Abdominal Physical Signs and Medical Eponyms: Part I. Percussion, 1871-1900

Vaibhav Rastogi, MD; Devina Singh, MD; Halil Tekiner, PhD; Fan Ye, MD;
Joseph J. Mazza, MD; and Steven H. Yale, MD

Background: Percussion is derived from the Latin word to hear and to touch. Percussion of the abdomen is used to detect areas of tenderness, dullness within an area of tenderness suggestive of a mass, shifting dullness representing fluid or blood, splenic, hepatic and bladder enlargement, and free air in the peritoneum. Covered are abdominal signs of percussion attributed as medical eponyms from the time-period beginning in the mid-late nineteenth century. Described is historical information behind the sign, descriptions of the sign, and implication in modern clinical practice.

Data sources: PubMed, Medline, online Internet word searches, textbooks, and references from other source text. PubMed was searched using the Medical Subject Heading (MeSH) of the name of the eponyms and text words associated with the sign.

Conclusion: Percussion signs defined as medical eponyms were important discoveries adopted by physicians prior to the advent of radiographs and other imaging and diagnostic techniques. The signs perfected during this time-period provided important clinical cues as to the presence of air within the peritoneum or rupture of the spleen.

Keywords: Abdomen; Eponyms; Inspection; Physical Examination; Signs; History of Medicine

Percussion is derived from the Latin word, *percutere*, referring to beating or striking.¹ Percussion was initially used by Hippocrates (460-377 BC) over the abdomen to distinguish tympanites from ascites² and later over the chest by Leopold Auenbrugger (1722-1809) as described in *Inventum Novum Ex Percussione Thoracis Humani Ut Signo Abstrusos Interni Pectoris Morbos Detegendi* in 1761.³ In John Forbes' 1824 English translation of Auenbrugger's 1761 original treatise in Latin, Auenbrugger wrote in the preface:

I here present the reader with a new sign which I have discovered for detecting disease of the chest. This consists in the Percussion of the human thorax, whereby, according to the character of the particular sound

thence elicited, an opinion is formed of the internal state of the cavity.^{3(p. 379)}

Auenbrugger described under his "Second Observation, On the Method of Percussion" that the direct method of percussion involves striking the thorax "[...] slowly and gently, with the points of the fingers, brought close together and at the same time extended"^{3(p. 381)} Furthermore, "during percussion the shirt is to be drawn tight over the chest, or the hand of the operator covered with a glove made of unpolished leather."^{3(p. 382)}

Corresponding Author: Steven H. Yale, MD, University of Central Florida College of Medicine, Department of Internal Medicine, 6850 Lake Nona Blvd, Orlando, FL 32827 USA, Email: steven.yale.md@gmail.com

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Table 1: Summary of abdominal physical signs of percussion (1871-1900)

Sign	Year	Description	Sensitivity	Specificity
Traube	1871	Palpatory pressure in the left iliac fossa. Some authors also include the presence of percussion dullness in the left iliac fossa after evacuation of the bowels.	Unknown	Unknown
Toma	1884	In inflammatory ascites percussion tympany is located of the right side of the abdomen and along a line extending obliquely from the second lumbar vertebra to the right sacro-iliac symphysis. In non-inflammatory ascites percussion tympany is centrally located with dullness is peripherally located.	Unknown	Unknown
Ballance	1898	Fixed dullness in the left flank and splenic region and shifting dullness in the right flank on percussion.	Unknown	Unknown

It was Pierre Adolphe Piorry (1794-1879) who developed a device called a plessimeter for percussion in 1826:

I use a circular ivory plate, which has no rim, and which has at its two extremities, one of its diameters, a projection of four lines in width and height. This projection, concave outside to accommodate the convex shape of the finger, is arranged perpendicular to the surface of the plate. The advantage of this instrument is to be able to be better fixed than any other, to increase the surface on which one can strike, and to make the percussion easier. [...] In any case, the plessimeter being well maintained with the left hand, the pulp of the fingers of the right hand carries out the percussion in the following manner: the nails being cut close enough (for the sound they produce alters substantially the results of the percussion), it is practiced with the indicator only, so long as the two first fingers are united: sometimes even a third is added, it is when, using the palette, a large area. The part of the pulp nearest the extremity of the fingers is the only one to strike, and the sound is so much less pure that the percussion part is farther from this extremity. The shock must be dry, and for this purpose the finger must be removed as soon as the pulse is given. It must be fast, so that the vibrations take place. The force employed varies according to the volume of sound to be produced, the degree of sensibility of the parts, and the width of the instrument which serves as a plessimeter.^{4(p. 21)}

As to the use of the fingers as a pleximeter Piorry writes:

