

THE ANATOMICAL EXPLANATION OF THE RELATIVELY LESS
RESONANT, HIGHER PITCHED, VESICULOTYMPANITIC
PERCUSSION NOTE NORMALLY FOUND AT THE
RIGHT PULMONARY APEX.¹

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Most clinicians, especially those who have devoted particular attention to diseases of the lungs, are agreed that in percussing the upper parts of the chest a slight difference in sound is normally heard when the two sides are compared. This difference consists in the fact that on the right side, from the apex down to about the level of the second interspace or the third rib, the note elicited is slightly higher in pitch, shorter in duration, and less resonant. Occasionally, also, the note is somewhat more tympanitic in quality.

The actual amount of difference in the afore-mentioned sound attributes, while never great in degree, is of extreme clinical importance on account of the frequency with which incipient tuberculosis manifests itself by physical signs at the right apex. If no allowance be made for a normal variation in the percussion sounds of the two sides of the chest, errors in diagnosis easily may occur.

On consulting various text-books on the subject one finds that in reference to the question under consideration they may be divided into four classes: (1) Those in which allusion is made to the difference, but no explanation is offered. (2) Those in which no mention of any difference is made. (3) Those in which it is denied that any difference exists. (4) Those in which more or less explanation of the phenomena is attempted.

The following statements are taken from works on physical diagnosis which comprise the first class:

"On the right side the sound is somewhat less clear, shorter, and of a higher pitch than on the left." (J. M. DaCosta.²)

"The pulmonary quality is slightly less marked on the right

¹ Read before the College of Physicians of Philadelphia, January 3, 1912.

² Medical Diagnosis, 1900, p. 270.

than on the left in supraclavicular and infraclavicular areas." (G. R. Butler.³)

"It [the resonance] is slightly higher in pitch at the right than at the left apex." (J. H. Musser.⁴)

Similar statements are made by J. C. Wilson⁵ and R. C. Cabot.⁶

Among the authors who make no mention of the normal variation in the percussion note of the two sides are: Loomis,⁷ Gibson and Russell,⁸ Vierordt,⁹ J. H. Bass,¹⁰ P. Simon,¹¹ S. Gee,¹² A. Weil,¹³ P. Niemeyer,¹⁴ Ebstein,¹⁵ Stokes,¹⁶ Sahli,¹⁷ Hare,¹⁸ Fowler and Godlee,¹⁹ and Fuller.²⁰

In the third class we found only one book, that by S. G. Bonney,²¹ who says, "The characteristics of normal resonance are identical upon the two sides of the chest in this (infraclavicular) region, as contrasted with the striking differences displayed below the third ribs."

The text-books of the fourth group offer numerous explanations of the phenomena.

The explanation is based on the thickness of the pectoral muscles by the following writers: A. Flint,²² J. G. Brown,²³ Edlefsen,²⁴ Beevor,²⁵ Guttman,²⁶ E. Cassaët.²⁷

Eichhorst²⁸ says that the difference is most marked in men of laborious occupations. He goes on to say, however: "Bei Linkshaendigen habe ich den Perkussionsschall beiderseits laut gefunden."

Brugsch and Schittenhelm²⁹ and C. L. Greene,³⁰ regard the difference as due to the nearness of the large bronchus.

Kidd³¹ attributes the variation in part to the difference in the

³ The Diagnostics of Internal Medicine, p. 426.

⁴ A Practical Treatise on Medical Diagnosis, 1899, p. 495.

⁵ Medical Diagnosis, 1909, p. 131.

⁶ Physical Diagnosis, 1909, p. 130.

⁷ Lessons in Physical Diagnosis, 1887, p. 27.

⁸ Physical Diagnosis, 1902, p. 142.

⁹ Lehrbuch d. klin. Untersuchungsmethoden, 1904, i, 117 and 634.

¹⁰ Medizinische Diagnostik, 1883, p. 112.

