25 and 75 per cent.; for purulent transformations, 45 and 55 per cent.; and for cases of which no account is given (and in which, in this analysis, I have taken as uncomplicated), 33 and 66 per cent. respectively. The difference in the frequency of phthisis and purulent transformation is scarcely sufficiently considerable to be made the basis of any special deduction, though, *à priori*, the former might have been expected to be less frequent and the latter more frequent, comparatively, after the age of thirty. The bulk of the cases in which the greater preponderant mortality depends after thirty appears, therefore, firstly, in the greater number of general grave complications which were present after this age; and secondly, among unexplained causes of death; the latter showing an inherent tendency to a greater fatality of the operation in more advanced periods of life, into which, however, on the data at present existing, it does not seem possible to pursue this inquiry further.

ON THE VALUE OF PARACENTESIS OF THE CHEST IN THE TREATMENT OF PLEURITIC EFFUSION.*

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ALTHOUGH the practical value of paracentesis of the chest in the treatment of pleuritic effusions is generally admitted by medical writers, there is still wanting an uniformity of opinion as to the conditions under which the operation should be performed, and the results which are to be expected from it. With a view of promoting the discussion on this important subject, I am induced to give the estimate which I have formed of its value; and, in so doing, I shall briefly consider some objections which have been urged against it, and make a few remarks upon the method of operating.

The cases which I shall use to illustrate the paper are eleven in number, and comprise three cases of simple acute pleurisy, two cases of acute pleurisy occurring as a complication of enteric fever, three cases of subacute or chronic pleurisy, and three cases of empyema.

1. *Acute Pleurisy.*—Taking first the cases of acute pleurisy, the first patient was a young woman aged 20. The pleurisy was on the left side; the heart was displaced; the dulness over the left lung was almost universal, and the general symptoms were of an urgent character. The amount of fluid removed by Bowditch's syringe was sixty-six ounces. In the second case, a young man aged 17, the effusion was on the right side. Fifty-seven ounces of fluid were removed by paracentesis. The immediate relief experienced by both patients after the operation was very marked, and convalescence ending in recovery was speedily established. Previously to operating, the ordinary treatment had been tried without producing any perceptible effect upon the amount of effusion. In the third case, the benefit of the treatment by operation was also well shown; and, as the case presents some features of interest, it is given more in detail.

J. A., aged 18, by occupation a blacksmith, was admitted into the Cumberland Infirmary on June 25th, 1877, complaining of shortness of breath. He stated that, about a month ago, while in his usual state of health, he was seized with sudden pain in the right side; worse on taking a long breath. About the same time, he began to be feverish, to have shortness of breath, a slight cough, and frothy expectoration. The pain and cough continued for about a fortnight. His difficulty of breathing increased, and was worst when he was recumbent. He had not received any special treatment. On admission, his condition was as follows. The patient was a strongly made muscular young man of florid complexion; height 6 ft. 1 in.; weight about 12 st.; his face was flushed; respiration shallow and rapid, thirty-six per minute; no cough. On examination of the chest, the left side appeared to be enlarged; the intercostal spaces were somewhat widened and flattened; but measurement showed both sides to be equal, the circumference in the nipple-line being thirty-eight inches. There was no œdema of the chest-walls. The expansion on the left side was diminished, and vocal fremitus feebler than on the right side. There was absolute dulness on the left side, posteriorly as high as the spine of the scapula, and anteriorly as high as the third rib; over the apex, the percussion-note was hyperresonant. The respiratory murmur was absent at the base, and generally feebler than on the opposite side, except at the apex, where the breath-sounds were distinctly heard. On the right side, occasional crepitations were heard. The action of the heart was laboured, rapid, and irregular; the apex-beat was to be seen and felt

