The surface landmarks of the abdominal wall: a plea for standardization

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Abstract
Despite centuries of anatomical studies, controversies and contradictions still exist in the literature regarding the definition, anatomical terminology and the limits of the abdominal wall. We conducted a systematic research of books published from 1901 until December 2012 in Google Books. After the index screening, 16 remaining books were further assessed for eligibility. We decided to exclude journals. The aim of the study was to focus on surface landmarks and borders of the abdominal cavity. After this revision of the literature, we propose that the surface landmarks of the abdominal wall should be standardized.

Key words: surgical anatomy, abdominal wall, narrative review.

Introduction
In the literature there are many controversies and inconsistencies concerning the definition of regions of the abdomen and the landmarks of the abdominal wall. Throughout the history of surgical anatomy, including the recent literature, semiotics of the abdominal wall have been disputed. The topographical division of the abdomen and the abdominal wall is necessary to describe systematic examination and exploration of the abdomen: il faut “s’orienter”, ici encore, pour explorer méthodiquement cette énorme cavité [1]. The goal of our review is to provide the surgeon with a description of standardized surface landmarks and borders of the abdominal cavity.

Material and methods
We conducted a systematic research of books published from 1901 until December 2012 in Google Books in English, Italian and French. Our search strategy included the use of the words “surgical semiotics” or “semeiotica chirurgica” or “surgical diagnosis” or “diagnostic chirurgical” or “surgical clinical examination”.

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According to the inclusion criteria we considered only education and teaching books in which the surface landmarks of the abdominal wall were clearly reported. Journal articles and specialist surgical books were excluded.

**Results**

The initial search produced 6,124 potentially relevant books. After screening titles for relevance, 16 remaining books were further assessed for eligibility.

**Discussion**

The abdominal cavity is bordered by the thorax cephalad, and by the pelvis caudad. The upper limit between the thoracic cavity and the abdominal cavity is represented by a horizontal plane passing through the base of the xiphoid appendix (xiphisternal articulation) and the spinous process of the 12th dorsal vertebra (Figure 1 A).

The topographic subdivision of the abdominal wall into upper, lower, anterior, posterior and lateral occurred long before Lejars in 1923 and Stern in 1928 [1, 2]. The right upper quadrant (RUQ) and left upper quadrant (LUQ) extend from the median plane to the right or the left of the patient, and from the umbilical plane to the right or left ribcage, respectively. The right lower quadrant (RLQ) and left lower quadrant (LLQ) extend from the median plane to the right or left of the patient, and from the umbilical plane to the right or left inguinal ligament, respectively. In French, there are 9 regions (epigastrium, hypogastrium, umbilical region, right and left flanks, left and right hypochondrium, left and right iliac) (Figure 2).

However, surgeons, still disagree on this division. For Lejars (1923), Rasario (1957), Ruggeri (1968), Fradà (2009) and Swartz (2010) [1, 3–6], the upper limit of the anterior abdominal wall does not correspond to the upper limit of the abdomen, as already highlighted by Dominici (1932) [7] and Provenzale (1963) [8], but is delimited by a thoraco-abdominal line that begins at the level of the ensiform apophyses and then heads at the lowest edge of the costal arch. On the other hand, for De Franciscis et al. (1998) [9] and Bellantone et al. (2009) [10] the upper wall of the abdominal cavity is represented by a thoraco-abdominal line that extends back to the spinous process of the 12th thoracic vertebra.

Standring (2008), Moore et al. (2010), Berti Riboli and Gipponi (2010), and Thomas and Monaghan...
(2007) [11–14] distinguish the upper limit of the anterior abdominal wall (the thoraco-abdominal line) from the line for the abdominal cavity (the diaphragm).

Moore et al. (2010) [12] used the term “costal line” as an alternative to the “thoraco-abdominal line”.

According to Dominici (1932) [7] and Provenzale (1963) [8] “i limiti del torace che si debbano considerare in clinica sono diversi da quelli anatomici, perché se nello studio del malato si considerasse come limite inferiore del torace il margine convesso delle costole si dovrebbero comprendere nell’esame clinico della cavità toracica il fegato, la milza” (The clinically relevant limits of the chest are different from the anatomical limits, because if the convex edge of the ribs is considered as the lower limit of the chest in the study of the patient, it should include in the clinical examination of the thoracic cavity the liver and the spleen).

Conversely, there are few controversies as to the lower limit, which starts from the pubic symphysis, runs along the entire inguinal arc and iliac crest, and terminates at the spinous process of the 5th lumbar vertebra (Figure 1 B).
In the physical examination of the abdomen, the fundamental landmarks are the axillary lines, as follows:

- **anterior axillary line** (right and left), which runs vertically from the anterior corner formed by the pectoralis major muscle to the chest wall (Figure 2 A);
- **midaxillary line** (right and left), which descends from the apex of the axillary cavity (Figure 2 B);
- **posterior axillary line** (right and left), which descends from the posterior corner formed by the latissimus dorsi muscle and the chest wall (Figure 2 C).

These axillary lines thus divide the abdomen into four walls: anterior, posterior, right and left lateral.

Anterior wall: the area between the two anterior axillary lines: right and left.

Posterior wall: between the two posterior axillary lines.

Lateral walls (right and left): between the anterior and posterior axillary lines.

In some anatomical books (Gray 2008; Moore et al. 2010) and in some surgery books (Bellantone et al. 2010; Dionigi 2011), the abdominal wall is divided only into two: anterior-lateral and posterior [12, 15].

For Bellantone [10] "la parete antero-laterale passa in quella posterolaterale senza soluzione di continuità lungo il corpo dei tre muscoli larghi dell’addome (obliquo esterno, obliquo interno e trasverso)" (the antero-lateral wall passes in that posterolateral seamless along the body of the three broad muscles of the abdomen: external oblique muscle, internal oblique muscle and transverse abdominal muscle). For Dionigi [15], the limit is “una linea verticale che decorre dalla spina iliaca antero-superiore al margine costale” (a vertical line that runs from the anterior superior iliac spine to the costal margin). In the classic work written by John Skandalakis [16] (The Embryologic and Anatomic Basis of Modern Surgery): “The anterior abdominal wall can be considered to have two parts: anterolateral and middle (or midline). The anterolateral portion is composed of the external oblique, the internal oblique, and the transversus abdominis muscles. The middle portion is composed of the rectus abdominis and pyramidal muscles.”

On the other hand, according to Dominici (1932) [7] and Provenzale (1963) [8], the posterior wall of the abdomen is limited by the paralumbar lines (Dominici 1932 [7]; Ruggieri 1968 [4]) and by the lateral margin of the sacro-lumbar muscles (Provenzale 1963 [8]), which always correspond to the posterior axillary lines (De Franciscis et al. 1998 [9]).

In conclusion, our review demonstrates that controversy concerning some anatomical aspects of the abdomen and abdominal wall still exists. The surface landmarks of the abdominal wall should be standardized. We propose, according to Dominici and Provenzale, that the limit of the abdominal wall and that of the abdominal cavity are to be considered different. Thus the upper limit of the abdominal cavity consists in a horizontal plane passing through the xiphisternal articulation and the spinous process of the 12th dorsal vertebra (Figure 1 A). Consequently the upper limit of the abdominal wall is represented by the thoraco-abdominal line which starts from the xiphoid appendix, runs along the lower edge of the costal arch and reaches the 12th thoracic vertebra.

As regards the subdivision of the abdominal wall in the transverse plane we suggest the axillary lines as landmarks instead of muscle borders which widely vary between the authors. Furthermore, we propose to separate the lateral wall from the anterior one, by considering the anterior axillary line as a border between them.

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