Scandinavian Journal of Gastroenterology. 2014; 49: 114–120

informa
healthcare

ORIGINAL ARTICLE

Impact of endoscopic ultrasound-guided fine-needle aspiration on incidental pancreatic cysts. A prospective study

JOSÉ CELSO ARDENGH[1,2], CÉSAR VIVIAN LOPES[3], EDER RIOS DE LIMA-FILHO[4], RAFAEL KEMP[1] & JOSÉ SEBASTIÃO DOS SANTOS[1]

[1]*Division of Surgery and Anatomy, Ribeirão Preto Medical School – University of São Paulo, São Paulo, Brazil,* [2]*Endoscopy Unit, Hospital 9 de Julho, São Paulo, Brazil,* [3]*Endoscopy Unit, Santa Casa and Moinhos de Vento Hospitals, Porto Alegre, Brazil, and* [4]*Department of Surgery, University of Rio de Janeiro, Rio de Janeiro, Brazil*

Abstract

Objective. Widespread use of imaging procedures has promoted a higher identification of incidental pancreatic cysts (IPCs). However, little is known as to whether endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) could change the management strategy of patients having IPCs. This study has aimed to evaluate the management impact of EUS-FNA on IPCs. ***Material and methods.*** Patients with pancreatic cysts (PCs) who were referred to EUS-FNA were recruited prospectively. The referring physicians were questioned about the management strategy for these patients before and after EUS-FNA. The impact of EUS-FNA on management was then evaluated. ***Results.*** A total of 302 PC patients were recruited. Of these, 159 (52.6%) patients had asymptomatic IPCs. The average size was 2.3 cm (range: 0.2–7.1 cm), and 110 patients having smaller than 3 cm sized cysts. Lesions were located in the pancreatic head in 96 (61%) cases, and most patients (94%) had only a single cyst. The final diagnoses, obtained by EUS-FNA (91) and surgery (68), were 93 (58%) benign lesions, 36 (23%) cysts with malignant potential, 14 (9%) noninvasive malignancies, 10 (6%) malignant precursor lesions (PanIN), and 6 (4%) invasive malignancies. Management strategy changed significantly after EUS-FNA in 114 (71.7%) patients: 43% of the cases were referred to surgery, 44% of the patients were discharged from surveillance, and 13% of the cases were given further periodical imaging tests. ***Conclusion.*** EUS-FNA has a management impact in almost 72% of IPCs, with a major influence on the management strategy, either discharge rather than surgical resection or surgery rather than additional follow up.

Key Words: *endosonography, fine-needle aspiration, incidental finding, outcome measure, pancreatic cyst*

Introduction

Incidental pancreatic cysts (IPCs) have been much more frequently identified with the widespread use of imaging methods [1–3]. Approximately 150,000 cases of asymptomatic cysts have been reported each year in United States [4]. Because an IPC may be a malignancy precursor or even a cancer [5,6], the physician must decide between an aggressive approach and no treatment [7]. But the greatest problem is the morbidity and mortality from unnecessary surgical resection versus the risk of missing the opportunity to cure [7]. For this reason, precise diagnosis is pivotal for guiding the management of IPC patients.

Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA), in addition to detecting the pancreatic cysts (PC), has the advantage of allowing aspiration of cyst contents and sampling of cyst wall and mural nodules or vegetations in a much safer and quicker way than percutaneous sampling [5,8,9]. However, the evidence of the role of EUS-FNA in the management strategy of IPCs is currently limited and little is known as to whether this procedure actually changes patient management. The purpose of this study is to evaluate the management impact of EUS-FNA in IPC patients.

Correspondence: César Vivian Lopes, Endoscopy Unit, Santa Casa and Moinhos de Vento Hospitals, Cristiano Fischer 668/ 1001, Petrópolis, Porto Alegre, RS 91410-000, Brazil. Tel: +55 51 99628623. Fax: +55 11 50558942. E-mail: drcvlopes@gmail.com

(Received 8 October 2013; accepted 9 October 2013)

ISSN 0036-5521 print/ISSN 1502-7708 online © 2014 Informa Healthcare
DOI: 10.3109/00365521.2013.854830

Methods

Patients were always submitted to evaluation by magnetic resonance imaging (MRI) if they are diagnosed with PC by transabdominal ultrasound; however, the patients were submitted to evaluation by computer tomography (CT), if they are diagnosed with pancreatic nodule by transabdominal ultrasound. If the CT detects the presence of a PC, the next imaging procedure would be the MRI. EUS-FNA is always used after CT and/or MRI and is also used when these imaging procedures are non-conclusive.

