# Acute pancreatitis CT evaluation - an update

| | |
|---|---|
| **Poster No.:** | C-2486 |
| **Congress:** | ECR 2013 |
| **Type:** | Educational Exhibit |
| **Authors:** | C. Oliveira, L. B. Barbosa, R. P. N. CATARINO, A. Estevao; Coimbra/PT |
| **Keywords:** | Pancreas, Abdomen, CT, Diagnostic procedure, Acute, Inflammation |
| **DOI:** | 10.1594/ecr2013/C-2486 |

## Learning objectives

CT is the imaging modality of choice to evaluate acute pancreatitis. The variety of acute pancreatitis presentations demands a universally applicable and standardized classification system, which allows a non confusing communication between radiologists and clinicians.

With this work we propose to attend these objectives:

- Provide an overview of acute pancreatitis imaging findings and their updated classification and terminologies.
- Review the spectrum of pancreatic/peripancreatic complications and extrapancreatic complications of acute pancreatitis.
- Describe the role of CT in the management of acute pancreatitis.

## Background

Acute pancreatitis is a relatively common cause of acute abdominal pain, mainly diagnosed by clinical and laboratorial findings. Clinical definition of acute pancreatitis requires two of the three criteria:

- Abdominal pain strongly suggestive of acute pancreatitis;
- Serum amylase and/or lipase activity at least 3 times greater than the upper limit of normal;
- Characteristic findings of acute pancreatitis on ultrassonography or on contrast-enhanced CT (CECT) (MRI can supplant CECT if available)

There have been different classifications of acute pancreatitis over the time, based in clinical, analitic or/and radiological criteria. An uniformized classification and definitions are essencial to avoid misunderstanding and allow a better comunication, especially between diferent medical modalities.

The Atlanta classification has been proved usefull over the years. Meanwhile revision has been necessary as a better understanding of the pathophysiology of necrotizing pancreas, improvement in diagnostic imaging and other technics arise.

We provide an update in acute panreatitis classification based in the revised Atlanta classification by the Acute Pancreatitis Classification Group (2008).

# Imaging findings OR Procedure details

Acute pancreatitis should be look at has continuum dynamical process that has two distinct phases: an early phase (1st week of onset) and late phase (after the 1st week). Note that the onset of acute pancreatitis is defined as the time of onset of abdominal pain.

## Early phase

In the early phase (1st week), clinical parameters and multisystem organ failure are the most important determinant of morbidity and mortality (Marshall Scoring System).

CT role is to evaluate severity, possible causes and early complications, mostly in high risk patients.

The ideal time for assessing these complications with CT is after 72 hours from the onset.

A contrast-enhanced CT (CECT) in the parenchymal or portal phase is recommended to distinguish intertitial edematous pancreatitis (IEP) from necrotizing pancreatitis (NP).

The radiologist should address whether pancreatic necrosis is present and its extension (<30%, >30%), identify and characterize pancreatic and peripancreatic fluid collections and describe the extra pancreatic findings such as gallstones, biliary dilatation, ascites, venous thrombosis, aneurysms and contiguous inflammatory involvement of gastrointestinal tract (Fig. 1 on page 8, Fig. 2 on page 8 and Fig. 3 on page 9).

It is important to remember that not all patients need to undergo CT initially; it's not indicated in patients who have no clinical signs of severe pancreatitis and who show rapid clinical improvement.

In contrast, CECT should always be performed in the first episode, in patients who are over 40 years of age, to exclude a possible neoplasm.

## Late phase

In the late phase (after the 1st week), CT has a more effectiveness in morphological differentiation of IEP and NP, playing a more relevant role in patient care management (always combined with clinical features).

The morphological CT image-based classification is based mainly in the extent of necrosis and infection (Table 1 and 2) (Fig. 4 on page 10, Fig. 5 on page 11 and Fig. 6 on page 12)

| Table 1 - Morphological CT criteria for image-based classification of acute pancreatitis | | |
|---|---|---|
| **Necrosis** | Absent | |
| | Present | -Pancreatic parenchyma with or without evidence of peripancreatic necrosis.<br>(Extension: <30%, >30% of total parenchyma)<br>-Evidence of peripancreatic necrosis (no parenchyma necrosis). |
| **Infection** | Absent | |
| | Present | |

**Table 1**: Morphological CT criteria for image-based classification of acute pancreatitis.
***References:*** Radiologia, Hospital Geral, Centro Hospitalar e Universitário de Coimbra - Coimbra/PT

| Table 2 - Morphological CT Image-based classification of acute pancreatitis (after 1st week) | | |
|---|---|---|
| | Necrosis | Infection |
| Interstitial edematous pancreatitis | No | No |
| Necrotizing pancreatitis:<br>- Sterile<br>- Infected | Yes<br>Yes | No<br>Yes |

**Table 2**: Morphological CT Image-based classification of acute pancreatitis (after 1st week).
***References:*** Radiologia, Hospital Geral, Centro Hospitalar e Universitário de Coimbra - Coimbra/PT

## Pancreatic and peripancreatic complications

Pancreatic and peripancreatic fluid collections (acute fluid collections, pseudocysts and post necrotic pancreatic necrosis) are the commonest complications. Actual classification differentiates them in fluid collections arising and resolving within the first 4 weeks and fluid collections persisting for more than 4 weeks from the onset, as they may have different pathogenesis and natural history (Table 3) (Fig. 7 on page ).

| Table 3 - Pancreatic and peripancreatic fluid collections characterization. | | | | | |
|---|---|---|---|---|---|
| **Type** | **Time** (weeks) | **Necrosis** | **Location** | **Appearance** | **Infection** |
| **Interstitial edematous pancreatitis** | | | | | |
| - APFC | </= 4 | No | Adjacent or distant to pancreas. | Homogeneous fluid attenuation;<br>No capsule. | Extremely rare |
| -Pseudocyst | > 4 | No | Adjacent or distant to pancreas. | Homogeneous fluid attenuation:<br>Encapsulated. | Rare |
| **Necrotizing pancreatitis** | | | | | |
| -ANC | </= 4 | Yes | Parenchymal and/or extrapancreatic | Heterogeneous, may be loculated;<br>No capsule. | Common |
| - WON | > 4 | Yes | Parenchymal and/or extrapancreatic | Heterogeneous, may be loculated;<br>Encapsulated. | Common |

**Table 3**: Pancreatic and peripancreatic fluid collections characterization; (APFC-Acute peripancreatic fluid collection;ANC- Acute post-necrotic fluid collection; WON- Walled-off pancreatic necrosis).
***References:*** Radiologia, Hospital Geral, Centro Hospitalar e Universitário de Coimbra - Coimbra/PT

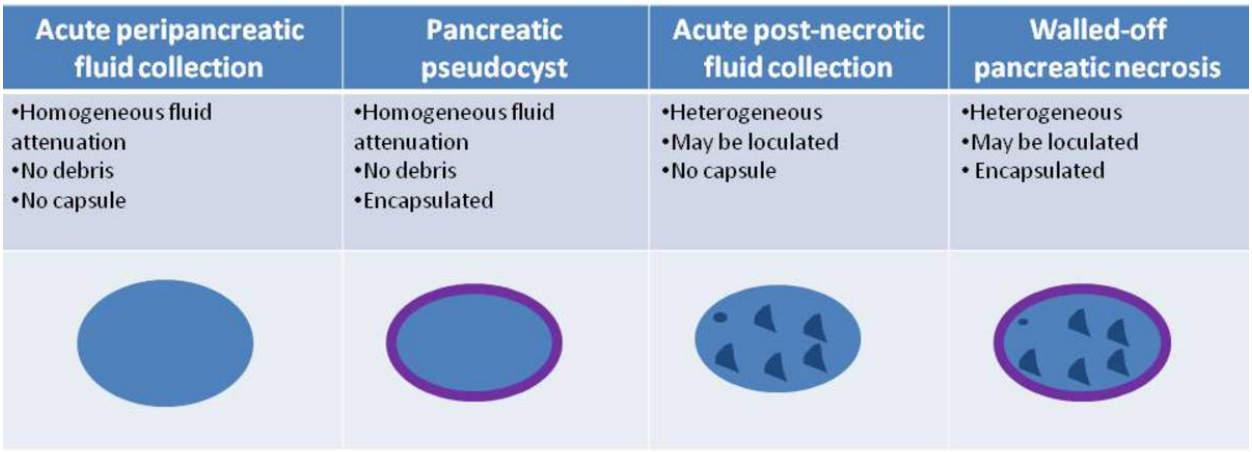


**Fig. 7**: Pancreatic and peripancreatic fluid collections schematic characterization.
***References:*** Radiologia, Hospital Geral, Centro Hospitalar e Universitário de Coimbra - Coimbra/PT

This classification provides general guidelines; indeed some collections may be very difficult to categorize.

