Pancreatic Cystic Lesions: Diagnostic, Management and Indications for Operation. Part II

Ferdinand Bauer

Director of Radiology Clinics in Kaufbeuren - Landsberg - Füssen, Germany

Mucinous Cystic Neoplasms (MCN)

Mucinous Cystic Neoplasms (MCN) occur almost exclusively in women during premenopause (> 90%) (1) and represent approximately 10% of the cystic lesions of the pancreas and 8% of the resected lesions (2). Therefore, a MCN will always be suspected when a medial-distal (corporeo-caudal) cystic lesion is identified in a middle-aged woman, the "mother" tumour, with no history of pancreatitis. Unlike SCN (serous cystic neoplasm), MCN are often malignant or they have a malignant potential (3).

They are usually corporeo-caudal (> 95%), very rarely cephalic (2). They are generally solitary lesions (4) with sizes between 3.5 and 6 cm (much smaller than those reported in the literature if we consider incidental findings) or with few macrocysts delimited by thin fibrous walls (Fig. 11, 12) (5). Cyst wall, septa and mural nodules are more pronounced after contrast administration (Fig. 12 C) (6, 7, 8). The MCN content is generally mucinous (with fluid densities at CT, hyperintense at T2 and hypointense at T1) (9, 7), but it can also be aqueous, necrotic or hemorrhagic (2). The presence of solid components and dysplasia is often associated with invasive behaviour (10). Peripheral calcifications are rare (<20%), particularly visible in CT, and may indicate a malignant lesion (6). The complex internal cyst architecture can be better observed by MRI (Fig. 12 A, C) or echoendoscopy, which helps differentiate from the serous cystadenoma.

As opposed to IPMN (intraductal papillary mucinous neoplasm), MCN rarely communicate with the pancreatic duct system (Fig. 11 D), but can sometimes cause duct obstruction by compression, leading to distal pancreatitis (7, 11, 8).
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The signs of malignancy are given by:

- peripheral calcifications
- irregular wall
- septal thickening
- papillary proliferation
- intracystic masses
- local invasion of surrounding structures
- hypervascular appearance

Fine “egg shell” calcifications are rarely visible, only at CT (Fig. 11 B, D), they are specific to the mucinous cystic neoplasm and have a high prognostic value for malignancy (6). Fine peripheral calcifications are not visualized with MRI (Fig. 11 A), meaning that they must be explicitly sought at CT (Fig. 11 B, C).

MCN have a broad morphopathological spectrum and are considered premalignant lesions. Therefore, the indicated therapy is surgical excision, especially in patients who are fit, even when they are asymptomatic (10, 8).

Staging is performed based on the same protocol for the ductal adenocarcinoma (13). In the case of complete resection, the prognosis of a noninvasive MCN is excellent, regardless of the degree of dysplasia (2).

If the invasion of adjacent structures is present, these lesions will be classified as mucinous cystadenocarcinoma. In males, although there are studies which confirm the possibility of developing MCN with varied localization (14), these are very rare and often prove to be IPMN.

Differential diagnosis is performed with other pancreatic cystic neoplasms and pseudocysts. The best way to get a correct diagnosis is to combine clinical, imaging and cystic fluid results (2).

Figure 11. Unilocular cystic lesion. (A, C) The axial MRI image reveals the irregularly thickened wall due to excess epithelial mucin (red arrow, A) and fine septa (yellow arrow, C). (B, D) The axial (B) and coronal (D) CT images show fine calcifications in the thickened wall with an “egg shell” appearance typical for MCN (blue arrow). Pancreatic resection was performed with spleen preservation. Histology: MCN with minimal dysplasia, no malignant signs, R0 margin. Resection is the indicated treatment because MCN has malignant potential.
Mucinous cystic neoplasms are cystic epithelial tumours which rarely communicate with the pancreatic ductal system (Fig. 11 D). According to WHO definition (15, 2), MCNs are composed of the mucin-producing columnar epithelium associated with subepithelial ovarian like stroma. These neoplasms occur almost exclusively in women (F: B = 20: 1). These data support the idea of derivation from the ovarian primordial stage (embryologically, the structures from which the gonads and the dorsal part of the pancreas emerge are adjacent up to 4-5 weeks of gestation) (8).