Several English or American physicians, who have done me the honor of attending my lessons, simplify the process I employ by using their finger as a plessimeter. It is the left finger that can fill this office, but it does it imperfectly: it gives less than the ivory plate, the skin which covers it, dampens the impulse; it has a rounded surface which it is not easy to strike perpendicularly; the shock it receives, communicated to the underlying parts, can be painful or dangerous because of the narrow surface with which it is related. In addition, the ordinary

plessimeter is itself of extreme simplicity; and, in default of such instrument, a coin may be put into use.^{4(p. 17)}

Percussion of the abdomen, similar to other sites, traditionally is performed using the indirect technique, whereby the distal palmar surface of the third finger of the left hand (pleximeter) is placed against the abdominal wall. The tip of the right third finger (plexor) is held in a rigid but partial flexed position and used to strike the distal interphalangeal joint of the pleximeter finger using only the wrist. The plexor finger is quickly removed after the blow. Typically one or two blows are delivered at one time.^{5,6} Percussion of the abdomen is useful for detecting organ enlargement (liver and spleen), ascites, intra-abdominal air, and the size and composition of an abdominal mass.

Eponyms associated with percussion are presented in two parts. In this paper, we covered eponymously named medical signs from the period extending from 1871 and 1900 described systematically from the date that they were first reported, if known, in the literature.

Data Sources

PubMed, Medline, online Internet word searches and bibliographies from source text and textbooks were used. PubMed was searched using the Medical Subject Heading (MeSH) of the name of the eponyms and text words associated with the sign.

Traube Sign

Ludwig Louis Traube (1818-1876) was born in Ratibor, Silesia Province (Prussian Silesia) and studied medicine at the Universities of Breslau and Berlin receiving his doctorate degree in 1840.^{7,8} After the revolution of 1848, he was appointed associate professor in the University of Berlin, and from 1849-1859, he served at the Charity Hospital as clinical assistant to the Clinic of Prof. Schoenlein.⁹ In 1853, he served as a physician to the hospital and director of the propaedeutic clinic—a medical service in German Universities:

Table 2: Significance of a positive diagnostic palpatory maneuvers

Sign	Interpretation
Traube	Peritonitis due by perforated appendix causes pain in the left iliac region.
Toma	Differentiates inflammatory ascites (malignant and tuberculous peritonitis) from noninflammatory ascites.
Ballance	Method for diagnosing splenic rupture.

[i]n which the students are prepared by an elementary study of pathology for attendance upon the superior clinics. The professors upon whom this teaching devolves have to instruct the students in the handling of the patient, and in the practice of the various physical and chemical means of diagnosis.^{8(p. 511)}

He served as instructor at the University of Berlin and in 1872 was appointed Ordinary Professor. He is recognized in the scientific community as being the first physician to apply thermometry at the patient's bedside.⁹ Traube played an important role in introducing pathological anatomy to the science of medicine. His character was described as follows:

By his students he will be remembered for his definite diagnosis, accurate prognosis, and the simplicity of his presence. He was not only a remarkable practicing physician, a clinical teacher of rear endowment, but also a man of exact scientific inquiry and standing in the front ranks of reformers in medical, as distinguished from surgical, theories.^{9(p. 323)}

Traube (1871), in his description of 30 patients with peritonitis caused by appendicial perforation, remarked in his chapter *Ein Fall von Durchbohrung des Wurmfortsatzes Kothbrechen* (A case of puncture of the appendix with cataclysm) (Tables 1 and 2):

In close consideration of our cases, significant for diagnosis, there is a second deviation from the usual picture of the disease. I mean that neither the pain nor abnormal sensitivity to pressure was present in the right iliac region. It is difficult to account for the cause of this phenomenon. It can be deduced that the inflammatory process was not quite accessible because it was at a greater distant from the abdominal wall and therefore could not be palpated in the right iliac fossa. Pain could be produced by palpatory pressure in the left iliac fossa. However, whatever the case may be, we can see that peritonitis caused by perforation of the appendix may be present, even though the pain and the morbid sensitivity to pressure may not present in the right iliac region.^{10(pp. 360-361; emphasis added)}

Wegele (1913), in his book *Therapeutics of the Gastrointestinal Tract*, noted that percussion over the sigmoid flexure had a higher pitch compared to other areas of the abdomen (Tables 1,2). Thus:

Normally, the various parts of the abdomen have different degrees of tympany, the left side of the abdomen over the flexure being of a higher pitch. This was utilized by Traube for the purpose of diagnosis. If there is a reduced tympanitic tone over the sigmoid flexure, after the bowels have been emptied, it points to disturbance in the tone of the muscle wall of the sigmoid (sigmoiditis, Traube's phenomenon)^{11(p. 178)}, [...] "If the inflammation is confined to the sigmoid flexure, there is dullness over that area (Traube's sign)."^{11(p. 191)}

