CLINICAL REMARKS

ON

THE RELATION BETWEEN EMPYEMA AND
CROUPOUS PNEUMONIA.¹

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FOR some time past I have instituted very careful inquiries into the earlier history of all cases of empyema that have come under my notice, with a view to determine the nature of the lesion that preceded the pus formation in the pleural cavity. This was done owing to a growing dissatisfaction with the theory, so commonly accepted, that empyema results as a rule from simple pleurisy. The task has proved an exceedingly difficult one in many instances. In some it was impossible to come to a decision as to the nature of the lesion; in others the necessary information was supplied by medical friends who watched the cases from the commencement, and in a considerable number of cases, in which the pus formation took place after the admission of the patients into the infirmary, the point was determined by a special mode of investigation. As it was the intention to consider only what may be called the ordinary cases of empyema, those, for example, in which the classical treatment is so satisfactory, the cases having an undoubted tuberculous, traumatic, or septic origin were excluded from the inquiry; not because they are necessarily fatal, but because they naturally fall into distinct groups, and their nature is sufficiently obvious.

The result of the inquiry has gone to support the view entertained by the late Dr. Wilson Fox,² who held the opinion that empyema does not result from a slow and gradual change in an effusion primarily serous, or, in other words, that a simple pleurisy has no tendency to go on to pus. This observer ascribed the pus formation to the special character of the inflammation; and up to this point I am in agreement with his views, but I entirely differ when he attempts to show that the special character of inflammation is supplied in a large number of cases by operative interference, as in tapping. Whatever might have been the result of this measure in pre-antiseptic times, it is reasonable to suppose that with the ordinary precautions taken in every good hospital no such catastrophe can happen at present, save in the rarest instances. I was next compelled to take the view, which I wish now to advocate, that in some way croupous pneumonia was associated with the pus formation; that, indeed, the ordinary empyema, generally supposed to result from a serous or sero-fibrinous pleural effusion (simple pleurisy), is, in the great majority of instances, a consequence of pleuro-pneumonia. That purulent pleurisy is not uncommonly preceded by pneumonia is proved by the fact that, during the past two years, the period over which the inquiry has specially extended, seven cases of empyema have, to my knowledge, developed in the wards of the Royal Infirmary after pneumonia. The total number of pneumonias admitted during that period was about 130, so that upwards of 5 per cent. of the cases of croupous pneumonia were followed by empyema. In some of these cases pus was detected as early as the tenth day of disease, whilst in others three weeks elapsed before the condition was suspected. The following case is a fair example of the group:

W. M'C., aged 25, a steelworker, living in a healthy and comfortable home, and a very moderate drinker, was admitted into the Royal Infirmary on March 8th, 1890. According to the statement of the patient and his friends, he went to work on March 2nd, feeling ill. During the day he shivered, and was obliged to return home. Next day he suffered from cough, with stabbing pain in the left side. The breathing became hurried, and the expectoration blood-tinged. On admis-

sion (seventh day of disease) the usual signs and symptoms of pneumonia were present. The respirations were 50, pulse 120, temperature 101°. The cough frequent; the expectoration rusty; marked eruption of herpes on lip. The left base was dull posteriorly, with tubular breathing and friction sound. Traube's space in front was resonant; the heart was in its normal position. On the morning of the ninth day of disease the pulse was 108, the temperature 100°, and the respirations 50. The dullness as marked as before. On the tenth day the pulse was 100, the temperature 99°, the respirations still rapid; dullness and tubular breathing much the same as before; friction sounds gone. Some effusion was now suspected. On the sixteenth day the pulse was 96, the temperature 100°, the respirations 40. The physical signs indicated fluid, and, on the introduction of a hypodermic exploring needle, pus was drawn off. Dr. Hume incised and drained. The patient made a good recovery.