one inch to the right of the lower end of the sternum; the appetite was slightly impaired; the urine normal; morning temperature, 101 deg.; evening, 102 deg. The diagnosis in this case was not difficult. The dulness over the left chest, the absence of vesicular murmur at the base, and the general feebleness of the respiratory sounds over the left lung, together with diminished expansion and absence of vocal fremitus, pointed to the presence of a large effusion in the left pleural cavity. The displacement of the heart was also confirmatory of this view. The absence of any symptoms of hectic, the comparatively low temperature, and the absence of œdema of the chest-walls, indicated that the effusion was probably sero-fibrinous in character. The occurrence of pain on the right side, associated with left-sided pleurisy, is interesting; it is confirmatory of Laennec's assertion that, while pleuritis is on one side of the chest, the pain is sometimes on the other, an assertion which has been directly contradicted by Andral and Wintrich, but which has recently been corroborated by Gerhardt, who, in order to explain it, has supposed that there is an anastomosis of the sensory nerves of both halves of the chest. This proposition Huss, one of his pupils, has endeavoured to demonstrate anatomically (*Archiv für Klin. Med.*, vol. ix, p. 242).

In regard to treatment, the patient was ordered to be kept strictly in bed, to have beef-tea diet, and to have large doses of diuretics (iodide of potassium and infusion of digitalis). On the following day, the area of dulness over the left chest had increased, but the breathing was slightly better. On the 27th, two days after admission, there was evidence of still further effusion, and the dyspnoea was very considerable. I performed paracentesis, and drew off forty-five ounces of fluid, which was clear and of a dark amber colour. When examined microscopically, it contained numerous blood-corpuscles. On being allowed to cool, it coagulated to a firm gelatinous mass. The patient experienced no pain or cough during the operation, and there was great relief to the breathing, the respirations becoming slower, fuller, and deeper. The apex-beat returned gradually to its normal position as the fluid was drawn off. In the evening, the temperature was 103.6 deg.; breathing easy. On the following day, the morning temperature was 98.6 deg. He had passed a good night, and expressed himself as feeling greatly better. On June 29th, there was dulness over the left back as high as the sixth rib. The local application of iodine was ordered, and acetate of potash, in twenty-grain doses, was ordered to be added to the mixture.

July 7th. The diuretic had acted well, and the iodine had produced slight vesication of the skin. The dulness over the left chest was nowhere absolute; but the resonance was still slightly impaired at the base. For the last few days, a friction-sound had been heard over the lower part of the lung; the apex-beat was in its normal position. From this date, the patient's progress was one of continued improvement. He daily gathered strength; he had no urgent chest-symptoms; the dulness at the left base became less marked, the friction disappeared, and he became quite well. Towards the end of the month, there was a return of pleuritic symptoms, owing to fresh exposure to cold; but these were not of a serious character.

In the two cases of acute pleurisy occurring as a complication of enteric fever, paracentesis was performed three times in each case. The first was a young man aged 19, and the pleurisy came on during a very severe and protracted attack of enteric fever. The effusion was on the right side, and was of a sero-fibrinous character. The amount of fluid removed was on the first occasion 46 ounces, on the second 56 ounces, and on the third 123 ounces. The urgent dyspnoea was greatly relieved by the operation, and the patient finally recovered. In the second case, the patient was a gamekeeper aged 43, and the fever was of a severe type. The chest-symptoms first appeared on the twenty-fourth day of the disease, and the effusion was on the left side. The fluid removed at the first operation measured 50 ounces, at the second 47 ounces, and at the third 90 ounces, and was always of a serofibrinous character. Recovery was complete, and the patient now continues to follow his usual occupation without ever experiencing any chest-symptoms.

2. *Chronic Pleurisy.*—Of the cases of subacute or chronic pleurisy, the following is a good illustration.

J. L., aged 23, called at my house on August 18th, 1876. He had been sent to me by Mr. Arras, surgeon, of Wetheral. He stated that he had always enjoyed good health until nine weeks previously, when, after returning from fishing, he was seized with pain in the right side and distress in breathing. He had no cough. The pain in the chest continued for about a fortnight, but he did not feel sufficiently ill to leave his work. As the pain subsided, he began to experience greater difficulty of breathing, especially after slight exertion; and, as this symptom continued, he sought the advice of Mr. Arras, who recognised the presence of a large effusion occupying the right pleura

* Read in the Section of Medicine at the Annual Meeting of the British Medical Association in Manchester, August 1877.