¹¹ Man. de Percussion et d'Auscultation, 1895, p. 35.

¹² Auscultation and Percussion, 1907.

¹³ Handbuch u. Atlas der Topograph. Perkussion, 1877, p. 42.

¹⁴ Handbuch d. theor. u. klin. Perkussion u. Auscultation, 1870, p. 130.

¹⁵ Leitfaden d. Aerztlichen Untersuchung, etc., 1907, pp. 151 to 153.

¹⁶ Diagnosis and treatment of the Diseases of the Chest, 1837, Part 1.

¹⁷ A Treatise on Diagnostic Methods of Examination, 1905.

¹⁸ Practical Diagnosis, 1906.

¹⁹ Diseases of the Lungs, 1898.

²⁰ Diseases of the Lungs and Air Passages, 1867, p. 51.

²¹ Pulmonary Tuberculosis, Philadelphia, 1908, p. 183.

²² Variations of Pitch in Percussion and Respiratory Sounds, 1852, p. 0.

²³ Medical Diagnosis, Edinburgh, 1857.

²⁴ Lehrbuch d. Diag. d. inn. Krankheiten, 1859, p. 449.

²⁵ Lancet, May 4, 1901, p. 1275.

²⁶ Lehrbuch der Klin. Untersuchungsmethoden (Klemperer), 1904, p. 145.

²⁷ Precis d'auscultation et de Percussion, 1906, p. 563.

²⁸ Lehrbuch d. Physikal. Untersuchungsmethoden, Berlin, 1889, i, 269.

²⁹ Lehrbuch Klinischer Untersuchungsmethoden, 1903, p. 80.

³⁰ Medical Diagnosis, 1910, p. 101.

³¹ Allbutt's System of Medicine, 1909, v, 346.

bronchi, stating that the right main bronchus is slightly wider and more vertical, and that the bronchus to the upper lobe is given off higher up, that is, near to the trachea.

In answer to this it may be stated that the point at which the upper lobe bronchus of the right side is given off is opposite the upper border of the third costal cartilage. Its effect on resonance at the apex must be very slight.

Walshe²² states that "In a certain number of persons whose lungs are perfectly sound the right infraclavicular region gives a more wooden note under percussion, and is at the same time less resonant than the left. This peculiarity is perfectly unconnected with excess of muscular substance on the right side, and depends on some hitherto unascertained condition."

In another place²³ the same author writes that: "Numerous differences in the results of percussion of corresponding points of the two sides of the chest have been noticed, and traced to an obvious cause the presence of texture and organs of different densities in those spots. Variable thickness of the external soft parts will have a similar effect; thus the right infraclavicular region is less resonant than the left in robust persons whose employment requires much use of the right arm; the pectoralis muscle enlarges from use. Here the explanation is obvious, but the explanation is not obvious when the right infraclavicular region emits less tone than its fellow, in persons presenting no muscular thickening of this kind. Such inferiority of resonance (sometimes attended, too, with slight elevation of pitch) is never great provided the lungs are perfectly healthy; it holds good whatever be the direction given to the fingers, and whether they fall outward toward the humerus or inward toward the sternum."

H. S. Anders²⁴ attempts an explanation by stating that in addition to greater thickness of the pectoral muscle and the presence of the liver on the right side, "an explicit reason is found in the fact that there is a different anatomical arrangement of the bronchial tubes, those on the right side being larger and situated more superficially and higher up; this, with a bunch of medium and small branches occupying space, that on the left side is filled with air vesicles, gives an amount of bronchovesicular tissue sufficient to elevate the pitch slightly but perceptibly, the tubes adding an element of tympany, the extra muscular and connective tissue of their firm walls an element of dulness."

Anders and Boston²⁵ state: "The higher pitched percussion note over the right than over the left apex is probably due to larger diameter and higher position of the right bronchus. The note is again modified by the thickness and tension of the chest wall as the result of muscular contraction, etc."

