

Emergency computed tomography of the acute abdomen. Why ? When and How to do it ?

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1. Why ?

A complete exploration of the entire abdomen, pelvis and lower thoracic bases, can be accomplished in just a few minutes with modern CT scanners whether we have recourse to spiral acquisitions or "dynamic" incremental acquisitions with a short time cycle (5 to 10 seconds with "continuous rotation").

Image quality is greatly improved by the reduction in slice thickness (5 mm), the 512 x 512 reconstruction matrix, and the enhancement quality (vascular as well as parenchymal) obtained by systematically using substantial quantities of contrast media (2 ml/kg) injected at a high enough (3 to 5 ml/sec) and controlled (mono or biphasic) output.

Therefore, every "acute abdomen" can be explored in approximately ten minutes with a complete study of the peritoneal cavity, the retroperitoneal space, and the bowel wall. The images obtained allow a precise evaluation of the macroscopic anatomical state of the pathological areas, which permits a well thought-out choice of the therapeutic options: emergency laparotomy or celiosurgery, fluoroscopically, US, or CT-guided drainage, medical treatment with or without deferred surgery, etc...

2. When ?

Emergency computed tomography is strongly recommended when initial laboratory investigations or imaging techniques (plain abdominal film, chest x-ray and abdominal ultrasound) are considered insufficient, whether it is because the results do not permit the treating physician or radiologist to make a diagnosis with enough conviction, or because the results do not even permit an orientation towards a diagnosis.

We must insist on the limitations in sensitivity and specificity of the plain abdominal film, regardless of the technique used (supine, upright, or left-lateral decubitus with a horizontally-directed ray), in demonstrating pneumoperitoneum or in formally differentiating true mechanical bowel obstruction from adynamic ileus when confronted with images of intestinal air-fluid levels [1,5].

Any delay in the initiation of an adequate treatment can be quite detrimental to the patient resulting in an aggravation of the post-operative morbidity, whether it be immediate or delayed. The economy of a lapa-

rotomy over a coelio-surgery can positively change the outcome of the remaining years of the patient by limiting the risks of eventration and probably by diminishing the incidence of post-operative adhesions and peritoneal bands.

We must therefore, if we have the possibility, perform a CT examination of the patient quite early when the clinical context suggests that only the CT will be effective in establishing the proper diagnosis and in choosing, in a clarified manner, the appropriate treatment. The interest of combining the plain abdominal film with the abdominal US must therefore be discussed by taking into consideration the real cost they both represent (displacement of the patients, repeated stretcher-bearing, difficulty in supporting the upright plain abdominal film by the patient), and the delay in diagnosis induced by performing these two studies.

Therefore, the CT scan will be preferred as the initial diagnostic tool in adult and elderly patients, especially if the patients are obese or if the acute pathology is suspected to be of mesenteric, submesocolic, or retroperitoneal (pancreatitis) origin, with the exception of urinary emergencies (ureterorenal colic) and gynecological emergencies. In particular, we prefer the CT scan as an initial diagnostic tool in patients presenting with important gaseous and/or liquid abdominal distention especially if we are dealing with patients that are elderly and bedridden, immunocompromised, or undergoing a treatment that could "mask" symptoms such as corticosteroids [2,3].

On the other hand, abdominal emergencies in children and in young women in their reproductive years, as well as acute urinary obstruction, can initially be explored by an abdominal ultrasound (usually without any abdominal preparation).

3. How ?

CT scanning of acute abdomen cannot be "standardized". It is a genuine clinical and radiological examination in which its organization must be adapted to each individual case in function of the clinical context and laboratory results, and in function of the previous radiological examinations at our disposal [2,6].

Therefore, we must specify in each case:
— the "intestinal preparation" using iodinated contrast media is proscribed unless there is a need to search

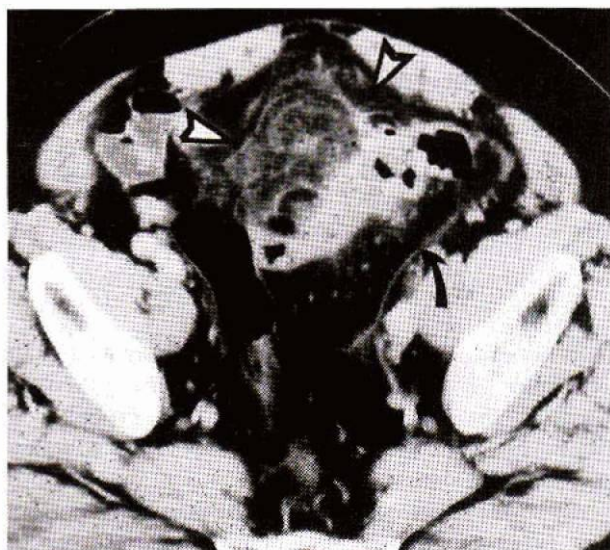


Fig. 1. — Acute diverticulitis - typical aspect :
 — circumferential thickening of the sigmoid wall, diverticules and fibrofatty proliferation of the mesosigmoid are signs of diverticular disease (diverticulosis)
 — signs of inflammation (diverticulitis) spread out beyond the colon wall and combine :
 — inflammatory infiltration of pericolic and mesenteric fat (arrowheads)
 — sigmoid mesenteric vascular engorgement (enlargement and blurring of the vessels)
 — fluid at root of mesentery (curved arrow).

