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Reappraising imaging features of pancreatic acinar cystic transformation: be aware of differential diagnoses

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Abstract

Objectives Imaging features of pancreatic acinar cystic transformation (ACT) have been published. We aimed to describe the clinical and radiological characteristics of patients with a presumed pancreatic ACT diagnosis, reappraising the value of these published imaging criteria.

Materials and methods Single-center retrospective study (2003–2021) of consecutive patients with a presumed diagnosis of ACT as suggested by the local expert multidisciplinary case review board. Patients without available imaging (CT or MRI) for review were excluded. Patients were classified into "certain" ACT (if ≥ 2 imaging criteria and no differential diagnosis) or "uncertain" ACT (if ≥ 1 imaging criteria and suggested differential diagnoses).

Results Sixty-four patients (35 males, [55%]) were included. ACT was considered "certain" for 34 patients (53%) and "uncertain" for 30 patients (47%). The number of ACT criteria did not differ between groups, with 91.2% of patients with ≥ 3 ACT imaging criteria in the "certain" group vs 93.3% in the "uncertain" group ($p = 0.88$). In the "uncertain" group, the main suggested differentials were branch-duct intraductal papillary mucinous neoplasm (18/30 patients, 60%), calcifying chronic pancreatitis (8/30 patients, 27%), both (three patients, 10%) and serous cystadenoma (one patient, 3%). Calcifications were significantly more frequent in the "uncertain" group (89% vs 63% in the "certain" group, $p = 0.02$).

Conclusion Published ACT imaging criteria are frequently associated with features suggesting differential diagnoses. They appear insufficient to reach a final diagnosis in a subset of patients.

Clinical relevance statement ACT displays a heterogeneous morphological imaging presentation challenging the non-invasive diagnostic work-up. Physicians' and radiologists' awareness of this entity is important to better understand its natural history and improve non-invasive diagnostic criteria.

Key Points

- *The criteria to help diagnose ACT are frequently associated with features suggestive of differentials.*
- *The main alternatives suggested when ACT diagnosis was "uncertain" were branch-duct intraductal papillary mucinous neoplasm and calcifying chronic pancreatitis.*
- *Published ACT diagnostic imaging criteria can be insufficient for a definite non-invasive diagnosis.*

Keywords Exocrine pancreas, Acinar cell cystadenoma, Pancreatic acinar cystic transformation, Pancreatic cyst, Diagnostic imaging

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Introduction

Pancreatic acinar cystic transformation (ACT), also known as acinar cell cystadenoma, is a pathological entity first described in 2000 as a new type of pancreatic cyst [1, 2]. It was defined as a cystic lesion lined by acinar cells with intracellular eosinophilic zymogen granules and no cellular atypia [3]. It is considered a rare disease, and since this first description, published case series have not exceeded 25 patients [4, 5]. Initially, ACT was suspected to be the precursor lesion of the acinar cell cystadenocarcinoma [3]; however, no case of malignant transformation has been reported [6–8]. Hence, the 2019 WHO classification has reclassified ACT as a non-neoplastic lesion [9]. The current management favours a non-surgical approach [10, 11].

There is sparse literature on ACT clinical characteristics; it has been reported that pathologically confirmed ACT lesions are found mainly in females, with a mean cyst size of 38–53 mm, and a main location in the body-tail of the pancreas [4, 5]. In the same way, little is known about ACT imaging characteristics [12, 13]. In 2014, Delavaud et al carried out a retrospective study to describe the imaging features of ACT by comparing CT and MR findings of five cases of ACT to 20 cases of branch-duct intraductal papillary mucinous neoplasms (BD-IPMN); all lesions were histologically proven. They proposed four radiological diagnostic criteria for multilocular ACT: (1) the presence of clustered peripheral small cysts, (2) the presence of five or more cysts, (3) the presence of cyst calcifications on CT and (4) no visible communication with the main pancreatic duct (MPD). The presence of at least two or three of these radiologic criteria had a sensitivity of 100% and 80% and a specificity of 85% and 100%, respectively, to differentiate ACT from BD-IPMN [13]. Since then, no study has confirmed these radiologic criteria nor explored other morphological ACT characteristics in imaging or endoscopic ultrasound (EUS).