²² Practical Treatise on the Diseases of the Lungs, 1871, p. 64.

²³ Lancet, 1849, i, 196.

²⁴ Physical Diagnosis, 1907, p. 99.

²⁵ Text-book of Medical Diagnosis, 1911, p. 55.

Gerhardt²⁸ offers the following reasons: (1) Increased size of the muscles on the right; (2) slight scoliosis often present; (3) difference in anatomical structure: (a) bronchi larger, (b) pulmonary apex smaller and lower, (c) bronchi retain large caliber near to the surface.

TABLE OF RESULTS OBTAINED BY EXAMINING THE CHESTS OF THIRTY-TWO LEFT-HANDED INDIVIDUALS.

No.	Circumference of chest (inches)		Vocal fremitus		Percussion resonance		Pitch (higher)		Breath sounds (harsher)		Remarks
	R	L	R	L	fl	L	R	L	R	L	
1	17½	17	+	..	-	..	+	..	Equal	Equal	Poorly developed; 18 yrs. old; looks to be 14.
2	14½	14	+	..	-	..	+	..	Equal	Equal	
3	10½	10	+	..	-	..	+	..	+	..	Large deep pectoral muscles; difference only on deep percussion.
4	18½	18	+	..	-	..	+	..	+	..	
5	10	15½	+	..	-	..	+	..	+	..	Large left pectoral muscles; difference slight.
6	10½	10½	+	..	-	..	+	..	+	..	
7	17½	17½	+	..	-	..	+	..	+	..	Well marked difference.
8	10½	10½	+	..	-	..	+	..	+	..	
9	15½	16½	+	..	-	..	+	..	+	..	Bilateral subclavian murmur.
10	10	10	+	..	-	..	+	..	+	..	
11	15½	15½	+	..	-	..	+	..	+	..	Difference slight. Funnel breasted.
12	17½	17½	+	..	-	..	+	..	+	..	
13	15½	16	+	..	-	..	+	..	+	..	Marked retraction of whole right side.
14	10½	10½	+	..	-	..	+	..	+	..	
15	17½	17½	+	..	-	..	+	..	+	..	
16	10	10	+	..	-	..	+	..	+	..	
17	18	17	+	..	-	..	+	..	+	..	
18	17	16½	+	..	-	..	+	..	+	..	
19	10½	17½	+	..	-	..	+	..	+	..	
20	17½	18½	+	..	-	..	Equal	+	+	..	
21	10½	18	+	..	+	..	+	..	-	+	Flat left chest; looks pathological.
22	18½	18½	+	..	-	..	+	..	+	..	
23	15½	15½	+	+	..	+	Equal	Equal	Very poor expansion; iccbe breath sounds.
24	18½	18½	+	..	-	..	+	..	Equal	Equal	
25	18½	18	+	..	-	..	+	..	+	..	
26	17	17	+	..	-	..	+	..	+	..	
27	10½	17	+	..	-	..	+	..	+	..	
28	15½	15½	+	..	-	..	+	..	+	..	
29	10	15½	+	..	-	..	+	..	+	..	Difference reversed on light percussion.
30	18½	18	+	..	-	..	+	..	+	..	
31	18	17½	+	..	-	..	+	..	+	..	
32	10½	16½	+	..	-	..	+	..	+	..	

²⁸ Krause's Lehrbuch d. klin. Diagnostik innerer Krankheiten, 1909, p. 122.

Inasmuch as none of these explanations are adequate to account for all cases, we have endeavored to solve the problem by the careful anatomical study of frozen sections of the cadaver, previously hardened in formalin, and by a critical study of the chests of 32 left-handed students. The examinations of the left-handed individuals were made with especial reference to the following points: (1) Circumference of the chest, right and left. A tape-measure was applied to the side of the chest, extending from the middle of the spine to the mid-sternum at the level of the nipple. For obvious reasons errors in such measurements may easily be made, and we, therefore, lay no great stress on the importance of the data thus obtained. The results show, however, that the *right* chest is not infrequently larger even in left banded-persons. (2) Vocal fremitus, elicited below the clavicle. (3) Percussion resonance, from the clavicle to the upper border of the third rib. (4) Percussion pitch, elicited over the same area. (5) Character of the breath sounds in the same region. Corresponding points on the two sides of the chest were of course compared, and the results immediately recorded.