All of the collections may be sterile or infected. The presence of extra luminal gas or image-guide fine needle aspiration with Gram strain and culture are the two conditions necessary to confirm pre-interventional diagnosis of infection (Fig. 8 on page 13)**.**

### Acute peripancreatic fluid collections (APFC)

These fluid collections occur within the first 4 weeks in patients with IEP. They have no solid components and are homogeneous, with no definable wall. They result from rupture of the main duct or small peripheral ductal side branch or from local edema related to pancreatic inflammation.

They occur predominantly adjacent to the pancreas, and are confined by the normal peripancreatic fascial planes, primarily the anterior pararenal fascia (Fig. 9 on page 14 and Fig. 10 on page 15).

The majority remains sterile and is reabsorbed, and interventional is usually not necessary, unless they become infected and require drainage.

### Pancreatic pseudocyst

Pseudocysts are defined as well-circumscribed, usually round or oval, homogeneous fluid collection surrounded by a well-defined wall with no tissue necrosis (Fig. 11 on page 16 and Fig. 12 on page 17). They develop from APFC that persist for more than 4 weeks.

The presence of ductal communication or dilated main pancreatic duct may be important clinically, dictating different management algorithms. Other imaging modalities may be necessary (ERCP, MRI or EUS) to further characterization, although not essential in the new image based classification.

### Post-necrotic pancreatic/peripancreatic fluid collections

Fluid collections arising in patients with acute necrotizing pancreatitis are term post-necrotic pancreatic/peripancreatic fluid collections (PNPFCs). These collections contain both fluid and necrosis in varying degree. It's usually associated with disruption of the main pancreatic ductal segment within the zone of parenchyma necrosis, and may or not have a connection with the pancreatic ductal system.

Acute post-necrotic fluid collections (ANC) occur within the first 4 weeks and don´t have a well defined wall. Within time, a thickened wall without epithelial lining may develop, and the designation of walled-off pancreatic necrosis (WON) should be used (Fig. 13 on page 18 and Fig. 14 on page 19). The presence of solid debris within the collection must be documented to differentiate this entity from a pseudocyst.

## Extrapancreatic findings

Some extrapancreatic findings suggest an etiology, such as the presence of gallstones, that can be identify in CT, along with biliary dilatation, and these are more important in the early phase.

Extra pancreatic complications can also be diagnosed and characterized by CT evaluation. The most common are venous thrombosis/obstruction of the portal, splenic, and/or mesenteric veins, arterial (pseudo)aneurysm, pleural effusion, ascites and

inflammatory involvement of peripancreatic organs (Fig. 15 on page 20 and Fig. 16 on page 21).

## Therapeutic procedures

CT also provides guidance to interventional therapeutic procedures such as percutaneous drainage that is indicated in infected collections (followed by surgery if necessary) (Fig. 17 on page 22) or fine needle aspiration to differentiate between sterile and infected collections.

**Images for this section:**

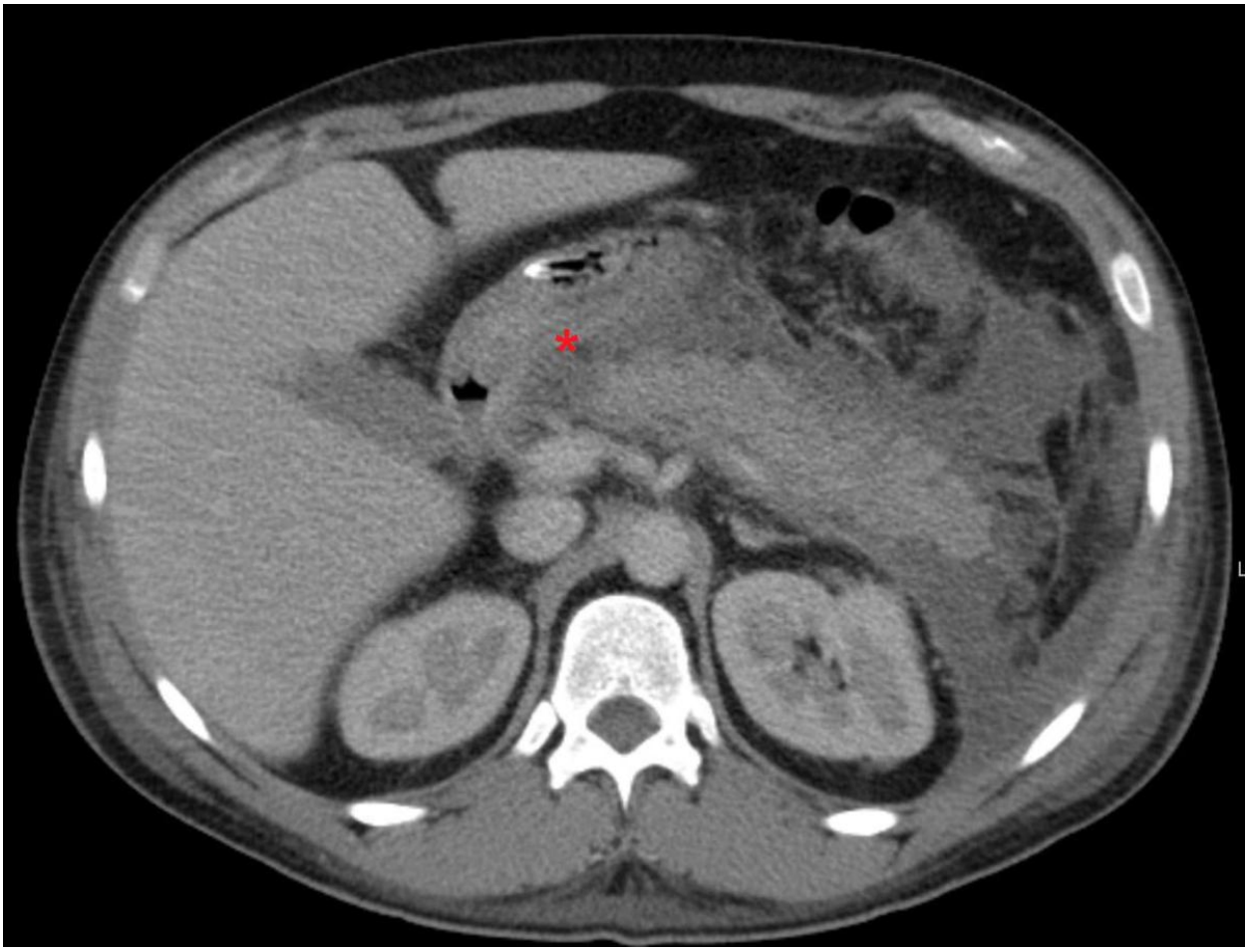

**Fig. 1:** Contrast enhanced abdominal CT in the portal phase in an early phase (1st week) of an acute pancreatitis. Note the diffuse peripancreatic edema extending into the posterior gastric wall (asterisk).

