

AN ADDRESS

ON THE

BEHAVIOUR OF FLUID IN THE CHEST AND THE TREATMENT OF EMPYEMA :

WITH SPECIAL REFERENCE TO THE VALUE, AS AN OPERATION,
OF REMOVAL OF RIB.

Delivered at a Meeting of the South-Eastern Branch at Gravesend.

By JAMES F. GOODHART, M.D., F.R.C.P.,
Physician to Guy's Hospital.

THE subject of my paper this afternoon is empyema, and the behaviour of fluid in the chest. It is an interesting and a large one, and treated—as I shall necessarily have to treat it—in a somewhat cursory manner, many points must remain untouched. And, first of all, it occurs to me to say—although I must not dwell upon so speculative a matter—how interesting, and withal important, a question is the process of the pouring out of fluid. How comes it that fluid is so rapidly effused, and sometimes as rapidly absorbed? Where lies the difference between the latter case and those where week after week goes by before the natural conditions are replaced?

We cannot tell; yet behind the answer lies a much more precisely directed treatment, for did we but know what was likely to be the course of a particular effusion, so we could the better say, this case for absorbents, that for aspiration. As it is, the patient is often the sport of the medical man's available energy. That early aspiration is the thing in pleuritic effusion is the outcome of the raw robustness of medicine with a lean to surgery. This leads me to say that some hold that an empyema is the outcome of serous effusion in the majority of cases. Fraentzel, in Ziemssen's *Encyclopaedia* says: "we must now, therefore, regard it as an established fact that primary purulent pleuritis is of extremely rare occurrence." Pathologically, this may be, perhaps, true; in practice it is most misleading. If we tap a pleuritic effusion in the first week, the fluid may possibly be of somewhat equivocal appearance. A storm of effusion necessarily means free dilution of the corpuscular part of the disease. But, unless you can show that a would-be empyema can be arrested in the serous stage, there is no point in the assertion; and this cannot be shown. Whereas, on the other hand, it can be shown that pus forms with great rapidity; that some serous effusions are by no means deterred from becoming empyemata by preliminary tappings; and that many serous effusions remain for weeks and months in the pleura, and never became purulent, unless, perhaps, after an ill-conducted aspiration.

That an empyema is no mere act of apostasy on the part of serum, I will instance—and only instance—the well-known fact that empyema is much more common in children than in adults. Empyema is not common in adults. I should think two or three cases a year would be more than a full average in my wards at Guy's; whereas, in any children's hospital with an equal number of beds it is as common as possible. What is the reason of this? Surely one cannot be far wrong in attributing it to the intensity of reaction in growing tissues to inflammatory irritation, to the rapidity with which cells grow, and to the greater sensitiveness in young life to sudden changes in their environment. Old age is callous, and one may well suppose that there comes a time to endothelium when it resembles the old and well-worn cab-horse, which takes repeated imprecatory flagellations without seeming to mind them, and certainly without any appreciable increase of its pace. It is a little different with the unbroken colt. In children, inflammation of the pleura is often associated with a most active formation of lymph, and being so, there must necessarily be much risk of this material degenerating and forming pus. And there cannot be a doubt that this is the explanation of many a case of empyema. Let me just indicate the practical bearing of this. In the first place, when the abscess is opened, this lymph is liable to block the tube and prevent the evacuation of the pus; it may lead to loculation of the cavity, and thus prevent complete drainage; and it may also—although I do not think as much of this as some would—contract round the lung and prevent its re-expansion.

Therefore it should always be an object to get away as much of this as possible; and, in passing, this is best done, in my opinion, not by

washing out the pleura, but by having as free an opening as possible. In the second place, this corpuscular development being unusually rich in childhood, the fluid of an effusion may be turbid, and yet not be incapable of absorption; and I have seen several instances where a consideration of this kind has led to the adoption of simple aspiration rather than incision, and with success. I think it possible that some, at any rate, of the recorded cases of empyema cured by simple aspiration have been of this sort. At least I doubt whether an equal number of ordinary abscesses could be found recorded as cured by the same means.

