Remarks

ON

APICAL AND SUBAPICAL TUBERCULOSIS.*

BY

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PATHOLOGIC anatomists and clinicians have known for many years that the number of people with tuberculous lesions in the lungs is much higher than that of those suffering and dying from actual tuberculous disease. Apical tuberculosis—active, quiescent, completely cicatrized, or calcified—is a banal incidental finding at necropsies of persons who have succumbed to any other disease, and who during life have either not known at all that they had lung trouble or considered their pulmonary symptoms of little if any significance. Of the 60 to 90 per cent. of tuberculous foci observed in routine necropsies, 30 to 60 per cent. are found to have been "obsolete." In other words, it appears that a large proportion of tuberculous lesions of the lungs heal spontaneously. This confirms the common observation of clinicians, who often find unequivocal symptoms and signs of apical lesions, yet the patients are getting along fairly well with or without treatment. These are facts known to all who have given this subject thoughtful attention in their routine work in sanatoriums, in dispensaries, and in private practice, and may be considered clinical platitudes.

Our great problem has been to differentiate these benign cases from the numerous others that are progressive and require treatment, be it climatic, institutional, or operative. Heretofore we held to the dictum—or should I say dogma?—that when there are changes in the resonance and breath sounds, perhaps also some adventitious sounds, over the region of the lung above the second or first rib, the patient is tuberculous; if there are also such constitutional symptoms as cough, loss of weight, fever, haemoptosis, etc., there is no doubt that there is an active lesion which must be cared for in accordance with the principles of modern phthisiotherapy. On the other hand, if the signs indicate a lesion lower than the apex, the chances of its being tuberculous are remote; at any rate, considerable circumspection must be exercised before pronouncing the patient tuberculous.

During the first years of wide application of the Roentgen rays in the diagnosis of pulmonary pathology these diagnostic principles appeared to have been confirmed. But with the more universal use of the Roentgen rays there has taken place during the past five years a radical change in our views of the early localization and evolution of tuberculous lesions in the lungs. It has been observed that in a decidedly noteworthy proportion of active and progressive cases the first lesions—those responsible for the initial symptoms of the disease—are located below the clavicle, while the apices remain free from pathological changes for some time. This is what some writers have called the "new doctrine" of subclavicular localization of fresh and active tuberculosis. Further research has confirmed the traditional teaching that apical lesions are very common, more common than those located below the clavicle, but they are, in the vast majority of cases, sclerotic in nature and display no tendency to cause symptoms of phthisis, which are disabling and lead to a fatal issue. In fact, it appears that these apical lesions are the ones that are so often found at necropsies of patients who died from other causes, and who during life had not suffered from disease of the lungs.

This "new doctrine" of subclavicular localization of tuberculous lesions is quite old when one considers the work of several British pathologists and clinicians. In his

Goulstonian Lectures of 1882 on "Pulmonary Cavities," William Ewart¹ is very explicit in his description of the "so-called apex lesion," which he found much below the apex of the lung in many cases:

"In the later stages of pulmonary consumption, it must be conceded, the vomica commonly extends to the summit of the lung. It is habitual, however, even at this stage, to find the cavity lateral rather than median in its axis; and I may state at once that the extension of a cavity to the periphery is mainly a matter of time. We cannot, therefore, with safety draw a conclusion from the size and position of the late cavity as to the size and situation of the earlier disease. Clinical observation supplies us with valuable evidence in our endeavour to settle the question. *A careful diagnosis will not fail to convince us that the early consolidations are more commonly seated in the subclavicular region than at the apex.* The same fact is often capable of direct demonstration, when at the time of death one of the lungs is as yet but slightly affected. I do not wish to underrate the clinical value of an examination of the supraclavicular space. This is undoubtedly a position in which the signs of the disease are very early perceptible; but I have not encountered breaking down in this situation with as much frequency as in the inner or in the outer subclavicular region." (Italics mine.)

