Advances in imaging of pancreatic masses

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Learning objectives

1. To be familiar with major types of pancreatic masses and their radiological manifestations.

2. To understand approaches to selection of diagnostic pathways in pancreatic tumours.

3. To get acquainted with new developments in diagnostic imaging of pancreatic tumours.
Main

Annual data on the diagnostic possibilities of modern diagnostic imaging modalities replenished hundreds of publications in international scientific literature.

Of course, not always possible to understand the role and value of the new diagnostic modality, if you read the research papers separately, from time to time.

Much more effective understanding of the overall review of the literature concentrated the main results show the advantages and disadvantages of new methods and techniques.

It is thought that pancreatic cancer grows 10-20 years. It goes through various stages and ultimately becomes aggressive.

There are publications showing that there is an increased incidence of pancreatic cancer in the world.

It is very likely that the number of new cases of cancer detection is also associated with more effective diagnosis of pancreatic cancer.

Technologies such as contrast-enhanced MDCT, MRI with bolus contrast enhancement, diffusion-weighted MRI, endoscopic ultrasonography have become routine.

In recent years, more and more data about PET/CT and PET/MRI for diagnosis of pancreatic tumors. MDCT perfusion use for estimation of tumors and pancreatic parenchyma.

Radiology of the pancreas: **diagnostic process can be represented as such a scheme**

Optimal visualization of the pancreatic lesions

- protocols of scanning and bolus of CM injection

**Differential diagnosis**

- signs of tissue:
- Normal
- inflammatory changes
- tumors
- benign
- malignant
- operability
- resectability
- staging (TNM)
- vascular invasion

**Assessment of the surgery**

(morphological study -R0, R1, R2)

(follow-up à signs of recurrence)

Pancreatic duct adenocarcinoma (fig.1) is the most common pancreatic neoplasm. It is the fourth leading cause of cancer-related deaths in the United States [Greenlee R et al. CA Cancer J Clin 2001;51:15-36]. It carries an extremely poor prognosis, with an overall 5-year survival rate of only 4.1% [Ries LAG et al. SEER cancer statistics review, 1973-1996. Bethesda, MD: National Cancer Institute, 1999]. The incidence and mortality of pancreatic cancer in 2009 were predicted as 42 470 and 35 240, respectively [CA Cancer J Clin 2009 ; 59 ( 4 ): 225 - 249].

There are main MDCT signs of ductal adenocarcinoma - hypoattenuating mass, pancreatic duct cutoff, dilatation of the pancreatic duct or common bile duct, parenchymal atrophy, contour abnormalities (fig.2)

Doing examination, studying the tumor, we answer the question of a possible form of treatment. Are the tumor: Resectable, Borden-line resectable or Non-resectable.

However, from our point of view, the primary MRI should be performed to reliably exclude inoperable tumors (fig.3).

For Staging of vessels infiltration different classification can be used (Loyer E et al. *Abdom Imaging* 1996; 21:202-206; Lu et al. *AJR* 168:1439-1443)

Evaluation of invasion is more effective if used not only axial images, but also the various reforming images (fig.4).

To assess the possible extended resection is important to evaluate the individual anatomy of arteries (OP Zakharova, GG Karmazanovsky, VI Egorov *World J Gastrointest Surg* 2012 May 27; 4(5): 104-113). The need for combined use of CT and EUS for the detection of arterial involvement by pancreatic cancer (VI Egorov, RV Petrov, EN Solodinina, GG Karmazanovsky, NS Starostina, NA Kuruschkina *World J Gastrointest Surg* 2013 April 27; 5(4): 83-96) According to our data, endoUS detect more precisely the lack of invasion (fig.5).

Need to remember that neurotropic factors within the pancreatic stroma appear to facilitate perineural invasion. Therefore, tumors of the pancreatic head grow perineurally to the root of the celiac trunk, and tumors from uncinate process of pancreas invade the nerve plexus around the root of the superior mesenteric artery (Swati D. Deshmukh et al *AJR* 2010; 194:668-674).

Patients without vascular invasion have cumulative surviving rate significantly higher than patients with suspicion on vascular invasion (Karmazanovsky G.G et al., *Abdom. Imaging*, 2005, v. 30, N4, pp 488-500).

MRI, especially diffusion-weighted images with a high b-value, can detect residual tumor without contrast enhancement (fig.6).

