years ago, Dr. Charrin and I proved the presence of the poisons of the bacillus pyocyanus in the urine of artificially protected animals fourteen days after these poisons had been introduced; and also that we succeeded in rendering rabbits resistant by the injection of the blood of animals suffering from the pyocyanic disease. The explanation we gave of this phenomenon was a good deal simpler than that now offered us; but we forgot to coin half-a-dozen Græco-Latin words in connection with it, which circumstance may perhaps account for the fact that our discovery has fallen into oblivion.

In conclusion, it is my firm conviction that the only process which has been proved to be essential to the resistance of animals—whether this resistance be natural or obtained by artificial means—is the power that amoeboid cells possess of taking into their interior and destroying micro-organisms, and that there is overwhelming evidence to show that this process is proportional to the resistance of the animal. Finally, let me again repeat that neither Metschnikoff nor any of his pupils have ever said that this was the only cause of natural or artificial resistance.

REMARKS ON TRACHEAL TUGGING AND ON ITS CLINICAL VALUE.

By WM. EWART, M.D. CANTAB., F.R.C.P.,

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OWING to the circumstance that Dr. Grimsdale's able and suggestive thesis¹ was, of necessity, a strictly separate production, towards which nothing beyond a series of observations conducted by myself, and very kindly recorded by Dr. Grimsdale and by Mr. L. Moysey, and various incidental remarks made as the occasions arose, was contributed from me, it differs in some particulars from the account which I had intended giving of the investigation. I therefore desire to state as clearly as possible, and without entering into much detail, the leading points in the inquiry, and the main conclusions arrived at by me.

At the time when Mr. MacDonnell's paper² called attention to the subject, I had under treatment in St. George's Hospital a case of inveterate cough and bronchial catarrh, beginning, so I thought, with gouty bronchitis, and presenting the usual signs. Up to that time, neither by myself, nor, as far as I gather, by anyone else, had any suspicion of aneurysm been entertained. The existence of aneurysm of the arch of the aorta was at once revealed to me when I applied Dr. Oliver's test, and shortly after the treatment had been modified, the cough and the noisy *râles* abated, and dulness and tubular breathing could be recognised in the interscapular region and to a very slight extent in the right infraclavicular space also. The patient is still in bed, and presents several obvious signs of aneurysm, but no pulsation. He owes his improved health and probably his life, through Mr. MacDonnell's agency, to Dr. Oliver.

Since that date I have regarded "tracheal tugging" as an important aid to diagnosis; and hearing that its value was doubted owing to its presence in some healthy persons, I was led to inquire into the frequency of its occurrence, independently of aneurysm, in the two sexes, at different ages, and under various states of health. With this inquiry I combined observations as to the relative value of Dr. Oliver's method of eliciting the sign, and of that which I had happened to devise and to use from the first.

The Method of Examination.—The process recommended by Dr. Oliver is as follows:³ "Place the patient in the erect position, and direct him to close his mouth and elevate his chin to the fullest extent, then grasp the cricoid cartilage between the finger and thumb, and use gentle upward pressure on it, when, if dilatation or aneurysm exist, the pulsation of the aorta will be distinctly felt transmitted through the trachea to the hand. The act of examination will increase laryngeal distress, should this accompany the disease."

The annexed woodcut, slightly modified from a sketch very kindly taken for me by Dr. Grimsdale some months ago, illustrates the alternative method. The observer stands behind the seated patient, whose head is slightly thrown back and steadied against the observer's chest. The tips of both index fingers are then inserted under the lower edge of the cricoid cartilage, which is gently raised by them. I have

Fig. 1.—The observer is supposed to be standing behind the patient.

carefully recorded the patients' estimates of the relative discomfort of the two methods. Those with soft and tender larynx (chiefly women and children) were about evenly divided in favour of one and in favour of the other. Many others, including even some children, were quite free from discomfort under examination; and this was almost invariably the case in subjects of mature age, with stiffened cartilages. The second method has one disadvantage affecting the observer—that it is almost too delicate, the fingers appreciating the slightest traction, whilst accuracy of observation is favoured by the patient's head being firmly steadied.