Patients referred consecutively to EUS-FNA for PCs were recruited between August 2004 and August 2009 at two Tertiary Reference Centers (Hospital 9 de Julho and Hospital das Clínicas from Ribeirão Preto Medical School). All procedures were performed by a single experienced endoscopist (JCA). PCs were submitted to EUS-FNA, despite the presence of imaging features suggestive of malignancy, such as size >3 cm, wall thickening, and nodule or vegetation inside the cyst. Those patients who were not subjected to FNA on request by the referring physician were excluded from the study.

Routine for EUS-FNA

The EUS-FNA always followed the same routine: a sectoral echoendoscope from Pentax (FG 38-UX, Pentax Precision Instruments Corp., Orangeburg, New York, NY, USA) coupled with a Hitachi ultrasound system (EUB 515A, Mitsubishi, Conshockon, Philadelphia, PA, USA) or from Fujinon (GF 530UT, Fujinon Fujifilm Corporation, Saitama, Japan) coupled with an ultrasound system (SU-7000, Fujinon Fujifilm Corporation, Saitama, Japan) were used; the routine examination included the whole pancreas, portal vein, superior mesenteric vein, splenic vein and splenic-mesenteric confluence, superior mesenteric artery, common bile duct, main pancreatic duct, duodenal papillae and liver; all identified PCs were submitted to FNA in an attempt to diagnose the type of tumor; 19 gauge needles (GIP, Medizintechnik GmbH, Grassau, Germany) were used for cysts larger than 3 cm, 22 gauge needles were used for cysts between 1 and 3 cm and 25 gauge needles were used for cysts smaller than 1 cm; only a single needle pass was performed, and the content of the cyst was completely aspirated in an attempt to prevent contamination of the cyst; after completely emptying the cystic fluid, tissue of the wall, septa, as well as nodule or vegetations, were obtained if present; the tissue was evaluated by the microhistological technique. The fluid, in the presence of >5 cc, was sent for cytopathology evaluation and dosage of Carcinoembryonic antigen (CEA), CA19-9, and amylase levels. The upper limit of normal serum values of CEA and CA19-9 were <5 ng/ml and <37 U/ml, respectively [10,11]. The upper limit of normal serum values of CEA and CA19-9 were <5 ng/ml and <37 U/ml, respectively. Cyst fluid concentrations of CEA and CA19-9 were measured using specific radioimmunoassays: CEA was measured on an Abbott Diagnostics IMX-MEIA immunodiagnostics analyzer, and CA19-9 was measured using immunoradiometric method. Cystic levels of CEA >192 ng/ml exclude serous cystadenoma and reinforce the possibility of a mucinous lesion; in turn, levels <5 ng/ml rule out mucinous cysts and cystadenocarcinoma. For CA19-9, cystic levels <37 U/ml exclude mucinous lesions and cystadenocarcinoma, and levels >10,000 U/ml rule out serous lesions or pseudocysts. In circumstances where <5 cc fluid was aspirated, the material was sent only for cytopathology. As in our practice, we have better results for defining the precise diagnosis with our histopathology team when compared to the single CEA value analysis (data not published), and as our laboratory requires at least 2 cc of fluid for dosage of CEA, CA19-9, and amylase levels, in the presence of <5 cc of fluid we sent the material only for cytopathology evaluation. examination in the presence of <5 cc of fluid, as our pathologist requires as much liquid as possible. The criteria used for defining the lesions were the echoendoscopic pattern, already well described in the literature, as well as the results of the fluid markers and the histology of the cystic wall obtained by EUS-FNA. Every patient was administered 1 g of ceftriaxone before the puncture and was given cephalexin 500 mg b.i.d. for more than 5 days after the procedure.

Evaluation of the management impact

All referring physicians were interviewed by phone or e-mail about the management strategy of their patients before and after EUS-FNA of the IPCs. Data on the diagnosis and the influence of EUS-FNA on the management strategy was obtained by means of a questionnaire which had four questions and was conducted in two phases: before EUS (phase 1), the first question was: what was the suspected diagnosis based on the other imaging methods? The second question was: what would be the management strategy for your patient, had EUS-FNA not been available (surgery, surveillance or discharge)? After EUS-FNA (phase 2), the questions were as follows: What was the final diagnosis? What is going to be the management strategy for your patient after EUS-FNA (surgery, surveillance or discharge)?