cavity, and recommended him to see me with a view to paracentesis. On examination, I found that the right side of the chest was universally dull, both anteriorly and posteriorly, the dullness extending to the left side of the sternum. The right chest measured nineteen inches, and the left seventeen inches and a half; the apex-beat was to the left of the nipple-line. The respiratory sounds were very feeble on the right side, and the dyspnoea rather troublesome. Three days later, as no diminution in the effusion had taken place under the influence of diuretics, which he had been taking freely, I had a consultation with Mr. Arras, and removed by paracentesis 126 ounces of sero-fibrinous straw-coloured fluid. The relief to the breathing was very manifest, and the patient experienced no bad effects from the operation. Within two days, he was able to be up and out walking. Within a week, he stated that he had no difficulty of breathing after walking upstairs; the apex-beat was in its normal position; the right chest measured eighteen inches and a half, and the left eighteen inches; the dullness was nowhere absolute on the right side, but was most marked over the lower third of the lung, posteriorly, where, on auscultation, a friction-sound could be distinctly heard. He stated that he felt getting stronger daily. He continued to improve daily after this, and the friction-sound gradually disappeared. When examined on September 28th, no abnormal chest-sounds could be heard, and the patient stated that he felt quite well.

The second case was somewhat similar, but of not quite so long standing. It was that of D. L., aged 37, a farmer, who called upon me on June 25th, 1876, complaining of difficulty of breathing, which had first been noticed a month previously, but had gradually been becoming worse. I found a large effusion occupying the left pleural cavity. Iodine liniment was applied to the chest-walls, and diuretics ordered in large doses; but, in spite of these, the effusion increased, and, on July 2nd, the dyspnoea was very urgent. I performed paracentesis, and drew off one hundred ounces of sero-fibrinous fluid, which formed a complete jelly on cooling. There seemed to be a slight reaccumulation during the week; and, on July 9th, I operated again, this time removing only ten ounces. The patient rapidly improved after this, and by the end of the month he was able to go about his work as usual. He has had no recurrence of the chest-symptoms since that date.

The third case of chronic pleuritic effusion was in a young man aged 20. It was a right-sided pleurisy, and presented many remarkable features; but, as I have elsewhere (*vide Practitioner* for September 1875) given a detailed record of the case, I will only briefly refer to it here. The effusion had probably lasted twelve months, and, during the time the patient was under treatment in the hospital, paracentesis was performed fourteen times. The greatest amount of fluid removed at one time was on the occasion of the second tapping (April 9th), when 104 ounces were removed, and the smallest amount was at the last tapping (July 25th) when only seven ounces and a half were extracted. The reason why the fluid reaccumulated so frequently seemed to me to be a diminution of the natural absorbing power of the pleural membrane, owing to its having been so long unduly stretched by its contents. The patient was quite well when he left the hospital, and has since continued well.

3. *Empyema*.—The employment of paracentesis in the treatment of empyema has, in my hands, given unusually satisfactory results. The first case was that of a young lady, aged 19, who caught cold after bathing six weeks previous to coming under observation. I saw her first on September 9th, 1874. She had suffered from frequent and very distressing cough, pain in the chest, great restlessness and delirium. She was much exhausted, and had profuse perspirations. The physical signs indicated the presence of fluid in the left pleural cavity. Paracentesis was performed, and sixty ounces of perfectly inodorous pus was withdrawn. The immediate relief afforded by the operation was great. The general treatment was directed to restore the patient's exhausted condition. In a week, there being evidence of a reaccumulation of pus, paracentesis was again performed, and twenty-seven ounces of pus were extracted. Seven days later, a third operation was deemed necessary, and on this occasion nineteen ounces of pus stained with blood were obtained. On September 28th, or nineteen days after the first operation, the aspirator was again used, the fluid removed consisting of about eight ounces of pus largely mixed with blood. After the first operation, the patient's condition gradually improved; and, although convalescence was rather slow, owing, I think, in a great measure, to the very exhausted condition in which she was prior to the first operation, she ultimately got quite well. Seven months afterwards, the left chest measured seven-eighths of an inch less than the right. The patient was quite well, and, since that date, has suffered from no affection of the chest. In the next case, the result was not quite so satisfactory. The patient was a young woman, aged 25, ad-