Nevertheless, incidental imaging findings of pancreatic calcifications associated with pancreatic cysts are not rare in medical practice, with the most frequent diagnosis being BD-IPMN [14, 15]. Moreover, differential diagnoses recalling other pancreatic cysts, such as serous cystadenoma or mucinous cystic neoplasms (MCN) or recalling calcifying chronic pancreatitis (CCP) with pseudocysts, represent a challenge in clinical practice to propose an ACT diagnosis with certainty [16]. Thus, ACT is probably misdiagnosed or underdiagnosed as insufficient clinical, radiological and EUS data exist to correlate to pathological diagnosis [12, 17].

The present study aimed to describe the clinical and radiological characteristics of patients with a presumed ACT diagnosis and to reappraise the relevance of the published radiological features.

Methods

We conducted a single-centre retrospective study in a tertiary university hospital. Patients with a presumed diagnosis of ACT, reported in the prospectively coded diagnostic database of the pancreatology department, Beaujon Hospital (Clichy, France), were consecutively included between 2003 and 2021. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki. Informed consent was obtained for all included patients.

Data collection

Clinical patient data, at the time of ACT's presumed diagnosis, were retrieved from medical records, including sex, age, body mass index (BMI), smoking status, excessive alcohol consumption status (> 8 drinks per week), diabetes mellitus and episodes of acute pancreatitis (AP). If pancreatic EUS had been performed, the presence of calcifications, the number of cysts, and cyst communication with MPD would have been recorded. For cases with histopathological material, a definite diagnosis of ACT on surgical or endoscopic samples was reviewed by a pathologist expert in the pancreatic field (J.C.). Cyst(s) had to be lined by normal-looking acinar cells with no mucin that could suggest an IPMN or an MCN and with no intracytoplasmic glycogen, suggestive of a serous cystadenoma. If follow-up clinical data was available, the clinical outcome of a pancreatic cancer diagnosis was assessed.

CT and MR imaging: radiological review

Patients without at least one available imaging (CT or MRI) at diagnosis or during follow-up were excluded. CT examinations were performed with the following systems: BrightSpeed, HighSpeed Advantage, LightSpeed QX/I, LightSpeed VCT (GE Healthcare) and Sensation 16 system (Siemens, Erlangen, Germany). MR examinations were performed with 1.5-T superconducting MR systems using a four-channel phased array coil: Gyroscan ACS-NT and Ingenia (Philips Medical System) and Sigma (GE HealthCare). CT and MR acquisition protocols are provided as Supplementary Material. One expert pancreatic radiologist reviewed CT and MRI examinations independently (M.R.). The radiological diagnostic criteria of Delavaud et al were recorded as well as other morphological characteristics: unilocular/multilocular aspect of the cyst(s) (defined as the absence or the presence of septa, respectively), largest single cyst size measurement, MPD diameter, and MPD irregularities. The radiologist was unaware of any diagnostic group allocation but was aware of the suspicion of ACT. Follow-up imaging was defined as available imaging done at least six months after the first diagnostic imaging, and imaging modifications were assessed when > 24-month follow-up imaging was available.

Groups of patients

All included patients had been discussed in a multidisciplinary case review board (MCRB) dedicated to pancreatic lesions. Two groups of patients were defined based on the conclusion of the MCRB. A group of "certain" diagnoses of ACT was defined as the presence of at least two Delavaud et al imaging criteria and no suggested differential diagnosis (BD-IPMN, serous cystadenoma, MCN or CCP). These differential diagnoses were not suggested when: (1) patients had no clinical arguments (concerning sex, age, alcohol and tobacco consumption) and (2) no radiological arguments (e.g. cyst communication with the MPD for BD-IPMN, posterior body-tail cyst localisation for MCN, etc.) in favour of one of these diagnoses. The other patients constituted the group of "uncertain" diagnoses of ACT, i.e. at least one Delavaud et al imaging criteria and one or more radiological arguments in favour of a differential diagnosis. In this group, the diagnosis of ACT was still considered because of the presence of at least one Delavaud et al imaging criteria.

Statistical analysis

Continuous variables were described as median with a 25–75 interquartile range (IQR) and also as mean for the largest cyst size variable with its respective standard deviation (SD). Categorical variables were described as frequencies and percentages. The clinical and imaging characteristics of patients in the "certain" group and "uncertain" groups were compared on univariate analysis by Pearson's chi-squared test or Fisher's exact test for categorical data and by non-parametric independent-samples Mann–Whitney *U* test for continuous variables. Values of $p < 0.05$ were considered to be statistically significant. All statistical tests were two-sided. Statistical analyses were performed using the SPSS software (version 29, IBM) and R studio software (version 2022).

Results

A total of 67 consecutive patients with a presumed diagnosis of ACT were identified in the prospectively coded diagnostic database. Three patients were excluded as no imaging examination was available for radiological review. Overall, 64 patients were included in this study.

