a consequence of softening of the heart. S. Hope relates...
relates two cases, and states that he has met with it in several others. He thus accounts for it: "It is produced on the same principle, as when it results from great dilatation of the mitral valve; namely, a powerful obstacle to the transmission of blood out of the lungs to the left side of the heart. The obstacle here consisting of the weakness of the organ, and its consequent inability to propel its contents." Pulmonary apoplexy may give rise to gangrene of the lung, which may therefore be said to be caused, though very indirectly, by disease of the heart.

Inflammation of the heart, or Pericardium, may by their proximity, cause a like inflammation of the pleurae or lungs, which may prove a dangerous complication, and one that ought to be carefully guarded against.

This concludes the
first division of my subject. It includes by far the most numerous, if not the most interesting class of cases. It is of great importance, as affording means for diagnosis, and scope for treatment in many diseases of the heart, although in the present state of our knowledge, there is generally little to be done, except in the way of amelioration.

We have now to proceed to the second division, namely, disease of the heart, caused by some morbid condition of the lungs. This class is far from being uninteresting or unimportant. Indeed no lesion of these organs could be so, especially when the heart is implicated.

As in the lungs, so in the heart, the principal cause of disease is obstruction to the blood leaving the organ. One great difference between this class and
the one we have already considered, is, that, whereas in the first, it was generally the left side of the heart which was diseased; in this, the right side is more frequently implicated.

On the right heart is thrown the burden of propelling the blood through the lungs, and any obstruction to its passage gives rise to hypertrophy, or it may be dilatation of its chambers.

Dilatation and hypertrophy are the only lesions likely to arise from this cause; they generally occur together, and are commonly associated with disease of the left heart. The lung, in these cases, as we have seen, becomes edematous and consolidated in a considerable part of its extent, thus offering an obstacle to the passage of blood, and consequent hypertrophy of the right heart; and this I think, in its turn, may cause hemorrhage from the lung.
Emphysema is by far the most frequent, as well as the most serious, because permanent, cause of dilatation and hypertrophy. As the air cells become dilated, the capillaries which surround them become elongated, and their calibre consequently diminished, till the blood globules are no longer able to pass through them, and at length they become obliterated. If this take place to any considerable extent, it must evidently cause obstruction to the flow of blood. The consequence of this, is to produce increased action of the right ventricle, in order to overcome the difficulty. Under the increased strain put upon the walls of that chamber, they may yield and to become dilated. This will more likely be the case, if the obstruction occur suddenly, before the heart has time to accommodate itself.
itself to the extra amount of work it has to perform. This dilatation is of itself a source of difficulty, tending to its own increase, and to hypertrophy. In fact dilatation can scarcely be of long standing, without hypertrophy supervening to a greater or less degree, unless the system be in a very debilitated condition, and the vital powers insufficient to compensate for the increased waste of the tissue.

If the obstruction come on more slowly, dilatation is not so apt to occur, as in that case, the muscular walls increase in thickness and strength, according to the greater amount of force required, and are thereby enabled to resist the tendency to dilatation.

Dr. Stokes in his admirable work on diseases of the chest, accounts for the cardiac complications in emphysema in three ways
ways. First, he says "we find the chest in a state of permanent
dilatation, which is little affected
by respiration; this must cause
accumulation of blood at the
right side of the heart, (and con-
sequent disease of its pulmonary
cavities)." Under these circumstances
the muscular parietes of the heart,
become hypertrophied, and an
active aneurism of the auricle and
ventricle is produced."

The second cause according
to him, is, that the presence of the
enlarged lung "must act directly
in impeding the circulation
through the pulmonary artery
and its ramifications," thereby
causing hypertrophy of the right
cavities.

The third is, that "the
heart itself is under the influence
of abnormal pressure." Between
the distended lung on the one
C. Howe
and the dilated abdomen on the other. Thus, the dilatation and contraction are intermixed, causing hypertrophy of the whole organ. Dr. Williams again describes cardiac disease, in cases of emphysema, to prepare on the thoracic vessels, caused by the increased amount of muscular power in endeavouring scarcely to depress the ribs.

It is probable that all these causes act more or less, in all cases of emphysema. What wonder then that the heart should be diseased? and as we would expect, it rarely escapes. This accounts for the frequency, with which heart symptoms are found in asthmatic patients.

