DOI: https://doi.org/10.25121/PNM.2018.31.2A.29 Post N Med 2018; XXXI(2A): 29-33

*Łukasz Durko[1], Magdalena Barańska[1], Aleksandra Kaczka[2], Ewa Małecka-Panas[1]

The evaluation of sensitivity and specificity of selected imaging techniques in diagnosing pancreatic lesions

Ocena czułości i swoistości wybranych badań obrazowych w diagnostyce chorób trzustki

[1]Department of Digestive Tract Diseases, Medical University of Łódź
Head of Department: Professor Ewa Małecka-Panas, MD, PhD
[2]Department of Clinical Nutrition and Gastroenterological Diagnostics, Medical University of Łódź
Head of Department: Cezary Chojnacki, MD, PhD

Keywords

pancreatic tumor, chronic pancreatitis, computed tomography, ultrasonography, endosonography

Słowa kluczowe

guz trzustki, przewlekłe zapalenie trzustki, tomografia komputerowa, ultrasonografia, endosonografia

Summary

Introduction. Endosonography (EUS) remains the most accurate method in detecting pancreatic abnormalities (presence of tumor, calcifications, cysts, dilation of pancreatic duct, dilation of common bile duct). Transabdominal ultrasound (US) and computed tomography (CT) are however first line imaging techniques, and still remain more accessible.

Aim. The aim of the study was the evaluation of sensitivity and specificity of US and CT for detecting selected pancreatic abnormalities in comparison to EUS.

Material and methods. We performed statistical analysis of the results of US, CT and EUS of 60 patients who were suspected of pancreatic mass and of 29 patients with chronic pancreatitis.

Results. In comparison to EUS, the sensitivity and specificity of diagnosing pancreatic tumor in CT was respectively 96.4 and 92.3%, for US 85.7 and 80%. For visualising PD dilatation CT 72.2 and 84.4%, US 38.9 and 79.2%. For evaluating CBD dilatation CT 100 and 100%, for US 95.0 and 97.6%.

In chronic pancreatitis in comparison to EUS the sensitivity and specificity of CT for detecting calcifications in pancreatic parenchyma in CT was 45.4 and 29.4%, US 26.1 and 27.0% and for detecting lobular structure of pancreas: CT – 69.2 and 20.0%, US – 33.3 and 10.0%. Sensitivity and specificity for detecting PD abnormalities were: for CT – 75.0 and 58.3%, for US – 42.8 and 40.0% and for visualising pancreatic cysts: CT – 88.9 and 93.7%, US – 77.8 and 90.9%.

Conclusions. The sensitivity of US is limited. CT presents relatively high sensitivity in detecting pancreatic abnormalities, however is less accurate than EUS. The sensitivity of US and CT in diagnosing CP might be insufficient in comparison to EUS.

Streszczenie

Wstęp. Endosonografia (EUS) stanowi najbardziej precyzyjną metodę w obrazowaniu trzustki (pozwala uwidocznić małe zmiany ogniskowe, zwapnienia, torbiele, poszerzenie przewodu trzustkowego oraz przewodu żółciowego). Przezbrzuszna ultrasonografia (US) oraz tomografia komputerowa (CT) pozostają nadal badaniami pierwszego rzutu w związku z ich większą dostępnością.

Cel pracy. Ocena czułości i swoistości US i CT w rozpoznawaniu nieprawidłowości w miąższu trzustki w porównaniu do EUS.

Materiał i metody. Wykonano analizę statystyczną wyników badań US, CT i EUS 60 pacjentów diagnozowanych z powodu podejrzenia zmiany ogniskowej trzustki oraz 29 pacjentów z podejrzeniem przewlekłego zapalenia trzustki.

Wyniki. W porównaniu do wyników EUS czułość i swoistość rozpoznawania guza trzustki wynosiła dla CT odpowiednio 96,4 i 92,3%, dla US – 85,7 i 80%. Czułość i swoistość TK dla oceny poszerzenia przewodu Wirsunga wynosiła 72,2 i 84,4%, zaś dla US – 38,9 i 79,2%. Czułość i swoistość TK dla oceny poszerzenia PŻW wynosiła w niniejszej analizie 100%, zaś dla US odpowiednio 95,0 i 97,6%.