The foregoing table represents in charted form the results of our examinations, and the data obtained were so uniform that it seemed needless to examine a larger number of men. From these studies the following conclusions may be drawn:

Vocal fremitus is normally more intense on the right side, even in left-handed individuals, and probably is due, as was pointed out by one of us (Fetterolf²⁷), to the immediate contact of the trachea to the right pulmonary apex. On the left side the aorta, the common carotid and subclavian arteries, and the esophagus, together with lymphatic and areolar tissue, a layer some 2 to 3 cm. in thickness, are interposed between the lung and the trachea.

While studying the percussion sounds at the two apices it was occasionally noted that after prolonged percussion differences quite noticeable at first tended to become less marked. This is by no means an original observation, and may be explained as due to one or all of the following factors: (1) Aural fatigue on the part of the examiner. (2) A pulmonary reflex, as described by Abrahms, by virtue of which percussion over a certain area of lung tissue produces a local reflex dilatation of the air vesicles, thus obscuring a slight degree of dulness. (3) Spasm of the deeper fibers of the pectoral muscle, analogous to the increased myotatic irritability of myoedema seen in low nerve tone,²⁸ which by increased muscular density tends to limit the penetration of the percussion vibrations.

In persons of poor muscular development, in case of the aged, the wasted, and the muscularly inactive, the difference in the

²⁷ Arch. Int. Med., February, 1909.

²⁸ This explanation, used in a somewhat similar connection, has been suggested by M. E. Rist, *Percussion Thoracique*, La Presse Medicale, December 16, 1911.

pulmonary resonance is present, while a corresponding unevenness in the thickness of the pectoral muscles may be either inconsequential or entirely lacking. The main cause, then, must lie deeper than in the muscles of the chest.

Let us consider for a moment what physical conditions underlie the changes in the percussion note which we are endeavoring to explain, namely, (1) diminished resonance; (2) elevated pitch; (3) a tympanitic element.

1. *Diminished resonance* over normal lung implies a lessened quantity of air and elasticity or the presence of overlying tissue, which by reason of its density vibrates less complexly, and transmits vibrations less well. The result, acoustically speaking, is a condition in which the fundamental note preponderates and fewer overtones are heard. The sound is more muffled and is shorter and weaker, tone enforcement being diminished. With the appearance of dulness there is always an increase in the elevation of pitch.

2. *Elevation in pitch* implies an increased vibratory rate, and this in normal pulmonary tissue again depends largely, other things being equal, on the amount of air, the size of the air columns.

3. *A tympanitic quality* is heard over pulmonary tissue when: (a) Air columns vibrate in smooth walled chambers which communicate with the atmosphere; (b) when air in closed cavities vibrates in unison with elastic walls; (c) when the normal pulmonary tension is relaxed, so that the lung vibrates as a whole (for example, in pleural effusion). Acoustically the underlying characteristic of tympany is preponderance of overtones. For the present purposes only the first proposition (a) need be considered.

It may be stated as a general principle that a less resonant note is produced by an increase in the amount of airless tissue. Writers who have hitherto considered this to be a factor, have confined their explanation to conditions of the chest wall, assuming that right-handed people have so much more muscular tissue over the pulmonary apex on that side, that the percussion note becomes dulled in quality. Thus two left-handed individuals were exhibited before the Clinical Society of London by Sir Hugh Beevor to prove this very point, that is, that the left side was less resonant.³⁹ Similar conclusions were reached by Brazil,⁴⁰ who, having studied a number of cases, states that the higher pitched note on the left, in left-handed people affects the entire chest, and is not limited to the apices. How this can be it is difficult to understand, because in the axillary region, for example, muscular development plays practically no role.

