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# *Abdominal aortic aneurysm in ultrasound and CT examination*

Abdominal aortic aneurysm is defined as a permanent localized dilatation of an artery having at least a 50% increase in diameter compared with the expected normal diameter of the artery, maximal sagittal diameter of infrarenal aorta exceeding 30 mm and at least one and a half time larger than the suprerenal diameter (11, 12, 13).

The prevalence of the abdominal aortic aneurysms (AAA) is increasing, and in subjects aged 50 years and older varies between 1.4 and 8.8%. It is estimated that AAA is fourfold as common and tenfold more fatal in men than in women, who are affected when 10 years older than their male counterparts (1, 7, 12).

About 75% of AAAs are asymptomatic. They come to light as the chance findings of a lump with or without pulsation, noted on self-examination, a routine physical check-up, or during diagnostic investigations, such as a plain abdominal film, intravenous urography, barium, US, CT, or magnetic resonance-imaging study, undertaken for some other reason. The aneurysm may also be found at laparotomy or post-mortem examination. Abdominal and/or back pain is the most common symptom of an AAA and may be acute or chronic and is due to stretching of the aortic wall (7, 10, 14).

The aim of the study was assessment of the diagnostic value of computed tomography and ultrasonography in evaluation of abdominal aortic aneurysm.

## MATERIAL AND METHODS

Material comprises a group of 26 patients with abdominal aortic aneurysm. There were 18 men and 8 women, aged between 48 and 76 years (mean age 62 years). In each patient computed tomography and ultrasound examinations were performed. The CT examination was performed in 10 mm thick axial sections from the level of diaphragm to the level of bifurcation of iliac common arteries. At the level of kidney arteries the section thickness was 3 mm. In patients with dilatation of suprarenal aorta additional axial sections of thoracic aorta were performed to reveal coexistent aneurysm of thoracic aorta. The CT examination was performed before and intravenous bolus of 100 of contrast agents. Standard ultrasound examination of abdomen was performed in each patient.

## RESULTS

In 18 patients the abdominal aortic aneurysm was fully visualized in both ultrasonography and CT (Fig. 1AB), although the CT images after administering the contrast agent was more distinct (Fig. 1C). The thrombus inside the aneurysm was seen in 23 patients, and was visible on ultrasonographic images. The aneurysm was infrarenal in 24 patients, which was determined after visualizing the normal

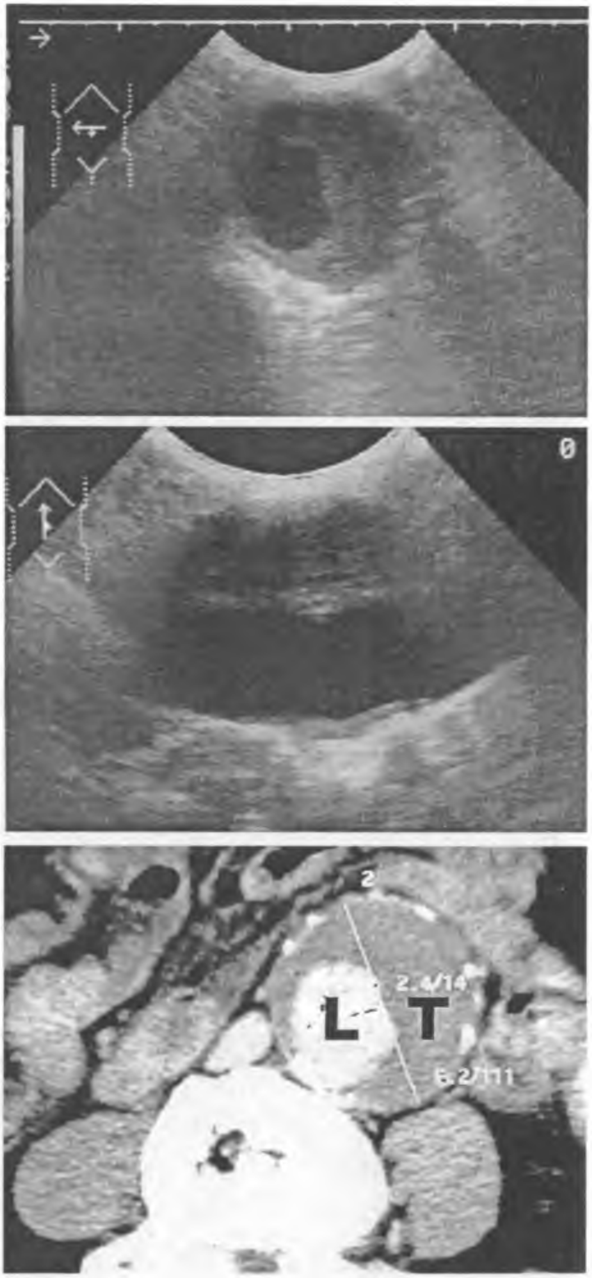


Fig. 1. The abdominal aortic aneurysm in ultrasonography in axial (A) and sagittal plane (B), and on axial CT section (C)