The impact of EUS-FNA on the management of the IPCs was classified into the following categories.

Table I. Management strategy after EUS-FNA.

Management strategy	Clinical impact	Explanation
Surgery rather than surveillance	Major	The initial intention was to follow up, but surgery was performed
Discharge rather than surgery	Major	The initial intention was to resect, but patient was discharged
Surveillance rather than surgery	Minor	The initial intention was to resect, but patient was followed up
Discharge rather than surveillance	Minor	The initial intention was to follow up, but patient was discharged
Surveillance to surveillance	No change	Management strategy in favor of surveillance was not modified
Surgery to surgery	No change	Management strategy in favor of surgery was not modified

EUS-FNA: Endoscopic ultrasound-guided fine-needle aspiration.

First, the major clinical impacts were: surgery rather than surveillance. The initial trend would be surveillance, but in the presence of a malignant and/or potentially malignant lesion, detected by EUS-FNA, surgery would be the therapeutic option; and discharge rather than surgery. However, if imaging studies suggested that the IPC was a potentially resectable lesion, but EUS-FNA revealed a benign lesion, surveillance would not be necessary. Second, the minor clinical impacts were: surveillance rather than surgery; the initial trend would be to resect the cyst, but if the EUS-FNA detected a side-branch Intraductal papillary mucinous neoplasm (IPMN), surveillance would be the best option; and discharge rather than surveillance. The patient would be under surveillance, but if the EUS-FNA confirmed a benign lesion, surveillance would be unnecessary. Finally, the events where EUS-FNA would not change the management strategy were: surveillance to surveillance and surgery to surgery (Table I).

Statistical analysis and informed consent

Sensitivity, specificity, positive and negative predictive values, and accuracy of EUS-FNA for diagnosis of IPCs by analysis of the specimens using microhistological technique were obtained. After the reasons for this study and the risks of the endoscopic procedure were explained, all patients signed a consent form used by the Endoscopy Unit of Hospital 9 de Julho and Hospital das Clínicas from Ribeirão Preto Medical School.

This study was approved by the Ethics Committee of both institutions. The protocol of this study follows the parameters and ethical rules established by the Declaration of Helsinki of World Medical Association, which regulates ethical principles involving medical research on humans.

Results

Patient demographics

We recruited consecutively 334 patients with PCs between August 2004 and August 2009. Thirty-two patients not subjected to FNA on request by the referring physicians were excluded from the study. EUS-FNA was performed in the remaining 302 cases. At the conclusion of the study, the mean follow up was 29.1 (16–45) months. PCs were asymptomatic in 159 (52.6%) cases. The most common clinical settings of IPCs were genitourinary disease (29%), abnormal liver function tests (18%), and periodical medical checkup (16%). Demographics of these 159 asymptomatic patients are provided in Table II. Cell block was obtained for all cases, and cytology was obtained for a smaller group of patients. The diagnoses of the lesions were as follows: benign lesions were found in 93 (58%) patients, cysts with malignant potential in 36 (23%) cases, noninvasive malignancies in 14 (9%), malignant precursor lesions (PanIN) in 10 (6%), and invasive malignancies were found in 6 (4%) cases. Table III presents the results of microhistology analysis of the specimens obtained by EUS-FNA and histology of the surgical specimens.

Diagnostic performance of EUS-FNA

The final diagnosis was obtained by EUS-FNA in 88 cases, whereas other 68 underwent surgery after EUS-FNA and three were not submitted to FNA because endoscopic ultrasound revealed a vascular malformation mimicking PCs in two cases, and a duodenal duplication cyst in one patient. The diagnostic capability of the microhistology obtained by EUS-FNA was based on 156 patients, excluding a duodenal duplication cyst and two cases of vascular malformation, none of them submitted to surgery. EUS-FNA confirmed the diagnoses of the lesions with malignant potential, noninvasive malignancies, malignant precursors lesions, and invasive malignancies in 52 of 66 (78.8%) cases. EUS-FNA confirmed a benign PC in 88 of 90 (97.8%) cases. For 24 cases of serous cystadenomas confirmed by surgery, EUS-FNA revealed serous cystadenomas in 11 cases and a neuroendocrine tumor in one case. In nine cases, FNA detected benign cells, but it was not possible to establish the final diagnosis, and three other cases did not have enough material for analysis. None of the

Table II. Demographics of IPC patients.