Dr. Southam says: "According to my own experience, the subject of asthmatic disease furnish the most frequent instance..."
of dilatation of the heart from causes seated in the lungs."... Gairdner says, that dilatation of the heart may be caused in the same way as the dilatation of the air cells, namely, by the expansion of the chest, when part of the lungs, from collapse or other causes, are unable to expand in a corresponding degree. It is easy to understand how this will cause dilatation of the air cells, as they communicate into the atmosphere, and the air they contain, is under the influence of its pressure. But the heart is filled with a fluid, scarcely, if at all, influenced by the pressure of the atmosphere, contains no air, and has no direct communication with the atmosphere. On these grounds, with all deference, I cannot help thinking, that dilatation could not be caused in this way.

Hyper trophy and dilatation
of the heart, may be caused in phthisis by indurations, obstructing the blood vessels, and acting in the way already described. Dr. Walke says, that in tubercular disease, the heart may be displaced by atmospheric pressure, thus in tubercle of the left lung it will be drawn, or rather pushed upwards, by the expanding lung, and in tubercle of the right lung, it will be pushed to that side. This can only make good, when there is diminution of the lung, which is not in every case, but where cavities have enlarged, then will probably be the displacement I have mentioned.

Pleuritic effusion will also cause displacement by direct of the heart, by direct pressure; thus in effusion of the left side, it will be pushed over to the right, and in effusion of the right side, it will be pushed to the left. On the absorption of the pleuric, if the disease was
not been of long standing, the heart will regain its natural position. And if it has been long displaced, adhesions are likely to be formed, which will retain it in its abnormal position. Again, if adhesions have not taken place in the chest, they may have done so in the lung, preventing it from expanding, in which case, the heart will be pushed to that side, by the expansion of the opposite lung. There is a case at present in No. 1 Ward of the Infirmary, of extensive pneumo-thorax of the left side, in which the apex beat of the heart is seen and felt under the third rib, whether the displacement be due to the distended state of the pleura, or to some other disease of the lung itself, cannot be ascertained, the state of the chest, preventing any examination of the left lung. He has marked clubbing of the nails, although his appearance generally,
is not such as to indicate phthisis. 

In all these cases of displacement of the heart, there is apt to be obstruction to the flow of blood through the vessels, from their being stretched or twisted. This will necessarily cause hypertrophy of the organ, and it may be dilatation. Or it may be forced into such a position, that its action will be interfered with, in which case also there will be hypertrophy. In phthisis we often find the heart diminished in size, owing to the reduced quantity of blood.

The pericardium, on account of its proximity, is apt to be excited to inflammation, by diseases situated in the lungs; thus pleurisy and pericarditis, are often associated. Phthisis, Cancer, and other diseases may in this way also be the exciting cause of pericarditis.
The third, and last division of my subject remains to be considered, namely, those cases in which the lungs and heart are simultaneously affected, by some morbid condition of the system.

The most important condition thus affecting both organs is Acute Rheumatism. In fact this complication is what we most dread, and seek to guard against, in the treatment of that disease. The heart is particularly liable to become affected, and the lungs, although not so frequently as the heart, are in many cases complicated.

Dr. Latham collected the statistics of one hundred and thirty six cases, showing the relative frequency of cardiac and pulmonary inflammation. The heart he says was inflamed in 90, or two thirds of the whole, and the lungs in 24, or one in five. These twenty four were made up of 4 cases of Rheumatic.
18 of pneumonia, and 2 of pleurisy. Of the 46 cases in which the heart was not affected, the lungs were inflamed only in five, or one in nine but of the 90 cases in which the heart was inflamed, the lungs also were affected in 19 or once three one in five. In the 90 cases of heart disease, 63 were cases of endo-carditis. In them the lungs were inflamed in 7 or one in nine – 9 were cases of pericarditis, in which the lungs were affected in 4 or one in two. In 11 other cases, both, endo and pericardium were inflamed, and of these no less than 8 were accompanied by inflammation of the lung. From these statistics, Satham draws the following conclusions: "We find it to be between inflammation of the pericardium, and inflammation of the lungs, and between endo-carditis and peri-carditis, most inflammation occurring simultaneously."
In the same subject, and inflammation of the lung, that frequent coincidence seems to establish a natural connection.

In scrofulous persons, tubercles may be deposited in the heart and lungs at the same time. The effect of these on the lungs, need not be here described, since, in the heart, they produce ulceration and softening, which, in such an important organ, are of the most serious import.

Cancerous depositions are also liable to occur simultaneously in the heart and lungs. Cancer rarely exists in the heart, without a similar production in other organs, and of all these other organs liable to suffer along with the heart, the lungs are the most frequently implicated.

John Strachan
6 Brighton St. John