MCN may be non / invasive (with low-, intermediate - or high-grade epithelial dysplasia) or may be associated with an invasive carcinoma (2). A higher incidence of MCN associated with invasive carcinoma in patients 5-10 years older than those with non-invasive MCNs was observed, claiming the hypothesis of a slow progression of malignancy (16).

Symptomatology correlates with dimension. Most patients with large MCN have non-specific symptoms: epigastric pain and feeling of fullness (due to compression on adjacent structures), more rarely vomiting, diarrhea, anorexia, weight loss (2). In case of malignant MCN, signs of invasion of adjacent anatomical structures occur. Approximately 25% of MCNs remain asymptomatic, especially those with less than 3 cm in diameter.

**Imaging Examination**

Mucinous cystadenocarcinoma (MCA) is a...
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unilocular/oligolocular cystic lesion (<6 cysts). It may contain viscous structures, particles, mucin, blood, frequently leading to a heterogeneous appearance: hypoechogenic at US, hypodense at CT, and discretely hyper-intense on T2-weighted MRI (17).

MCN have walls thicker than 2 mm and septa which assimilate the contrast medium, sometimes presenting peripheral calcifications (Fig. 11) (18, 19), which is why the application of contrast agents improves the characterization of pancreatic MCN. The visualization of vascularised vegetations is crucial for the differentiation between MCN and pseudocyst (20, 21).

MCNs are located at the corporeo-caudal level and usually do not communicate with the pancreatic duct, having a normal calibre (Fig. 13 B, D), which is why ERCP is generally not performed (8, 2). Aggressive forms (mucinous cystadenocarcinoma) show irregular thickening of the septa and mural nodules and can lead to metastasis (22).

The imaging methods routinely used in the assessment of mucinous cystic neoplasms are those with MR (with MRCP sequence) (Fig. 13 D) and echoendoscopy. Doppler ultrasound, elastosonography and contrast-enhanced ultrasound are useful as a first step in the diagnosis of pancreatic tumours (2, 17). In recent years MDCT with postprocessed reconstructions has demonstrated a diagnostic accuracy similar to that of MRI in the detection and characterization of pancreatic cystic lesions (23).

However, MRCP remains the imaging modality of choice in the study of cystic pancreatic neoplasms because it has excellent...
resolution and allows for non-invasive assessment of the pancreatic ductal system (Fig. 12B, 13D) (24, 22).

EUS (echoendoscopy) allows a better visualization of the pancreas, with higher resolution for MCN and an accuracy of 82-96% (2), but it is insufficient for the differentiation between benign and malignant cystic lesions. EUS-FNA (endoscopic ultrasound-guided fine needle aspiration) is a safe and effective diagnostic modality for pancreatic lesions (25).

However, D’Onofrio (2) recommends the resection of all MCAs with a typical non-invasive imaging result, and the current consensus guideline recommends even the resection of all MCNs, if there are no contraindications to the operation, as they are all considered having a malignant potential (10, 8).

Therapeutic Indications

As mentioned, MCNs have a wide range of manifestations, with a classical carcinogenic pattern, from atypia to dysplasia and invasive carcinoma, and these forms may coexist within the same lesion. For this reason, MCNs are considered pre-malignant lesions with potential for malignant degeneration. This malignant degeneration is usually very slow for a few years, but quite common (26).

Risk factors for malignancy are (27):

1. Large tumours (Fig. 14): Larger studies have shown that malignant MCNs (generally >4cm) are on average larger than benign ones, and a diameter of ≥ 6 cm is associated with a much higher risk of malignancy than a smaller diameter (16, 28);
2. The presence of an eccentric solid mass, mural nodules, solid and cystic mixed components, prominent papillary projections, irregular wall, or other signs of morphological heterogeneity. The observed malignant MCNs included nodules 16 times more often. In addition, they were either ≥ 4 cm or had nodules (16);
3. The presence of calcifications, generally peripheral, with “egg shell” appearance.
4. Age: patients with carcinoma are older than those with benign lesions (a mean of 55 years against 45 years).

This malignant potential indicates surgical resection as treatment of choice for all MCNs without a surgical risk (27). The Consensus Guideline (2012) of the International Association of Pancreatology supports this approach (10).