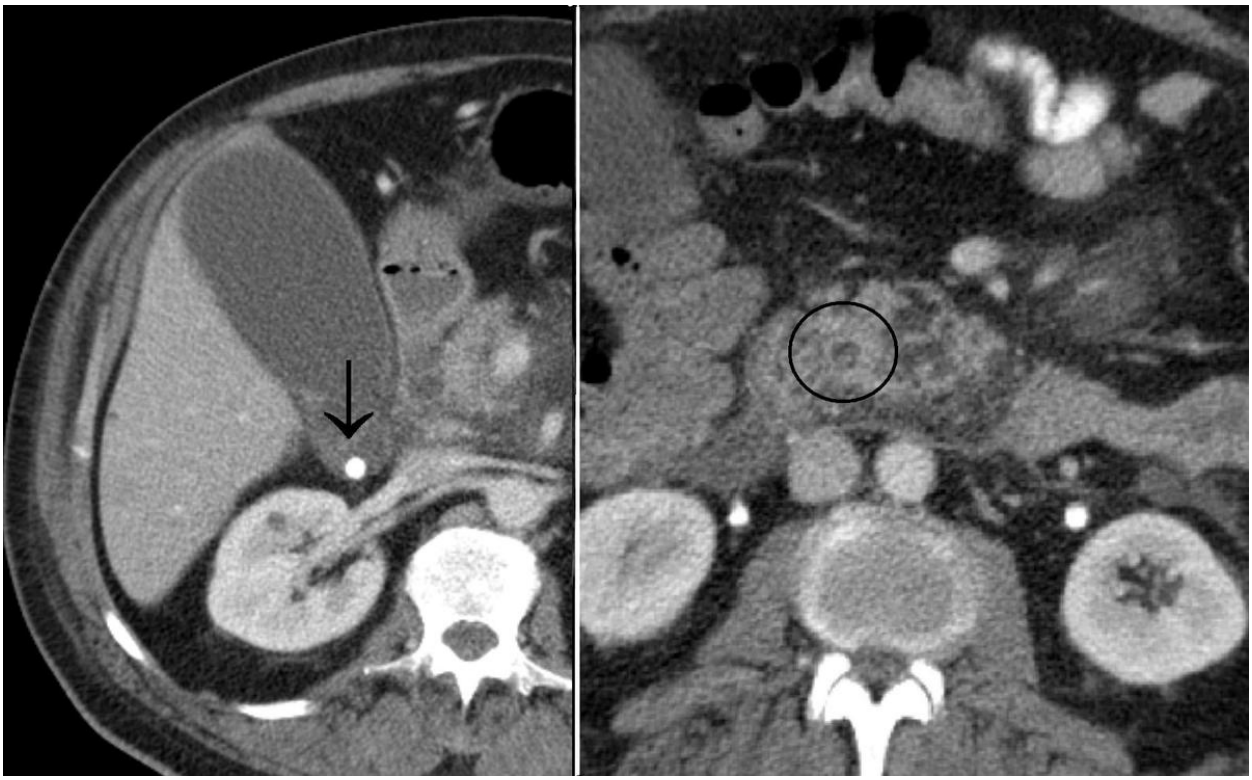

**Fig. 2:** Contrast enhanced abdominal CT in the portal phase in an early phase (1st week) of an acute pancreatitis. There are calcified gallstones (arrow in right picture) and the biliary duct is filled with heterogeneous hyperattenuating material - biliary sludge (circle in left picture).

**Fig. 3:** Contrast enhanced abdominal CT in the portal phase in an early phase (1st week) of an acute pancreatitis. Pancreatic head is diffusely enlarged (asterisk) and there is diffuse peripancreatic edema. There is also fluid effusion in both pararenal spaces (arrows) sparing the perirenal space -"renal halo sign".

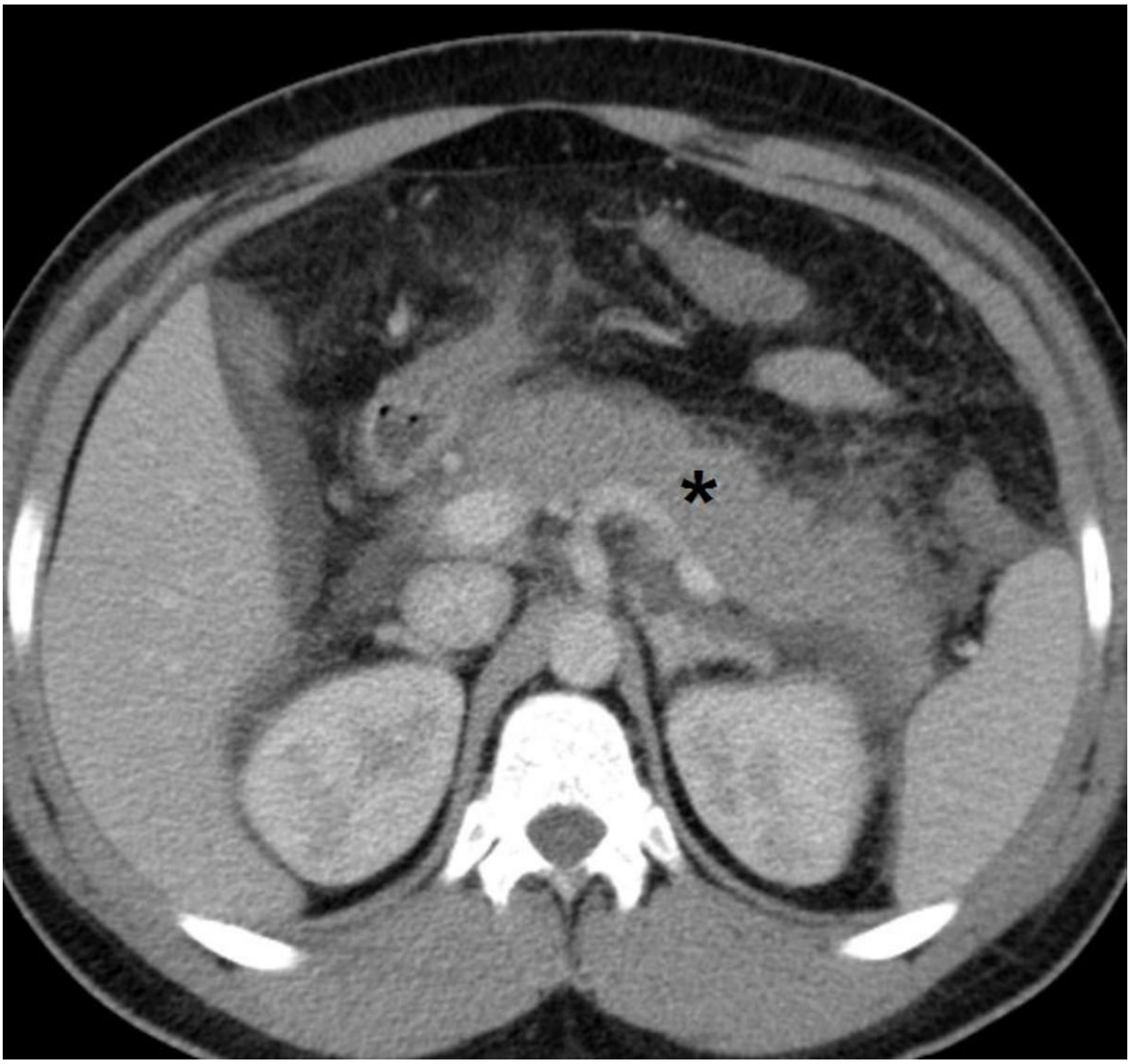

**Fig. 4:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis. The pancreatic parenchyma has a normal enhancement, with no hypoattenuating areas (asterisk); they are no signs of infection. This case should be classified as an interstitial edematous pancreatitis.