mitted into the Cumberland Infirmary on April 15th, 1875. She had been ill since the 6th, suffering from symptoms of pleurisy. A physical examination revealed the presence of a large effusion in the left pleural cavity. As the dyspnoea was urgent, paracentesis was performed at once, and forty-eight ounces of slightly opalescent fluid removed. On microscopic examination, this was found to contain numerous pus-corpuscles. On the 24th, as the fluid had reaccumulated, paracentesis was again performed, and seventy-one ounces of perfectly inodorous pus was removed. On four subsequent occasions, the aspirator was used; but ultimately, from necrosis of the parietal pleura, there was a fluctuating tumour pointing about two inches below the angle of the scapula. On this being laid open, the empyema continued to drain, at first slowly, and after some days profusely. The patient's strength failing, a counter-opening was made and a drainage-tube introduced, a weak solution of carbolic acid (1 to 40) being syringed through the tube twice a day. From this date, the patient's condition rapidly improved. The discharge gradually became smaller and smaller in quantity. In six weeks, the drainage-tube was shortened, and the posterior opening was allowed to heal. In another fortnight, the tube was removed, and the patient rapidly recovered. When the patient left the hospital, there was a difference of one inch and a quarter in the measurement of the two sides of the chest, the left being the smaller. The third case of empyema was complicated with pneumothorax, and was probably the result of traumatic lesion. The patient was a married woman aged 53. I saw her for the first time in consultation with Dr. Maclaren on September 19th, 1876. She stated that, on the 13th, while engaged in forking corn from a cart, the horse moved forwards and she lost her balance. In the fall, her head struck the ground, and the front part of her chest was squeezed. She was greatly shaken and stunned, but, with assistance, was able to walk to a house near at hand. On the following day, she complained of pain under her right breast and slight shortness of breath. On the 18th, there was evidence of fluid in the right pleural cavity. On the 19th, when I saw her, the dullness over the right chest was universal; there was slight oedema of the chest-walls; the intercostal spaces on the right side were obliterated; the apex-beat was in the nipple-line; there was no evidence of fractured ribs. The dyspnoea was very urgent. Paracentesis was performed, the puncture being made two inches and a half below the angle of the scapula, and one hundred and fifty ounces of fluid removed by the aspirator. The fluid was of a pinkish colour, and consisted of perfectly inodorous pus. Towards the end of the operation, some air was withdrawn from the chest, and, on examination after the operation, there was tympanitic resonance over the greater part of the right chest. The distress of breathing was greatly relieved by the removal of the fluid; but, the patient's home surroundings being unsatisfactory, she was two days afterwards removed to the Cumberland Infirmary and placed under my care. On examining her some hours after admission, I found that there was absolute dullness over the base of the right lung; but above the percussion-note was quite tympanitic. Crepitations were rather abundant over the whole of the right chest; the pulse was full and rapid; temperature 99.6 deg. She was ordered complete rest in bed, beef-tea, and milk, and a grain of quinine three times a day. On the 28th, as the dullness still continued over the base of the right lung, and as it was believed that more pus remained in the pleural cavity, paracentesis was again performed, and twenty-one ounces of purulent fluid were removed. On examination under the microscope, this fluid was found to contain numerous pus-corpuscles, stellate and shrivelled blood-corpuscles, granules, and a few vibrios. From this date, the patient rapidly improved. On October 3rd, a friction-sound was observed as occurring over the base of the right lung, and the resonance at the base was improved. On the 12th, the resonance at the two sides was nearly equal. On the 18th, there were no abnormal chest-sounds to be heard, and she expressed herself as feeling quite well. She was discharged, but occasionally presented herself at the out-patients' room during the next four months, when I had an opportunity of satisfying myself that she continued well, and had no return of her chest-symptoms. When I saw her last, on February 6th of the present year, she stated that she felt quite well and strong for her work. On examination, I could detect no abnormal chest-sounds. This, I think, must be considered a very gratifying recovery from a condition which had in it many elements of danger, and rendered at one time the prognosis not very favourable.

