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ON THE PHYSICAL EXAMINATION OF THE ABDOMEN IN HEALTH AND DISEASE.

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(*Continued from page* 203, *in Number for March* 1851.)

ACOUSTIC SIGNS—HEALTHY PERCUSSION SOUNDS.

THE acoustic signs of the abdomen are by no means so numerous or so important as those of the chest. The movements of respiration and circulation, and the sounds of the voice, which are the chief causes of the acoustic phenomena of the chest, extend only in an inferior degree to the abdomen; and they have here neither the same facilities for developing sounds, nor the same definite relation to those which actually do occur. Borborygmi of the stomach and intestines sometimes do strike up an accompaniment to the movements of breathing or of the heart that is obvious enough, and too noisy for the comfort of the patient; but beyond the point of showing the presence of air in an intestine deficient in tone, the phenomenon is of little significance. Nor do the spontaneous movements of the abdominal viscera themselves produce sounds of much importance in diagnosis: a few instances, however, will be noticed. By far the most important class of acoustic signs, are those elicited by percussion: these will first claim our attention; and subsequently those arising from the spontaneous movements of respiration, circulation, and peristaltic action, will be briefly considered.

As on the chest, so also on the abdomen, striking with the ends of the fingers produces a sound, varying according to the condition of the walls and the nature of the parts underneath. If the walls are flaccid, it may be difficult to elicit any distinct sound; and even when they are more tense, direct percussion on them yields but a muffled note, and is further objectionable as it may give pain. It is therefore expedient in all cases to use *mediate* percussion; by striking on a thin plate of wood or ivory, or, what answers every purpose, and

is far more convenient, on one or more fingers of the left hand, closely applied to the surface. Now, as this manœuvre both obtains a hard surface from which sound can be elicited, and supersedes any deficient tension in the walls, it affords the means of testing the acoustic properties of the parts underneath, and of thus determining their physical condition. Thus, if we percuss on a finger applied over the stomach or a portion of intestine containing air, we obtain a sonorous note, which we call *hollow*, from the experience that such a sound is emitted from hollow bodies when struck; or *tympanitic*, from its resemblance to the note of a little drum. On the other hand, if we strike over the thick part of the liver, or over the stomach or an intestine filled with liquid, or over the bladder distended with urine, the sound is dull and short, the materials underneath being incapable of receiving or prolonging the sonorous vibration. Again, there are intermediate or mixed stroke-sounds, such as those proceeding from a mixture of air and solid or liquid in the intestines; or from a layer of soft solid overlapping an intestine; and these sounds will vary in every degree, according as the aerial hollow, or the dull sounding liquid or solid, predominates.

In addition to the broad distinction between the hollow and the dull stroke-sounds of the abdomen, we shall find it instructive to analyse the hollow sounds, with the view to learn all that they can teach us of the conditions of the alimentary canal which they represent. The note resulting from percussion over the stomach on a portion of intestine will be deep and sonorous, in proportion to the extent of its hollow containing air. Thus, over the stomach distended with air, a peculiarly loud and deep tympanitic note may be elicited: and this may extend from the left hypochondrium upwards and backwards over three or four lower ribs at the side, and downwards and forwards nearly to the umbilicus. Another frequent situation of a deep full note, yet having its own character, is in the right iliac region over the cæcum; and this note sometimes reaches upwards towards the right hypochondrium. In other parts of the abdomen, over the convolutions of the small intestines, the tympanitic note is commonly much higher in pitch; and although giving the idea of a hollow underneath, represents it as of smaller dimensions. Further, on different spots, this higher note will be found to vary much in pitch and tone, from the different size and form of the cavities in the several portions of the intestinal tube.

Now although these tympanitic notes of the abdomen are subject to great variations, according to the amount of air present in each portion of the canal; yet they generally retain enough of a distinctive character to indicate more or less of the situation and condition of these parts. The fact that is most instructive is this, that each part has its proper note for the time being, however it may vary at different times. Thus, if striking on the cartilages of the lower left ribs elicits a deep hollow note, and precisely the same note is emitted on percussion of the lower ribs several inches further to the left, and of the abdominal walls some inches lower down, we know that the same hollow viscus (the stomach) occupies the whole of this extent. Possibly below the margin of the right ribs, in the same subject, percussion may produce another specimen of a deep hollow sound; but its difference of pitch or tone will show that it is seated over another cavity; and by tracing its limits, we may find it extending downwards on the right side

of the abdomen, in the situation of the ascending portion of the colon. Again, further down still, in the right iliac region, and stretching more or less towards the hypogastrium, we may encounter another deep-toned note, yet of a distinct pitch, proving its origin in a separate portion of the canal, most probably the cæcum. In other parts of the abdomen, we detect the more limited cavities of the small intestines; which are known, not only by the higher pitch of their note, but especially by its varying in key or tone over every two or three inches of surface; indicating the distinctness and limitation of their respective hollows.