aorta at the level of the renal arteries. The renal arteries were seen in 23 patients in CT (Fig. 2A) and only in 15 patients in ultrasonography (Fig. 2B) because of the presence of bowel gases and obesity. In four cases the aneurysm was suprarenal, and the dilated aorta at the level of the renal artery was seen only on CT images. The coexistent aneurysm of the thoracic aorta was visible in two patients only in CT on additional sections above the diaphragm.

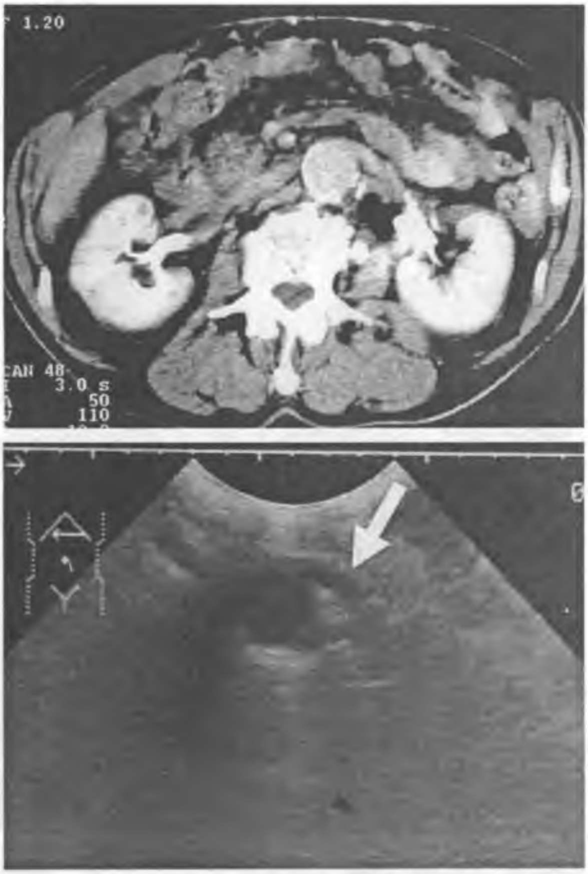


Fig. 2. Renal artery visible on both CT (A) and ultrasonographic (B – arrow) images

In three patients aneurysm involved the iliac arteries, which were visible only on CT images. In one of them there was visible dissection in the left iliac artery (Fig. 3).

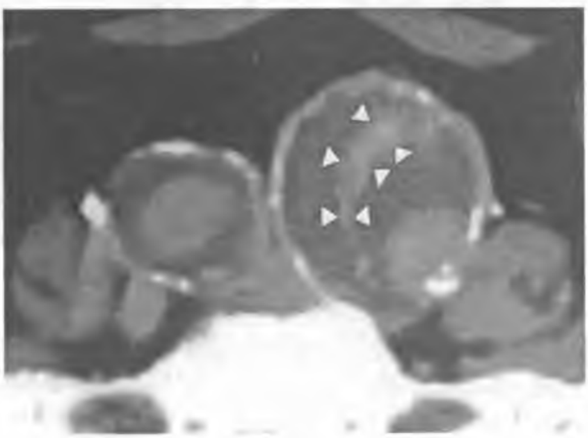

Fig. 3. The aneurysms of iliac artery, with the signs of dissection in the left iliac artery

## DISCUSSION

Abdominal aortic aneurysms may be diagnosed both in physical examinations and in various imaging modalities.

Physical examination for the diagnosis of AAA is associated with a large proportion of false-negative and false-positive findings, resulting in poor predictive value. Therefore imaging techniques are required for the detection of AAA (4, 5, 7, 15).

In the study of Karkos et al., more than a third of AAAs detected radiologically were missed in physical examination. Abdominal US and CT scan were the two most common investigations, responsible for the opportunistic detection of 56 (75%) of the 74 aneurysms found during radiological procedures (7).