Having recapitulated the chief points in the cases that have come under my own observation, I desire now to consider some of the opinions which have been advanced as adverse to paracentesis; to state the conditions under which I operate, and to discuss the best method of operating. In the eleven cases, the particulars of which I have given, paracentesis was performed thirty-eight times; viz., in four cases once, in two cases twice, in two cases three times, in one case

four times, in one case six times, and in one case fourteen times. In these operations, I met with no difficulty, and saw no danger that need cause any alarm. The admission of air into the pleural cavity happened on two occasions, but no evil consequences followed. The danger of it arises from the fear of converting a sero-fibrinous into a purulent effusion by the admission of septic particles. It is obviated by the improvements which have recently been made in the aspirator, and it is highly important that the physician should himself see that the apparatus is in good working order before proceeding to operate. It was from the apparatus getting out of order that air was admitted into the chest on the two occasions just referred to. In regard to syncope, it has been found that this is more likely to occur in left-sided pleurisy, and, as pointed out by Bartels, it is probably due to a twisting of the vena cava inferior as it passes through the quadrilateral foramen of the diaphragm, consequent upon the heart being pushed over to the right side by the effusion. In large effusions, this danger will be increased by the longer continuance of the effusion, and we ought to operate earlier in left-sided pleurisy than when the effusion is on the opposite side, on this very ground. The gradual withdrawal of the fluid which may be accomplished by the aspirator diminishes the risk of syncope, whereas, if the fluid prop to the heart be suddenly removed by the rapid withdrawal of the fluid, the danger will be increased. In introducing the trocar, one ought to prevent the risk of hæmorrhage from wound of the intercostal artery, by avoiding as much as possible the lower margin of the rib in the intercostal space, which is selected for the puncture. Several fatal results have been met with on the Continent from what is by the French physicians termed albuminous expectoration, and which, as stated by Fraentzel (*Ziemssen's Cyclopaedia*, vol. iv, p. 672), is obviously identical with acute oedema of the lung. If this condition be due, as suggested by Dr. Johnson (*BRITISH MEDICAL JOURNAL*, October 1873, p. 479), to blood-stasis in the pulmonary capillaries, caused by coagula in the pulmonary veins, it is rather an argument in favour of operating at an early period of the disease. The longer the pressure of an effusion continues, the more likely are coagula to form. In all cases where the effusion is large, and where the dyspnoea is at all urgent, it is better to operate at once. There is, in my opinion, more danger in delay than in operating. Whether the case be one of acute pleurisy, chronic pleurisy, or empyema, better results may be obtained by paracentesis than could be expected from any other treatment. The cases of empyema which I have brought forward show, I think, that a fair trial should, in the first instance, be given to paracentesis before resorting to the radical method of free openings, counter-openings, and drainage-tubes. It is my practice to operate at once in all cases when the chest is two parts filled with fluid, without waiting for urgent dyspnoea to set in; but, if the chest be only half full, I usually wait for a few days to give a chance to ordinary treatment, and I have often been surprised at the rapid disappearance of effusions occupying nearly one-half of one pleural cavity under the influence of rest, iodine applications to the side, and diuretics. If, however, in the course of a few days, there be no diminution in the amount of effusion, I think it is better to perform paracentesis than to wait. The recovery is in this way more speedily expedited.

Having decided to operate, there are three points to consider:—1. What instrument to use; 2. Where the puncture should be made; 3. What amount of fluid to remove. In my own cases, I have used Wyman's syringe, as recommended by Bowditch, Dieulafoy's aspirator, and the bottle-aspirator introduced about the same time by Rasmussen of Copenhagen and Potain and Castiaux of Paris. I prefer the latter instrument; it is easier to the operator, and, I think, safer for the patient. The trocar ought to be a capillary one, so as to make a small a wound in the chest-wall as possible, and obviate the risk of suppuration along its track, which a large trocar would cause. The place I have selected for puncture has usually been in a perpendicular line with the angle of the scapula, in the eighth or ninth interspace, and an inch and a half above a horizontal line drawn through the lowest point at which the respiratory murmur is distinctly heard on the opposite side. This is the situation which is recommended by Bowditch. I endeavour to obtain as much fluid from the chest during the operation as possible, provided the patient experience no unfavourable symptoms. If there be much pain complained of, or very distressing cough, or if the patient feel sick or faint, I suspend the operation. During the operation, I recommend the patient to be in a semi-recumbent position, and I think it desirable to keep a watch on the pulse, and, if necessary, administer a stimulant. If there be a sudden stoppage to the flow of fluid before the effusion is exhausted, it may possibly arise from a plugging of the cannula by a fibrinous clot. This has happened to me once. Under these circumstances, it is usually recommended to withdraw the trocar and clean it; but this is