It is obvious that sounds dependent on a circumstance so variable as the quantity of air in a given part of the alimentary canal, must be frequently changing their character and position; and it sometimes happens, even during examination, that a volume of air is shifted from one part of the bowel to another, or may be dispersed from the stomach by eructation. So, likewise, we may fail to find any of the deep sounds characteristic of a large body of air in any part of the abdomen, the portions present in the stomach and large intestines not exceeding those in the smaller bowels. Still these exceptions, which apply rather to healthy than to invalid subjects, do not destroy the utility of the general rule, that the deeper tones in the normal state indicate the position of the larger bowels. The best time for observing these distinctions, is as long as possible after a meal; the gaseous contents of the canal then usually bearing the largest proportion to the fluid and solid matters.

Besides the pitch or key of the hollow stroke-sounds of the abdomen, there are often other characters in them, such as a tinkling or metallic ring, or a musical or tubular note; or a modification of these, like the sound of dropping into water. These adventitious sounds are by no means significant in proportion to their loudness; and the best way to understand them and appreciate their meaning, is by tracing them to their true physical causes, as I have endeavoured to do with regard to the sounds of the chest.

The hollow or chest notes of the abdomen consist of one or more of the following elementary sounds:

I. The proper TYMPANIC SOUND, caused by the vibration of the walls of the cavity.

II. A METALLIC RESONANCE, or TINKLING ECHO, produced by transverse vibrations of the air in the cavity.

III. A TUBE-NOTE, arising from longitudinal vibrations of the air in one portion of intestine opening into another of larger dimensions.

These several sounds can be produced in the cavity of the mouth also; and as this affords a ready means of experimenting on them and illustrating their nature, we shall find it profitable to describe the parallel sounds thus developed.

1. With the mouth closed, and cheeks moderately inflated, if fillipping percussion (mediate or immediate) be practised on one cheek, a hollow sound is elicited, consisting of two distinct notes; and by varying the distension of the cheeks, the distinction between the two is rendered still more evident. One is deeper in tone, and depending on the vibrations of the cheeks themselves, is most clear when these are

moderately inflated, so as to be free to vibrate; it is fainter and raised in pitch by further inflating the cheeks, which by tightening them both, shortens and quickens their vibrations. This is the proper *tympanic sound*, being produced by the vibrations of the extended walls, like those of the parchment of a drum.

2. When the cheek is percussed in the manner just described, the deeper tympanic sound may be observed to be accompanied by a note of much higher pitch, of somewhat tinkling or metallic character; and this becomes more distinct, and somewhat lower in tone, on further inflating the cheeks, which has exactly an opposite effect on the tympanic sound. This acute note is like that of a china cup when struck; it depends on the vibrations of the air contained in the cavity; and these being reflected from side to side, produce a note varying with the diameter of the cavity. This is the *tinkling echo*, or *metallic note*. Like the metallic tinkling of pneumothorax, it is a true echo note, the shrill key of which is precisely determined by the rapidity with which the vibrations of the air are reflected backwards and forwards from wall to wall. Such a tinkling echo accompanies all impulses and noises communicated to the interior of smooth and free cavities containing air, and having little or no outward opening. A similar sound is heard on applying the ear to the bung-hole of a barrel, where the pitch is lower, and the reverberation prolonged; or to the mouth of a bottle of glass or india-rubber, in which it more resembles that of the mouth or intestinal canal.

3. The *tube-note* of the mouth is produced by striking the cheek with the mouth open, as for the pronunciation of the vowel O. This is the loudest and most musical of the three classes of sound, its pitch being readily determined by varying the size either of the cavity, or of the aperture at the mouth. This sound depends on the longitudinal vibrations of the air in the hollow of the mouth, which are less frequent, and the tone is deeper in proportion to its depth and the smallness of the opening. It is like the tubular note of the trachea in health, and that of the large bronchi in condensation of the lung.