Figure 14. MRI, 71 years old patient. (A) T2w axial image shows a large cystic lesion (green star) (3.5 cm) located in the tail of the pancreas, outside the duct, comprising a solid mass (red star) (a sign of malignancy) of 2 cm and 2 smaller cystic lesions (8 mm). We also notice the abrupt disruption of the pancreatic duct (green arrow) (sign of malignancy). (B) The contrast medium enhances both the cystic and solid components. The disruption of the pancreatic duct is highlighted (green arrow). Treatment: Corporeo-caudal pancreatectomy. Histology: Malignant transformation in mucinous cystadenocarcinoma, associated with moderately differentiated adenocarcinoma of the duct. Outcome: Death after one year (liver metastases, lymphoganglionic and peritoneal carcinomatosis).
More recently, a conservative approach was proposed for patients with low-risk MCN (asymptomatic, dimensions < 3 cm, without mural nodules and without dilatation of pancreatic or bile ducts) (11, 16). This imaging follow-up approach is a trade-off between delay of the surgery moment associated with a possible development of incurable disease versus early resection of a benign MCN associated with some degree of morbidity and mortality.

Careful follow-up may be considered in high-risk patients with severe comorbidities or in the elderly (30), as suggested by the recent IAP guidelines. The patient should be well informed of the risks associated with a conservative approach and understand that accurate and early preoperative detection of MCN malignant transformation is not always possible.

**Intraductal papillary mucinous neoplasms (IPMN)**

IPMN represent a spectrum of exocrine neoplasias characterized by mucinous transformation of the pancreatic ductal epithelium, with or without papillary proliferation and varying degrees of dysplasia. They produce an excess of mucin which leads to the dilatation of the pancreatic ductal system. Unlike MCN, IPMN do not contain residual ovarian stroma and do involve the pancreatic duct.

They are diagnosed at an average age of 60 years with a slight male prevalence of 1.5:1 (19, 31, 8) and represent about one-third of all pancreatic cystic neoplasms as the mean of the figures reported in the literature (4, 32, 33), although their true incidence is unknown, IPMN being generally asymptomatic and therefore only discovered accidentally.

IPMN may involve the main pancreatic duct, a secondary branch or a combination of the two (the mixed type) (Fig. 15). Differentiation is important because the involvement of the main duct is associated with a much higher frequency of malignancy: 61.6% (main duct) vs. 25.5%
(secondary branch). The clinical-pathological behaviour of the mixed type resembles that of the main duct type (8). IPMN may be multi-focal and have malignant potential (Fig. 18) - nearly 40% of patients with IPMN present malignant transformation at the time of diagnosis (34, 35).

**Imaging Examination**

The imaging characteristics of IPMN depend on the location of the tumour. In the case of MD-IPMN there is a diffuse or segmental dilatation of Wirsung (6, 7). The optimal view of internal nodal components is obtained after applying the contrast, although they often remain hidden even so, the tumour being generally small and flat (6). Branch duct type IPMN (BD-IPMN) can be either as a unilocular cystic lesion (Fig. 17), or as a group of pleomorphic cysts often involving the uncinate process (Fig. 18) (6, 36). The communication between the cystic lesion and the main pancreatic duct is a key element in diagnosis (Fig. 17, 18, 19) (22).

Innovations in imaging technique have led to an increasing incidence of IPMN detection: in several studies, the prevalence of pancreatic cystic lesions may be up to 19.6%, MRI being the most sensitive imaging method (37, 38) with a significant proportion of IPMNs and MCNs (2). MRCP also allows a clear view of the cyst relation with the main pancreatic duct.

The demonstration of the involvement or communication with the pancreatic ductal system is fundamental for the diagnosis of IPMN (22, 39), and therefore a major goal of the imaging examination.

The localization and the type of an IPMN determines its imaging appearance. This occurs as the cystic dilatation of the involved segment, either the main duct (Fig. 16) or the secondary branches (Fig. 17). Mucin production is the main cause of dilatation of the ducts, along their entire length or segmented, with or without intraductal masses (2). In the case of the main duct (MD-IPMN), the atrophy of the pancreatic parenchyma is additionally noted in an advanced stage (Fig. 16) (40).