now rendered unnecessary by the invention of a trocar by Dr. Fraentzel. As soon as the operation is over and the trocar withdrawn, a little dressing of lint and plaster is all that is required for the puncture, and the plan of placing a small ice-bag to the seat of puncture may be followed with advantage, so as to obviate the fear of inflammation being set up along the wound of the trocar. In the after-treatment, I find the best results from iodine applications externally, and diuretics, consisting of the iodide of potassium, the acetate of potash, with small doses of infusion of digitalis or bitter infusion. In bringing my paper to a close, I trust that I have said enough to show that I place a high value on paracentesis of the chest in the treatment of pleuritic effusion, and that my confidence is based on good grounds. It will be a great satisfaction to me if the discussion on this subject which is now initiated should result in a more general adoption of the operation, so that in a short time we may be able to say of our medical men what Rasmussen says of those in Copenhagen, that every medical practitioner possesses his aspirator apparatus, and makes use of it in suitable cases.

NOTES ON PLEURITIC EFFUSION IN CHILDHOOD.*

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THE following notes are based chiefly upon observations made by the authors at the Children's Hospital, Great Ormond Street, and at the East London Children's Hospital. We have to thank our respective colleagues for permission to make use of such of their clinical material as we had the advantage, either conjointly or separately, of daily observing.

We do not attempt in this paper anything like a formal or exhaustive consideration of the subject. Such notes as we have to offer are based exclusively on what we have ourselves observed, and are laid down in the following lines:—

- The difficulties of diagnosis between pleuritic effusion and other chest affections in childhood;
- The difficulties of diagnosis between serous and purulent effusion.
- The natural course of pleuritic effusion in childhood, when unmodified by surgical treatment;
- The methods of treatment which have appeared to us most successful.

a. Difficulties of Diagnosis between Pleuritic Effusion and other Chest-Affections in Childhood.—There is very little more difficulty in discriminating lobar pneumonia from pleurisy in children than in adults. It is when we have to do with bronchial catarrh and collapse, with bronchopneumonia, or with the various forms of tuberculosis of the lungs, that difficulty constantly arises. We have repeatedly observed an amount of dulness due solely to collapse of lung, quite equal to that produced by a localised pleuritic effusion. Although it is true that bronchopneumonia and the various forms of tuberculosis of the lung are generally bilateral, we have seen three cases of bilateral empyema and three at least of bilateral serous effusion, undoubtedly inflammatory and not mere hydrothorax. Taking the classical signs of pleuritic effusion, we have seen in one case undoubted bulging and displacement downwards of the liver by lobar pneumonia. On the other hand, the concurrence of considerable retraction of one side of the chest, with a loculated empyema of that side and shrinking of the lung, is very common. It is well known that moderate effusion on the right side may exist, without displacement of the heart's apex to the left. On the other hand, we have seen cases of loculated empyema on the left side, where, in consequence of adhesions, or possibly of concomitant collapse of lung, the heart has not been displaced to the right. The use of the cyrtometer, introduced by Woillez and perfected by Dr. Gee, has almost superseded the old tape-measure as formerly used. We have again and again verified Dr. Gee's observation, that "considerable increase in the sectional area of the chest may occur, and the length of the periphery remain the same, by the passage of the elliptical form into the circular." "Thus with a moderate effusion in one pleura, the measurement is frequently identical with the measurement of the sound side." The essential fact is that, if the effusion be equally distributed, the shape of the transverse section of the affected side tends to assume the semicircle, as cyrtometer tracings show.

* Read in the Section of Medicine at the Annual Meeting of the British Medical Association in Manchester, August 1877.