Approximately 15-20% of islet cell tumors do not secrete any hormones and are called non-secreting tumors. They become symptomatic through their mass effect. (Fig.7)

But usually, insulinoma is hyperdense or hyperintense (fig.8).

Necrotic changes are predictor of malignancy (fig.9).

Large tumors with cystic areas and calcifications are malignant (fig.10).
SOLID PSEUDOPAPILLARY TUMOUR a rare condition with a low potential for malignancy. Usually affect women in the second or third decades of life. The prognosis is favorable even in the presence of distant metastasis. Surgical resection is generally curative (fig.11)

Cystic lesions. Benign cysts such as congenital cyst and macrocystic SCA can clinically be managed in a non-surgical manner unless the lesions are symptomatic. In contrast, MCN, IPMN of the branch duct type and tumor with cystic change are premalignant or malignant, and so they warrant surgical resection (Seong Hyun Kim et al. European Journal of Radiology 71 (2009) 122-128).

MDCT revealed calcifications better than MRI, but MRI can better assess the structure of serous cystadenoma (fig.12)

Mucinous cystadenoma may mimic solid-pseudopapillary tumor, malignant neuroendocrine tumor and hydatid cyst (Fig. 13).

Intraductal papillary mucinous neoplasia (IPMN) accounts for 1% of all exocrine pancreatic neoplasms. IPMN can be divided on 3 types: MPD-type, Mixed type and BPD-type. Morphologically tumor can be divided on: IPMN Adenoma, IPMN Borderline, Intraductal papillary mucinous carcinoma (noninvasive lesions, carcinoma in situ) - 7 -42% of IPMNs and invasive carcinomas - 25-46% (fig.14).

§Duct dilatation without stricture and a grape-like cyst shape were independently associated with the IPMN. §Duct dilatation with strictures was independently associated with the chronic pancreatitis. J.H. Kim et al. / European Journal of Radiology 81 (2012) 671-676

IPMN - CT findings of an invasive malignancy (the Sendai criteria) cysts #3 cmin the axial plane, main pancreatic ductal dilatation #6 mm, or mural nodularity within a cyst.

the 5-year survival rates- 89.2% benign IPMNs, - 62.5% malignant IPMNs- 49.2% invasive adenocarcinoma-Murakami Y et al. J Gastrointest Surg 2007;11:338-44

Follow-up of cystic lesions

• yearly follow-up if the lesion is <10 mm;
• 6- or 12-month for lesions between 10 and 20 mm;
• 3- or 6-month for lesions >20 mm.

• On follow-up studies:
  • presence of intramural nodules,
  • cyst size >30 mm,
  • dilation of the main pancreatic duct (>6 mm) [Atif Khan et al AJR:196, June 2011]

NB!! After 2 years of stability the follow-up interval may be lengthened.

Conclusions

The use of radiological examination in evaluation of pancreatic tumors provides valuable pre-operative assessment of surgical resectability and may be performed in the clinical examination.

The tumor localization in the medial part of pancreatic head predicts poor prognosis, because of the frequent vascular invasion.

It is wise to classify patients in three groups, based on CT signs of vascular invasion by pancreatic head tumor, because this helps to estimate more precisely the tumor stage and preoperatively plan to perform the vascular resection during Whipple procedure. The possibilities of modern MRI diagnosis of the pancreatic Diseases are not inferior opportunities MDCT, but often exceed them, particularly in the diagnosis of cystic tumors. Contrast enhancement in MRI diagnosis provides an excellent diagnostic information, and in contrast to the contrast enhanced MDCT not associated with radiation exposure MRI most suitable for follow-up examinations.

Accumulation of experience with DWI, using perfusion techniques at MDCT with iterative image reconstruction (low dose), more frequent use of endoscopic ultrasound and such expensive procedures as PET/CT and PET/MRI will improve the efficiency of diagnosis and differentiation of pancreatic mass.

Endoscopic ultrasound and MR pancreaticocholedangiography are really effective methods for evaluation of cystic lesions. Conventional cysts have clear, smooth contours and are not associated with the ductal system. With these techniques it became possible, for example, to differentiate the different types of IPMN (main
duct, side ducts, mixed type). The rapid increase diameter of cystic lesion (at dynamic monitoring), the grows of internal papillary mass, infiltration of pancreatic tissue - there are signs of malignancy.