During the past two years I have traced, without doubt, fourteen cases of empyema to an antecedent attack of pneumonia. In several other cases the history justified the opinion that there had been an attack of pneumonia, but this could not be proved. And I may state that during that time I have not met with a single case of simple pleural effusion that went on to pus, notwithstanding, in some instances, frequent tapping. In my attempt to procure information upon this subject—in which I have been largely aided by the employment, with strict antiseptic precautions, of the hypodermic needle used as an explorer—I have satisfied myself that, as a rule, croupous pneumonia is accompanied by a slight degree of pleural effusion. It is true that the quantity is generally small, the layer of fluid being usually from $\frac{1}{2}$ to 1 centimetre in thickness. It is generally reddish in colour, though at times orange yellow. This fluid is usually exuded about the third or fourth day, and is generally at its height about the fifth or sixth, and disappears very speedily. In some cases it can only be demonstrated at the extreme base, and may be absorbed at once, and in others it appears to be absent throughout. Its presence seems in no sense to influence the course of the attack. It would appear to be absorbed almost invariably during the last few hours in fatal cases, as it is seldom to be found at *post-mortem* examinations. I am unable to say what the relation is between this fluid and the subsequent empyema. In cases in which empyema follows pneumonia it is common to meet with an extension of the consolidation about the time the crisis is expected. A new area is affected, in which tubular breathing with friction sound can be detected—say on the ninth or tenth day. An examination now of the part first affected—the base, for example—reveals the presence of *râles*, whilst the breath sounds are less tubular, though dullness on percussion still remains, or has become more pronounced. The introduction of the exploring needle at this stage will often demonstrate the presence of pus. The temperature and pulse keep up, the former reaching 101° in the evening, and the latter running from 90 to 100. The respirations also continue high, and are seldom lower during the next few days than 35 or 40 in the minute. By degrees the breath sounds are diminished in intensity, the vocal fremitus is lessened, and the dullness assumes the flat, toneless quality so characteristic of fluid.

The importance of recognising the pneumonic origin of empyema cannot well be overstated. The transition from acute pleuro-pneumonia to empyema is often so gradual that the practitioner may be pardoned, as time advances, for regarding the case as one of lingering consolidation, and the patient may die with his pleural cavity nearly filled with pus. Again, the early discovery of pus has in some cases so far simplified the treatment as to do away with the necessity of incising and draining; witness the following case, treated successfully by my colleague, Professor Philipson, who has kindly given me permission to refer to the notes. I am sanguine enough to believe that before long it will be the rule, and not the exception, to cure empyema by a single tapping, provided the condition be recognised at the outset.

T. M., aged 19, a sailor, was admitted into the Royal Infirmary for rightsided pleuro-pneumonia on the fourth day of an illness ushered in, in the usual way, by a severe rigor. On examination, dullness on percussion, tubular breathing, and exaggerated vocal fremitus were evident over the right base, with pain of pleuritic character. Respirations, pulse,

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¹ Read before the Branch on October 7th, 1890.² BRITISH MEDICAL JOURNAL, p. 752, vol. ii, 1877.

and temperature were 56, 100, and 103° respectively. On the seventh day the respirations rose to 72, the pulse to 116, and the thermometer stood at 104°. There was some delirium, and marked restlessness. On the eighth the face was cyanosed, delirium more pronounced, and physical examination revealed the fact that the pneumonia had extended to the middle and upper lobes. The expectoration was rusty, but very scanty. During the next few days the temperature varied from 99° to 101.5°, but was seldom above 101°; the pulse from 95 to 105, and the respirations from 32 to 60—average 45. On the eleventh day the delirium subsided, and the patient's general condition improved, and crepitus *redux* was to be heard at the base of the right lung. After the fourteenth day the temperature and pulse, though still indicating the febrile state, moderated considerably, but the breathing remained about 40 in the minute. Dulness continued at the right base, and the breath sounds and crepitations gradually became more feeble and distant. On the twenty-first the chest was explored, and pus drawn off by means of the hypodermic syringe. On the twenty-eighth day paracentesis was performed, and thirty ounces of pus withdrawn. On the forty-second day, as the base was still relatively dull, the needle was introduced once more, but with negative result. Eight days later the chest was again explored at the point of maximum dulness, and the result was the same. By degrees the dulness disappeared, and the patient made an excellent recovery.

This case cannot certainly be said to be unique, and I am disposed to think that if practitioners who have met with instances of empyema cured by one tapping will endeavour to recall the earlier history of the case they may be persuaded to admit a pneumonic origin. In conclusion, I would venture to suggest that some, at least, of the recorded cases of abscess of the lungs following pneumonia have been limited empyemas that have found their way through the visceral pleura. True abscess of the lung, apart from sepsis or tubercle, I have never seen, and I have now for upwards of thirteen years superintended the *post-mortem* examinations at our Royal Infirmary.

EXPERIMENTS UPON THE INFLUENCE OF THE MINERAL CONSTITUENTS OF THE BODY UPON IMMUNITY FROM INFECTIVE DISEASES.