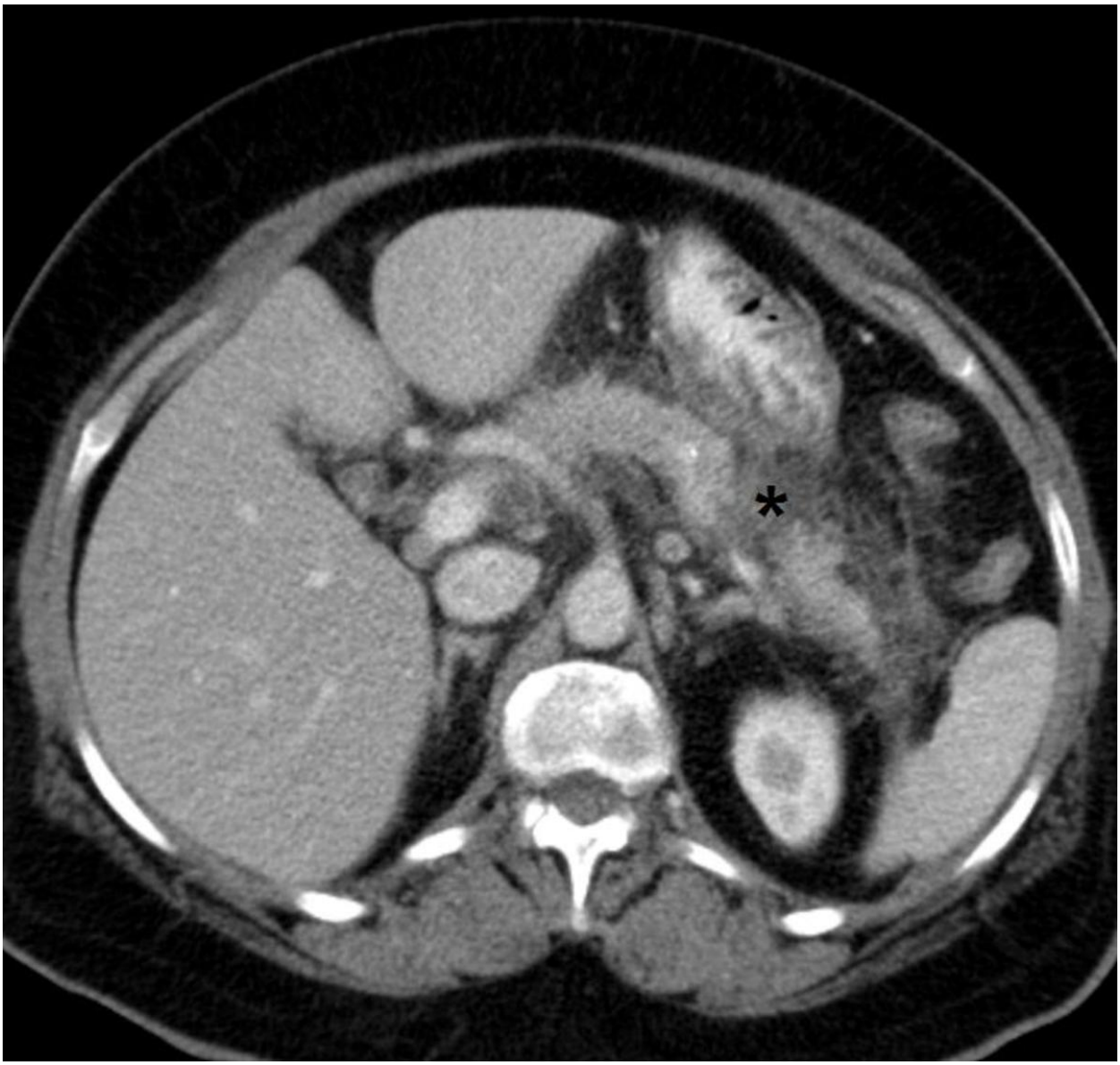

**Fig. 5:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis. There is a hypoattenuating area in the pancreatic body (asterisk), occupying less than 30% of the total pancreatic parenchyma; they are no signs of infection. This case should be classified as a sterile necrotizing pancreatitis.

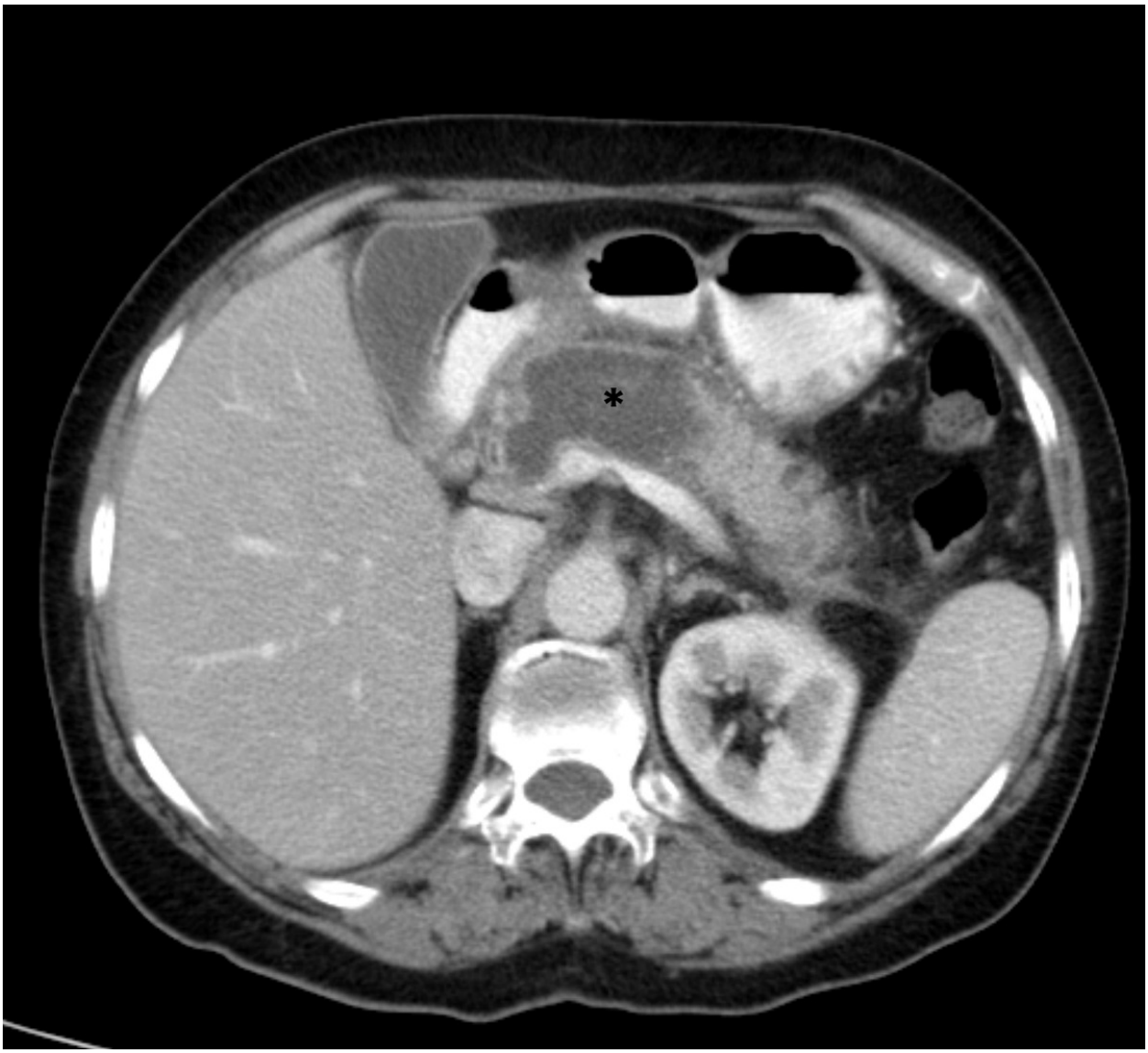

**Fig. 6:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis. There is a hypoattenuating area in the pancreatic head and neck (asterisk), occupying more than 30% of the total pancreatic parenchyma; they are no signs of infection. This case should also be classified as a sterile necrotizing pancreatitis.