Similar views are held by E. Lloyd Jones,⁴¹ who in an interesting article quotes as corroborative evidence the fact that in a right-handed patient of his the left side was less resonant than the

³⁹ Lancet, May 4, 1901, p. 1275.

⁴⁰ Brit. Med. Jour., October 26, 1899, p. 920.

⁴¹ Brit. Med. Jour., October 24, 1903.

right on account of a "former venous thrombosis in the left arm," the veins in the upper part of the left chest being much enlarged. It seems to us that Jones' explanation, which links a diminished resonance with the presence of thrombotic vascular changes on the left side, is in entire consonance with the explanation proposed in this communication. We believe, however, that the percussion changes in such a case as he reports are due more to a distention of the large vessels crossing the apex than to a thickening of the superficial tissues.

AUTHORS' EXPLANATION.

As the result of our studies we believe that the anatomical basis for the conditions under discussion consists of three factors, namely, the anterior position of the vessels in relation to the right apex as compared with the left, the consequent encroachment upon and reduction in size of the right apex, and the apposition of the trachea to the inner surface of the right apex, while the same aspect of the left is in contact with a thick layer of solid tissue.

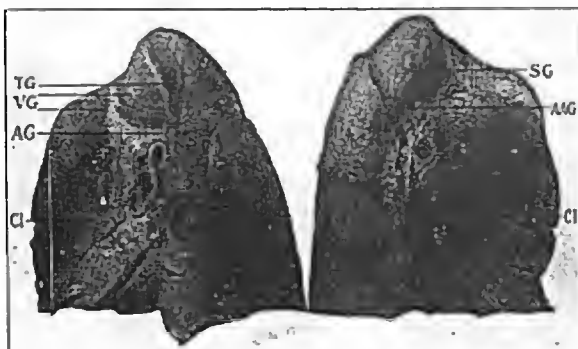


FIG. 1.—Medial surface of lungs hardened before removal. This photograph shows (a) the groove produced in the right apex by the trachea; (b) the relatively anterior position of the vessels on the right side; and (c) the smaller size of the right apex. AG, axillary groove; VG, grooves for superior vena cava, innominate vein, and subclavian vessels; TG, tracheal groove; SG, subclavian groove; AAG, aortic groove; CI, cardiac impression.

Reduced to their last analysis the anatomical differences between the two sides in the upper thorax will be found to be due to the fact that man is a sinistro-aortic individual. In some of the lower vertebrates, for example, the birds, the aorta is on the right side, and in others, as some of the lizards, there is an aorta on both sides.

In the early human embryo, when the heart is situated far forward in the pharyngeal region, the arrangement of the large arteries is



FIG. 2.—Anterior view of lungs hardened before removal. This photograph shows the anterior position of the groove for the subclavian vessels on the right side, compared with the more superior position on the left. SG, subclavian groove.

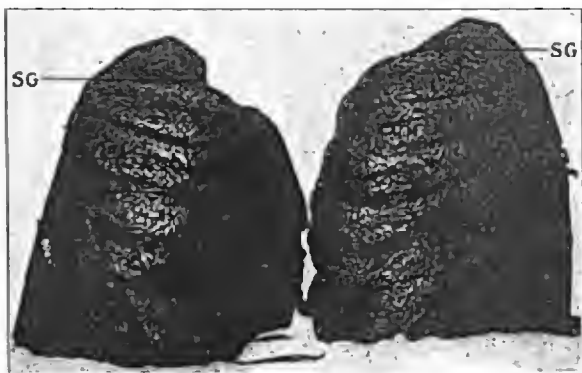


FIG. 3.—Lateral view of lungs hardened before removal. This photograph shows the deeper vascular groove and the smaller size of the right apex as compared with the left.

symmetrical. As development proceeds the main trunk, the aorta, is established on the left side.