Patients' characteristics

The median age at presumed diagnosis of ACT was 60 years (IQR 47–67). Thirty-five patients (35/64, 55%) were male, and 28 (28/59, 47%) were active smokers. No patient declared excessive alcohol consumption. Pancreatic lesions were incidentally discovered in imaging for 47 patients (47/64, 73%) or after a first episode of non-severe AP for ten patients (10/64, 16%).

The ACT diagnosis was considered "certain" for 34 patients (34/64, 53%) and "uncertain" for 30 patients (30/64, 47%). In the "uncertain" group, the main suggested differential diagnoses were BD-IPMN (18/30 patients, 60%), CCP (8/30 patients, 27%), both BD-IPMN and CCP (three patients, 10%) and serous cystadenoma (one patient, 3%) (Fig. 1). There was no significant difference between the two groups regarding clinical criteria studied. Patients' characteristics and comparisons between groups are described in Table 1.

Imaging features

For the first imaging available for review (i.e. at diagnosis), 27/64 patients (42%) underwent an initial MRI, 28/64 patients (44%) underwent an initial CT, and 9/64 (14%) underwent both. Fifty-eight patients (91%) underwent an MRI in initial and/or follow-up imaging. Fifty-three patients (53/64, 83%) presented diffuse lesions. The median size of the largest cyst was 5 mm (IQR 3–9.2). Thirty-six patients (36/64, 56%) had unilocular cysts and 28 patients (28/64, 44%) presented multilocular cysts. No unilocular cystic lesion presented a capsule and was located posteriorly on the body-tail of the pancreas, suggesting an MCN. Only six patients did not have an MRI available for review (either initial or follow-up) to assess cyst duct communication. These patients had undergone an EUS. Radiological characteristics of the overall cohort and comparison between groups are described in Table 2.

Among the Delavaud et al radiologic criteria, clustered peripheral small cysts, ≥ 5 cysts, cystic or parenchymal calcifications, and no communication with the MPD were observed in 86% (55/64), 97% (62/64), 76% (44/58) and 94% (60/64) of the patients, respectively. The distribution of these criteria in the "uncertain" group according to the suggested differentials is illustrated in Fig. 2. The distribution of the number of Delavaud et al radiological criteria between the two groups is illustrated in Fig. 3a.

In the "certain" group, 31 (91.2%) patients presented ≥ 3 Delavaud et al radiological criteria vs 28 (93.3%) in the "uncertain" group ($p = 0.88$) (Fig. 3b). Examples of MR cholangiopancreatography of one patient of the "certain" group and of one of the "uncertain" group are illustrated in Fig. 4. Examples of coupled imaging modalities of MR T2-weighted sequence and contrast-enhanced CT scan for one patient of the "certain" group and one of the "uncertain" group are illustrated in Fig. 5.

There were significantly more calcifications in the "uncertain" group compared to the "certain" group (89% vs 63%, $p = 0.02$). There was significantly more visible communication with the MPD in the "uncertain" group compared to the "certain" one (13% vs 0%, $p = 0.04$). There was no significant difference for the other two radiological criteria (i.e. the peripheral distribution of lesions and the presence of ≥ 5 cysts) between groups (Table 2).

