Original Articles.

VARIATIONS IN PULMONARY RESONANCE.

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GENERAL OBSERVATIONS.

For a number of years I have been studying variations in pulmonary resonance in order to determine their significance in cases in which the question of the existence of tuberculosis of the lungs might arise.

The frequency of slight dulness at the right apex above the clavicle in normal chests is well recognized, and requires no further comment; but when disease exists at the right apex, and when auscultation reveals no sign of it on the left, one would expect the right apex behind to be duller than the left. This is by no means always the case. In fact it was noticed repeatedly in cases in which the diagnosis of early pulmonary tuberculosis of the right apex had been made that slight dulness was found at the *right* apex in front and at the *left* apex behind; also that there were differences of resonance between the bases of the lungs in the back.

To throw light on the significance of these facts, supposedly normal chests were carefully examined, with the result that slight relative dulness at the left apex behind was found not infrequently.

The differences between the apices behind was less marked than that above the clavicles, but was definite enough to be recognized occasionally by students learning to percuss.

With regard to the bases behind, the problem is more complex because, as Dr. Richard C. Cabot has pointed out, stomach resonance can often be elicited in this region. It mixes with the lung resonance and modifies the sound by adding a tympanitic quality to the percussion note. This difference in quality of resonance sometimes makes it difficult to decide which side is the more resonant.

A series of one hundred supposedly normal chests has been studied recently in detail in order to provide more definite data on the occurrence of the variations mentioned above.

Resonance was compared above the clavicles, in the second interspace in front, and at the apices and bases behind. When comparing the apices behind it is important to select the most resonant point which is near the centre of the triangle formed by the upper edge of the trapezius muscle, the lateral muscles of the spine, and the spine of the scapula. Misleading results are likely to be obtained if the points selected for comparison are not symmetrically situated, because the best resonance covers a very limited area.

At the bases there is an area bounded by the spinal muscles, the diaphragm and the roll of the latissimus dorsi which has been called the "triangle of percussion." The best resonance in this region is found where the muscles are thinnest; that is to say, a little below the angle of the scapula and well above the diaphragm.

For the observations which follow, the lightest percussion was used which, in the individual case, would give a clear, resonant note. When heavier percussion is used, slight differences of resonance are more difficult to detect, but do not disappear.

MATERIALS.

Cases were excluded from the series if cardiac or pulmonary symptoms were complained of, if the past history gave evidence of phthisis, pleurisy, pneumonia or protracted cough, if careful examination showed anything abnormal, or if there was more than the usual slight asymmetry of the chest. Most of the obese patients were excluded also because such heavy percussion was required to elicit resonance that slight differences were difficult to detect. The series includes women only, nearly all of whom were over 20 years of age and none younger than 16. The cases were taken consecutively as they came to the Out-patient Clinic, without selection except as in above mentioned. The results in detail are shown in the table which follows.

While under examination the patients sat with hands in the lap, the shoulders relaxed as much as possible, and they were asked to bend forward slightly when the bases were being compared.

RESULTS.

Perhaps the most interesting facts brought out are that dulness at the right apex in front frequently extends below the clavicle to the second rib, that slight relative dulness of the left apex behind is common and that the same is true of the left base behind. Relative dulness of the left apex in front was found in only two cases. One of the patients was left-handed but the heart was in the usual position.

Relative dulness was generally, if not always, associated with increase of resistance.

TABLE OF RESULTS IN 100 CASES.

1. No definite difference of resonance at apices or base behind: 22 per cent.
2. Resonance slightly less at *right* apex in front above clavicle only: 27 per cent.
3. Resonance slightly less at right apex in front above clavicle and to second rib: 31 per cent.
4. Resonance slightly less at *left* apex above clavicle: 2 per cent. (one case was left-handed.)
5. Resonance slightly less at *right* apex behind: 7 per cent.
6. Resonance slightly less at *left* apex behind: 34 per cent.

FIG. 1. a Resonant area of apex. The crosses show the points at which resonance was compared. Outside of the circumscribed area relative dullness is to be expected.

7. Resonance slightly less at *right* base behind: 6 per cent.

8. Resonance slightly less at *left* base behind. 28 per cent.

DISCUSSION.

In attempting to explain slight relative dullness of the left apex behind, it may be observed that a little drooping of the right shoulder is extremely common. This was, in fact, observed in a large proportion of the cases even when every effort was made to have the patient sit straight. Drooping of the right shoulder is associated with slight relaxation of the muscles which cover the right apex behind, those on the left being relatively contracted. It is well known that differences in tension of muscles modifies resonance and that resonance is distinctly diminished over contracted muscles. This difference in muscle tension could easily account, I think, for most of the cases in which relative dullness was found at the left apex behind, but in some of the cases in which it occurred no such asymmetry was observed.

For relative dullness at the left base no such simple explanation presents itself. If the reverse were generally true, as it was in six of the cases, this might be explained on the ground that the right diaphragm is higher than the left and rests upon a large, solid organ, namely the liver. But, if this explanation is plausible, is it not at least as likely that the heart, which considerably diminishes the depth of lung on the left side, might diminish lung resonance below the angle of the scapula?

If we accept the view now prevailing that even very light percussion sets the depths of the lungs in vibration, is there anything improbable in the above hypothesis? I think not, and I am convinced that slight cardiac dullness can often be found by light percussion in the axilla,

FIG. 2. a a Most resonant areas. The crosses show the points at which resonance was compared. Outside of the circumscribed areas relative dullness is to be expected.

even when the heart is of normal size. (Relation of Dulness to Cardiac Outlines, *Boston Medical and Surgical Journal*, Vol. clxxiv, p. 301, 1916.) It would not seem surprising, therefore, if traces of it should appear in the back. The shape of the chest might determine its presence or absence there.

X-rays of the chest were taken in 6 of the patients. These showed slight abnormalities such as are found in 90-95 per cent. of all chests; but it seems improbable that these abnormalities bore an important relation to the findings above described.

CONCLUSIONS.

Slight differences in pulmonary resonance below the clavicles in front, and at the apices and bases behind, are common in chests which can properly be regarded as negative from a clinical standpoint. These differences are ordinarily disregarded. They are important when, for other reasons, the existence of pulmonary disease is suspected. Under these conditions they may lead the examiner to believe the disease is more extensive than it is, or they may be a factor in causing him to make a diagnosis of phthisis when it does not in fact exist.

I think that I have seen many cases in which the diagnosis of phthisis has been made on insufficient evidence, with resulting hardship to the patient, and that the variations of resonance above mentioned may have led to errors in this direction. On the other hand, it should be emphasized that the variations of resonance discussed here are slight, and that the importance of well-marked dullness for diagnosis is not in question.

To the skeptical it may be said that the variations above described have been confirmed by other physicians to whose attention they were called, and that even students learning percussion can sometimes recognize them.