W przewlekłym zapaleniu trzustki, w porównaniu do wyników EUS, czułość i swoistość TK dla rozpoznawania zwapnień w miąższu trzustki wynosiła odpowiednio 45,4 i 29,4%, dla US – 26,1 i 27,0%. Czułość i swoistość TK dla oceny zrazikowej struktury trzustki wynosiła 69,2 i 20,0%, dla US – 33,3 i 10,0%. Czułość i swoistość TK dla oceny nieprawidłowości

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

Address/adres:

*Łukasz Durko
Klinika Chorób Przewodu Pokarmowego
Uniwersytet Medyczny w Łodzi
ul. Kopcińskiego 22, 91-425 Łódź
tel.: +48 (42) 678-64-80
lukasz.durko@umed.lodz.pl

w przebiegu przewodu Wirsunga i obecności złogów w jego świetle wynosiła 75,0 i 58,3%, dla US – 42,8 i 40,0%. Czułość i swoistość TK dla uwidocznienia torbieli trzustki wynosiła 88,9 i 93,7%, dla US – 77,8 i 90,9%.

Wnioski. Czułość US dla oceny miąższu trzustki jest ograniczona. Badanie CT odznacza się względnie wysoką czułością w rozpoznawaniu nieprawidłowości w miąższu trzustki, choć jest mniej dokładne niż EUS. Czułość US i CT może być niewystarczająca do rozpoznania przewlekłego zapalenia trzustki.

INTRODUCTION

Endosonography (EUS) is a highly accurate technique for imaging pancreas. In 99% procedures the whole pancreatic parenchyma can be visualised. The sensitivity of this method for detecting focal lesions in the pancreas reaches 94-98% with specificity of 86%. EUS is also efficient in detecting small pancreatic lesions (< 2 cm) – its sensitivity is higher than contrast computed tomography (CT) – 93 vs 53%. Additionally, negative result of EUS examination rules out the presence of focal pancreatic lesion with high probability (1, 2).

Among solid focal lesions in the pancreas, the majority are pancreatic adenocarcinoma (PDAC) – 85%, pancreatic neuroendocrine tumors (PNET) are diagnosed in 7-10% cases and inflammatory lesions are found – in 15-18% patients. Other solid lesions are rare (lymphoma, mesenchymal neoplasms, metastases) (3, 4).

In retrospective analysis by Lahat et al. of the group of 475 patients who underwent pancreatic resection due to the detected pancreatic lesions, 86.5% individuals had symptoms and 13.5% were asymptomatic. Among symptomatic patients 69% had malignant lesions, 26% potentially malignant lesions (mainly mucinous cystadenomas) and 2% – benign lesions. In the group of asymptomatic patients malignant lesion were found in 34%, potentially malignant in 60% and benign in 6% (5).

Transabdominal ultrasonography (US) is a first line diagnostic tool in patients presenting with abdominal pain or jaundice. The method is non-invasive and widely available. Pancreatic head tumors, presenting as a hypoechoic mass are often accompanied by dilatation of common bile duct (CBD) and dilatation of pancreatic duct (PD). Lesions in the body and tail of the pancreas might be difficult to detect in US due to lack of CBD dilation and the presence of gas in surrounding intestinal loops, stomach or colon. Additionally, the accuracy of US is highly dependent on the operator's experience. The sensitivity of US for detecting pancreatic masses among different observers reaches 50-90% (6, 7). Performing US without contrast media often does not allow for differentiation between PDAC, PNET and inflammatory lesions. Nevertheless, US is an acceptable first imaging method but does not allow for exclusion of small pancreatic tumors (< 2 cm) which might have better prognosis than advanced lesions (8). As the accuracy of US constantly improves due to technical development and regarding the fact that there is few recent data regarding US sensitivity and specificity in detecting pancreatic masses, we believe that diagnostic value of this method should be reexamined.

The sensitivity of contrast enhanced computer tomography (CT) for detecting pancreatic tumors has improved over the last years and reaches 75-100% with specificity of 70-100% (9). As sensitivity of CT for diagnosing large pancreatic tumors reaches 98%, small lesions (< 2 cm) are diagnosed by CT only with 68-77% sensitivity (10, 11).