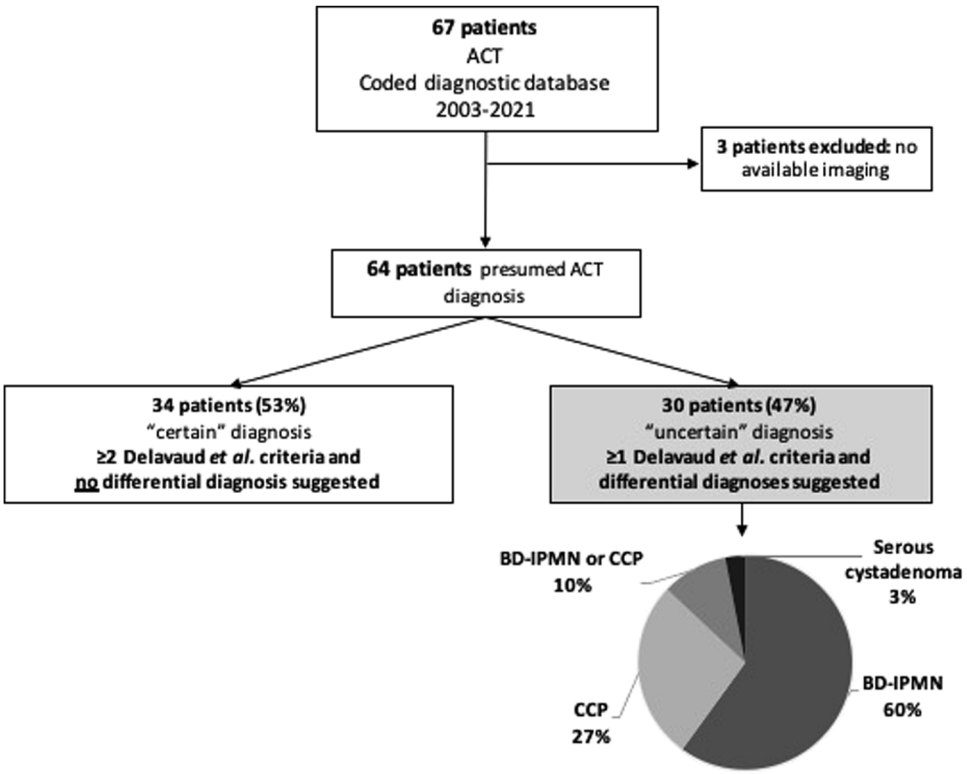

Fig. 1 Population flowchart of patients with a presumed diagnosis of ACT of the pancreas included in this study and group allocation into "certain" and "uncertain" ACT diagnosis and the differential diagnoses suggested. BD-IPMN, branch-duct intraductal papillary mucinous neoplasm; CCP, calcifying chronic pancreatitis

Table 1 Patient characteristics of the presumed ACT diagnosis overall cohort ($n = 64$) and univariate analyses comparing the "certain" ACT diagnosis ($n = 34$) and the "uncertain" ACT diagnosis group ($n = 30$)

Patient characteristics	Patients, $n = 64$ (%)	"Certain" group, $n = 34$ (%)	"Uncertain" group, $n = 30$ (%)	p value
Sex				0.76
Male	35 (55)	18 (53)	17 (57)	
Female	29 (45)	16 (47)	13 (43)	
Age of diagnosis, median (IQR), years	60 (47–67)	54 (44–65)	61.5 (51–68)	0.13
BMI (kg/m^2), median (IQR), $n = 42$ patients*	23.8 (21.5–25.4)	23.8 (21.3–25.9)	23.8 (21.5–24.9)	0.68
Smoking, $n = 59$ patients**				0.24
No-smoker	31 (53)	18 (60)	13 (45)	
Smoker	28 (47)	12 (40)	16 (55)	
Diabetes mellitus				0.8
No	52 (81)	28 (82)	24 (80)	
Yes	12 (19)	6 (18)	6 (20)	
Presentation at diagnosis				0.08
Incidental imaging diagnosis	47 (73)	28 (82)	19 (63)	
Symptoms leading to imaging diagnosis***	17 (27)	6 (18)	11 (37)	
AP at diagnosis				0.49
No	54 (84)	30 (88)	24 (80)	
Yes	10 (16)	4 (12)	6 (20)	

Data presented as *n* (%) unless otherwise indicated
ACT pancreatic acinar cystic transformation, *IPMN* pancreatic intraductal papillary mucinous neoplasms
* Missing data for 22 patients
** Missing data for five patients
*** Nonspecific abdominal pain, AP or pancreatic exocrine insufficiency

Table 2 Imaging characteristics of the presumed ACT diagnosis overall cohort and according to Delavaud et al criteria from patients of the "certain" group compared to the "uncertain" group of presumed ACT diagnosis and its univariate analyses