Aneurysm size is the most important factor related to likelihood of rupture. Although rupture may occur with an aortic diameter of less than 4 cm, the risk is small. With an AAA diameter under 5 cm, the yearly chance of rupture is about 0–5%. For AAA of 5–6 cm, annual chance of rupture is 5%, increasing exponentially for larger aneurysms, but most individuals with a ruptured AAA die before reaching the operating theatre. Out of the remaining 25%, subjected to an emergency operation, about a half dies during or after the operation due to myocardial infarction, hemorrhage, or multiple organ dysfunction. The overall mortality of AAA rupture is therefore still around 80–90% (7, 11, 14, 15).

Also the presence of thrombus in general and growth of thrombus in particular is associated with an increased risk of rupture. The precise mechanisms behind this association remain to be clarified. Whether thrombus growth is a better predictor than surface growth is a question, which will have to be confirmed in further studies (14).

In view of the rising chance of rupture, many surgeons have a policy of proceeding to repair symptomatic AAAs or when their diameter has reached 5 or 5.5 cm or growth of more than 1 cm per year is recorded. The conventional treatment involves insertion of vascular prosthesis within the lumen of the aneurysm. Less invasive endovascular treatment of selected aortic aneurysm with stent-grafts is also common procedure. The smaller aneurysms should be monitor in USG examination (1, 5, 6, 15).

The elective surgery are preferred, for peri- and postoperative mortality is 36%, while for ruptured aneurysm perioperative mortality is 66–95% (8).

Ultrasonography and computed tomography are the main modalities used to measure aortic diameter. Ultrasound has emerged as the most practical method for screening and follow-up of infrarenal abdominal aortic aneurysm while CT has become the preferred preoperative imaging technique (15, 16).

For conventional treatment of an aortic aneurysm, imaging modalities are mainly used to determine the diameter of the aneurysm, its relation the renal arteries and extension in the iliac arteries. In addition the presence of occlusive disease is important.

With the introduction of the endovascular treatment of abdominal aortic aneurysm the more precise measurements are important, including measurements of iliac arteries. As both the maximal AAA diameter and the growth rate impact treatment decision, a high degree of reproducibility is essential (1, 2, 12, 13).

Sonography is recognized as a tool for screening patients with suspected aneurysm of the abdominal aorta. However, ultrasound is usually employed only for identifying the presence of the aneurysm and is not considered a reliable imaging modality for surgical planning (3).

There is a difference between the aortic diameter measured in ultrasonography and CT. The difference is more evident in normal aortas, and is smaller in aortic aneurysms. It appears that the smaller the aorta the larger the difference. The transverse measurements have larger variability than anteroposterior measurements. The lack of agreement between ultrasonography and CT was observed despite the fact that 15% of examined patients were excluded due to suboptimal visibility with ultrasonography. All ultrasonography examinations were considered to be of high quality.

Ultrasonography systematically gives the larger diameter of non-aneurismal aortas (diameter < 30 mm) by 2.8 mm (1.7–4.0) in anteroposterior plane and 3.8 mm (2.3–5.3) in transverse plane. In aneurismal aorta the difference in ultrasound and CT measurements of the aneurysm diameter was over 5 mm in 24% of patients in anteroposterior diameter and in 33% of patients in transverse diameter. These differences are important both for clinical practice and for research (16).

Variations of measurement, which has been shown to be important in the ultrasound follow-up of small abdominal aortic aneurysms (AAA), may affect clinical decisions when these are based on the actual diameter or demonstration of accelerated growth. The aorta is a three-dimensional structure and aneurysms may expand in all dimensions. Increasing aneurismal length leads to aortic convolution or unfolding and may confound interpretation of measurements based on simple two-dimensional images (12).

Interobserver variability in the measurements of the anteroposterior diameters of abdominal aortic aneurysm has been 2.2–8 mm. Interobserver variability was also larger for transverse measurements in our study, probably due to the superior axial compared to lateral resolution (2, 4, 9, 10, 11).

Another problem is the presence of gas in the bowels, and obesity. In some situations it is impossible to imagine mesenteric or renal arteries. In some patients the abdominal aorta is completely invisible in ultrasonography (11).

In cases of dilatation of the suprarenal part of aorta ultrasonography is not able to assess if thoracic aorta is also dilated, and CT examination is necessary.

Sonography is commonly considered to be less reliable than computed tomography and angiography for surgical planning in patients with abdominal aortic aneurysm (3).