In its course from the heart to the vertebral column the systemic aorta passes first slightly to the right, then slightly to the left, and finally almost directly backward between the left side of the trachea and the mediastinal aspect of the left lung. Thus situated it affects both the trachea and the lung, throwing the lower end of the former over toward the right, thereby producing the now well recognized dextro-inclination of the trachea, and grooving deeply, in an arciform manner, the inner aspect of the left lung, in front, above, and behind the root of the latter.

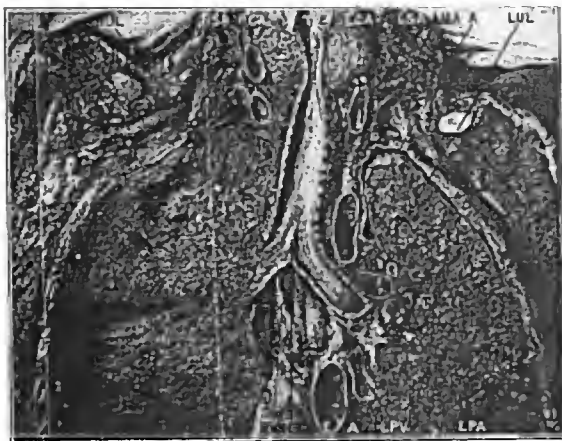


FIG. 4.—Frontal section of the thorax in the axis of the trachea. This photograph shows (a) the contact of the right upper lobe with the trachea, (b) the mesial position of the left subclavian artery in relation to the left upper lobe, and (c) the essentially anterior position of the right subclavian in relation to the right upper lobe. *RUL*, right upper lobe; *RSA*, right subclavian artery; *RCA*, right common carotid artery; *T*, trachea; *E*, esophagus; *LCA*, left common carotid artery; *LSA*, left subclavian artery; *LMA*, left internal mammary artery; *A*, aorta; *LUL*, left upper lobe; *LPV*, left inferior pulmonary vein; *CT*, carina tracheae; *RVN*, right vagus nerve. (Reproduced from the Archives of Internal Medicine, February, 1909.)

The aortic arch is usually divided by writers into three portions, an ascending, a transverse, and a descending. The first and third of these parts are properly named, but "transverse" is incorrectly applied to the second portion. As regards the aorta, it should be abolished from anatomical terminology and some such term as "horizontal" substituted for it. Its use in this connection probably originated from the fact that when the chest is opened under ordinary condition, the collapsed lungs and the heart fall backward,

and the second portion of the arch becomes approximately transverse. But when the thoracic contents are hardened before the chest is opened it is seen clearly that there is no justification for applying to the second part the term "transverse." When examined under such conditions the general course of the aortic arch is seen distinctly to be almost anteroposterior, there being, of course, a slight tendency to run toward the left. This is demonstrated most clearly in all of the sections that we have prepared; and in nearly all of those cut in the sagittal plane the entire aortic arch from beginning to end is included in the section.