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**Figure 16.** Main-duct (MD-IPMN) intraductal papillary mucinous neoplasms with large intraductal nodular vegetation. (A) Schematic representation. (B) MRCP confirms the diffuse dilatation of the main pancreatic duct with clearly visible endoductal defects (red star). (C) Underwater HD photography, coral-shaped papillae. (D) The T2w coronal MRI image shows the diffuse dilatation of the main pancreatic duct and the presence of solid vegetations (red star)
Figure 17. MRI study of a branch duct type IPMN: monofocal appearance. (A) MRCP shows the communication between the cystic lesion and the main pancreatic duct (green arrow). (B.C) At T2 MRI the appearance is typically hyperintense with lobular shape (yellow arrow).

Figure 18. MRI study with branch duct type IPMN: multifocal appearance (yellow star). (A) The MRCP image visualizes a multicystic lesion with a grape-like appearance (yellow star), spread throughout the pancreas. There is also a very fine connection between the lesion and the main pancreatic duct - each cyst (grape berry) communicates with the ductal system (grape cluster). (B) The surgical specimen (pancreatectomy) confirms the outcome of MRCP: pancreas with multiple small, multifocal cystic lesions, normal size duct of Wirsung (W) (purple line), secondary branches with multicystic dilatation.
Branch duct IPMN (BD-IPMN) may have the appearance of unilocular (Fig. 17) or multilocular (Fig. 18) cystic lesions communicating with the main duct (Fig. 18), grape-like appearance, with variable diameter from a few millimetres to several centimetres, uni- or multifocal (2). The cysts are separated by thin septa, hyperenhanced after contrast administration. In the case of BD-IPMN located very close to the main duct, the 3D-MRCP assessment can be useful for their correct characterization (Fig. 19 D).

In the mixed IPMN, both types of pancreatic ducts (main and secondary branch) are dilated (Fig. 19). The differential diagnosis of BD-IPMN can be difficult when the main dilatation is caused solely by the overproduction of mucin (41).

A clear differentiation between different forms of IPMN is complicated if there is no clear evidence of malignancy (42, 43).

The signs suggestive of an increased possibility of malignancy and which impose a surgical resection, if possible, are as follows: duct of Wirsung size >10 mm for MD-IPMN (Fig. 16), solid nodules inside the BD-IPMN cyst (Fig. 19), or obstructive jaundice in the presence of a cystic lesion in the pancreatic head (2, 44).

The worrisome signs (44), independent of size, suggesting the possibility of a malignant lesion (Table 1) and requiring an endoscopic assessment and strict follow-up are: cyst size >

<table>
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<tr>
<th>WORRISOME SIGNS</th>
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<tr>
<td>Malignancy ≠ size.</td>
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<tr>
<td>Worrisome signs, independent of size:</td>
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<tr>
<td>- Mural nodules</td>
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<tr>
<td>- Dilated bile duct</td>
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<tr>
<td>- Dilated duct of Wirsung (&gt; 6 mm)</td>
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<tr>
<td>- Thick cystic wall</td>
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<td>- Lymphadenopathy</td>
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<td>- The emergence of pain</td>
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Table 1. Worrisome signs, independent of size

Figure 19. MRI study with symptomatic mixed type IPMN. The T2w images (A, B) and MRCP (C) images show diffused dilatation of the main pancreatic duct (W) and of the secondary duct branches throughout the pancreas. The common bile duct (C and D) has normal size. (D) There is a huge cystic mass in the pancreas head with an obvious solid component (discontinuous red arrow).
3 cm, thickened walls with contrast medium uptake, duct of Wirsung of 5-9 mm or its sudden collapse, mural nodules without contrast medium uptake, distal pancreas atrophy, lymphadenopathy, coarse calcifications (45), and rapid cyst growth (46). The emergence of pain is an important indication of malignant transformation of intraductal mucinous lesion.

**Therapeutic Indications**

The therapeutic decision for IPMN is based on the risk-benefit ratio, taking into account the patient’s clinical status, the age and the risks of an operation, and the magnitude of the lesion and the imaging results on cyst morphology.

IPMN management depends on the location (MD vs. BD vs. mixed-IPMN), lesion size and presence of malignant transformation signs.