The role of PET will grow (fig.15). Will be found new "markers" of various tumors. However, PET (with MRI and MDCT) is expensive method and it will carry out in specialized centers after the initial diagnosis, when the tumors are more likely to be detected on early stages. Fast MR pulse sequences will use this method for diagnosing pancreatic tumors more often. In elderly patients, MDCT remains the leading method. However, new technologies (such as iterative reconstruction) will make this method more deleterious to the patient.

Radiology of the pancreas and surgical pancreatology are two interrelated processes, the success of each of them contribute to the development of other branche of medicine.

![Fig. 15: PET (PET/CT) very sensitive to detection of neuroendocrine tumors](image-url)

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>Accuracy (%)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
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<tbody>
<tr>
<td>Delbeke et al.</td>
<td>65</td>
<td>91</td>
<td>92</td>
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<td>Zimmery et al.</td>
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<td>Ho et al.</td>
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<td>Kato et al.</td>
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<td>Bares et al.</td>
<td>40</td>
<td>90</td>
<td>92</td>
<td>84</td>
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74 pts= pancreatic mass (1-10 cm) susp. pancreatic cancer. Sens/spec = 96% and 78% PET 91% and 56% CT

[Inokuma T et al Gut 1996;39[suppl 3]:12]
Fig. 14: Huge IPM-carcinoma which mimic mucinous carcinoma

References: Grigory G.Karmazanovsky
Fig. 13: The higher the density of mucin, the more it looks like a solid part of the tumor.

References: Grigory G.Karmazanovsky
Fig. 12: MRI sensitivity in detecting tumor structure higher than that of MDCT

References: Grigory G. Karmazanovsky
Fig. 11: small tumor is usually solid, the larger the tumor, the more it is heterogeneous. This tumor has a greater potential for malignancy. In this patient there is a necrotic changes inside tumor

References: Grigory G.Karmazanovsky
Fig. 10: malignant insulinoma of the pancreatic tail

References: Grigory G. Karmazanovsky
Fig. 9: hypodense area in the tumor is the necrotic zone

References: Grigory G.Karmazanovsky
**insulinoma**

Endocrine tumor (insulinoma) tail of the pancreas T1N0M0. Organic hyperinsulinism. Diffuse gastritis. Obesity II stage. Cholesterosis of the gallbladder.

**Fig. 8**: insulinoma of the pancreatic tail. Results of MDCT, MRI and endoUS are comparable

**References**: Department of Radiology, Vishnevsky Institute of Surgery - Moscow/RU
Fig. 7: on dynamic MR imagings with gadobutrol insulinoma have the isointense signal with pancreatic tissue

References: Grigory G.Karmazanovsky
Fig. 6: DWI with b-value 1000 show high intensity signal in the projection of roots of the celiac trunk and the superior mesenteric artery (remnant of Neuroendocrine tumor - R2 resection).

References: Grigory G. Karmazanovsky
Fig. 5: In cases of dispute, assessing resectability we are always prefer endosonography. On endoultrasound images visible fatty tissue between the tumor and the vessel.

References: World J Gastrointest Surg 2013 April 27; 5(4): 83-96)
**Fig. 4**: On axial images is better seen the circumferential invasion, but extent of invasion is better visible on sagittal images

**References**: Grigory G. Karmazanovsky
Fig. 3: Avascular invasion on MRI without contrast enhancement is visible much better than at MDCT without contrast enhancement.

References: Grigory G. Karmazanovsky
Fig. 2: MDCT signs of ductal adenocarcinoma

References: Grigory G.Karmazanovsky
Fig. 1: Despite the fact that the ductal epithelium is only 4% of pancreatic tissue, 80-95% of pancreatic cancers grow from ductal epithelium. Ductal adenocarcinoma is the most dangerous tumor of the pancreas.

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References

Greenlee R et al. CA Cancer J Clin 2001;51:15-36


Bethesda, MD: National Cancer Institute, 1999


Lu et al. AJR 168:1439-1443

OP Zakharova, GG Karmazanovsky, VI Egorov World J Gastrointest Surg 2012 May 27; 4(5): 104-113

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Swati D. Deshmukh et al AJR 2010; 194:668-674


Atif Khan et al AJR:196, June