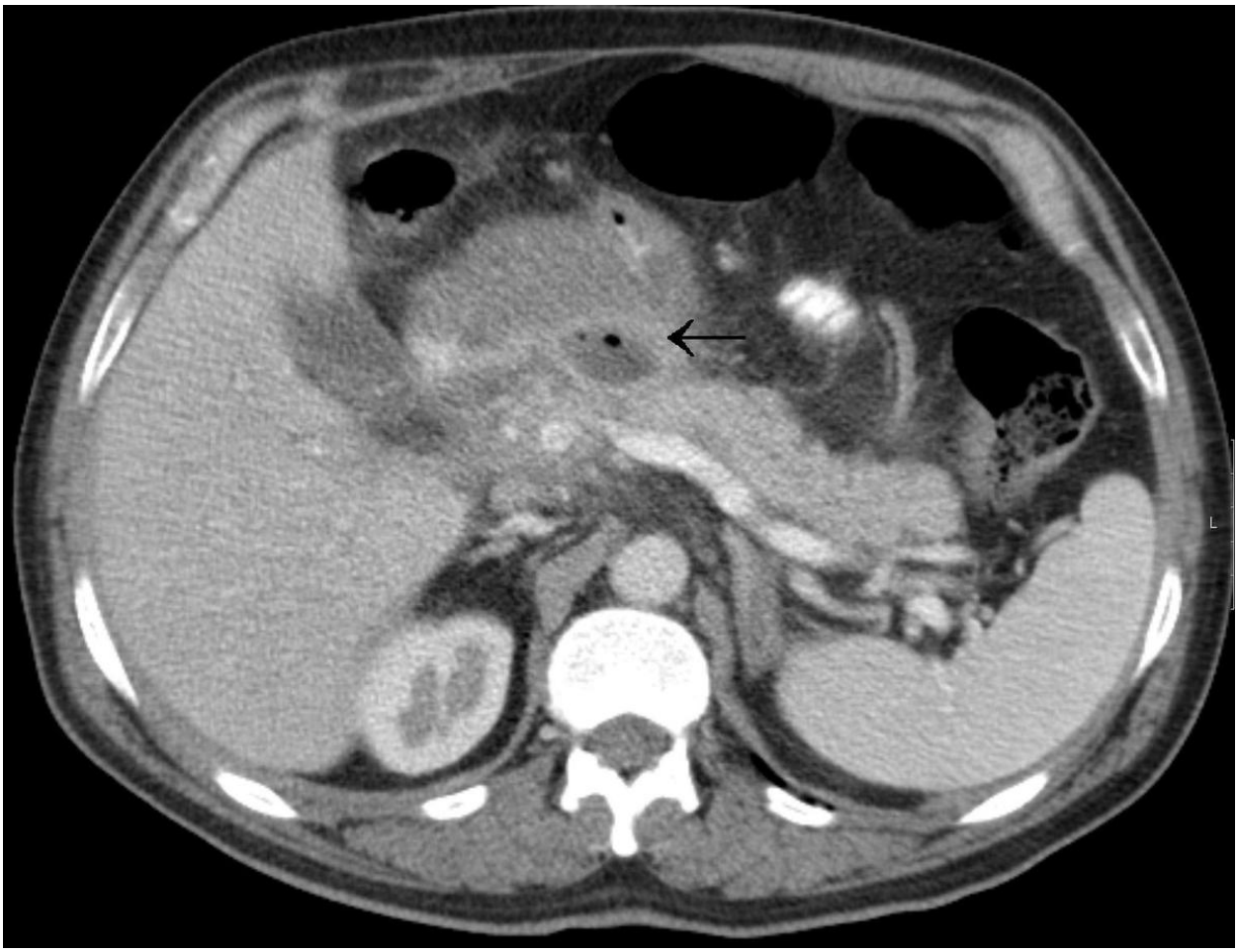

**Fig. 8:** Contrast enhanced abdominal CT in the portal phase of an acute pancreatitis more than 4 weeks after the onset. Note the encapsulated peripancreatic fluid collection with gas bubble in the inside (arrow). This was an infected walled-off necrosis. Surgical or drainage may be necessary to achieve complete treatment.

