Aorta 11

Aortic aneurism is a time bomb that has consigned countless victims to the corridors of ERs over the years, and to CT rooms in recent times. Defusing this bomb has been possible from around 1982, in the routine examination of any thoracoabdominal pain, since excellent 40-cm wide machines with wheels became available at this time. A few seconds were usually sufficient, beginning by the abdominal aorta.

Our 5-MHz microconvex probe with its 17 cm of maximal range gives the best conditions for studying the thoracic and abdominal aorta, as well as the retroperitoneum in most patients in our institutions.

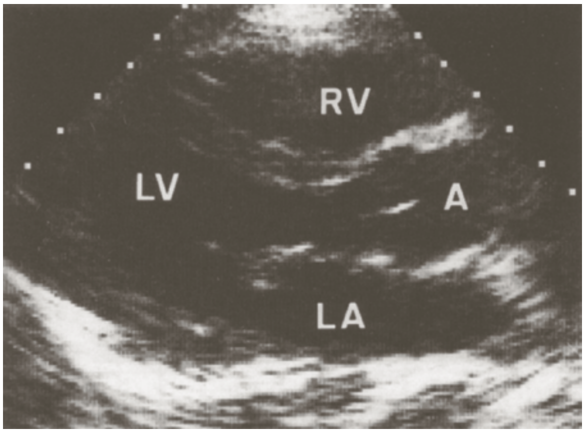

Fig. 11.1 Initial aorta. Cardiac parasternal long-axis scan. The aorta (*A*) is seen between the left auricle (*LA*) and right ventricle (*RV*). *LV* left ventricle. This scan follows the conventions in cardiac imaging for once (head of the patient at the right of the image)

Thoracic Aorta

The perfect ergonomy and resolution of our microconvex probe for supraclavicular or suprasternal approaches may make one reconsider the usual approaches (TEE, CT, RMI) for immediate assessment of the thoracic aorta. Clearly, we do not have 100% success, mostly depending on the patient's morphotype, but all favorable morphotypes can benefit from precious minutes using early diagnosis.

The thoracic aorta can, to a various extent, be visualized by surface ultrasound.

1. The initial aorta is usually visible via the left parasternal route (Fig. 11.1).
2. The ascending aorta is sometimes visible by the supraclavicular route (Fig. 11.2).
3. The aortic arch and the three supra-aortic trunks are sometimes well visible via the suprasternal route (Fig. 11.3). Any pathologic enlargement increases the acoustic window and increases the success rate of our approach.

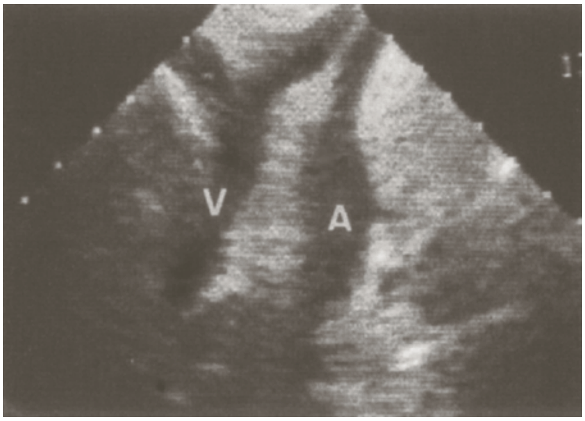

Fig. 11.2 Ascending aorta (*A*), inside the superior vena cava (*V*). Right supraclavicular approach. The origin of the brachiocephalic artery can be seen

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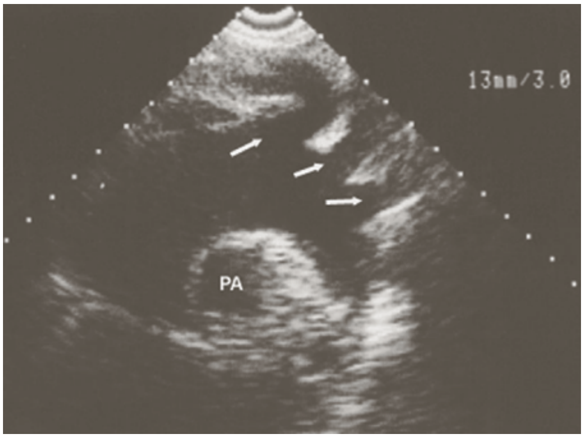