Sir James Kingston Fowler² is another British physician who was well acquainted with the subclavicular localization of early tuberculous lesions before Central European clinicians and roentgenologists described them in detail. He emphasizes that:

"the extreme apex of the lung is not often the site of the primary lesion. . . . *It is situated from an inch to an inch and a half below the summit of the lung, and rather nearer to its posterior and external borders.* . . . A second and less usual site of the primary affection of the apex corresponds to the chest wall within the first and second interspaces below the outer third of the clavicle. The lines of extension are usually downwards, so that after a time an oval area of lung is involved, occupying the outer part of the upper lobe. *It is possibly true that the spread of the disease is more rapid when the primary lesion occupies this site.* The lesions in the advanced stages—induration and cavities—are formed by the coalescence and extension of these primary foci." (Italics mine.)

Subsequently Birch-Hirschfeld,³ Schmorl,⁴ Aschoff,⁵ and other pathological anatomists showed that the initial lesion of pulmonary tuberculosis is not usually found in the real apex of the lung but lower down.

But these anatomical and clinical observations were neglected for many years, merely because the physical signs of tuberculosis in its earliest stage, if decisive at all, point to the lesion being localized in the apex. It remained for the Roentgen rays to clear up this point. Dr. Harry Wessler⁶ of New York seems to have been the first to describe opacities on the Roentgen picture which are "the earliest evidences of the disease," and which "are less often found in what is clinically known as the apex than in the infraclavicular region. Furthermore, the axillary half of the lung is more apt to be involved in the beginning than the mesial half." Then came Dr. Herbert Assmann⁷ of Leipzig, who showed that these early lesions in active and progressive tuberculosis of the lung can only exceptionally be demonstrated by physical signs, but are usually found on the Roentgen picture to be located below the clavicle. Since Assmann's paper there have appeared many others—for example, those of Romberg,⁸ Lydtin,⁹ Redeker,¹⁰ Baumeister,¹¹ Fishberg,¹² H. V. Morlock,¹³ and many others—tending to confirm these observations.

APICAL LESIONS.

It must be emphasized at the onset that the vast majority of tuberculous lesions are found in the apex of the lung, and they remain circumscribed to that region. This point is best shown at necropsies in persons who succumbed to causes other than tuberculosis. Nearly all lesions in the lung which had cicatrized, remained inactive, and gave no trouble during the life of the individual are in the apices. One may also discover them during thorough and careful physical examination of chests of persons who have had no constitutional symptoms of phthisis. These lesions are very often discovered clinically and with the aid of the Roentgen rays during the course of the periodical examinations of the healthy, which are becoming the vogue

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in the United States. In patients with extrathoracic tuberculous lesions, as of the skin, the kidneys, the adnexa, the bones, joints, or glands, and who are very often referred for chest examination, the lesions are almost invariably found in the apex, as may be evident from the changes in resonance, breath sounds, and perhaps some adventitious sounds discovered over that region. But it is noteworthy that such patients hardly ever suffer from significant pulmonary symptoms. Their troubles are those of the extrathoracic lesions. In most of these cases, if death ensues because of the tuberculous infection, it results from acute pneumonic phthisis, or more commonly miliary tuberculosis. Similar apical lesions are found in many persons without extrathoracic tuberculosis. They suffer from frequent "colds"; at times they have subfebrile reactions lasting a few days or weeks. They are rather slim, though now and then we meet some who are more or less obese, especially those who have pulmonary emphysema in addition to the apical lesions. They may spit blood, even copious haemorrhages may occur, and tubercle bacilli may be demonstrated in the sputum. Apical retraction is perhaps evident on inspection of the thorax, and the changes elicited by auscultation and percussion are those described as typical of early tuberculosis. But with or without any therapeutic intervention they are doing well, as a rule. They live indefinitely unless carried off by some intercurrent disease. They are diagnosed as tuberculous by ultra-cautious physicians, and they supply the clinical material for any "cure" which happens to be introduced at the time, proving the efficacy of the particular remedy or method of treatment. They also supply the "early" and the "curable" cases considered ideally suitable for sanatorium treatment. These lesions are apparently the residua of childhood infection which had become obsolete, only to be discovered when a physical examination of the chest is made for any reason.

During recent years there has appeared evidence to the effect that lesions limited to the apex of the lung only exceptionally develop into active and progressive tuberculosis which requires treatment, and which is the cause of death in about 10 per cent. of civilized humanity. Statistics collated by Bräuning,¹⁴ Lydlin,⁹ Redeker,¹⁰ Kayser-Petersen,¹⁵ and others tend to show that only about 7 per cent. of these persons with apical lesions develop active and progressive tuberculosis or die from this disease. From figures given later on it will be seen that while these findings are more favourable than our own, yet it must be acknowledged that the outlook in real apical tuberculosis is good in the large majority of cases.