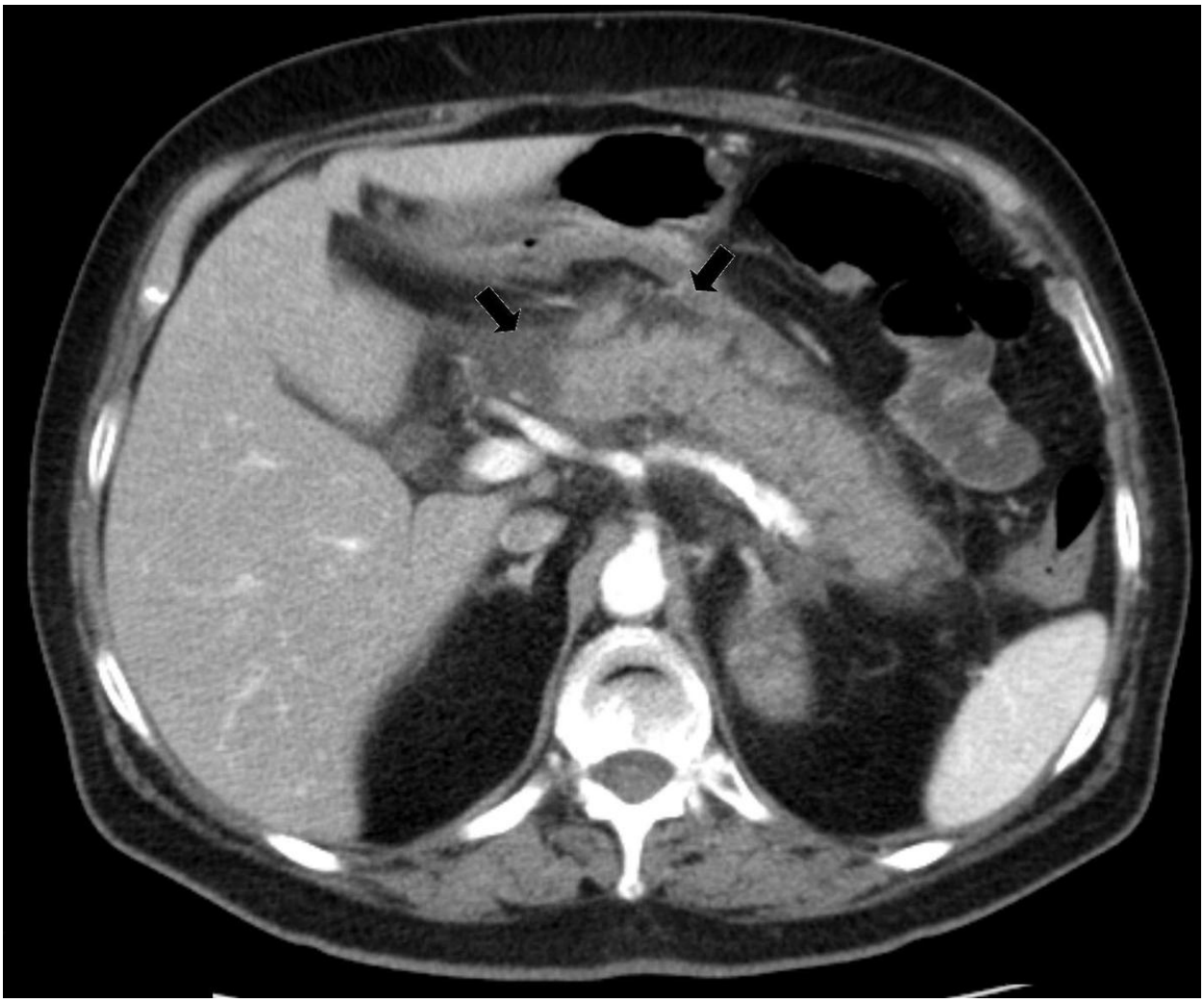

**Fig. 9:** Contrast enhanced abdominal CT in the arterial phase in an acute pancreatitis (less than 4 weeks after the onset). Note the two peripancreatic fluid collection (APFC) (arrows). They have a homogeneous fluid attenuation, no definable wall and are confined by the normal peripancreatic fascial planes. They are peripancreatic and not pancreatic as they don't result from pancreatic necrosis.

**Fig. 10:** Multiplanar reconstruction in the coronal plan of a contrast enhanced abdominal CT in the portal phase in an acute pancreatitis (less than 4 weeks after the onset). Note the peripancreatic fluid collection (APFC) (asterisk). It has a homogeneous fluid attenuation, no definable wall and is confined by the normal peripancreatic fascial planes. No pancreatic necrosis has evident.

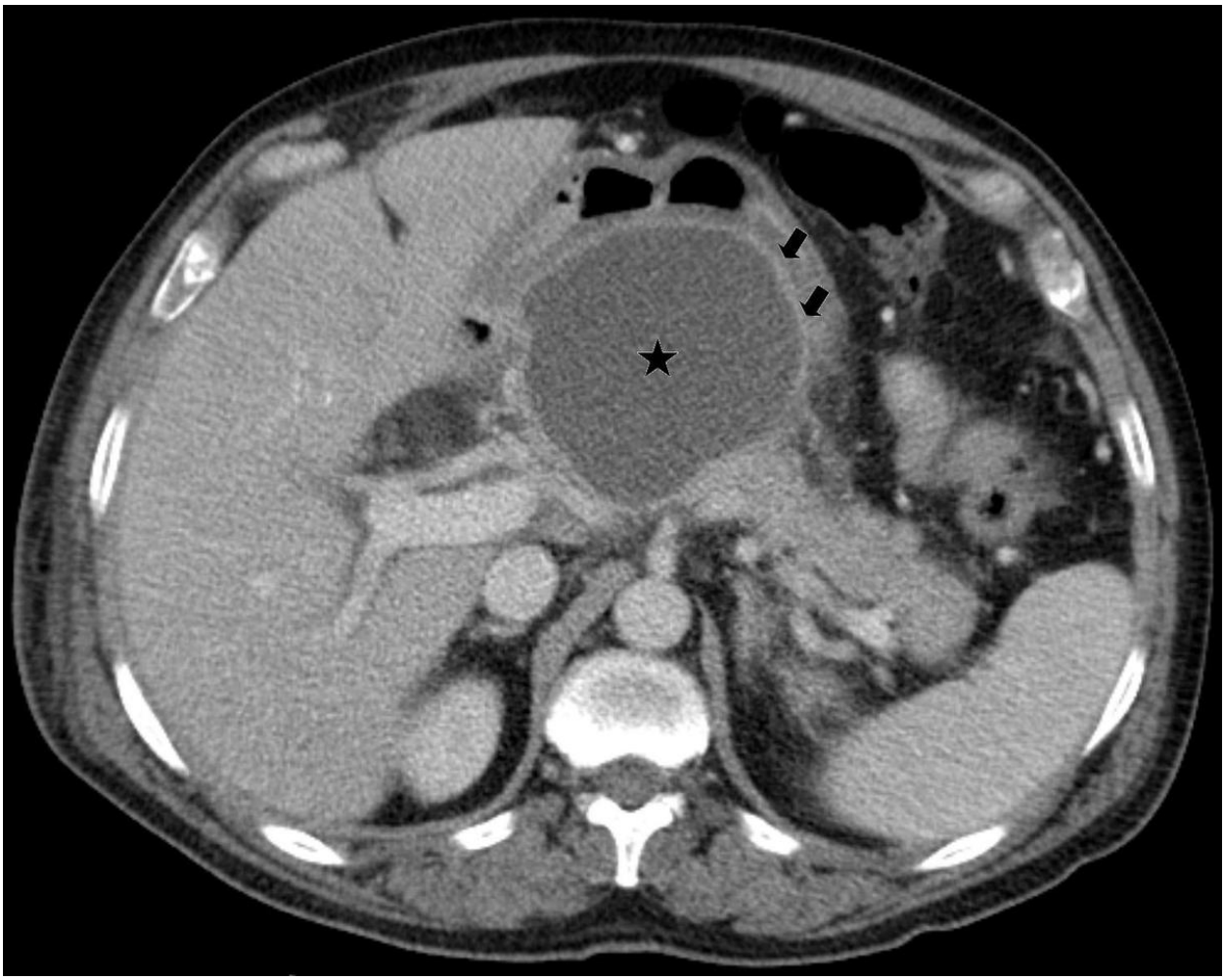

**Fig. 11:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis more than 4 weeks after the onset. Note the large peripancreatic fluid collection adjacent to the cephalic pancreatic region (star). It has a well defined capsule (arrow) and homogeneous content. This fluid collection should be classified as a pseudocyst.

**Fig. 12:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis more than 4 weeks after the onset. There is a peripancreatic fluid collection (asterisk) with a well defined capsule and homogeneous content. This fluid collection should also be classified as a pseudocyst.