Fig. 11.3 Aortic arch. Exposure in a young woman with a favorable morphotype, suprasternal approach, microconvex probe. The origin of the supra-aortic trunks (*arrows*) and a transverse section of the right pulmonary artery (*PA*) are exposed in detail

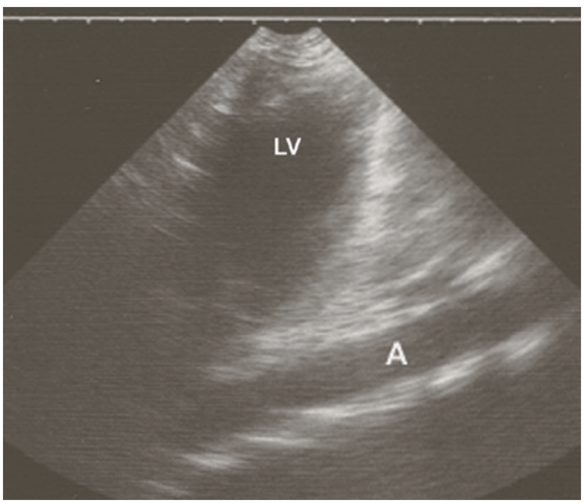

Fig. 11.4 The descending thoracic aorta. It is exposed over 12 cm in this scan, which exploits the cardiac window (apical scan of the heart). *LV* left ventricle

4. The isthmus is usually not well accessible – this is a limitation in the traumatized patient, since this segment is of strategic importance.
5. The descending thoracic aorta is visible over several centimeters, behind the heart, via the cardiac apical route (Fig. 11.4). A posterior approach is usually futile because of the lung interposition. In pathologic conditions, however, a left pleural effusion (a hemothorax in the case of aneurysm leakage) provides a correct posterior acoustic window (see Fig.15.10 page 135).

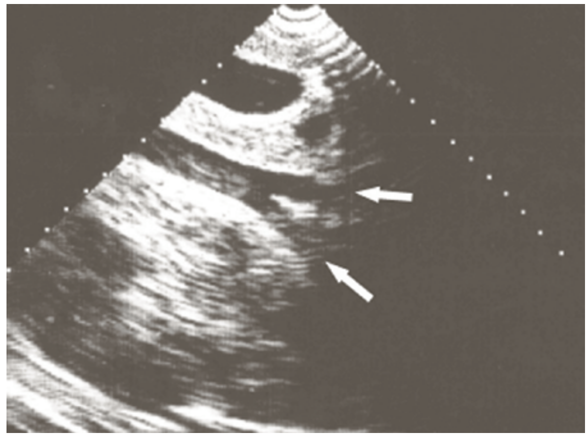

Fig. 11.5 Terminal aorta, longitudinal section. *Arrows* origin of the iliac arteries. This type of image can replace invasive modalities such as CT or angiography in emergency situations. The bright linear echo within the aortic lumen is typical of a ghost artifact: straight and motionless, like a ghost in real time – see the bright surroundings

The abdominal aorta is then followed via the abdominal route up to its bifurcation (Fig. 11.5).

Thoracic Aortic Dissection

This disease can give misleading presentations, meaning that any physician will from time to time (by mistake so to speak) face this kind of patient. A routine ultrasound examination of any thoracic pain can immediately rectify the diagnosis.

The diagnosis of thoracic aortic dissection can be fully accessible to a simple approach, with the restrictions written above. We observe the following signs:

- The aortic lumen is enlarged (Fig. 11.6).
- The intimal flap is recognized using these signs:
  - This is an echoic structure within an anechoic lumen.
  - This structure is never perfectly straight or regular, as would be a tangential artifact (these artifacts are usually located in a geometric axis, i.e., horizontal or vertical). It has anatomic shapes.
  - Its dynamic is relative with respect to the vessel dynamic. This relativity can be printed on M-mode in the favorable cases, but can also be just visualized.
- A hemopericardium is often present (Fig. 11.7).