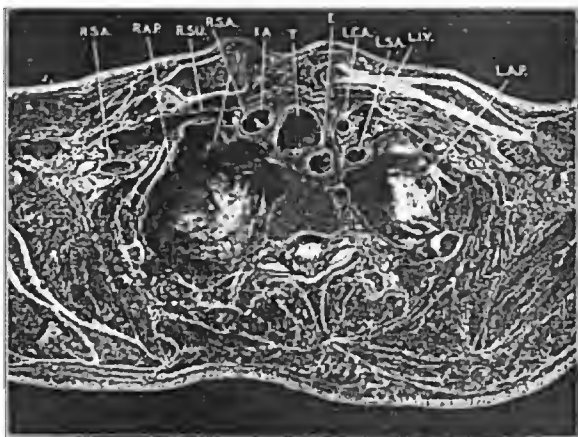


FIG. 5—Section through the upper part of the thorax, viewed from below. The line of section is not exactly horizontal, a slightly lower plane being reached on the right side than on the left. In order to show the apical parietal pleura, the pulmonary apices have been removed. There can be noted in this specimen the beginning contact of the right pleura with the trachea, and the anterior position of the innominate artery, whose bifurcation is well shown. On the left side, the wide separation of the pleura from the trachea by means of the large arteries, esophagus, and areolar tissue can readily be seen. There can be seen well the deep position of origin and the obliquely anterior course of the left subclavian artery. T, trachea; E, esophagus; RAP, right apical pleura; LAP, left apical pleura; IA, innominate artery, dividing into RSA, right subclavian artery and RCA, right common carotid artery; LSA, left subclavian artery; LCA, left common carotid artery; RSV, right subclavian vein; LLI, left innominate vein.

As stated above, we believe that there are three ultimate factors at work to produce the normal discrepancies at the apices.

First. As regards the anterior position of the vessels of the right side. The first branch, better called the anterior branch, of the horizontal part of the aortic arch is the innominate artery, destined for the supply of the right head and the right upper extremity. Arising, as it does, to the left of the median line, it is compelled to

pass anterior to the trachea in order to reach its destination. This position of its origin is responsible for the anterior situation of the vessels in relation to the right apex. Having crossed the anterior aspect of the trachea and turned somewhat posteriorly, it divides into its terminal branches, the right common carotid and the right subclavian, the former of which does not concern us. The latter passes obliquely upward and *backward* to reach its groove on the upper surface of the first rib. In its course it produces a deep sulcus in the anterior aspect of the pulmonary apex.

The second branch of the horizontal part of the arch is the left common carotid. It passes upward at the side of the trachea, between the trachea and the left apex, and enters the neck.

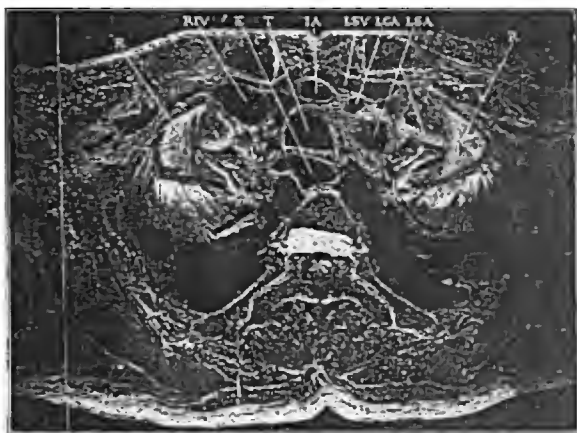


FIG. 6.—Horizontal section of the thorax just above the sternoclavicular articulation. The pleura has been dissected away. This photograph shows (a) the anterior position of the innominate artery, (b) the posterior position of the left subclavian artery, and (c) the anterior position of the right innominate vein. *R*, first rib; *RIV*, right innominate vein; *E*, esophagus; *T*, trachea; *IA*, innominate artery; *LSV*, left subclavian vein; *LCA*, left common carotid artery; *LSA*, left subclavian artery.

The third or posterior branch of the horizontal part of the arch is the left subclavian. This vessel is given off well back in the mediastinum, opposite the posterior surface of the trachea, or even at the left side of the esophagus. It arises so deeply that it is compelled to pass slightly *forward* as well as laterally to reach its groove on the first rib. In the greater part of its thoracic course it occupies the layer of tissue between the left upper lobe and the trachea. Nearing the first rib it produces in the left apex a groove which is shallower and nearer the summit than on the right side.

The same principle applies to the veins. The right apex is enroached upon and markedly grooved by the subclavian and innominate veins, these grooves being continuous with one another, and situated in front of the groove for the subclavian artery. On the left side the subclavian vein produces a sulcus in front of that of the artery, but being more mesial it does not enroach to so great an extent on the apex.