But, turning now to the behaviour of fluid in the chest, it seems to me that incomplete knowledge and inefficient treatment have resulted from the too precise statements made in text-books. For example, in any case of pleurisy we expect the dulness, absence of respiration, of tactile vibration, etc., at the base of the lung; and we draw a line round the chest at the particular spot, and say there is the water-line; and we watch it, as we suppose, in the daily rise and fall. And if, further, it should be a case where we deem it necessary to tap, we guide the operation in accordance with that line. This is all right as far as it goes, but, as regards the position of the fluid, the knowledge that is thus obtained is very inefficient. At least I shall venture to say that it is no uncommon experience to put in an exploring needle with these indications for a guide, and to find nothing come out. It is an old observation that if, in children, you wait to tap until you can find a spot where dulness and absence of respiratory murmur meet, you may often wait until Nature or some better informed man wipes your eyes. It is common enough that one draws fluid from such part of the chest as is apparently filled with air in inspiration, and gives clear resonance on percussion. The explanation of the fact may perhaps be that a good deal of fluid is required to damp the vibrations of the thoracic wall, or to drive out all the air and to produce dulness and complete absence of respiration. The respiratory sounds, too, may be transmitted by neighbouring lung. All this I admit; but then, on the other hand, the admission is to some extent counter-veiled by another well-known fact—that many of the physical signs indicating fluid are produced by a quite moderate quantity. I have repeatedly seen a large part or the whole of the lower lobe of the lung quite airless when the amount of fluid has been no more than five or six ounces.

Well then, again, how great is the impairment of movement of the affected side in most cases of pleuritic effusion. It always seems to me that this is far more in many cases than can be explained by the existing amount of fluid, and more by far than a simple dry pleurisy effects.

An allied phenomenon is what is called Skoda's tympanitic resonance, one of the most valuable sign-posts in existence. It points to a generally impaired resonance all over the affected side, and whether you deem it to depend upon the diminished volume of air contained in the lung under the part percussed, or to diminished vibration of the thoracic wall, the diminished resonance is not adequately accounted for by so small a quantity of fluid as will often be found to exist at the base of the lung.

Now these various phenomena are, it seems to me, fairly well explained by supposing that the fluid does not persistently occupy the base of the chest by the force of gravitation, but is more or less drawn up or pumped up or spread over the lung by the inspiratory expansion of chest-wall and lung, and varies therefore from time to time, according as the inspiratory force is weak or strong in this part or in that.

I think it may fairly be said that in pleuritic effusion, the lung is placed upon a water-bed, and just as in a water-bed the water recedes from such parts as are subject to most pressure and accumulates for the time being elsewhere, so in the pleura there is more or less displacement under the inspiratory forces, and the water covers more or less of the lung. If the fluid be in small quantity it may be spread all over the surface; if in large amount, then such parts as have most free play will best allow of the continuance of lung-expansion, and thus displace the fluid to less favoured positions; and in these no doubt there will be a tendency for the fluid ultimately to be permanently located.

To my mind this supplies a satisfactory explanation of the extent of the dulness—the greatly impaired movement, met with in so many cases; of the existence of fluid in places where, from all the physical signs obtainable, it could not have been predicted, and we are prepared to be cautious, even if we lack the experience which certainly will make us so, as regards confidently affirming the existence of fluid at the base, because of such signs as dulness to percussion.

Lung collapsed from disease is a potent cause of dulness; and, given the existence of a small amount of fluid hampering the expansion of

the lung, the base will undergo most collapse, not altogether because the fluid accumulates there, but because under all conditions of restricted action it is the less expanded, and the surrounding parts close in and make for complete airlessness. This hypothesis enables us also to see very well that in old people, with but little inspiratory power, and with impaired movement of the chest from senile changes in the cartilages, etc., a small quantity of fluid will produce an extreme amount of collapse; and the fluid will, in the absence of adhesions, be located at the base. Old people live much in the attics of their lungs, and find them, unfortunately, too often but garrets unpleasantly near the sky. The vigorous, on the other hand will stand a good deal of fluid in the chest without the occurrence of any marked collapse.

