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CT features of the main pancreatic duct in chronic pancreatitis and pancreatic cancer

Diagnosis of pancreatic diseases is difficult and it is impossible to draw unequivocal conclusions without pathological examination results. The most difficult it is to differentiate inflammatory and neoplastic lesions. The main pancreatic duct (MPD) is an important feature in diagnosing and differentiating pancreatic diseases. Its dilation is observed with a similar frequency in both diseases. Computed tomography (CT) is a method of choice in diagnosing pancreatic lesions. It enables visualisation of the dilated main pancreatic duct and common bile duct (CBD) in most cases. Good visualisation of those structures may be difficult, especially because of their anatomic location, it is impossible to assess their courses on one scan. These problems can be eliminated by using multislice CT or magnetic resonance cholangiopancreatography (MRCP).

In this work we analysed and correlated the dilation of MPD with other lesions encountered in the course of neoplastic diseases and chronic pancreatic inflammation, such as dilation of the common bile duct, size and localisation of a lesion.

MATERIAL AND METHODS

The material consisted of 133 patients examined with computed tomography technique in the years 1995–2002 at the 2nd Department of Clinical Radiology, Medical University of Lublin. The aim of our research was to assess the possibility of differentiating pancreatic cancer and chronic inflammation in patients with a pathological pancreatic mass visualised during a CT examination. In all patients the operation or biopsy of the pathological mass was further performed. According to pathological results, patients were divided into 2 groups: those with an adenocarcinoma (87 patients) and those with chronic inflammation (46 patients). CT examinations were conducted with Siemens Somatom ART scanner before and after an intravenous injection of iodine, non-ionic contrast solution, preceded by oral contrast ingestion. Axial scans of 10 and 5 mm were done, supplemented by sagittal and multiplanar reconstructions.

RESULTS

DILATION OF THE PANCREATIC DUCT

The dilated pancreatic duct was observed in 50 patients (57.5%) with pancreatic cancer (Fig. 1) and in 25 (54.3%) patients with chronic inflammation (Fig. 2). This feature was present in both diseases with a similar frequency. Differences appeared while assessing the limits of the duct. Smooth limits were present in 44 patients with cancer (88%) and in 6 patients with chronic inflammatory disease

(24%), irregular limits in 6 (12%) and 19 (76%) patients, respectively. The pancreatic duct was visualised inside the pathological mass in 8 patients with cancer (9.2%) and in 12 patients with chronic inflammation (26.1%). These results differed statistically among both groups ($p<0.01$) (Table 1).

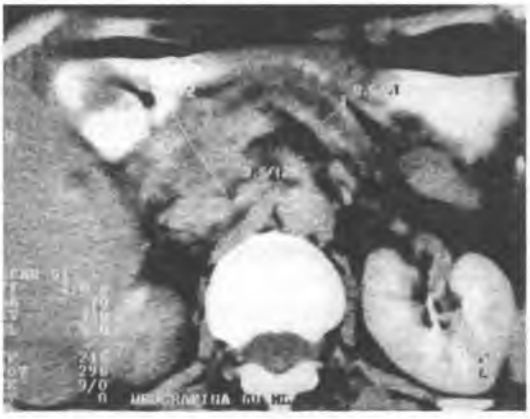

Fig. 1. Pancreatic adenocarcinoma. Low density mass in the head of pancreas. Dilation of the pancreatic duct in atrophic body and tail of the pancreas

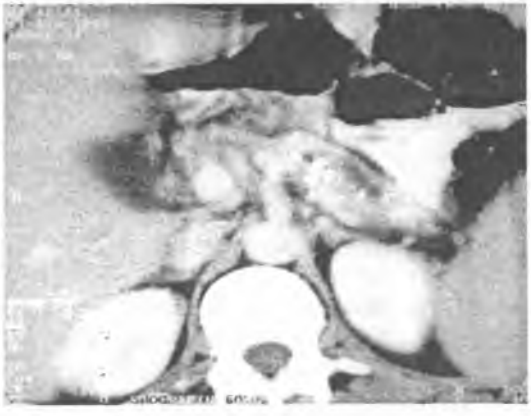

Fig. 2. Chronic pancreatitis. Irregular dilation of pancreatic duct with duct concrements

Table 1. Pancreatic duct (ca – pancreatic adenocarcinoma, cp – chronic pancreatitis)

Sign	Category	f			%			χ^2	p
		all	ca	cp	all	ca	cp		
Diameter of MPD	dilated	75	50	25	56.4	57.5	54.3	0.12	>0.72
	normal	58	37	21	43.6	42.5	45.7		
Borders of MPD	smooth	50	44	6	66.7	88.0	24.0	30.72	<0.001
	irregular	25	6	19	33.3	12.0	76.0		
Duct inside the mass	visible	20	8	12	15.0	9.2	26.1	6.72	<0.01
	invisible	113	79	34	85.0	90.8	73.9		