EUS as a highly sensitive method for evaluating pancreatic parenchyma is a recommended tool for diagnosing chronic pancreatitis (CP). Close proximity of the transducer to the pancreas allows the whole parenchyma visualisation, and is more accurate for detecting small lesions than US and CT (12). In 2007 Rosemont Criteria which describe endosonographic features of CP were introduced. CP diagnosis is certain, suggestive or undetermined depending on the combination of detected features (13).

AIM

The aim of the study was to evaluate the sensitivity and specificity of US and CT for evaluating selected pancreatic abnormalities (presence of tumor, calcifications, cysts, dilation of pancreatic duct, secondary dilation of common bile duct) in comparison to EUS.

MATERIAL AND METHODS

We analysed 60 individuals in whom the presence of pancreatic mass was suspected (subtle to gross abnormalities in pancreatic parenchyma, dilatation of CBD in ultrasound or CT examination, elevated Ca 19-9 levels, cholestasis, weight loss, family history of pancreatic tumors). Patients underwent EUS examination in the Department of Digestive Tract Diseases, Medical University of Łódź in the years 2015-2016. For the purpose of the study we selected patients who had the results of US and contrast CT within the previous 3 months (the examinations were performed in random centers). Regarding short observation period we used the result of EUS examination as the reference. We performed a retrospective analysis of the sensitivity and specificity of CT and US in detecting the presence of pancreatic mass (the size of masses were 1-5 cm), dilatation of PD and dilatation of CBD.

We also analysed a group of 29 patients in whom we diagnosed chronic pancreatitis (CP) with the use of EUS. Similarly, all these patients had previous contrast CT and USG examinations performed in random centers within previous 3 months. EUS was considered as a reference examination as it allowed for precise identification of CP Rosemont Criteria. We analysed the

sensitivity and specificity of CT and USG for detecting Rosemont criteria features in CP.

RESULTS

In the group of 60 patients diagnosed for pancreatic mass, the focal tumor was detected by EUS in 35 cases (58.3%). Among those patients CT showed the presence of a solid lesion in 34 cases (56.7%) and US in 30 cases (50.0%). EUS showed no lesions in 25 patients (41.7%), whereas normal pancreatic structure was seen in 26 CT images (43.3%) and 30 US examinations (38.6%). EUS results were considered as a reference value to other imaging studies. In such comparison the sensitivity and specificity of diagnosing pancreatic tumor in US was respectively 85.7 and 80% whereas the CT sensitivity and specificity was 96.4 and 92.3%. The negative predictive value of US was 0.8 and for CT 0.92. The positive predictive value of US was 0.85 and for CT 0.87 (fig. 1).

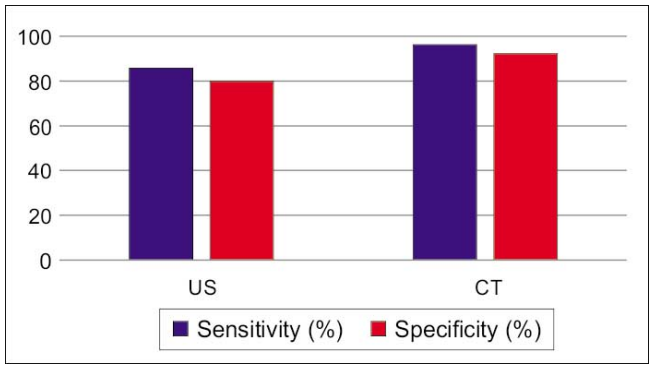

Fig. 1. The sensitivity and specificity of CT and US in detecting pancreatic mass

We further analysed the sensitivity and specificity of visualization of PD dilatation above 2 mm in US and CT comparing to EUS findings in patients suspected of pancreatic tumors. In the group of 60 patients EUS detected dilatation of PD in 18 cases (30.0%). In the same group CT showed PD dilatation in 15 cases (25.0%) and its normal appearance in 25 cases (75.0%). US examination allowed for PD dilatation detection in 7 cases (11.7%) and presented normal PD appearance in 53 cases (88.3%). These results allowed for determining the sensitivity and specificity of CT in visualising PD dilatation respectively at 72.2 and 84.4%. US sensitivity and specificity for PD evaluation was 38.9 and 79.2%. The NPV for PD dilation in CT and US was respectively 0.84 and 0.79. The positive predictive value for determining PD dilatation in CT and US was 1.0 (fig. 2).