Imaging characteristics	Patients, $n = 64$ (%)	"Certain" group, $n = 34$ (%)	"Uncertain" group, $n = 30$ (%)	p value
Main location of lesions				
Diffuse	53 (83)	30 (88)	23 (77)	
Head	9 (14)	4 (12)	5 (17)	
Body-tail	2 (3)	0	2 (7)	
Largest size of cyst				
Median (IQR), mm	5.0 (3–9.2)	5.0 (2.25–9.5)	5.0 (3.25–8.75)	0.81
Mean (SD), mm	7.1 (± 5.9)	7.1 (± 5.4)	7.1 (± 6.5)	
Unilocular or multilocular cysts				
Unilocular	36 (56)	18 (53)	18 (60)	0.79
Multilocular	6 (9)	3 (9)	3 (10)	
Both	22 (34)	13 (38)	9 (30)	
Well-defined cyst(s)				
Yes	47 (73)	24 (71)	23 (77)	
No	17 (27)	10 (29)	7 (23)	
Number of cysts				0.07
≥ 10	55 (86)	32 (94)	23 (77)	
< 10	9 (14)	2 (6)	7 (23)	
Delavaud et al criteria				
Distribution of lesions with respect to MPD				0.48
Peripheral	55 (86)	28 (82)	27 (90)	
Diffuse	9 (14)	6 (18)	3 (10)	
Number of cysts				> 0.99
≥ *5*	62 (97)	33 (97)	29 (97)	
< *5*	2 (3)	1 (3)	1 (3)	
Calcifications in CT scan, $n = 58$*		$n = 30$	$n = 28$	0.02
Yes	44 (76)	19 (63)	25 (89)	
No	14 (24)	11 (36)	3 (11)	
Visible cyst and MPD communication				0.04
No	60 (94)	34 (100)	26 (87)	
Yes	4 (6)	0	4 (13)	

Data presented as *n* (%) unless otherwise indicated
ACT pancreatic acinar cystic transformation, *MPD* main pancreatic duct, *SD* standard deviation
* No CT available or performed for six patients

Pancreatic EUS characteristics

EUS was performed in 22 patients (34%) during the initial work-up and was significantly more frequently performed in the « uncertain » group (15/30) compared to the « certain » group (7/34) (50% vs 21%, $p = 0.01$). No cyst communication with the MPD was described in the "certain" group (0/7). EUS's conclusion was "calcifying BD-IPMN" for seven patients (7/22, 32%). An ACT diagnosis was suggested for five patients (5/22, 23%). CCP diagnosis alone was suggested for three patients. Other pancreatic EUS reports' conclusions are illustrated in Supplementary material.

Pathological findings

The pathological confirmation of ACT was obtained for two patients belonging to the "uncertain" group. One of these patients underwent pancreatic surgery as the suspected pre-operative diagnosis was a BD-IPMN with a worrisome feature (cyst increasing size over time), and the other underwent EUS with guided biopsy (Moray® micro forceps). The latter concerned a male patient presenting a thinned-wall unilocular cystic lesion of 25 mm, located at the pancreatic uncinate process with small calcifications along the cystic wall. EUS biopsy was performed because of the undetermined nature of the cyst.

Follow-up

Follow-up imaging was available for review for 59 patients (59/64, 92%). Among these patients, 48/59 underwent an MRI, and 12/59 underwent a CT. For 27/59 (46%) patients, the follow-up imaging modality was the same as the initial one. The median follow-up (from first to last imaging available) was 49 (IQR 29–93) months. No pancreatic cancer occurred during the follow-up. Forty-seven patients (47/64, 73%) had at least a 2-year follow-up with at least two follow-up visits. Among these patients, 20 (20/47, 43%) presented lesions' modifications in imaging over time, and 27 (27/47, 57%) presented no modification. For the three patients for whom imaging displayed an appearance of CCP over time, there were no clear ductal abnormalities, except for one patient who presented an irregular MPD associated with parenchymal atrophy, indicating a strong presumption of CCP instead of the ACT diagnosis at last follow-up. The type of modifications for the overall cohort and for each group are summarized in Table 3.

Discussion

This single-center retrospective observational study included 64 patients with a presumed diagnosis of ACT. Almost one-half (47%) of the patients in this cohort were allocated to the group of "uncertain" diagnoses of ACT, which means that they presented ≥ 1 Delavaud et al imaging criteria [13] but also features suggesting possible differentials. The main differential diagnoses were BD-IPMN and CCP in 60% and 27% of "uncertain" cases, respectively. This reflects the real-life practice obstacles to diagnosing ACT with a non-invasive workup, having considerably more frequent differential diagnoses to rule out [17–20]. Indeed, in both "certain" and "uncertain" groups, more than 90% of patients presented at least three