CORRELATION BETWEEN DILATION OF THE TERMINAL PART OF THE COMMON BILE DUCT (CBD) AND THE MAIN PANCREATIC DUCT (MPD)

Both in the cancer and chronic inflammation group, an important statistical correlation was observed. In the cancer group, a dilated CBD was observed in 84% of patients with the dilated MPD and in 54% of patients with the normal MPD. In the chronic inflammation group, a dilated CBD was observed in 68% of patients with the dilated MPD contra 38% of patients with the normal MPD. The observed frequency of different combinations in the cancer group did not differ statistically from the respective frequency in the chronic inflammation group. Thus, the normal CBD coexisted with the normal MPD in 19.5% patients with cancer and in 28.3% patients with inflammation. The observed difference is typically random ($p>0.25$). The normal CBD coexisted with the dilated MPD in 9.2% and 17.4% of patients with cancer and chronic pancreatic inflammation, respectively ($p>0.16$). The dilated CBD coexisted with the normal MPD in 23% and 17.4% of patients ($p>0.45$), respectively, dilated both CBD and MPD were observed in 48.3% and 37% of patients ($p>0.21$) (Table 2).

Table 2. Comparison of the diameter of the pancreatic and biliary ducts

Combination of signs	f		%			
	ca	cp	ca	cp	χ^2	p
Normal CBD and normal MPD	17	13	19.5	28.3	1.31	>0.25
Normal CBD and dilated MPD	8	8	9.2	17.4	1.91	>0.16
Dilated CBD and normal MPD	20	8	23.0	17.4	0.57	>0.45
Dilated CBD and dilated MPD	42	17	48.3	37.0	1.55	>0.21
All	87	46	100	100	-	-

Absence of statistically important differences in frequency of four analysed combinations between both groups (pancreatic cancer and chronic inflammation) authorises us to analyse further correlations of these features in the whole material of 133 patients. Out of 75 patients with dilated MPD, 78.7% also had a dilated CBD, and out of 58 patients with normal MPD, 48.3% had also a dilated CBD. The observed differences (78.7% to 48.3%) turned out to be strongly important ($p<0.001$). These results enable to conclude a statistically higher frequency of CBD coexisting with the dilated MPD.

CORRELATION BETWEEN LOCALIZATION OF THE LESION AND DILATION OF THE MPD

In our material, most lesions were located in the head of the pancreas. In only 10.3% of patients with cancer and in 4.3% of patients with chronic inflammation the lesions were located outside the head (in the body and/or tail of the pancreas) Among patients with cancer, the dilated MPD was observed more often with the mass located in the head of pancreas (62.8% to 11.1 % of cases with localisation outside the head of the pancreas $p<0.01$). A similar trend was noticed in inflammatory cases, but there, the number of cases with lesions outside the head of the pancreas was too small to allow a good statistical analysis. Differences in frequency of other combinations between two analysed groups were highly random.

CORRELATION BETWEEN DILATION OF MPD AND SIZE OF THE LESION

We did not observe any statistical difference between dilation of MPD and size of the lesion defined in ranges <50mm and ?50mm, in both diseases. No statistical difference was either seen in any combination of these features in both groups.

DISCUSSION

The diameter of MPD is the largest in the pancreatic head and decreases gradually towards the pancreatic tail. The use of thin, 5-mm slices and contrast injection in bolus using the dynamic option enable to show the normal MPD in 70% of cases. The dilated duct is always shown with this optimal technique (3). The normal diameter of MPD in AP projection is 3 mm in the head, 2 mm in the body and 1.5 mm in the tail (11). MPD is visible already in 50% of patients using slices of 8–10 mm. MPD with a diameter of 1–3 mm is more difficult to visualise. After a contrast bolus, when the diameter of MPD is above 5mm, the duct may be seen as a linear band. Detection of the dilated MPD with different techniques increases in such situations and achieves the value of 70% (2). Dilation of MPD in the pancreatic body and tail is considered to be an important indirect symptom of a head tumour. It was observed in 56% of cancer cases and in 58% of chronic inflammation cases (6).