Second. The smaller size of the right apex as compared to the left. This is dependent on the facts enumerated in the previous section. On the right side the vessels pass in front and occupy space which on the left side is occupied by lung tissue.

The shape and size of the pulmonary apices are modified by the vessels in the same way as would be two small hills over which roads were cut. In one case, as on the right side, the road is cut over the side of the hill and requires excavation. On the other side, corresponding to the left apex, the road is carried more nearly over the summit and comparatively no excavation is needed. The result, as far as the apices are concerned, is to cause the former to be smaller than the latter and to give the right apex a more conical, and the left a more dome-like shape.

Third. The apposition to the inner surface of the right apex of the trachea and to the left of solid tissue. This has been emphasized by one of us in a previous paper,² and is demonstrated clearly in Figs. 4 and 5.

CONCLUSIONS.

1. The dexterity of the individual has no effect on either the vocal resonance and fremitus or on the percussion pitch and resonance at the apices.

2. The percussion note in the healthy individual is practically always less resonant and higher pitched at the right apex, except in the presence of unusually well-developed left pectoral muscles, and then only if very light percussion is employed.

3. The normal differences are due to the anterior position of the large vessels in relation to the right apex, as compared with the left, to the consequent enroachment upon and reduction in size of the right apex, and to the contact of the inner surface of the right apex with the resonating trachea, while the left is in contact with non-resonating solid tissue.

4. The differences are most marked anteriorly and mesially, because in this situation both trachea and vessels would exert their greatest influence, less marked posteriorly and mesially where the influence of only the trachea would be present, and least marked laterally, since the upper portion of the apex is farthest removed from the trachea, and the vessels at this point are practically similar in their relations on the two sides.

² Loc cit.

We wish to express our indebtedness to Dr. George A. Piersol for anatomical material placed at our disposal, to Dr. R. Tait McKenzie for the privilege of examining a large number of left-handed students, and to Dr. P. G. Skillern, Jr., for assistance in preparing our anatomical specimens.

RUPTURE OF THE KIDNEY IN CHILDREN.¹

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RUPTURES or other subcutaneous injuries are very uncommon in children, only 22 cases being reported in tabulated statistics.² My experience comprises 4 cases of complete rupture of the kidney in children, aged from eight to twelve years, and a consideration of the conditions found furnishes some interesting features.

CASE I.—Barbara S., aged ten years. Admitted to St. Luke's Hospital August 25, 1902. Two weeks ago was kicked on the right side of the body by a horse; unconscious for a while. Next morning urine contained some blood, none seen since. Some swelling of the right side developed with a considerable amount of pain. Has had no chills, but there have been fever and sweating.

Physical examination showed a bright, healthy child, with a visible swelling of the right lumbar region. No superficial discoloration. The swelling was elastic, insensitive to pressure, flat on percussion. Urine: acid; 1018; no albumin.

Operation: Right lumbar incision, showed the swelling to be a large retroperitoneal accumulation of normal appearing urine. The kidney was ruptured in two, the lower pole entirely separated from the upper three-fourths of the viscus. Nephrectomy; good recovery. Discharged October 3, 1902.

CASE II.—These details are as exact as I can furnish them from memory, the record being lost. Boy, aged about ten years. Admitted to the Hudson Street Hospital probably in the summer of 1907. Runover injury; abdominal symptoms; median laparotomy by a colleague; negative findings. Seen by me several days later; diagnosis of rupture of left kidney. Lumbar incision revealed complete tear of left kidney. Nephrectomy; good recovery.

CASE III.—James L., aged twelve years. Admitted to the Hudson Street Hospital November, 1909. While running across the street an automobile struck him in the left side, knocking him down. Scalp wound, requiring two stitches. Brought to the hospital in the guilty automobile. Soon began to complain of great pain and tenderness over the left kidney region.

¹ Read before the Section of Surgery of the New York State Medical Society, April 17, 1912.

² Watson and Cunningham. *Genito-urinary Diseases*, vol. ii.