The Occurrence of Tracheal Tugging in the Absence of Disease of the Aorta.—Sixty male subjects and fifty-seven females were examined with both methods. In 28 per cent. of the females and in 50 per cent. of the males, some degree of "tracheal tugging" was recognised, the higher percentage in the males being partly accounted for by three cases of aneurysm which gave the tug being included in the list. This unexpected frequency appeared to detract from the diagnostic value of the sign; but, in reality, a large majority of the cases were described as "doubtful or very slight," a few as "moderate," and three only as "marked," and these were the three cases of aneurysm.⁴ In none of the females was the tugging pronounced, and in several it was present only during excitement.

Although, in a modified sense, Dr. Oliver's views had been confirmed, yet the upshot of the inquiry was to show that the significance of the sign was not so simple a question as had been stated originally, and that, before any final conclusions could be drawn, much more numerous observations were needed than I had had leisure to make. It had also come to light that some account must be taken of the personal factor in the perception of the slighter degrees of tugging, and in the appreciation of their value.

Circumstances Influencing the Occurrence or the Degree of Tugging.—Early in the inquiry I had suspected that thoracic conformation and the size of the lungs might have some connection with the existence of this peculiarity, and I had imagined that a short thorax and pulmonary emphysema might favour the occurrence of tugging. These were only suggestions, which I have not had an opportunity of putting to the test. Two points were very clearly made out—(1) the favouring influence of cardiac excitement (this was most obvious in several females), and (2) the favouring influence of forcible inspiration. The former might have been expected. The latter is, I believe, explained by the stretching of the air passages as a whole during inspiration, and particularly by

¹ *Practitioner*, February, 1892.

² *Lancet*, 1891.

³ *Lancet*, September 21st, 1872.

⁴ In a fourth case (of emphysema), tugging was decided during expiration, but very slight during inspiration.

the slight inspiratory descent of the larynx, which perceptibly intensifies the traction already made on the cricoid by the observer's fingers. In anticipation of remarks which are to follow on the subject of the probable mechanism of the tugging in aneurysm, it may be provisionally stated that in that disease tugging, when present, has been, in my experience, unmistakable and easily obtained even with so rough a method as tilting the cricoid cartilage on the tip of a single finger or thumb placed in the middle line and whilst the patient remained in the horizontal position.

The Value of Tracheal Tugging in the Diagnosis of Thoracic Aneurysm.—I have related an instance in which Oliver's sign led to the diagnosis of aneurysm and to its proper treatment. The following is an instance of the failure of diagnosis in a case where this method was not employed:

A middle-aged man was admitted under my care suffering from severe dyspnoea, universally audible *râles*, and abundant, thin, frothy, mucopurulent expectoration. He was supposed to be the subject of asthma and bronchitis. The chest was everywhere hyper-resonant, and the loud *râles* precluded a satisfactory examination of the heart. In the absence of any other indication the case was diagnosed as one of acute bronchial catarrh complicating pulmonary emphysema. My attention having of late been engaged with the subject of aneurysm, the thought that the patient's symptoms might be due to aneurysmal pressure on the trachea arose vividly after I had finished my rounds, and I returned to the hospital in the later afternoon for the purpose of detecting aneurysm if it could be traced. This was in vain; no further information was yielded by the chest; an internal examination of the larynx was out of the question, and no collateral signs threw any light on the case. The diagnosis was not made, but the necropsy, which occurred two days later, proved that my suspicion had been correct, though the means of diagnosis were at fault. The patient had died from the pressure of an aneurysm of the arch of the aorta on the trachea and bronchi. Had I had the additional help of a sign such as tracheal tugging (but this was long before the appearance of Professor MacDonnell's paper) the case would most probably have been correctly diagnosed.

Similar instances must be within the experience of most hospital physicians. They form a distinct class, in which Oliver's test is indispensable, because it may supply confirmatory evidence for a diagnosis which otherwise would be pure guess-work, and because it can be applied, even in the worst cases, without danger or distress to the patient. In my opinion, the value of the test is not destroyed by the fact that slighter degrees of tracheal tugging are to be observed in a large number of healthy individuals.

Two important questions will require for their solution further observations and careful study: (1) Can an aneurysm of the arch of the aorta be present without yielding Oliver's sign? and (2) Is tracheal tugging ever strongly developed, except in cases of aortic aneurysm or dilatation involving the transverse portion?