Compared to ultrasound assessment, CT scanning would appear to provide a more objective assessment of aorta diameter. There are several factors that may impact upon measurement consistency. These factors predominantly relate to the problems of the assessment of a three-dimensional structure using a two-dimensional image. Because imaging protocol may vary in the distance between each level of tomography, it is possible that different cross-sections of aneurysms are measured at different times. Even if measurements are performed at pre-determined anatomical levels, the following two-dimension measurements at that level may not reflect the real increase in size, for aneurysms expand in three dimensions. CT scans in situations where the aorta does not lie perpendicularly to the plane of the scan produces an elliptical image. Measurements of those images do not reflect the real aortic diameters (12).

## CONCLUSIONS

In the evaluation of abdominal aortic aneurysm different imaging modalities may be used. Computed tomography is more accurate technique than ultrasonography.

In obese patients or in the presence of gas in the bowel the abdominal aorta may be invisible in ultrasonography, but is a easily and clearly visualized in CT.

Measurements of aneurysm diameters are much more reliable in CT than in ultrasonography. In CT it is possible to imagine and measure the length of the aneurysm in various MPR reconstructions. The bifurcation of the aorta and iliac arteries are well imagined in CT. The coexistent aneurysms of thoracic aorta are easily diagnosed just by performing few additional sections of thoracic aorta.

In properly prepared patients ultrasonography provides good imaging modality in performed screening examination, and in controlling patients with small aneurysm because it is widely accessible and cheap.

In preoperative assessment the CT examination is necessary.

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## SUMMARY

About 75% of AAAs are asymptomatic. They come to light as the chance findings of a lump with or without pulsation, noted on self-examination, a routine physical check-up, or during diagnostic investigations. Ultrasonography and CT are two most often used in diagnosing of AAAs. The aim of the study was the assessment of the diagnostic value of computed tomography and ultrasonography in the evaluation of abdominal aortic aneurysm. Material comprises a group of 26 patients with abdominal aortic aneurysm. There were 18 men and 8 women, aged between 48 and 76 years (mean age 62 years). In each patient computed tomography and ultrasound examinations were performed. Computed tomography is more accurate technique than ultrasonography. In obese patients or in the presence of gas in the bowel the abdominal aorta may be invisible in ultrasonography, but is easily and clearly visualized in CT. Measurements of aneurysm diameters are much more reliable in CT than in ultrasonography. In CT it is possible to imagine and measure the length of the aneurysm in various MPR reconstructions. The bifurcation of the aorta and iliac arteries are well imagined in CT. The coexistent aneurysms of thoracic aorta are easily diagnosed just by performing few additional sections of the thoracic aorta. In properly prepared patients ultrasonography provides good imaging modality in performed screening examination, and in controlling patients with small aneurysm because it is widely accessible and cheap. In preoperative assessment the CT examination is necessary.

Tętniak aorty brzusznej w ultrasonografii i tomografii komputerowej

Około 75% tętniaków aorty brzusznej jest bezobjawowych. Są one wykrywane przypadkowo jako pulsowanie lub guz, stwierdzone przez pacjenta lub w czasie rutynowego badania fizykalnego, czasem w czasie badań diagnostycznych. USG i TK są najczęściej wykorzystywane w badaniu tętniaków aorty brzusznej. Celem pracy była ocena wartości diagnostycznej tomografii komputerowej i ultrasonografii w ocenie tętniaków aorty brzusznej. Materiał stanowiła grupa 26 pacjentów z tętniakiem aorty brzusznej. Było to 18 mężczyzn i 8 kobiet, w wieku miedzy 48 a 76 lat (średni wiek 62 lata). U każdego pacjenta było wykonane badanie TK aorty brzusznej i badanie USG. W ocenie tętniaka aorty brzusznej tomografia komputerowa jest dokładniejsza niż badanie USG. U otyłych pacjentów lub w przypadku obecności gazów jelitowych aorta brzuszna może nie być widoczna w USG, ale jest łatwo obrazowana w TK. Pomiary średnicy tętniaka są również bardziej dokładne w TK niż w USG. TK umożliwia ocenę długości tętniaka w różnych rekonstrukcjach MPR. Rozdwojenie aorty i tętnice biodrowe są również łatwo obrazowane w TK. Współistniejący tętniak aorty piersiowej jest łatwo rozpoznawany w TK dzięki możliwości rozszerzenia badania na odcinek piersiowy aorty. U odpowiednio przygotowanych pacjentów USG jest dobrą metodą obrazowania w badaniach skriningowych oraz do kontroli pacjentów z małymi tętniakami, ponieważ jest łatwo dostępna i tania. Do oceny przedoperacyjnej konieczne jest wykonanie badanie TK.