Similar analysis was made for evaluation of CBD dilatation. In the group of 60 patients who underwent EUS examination dilatation of CBD was found in 20 cases (33.3%). In the same group CT showed CBD dilatation in 20 patients as well (33.3%). US revealed CBD dilatation in 19 patients (31.6%). In comparison to EUS results, the sensitivity and specificity of CT in evaluating CBD dilatation was both 100%. The specificity of US was respectively 95.0 and 97.6% (fig. 3).

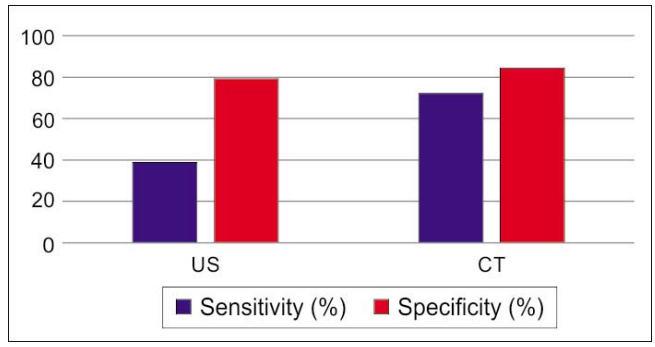

Fig. 2. The sensitivity and specificity of CT and US in detecting PD dilatation

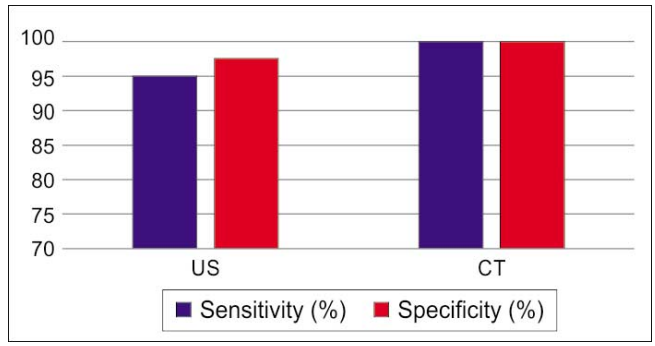

Fig. 3. The sensitivity and specificity of CT and US in detecting CBD dilatation

In 29 individuals suffering from CP we analysed the sensitivity and specificity of imaging techniques for detecting features of Rosemont criteria. Calcifications in pancreatic parenchyma and in PD (Major A criteria) were detected in 23 patients (79.3%). In the same group CT showed calcifications in 10 individuals (34.48%). US showed the presence of calcifications in 6 cases (20.7%). The sensitivity and specificity of CT in detecting calcifications in pancreatic parenchyma was respectively 45.4 and 29.4% and for US respectively 26.08 and 27.0%. The NPV for pancreatic calcifications identification for CT and US was respectively 0.29 and 0.26. The PPV for CT and US in detecting this feature was respectively 0.9 and 1.0 (fig. 4).

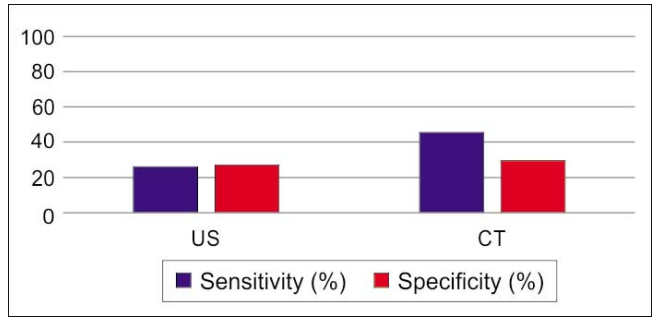

Fig. 4. The sensitivity and specificity of CT and US in detecting CP – Major A Criteria – calcifications in pancreatic parenchyma and in PD

The lobular structure of pancreatic parenchyma (Major B criteria) was detected in 27 (93.1%) among 29 patients with CP diagnosed with EUS. In 2 individuals (6.9%) no lobularity was seen. In the same group CT showed lobular structure of pancreatic parenchyma

in 18 cases (62.1%). US showed lobular pancreatic structure in 9 individuals (31.0%). The sensitivity and specificity of CT in detecting lobular structure of pancreas in CP was respectively 69.2 and 20.0% (NPV – 0.2; PPV – 1.0). For US the sensitivity and specificity was 33.3 and 10.0% (NPV – 0.1; PPV – 1.0) (fig. 5).