Professor MacDonnell has shown, and I am now able to show, that aneurysm of the ascending aorta does not necessarily occasion tugging. This, again, might be thought to lessen—my own impression is that it raises—the practical value of the sign. In these cases the difficulty does not reside, as when the disease is limited to the transverse portion, in the discovery of the aneurysm, but in an estimation of its size. What we want to find is whether the aneurysm does or does not involve the arch of the aorta also. If strong tugging could only be produced by disease of the transverse position its localising value would be in proportion to this strict limitation; and we should derive from its occurrence in disease of the ascending portion most important information.

I have at the present time under treatment two cases of aneurysm of the ascending aorta, with pulsation in the right third intercostal space, between the nipple line and the sternum. In one of these men marked tracheal tugging occurs; in the other (whose pulsating tumour was rather larger than that of the first) it is completely absent. How do these two aneurysms differ in size and in shape? Do they both, or does only one of them, implicate the arch? Tracheal tugging may in the future enable us to determine important differences of this kind; for the present it has at least succeeded in calling our attention to the possibility of diagnosing them long before the stage of laryngeal symptoms—this alone is an advance.

The Supposed Mechanism of Tracheal Tugging.—The accompanying diagram shows that the surface of contact between the arch of the aorta and the left bronchus is of very limited extent (from A to R). Any circumstance which will cause the vessel to sit tightly instead of loosely astride the bronchus would presumably give rise to tugging. Thus, a considerable aortic dilatation or an aneurysm, if occurring

at that part, would occasion the sign. With regard to aneurysm, it may be remarked that, since internal space is occupied—whether the lower or whether the upper aspect of the transverse portion be involved—closer contact with or even pressure on the bronchus would result in both cases.

Fig. 2.—Diagram of the trachea, main bronchi, aorta, and pulmonary to illustrate tracheal tugging. A, transverse portion arching over the left bronchus; P, pulmonary artery before its bifurcation; R, recurrent laryngeal nerve, just external to the ductus arteriosus. The right and the left auricular appendix and the conus arteriosus are also in view. The arrow shows the direction of the tugging.

When the ascending portion is alone involved the conditions are quite different. Pressure may bear on the right bronchus and on the tracheal bifurcation, but no pressure arises from above such as would depress the left bronchus. Indeed, if I am right in thinking that the effect of an aneurysm of this sort is to lengthen the axis as well as the transverse diameter of the aortic segment involved, a previously tight-fitting arch might become loosened. This explanation has suggested itself for the apparent anomaly in one of the two cases of pulsating aneurysm mentioned above. It is open to us to assume that in this patient—not presenting tracheal tugging—the transverse part of the arch is free from dilatation, whilst dilatation probably exists in the other case.

If, however, Dr. Grimsdale's idea should prove to be correct, and that it should be established at some future time that tracheal tugging can result only from such aneurysms as involve the posterior and inferior aspect of the vessel, then the localising value of the sign would be still greater, and we might even find ourselves in possession (see Fig. 2) of two alternative means of diagnosis: tracheal tugging occurring without laryngeal symptoms might point to the existence of a very small aneurysm, threatening death by rupture into the left bronchus; whilst paralysis of the left vocal cord, occurring in the absence of tracheal tugging, might be interpreted to mean that the bronchus was not under pressure, although some bulging of the anterior surface of the arch had occurred.

The General Clinical Value of Tracheal Tugging.—The foregoing remarks, although partly speculative, may justify the view which I take of the importance of tracheal tugging in the diagnosis of aneurysm. There is, however, a further aspect to this subject. What significance are we to attach to the relatively frequent occurrence of slight tugging in healthy persons? The presence or the absence of this peculiarity constitutes a difference between individuals which must have its meaning, and which probably will have its future uses, perhaps in directions far removed from the diagnosis of aneurysm. Any clinical sign is worth studying in itself,

irrespective of its practical applications. Moreover, the uncertainty still prevailing as to the mechanism of tracheal tugging in particular should be an additional incentive to research. As an outward sign of deep-seated internal events, I believe that tracheal tugging will acquire as much clinical importance as the other vascular and cardiac impulses which we have been trained to observe. In any case, this is a subject worthy of thorough investigation on a much larger scale than I have had leisure to attempt; and physicians should not lightly neglect the opportunity afforded to them by a large proportion of subjects of indirectly feeling the pulse of the transverse aorta.