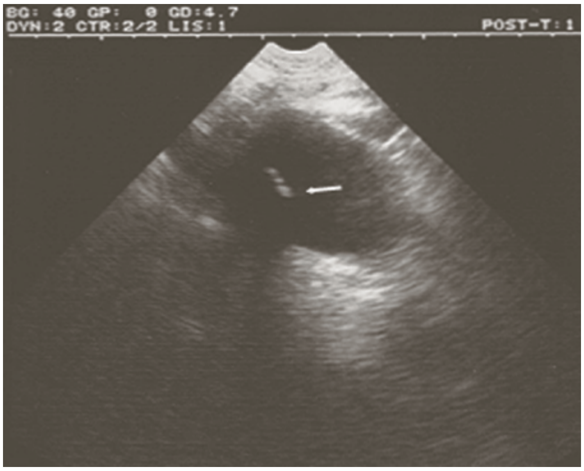

Fig. 11.6 Dissection of the thoracic aorta. Intense chest pain in a 77-year-old female. A suprasternal scan demonstrating an enlarged aortic lumen (45 mm) with an internal image that is irregular, nonartifactual (neither horizontal nor vertical nor parallel to strongly echoic external structures), and mobile, indicating intimal flap (*arrow*). Such images are highly more characteristic in real time than in this single view (see Fig. 11.16)

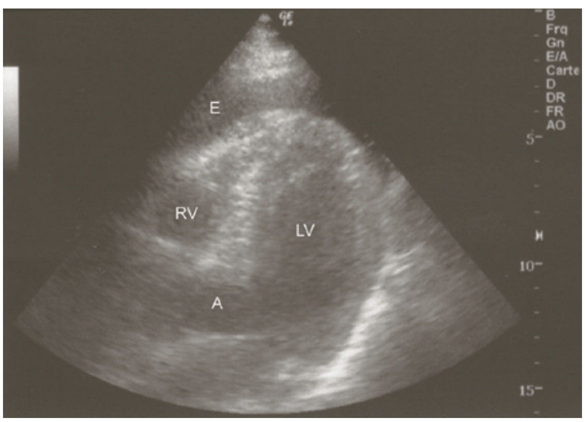

Fig. 11.7 Hemopericardium. Usual appearance in patients with aortic dissection. Note the echoic pattern (this is blood). The small size of the right ventricle should prompt immediate management. This image is one among two already featuring in this book, but such easy-to-diagnose and easy-to-manage life-threatening conditions symbolize the whole meaning of critical ultrasound. *E* pericardial effusion

When these signs are present, the diagnosis can be obvious to the point that it becomes risky to refer such patients to confirmation tests like CT.

Figure 11.5 provides an example of a ghost artifact that may mimic an intimal flap for the very inexperienced user.

Thoracic Aortic Aneurism

A thoracic aortic aneurysm yields a large mediastinal mass accessible to a microconvex probe. The walls of the aorta generally have a sacciform pattern. The content can show massive thrombosis and then appear as a tissular mass (Fig. 11.8). However, this mass will contain a central lumen, with a stratified periphery. Often, the most central layers of the thrombosis are still mobile, and one can see them driven back to the periphery a few millimeters in each systole.

The supra-aortic vessels can be followed to various lengths, but this has rare applications, at least in medical ICU use (see Chap. 25).

Abdominal Aortic Aneurism

Aortic analysis is routine in any abdominal pain. Studying the aorta diameter should not yield particular difficulties in thin patients without gas. As for the others (who are often the ones who actually have the disease), subtle maneuvers are usually efficient. The anterior barriers (fat, gas) can be drawn away by pressure – here, the pressure should be done gently, in order to avoid any uncontrolled consequences (pain, deleterious hyperpressure). We use one hand to hold the microconvex probe and our other hand to spread the pressure. See Fig. 11.9 page 86 for how to gently hide gas. If the fat/gas barrier is too substantial, we do not persist and