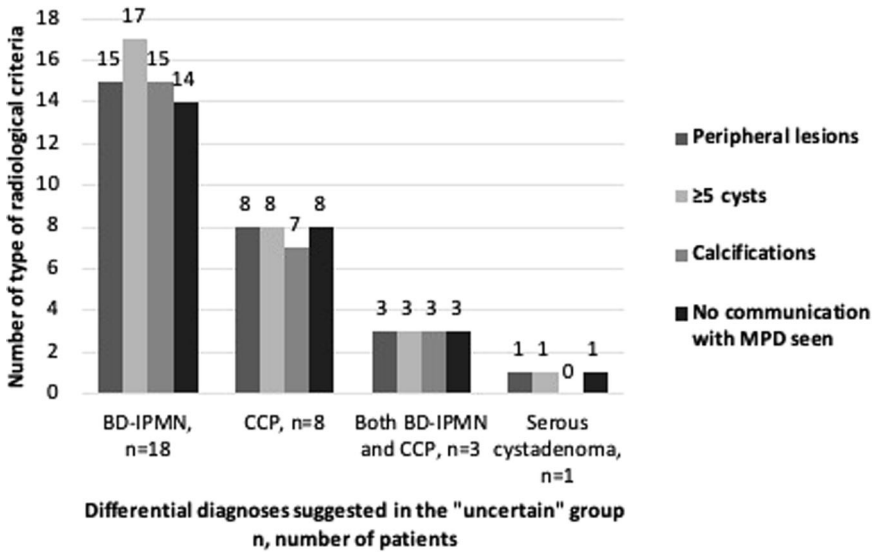

Fig. 2 Distribution of radiological criteria according to Delavaud et al in function of the differential diagnoses suggested in the "uncertain" group

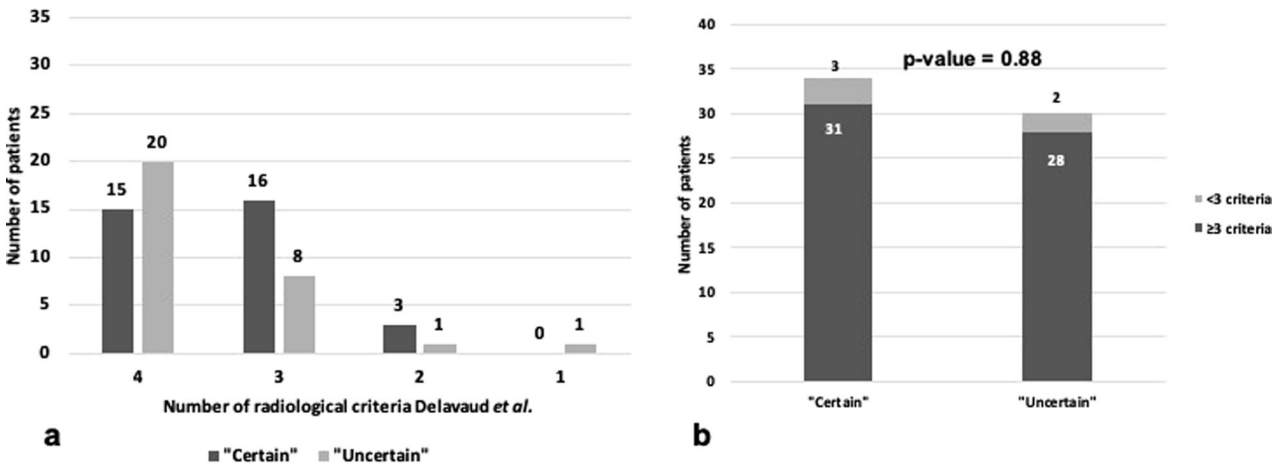

Fig. 3 Distribution of the number of radiological criteria according to Delavaud et al in the "certain" and the "uncertain" ACT diagnosis groups (**a**). Number of patients with ≥ 3 radiological criteria according to Delavaud et al in each group (**b**). ACT, pancreatic acinar cystic transformation

of the radiological criteria of Delavaud et al [13], challenging their discriminative value in clinical practice.

For 73% of patients in the overall cohort (and 82% in the "certain" group), the presumed ACT lesions were discovered incidentally, alleging their benign natural history. We note that 16% of patients presented an episode of oedematous AP, suggesting that ACT may be associated with AP [4].

Concerning the radiological characteristics, lesions were diffuse in 83% of cases (and 88% of the "certain" group), so no predominance for localized lesions in the head or body-tail of the pancreas was observed. The mean size of the largest cyst was only 7.1 mm, which is considerably smaller than all published cases (mean size: 53 mm) and in particular, in the Delavaud et al series where the five histologically proven ACT mean cyst sizes were 19.8 ± 13.5 mm. This may be explained by the fact that larger cysts—more likely to be symptomatic—are more often prone to surgical management, especially when the preoperative diagnosis is not obvious [11, 21]. Patients in our study bore lesions suggesting ACT and thus conservative management was proposed to most in the cohort. All the more, the five cases from the Delavaud et al series may not represent the actual size of cysts in ACTs; it is likely that the largest mean cyst in their series corresponded to the measurement of a