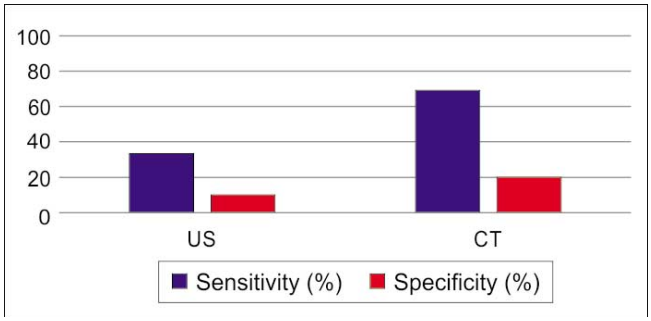

Fig. 5. The sensitivity and specificity of CT and US in detecting CP – Major B Criteria – lobular structure of pancreatic parenchyma

The dilatation or irregular PD duct (Minor criteria) in the group of 29 patients with CP was seen in EUS in 21 cases (72.4%). In the same individuals CT revealed PD irregularity or dilatation in 17 cases (58.6%). In US deformed PD was seen in 9 patients (31.0%). The sensitivity and specificity of CT for detecting PD abnormalities in CP was respectively 75.0 and 58.3% (NPV – 0.58, PPV – 0.93). The sensitivity and specificity of US for this feature was respectively 42.8 and 40.0% (NPV – 0.4; PPV – 1.0) (fig. 6).

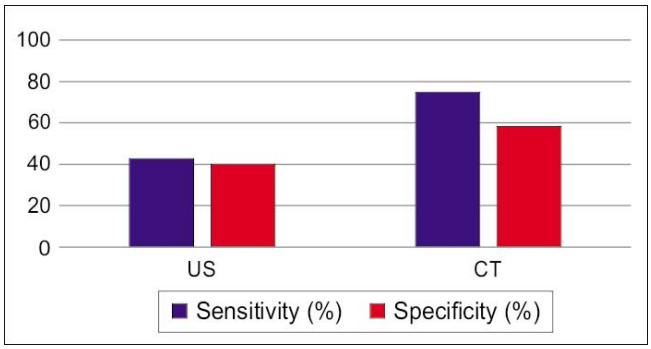

Fig. 6. The sensitivity and specificity of CT and US in detecting CP – Minor Criteria – PD irregularity

Another minor criteria – pancreatic cysts (size > 5 mm) were detected by EUS in 9 patients (31.0%) among 29 examined individuals with CP. Interestingly in the same group CT showed cysts in 12 patients (41.4%). Few patients in whom CT revealed small cysts (5-10 mm), EUS revealed dilatation of secondary pancreatic ducts. US showed pancreatic cysts in 7 individuals (24.1%). Considering EUS as a reference method in evaluating Rosemont criteria the sensitivity and specificity of CT for pancreatic cysts detection was respectively 88.9 and 93.7% (NPV – 0.93; PPV – 0.67). The sensitivity and specificity of US for this feature was 77.8 and 90.9% (NPV – 0.9; PPV – 1.0) (fig. 7).