That there is a type of pulmonary tuberculosis which runs a benign course has been known for a long time. We speak of "abortive tuberculosis," which presents symptoms and signs of the disease, even tubercle bacilli in the sputum, but the patient recovers quickly with or without treatment. In many cases this is the end of the trouble, but in others the symptoms recur at irregular intervals, the patient being considered either as "subject to colds," or as tuberculous, depending on the skill in physical diagnosis of the physician or the employment of the Roentgen rays. This group, which is not inconsiderable, is usually made up of persons with tuberculous lesions limited to the apical region. It also makes up the large contingent of "repeaters" at sanatoriums, patients admitted with minimal lesions, kept for a few months, and discharged with the disease arrested or cured, to be readmitted within a comparatively short time, again as incipient cases, to be shortly discharged for the same reasons as on previous admissions. It is remarkable that they nearly always remain "incipients." I have cases at Bedford Hills Sanatorium and at the Montefiore Hospital that have been in these and in other institutions five and even more times, and the lesions, limited to the apices, are found to be of the same character and extent at each admission. We meet bearers of these apical lesions in droves at health resorts which accommodate well-to-do consumptives, who feel that they must stay at the sanatorium for life, and claim that as soon as they return home they have a relapse. They nearly all have apical lesions, if any at all, which never spread, and show no symptoms of progression. Some French authors have spoken of them as recurrent apical pleurisy,

while German physicians, notably Krönig, described them as "collapse induration," altogether of non-tuberculous origin and occurring mainly in mouth-breathers. With a view to differentiating them from progressive phthisis Neisser¹⁶ spoke of these apical cases as "tuberculosoid." What had not been emphasized until recently, however, is the fact that these lesions are limited to the apex, and remain so limited indefinitely.

Correlating these cases with the fact that nearly everybody has been infected with tubercle bacilli during early life, it would appear that they originate in the primary infection which took place during childhood, and, because of the strong resistance of the individual concerned, the lesion cicatrized. In some instances we may note that the lesion became calcified. As a rule they do not require prolonged and costly treatment; there is no reason for banishing them to distant climes. It is only phthisiophobia that urges them to remain away from home for years, as is the case with many in sanatoriums and health resorts. They are easily diagnosed by the physical signs, which are those described in textbooks and monographs as pathognomonic of "incipient" tuberculosis, and with the aid of the Roentgen rays, which show clearly shrinkage of one or both apices. In some cases of fibroid phthisis of the emphysematous type, or those showing the stigmata of diffuse tuberculous fibrosis, there are physical and Roentgen signs of apical lesions, unilateral or bilateral. They live on for years in comparative comfort. I have had under my care some who have thus continued at their avocations for over twenty years. It is probably true that in nearly all such cases the onset is very insidious, but inasmuch as the usual reasons for their seeking medical advice are transient acute or subacute episodes, the onset is at times put down as more or less sudden. As has already been mentioned, many are discovered during a routine examination, but more often as a result of some intercurrent non-specific respiratory infection, influenza, or "grippe." Real exacerbations of the tuberculous lesions, which occur now and then, are usually short-lived; recovery is rapid, and a change of environment for a few weeks works magically. One thing is to be mentioned: these cases are the backbone of the favourable sanatorium statistics. Without these apical cases, the results of sanatorium treatment in climatic resorts would not make as good a showing as they do.

SUBAPICAL LESIONS.