Irregular dilation of MPD was observed in 73% of chronic inflammation cases . About half of irregular dilation cases coexisted with duct concrements (Fig. 2). In 27% of patients with chronic inflammation, contours of MPD were similar to those observed in cancer cases. Chronic inflammation can cause a large dilation of MPD along its length without any nodular protuberances (10). CT in chronic inflammation shows in 30% of cases the irregular, dilated MPD, with a diameter larger than 5 mm in the head and 3 mm in the tail. The fibrous tissue replaces pancreatic lobules causing narrowing of ducts and a dilation and congestion above resulting in atrophy of the normal pancreatic tissue and forming concrements. Narrowing of the MPD and its branches can be caused by an inflammatory, local or diffuse mass. Cicatricial deformation is usually more irregular than neoplastic one (9). The diameter of MPD lumen beside a local lesion was bigger in cancer and normal in inflammatory cases. Dilation was smaller and irregularities were seen less often in chronic inflammatory disease (2). In 73% of chronic inflammation cases, contours of MPD were irregular, half of them contained duct concrements (13). Calcifications in MPD of irregular contours were very specific of chronic inflammation disease. Only in 15.4% of cases MPD had regular contours (8).

Dilation of MPD was diagnosed in 56% of patients with cancer and in 70% of patients with tumours limited to the pancreatic head and body. Smooth (43%) or bead-like (40%) dilation was most often involved with cancer (10). Cancer is characterised by a pathological mass, dilated MPD and atrophy of the normal pancreatic tissue. Sometimes such features may be present in chronic inflammatory disease. This disease alone, or in coexistence with cancer, may also cause MPD dilation (3). In about 5% of patients with cancer, MPD dilation may be the only, isolated pathology (7). However, isolated MPD dilation is non-specific (12). CT examination gives more information about accessory lesions, especially a pathological pancreatic mass. Dilated MPD was not observed in tail cancer or diffuse pancreatic cancer (4).

A larger dilation with smooth, linear contours is found in cancer, whereas in chronic inflammation a smaller dilation with irregular contours is observed (1). Small ductal adenocarcinoma from small braches of PD may not narrow the MPD, or dilate it (4). Contrary to chronic inflammatory disease, in cancer, contours of the dilated MPD are smooth.

Its walls are usually parallel resembling an image of a smooth, hypodense column. Sudden and important dilation of MPD or/and CBD is characteristic of malignancy (13). Smooth or bead-like dilation is present in 65.9–80.8% cases of cancer. However, irregular contours of MPD, without any other symptoms of chronic inflammatory disease may indicate a neoplastic process. In cicatricial deformations, contours of MPD are more irregular than in tumour that causes narrowing. Irregular dilatation characteristic of chronic inflammation are present in 73% of cases (13).

In our material differences between the diameter of MPD and pancreatic tissue in cancer and chronic inflammation were statistically important. In the group with cancer, dilated MPD was found more often when the pathological mass was located in the pancreatic head (62.8% with a similar tendency in chronic inflammation). Dilation of both MPD and CBD (symptom of double duct) is characteristic of both diseases. Dilation of MPD with a focal enlargement of the pancreas may imitate cancer. Dilation in cancer has in 66–73% of cases smooth and bead-like contours, whereas in chronic inflammation – more often irregular ones (6). Differences between contours of MPD turn out to be highly statistically important ($p<0.001$), smooth in 88% in cancer contra 24% in chronic inflammation, irregular in 12 and 76%, respectively. Visualisation of MPD inside the pathological mass in both diseases also differed statistically ($p<0.01$) (9.2% in cancer contra 26.1% in chronic inflammation).

Dilation of MPD and/or CBD is a suggestive feature of pancreatic pathology but it appears both in cancer and in chronic inflammation. It is therefore more important to analyse the course and character features of both ducts. CT enables such an assessment but it is not the best method compared to nowadays rarely used ERCP. MR cholangio-pancreatography and multislice CT seem to be the future methods in such a diagnosis. A larger dilation of MPD with smooth, linear limits is observed in cancer; a smaller dilation with irregular limits – in chronic inflammation. In pancreatic cancer the MPD becomes dilated in its distant part from the tumour mass. This may be similar in a focal type of chronic inflammation but diffuse lesions, causing diffuse tissular and ductal lesions and irregular course of MPD are encountered more often in this disease (5).

CONCLUSIONS

1. Features more frequent statistically in pancreatic cancer comprise smooth contours of the dilated pancreatic duct, invisible pancreatic duct in the lesion itself and more frequent dilation of the pancreatic duct in cancers located in the pancreatic head.
2. Features characteristic of chronic inflammation comprise irregular contours of the dilated pancreatic duct, visible inside the lesion.
3. In both diseases there exists a correlation between dilation of the pancreatic duct and the terminal part of the common bile duct. The size of the lesion, however, does not effect the frequency of MPD dilation.