The hollow percussion sounds of the abdomen consist of varieties or combinations of one or more of these several elementary sounds, especially the two first. In large cavities, as those of the stomach and large intestines, the most obvious is the tympanic sound, more or less deep in tone, produced by the vibration of the walls of the cavity. But on listening more closely, or with the ear or a stethoscope applied to the abdomen when the percussion is made, the tinkling echo of the interior may often be distinctly heard, and the more so, the nearer the bowel approaches to the surface, and is in a state of distension. Where a large portion of intestine is less distended, the drum sound is deeper in tone, with little or none of the tinkling echo. On the other hand a small portion of intestine much distended, yields a high tympanic note, more or less blended with its metallic accompaniment. A small intestine containing a moderate amount of air, gives a medium tympanic note with little or no tinkling; and this is the kind of sound commonly elicited over the region of the small intestines, the note somewhat varying, as before described, over each knuckle of intestine.

It may be questioned whether the third description of sound, the *tube-note*, is ever developed in the intestinal canal, seeing that it im-

plies that the tube is open at one end. However, I have sometimes elicited a note so very musical and tubular in character, generally over the region of the small intestines, as to make me suspect that it might be produced in a short tube of intestine opening into another of larger dimensions.

The tympanic note of the stomach and intestines may be further modified by the presence of liquid or solid matter in addition to the air. Thus percussion, and still more abrupt pressure over a part containing air and liquid, may cause a sound of gurgling, or obscure bubbling, in addition to the drum note; and this gurgling being accompanied by the metallic echo of the cavity, acquires the somewhat musical note, termed by M. Piorry, "humorique".[1] Many years ago, I explained the cracked metal sound in the chest (*bruit de pôt fêlé* of Laennec) on this principle. This sound of liquid and air is most commonly heard in the region of the stomach and cæcum; but it is sometimes met with in the course of the small intestines. It is usually attended with some feeling of gurgling under the fingers; and by various degrees and kinds of pressure, the presence of the liquid may be made more obvious to the ear or stethoscope applied. The gurgling noise thus occasioned, will be observed to be more or less accompanied by the metallic echo wherever there is a considerable body of air present, and the liquid, by the noise that it thus makes, affords an additional means of manifesting the echo; but neither in this case, nor in the analogous one of metallic tinkling within the chest, is the presence of liquid essential for its production, as was imagined by Laennec.

If there be much liquid, and little air in a portion of bowel, the tympanic or metallic sound will be circumscribed in extent, and high in pitch, usually occupying the higher part, the rest having the dead dull stroke, and the soft heavy feel of liquid. Thus the clear sound of an empty stomach, which is deep in tone in proportion to the quantity of air in it, after a full liquid meal is replaced by more or less dulness at and below the margins of the left ribs, whilst a clear and rather high-keyed tympanic note, almost tubular in character, may be heard at the lower ribs.

The soft matters which constitute the more solid contents of the alimentary canal, are calculated also to deaden the clear percussion sounds, but in a manner different from that of liquids. Rarely entirely superseding the air, they obscure, but do not destroy, the tympanic note. They however completely stop the metallic echo, the vibrations of which are as easily checked by soft and inelastic matters in the cavity, as the echo of a room is by drapery. The dispersion of a considerable amount of pultaceous matter throughout the intestines, blended as it always is with more or less gas, occasions the duller degree of tympanic resonance commonly met with in cases of torpid bowels, which may be free from the clearer and metallic notes, unless there may happen to be a large accumulation of air in any particular part. This more diffused and uniform resonance has some resemblance

[1] M. Piorry has, however, confounded under this term some of the loud intestinal sounds of high pitch, which I have before referred to the tympanic note and accompanying metallic echo of a membranous cavity containing air only, as in the example of the inflated cheeks.

in tone and origin to the pulmonary stroke-sound, which equally excludes clear tympanic, and metallic notes.