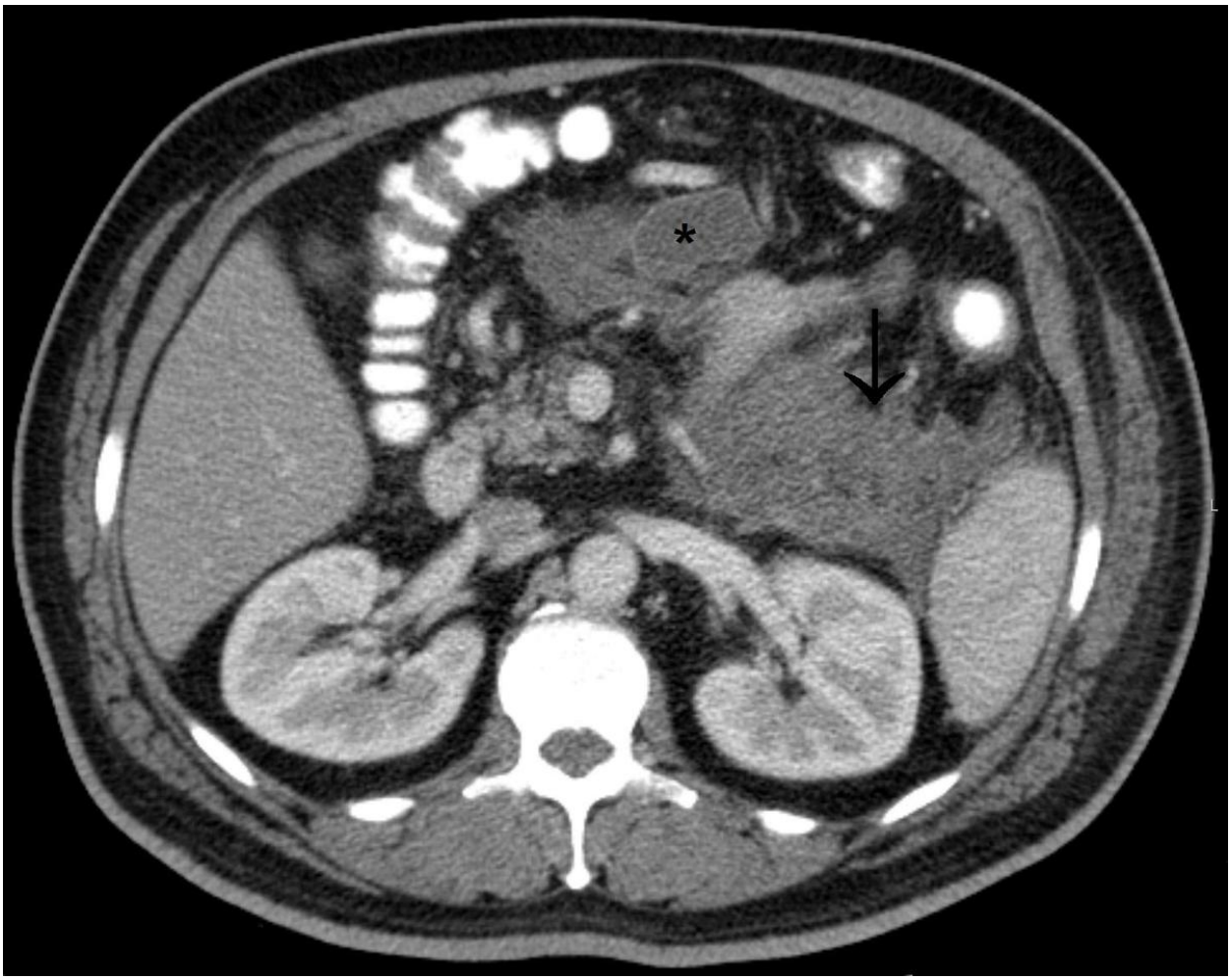

**Fig. 13:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis less than 4 weeks after the onset. There is a large, heterogeneous pancreatic fluid collection (arrow) with no capsule, substituting the pancreatic parenchyma; this collection should be classified as an acute post-necrotic fluid collection. In the other hand, there is a smaller peripancretic fluid collection (asterisk), encapsuled with homogeneous content; this collection is probably a pancretatic pseudocyst from a precedent pancreatitis.

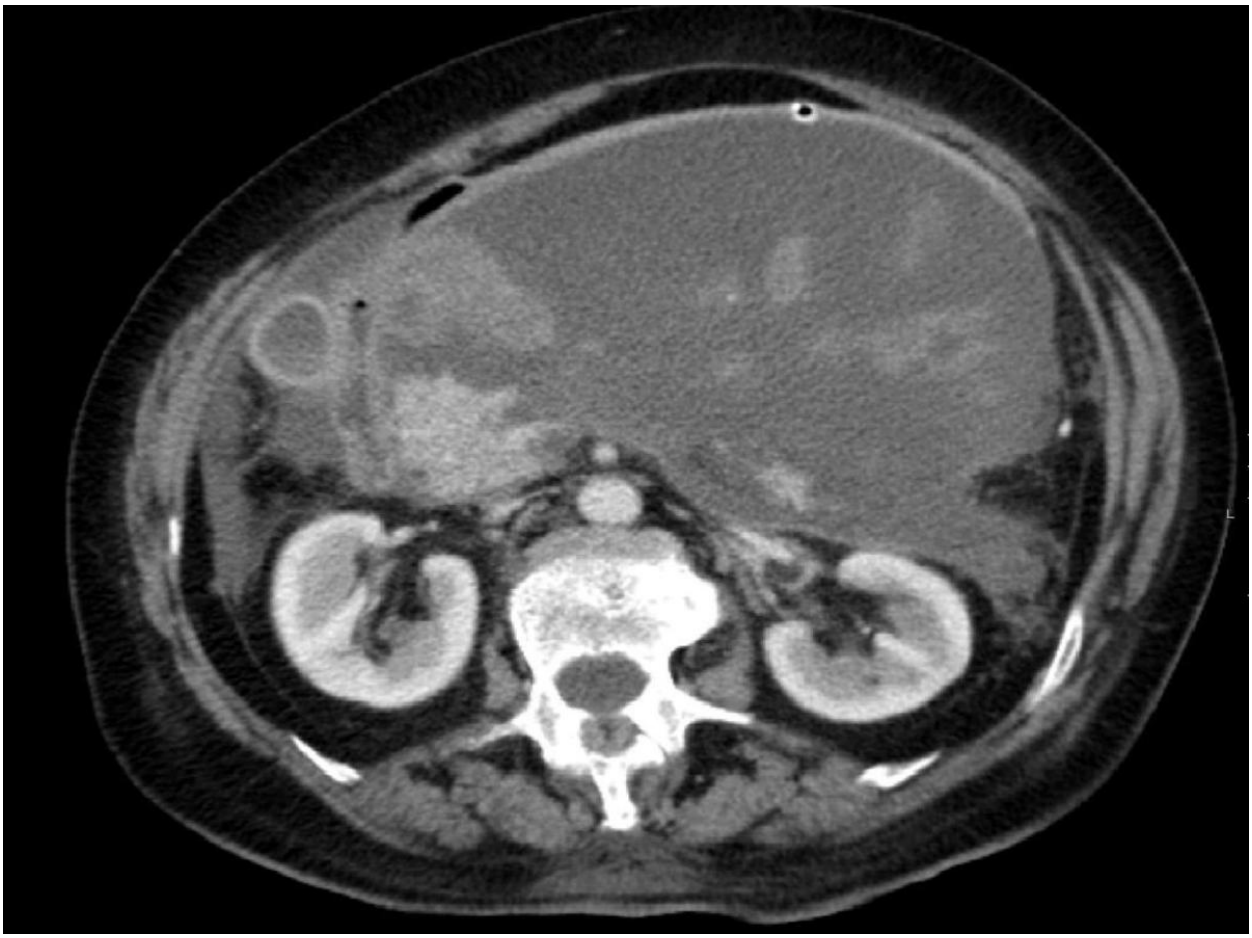

**Fig. 14:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis less than 4 weeks after the onset showing a very large pancreatic fluid collection, occupying the abdominal cavity, compressing anteriorly the stomach (note the nasogastric tube). The collection has a poorly defined capsule, but a very heterogeneous content, with some high attenuation solid components. An acute post-necrotic fluid collection or a walled-off pancreatic necrosis may be difficult to differentiate in this case.