Publications on this topic indicate that cysts with septa and diameter < 3 cm without suspicious signs have low malignancy potential; therefore an aggressive intervention on the pancreas is unjustified (44).

The cyst location can also be a decisive factor, because a pancreatic resection of caudal small lesions is less aggressive than the complex Whipple procedure required for a pancreatic cephalic lesion.

By systematizing, the risk factors for malignancy within IPMN are:

1. MD-IPMN (Fig. 16) is associated with a malignancy risk of 50-60% (both in situ and invasive carcinoma), in some specific cases a risk of up to 92% (27). An average time of approximately 5 years is estimated from the IPMN diagnosis to the occurrence of invasive carcinoma (47). The risk increases significantly when the main duct is dilated >1 cm and mural nodules are present (36). In contrast, BD-IPMN has a much lower malignancy risk.

2. BD-IPMN with clinical symptoms and suspicious signs such as cyst diameter > 3 cm, presence of mural nodules (especially > 2 mm) and dilatation of the main duct.

3. The dilatation of secondary branches >3 cm gives an increased risk of malignancy. However, Jang et al. (48) report a risk of only 10% if BD-IPMN < 2 cm.

4. The presence of mural nodules (Fig.19 D).

5. Age >70 years.

6. The presence of symptoms such as extrahepatic bile duct dilatation, weight loss. However, the absence of symptoms does not guarantee the absence of malignancy (10).

7. Increased telomerase activity in the pancreatic cystic fluid and elevated CA serum levels by 19-9 (27).

8. The oedematous ampulla of Vater with mucin secretions at the ampulla level (47). Histological changes (atypia, dysplasia, in situ carcinoma or invasive cancer) can be simultaneously present in discontinuous areas along the pancreas, raising the question whether IPMN is a generalized global disorder of the pancreatic duct epithelium or rather a localized one (Fig. 16), field defects. MD-IPMN multicentricity is rather rare (<10%), but much more common in BD-IPMN (Fig. 18) (10) and is of particular clinical importance for surgical treatment.

Due to the malignant potential, surgical resection is the therapy of choice for most patients with MD and mixed IPMN (Fig. 19) (27).

In conclusion, oncological resection is indicated for:

1. MD-IPMN and mixed type;
2. BD-IPMN with a cyst diameter of over 30 mm or of 10-30 mm, but with mural nodules;
3. Positive cytology;
4. The presence of clinical symptoms (obstructive jaundice, unexplained weight loss).

International guidelines (10) recommend resection in the presence of high-risk imaging signs, while in the presence of worrisome features the lesion should be evaluated by EUS and MRI at a regular interval, W&W (“watchful waiting”) approach.

This conservative approach was accepted in selected patients with BD-IPMN due to a much lower incidence of malignancy for them (44) but with periodic imaging monitoring.

Also, patients with BD-IPMN with cysts > 3 cm without other suspect signs can be taken
into consideration for follow-up by EUS. In this situation, the absence of thickening or of parietal nodules will be checked, especially in elderly patients. If the patient is younger, the first-line treatment should be surgery.

MD-IPMN with Wirsung duct dilatation between 5-9 mm is considered a suspicious (worrisome) trait with W&W recommendation but without immediate resection (44).

Table 2 summarizes the recommendations of the International Pancreatology Association on optimal management for IPMN and MCN, Sendai 2006.

**Solid pseudopapillary neoplasm (SPN) of the pancreas**

Solid pseudopapillary neoplasm (SPN) is a rare pancreatic tumour with a low malignant potential, representing less than 10% of all pancreatic cystic lesions (8). It is usually incidentally discovered, almost exclusively in the "daughter" category, often under the age of 18, "adolescent". The diagnosis of this rare tumour can be made quite easily, given that it is incidentally discovered almost exclusively in adolescent girls and that the tumour has a typical imaging morphology. The differential diagnosis of this tumour is of crucial importance for its treatment.

It is believed that SPN has a low malignancy potential due to good prognosis and high survival rate, even with local recurrence, metastasis or local invasion (survival rate at 5 years approximately 95%) (49).

In terms of malignant potential, consensus has been widely reported that it is not closely related to clinical factors such as gender, age, symptoms, or tumour location (50, 51, 52, 53). However, increased tumour size has been shown to be a sign of malignant transformation (51, 54).