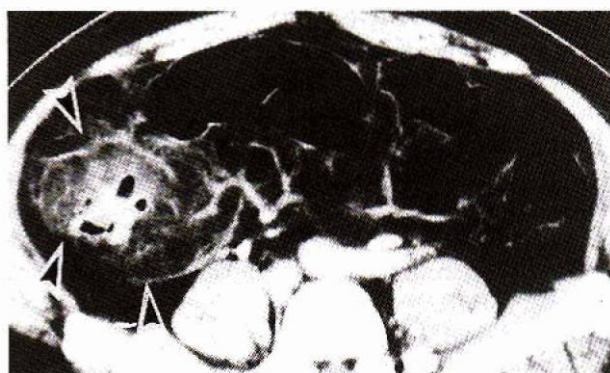


Fig. 2. — Painful palpable mass of the right lower quadrant with fever and diarrhea suggesting complicated appendicitis or infected cancer of the caecum. CT shows typical aspects of complicated diverticular disease developed on a dolicho-sigmoid in the right iliac fossa.

for peripancreatic or peritoneal collections and differentiate these collections from distended bowel loops.
 — the opportunity to perform *non-enhanced CT image slices* “before contrast injection” by using the precise window level and width to confirm the presence of extraluminal air or to demonstrate a spontaneous hyperdensity of a hematologic structure (endoluminal blood clot, hematoma).

— the *injection parameters of the contrast media* and the acquisition of the slices by recalling that the

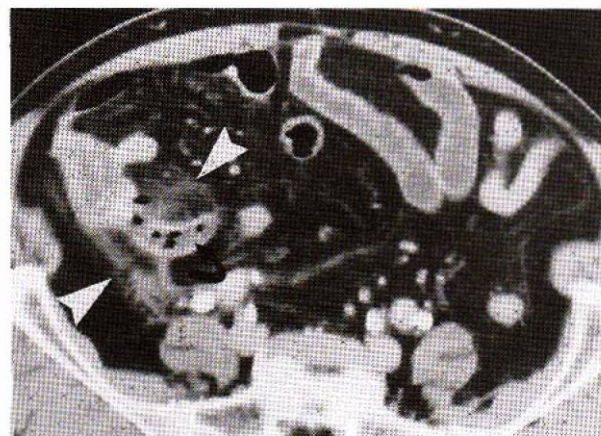


Fig. 3. — Acute appendicitis. Loss of radiolucency of the periappendicular fat associated with thickened latero-conal fascia are the most important features of appendicitis. Hazy densities are centered (white arrowheads) by a fluid and gaz distended appendix with thickened and overhanced wall (curved black arrow).

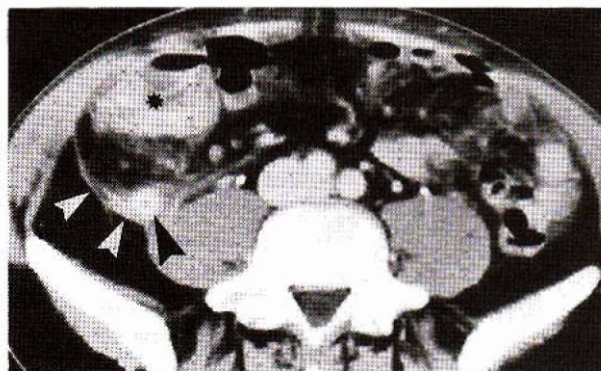


Fig. 4. — Classical CT appearance of appendicitis. Thickened lateroconal fascia and inflammatory infiltration of retrocaecal fat with blurring of the anterior border of the psoas muscle (white arrowhead) ; annular image of the highly enlarged and overhanced wall of the appendix (black arrowhead). Caecum wall is enlarged with concentric rings of low and high attenuation (target sign), related to sub-mucosal oedema (asterik). This “typhlitis” close to the appendiceal inflammatory process is very common and must be distinguished from a tumoral thickening.

maximal enhancement of intestinal mesenteric parenchymal structures and vascular portal structures is observed during the “golden minute” (between 60 and 120 seconds with a peak at 90 seconds) after the beginning of the injection. Only arterial structures, the pancreatic parenchyma, and the renal cortex benefit from an earlier acquisition (between 30 and 50 seconds).

— the opportunity of having *spiral acquisitions* permits a more rapid examination with maximal enhancement of vascular arterial structures but with a deterioration of the image quality (quantic noise level, effect of partial volume in the Z-axis) which can be more or less pronounced. Anyway, because of the asynchronous

arterial and venous vascular phases, it will be necessary to perform either a single spiral acquisition with a delay (in the beginning of the acquisition with regards to the beginning of the injection) of 50 seconds or less (but we lose the pure "arterial" images in this case or, preferably, a double acquisition using two successive spirals : one at the arterial phase and the other at the portal and parenchymal phase.

The imaging windows used must be adapted to every case. We must be particularly careful in evaluating the supra-mesocolic area where the optimal windows for the study of the liver can totally mask a pneumoperitoneum [4]. We must, therefore, always be conscious of the necessity of having the most optimal imaging windows of the mesenteric fat on all scan slices since the earliest and most sensitive signs of infectious or inflammatory bowel wall involvement will be demonstrated at this level (in particular, infectious, complications and/or

colonic diverticula and appendiceal perforation or gastroduodenal ulcer perforation) (fig. 1 to 4).

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