It may be collected from the preceding description, that throughout the abdominal regions generally, the tympanic sounds in some of their modifications prevail, except where temporarily superseded by a considerable bulk of liquid in a part, or parts, of the alimentary canal. The tympanic or intestinal region is bounded above by the dulness caused by the liver; this, in health, extends nearly along the margin of the right ribs, and more commonly an inch or so below than above them; at the epigastrium, it frequently occupies from one to two inches below the ensiform cartilage, and meets the margin of the left ribs, and there terminates below the spot where the apex of the heart beats. But the inferior margin of the healthy liver being thin, it does not abruptly terminate the intestinal and stomachal resonance, but *shades it off* by degrees, from below upwards, into the absolute dulness of the mass of the liver. This gradual transition of the tympanic into the dull hepatic sound is an important sign of the healthy condition of the liver, and corresponds with the absence of any abrupt line of resistance in palpation of the lower margin of the organ. The shading off is more gradual in the anterior margin than at the right side, where the lobe ends more abruptly and with a thicker edge. The practice of percussion to determine the dimensions of the liver requires some delicacy of manipulation, the method of fillipping mediate percussion, which I introduced many years ago, being the most exact. If the strokes be made very gently, and carried from the absolute dulness downwards, the diminishing thickness of the liver may be measured with great accuracy, by the increasing clearness of the sound, until the finger passes the margin, and arrives at the unobscured intestinal note.

The stomachal sound to the left of the liver has no such precise limits above it, being more apt to encroach on the mixed sounds of the heart and lung, which form its upper boundary. Further to the left, the stomachal and intestinal note passes into the pulmonary, two or three inches above the margin of the ribs, there being usually a space of imperfect dulness of two or three superficial inches, corresponding with the spleen.

Posteriorly, where the pulmonary resonance at the margin of the base of the lungs terminates, strong percussion may elicit an obscure tympanic sound, which becomes clearer lower down in the loins, until it is again obscured by the iliac bones. The great thickness of the muscular walls, more or less increased by fat, renders it impossible to trace by percussion the position or bulk of the kidneys in a state of health; but their enlargement by disease does sometimes distinctly increase the dulness of the upper portion of the lumbar regions. As before stated, palpation is a far better test than percussion of the state of the kidneys.

Anteriorly, the abdominal or intestinal region is abruptly terminated by the crests of the ilia and the rami of the pubis. Above the latter, a distended urinary bladder may rise and cause a dulness, having superiorly a rounded and rather abrupt margin, one, two, or more inches towards the umbilicus, the dulness being most complete immediately over the symphysis.

Any considerable thickness of fat, or œdema in the walls of the abdomen, necessarily obscures the clear notes of the subjacent viscera, and renders the more delicate distinctions impracticable. But by employing careful mediate percussion, the applied hand or fingers being pressed firmly on the walls, and the strokes being pretty forcible and abrupt, we rarely fail to obtain all the more important results of this method of examination.

In order to distinguish the dulness of fat or œdematous abdominal walls from that of increased density of the contained viscera, it is necessary to practise palpation in the modes already described; and having by these means determined the existence of unusual thickness of the walls, we shall be better prepared to estimate the amount of dulness which it would cause, and to use the degree of pressure and strong percussion which will elicit the resonance of the viscera underneath. Neither extreme flaccidity of the walls, nor rigidity from muscular action, materially interferes with the results of percussion; for this being practised mediately on the fingers, they supply the uniformity of superficial tension adapted, and required for the production of sound.

(To be continued.)

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ON SUPPURATION IN BONE; WITH CASES OF ABSCESS IN THE TIBIA SUCCESSFULLY TREPHINED.

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CASE I. James Stocker, æt. 26, came under my care at King's College Hospital, on the 16th June, 1851. He then complained of intense pain in the left leg, which had prevented him sleeping, except at very short intervals, for a month previously. The pain continued without intermission, but was aggravated by occasional paroxysms. At such times, it would first be felt in the tibia, extend thence to the knee, and shoot up the thigh to the hip. This shooting pain was of a most excruciating character.

Upon examination, the shaft of the tibia was found enlarged to double its natural size. The enlargement occupied four or five inches of the bone, being most marked in its middle third, but altogether situated nearer the upper than the lower extremity. Pressure upon the swelling caused no uneasiness, nor did the position of the limb in any way appear to affect the character of the pain. No tender point could be detected in any part of the enlargement. When the pain was most severe, he appeared to derive some comfort from walking about; and he would occasionally get up in the night to do so. The pain and want of sleep had evidently given him a careworn appearance: but as far as the different functions were concerned, he appeared to be in perfect health; nor was there any history of his having suffered from constitutional disease.