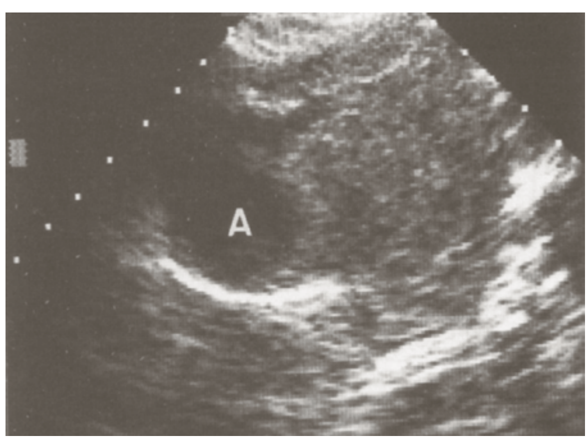

Fig. 11.8 Thoracic aorta aneurysm. A suprasternal scan of a patient with thoracic pain and shock. Note the substantial thrombosis, with regular layers. *A* circulating lumen of the aorta

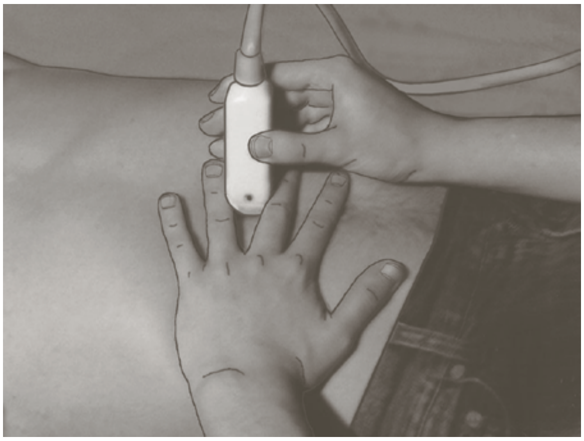

Fig. 11.9 The free hand is spread over the abdomen and the microconvex probe is inserted as shown. The free hand gently controls the pressure, and even makes the clinical work of palpation

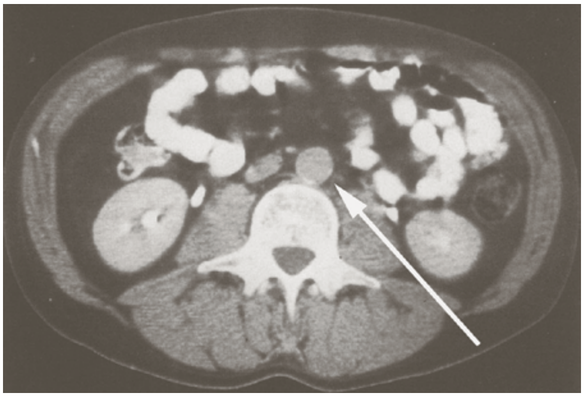

Fig. 11.10 CT scan of the abdomen, showing that in case of anterior gas interposition, a translumbar approach is available for analyzing the abdominal aorta (*arrow*), using a short probe

shift to a translumbar approach (Figs. 11.10 and 11.11).

We know that the longitudinal approach is advocated by some. Scanning the abdominal aorta via a transversal approach allows immediate location. The Carmen maneuver makes everything more evident and provides equivalent information to longitudinal scans. The diagnosis is usually basic, showing an enlarged aorta (Fig. 11.12), loss of parallelism of the aortic wall, with a fusiform or, less often, sacciform shape (Fig. 11.13).

The basic signs of abdominal aortic aneurysm are a loss of parallelism of the aorta walls with a fusiform or, less often, sacciform shape (Fig. 11.13). When local conditions are favorable, ultrasound provides, like CT, a global overview of the lumen, thrombosis, wall thickness

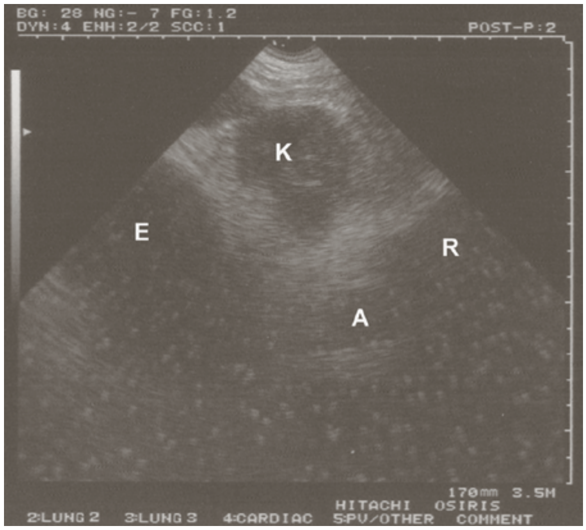

Fig. 11.11 Translumbar approach to the aorta. The probe is placed like the *arrow* in Fig. 11.10 (in fact through the kidney, *K*). Fine movements allow the aorta (*A*) to be exposed, against the rachis (*R*). Note in the bottom of this figure, multiple snow artifacts, called K-lines, due to sectorial interference