Pulmonary tuberculosis of more serious prognostic significance generally begins differently, has a relatively abrupt onset, and the lesion is located below the clavicle in the vast majority of cases. A patient, who has no history of previous pulmonary complaints, who had not been "subject to colds," begins to feel tired at the least exertion, coughs, has night sweats, and, in some instances, expectorates blood. Physical examination of the chest does not reveal signs which would clinch the diagnosis of a localized lesion in the lung. There may be impairment of resonance, perhaps some prolongation of the expiratory murmur in the region of the second or third interspace, or the interscapular space, but this is not sufficient to make a diagnosis of a localized lesion. For this reason valuable time may be lost unless microscopic examination of the sputum reveals tubercle bacilli, or the Roentgen examination discloses a soft, cloudy patch, isolated in the midst of apparently healthy lung tissue, just below the clavicle and often toward the axillary portion of the lung. The nature of the patch is broncho-pneumonic, of the type seen in primary tuberculosis in children, or in tuberculous pneumonia in adults. In most cases it is found on a level with the second or third interspace, but it may be located lower down, even in the lower lobe. It may be small, the size of a cherry, or larger, involving the greater part of the upper lobe. The apical region appears free from pathological changes. The shadow may be distinct and clear-cut, but in most cases it has an irregular outline. Inasmuch as softening of the caseous material may take place rapidly, the formation of excavations occurs at times very soon, and we may find at the first Roentgen examination signs of an isolated cavity surrounded by a thin shell in the midst of unaltered lung.

These early lesions occur mainly in young persons and adolescents, though I have met with many in persons over 45 years of age. The age incidence of subapical lesions as compared with apical is shown in the appended table which Dr. Arnold Shamaskin and I compiled from an examination of radiograms of 1,000 patients admitted to Bedford Hills Sanatorium within the past five years. Of these, in only 167 cases could the location of the first lesion be determined with a certain degree of exactitude.

TABLE I.—Age Incidence of Apical and Subapical Lesions.

Age.	Subapical lesions.		Apical lesions.	
	Number.	Per cent.	Number.	Per cent.
Under 20 years ...	36	33.7	8	13.3
20 to 25 " ...	29	27.1	14	23.3
25 to 35 " ...	30	28.0	19	31.7
35 to 45 " ...	9	8.4	12	20.0
45 and over ...	3	2.8	7	11.7

It will be noted that over 60 per cent. of subapical lesions manifest themselves in persons under 25 years of age, as against 36 per cent. of apical lesions. On the other hand, the percentages are 11 and 32 respectively in persons over 35 years of age. In our daily practice we meet with these subapical cases more often in individuals under 25 years who feel out of sorts, but in whom careful physical exploration of the chest reveals nothing definite. Unless a good radiogram is taken, or tubercle bacilli are found in the sputum, the patient is apt to be treated for neurasthenia, bronchitis, "gastritis," or any other minor ailment. It is only after the lesion has spread upward, involving the summit of the lung, and physical signs are easily elicited, that the diagnosis of tuberculosis is made. It is for this reason, perhaps more than any other, that these subapical lesions formerly eluded us. It also appears that chronic phthisis without any definite physical signs, often described by authors of former generations, also pulmonary haemorrhages in persons without signs of lung lesions, were often manifestations of subapical lesions.

It is a peculiar fact that the first cases of subapical tuberculosis reported were mainly in individuals who had been exposed to contact infection with tubercle bacilli to a greater degree than the average person—such as medical students, bacteriologists, physicians in hospitals and sanatoriums, nurses, relatives of patients with active tuberculosis, etc. Hence the conclusion was drawn that they are the result of recent exogenous superinfection. The fact that the x-ray appearance of the lesion is not unlike the kind seen in children in whom the infection is undoubtedly primary seemed to confirm this view. But further observation has shown that many more cases are discovered in individuals who had not been unduly exposed to potential sources of infection. Moreover, in the vast majority of our cases we find sufficient evidence of earlier tuberculous infection, and only rarely are the regional lymph glands found to be enlarged, which would be the case in primary, exogenous entry of the virus. This sort of lesion is also encountered in patients with old extrathoracic tuberculosis.

It is well known that persons unduly exposed to tuberculous infection are just the ones who, when feeling out of sorts, will utilize modern methods of diagnosis earlier than others. Physicians, nurses, and relatives of patients with active tuberculous lesions will have their sputum examined, and x-ray films made, as soon as they cough or lose in weight; and for this reason these lesions, which can only be discovered very early, are found more often in this class of people.