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ONE of the most striking points in regard to infective diseases is the degree in which animals resist their attacks or succumb to them. The direction in which an explanation of this phenomenon is at present chiefly sought is the powers of living cells to destroy intruding microbes, or of albuminous substances in the blood or lymph to destroy the invading microbes and to neutralise the action of their poisonous products. The differences which exist between albuminous substances are probably due in part to their different molecular weight, but we also know that the reactions of many albuminous bodies are greatly modified by the various proportions of inorganic constituents, such as soda, potash, or lime, in the fluid which dissolves them, or from which they may be precipitated by heat or by various reagents.

It has been found by Gilbert and Lawes that the ashes of different animals are not alike in their composition, and it seems therefore possible that a difference in the mineral ingredients of an animal's body may be one of the factors in determining the amount of resistance it may present to infective diseases.

In a research made by one of us (Brunton), along with Cash, it was found that not only was the effect of barium on the frog's muscle counteracted by potash, but by feeding an animal for some time with potash the poisonous action of barium could be to a considerable extent counteracted, the potash appearing to have accumulated in the body to such

an extent as partially to antagonise the barium, which was afterwards administered. By treating an animal with perchloride of mercury, Cash succeeded in conferring immunity against anthrax, so that when subsequently inoculated it remained alive, while a control animal died in a few days. These facts seemed to render it worth while to undertake a research into the effect of the administration of potash, soda, or calcium in increasing or diminishing the resisting power of animals to anthrax. The effect of sodium bicarbonate has already been tested by Fodor, but his experiments were directed to the effect of it upon the alkalinity of the blood, and not to the effect of the base as compared with other alkalies or alkaline earths. His experiments seemed to show that sodium bicarbonate tended to confer immunity, for of nineteen rabbits treated by injection of its solution and then inoculated with anthrax, seven survived, three developed the typical disease, while in the remaining nine the cause of death was uncertain. M. Chor¹ has performed similar experiments, but with different results, for he found that animals thus treated not only did not recover from the disease, but died almost uniformly before control animals inoculated without previous preparation. He found, also, that by using the alkali, as recommended by Fodor, death might ensue from this alone without subsequent inoculation. These experiments seem to show that the alkalinity of the blood is not the important factor in resistance, and it is possible that the contradictory results of these observers may have been partly due to the nature of the food which the animals received before and during the experiments. But in all probability the soda salts were kept rather in excess in the animal by the administration of the drug, and we may regard them as indicating that an increased proportion of sodium does not tend, to any great extent at least, to confer immunity, although the increased resistance observed by Fodor might be explained on this hypothesis as well as on that of increased alkalinity.

In the present paper we intend to consider the effect of potash, reserving for another communication the effect of lime, magnesium, and alumina, as our experiments on them are not yet concluded. In February of this year we commenced the research by feeding a number of guinea-pigs with bran containing potassium chloride (30 to 60 grammes per kilo.). They took this food readily, and were fed on it and on cabbage for periods varying from three weeks to three months. They all maintained excellent health and in no case lost weight. The animals were then inoculated with anthrax, controls being also inoculated with the same virus. We think our method of feeding the animals preferable to that adopted by MM. Fodor and Chor, as in every case the animals remained in perfect health till inoculated. The results were as follows:—

(a) Six guinea-pigs, fed with potassium chloride for periods varying from three to six weeks; three control animals fed in the ordinary manner. Inoculation with a virus (proved to be fatal to rabbits in three days) caused development of anthrax in all the animals, so that all died in from forty to forty-eight hours.

(b) Six guinea-pigs were fed with potassium chloride during two months; six control animals were fed in the usual way. Inoculation with a feebly virulent anthrax (Pasteur's second vaccine) proved fatal to all in from forty-four to seventy hours. Four of the prepared animals died before any of the controls.

(c) Two guinea-pigs, fed (with a short intermission) with potassium chloride for three months, and one control animal, were inoculated with the second vaccine anthrax. One of the prepared animals was moribund in forty-four hours, the other two being found dead next day. Typical cultures of anthrax were obtained from all the animals mentioned above.

The result of our experiments is that saturation of guinea-pigs with potassium chloride in no way confers immunity against anthrax—in fact, that in animals thus prepared death occurs more rapidly than in control animals. This result may be due either to a positive action of the potash itself or its having tended to cause elimination of other bases, such as sodium or calcium. We think it is just possible that if the food of Fodor's animals happened to contain a large proportion of potash salts, the comparative immunity produced in them by the injection of soda might be due, not to any

¹ *Annales de l'Institut Pasteur*, May, 1891.