It has not yet been pointed out that the left bronchus has a still closer connection with the left pulmonary artery than with the aorta, whilst the arch formed by the former vessel is much shorter and less curved than the aortic arch. Perhaps the slight tugging discovered in healthy persons may have its origin in the normal pulsation of the pulmonary artery.

CASES OF SUPPURATIVE AND TUBERCULOUS PERITONITIS ILLUSTRATIVE OF THE CURATIVE EFFECT OF ABDOMINAL SECTION AND DRAINAGE.

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In reporting successful surgical cases, I fear that many of us are guilty of giving an account of the immediate results without regard to the subsequent course of events. If any excuse be needed for reporting the following cases of suppurative and tuberculous peritonitis treated by abdominal section, lavage, and drainage, it must lie in the fact that I am able to give a thoroughly reliable after-history, proving that a complete and permanent cure has resulted in each case.

CASE I.—Emma P., aged 9, a weak, sickly-looking child with a tuberculous family history, was seized suddenly, without apparent cause, one night in April, 1890, with severe pain on the right side of the abdomen near the cæcum. When seen by my brother, Mr. Herbert Robson, her ordinary medical attendant, there was localised tenderness over the cæcum, but no fluctuation could be felt, nor was fluctuation discovered for nearly a week. The child was very ill generally, and was treated by sedatives and careful dieting; but operation was resolutely declined. At the end of a week the peritonitis had apparently extended to the whole of the abdomen, and no food could be taken on account of the vomiting. The little patient had wasted extremely rapidly.

At this time I was asked to see the child, but still the friends were very much averse to operation, which, although recommended, could not be strongly pressed, as it looked as if the child must die in any case. Eventually, however, in the fourth week, when the patient was almost worn to a skeleton, and it became evident that she must die very shortly if unrelieved, the parents gave their consent. Fluctuation was then very distinct all over the lower part of the abdomen. After the abdomen had been thoroughly cleansed with benzoline, and aseptically, it was opened in the middle line, a little below the umbilicus, by an incision about an inch in length, when pus immediately welled up, and several pints were evacuated. The abdomen was then thoroughly washed out with many pints of hot boracic lotion until the fluid returned clear. As the parts in the pouch of Douglas were so much matted, I thought it unsafe to employ a glass drainage tube, hence a large soft rubber tube was inserted for several inches. Two silk-worm-gut sutures closed the parietal incision beyond the tube. From this time the child steadily improved: she began to take food the next day; all pain ceased; there was no more vomiting; and in fact recovery was uninterrupted. The drainage tube was shortened at the end of a week and was removed in the third week, as the discharge had then practically ceased. At first the dressings, which consisted of sal alembroth gauze next the wound, and salufer wool over that, were changed daily, but later every second or third day. It is two years since the operation, and my brother assures me that the patient is now stout and strong, and in every way in excellent health.

CASE II.—Mrs. W. M., aged 22, a delicate looking woman, with a tuberculous family history, was operated on in the Leeds Infirmary on May 1st, 1890. She said that she had been confined of her first child in June 1888, and that she was quite well up to February 1890, when, being 8 months pregnant of her second child, she attended a funeral and got wet through. She shivered the same day, severe abdominal pain set in the day following, and she was prematurely delivered of a living child the following week. At the time of her accouchement the temperature, as I was informed by the medical man who attended her, was 102°; and although the lochia kept sweet and, so far as the labour was concerned, all appeared to be going on well, the temperature for the next few weeks ranged between 99° and 103°, and before long fluid could be distinctly felt in the abdomen.

I saw the patient in consultation in March, 1890, when I diagnosed tuberculous peritonitis and recommended operation, which was however declined. About 8 weeks after labour, clear fluid flowed from a small opening close to the umbilicus. The patient, however, still went from bad to worse, lost flesh, suffered from night sweats and evening

fever, and although she took a fair amount of nourishment it seemed to do her no good.

