
BIOPHYSICS AND BIOCHEMISTRY

Analysis of Elastase 1 for Evaluation of Excretory Function of the Pancreas after Gastropancreatoduodenal Resection

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The level of elastase 1 in feces was markedly decreased in all patients with tumors of the pancreatic head or its involvement before and after gastropancreatoduodenal resection and was close to normal in patients with retroperitoneal tumors not invading the pancreas. Serum elastase 1 concentrations were virtually the same in patients, normal subjects, and patients without signs of pancreatic involvement. The presence of elastase 1 in feces reflects adequate function of the pancreato-digestive anastomosis, while low concentrations of the enzyme indicate impaired function of the pancreas, presumably because of operation trauma and tumor process. Measurement of elastase 1 in feces is a highly informative and specific test for evaluation of pancreatic function in patients with pancreatic tumors, which can be used in clinical practice.

Key Words: *exocrine function of the pancreas; gastropancreatoduodenal resection; pancreatic elastase 1*

Pancreatoduodenal resection, the only operation ensuring radical removal of the tumor in the biliopancreatoduodenal zone, is a highly traumatic intervention. The pancreas is extremely sensitive to surgery and its status determines the immediate and delayed results of treatment; clinical signs of pancreatic exocrine insufficiency are observed in more than half of patients.

The exocrine function of the pancreas can be evaluated by direct (secretin-pancreozymin test) and indirect methods (serum pancreolauryl test, fecal tests for chemotrypsin and pancreatic elastase 1) [2,6,7].

Measurement of pancreatic elastase 1 (E1) is a simple and highly sensitive and specific test for evaluation of the pancreatic secretory function, close to the "golden standard" (secretin-pancreozymin test) [1,3,5]. The enzyme is produced by acinar cells and is not destroyed in the intestine, therefore its concentration in feces adequately reflects the exocrine function

of the pancreas. Measurements of serum E1 are used for the diagnosis of acute pancreatitis, because during inflammatory processes in the pancreas the enzyme in high concentrations appears in the circulation.

There are virtually no published reports about E1 level in patients with cancer involving the pancreas. Since the excretory function of the pancreas can be impaired by both tumor process and gastropancreatoduodenal resection (GPDR), we measured E1 concentrations in the serum and feces before and after surgery.

MATERIALS AND METHODS

The study was carried out in 24 patients after GPDR for cancer of the pancreatic head, major duodenal papilla, duodenum, and distal choledochus involving the pancreatic head and in 1 patient, who undergone the same surgery for malignant paraganglioma. Pancreato-digestive anastomoses were formed at the reconstructive stage of the operation in all patients. The serum and fecal concentrations of E1 were measured before

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and 14 days after surgery in 5 patients and 14 days to 10 years after the operation in 20 patients. By the moment of E1 measurement ultrasonic and computer-assisted tomography of the pancreatic stump showed normal structure of the gland. For comparison E1 concentrations were measured in the blood and feces of 5 normal subjects and 17 patients with mammary gland pathologies and retroperitoneal tumors not involving the viscera, without pancreatic diseases by the moment of examination.

The concentration of pancreatic E1 was measured using ScheBo Pancreatic Elastase 1 Stool Test (coprological test) and Schebo Pancreatic Elastase 1 Serum Test (serum test) (ScheBo Tech). The test systems are based on the direct two-step enzyme immunoassay with double monoclonal antibodies. The detection was carried out on an ELx-800 automatic reader (Bio-Tek Instruments). Quantitative estimation of results of E1 measurements in feces was carried out with consideration for the weight of the sample (100 mg) and volume of buffer for extraction (10 ml), the final concentration of the enzyme was expressed in $\mu\text{g/g}$ feces. Normal values of E1 in accordance with the manufacturer's recommendations were <3.5 ng/ml for the serum and >200 $\mu\text{g/g}$ for feces.

The results were statistically processed using Statistica 5.11 software with calculation of the mean and its error. The significance of differences was evaluated using Student's test, the differences were considered significant at $p < 0.05$.

RESULTS

Analysis of E1 in the serum and feces of 5 healthy controls and 17 cancer patients without pancreatic involvement showed that the enzyme concentrations in general were within the normal range (Table 1). These data indicate preserved function of the pancreas in healthy subjects and cancer patients without pancreatic involvement.

Analysis of E1 values in patients with pancreatic involvement showed that the exocrine function of the gland was suppressed in primary tumors or dissemination of the tumor process to the gland. The level of E1 in feces in all patients subjected to GPDR for cancer of the biliopancreatoduodenal zone decreased compared to the control at different terms after surgery (Table 1). In 4 patients with malignant involvement of the pancreatic head, in whom coprological tests were carried out in dynamics, the level of E1 was virtually the same before and after surgery (18.6 ± 0.9 and 17.5 ± 0.2 $\mu\text{g/g}$, respectively). These data indicate that the initial inhibition of the pancreatic function was caused by dissemination of the tumor to the gland head.

The results of coprological test in a patient operated on for malignant paraganglioma situated closely to the pancreatic head but not invading it (according to postoperation histological data), in whom a pancreoenteric anastomosis was created, are of particular interest. The level of E1 in feces was close to normal (167 $\mu\text{g/g}$), which indirectly confirmed adequate function of the pancreas before and after surgery and normal function of anastomosis.

In all patients measurements of serum E1 with pancreatic involvement showed no signs of acute pancreatitis (Table 1).

It is noteworthy that the quality of life after pancreatoduodenal resection depends largely on adequate function of resected organs and on how physiologically the reconstruction was performed. According to previous report [4] evaluation of the pancreatic function after pancreatoduodenal resection showed that surgical trauma is the main cause of pancreatic insufficiency. There are data that the production of the pancreatic juice drops 2-fold during the immediate period after GPDR in comparison with secretion during the same periods after pylorus- and duodenum-sparing resections of the pancreas [8]. In our study the patients were subjected to GPDR, and therefore it was important to evaluate the effect of surgical and reconstruction methods and the secretion composition on the immediate results of GPDR.

Our data indicate adequate functioning of the pancreato-digestive anastomosis, because coprological tests showed E1 in different concentrations in all patients irrespective of the location of the primary focus and dissemination of the tumor process and of the type of anastomosis. Since one of our patients was subjected to GPDR for a tumor not associated with the pancreas and his postoperative level of E1 was close to normal, we believe that insufficient exocrine function of the pancreas after GPDR in patients with biliopancreatoduodenal cancer is determined by tumor process, rather than surgical injury. In accordance with

TABLE 1. E1 Concentrations in Serum and Feces of Patients with Pancreatic Cancer after GPDR and in Healthy Controls ($\bar{X} \pm m$)

Group	E1 concentration	
	serum, ng/ml	feces, $\mu\text{g/g}$
Control	0.74 ± 0.09 (0.51-1.95)	624.5 ± 44.2 (235.1-854.3)
Patients	0.63 ± 0.03 (0.47-1.01)	$28.6 \pm 4.6^*$ (16.1-85.0)

Note. $*p < 0.001$ compared to the control. The range of values is shown in parentheses.

the findings of coprological test and severity of clinical manifestations of pancreatic excretory insufficiency, all patients received therapy including enzymes during the postoperation period, which improved the quality of their life.

Hence, coprological test for E1 is a specific and highly informative indicator of the exocrine function of the pancreas and can be used for evaluation of pancreatic status in patients after GPDR.

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