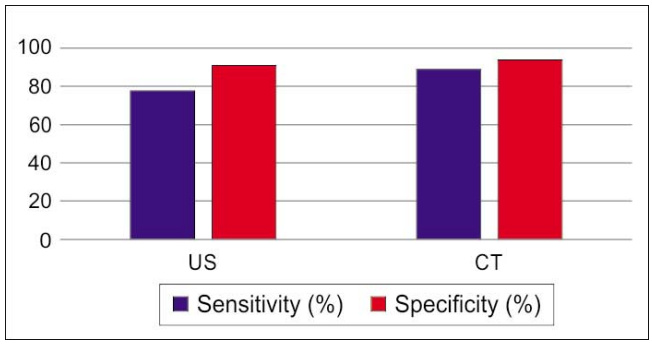

Fig. 7. The sensitivity and specificity of CT and US in detecting CP – Minor Criteria – cysts

DISCUSSION

Multiple metanalysis provide strong data regarding high sensitivity and high specificity of EUS in detecting pancreatic abnormalities (1, 2). Therefore, for the purpose of this study we decided to establish EUS a reference diagnostic method. However, lack of long term follow up of the patients might be a partial limitation of this study.

Our study showed that sensitivity of US in detecting pancreatic mass reaches 85%. According to numerous other studies US presented with 64-91% sensitivity for this feature (14, 15). The accuracy of US greatly depends on operator's skills. CT detected pancreatic masses of all sizes with 96% sensitivity. This data corresponds to the results of other authors which show 98% sensitivity of CT for detecting pancreatic masses > 2 cm (10), and 68-77% sensitivity for tumors < 2 cm (16).

We presented high sensitivity of CT (100%) and US (95%) in detecting dilation of CBD. For detecting PD dilation the sensitivity of CT was 72% and US 38%.

Literature data regarding the sensitivity of US in detecting PD and CBD dilation is limited. Yoon et al. presented results of a study evaluating secondary signs of PDAC (dilation of PD and/or CBD) in 130 patients who were examined by CT. The authors showed that the prevalence of secondary signs differed significantly according to tumor size (76% for tumors < 2 cm and 99% for larger tumors) (17). The multicenter data from 2002 showed that CT detects secondary signs in 88% cases of PDAC (18). Our data confirms high accuracy of CT for detecting dilation of CBD and PD. Additionally, presented results suggest that US has high sensitivity for evaluating CBD dilation, but low sensitivity for determining PD dilation.

The sensitivity of US and CT for diagnosing Rosemont criteria features in our study was relatively low – Major A (CT 45%, US 26%), Major B (CT 69%, US 33%), Minor – PD abnormalities (CT 75%, US 42%). The sensitivity of these methods to evaluate Minor criteria regarding the presence of cysts were higher (CT 88%, US 78%). The data comparing accuracy of US with other imaging modalities in detecting separate features of CP is not available. However, a recent metaanalysis on 3460 patients showed that the sensitivity and speci-

ficity of US for diagnosing CP reaches 67%/98% and is lower than CT – 75%/91% (19, 20). Anderson and Soto presented a study on a group of 93 patients suspected with pancreatic disease in whom portal phase contrast CT was performed. The authors showed high sensitivity – 99% in detecting calcifications in PD (21). The low sensitivity of CT in detecting pancreatic calcifications in our study results most probably from diagnosing even small calculi (> 2 mm) with shadowing in EUS. Transabdominal US is an accurate method for diagnosing CP complications such as fluid collections or pseudocysts (22). Our data presenting high sensitivity of US and CT for detecting this feature confirm findings of other authors.

CONCLUSIONS

Transabdominal US remains a first line imaging modality in pancreatic diseases. The sensitivity of this method is however limited. Negative result of US does not rule out the presence of pancreatic lesion. CT presents relatively high sensitivity in detecting pancreatic abnormalities, however is less accurate than EUS. The sensitivity of US and CT in diagnosing CP might be insufficient in comparison to EUS.