Kraker (1914), in his description of mucous colitis and membranous enteritis, stated that "tenderness on pressure over the descending colon and sigmoid, and dullness on percussion when the bowl is empty, this is Traube's sign."^{2(p. 598)}

Traube's namesake has also been used, and is best known, to describe the faint double sound heard during auscultation over the femoral arteries in patients with aortic insufficiency and in some case of mitral stenosis (Traube sign),^{13,14} and the area below the left 6th rib anteriorly, which is tympanic to percussion caused by gas in the stomach (Traube semilunar space).¹⁴ To the best of our knowledge, Traube spoke only of a palpatory, not percussion tenderness, confined to the left lower quadrant in patients with peritonitis secondary to perforated appendicitis. We were unable to confirm the percussion dullness in the cases of sigmoiditis. We are unaware of any studies that evaluated the sensitivity or specificity of this abdominal sign.

Toma Sign

Josef Thomayer (1853-1927) was born in Trhanov, Domažlice district, Chodsko, and graduated from the unallocated Karlova-Ferdinand University (currently named Charles University) in 1876.¹⁵ After graduation he spent one year volunteering for military service at Garrison No.11 in Prague, as a demonstrator in the pathological and anatomical institute and as a general practitioner.¹⁵ He then traveled abroad to Paris and London, where he studied under several leading physicians including the neurologist Jean Martin Charcot, who was influential in shaping his lifelong medical views.¹⁵

In 1885, he founded the 2nd Czech medical journal *Sborník Lékařský* (Medical Proceedings).¹⁶ He served from 1902 to

1921 as the chief physician of the 2nd Internal Medicine Clinic at the Medical Faculty of the Czech University.^{16,17} In this role, he introduced all field of internal medicine including endocrinology, neurology, pulmonary medicine, and cardiology. He is considered one of the founders the Czech School of Internal Medicine, Czech modern medical science, and Czech medical literature,^{16,18,19} introducing Czech medical terminology.²⁰ He was known to approach disease based on an anatomical, pathological, and physiological basis.¹⁵ Thomayer has been credited for the development of medical sciences by establishing a novel method of learning through lectures, and in 1889 published the Collection of Lectures and Debates, later known as the Thomayer Collection.

He published over 200 manuscripts and books. In addition to his work as a physician, he also wrote stories, poems, drama about nature, travel, characters, and motifs from the medicine, literary, and artistic life under the pseudonym^{21,22} or pen name “R. E. Jamot,” which is the phonetic anagram Thomayer.”²²

In honor of his contribution to science, patients, national cultural institutions, and the literary world, his images and name have been displayed on commemorative stamps and coins from Czech Republic.^{23,24} The hospital in Prague, colloquially known as Krč Hospital or full name SOLOÚ (Státní Odborné Léčebné a Ošetrovací Ústav v Krči) (State Specialized Medical Care Institutions in Krč) (originally named Masaryk Homes), was renamed Thomayer University Hospital or Thomayer Hospital in 1954.²⁵⁻²⁷

Inscribed on this gravestone are the words:

In this house lived and died Dr. Josef Thomayer a professor of Charles University, a renowned scholar and write who devoted his million-dollar property, literary and artistic treasures to the Central School Foundation, the National Museum, Charles University and Modern gallery Bohemia.¹⁷

Thomayer’s paper entitled Beitrag zur Diagnose der tuberculösen und carcinomatösen Erkrankungen des Bauchfels (Contribution to the Diagnosis of Tuberculous and Carcinomatous Lesions of the Peritoneum)²⁸ described the mechanism and use of percussion as a means to differentiate peritoneal carcinomatosis and tuberculosis (inflammatory) from other non-inflammatory caused of peritoneal ascites (Table 1):

We know that the mesenteric root begins at the lumbar spine and runs in a oblique direction from the second lumbar vertebra to the right sacro-iliac symphysis. On the basis of these circumstances it is self-evident why, especially in the case of scirrhus forms of cancer, the small intestinal bundle is shifted more to the right side. In this disease, the mesentery shrinks to an abnormal mass and as a result the small intestinal coil must follow the shrinking mesentery. Since the root of the small intestine originates on the right, it must be found more in the right than in the left half, provided that

special conditions do not prevent it from such a displacement. Because of these circumstances, it is clear to me that the result of percussion significantly differs from that found in ordinary free ascites.^{28(p. 359; emphasis added)}

He recognized that these findings seen in patients with peritoneal carcinoma were analogous, but perhaps less intense, to that occurring in patients with tuberculous peritonitis. Thus, in patients with inflammatory ascites (malignant and tuberculous peritonitis) percussion (Table 2) “*tympany is found to the right side of the abdomen and along the line of the root of the mesentery, while the dullness lies to the left, extending high in the left flank.*”^{28(p. 358; emphasis added)} Conversely, in patients with non-inflammatory ascites percussion “*tympany is central in location while the dullness (fluid) is peripheral.*”^{28(p.358; emphasis added)} Although the position of the patient was not explicitly stated in Thomayer’s paper, Livingston wrote “as the patient lies upon his back”,²⁹ while another author wrote that the findings are found “irrespective of the position the patient assumes.”³⁰

Toma’s sign may be found in patients with chronic inflammatory peritonitis with ascites secondary to other conditions.²⁹ We are unaware of any study that validated this sign.