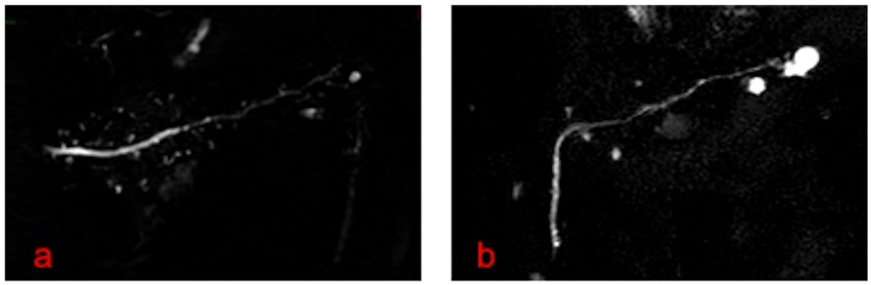

Fig. 4 **a** 3D-MR cholangiopancreatography coronal MIP of a patient from the "certain" ACT imaging group: three out of the four Delavaud et al criteria were observed (no calcifications could be depicted on the MRI), and no other diagnosis was suggested. **b** 3D-MR cholangiopancreatography coronal MIP of a patient from the "uncertain" ACT diagnosis group: two out of the four Delavaud et al criteria (no calcifications could be depicted on the MRI) were observed, and branch duct IPMN was suggested as possible differential because of possible communication with the MPD. ACT, pancreatic acinar cystic transformation

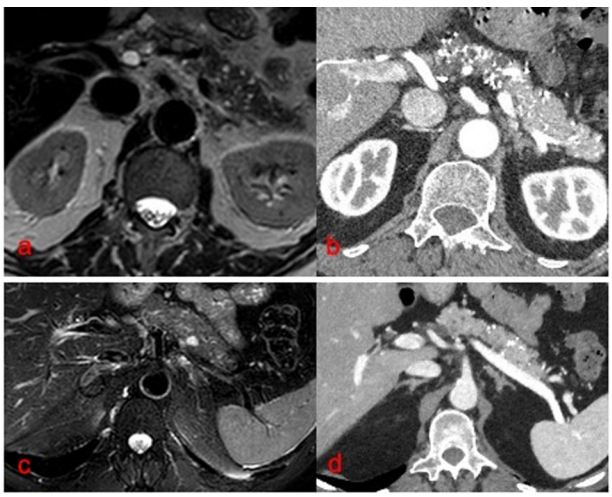

Fig. 5 MR axial T2-weighted image (**a**) and contrast-enhanced CT (pancreatic phase acquisition) (**b**) of a patient from the "certain" ACT imaging group. The MR imaging showed multiple sub-centimetric peripheral cysts without communication with a non-dilated MPD. The CT images showed multiple calcifications located in the cysts. MR axial T2-weighted (**c**) and contrast-enhanced CT (pancreatic phase acquisition) (**d**) of a patient from the "uncertain" ACT imaging group. The MR images showed fewer cystics in the body and tail of the pancreas, some centimetric in size. There was a doubt regarding a possible communication with the MPD, that was non-dilated. The CT images showed small peripheral calcifications. Branch-duct calcifying IPMN was suggested as a differential. ACT, pancreatic acinar cystic transformation

"bundle" of unilocular cysts (considered as one multilocular cyst). We have considered single unilocular cysts in our cohort.

Calcifications were more often observed in the "uncertain" group (89%) compared to the "certain" group (63%). Calcifications are common in pancreatic lesions, and they may constitute a misleading feature, as illustrated by the fact that CCP was suggested in 27% of the patients in the "uncertain" group. In ACT, these calcifications result from calcifying acellular eosinophilic material inside the cysts, as described in microscopic examination [2]. In the same way, there was significantly more visible communication of cysts with the MPD in the "uncertain" group compared to the "certain" one (13% vs 0%), which was expected as it is characteristic of BD-IPMN. Nevertheless, ACT cyst communication with MPD has already been described after endoscopic retrograde cholangiopancreatography for two out of ten patients of the pathologically confirmed series of Zamboni et al [3]. This may also constitute a misleading feature of the published ACT imaging criteria.

Pancreatic EUS was performed in one-third of the patients of the cohort and was significantly more often performed in the "uncertain" group compared to the "certain" one; yet, it did not help to reach a more certain diagnosis of ACT. However, EUS did allow to reach a definite diagnosis of ACT in one case when a through-the-needle biopsy was performed in a unique unilocular cystic lesion. In case of a single unilocular cyst of an undetermined nature, that remains asymptomatic, but changes (e.g. in size) over time, an EUS-guided-through-the-needle biopsy may be a good option to consider, before a surgical management decision [8, 17].