This is, however, not the whole of the matter. Experiments have been made by Dr. Garland, of Boston, Massachusetts, upon dogs, which go to show that the fluid accumulates according to a particular curve. The experiments were upon dogs which were suspended by their heads, and their pleuræ then injected with either plaster-of-Paris or cocoa butter. I need hardly say that the results of such proceedings must be taken with a considerable amount of qualification. But Dr. Garland found that the lung was smaller in volume, having contracted before the encroaching fluid; but with medium-sized injections it was nowhere compressed or plunged into fluid, as we read in text-books. The cast all lay between the lung and the diaphragm. "In other words," he says, "instead of the fluid compressing and deforming the lung, as we are taught, I found that the lung retained its own outline, being merely reduced in volume, and that it dictated shape to the fluid." Dr. Garland attributes this storage under the diaphragm to what he terms the retractile force of the lung, and I should certainly suppose that the expiratory forces are as active as the inspiratory, within their limits, in modifying the position of the fluid.

Now all this upon the behaviour of the fluid I mean to lead up to the very practical question—what happens when we open an empyema? It seems to me that the generally received doctrine may be put in this way. A hole is made in the chest-wall, the natural vacuum is destroyed, the lung becomes collapsed, and it becomes a simple question of draining a barrel, while closure of the cavity has to take place by means of the gradual retraction of the inflammatory material formed in the pleura, and by granulation from the bottom, as in an ordinary abscess. And this is so sometimes, but when it is, the outlook is a bad one for the patient. He is likely enough, and quite properly so, to come chiefly within the province of surgery, and to have his ribs battened in by the excision of an inch or two of from two to six of them. Then possibly, between the clouds, he may be seen at one of the medical societies as a cure, and then, in due course of time, he will succumb to lardaceous disease. I state it thus to impress what I believe to be the fact. Empyemata, with free entrance and exit of air, are mostly bad cases, and although they may be relieved by such measures as I have spoken of, sinuses generally remain, and there is a great risk of the supervention of lardaceous disease or phthisis. But this is, happily, not the average condition when an empyema is opened. If we watch a few we soon see that it cannot be so, and for this reason, that the patient begins to breathe with the implicated lung within a very short time of the chest being opened. I should say that this is so in the majority of cases in children, and I say in children first because empyema is one of the special experiences of childhood, as I have already said and you well know; and because, for the most part, the empyema is more recent, and, therefore, more favourable a case than in adults. In adults, phthisis and all sorts of morbid conditions in the lung itself interfere with the more normal condition. Hence one must make a difference. Therefore, I say that in the majority of empyemata of children, directly the pus is let out, the lung begins to act again more freely. Well, but you say, how can it? You have put in a drainage-tube, and let air into the pleura, and thus collapsed the lung. I have, however, done nothing of the kind, at least so I maintain. When you pass a catheter into the bladder you let out the urine, but the bladder does not fill with air. As the urine flows out the walls close in, and the parts are as air-tight at the end as at the beginning.

There seems to be a sort of idea abroad that by opening the chest you inevitably fill the pleura with air at every movement of respiration, but it is not so if the lung is in anything like a healthy state. If it is bound down by very old tough adhesions no doubt this does happen, but in recent cases, directly the pus is let out the tension is relieved, and there is a rush towards the opening; the ribs fall in a little, the diaphragm goes up, the mediastinum yields, the other lung somewhat also, and all the parts press shoulder to shoulder, in the same way as the surrounding parts drop down as the bladder contracts