The pancreatic tail tends to be the most common location (49, 55, 52), although some reports mention that SPN has no preference for a specific location (56, 57).

**Imaging Examination**

Magnetic resonance imaging (MRI) is the diagnostic method of choice because it provides

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**Table 2. Guidelines 2012 for the management of IPMN and MCN of the pancreas (modified from Tanaka et al. [9])**

<table>
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<tr>
<th>MD-IPMN</th>
<th>BD-IPMN</th>
<th>MCN</th>
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<tbody>
<tr>
<td>Surgical resection is recommended for all patients who can undergo surgery</td>
<td>The resection is mainly discussed in young patients (&lt;65 years) with cysts &gt;2 cm</td>
<td>Resection is recommended for all patients who can undergo surgery</td>
</tr>
<tr>
<td>The lesion involves only 1 segment; focal pancreatic resection</td>
<td>The medical co-morbidities and cyst location should be considered</td>
<td>Imaging monitoring for patients at risk</td>
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<tr>
<td>Dilatation of the pancreatic duct: straight pancreatectomy (usually)</td>
<td>W&amp;W conservative management with monitoring for patients who do not have the following malignant risk factors:</td>
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<td>Result of biopsy (resection margin):</td>
<td>- Increase in size of the cyst</td>
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<tr>
<td>- High degree dysplasia: the resection is continued - R0 resection</td>
<td>- Mural nodules (especially &gt;2 mm)</td>
<td></td>
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<tr>
<td>- Moderate / reduced dysplasia: the optimal procedure for resection, for now controversial</td>
<td>- Dilatation of the main duct (&gt;7 mm)</td>
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<tr>
<td>Total pancreatectomy: is performed selectively in young patients (who are better tolerant to post-pancreatectomy: diabetes and exocrine failure)</td>
<td>- High grade atypia</td>
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<tr>
<td>BD-IPMN &gt;3cm without risk factors can be W&amp;W monitored without surgery, especially in elderly patients</td>
<td>- Positive cytology for malignancy</td>
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decisive evidence for differential diagnosis with other pancreatic cystic lesions in an appropriate context (56). The typical appearance is a very well defined lesion, with thickened wall and solid cystic components. It may vary from a predominantly solid tumour (< 3 cm) to a predominantly cystic tumour (> 3 cm).

Tumour size at the time of diagnosis averages 6 cm (49, 51, 52, 58) and generally only displaces the adjacent anatomical structures, rarely invades them (55, 56).

MRI has a great sensibility of visualizing cystic degeneration, often necrotic-haemorrhagic (Fig. 20). Also, MRI visualizes a very important diagnostic factor: the tumour relationship with the pancreatic duct and the bile duct. It should be noted that the tumour is always outside the pancreatic duct (differential diagnosis with ductal adenocarcinoma) and even if it is larger than 4 cm and has a cephalic location, SPN does not compress or infiltrate, which emphasizes the soft appearance of the tumour. Also, with no mass effect, SPN does not compress the bile duct. The tumour is very well defined, encapsulated, soft and has the character of a "sponge soaked in blood", fact explained by early cystic degeneration with haemorrhage. In the case of an enlarged neoplasm, the ducts are displaced and stretched but not infiltrated, which underlines the benign nature of the lesion. Retroperitoneal vessels are not invaded, and pancreatic parenchyma shows no sign of atrophy (differential diagnosis with ductal adenocarcinoma).

SPN may be invisible on the computed tomography (CT) without a contrast agent (isodense pancreatic parenchyma), especially

![Figure 20.](image)

SPN (yellow star) at MRI with MRCP (A) Early cystic-haemorrhagic degeneration, the high signal indicates haemoglobin inside the lesion. (B) Circumferential delineation is clearly depicted. The pancreatic parenchyma is completely intact and lacking atrophic changes. (C) The bile duct is not dislocated or infiltrated. (D) The lesion is located clearly outside the pancreatic duct. Primary SPN diagnosis (incidentaloma) at the age of 15 years old. We’ve opted for a watch-and-wait treatment. At periodic 3-year follow-up, the lesion did not show any changes, with the patient still asymptomatic. Progression of cystic degeneration, often haemorrhagic, is not a sign of malignancy if the size does not change and the capsule is not interrupted. Retroperitoneal vessels are not infiltrated even though they are in proximity of the tumour, which is a clear sign of benignity.
if it is less than 3 cm, making it hard to be detected, with no mass effect. In some cases outbreaks with peripheral calcifications can be seen (55, 59, 60). The delimitation is made easier after administration of the contrast agent (Fig. 21).