In April she was admitted to the infirmary in a very exhausted condition, there being then a small sinus near the umbilicus through which offensive pus was being discharged. On May 1st the abdomen was opened by an incision extending from $\frac{1}{2}$ inch above the umbilicus to half an inch below it, when about two pints of greenish yellow pus with a very offensive odour gushed out. The cavity was then thoroughly washed out with salufer lotion, 10 grains to the pint. Intestines formed the walls and floor of the pus-containing cavity. The edges of the fistula, which communicated by a slightly circuitous route with the abscess cavity, were thoroughly scraped, the cavity was again well irrigated and a large india-rubber tube inserted. It was dressed on May 2nd and again on May 3rd when there was very little discharge. On May 9th the drainage tube was shortened, and on May 12th it was removed. On May 28th, the wound had healed and the patient was allowed to sit up. She returned to her home on May 31st taking food well, being free from all pain and having improved very much in every sense of the word. I had the opportunity of seeing her a short time since, that is, nearly two years after the operation, and she was looking the picture of health. Her medical attendant tells me that she not only looks healthy, but that generally and locally she is extremely well.

CASE III.—The following letter from Dr. Gordon Black of Harrogate, gives a history of the case up to the time of my seeing the patient on March 7th, 1889. "I am trying to induce a poor girl aged 15, whose case I think you will agree is an interesting one, to become a patient of yours at the infirmary. She has never menstruated. Since about Christmas there has been an increasing fluctuating swelling in the hypogastric region which is very painful on pressure. During the last two months she has been subject to attacks of severe pain of a colicky character. About Christmas she also suffered from severe cough and congestion of of the apex of the left lung, with dulness and sub-crepitant râles. This condition cleared up on treatment, but the general ill-health and emaciation are extreme, and unless something is done, I fear she will not last long. I have made a careful vaginal examination under ether, but cannot find any tumour or feel fluctuation there, and the uterus is quite infantile. The swelling does not behave like ascites. It is central and I cannot feel any hard tumour. If you decide on operation, I would urge its being done without loss of time, as the girl is losing health and flesh rapidly."

A diagnosis of tuberculous peritonitis was made and abdominal section recommended; for which purpose she was admitted to the infirmary in March 1889. At the time of operation, the patient was in such an emaciated state that it seemed quite impossible to hope for much benefit from any form of treatment, but as there was distinct fluctuation at the lower part of the abdomen, operation was decided on.

Through a small incision in the linea alba, the abdomen was explored and the peritoneal and visceral surfaces were found to be covered with miliary tubercle, the mesentery being thickened and the intestines adherent and matted; several nodules were removed for confirmatory diagnosis, and were found to contain tubercle bacilli. The abdomen was well washed out with boracic lotion, and a drainage tube left in. The tube remained *in situ* for about ten days, when, the secretion of fluid having apparently ceased, it was removed. The patient immediately after the operation began to pick up flesh, and before she left had gained several pounds in weight.

Her condition on March 23rd 1891, two years after, will be seen by the following letter, received from Dr. Black. "In reply to your inquiry as to the present state of health of Miss O., upon whom you operated for tuberculous peritonitis two years ago, I am very pleased to report that she is in perfect health. I called to see her to-day, and certainly was surprised at the wonderful change in her personal appearance."

She and the rest of her family were pale, sickly, and cadaverous-looking as a rule; just the kind of people to develop tuberculous ailments. To-day Miss O. is stout and well conditioned with a healthy bloom on the cheek, indeed she looks the picture of health. She is as I remarked to the mother, by far the best looking of the family now. She has never ailed anything since the operation. There has been no pain in the abdomen of any kind, and the menses, which had never been established, are now perfectly regular. You may certainly hesitate no longer to put this case down as a 'cure' in every sense of the word."

Were it needful I could add, from my own experience alone, very considerably to this list of cases, as they are by no means exceptional.

I have spoken of the first two cases as suppurative peritonitis, since it was difficult to make an exact diagnosis of the cause of either. The first case, from its sudden onset and its commencing near the cæcum, probably had its origin in the appendix vermiformis; the second was probably tuberculous in origin, although at the time of operation no miliary tubercles were seen. Concerning the diagnosis in the third case, no doubt can be entertained, and even if no other evidence were obtainable, it alone proves that tuberculous peritonitis may be completely recovered from. It is quite easy to understand the *rationale* of the cure by operation in cases of suppurative peritonitis, but it seems to me that no wholly sufficient explanation has yet been given of the relief or cure effected by laparotomy in tuberculosis of the peritoneum.

At one time I thought that it was useless operating except in tuberculous peritonitis with effusion, but from what I have seen of operation where there was little or no effusion, and where adhesions were simply separated and the parts sponged or washed out, drainage being sometimes used at others not, I am inclined to think that this opinion, already modified, may need completely changing. In the meantime several such cases on which I have operated are under observation