when the urine is voided, and the vacuum is never totally destroyed, even by the inspiratory act. We interpret all our facts so much in accordance with preconceived or pretaught notions; and no doubt when we have to deal with an empyema after opening, and hear the sniffling in and out of the air at the opening, in accordance with the respiratory movement, it is easy to conclude, albeit as I contend too hastily, that the air is going in and out of the general pleural cavity. In the same way we pass in several inches of drainage-tube, and could pass several feet for that matter if we wished it; and we may, perhaps too hastily, think what a huge cavity is here! But the exact state of affairs is this. Just round the opening there is more or less space into which air enters freely; of course, during inspiration so much of the cavity is opened no doubt; elsewhere, the pleural surfaces are still in contact. They can, of course, be separated when we pass in a tube, but pull out the tube, and the passage it made for itself disappears again, and it has entered no cavity whatever, if by that we mean a gaping space. If all go on well adhesions form all over, except just round the opening or along the sinuses more or less, and the parts are then nearly sound again, and respiration soon goes on fairly well.

There are some points about pneumothorax which I think tend to corroborate these statements very strongly. It is said, and it quite coincides with my own observations, that pneumothorax is decidedly uncommon after fracture of the ribs and wound of the lung. My colleague, Mr. Howse, has observed that pneumothorax, under these circumstances, is more common in old people than in the young, and this is precisely what one would expect if the line of argument already adopted be correct. In old people the ribs have stiffened, and are therefore unable to fall in and reduce the size of the thoracic cavity. In young people the chest is reduced to a minimum capacity, and the inspiratory suction is diminished in proportion. The differences in the case of pneumothorax at these two periods are similar to those in empyema in the young and adult; in both cases—in young people with healthy lungs, the lung and chest-wall fall on each other; in the adult, with old lung disease, or in the old person with stiff ribs, the two cannot play so well together, and thus when air has a chance of admission to the pleura, it separates the two surfaces, and leads to collapse of the lung. Yet further, it is a recorded fact well known to army surgeons and some few others, that an incised wound of the thorax by no means necessarily gives rise to pneumothorax. As Mr. Howse puts it, the exposed lung remains in apposition with the sides of the wounded pleura, and moves with each act of respiration.

See now the importance of all this in its bearing on the treatment of purulent effusion. The simile of the barrel is not applicable for the majority of cases, and it is therefore not necessary to get to the bottom of the chest in order to drain it effectually, and, as a matter of fact, the opening is usually made a third or half way up the chest, and its site may, in fact, for the most part, be determined by local exigencies, rather than upon the question of which is the best spot for drainage. Of late years, indeed, Mr. Marshall, guided, if I remember rightly, to that spot by the fact that when empyemas open spontaneously they very generally made their way forward, somewhere below the nipple, has suggested that position as a not unsuitable one for making an opening; and obviously if dependency were necessary for emptying the cavity, this could never be the place to make an incision. Mr. Marshall believes that the selection of a particular spot for the spontaneous opening of empyemata is determined by the course of the muscular fibres. There is one spot less protected by muscles than other parts, and this being the point of least resistance, gives way first, and thus settles the site. I also take the fact of spontaneous opening being prone to occur here, or somewhere in front, sometimes, indeed, quite under the clavicle, to corroborate the opinion I have expressed that fluid plays round the lung much more than we are in the habit of thinking. Now this all bears upon the practice of excision of the ribs, which is becoming a daily more common and dogmatically advocated plan of draining the chest in empyema. The prevailing impression seems to me to be that in empyema the lung collapses, and there is a cavity of large size which must contract and granulate up from the bottom. I thought the same myself once, and in that light looked upon the disease as a very desperate one, and for granting the full power of the pleura to form a copious supply of lymph, and of the ribs to sink in to a great extent, yet even with all this help it hardly seemed a likely thing that the cavity could be obliterated. But a larger experience tells one, I think, that the argument is only good for cases that are neglected by long standing, and for cases in which pre-existing disease of the lung is the cause of the empyema. These are the cases in which the surgeon is at his wit's end to procure obliteration of the cavity, and, do

all he can with excision of the ribs, and what not, many are the cases of this sort in which the surfaces will not come together, and the cavity will not close. But this is not the rule; it is the exception.