REFERENCES

1. Bryc S. Kraśniak J: Badanie trzustki różnymi technikami obrazowania. Annales UMCS Sectio D, 67, 83, 1992.
2. Daniel B., Pruszyński B.: USG versus KT w kompleksowej diagnostyce jamy brzusznej. Część I. Trzustka. Ultrason Pol., 2, 35, 1992.
3. Federle M., Goldberg H.: The pancreas. In: A. Moss, G. Gamsu, H. Genant: Computed tomography of whole body with magnetic resonance imaging. W.B. Saunders Co, Philadelphia 1992.

4. Freeny P. C. et al: Pancreatic ductal adenocarcinoma: diagnosis and staging with dynamic CT. Radiology, 166, 125, 1998.
5. Jędrzejewski G. Złomaniec J: Difficulties in differentiating focal chronic pancreatitis from pancreatic cancer with contrast enhanced computed tomography. Pol. J. Radiol., 68, 34, 2003.
6. Karasawa E. et al: CT pancreatogram in carcinoma of the pancreas and chronic pancreatitis. Radiology, 148, 493, 1983.
7. Moos A., Gamagami R.: Diagnosis and staging of pancreatic neoplasms. Surg. Clin. North Am., 75, 871, 1995.
8. Piotrowski Z., Puchalski Z.: Przewlekłe, wapniejące zapalenie trzustki i kamica trzustkowa. Nowa Klin., 7, 18, 1995.
9. Robinson P. J. A., Sheridan M. B.: Pancreatitis: computed tomography and magnetic resonance imaging. Eur. Radiol., 10, 401, 2000.
10. Soyer P. et al: Cystic tumors of the pancreas: dynamic CT studies. J. Comput. Assist. Tomogr., 18, 420, 1994.
11. Stephens D. H.: Pancreatic adenocarcinoma: radiologic diagnosis and staging. In: P. C. Freeny, G. W. Stevenson: Alimentary tract radiology. Mosby, St. Louis 1994.
12. Todd K. et al: Management decisions for unusual periampullary tumors. Am Surg., 63, 927, 1997.
13. Wegener O. H.: The pancreas. In: O. H. Wegener: Whole body computed tomography. Blackwell Scientific Publications, Cambridge 1993.

SUMMARY

The purpose of this study was to evaluate the features of the main pancreatic duct and coexisting lesions in patients with chronic pancreatitis and pancreatic cancer. The material comprised 133 patients with the presence of a pancreatic mass on CT examination, 87 patients with pancreatic cancer and 46 with inflammatory disease. The CT features of the pancreatic duct were assessed and correlated with pancreatic changes in chronic pancreatitis and pancreatic cancer. The features that most commonly appear in pancreatic cancer are smooth contours of the dilated main pancreatic duct and invisibility of the duct inside the pancreatic mass. The dilation of the duct is encountered more often in cancers located in the pancreatic head. In chronic pancreatitis the ducts are irregularly dilated and gradually obstructed. Sometimes the duct may be visible inside the pancreatic mass. There is a strong correlation between dilations of the pancreatic and biliary duct. Contrast enhanced CT is the method of choice in differentiating pancreatic masses, both in chronic pancreatitis and pancreatic cancer. It makes it possible to assess the pancreatic and duct changes during one examination.

Ocena głównego przewodu trzustkowego w raku i przewlekłym zapaleniu trzustki przy pomocy tomografii komputerowej

Celem pracy jest ocena głównego przewodu trzustkowego i współistniejących zmian w trzustce w raku i przewlekłym zapaleniu trzustki. Materiał stanowi grupa 133 chorych z obecnością masy trzustkowej w badaniu TK, 87 z rakiem trzustki i 46 z przewlekłym zapaleniem trzustki. Oceniano zmiany przewodu trzustkowego i korelowano je z innymi zmianami w trzustce w przebiegu obu schorzeń. Wśród objawów charakterystycznych dla raka trzustki stwierdzono gładkie zarysy

poszerzonego przewodu trzustkowego, brak widoczności przewodu trzustkowego w obrębie zmiany oraz znamiennie częstsze poszerzenie przewodu trzustkowego przy rakach zlokalizowanych w głowie trzustki. Objawy charakterystyczne dla przewlekłego zapalenia stanowią nierówne zarysy poszerzonego przewodu trzustkowego oraz widoczność przewodu trzustkowego w obrębie zmiany. W obu schorzeniach istnieje korelacja pomiędzy poszerzeniem przewodu trzustkowego i końcowego odcinka przewodu żółciowego wspólnego. Dynamiczna TK jest techniką z wyboru w diagnostyce mas trzustkowych, pomocną w różnicowaniu raka i przewlekłego zapalenia trzustki. Pozwala na równoczasową ocenę zmian miąższowych i przewodowych.