Concerning follow-up data, we had a follow-up imaging of > 24 months for 73% of the cohort. No imaging modification over time helped to state a differential diagnosis with more certainty, except for one patient with an explicit appearance of CCP. This observation strengthens the presumed diagnosis of ACT in our cohort, even in the "uncertain" group. All the more, since a pathological diagnosis of ACT is rarely obtained and the natural history of this condition is not well known, we suggest prolonged follow-up by imaging to strengthen a presumed diagnosis of ACT.

Our study presents several limitations; besides its retrospective nature, the main methodological limitations

Table 3 Imaging modifications of the overall cohort, the "certain" and the "uncertain" diagnosis groups during follow-up (of > 24 months and ≥ 2 follow-up visits) ($n = 47$)

	Patients, $n = 47$ (%)	"Certain" group, $n = 24$ (%)	"Uncertain" group, $n = 23$ (%)
Imaging stability	27 (57)	15 (63)	12 (52)
Imaging modifications	20 (43)	9 (37)	11 (48)
Cyst size increase	15	8	7
Appearance of new calcifications	3	0	3
Cyst size decrease	2	1	1

Data presented as *n* (%) unless otherwise indicated

were the absence of a definite histopathological diagnosis of ACT for most of the cohort and therefore, a group allocation into "certain" or "uncertain" that may be considered as arbitrary. The MCRB was the best way to overcome the inherent subjectivity of group allocation because its conclusion was always categorical: ACT (certain and positive), not an ACT (certain and negative) or possible ACT (uncertain). This reflects the pitfall and challenges of the diagnosis of ACT nowadays, having no accurate surrogate for gold standard histopathological diagnosis, in a condition that has proven benign and may not require surgical management.

Another limitation of our study was that contrary to Delavaud et al study, all patients in our study did not undergo both imaging modalities MRI and CT. Considering that we aimed to describe patients with a presumed diagnosis of ACT and to reappraise the value of Delavaud et al's criteria in a real-life practice setting (and not to assess their diagnostic value), the absence of a control group, a single radiological review and the use of different imaging modalities, initially and during the follow-up, were not essential.

Fairly, our series is one of the largest in the literature to study ACT's clinical and radiological characteristics and points out diagnostic difficulties for ACT in the clinic. We stress that ACT's heterogenous clinical and morphological presentation may reflect a heterogenous etiopathogenesis, as suggested by Luchini et al [5], and may also imply the possible coexistence of ACT lesions with more frequent lesions, such as BD-IPMN [22].

Physicians' and radiologists' awareness of ACT's existence is necessary to better understand ACT's natural history, to diagnose this condition better and to lead to more appropriate management. In conclusion, ACT unveils a heterogeneous morphological imaging presentation. The published diagnostic radiological criteria seem insufficient, especially in the case of features suggesting differential diagnoses as calcifications in cross-sectional imaging and cyst communication with the MPD.

Abbreviations

ACT	Pancreatic acinar cystic transformation
BD-IPMN	Branch-duct intraductal papillary mucinous neoplasm
CCP	Calcifying chronic pancreatitis
EUS	Endoscopic ultrasound
IQR	Interquartile range
MCN	Mucinous cystic neoplasm
MCRB	Multidisciplinary case review board
MPD	Main pancreatic duct

Supplementary information

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Compliance with ethical standards

Guarantor

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Conflict of interest

Maxime Ronot is a member of the *European Radiology* Editorial Board. He has not taken part in the review or selection process of this article. The other authors of this manuscript declare no relationships with any companies, whose products or services may be related to the subject matter of the article.

Statistics and biometry

No complex statistical methods were necessary for this paper.

Informed consent

Written informed consent was obtained from all subjects (patients) in this study.

Ethical approval

Institutional Review Board approval was not required because this is a retrospective study and it did not imply an interaction or intervention with the subjects included (the data collected and the examinations performed were done in the context of standard care).

Study subjects or cohorts overlap

Some study subjects have been previously reported in Aguilera Munoz L, Boros C, Bonvalet F, et al (2023) Pancreatic Acinar Cystic Transformation: Familial Forms Do Exist. Pancreas. https://doi.org/10.1097/MPA.0000000000002233

Methodology

- Retrospective
- Observational
- Performed at one institution

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