	Incidental cysts	Surgery	No surgery
n (%)	159	68 (42.7)	91 (57.3)
Female (%)	118 (75%)	51 (32)	67 (42.1)
Age (mean + SD) (years)	57.2 + 15 (15–86)	57.8 + 15 (15–84)	56.9 + 15 (15–86)
Cyst location			
Head/uncinate	97 (61%)	32 (20%)	65 (41%)
Body	50 (31%)	26 (16%)	24 (15%)
Tail	12 (8%)	10 (6%)	02 (1%)
>1 site	10 (6%)	07 (4%)	03 (2%)
Size of lesion (cm)			
>3	46 (29%)	20 (13%)	26 (16%)
<3	113 (71%)	48 (30%)	65 (41%)
Mural nodule or mass	29 (18%)	21 (13%)	8 (5%)
Cyst size (mean + SD)	2.3 + 1.2 (0.2–7.2)	2.4 + 1.3(0.2–7.2)	2.2 + 1.2 (0.4–7.2)
Biochemical analysis	77 (48%)	35 (22%)	42 (26%)
CEA (mean + SD) (range)	81 + 116 (0.2–543)	97 + 143 (0.2–543)	69 + 85 (0.3–387)
CA19-9 (mean + SD) (range)	4.2 + 18,830 (0.1–159,400)	2.15 + 5,587 (0.3–25,632)	5.86 + 24,850 (0.1–159,400)
Amylase (mean + SD) (range)	10.68 + 26,428 (12–168,570)	8.20 + 20,608 (38–86,828)	12.80 + 30,283 (12–168,570)

IPC: Incidental pancreatic cysts.

24 cases in which the surgery confirmed serous cystadenomas had the benign diagnoses previously suggested by CT and or MRI. The sensitivity, specificity, positive and negative predictive values, and accuracy, with their respective 95% confidence intervals, were 78.8% (68.9–88.7%), 97.8% (94.8–100%), 96.3% (91.3–100%), 86.3% (79.8–93%), and 89.7% (85.1–94.5%), respectively. There were three minor complications (acute pancreatitis) after EUS-FNA but not related to the needle size. All these cases were treated conservatively.

Influence of EUS-FNA on management strategy of IPCs

Information was obtained whether the management strategy of IPCs was modified after EUS-FNA. The management was altered in 114 of 159 (71.7%) patients as follows: 68 (43%) patients were referred to surgery, 70 (44%) patients were discharged from additional follow up, and 21 (13%) patients were planned for surveillance through imaging methods. Surgical complications after resection of the cysts occurred in three cases – a gastric fistulae after eight surgical interventions due to bleeding; a pancreatic fistulae; and a pseudocyst after distal pancreatectomy, all of them treated successfully.

Concerning the 24 serous cystadenomas subjected to surgery, the management until surgery had been the periodical surveillance by CT and/or MRI for seven of these cases because these lesions had no radiological evidence for malignancy. After EUS-FNA, surgery was the option for mass-related symptoms in three patients (all of these cases confirmed as a benign lesion by EUS-FNA); for cystic levels of CA19-9 >10.000 U/dl in three patients, of which EUS-FNA detected a benign lesion in two cases, and was non-contributive in one case; and for a single case in which EUS-FNA revealed a neuroendocrine tumor. The therapeutic intention before EUS-FNA was the surgical resection in the remaining 17 cases, and this intention was not changed after EUS-FNA. In fact, EUS-FNA reinforced the option of surgery in 7 of 17 (41.4%) cases in which cystic levels of CA19-9 were >30.000 U/dl (two cases), and in five cases with mass-related symptoms. Surgeon and patients preferred surgery in the other 10 cases.

In regard to the long-term follow up for the cysts considered benign by the EUS, none of these cases evolved to malignancy. Only one case of serous cystadenoma detected by EUS presented a complication (acute pancreatitis), and this patient was treated with periodical alcoholization of the cyst due to lack of clinical conditions for surgical resection.

There was a major management impact of IPCs in 77 of 159 (48.4%) patients submitted to EUS-FNA, a minor impact occurred in 37 of 159 (23.3%) cases, and there was no change on management strategy in 45 of 159 (28.3%) cases (Table IV).