The nature of these early lesions has been the subject of considerable discussion. Anatomic and radiographic studies of tuberculous lesions of this type in children and in adults show clearly that they are broncho-pneumonic. The recently emphasized fact that they often undergo involution—that is, are absorbed, leaving hardly any trace—is interesting, even though it has been known for a long time

that tuberculous lesions are very often absorbed. On the other hand, some authors speak of them as perifocal inflammatory processes, only the centre of which is tuberculous and is surrounded by a large area in which an allergic reaction has so increased the density of the lung, particularly by a process of exudation, that the characteristic radiographic appearance is produced. According to this conception the tuberculous lesion is rather small, and when the perifocal anatomically non-specific exudate is absorbed hardly any traces may be left as far as the x-ray picture shows. Unfortunately there is little actual anatomic evidence that such is the actual course of events. Nevertheless there is a great deal in favour of this view when we recall other allergic reactions in the tuberculous. Thus injections of excessive doses of tuberculin produce the well-known focal reaction because of tissue allergy, which generally disappears sooner or later. After pulmonary haemorrhages also we often observe such phenomena in tuberculous lungs; they can be readily followed by any method of examination, physical or radiographic—the spread of the lesion being temporary and disappearing soon after the haemorrhage ceases.

PROGNOSIS.

It has already been mentioned that the prognosis in apical lesions is more favourable than in the subapical. Those with lesions limited to the apices last much longer, and may continue at their avocations for many years. This point is well shown in Table II.

TABLE II.—Duration of the Disease.

Age.	Subapical lesions.		Apical lesions.	
	Number.	Per cent.	Number.	Per cent.
Under 1 year ...	28	25.2	8	13.3
1 to 3 years ...	48	44.9	12	20.0
3 to 5 " ...	20	18.7	9	15.0
5 to 10 " ...	9	8.4	12	20.0
10 and over ...	2	1.8	19	31.7

Among the patients at the Bedford Hills Sanatorium less than 2 per cent. with subapical lesions had been sick for ten years or more, as against 32 per cent. of those with apical lesions; over five years, the percentages are 10 and 52 respectively. The main contingent of progressive cases, leading to serious illness and ultimately to a fatal issue, is derived from the subapical group.

We have found that patients with apical lesions have generally mild, and but rarely severe, brief exacerbations of symptoms at irregular intervals, while prolonged, continuous, or remittent febrile reactions are uncommon. In fact, the enormous number of patients in sanatoriums that run an afebrile course with slight febrile episodes which abate soon are mainly those with lesions limited to the apices. Among our patients at the Bedford Hills Sanatorium we found that 70 per cent. of those with apical lesions ran an afebrile course, while of those with subclavicular lesions only 42 per cent. were afebrile. Blood-spitting, on the other hand, is about as common in one group as in the other, but this refers only to streaked sputum or mild haemoptysis. Copious haemorrhages are more common in patients with subclavicular lesions. The following table illustrates this point:

TABLE III.—Incidence of Pulmonary Haemorrhage.

Haemoptysis.	Apical lesions.		Subclavicular lesions.	
	Number.	Per cent.	Number.	Per cent.
None ...	28	46.7	42	39.2
Streaked sputum ...	15	25.0	33	21.6
Copious haemorrhages ...	17	28.3	42	39.2

EVOLUTION OF THE SUBCLAVICULAR LESION.

The progress of the subclavicular lesion can be followed only with the aid of serial radiograms. The lesion may remain unaltered for weeks and months. With the improvement in the general condition involution may take place and the infiltration is absorbed, leaving merely linear markings denoting fibrosis. In other cases signs of thickened interlobar pleura remain. In rare instances calcification of the lesion takes place and there remain sharply demarcated, homogeneous spots immediately below or above the clavicle. The patient may remain well indefinitely. The number that terminate thus is much larger than is generally appreciated.

In active and progressive cases the lesion usually extends upward, involving the summit of the lung, and there results the common variety of chronic phthisis in any of its protean forms. It is then that it can be easily diagnosed by the physical signs, and for this reason the really early lesions were generally overlooked prior to the universal application of the Roentgen rays for diagnosis. In some patients the infiltration extends both upward and downward, so that an entire lobe is involved in a short time, at times a whole lung. The clinical picture is then that of acute pneumonic phthisis. I have seen cases of this type which ran their complete course within a few weeks.