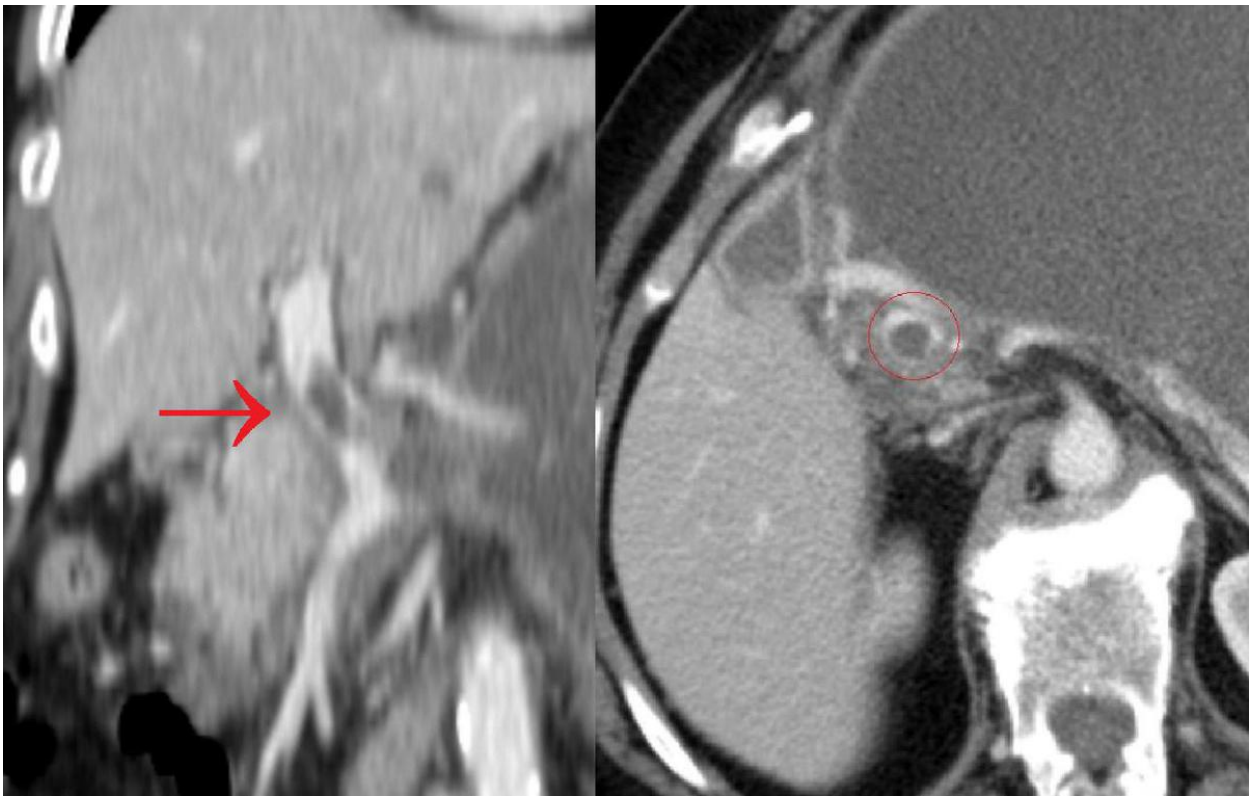

**Fig. 15:** Contrast enhanced abdominal CT in the portal phase (left side picture) and multiplanar reconstruction in the coronal plan (right side picture) in an acute pancreatitis. There is a thrombus in the portal vein (red arrow and circle), a frequent extrapancreatic complication of acute pancreatitis.

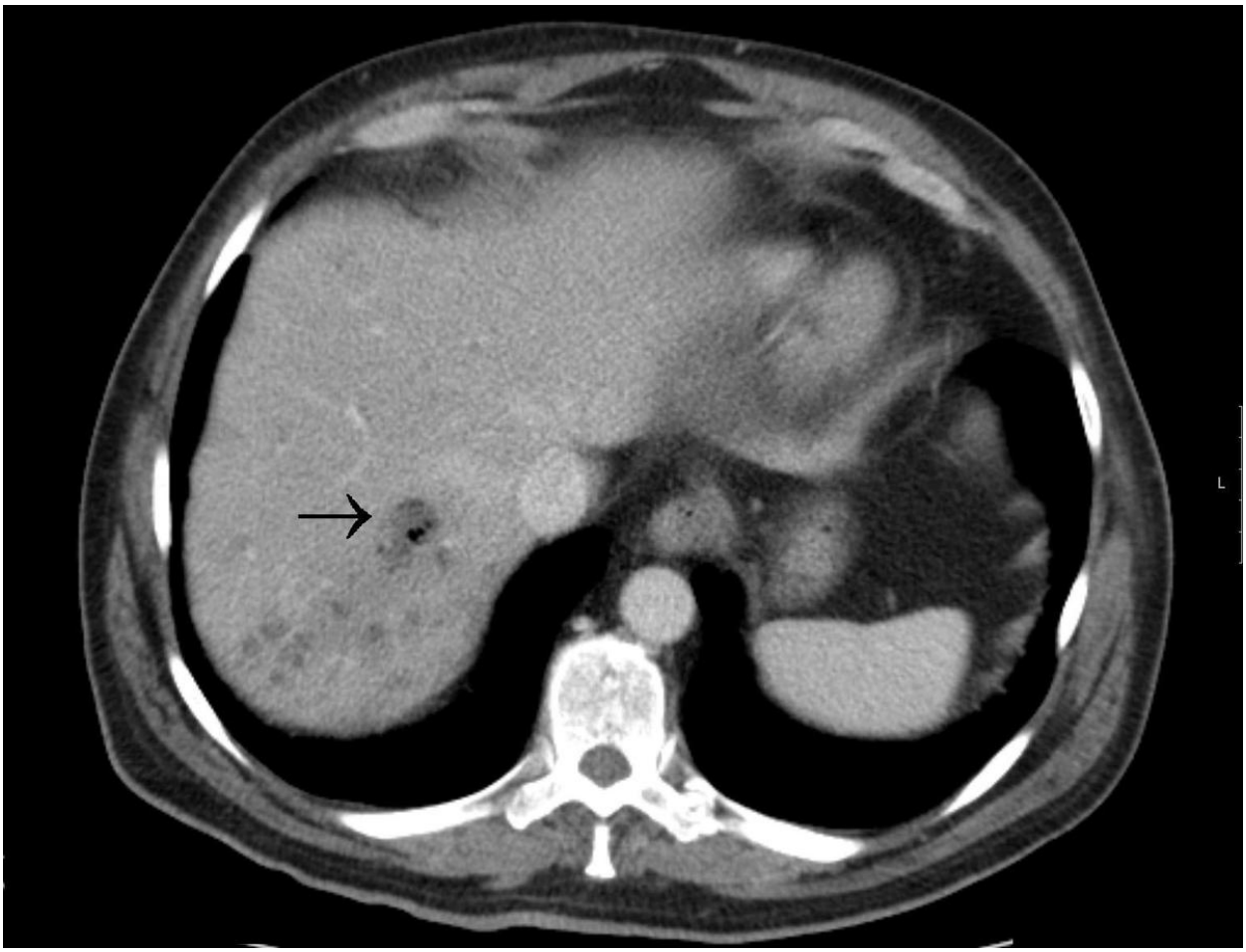

**Fig. 16:** Contrast enhanced abdominal CT in the portal phase in an acute pancreatitis. There are multiple hepatic abscesses (arrow) a complication of acute pancreatitis.

**Fig. 17:** Contrast enhanced abdominal CT in the portal phase showing a walled-off pancreatic necrosis, with a drainage tube inside. A percutaneous CT guide intervention allowed this therapeutic procedure.

## Conclusion

- CT allows to evaluate severity, possible etiology and complications of acute pancreatitis and also to guide intervention therapeutic procedures.
- Knowing CT indications in the different phases of acute pancreatitis and using the standardized imaging findings terminologies are essential features for an accurate radiologic evaluation.

## References


1. Acute pancreatitis Classification Working Group. Revision of the Atlanta Classification of Acute pancreatitis. April, 2008.
2. Ruedi F. Thoedi. The Revised Atlanta Classification of Acute Pancreatitis: Its importance for the Radiologist and Its effect on treatment. Radiology. March 2012.
3. Prokop M and Galanski M. Spiral and Multislice Computed Tomography of the Body. Thieme, New York 2003.


## Personal Information