Discussion

EUS-FNA is a very useful tool in the evaluation of PCs [11]. It provides detailed characteristics of the lesions, including the thickness of the wall, the presence of *septae*, nodules, and debris, and allows for the sampling of their fluid and solid components [7]. It can also identify other lesions in the whole pancreas, the presence of lymph nodes, and the vascular involvement [12]. In our experience, EUS-FNA obtained fluid and solid specimens in all cases. In

Table III. Final diagnosis and management of 159 IPC patients.

Diagnosis	Incidental cyst (159)	Surgery (68)	No surgery (91)
Benign lesions	93 (58%)	26[§] (16.3%)	67 (42.1%)
Serous cystadenoma	51	24	27
Simple cyst	22	1	21
Pseudocyst	6	0	6
Chronic pancreatitis	4	0	4
Pancreatic tuberculosis	2	0	2
Retention cyst	2	0	2
Vascular lesion mimicking PC*	2	0	2
von Hippel–Lindau disease	2	0	2
Duodenal duplication cyst *	1	0	1
Lymphoepithelial cyst	1	1	0
Lesions with malignant potential	36 (23%)	19 (11.9%)	17 (10.6%)
IPMN with adenoma	29	14	15
Mucinous cystadenoma	4	2	2
Pancreatic endocrine tumor	2	2	0
Solid pseudopapillary tumor	1	1	0
Noninvasive malignances	14 (9%)	14 (8.8%)	0 (0%)
IPMN with ca *in situ*	4	4	0
Mucinous cystadenoma with ca *in situ*	10	10	0
Malignant precursor lesions	10 (6%)	6 (3.7%)	4 (2.5%)
PanIN 1	7	3	4
PanIN 2	2	2	0
PanIN 3	1	1	0
Invasive malignancies	6 (4%)	3 (1.8%)	3 (1.8%)
Invasive IPMN	5	2	3
Cystadenocarcinoma	1	1	0

*These cases were not submitted either to FNA or to surgery.
[§]The option for surgery in benign cysts was due to patients and/or surgeons preference, despite the diagnoses of the lesions in 66% of the cases, cyst size >3 cm in 24% of the cases, elevated cystic levels of CA19-9 in 5% of the patients, and diagnostic error of the endoscopic ultrasound in 5% of the cases.
IPC: Incidental pancreatic cysts.

regard to the amount of fluid, there was liquid for biochemical and cytopathological analyses in 48% of the patients, and for the other 52% of the patients the fluid was enough only for cytopathology. FNA was not performed in three patients who had lesions mimicking PCs (two vascular lesions and one duodenal duplication cyst).

EUS has the ability to provide more detailed morphological information of IPCs compared with current cross-sectional imaging methods. In particular, demonstration of solid components, invasion outside the pancreatic borders, or obstruction of the pancreatic duct are highly suggestive of malignancy [7,8]. However, in the absence of these features, the ability of EUS imaging alone to diagnose malignancy is limited, with an overall sensitivity, specificity, and accuracy of, 56%, 45%, and 51%, respectively [7]. In the study by Ferrone et al. [7], the sensitivity, specificity, and positive and negative predictive values of EUS imaging to distinguish benign from (pre)malignant PCs were 50%, 56%, 36%, and 54%, respectively. In spite of these figures not being so optimistic, the sensitivity of EUS-FNA with cell block technique for diagnosis of PCs was 72% [13]. In our experience, EUS-FNA was performed in 99% of patients with IPCs, and solid components for microhistology analysis were obtained in all patients. The sensitivity, specificity, and positive and negative predictive values of EUS-FNA to distinguish benign from (pre) malignant PCs were 78.8%, 97.8%, 96.3%, and 86.3%, respectively. These results are similar to those of Aljebreen et al. [11], where the sensitivity, specificity, positive and negative predictive values of EUS cytology to distinguish benign from (pre)malignant PCs were 71%, 96%, 92%, and 85%, respectively. These authors concluded that the cytology is a very useful tool in distinguishing benign from (pre)malignant PCs, and in our experience the cell block technique with microhistology analysis presented similar results.