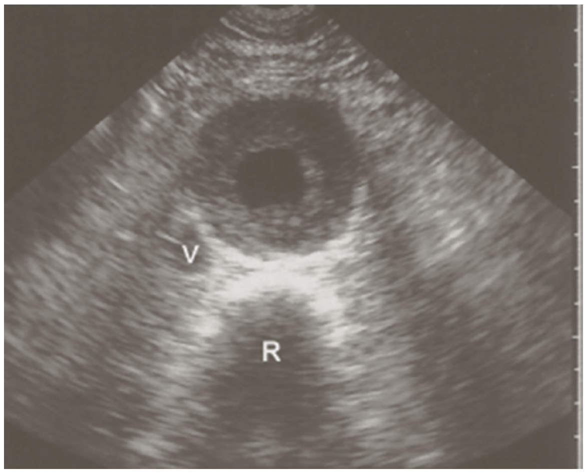

Fig. 11.12 Aortic aneurism. Transverse scan of the epigastric area. The aorta is recognized by its location anterior to the rachis (*R*), at the left of the inferior vena cava (*V*). A substantial enlargement of the caliper (5 cm) is immediately noted. A large, regular thrombosis within the aneurysm yields a quasi-normal caliper of the lumen (a standard aortography would underestimate this aneurysm)

(increased in the case of inflammation) and main collateral vessels. The diagnosis of aneurism is usually done for a caliper >3 cm. In the case of leakage, a collection is found in the left retroperitoneal space (Fig. 11.14). Serendipitous cases show a precise area of whirling, in rhythm with heart frequency, within the hematic effusion.

Fig. 11.13 Aortic aneurism. This scan specifies the 10-cm extension of the aneurism of Fig. 11.12

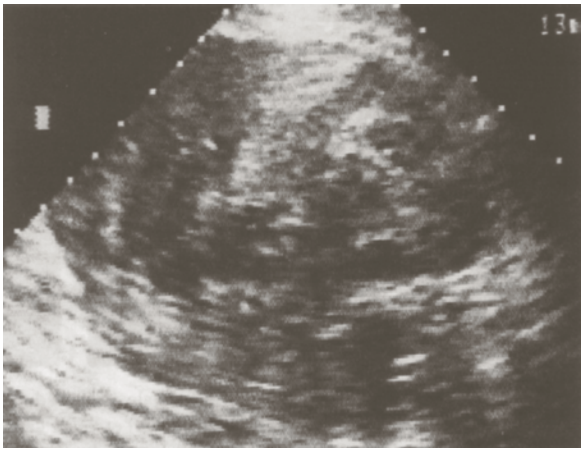

Fig. 11.14 Retroperitoneal hematoma. Patient in shock with abdominal pain. Huge, roughly rounded mass with anterior contact (transversal scan, left flank approach). The echoic heterogeneous pattern indicates early clotting

This dynamic pattern obviously indicated the location of the leakage and indicated extremely urgent surgery.

Fortuitous discovery of incipient aneurysm can occur in the medical ICU and should prompt further investigations. An atherosclerotic aorta with irregular borders simply indicates that the patient may have diffuse potential arterial damage.

Abdominal Aortic Dissection

A dissection of the abdominal aorta (or extended to it) yields enlarged lumen with an intimal flap separating

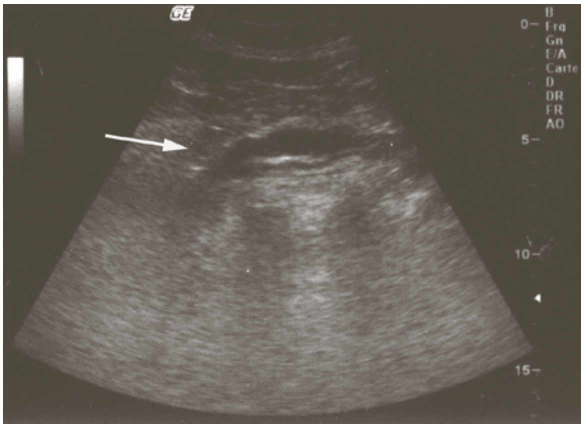

Fig. 11.15 Aortic dissection. Epigastric longitudinal view of a patient in shock with thoracoabdominal pain. Within the abdominal aorta (*arrow*), a long intimal flap is clearly visible, with characteristic static signs (sinuous shape). See Fig. 11.16 for the dynamic description