It should be recognized that among Thomayer’s many other accomplishments, he also described another sign in patients with massive pericardial effusion: that is the loss of the bronchial breath sound under the left clavicle when the patient is in a recumbent position and returning when assuming an upright posture. This finding is believed to be caused by the weight of the pericardial effusion compression the left bronchus.³⁰

Ballance Sign

Sir Charles Alfred Ballance (1856-1936) was born in Clapton, Middlesex England, received his Bachelor of Medicine and Surgery (MBBS) degree from St. Thomas Medical School in 1881, and was a recipient of a gold medal in surgery for his final examination.³¹ He interned at St. Thomas Hospital, later serving as surgical registrar and demonstrator in anatomy.¹⁴ He was elected for fellowship in the Royal College of Surgeons in 1885³² and served as an anatomy examiner in the College. At St. Thomas Hospital and at the Hospital for Sick Children, he was appointed assistant surgeon in 1891, surgeon in 1900, and consulting surgeon in 1919. In 1906, he served as President of the Medical Society of London.³³

During World War I in 1915, he served as consultant surgeon stationed at Malta and, for his exemplary service, was honored by the University of Malta and knighted, Order of St. John of Jerusalem.³⁴ In 1922, he was elected honorary fellow of the American Surgical Association³⁵ and in 1927, served as the first President of the Society of British Neurological Surgeons. In 1933, he received the Lister Medal, a distinguished award presented by the Royal College of Surgeons of England to

recognize individuals for their outstanding contribution to the surgical sciences. His interests were in the areas of experimental surgery including tissue repair, degeneration, and regeneration of peripheral nerves and parasitic theory of cancer.³¹ Thus, his accomplishments spanned the fields of otolaryngology, neurosurgery, and cardiac surgery.

In his 1898 publication entitled *On splenectomy for rupture without external wound*, Ballance described the findings of fixed dullness to percussion in the left flank and shifting dullness to percussion in the right flank seen with splenic rupture/hematoma (Table 2).³⁶ He wrote that (Table 1):

*[t]he diagnosis of ruptured spleen is arrived at from: (1) The locality of the injury. (2) The evidence of internal haemorrhage; and (3) The large fixed dullness in the left flank. The fixed dullness in the left loin and splenic region is not present in intra-abdominal haemorrhage from other organs, and is caused by this region being occupied by large quantities of clot. The dullness, therefore, cannot change with position, and is pathognomonic of this injury. The unusually large proportion of white corpuscles in splenic venous blood offers an explanation of the local coagulation of the effused blood in splenic rupture. Further, the exceptional coagulability of the splenic blood offers an explanation of the fact that these patients do not rapidly bleed to death.*³⁶(p. 357; emphasis added)

During traumatic assessment of the abdomen, Ballance sign may be observed and caused by dullness in the left flank due to coagulated blood, and shifting dullness on the right flank from fluid blood.³⁶ We are unaware of any study that validated this sign.

Conclusion

Percussion is an important bedside technique that is essential for clinicians to perfect. Percussion sounds are based primarily on the properties of tone and pitch. It is through these properties that the type of sound emitted and the density are distinguished. Clinicians do remarkably well in distinguishing different qualities of sounds heard through percussion. Through auscultation of the abdomen, we detect the presence of bowel sounds, friction rubs, and venous hums. However, this technique alone provides only a limited picture and, thus, the use of both techniques provides a more comprehensive and summative assessment of underlying disease and further assist in determining an accurate diagnosis.

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Author Affiliations

*Vaibhav Rastogi, MD; * Devina Singh, MD; † Halil Tekiner, PhD; ‡ Fan Ye, MD; * Joseph J. Mazza, MD; § and Steven H. Yale, MD¶*

**University of Central Florida College of Medicine, Graduate Medical Education, 6850 Lake Nona Blvd, Orlando, FL 32827 USA*

†University of Florida, Department of Medicine, 2000 SW Archer Rd, Gainesville, FL 32610 USA

‡Erciyes University School of Pharmacy, Department of the History of Pharmacy and Ethics, Talas, Kayseri 38280 Turkey

§Marshfield Clinic Research Institute, 1000 North Oak Avenue, Marshfield, WI 54449 USA

¶University of Central Florida College of Medicine, Department of Internal Medicine, 6850 Lake Nona Blvd, Orlando, FL 32827. Email: steven.yale.md@gmail.com