In regard to the influence of EUS-FNA on the management strategy of IPCs, our study demonstrated that EUS-FNA caused a change in the management strategy in almost 72% of asymptomatic cysts, and this rate was higher when compared to the prospective and retrospective studies published, respectively, by Allen et al. [2] and Ferrone et al. [7], in which EUS influenced the management in 40% of incidentally found cysts. It is important to highlight that these studies were analyzed using only morphological features obtained by EUS. On the other hand, our study analyzed not only the morphological features but also the combination of biochemical and pathological results obtained by FNA. This way, EUS-FNA added important clues to correctly identify several types of PCs and, as a consequence, contributed to the choice of the best management for every patient. Among the trials in which EUS changed the management [2,7], a major impact on the management was found in 49% of the cases, although in the study by Ferrone et al. [7], most cases had been submitted to surgery rather than to surveillance, which was the same for 21% of our cases, and in the experience by Allen et al. [2], most cases had been discharged rather than submitted to surgery, which occurred in 28% of our patients.

Once identified as an IPC, some important aspects should always be raised: is the IPC in the head of the pancreas? is it larger than 3 cm? is the cyst communicating with the main pancreatic duct? are there septa, nodule, or vegetation? and what is the age and gender of the patient? All these factors should

Table IV. Changes on management strategy of IPCs after EUS-FNA.

Management	Impact	*n*
Discharge rather than surgery*	Major impact	44 (27.6%)
Surgery rather than surveillance	Major impact	33 (20.7%)
Discharge rather than surveillance	Minor impact	26 (16.3%)
Surveillance rather than surgery	Minor impact	11 (6.9%)
Surgery to surgery	No change	35 (22%)
Surveillance to surveillance	No change	10 (6.5%)

* Two vascular lesions and a duodenal duplication cyst mimicking PCs were not submitted to EUS-FNA.
EUS-FNA: Endoscopic ultrasound-guided fine-needle aspiration; IPC: Incidental pancreatic cysts.

be analyzed before deciding the best management strategy for every patient. Imaging findings based only on CT or MRI can be controversial, because the capacity of these methods to properly characterize IPCs remains poor and ranges between 25% and 30% [14–16]. More recently, magnetic resonance cholangiopancreatography (MRCP) is an imaging method which allows more detailed characterization of PCs, including size, septa, calcifications, mural nodules, and communication with the main pancreatic duct. Even though with better results when compared to CT/MRI, it is still lacking the comparative studies with EUS-FNA, but it is not probable that an imaging method alone will be as accurate as a method which gives us the possibility to sample fluid and tissue from the cysts. However, MRCP is the cross-sectional imaging method of choice to characterize the pancreatic duct and communication between the cyst and the ductal system, which is important for differentiating mucinous cystic neoplasia from intraductal papillary mucinous neoplasia [8].

Despite the role of EUS-FNA for the diagnosis of PCs, physicians often face a difficult situation, in which they hesitate to select between two invasive methods (i.e., surgery and EUS-FNA) for characterization of IPCs. As we could see in our experience, EUS-FNA provides additional information in diagnosing PCs and, by this way, the method may guarantee physicians to take the best decision — whether to go for surgery or not [17].

Our study defined six occurrences which might be appreciated for the decision-making of IPC patients. The two major changes on management strategy occurred in 77 of 159 (48.4%) patients. The initial tendency was to resect in 44 (27.6%) patients, but EUS-FNA defined that neither surgery nor follow up would be necessary due to the confirmation of a benign process. Other 33 (20.7%) cases, in which the initial trend was to keep patients under surveillance, were submitted to surgery for (pre)malignant cysts. Minor impact on management was found in almost a quarter of these patients (37 of 159 [23.3%]). Cases in which follow up was no more necessary accounted for 16.3% (26 of 159), and 6.9% (11 of 159) cases, in which the initial trend was to submit to surgery, were kept under surveillance due to side-branch IPMNs. Last, EUS-FNA did not modify the initial management strategy in 45 (28.3%) IPCs, 35 (22%) patients were sent to surgery, and other 10 (6.5%) cases were kept under imaging surveillance.

In this study, EUS-FNA showed false-negative results in 14 cases, and, as a consequence, the management was changed from surveillance to surgical treatment in 5 cases, and from surgery to surveillance in 3 patients. These latter three cases resulted in a detrimental surveillance, and patients lost the opportunity of curative resection. Other six cases did not change their management strategy (surgery to surgery [4]; surveillance to surveillance [2]). The negative predictive value of EUS-FNA was high but not 100%. Therefore, it is still necessary to carefully deal with a negative result for (pre)malignant cysts. EUS-FNA results were false-positives in two patients. FNA revealed a pancreatic endocrine tumor and the histology of the surgical specimen revealed a serous cystadenoma in one patient. In the other case, EUS imaging showed a simple cyst, which disappeared in a controlled EUS some months later, though FNA had revealed a side-branch IPMN.