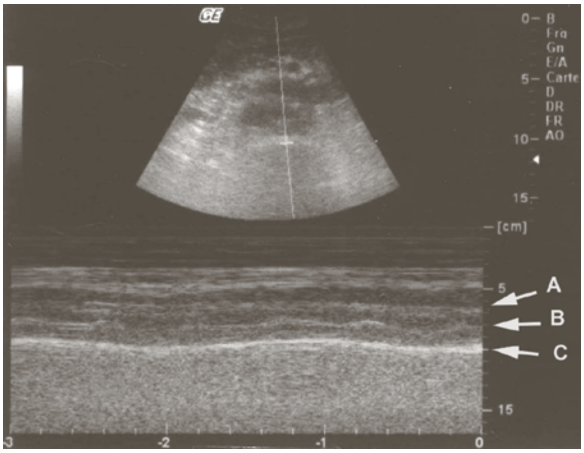

Fig. 11.16 Aortic dissection, sequel of Fig. 11.15. M-mode on a transversal scan of the abdominal aorta. *A* and *C* are the proximal and distal walls of the aorta, *B* is the intimal flap. The relative dynamic of *B* when compared with the walls, *A* and *C*, is characteristic, as demonstrated on this frozen image

two channels. The flap is easy to identify, with these major criteria.

1. It appears echoic within an anechoic surrounding (Fig. 11.15).
2. This image is anatomic, not strictly straight, as some artifacts appear (see Fig. 13.7 page 103).
3. The visualization of an intrinsic dynamic at the flap level is characteristic (Fig. 11.16).

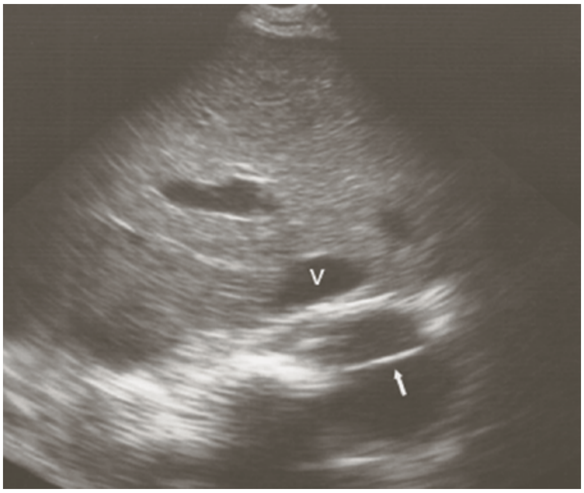

Fig. 11.17 Aortic dissection. Within the aorta, the intimal flap is clearly visible (*arrow*) in this transversal scan. In real-time, this flap has an intrinsic movement (unlike any artifact)

Such patterns must prompt for a search for thoracic aortic dissection.

When the aorta can be followed to its bifurcation, the progressive disappearance of one channel can be noted (Fig. 11.17).

Retroperitoneal Hematoma and Other Disorders

The mass is usually voluminous, heterogeneous, often with a dependent zone that is rather echoic and that corresponds to blood clots, and a nondependent area that is rather poorly echoic, and that corresponds to the serum. This area can be rich in septations due to fibrin deposits (Fig. 11.14). It is possible to follow this hematoma up to the insertion of the psoas muscle. Peritoneal blood effusion can be associated with contiguity and should not be misleading.

A posterior translumbar approach is logical, but an extensive hematoma generally comes in contact with the anterior abdominal wall (clinically detectable). The differential diagnosis with a parietal hematoma, whose treatment is different, will be resolved by studying the linking angles.

When a superinfection is suspected, a diagnostic ultrasound-guided tap is possible.

Retropneumoperitoneum should theoretically yield a characteristic image, since air stops the ultrasound beam.