It has been the common practice of surgery of the last few years to make a free incision in these cases, and this plan has been very generally adopted, I think, at Guy's Hospital, and certainly so both by Dr. Taylor and myself at the Evelina Hospital. A large-bore rubber drainage-tube is inserted and retained as long as may be necessary. I myself prefer that this tube should be shortened after a week or ten days, so that it is just long enough to pass in between the ribs and no more. This allows for the continued patency of the opening into the pleura as long as may be necessary, and believing, as I do, that the idea of drainage being required from the very lowest part of the pleura is a mistaken one, I have been confirmed in this opinion by finding that, in the large majority of cases, this plan is successful. So far as I can make out, there have been forty-seven cases operated upon in the Evelina Hospital in the last five or six years, some under my own care, others under Dr. Taylor, and to those I may add three others which have occurred to me elsewhere in the last few months, making a total of fifty; of these, forty-two have quite recovered; a sinus has remained in three, and there have been five deaths. As regards these, however, it is only fair to say that one was due to suppurative pericarditis in addition to the empyema; another to the empyema being double; a third was due to a foreign body in the bronchus and septic pneumonia; a fourth was a huge collection, with a history of eighteen months' duration, and death occurred within a few days of the operation; and the last case had been operated upon, and was doing well, when the child caught measles and died from the effects of broncho-pneumonia. I do not think that in any one of the five was there any difficulty as regards the drainage from the simple incision, and none of them can be supposed to have any bearing upon the question whether or no excision of a portion of one or more ribs is advisable as a rule. In this series of cases a portion of rib has been excised three times¹; all three were under my own care. In two of them the operation was done when I was away for my holiday, and although several weeks had elapsed since the incision, I am not prepared to say that I might not have waited longer, and still with the hope of a good result. Nevertheless, to make the case as full as possible in favour of excision of the ribs, I will say that here were two cases in which simple incision was not satisfactory, and excision of a rib had to be practised. One of them healed up and did well; the other, after several months, has still a sinus, and I propose to have still more of the ribs removed. In the third case, a small piece of one rib was removed at the first operation, because it was quite impossible to pass a tube into the chest of any size sufficient to ensure adequate drainage.

Now in the *Lancet* for 1886 (On the Surgical Treatment of Empyema, vol. i, 1886, p. 51) my friend Mr. Godlee, for whose surgical skill I have the highest possible respect—so much so, indeed, that I would almost rather distrust my own opinion than his in this matter—published a series of thirty cases of empyema in children, and in nineteen of them a piece of rib was removed. I suppose it will be allowed that any operation, if unnecessary, is harmful; and I feel further disposed to say that the resection of a rib in young children is an operation of some severity, do it with what ease you may, although it is not a proceeding that need be made much of, if it can be shown that any gain comes of it. Well here is one observer who thinks it advisable to excise a piece of rib in two-thirds of his series of cases; another only about once in every fifteen cases.

I cannot think that there can have been such a difference between the two sets of cases; and I believe the difference of treatment is to be attributed to our starting on different bases. Mr. Godlee starts on this basis. He says, let us consider the manner in which a cure is effected under the circumstances of free incision into the chest (*Lancet*, 1886, vol. i, p. 51). "The lung, unless it has previously become adherent to the chest-walls at some points, is lying at the back of the thoracic cavity, occupying the hollow formed by the angles of the ribs, and perhaps adherent also to the structures in the middle and posterior mediastina. The process which has to take place in order that the opening may close is a bringing together of the walls of the cavity and the surface of the lung. Now it is quite impossible for the lung to be distended by any inspiratory efforts; this would be opposed to the laws of physics, and no suction power is available as long as there is a free opening into the chest, yet somehow the closure of the cavity is brought about." Well, if physics decline to

¹ There is now in the hospital a fourth case of excision of a rib. The child was in the hospital three or four years ago, and is therefore one of the fifty; but it appears that she has been well in the meantime, and has lately developed another empyema on the same side.