In case of diagnostic uncertainty, EUS-guided fine needle aspiration is recommended, which plays an important role in providing accurate and reliable preoperative cytological diagnosis (61, 62, 63). Papavramidis and Papavramidis (49) include CT-guided FNA in the SPN diagnostic algorithm.

**Therapeutic Indications**

The current treatment of SPN is surgical resection, depending on the radiological characteristics and the location of the tumour in the pancreas (49, 50, 52, 57, 54).

However, given the clear imaging criteria of benignity, one can opt for non-invasive watch-and-wait treatment with imaging follow-up. This approach is especially recommended for young, minor patients, thus avoiding an early pancreatectoduodenectomy which would significantly reduce their quality of life.

For these selected young patients, we regularly perform MRI monitoring. The intention is to postpone the operative moment, which can be determined either at the time when the patients are 18 years old or when the worrisome features show up, such as interruption of the capsule, increase of the solid portion at a rapid rate or compression of the common bile duct with secondary dilatation of bile ducts. If there is no change of the tumoral formation in the follow-up, the W&W treatment can be

![Figure 21. SPN (yellow star) in a 15 year old patient. (A) CT imaging in the arterial phase. (B) Axial CT imaging in the venous phase. (C, D) Venous phase, coronal section. Well delineated, solid tumoral formation, approx. 3.3 cm located in the pancreas head. Although the tumour is large enough, it does not have a mass effect and therefore does not compress the bile duct or the pancreatic duct. Absence of pancreatic parenchyma atrophy and of the infiltration of retroperitoneal vessels, a clear sign of benignity.]
continued with periodic monitoring. The mean / distal location of the tumour in the pancreatic body or tail is associated with a much earlier indication for surgery (left pancreatectomy). For cephalic tumours, taking into account the age of patients, the operative indication shall be cautious.

In the case of surgical approach, especially in the presence of worrisome signs such as interrupted capsule or predominantly solid tumour (50, 60, 52), the radical resection is usually chosen. However, in the case of minor patients, taking into account the increased survival rate and the consequences of extensive surgery that considerably lower the quality of life, it is advisable to perform a minimum resection with tissue preservation, such as tumour enucleation whenever possible (64, 65, 66, 67).

**Conclusions (Parts I and II)**

In recent years, the prevalence of incidental discovery of pancreatic cystic lesions has increased due to technical advances in the field of modern imaging techniques (MRI with MRCP, MDCT) which help both to identify lesions and to differentiate them.

The morphological appearance, age, gender, clinical parameters are important factors for characterizing pancreatic cystic lesions and for their differentiation from pseudocysts.

**Synopsis of pancreatic cystic lesions:**

- **SCN (Part I)** – Serous cystadenoma the only benign tumour, which needn’t be resected on asymptomatic patients.
- **MCN** – Mucinous cystic neoplasm has malignant transformation potential, so it must always be surgically resected.
- **MD-IPMN** – main duct IPMN has a high malignancy potential when duct dilation > 1 cm and mural nodules are present. Surgical resection is the therapy of choice for the majority of patients with MD and mixed IPMN.
- **BD-IPMN** – Secondary branch IPMN with a cyst < 3 cm without any other suspicious signs is monitored through imaging (watch-and-wait).
- **SPN** – Solid pseudopapillary neoplasm has low malignant potential, which is why surgical resection is generally chosen. In special cases, especially in minor patients without malignancy signs, periodic long-term follow-up is recommended, with the delay of the operative moment until worrisome signs appear, or until reaching the age of 18 years old.

In the case of the “watch and wait” approach, the purpose of imaging monitoring is to quickly identify the appearance of worrisome signs in order not to miss optimal surgical momentum.

*Graphic 1* presents a proposed algorithm for managing asymptomatic pancreatic cysts in order to avoid unnecessary surgery.
Conflict of Interest: none declared.

References