BIBLIOGRAPHY

1. Hewitt MJ, McPhail MJ, Possamai L et al.: EUS-guided FNA for diagnosis of solid pancreatic neoplasms: a meta-analysis. Gastrointest Endosc 2012; 75(2): 319-331.
2. Li JH, He R, Li YM et al.: Endoscopic ultrasonography for tumor node staging and vascular invasion in pancreatic cancer: a meta-analysis. Dig Surg 2014; 31(4-5): 297-305.
3. Kitano M, Kudo M, Yamao K et al.: Characterization of small solid tumors in the pancreas: the value of contrast-enhanced harmonic endoscopic ultrasonography. Am J Gastroenterol 2012; 107(2): 303-310.
4. Ducreux M, Cuhna AS, Caramella C et al.: ESMO Guidelines Committee. Cancer of the pancreas: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Ann Oncol 2015; 26 (suppl. 5): v56-68.
5. Lahat G, Ben Haim M, Nachmany I et al.: Pancreatic incidentalomas: high rate of potentially malignant tumors. J Am Coll Surg 2009; 209(3): 313-319.
6. Maringhini A, Ciambra M, Raimondo M et al.: Clinical presentation and ultrasonography in the diagnosis of pancreatic cancer. Pancreas 1993; 8: 146-150.
7. Karlson BM, Ekbom A, Lindgren PG et al.: Abdominal US for diagnosis of pancreatic tumor: prospective cohort analysis. Radiology 1999; 213: 107-111.
8. Lee ES, Lee JM: Imaging diagnosis of pancreatic cancer: A state-of-the--art review. World J Gastroenterol 2014; 20(24): 7864-7877.
9. Agarwal B, Abu-Hamda E, Molke KL et al.: Endoscopic ultrasound-guided fine needle aspiration and multidetector spiral CT in the diagnosis of pancreatic cancer. Am J Gastroenterol 2004; 99: 844-850.
10. Kitano M, Kudo M, Maekawa K et al.: Dynamic imaging of pancreatic diseases by contrast enhanced coded phase inversion harmonic ultrasonography. Gut 2004; 53: 854-859.
11. Shrikhande SV, Barreto SG, Goel M, Arya S: Multimodality imaging of pancreatic ductal adenocarcinoma: a review of the literature. HPB (Oxford) 2012; 14(10): 658-668.
12. Iglesias-García J, Lindkvist B, Lariño-Noia J, Domínguez-Muñoz JE: The role of EUS in relation to other imaging modalities in the differential diagnosis between mass forming chronic pancreatitis, autoimmune pancreatitis and ductal pancreatic adenocarcinoma. Rev Esp Enferm Dig 2012; 104(6): 315-321.
13. Catalano MF, Sahai A, Levy M et al.: EUS-based criteria for the diagnosis of chronic pancreatitis: the Rosemont classification. Gastrointest Endosc 2009; 69(7): 1251-1261.
14. Palazzo L, Roseau G, Gayet B et al.: Endoscopic ultrasonography in the diagnosis and staging of pancreatic adenocarcinoma. Results of a prospective study with comparison to ultrasonography and CT scan. Endoscopy 1993; 25(2): 143-150.
15. Lin JT, Wang JT, Wang TH: The diagnostic value of endoscopic ultrasonography in pancreatic disorders. Taiwan Yi Xue Hui Za Zhi 1989; 88(5): 483-487.
16. Bronstein YL, Loyer EM, Kaur H et al.: Detection of small pancreatic tumors with multiphasic helical CT. AJR Am J Roentgenol 2004; 182(3): 619-623.
17. Yoon SH, Lee JM, Cho JY et al.: Small (≤ 20 mm) pancreatic adenocarcinomas: analysis of enhancement patterns and secondary signs with multiphasic multidetector CT. Radiology 2011; 259(2): 442-452.
18. Horton KM: Multidetector CT and three dimensional imaging of the pancreas: state of the art. J Gastrointest Surg 2002; 6(2):126-128.
19. Löhr MJ, Dominguez-Munoz E, Jonas Rosendahl J et al.: United European Gastroenterology evidence-based guidelines for the diagnosis and therapy of chronic pancreatitis (HaPanEU). United European Gastroenterol J 2017; 5(2): 153-199.
20. Issa Y, Kempeneers MA, van Santvoort HC et al.: Diagnostic performance of imaging modalities in chronic pancreatitis: a systematic review and meta-analysis. Eur Radiol 2017; 27(9): 3820-3844.
21. Anderson SW, Soto JA: Pancreatic duct evaluation: accuracy of portal venous phase 64 MDCT. Abdom Imaging 2009; 34(1): 55-63.
22. Remer EM, Baker ME: Imaging of chronic pancreatitis. Radiol Clin N Am 2002; 40: 1229-1242.

received/otrzymano: 12.03.2018
accepted/zaakceptowano: 4.04.2018