have my explanation, I feel disposed to say so much the worse for physics. Anyhow, I have seen a large empyema close up in eight days, which is an equal dilemma for the granulating-up-from-the-bottom and contractile-closure theories. Or, take a recent case that has happened to me: A little girl, aged 8 years, has had an obscure chest mischief since early in January. She does not throw it off, has an evening rise of temperature, and her spine is beginning to curve. I find, on examination, the left side considerably retracted, the heart displaced a little to the right of the sternum. No absolute dullness anywhere, but tubular breathing at the apex under the clavicle, and a generally deficient movement of that side of the chest, and a very poor inspiratory murmur. A needle is put in at the angle of the scapula, and pus drawn; a free incision is then made, and four ounces of pus evacuated. A small piece of rib was excised in this case, because the ribs were so close together that no adequately large drainage-tube could be passed between them. There has been practically no discharge since; the temperature has averaged 99°, or under. The tube was removed on the ninth or tenth day, and the child appears to be well.

Cases such as these (and I have no doubt whatever there are some here who could match them) are by no means satisfactorily cleared up by an explanation of their course such as Mr. Godlee seems to me to sketch, but I venture to think such things are reasonably probable by the means I have indicated. It may indeed be said that the contraction of lymph goes on with extreme rapidity, so much so, indeed, that it is difficult to fix limits to its capacity in this respect, and I should admit this if the contraction were free to act in all directions; but this is not so in the chest; the contractile force is materially limited by the ribs, can only act to any large extent when it has reduced the thoracic wall to the state of forced expiration, by dragging on the lung and diaphragm. But then there is this other difficulty in that explanation. It is in just those cases which close up rapidly that the amount of lymph is smallest, therefore, in just those cases in which repair takes place most quickly and perfectly, the contractile force is most, and I think practically altogether, in abeyance.

I cannot pursue this matter further; I will only say in conclusion, that I never have a rib excised unless the case is an old standing one, or there is no room to put in a large drainage-tube; and as a part of the outcome of the experience I have attempted to condense, I interfere with the pleura as little as possible, and for as short a time as possible. Therefore I never wash out the chest, and I attempt to do away with the drainage-tube at the earliest possible period. A free incision is made in the chest wherever is most convenient, pus having been previously proved to exist at the selected spot by the exploring syringe. A large sized tube is put into the opening perhaps 5 or 6 inches long. This is shortened within a few days, and if all goes well after a week or ten days, the length may have been reduced to an inch or so, just enough in fact to go between the ribs and no more. The external opening should be kept open long enough to insure that there is no re-collection going on inside. The last case I have had has been treated by a silver tube I had made on the principle I advocate, of keeping the external wound open and leaving the pleura alone. It is a flattened oval \ominus an inch long, with a bore of 4 millimètres by 12. It has a thin metal shield which can be moulded somewhat to the side of the chest. It answered admirably, keeping the ribs apart and giving a free vent, and this in a case not very favourable to success, for the child was only 2 years old. The case was operated upon by my colleague Mr. Symonds; the tube was removed on the fifteenth day, the wound healed up forthwith and the child has since then remained well.

In conclusion, let me say that I have not intended to make any objection to the removal of ribs in properly selected cases, and such I take to be very long-standing cases, or when, which according to our experience is I think not very common, the ribs come so close together that a properly large tube cannot be inserted, or is nipped between them. But it is my belief that in the present day resection of ribs is a common operation, and becoming yet more so. Whereas I think it is quite unnecessary for the great majority of cases. This is the main point of my paper, and the one I hoped to see well discussed.

POISONING BY SEWER-GAS.—The death of a child, aged 3, the daughter of a bricklayer's labourer, occurred this week at Hackney Wick from poisoning by sewer-gas. Mr. Bothamley, the surgeon who examined the house in which deceased lived, said, from a sanitary point, it was not fit to live in, and two other children of the family were suffering in a similar way. The attention of the sanitary authorities was called to the matter.

SOME official statistics just issued as to the death-rate in the principal Austrian towns show that Vienna has become, since the construction of its water-works, one of the healthiest of cities.