In a large proportion of cases the lesion caseates, softens, is expectorated, and finally leaves an excavation. These early cavities may form quickly, within a few weeks after the first symptoms of the disease appear, and in fact even before one has any suspicion that he is dealing with tuberculosis. I meet with such cavities now and then in patients who had felt out of sorts for one or two weeks only. As a rule, these cavities are not revealed by physical signs; only the Roentgen rays disclose them. They have certain characteristics which differentiate them from excavations formed later in the disease. They appear on the radiogram as spherical or oval in shape, isolated in the midst of apparently healthy lung tissue, surrounded by a sharply demarcated border consisting of a thin or moderately thick wall; in exceptional cases a shifting fluid-level may be noted at the most dependent part. It is noteworthy that the area within the walls of the cavity may exhibit lung markings not unlike those in the remainder of the lung, thus demonstrating the integrity of the parenchyma in front of or behind the excavation.

These early cavities are usually located below the clavicle, though at times we find them in any part of the lung, even in the lower lobe. They may be multiple and coalesce to form the well-known honeycomb picture. Cavities formed later in the course of disease have thick walls, which are surrounded by infiltrated lung tissue, while around the early cavities the surrounding lung is apparently healthy. In many instances of late cavitation we find the lobe in which they are located completely obscured by a shadow in the midst of which there is brightness of variable degree. It is also noteworthy that in late cavities the mediastinal organs and also the trachea are, as a rule, drawn toward the affected side, owing to shrinkage of the lung, which is not common in cases with early excavations.

In exceptional instances these early cavities heal, as has been observed by all those who have taken serial radiograms of tuberculous patients. The circular shadow disappears, leaving linear markings pathognomonic of fibrosis or at times no visible trace at all. In fact, some authors have for this reason spoken of these "annular shadows" as representing pleural adhesions, localized pneumothoraces, etc., and not at all as excavations of the parenchyma. But more careful studies have shown conclusively that, with but extremely rare exceptions, they are cavities even though they heal.

In many cases of these subclavicular infiltrations the lesion spreads along the lymphatics so that on the radiogram there are dots and spots running from the original lesions outward and downward. In still others caseating areas suddenly appear in other parts of the same or the contra-

lateral lung. Now and then we meet with a case in which numerous isolated lesions of various sizes appear in one or both lungs simultaneously. The main characteristic of these lesions is that they develop quickly, and do not proceed by the direct continuous extension of the original lesion. An extensive lesion means, as a rule, coalescence of several of these infiltrations. As each new infiltration appears there is an exacerbation in the symptoms.

THERAPEUTIC INDICATIONS.

The differentiation of apical from subapical lesions is of immense therapeutic importance. To begin with, the prophylaxis of clinical tuberculosis is narrowed down mainly to the latter group. Among our patients at Bedford Hills Sanatorium we found that "open" tuberculosis—that is, the type of case in which there is expectoration of sputum containing demonstrable tubercle bacilli—is uncommon in the apical group. Tubercle bacilli were found in the sputum of 66.4 per cent. of patients with subclavicular lesions, as against only 15 per cent. with apical lesions. It is thus clear that strict isolation, the backbone of tuberculosis prevention, is not indicated in some 85 per cent. of apical cases. And prophylaxis is considered one of the main reasons for institutional treatment of tuberculosis.

It appears, further, that prolonged and costly treatment is unnecessary in the vast majority of apical cases. We have shown that they remain in good condition indefinitely, and only rarely develop active and progressive phthisis. The finding of signs of apical condensation, such as impairment of resonance, prolonged expiratory murmur, or even some adventitious sounds limited to the apical region in a patient with symptoms of a common cold, or "grippe," and radiographic confirmation that the changes are limited to the apical region, does not invariably mean urgency of climatic, institutional, or operative treatment. We may most often look to an early recovery after a few weeks' rest; perhaps a change of environment for a month or so will be effective in restoring the patient to health. Indeed, from my observations in sanatoriums in various countries it appears that a large proportion of patients with these apical lesions could be discharged with benefit to themselves, the institutions, and the communities which are charged with their care.

It is different with patients having subclavicular lesions. While many recover within a short time under any form of treatment, a large proportion are in need of careful attention. They have the symptoms of acute, subacute, or chronic phthisis which urgently requires treatment. Many are benefited by rest, at home or in institutions, but others require artificial pneumothorax. The latter should be induced early, before the formation of pleural adhesions, which are responsible for so many failures in collapse therapy. Induced early, when the filtration is still limited and circumscribed within the parenchyma, we usually find a free pleural cavity, so that it is feasible to collapse the entire or the greater part of the affected lung.

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