In conclusion, EUS-FNA is useful for a better characterization of PCs and a decision-making tool for the management of IPCs. This prospective study shows that the method made a significant change on management strategy of over 70% of patients with IPCs – almost 50% of them with a major impact, either the option for surgical resection or discharge from additional surveillance.

Declaration of interest: The authors declare that they do not have any financial and personal relationships with other people or organizations that could influence the results of this work. The acquisition of the needles for the patients of this study was supported by the Foundation Waldemar Barnley Pessoa.

References

[1] Fernandez-del Castillo C, Targarona J, Thayer SP, Rattner DW, Brugge WR, Warshaw AL. Incidental pancreatic cysts: clinicopathologic characteristics and comparison with symptomatic patients. Arch Surg 2003;138:427–33.

[2] Allen PJ, D'Angelica M, Gonen M, Jaques DP, Coit DG, Jarnagin WR, et al. A selective approach to the resection of cystic lesions of the pancreas: results from 539 consecutive patients. Ann Surg 2006;244:572–82.

[3] Brugge WR. Diagnosis and management of relapsing pancreatitis associated with cystic neoplasms of the pancreas. World J Gastroenterol 2008;14:1038–43.
[4] Singh M, Maitra A. Precursor lesions of pancreatic cancer: molecular pathology and clinical implications. Pancreatology 2007;7:9–19.
[5] Sachs T, Pratt WB, Callery MP, Vollmer CM. Jr. The incidental asymptomatic pancreatic lesion: nuisance or threat? J Gastrointest Surg 2009;13:405–15.
[6] Fernandez-del Castillo C, Warshaw AL. Cystic tumors of the pancreas. Surg Clin North Am 1995;75:1001–16.
[7] Ferrone CR, Correa-Gallego C, Warshaw AL, Brugge WR, Forcione DG, Thayer SP, et al. Current trends in pancreatic cystic neoplasms. Arch Surg 2009;144:448–54.
[8] Edirimanne S, Connor SJ. Incidental pancreatic cystic lesions. World J Surg 2008;32:2028–37.
[9] van der Waaij LA, van Dullemen HM, Porte RJ. Cyst fluid analysis in the differential diagnosis of pancreatic cystic lesions: a pooled analysis. Gastrointest Endosc 2005;62: 383–9.
[10] Ardengh JC, Lopes CV, de Lima LF, Venco F, Santo GC, Begnami MD, et al. Cell block technique and cytological smears for the differential diagnosis of pancreatic neoplasms after endosonography-guided fine-needle aspiration. Acta Gastroenterol Latinoam 2008;38:246–51.
[11] Aljebreen AM, Romagnuolo J, Perini R, Sutherland F. Utility of endoscopic ultrasound, cytology and fluid carcinoembryonic antigen and CA 19-9 levels in pancreatic cystic lesions. World J Gastroenterol 2007;13:3962–6.
[12] Ardengh JC, Malheiros CA, Pereira V, Coelho DE, Coelho JF, Rahal F. Endoscopic ultrasound-guided fine-needle aspiration using helical computerized tomography for TN staging and vascular injury in operable pancreatic carcinoma. JOP 2009;10:310–17.
[13] Ardengh JC, Lopes CV, de Lima LF, de Oliveira JR, Venco F, Santo GC, et al. Diagnosis of pancreatic tumors by endoscopic ultrasound-guided fine-needle aspiration. World J Gastroenterol 2007;13:3112–16.
[14] Le Borgne J, de Calan L, Partensky C. Cystadenomas and cystadenocarcinomas of the pancreas: a multiinstitutional retrospective study of 398 cases. French Surgical Association. Ann Surg 1999;230:152–61.
[15] Curry CA, Eng J, Horton KM, Urban B, Siegelman S, Kuszyk BS, et al. CT of primary cystic pancreatic neoplasms: can CT be used for patient triage and treatment ? Am J Roentgenol 2000;175:99–103.
[16] Planner AC, Anderson EM, Slater A, Phillips-Hughes J, Bungay HK, Betts M. An evidence-based review for the management of cystic pancreatic lesions. Clin Radiol 2007;62:930–7.
[17] Pausawasdi N, Heidt D, Kwon R, Simeone D, Scheiman J. Long-term follow-up of patients with incidentally discovered pancreatic cystic neoplasms evaluated by endoscopic ultrasound. Surgery 2010;147:13–20.