**ON THE POSSIBILITY OF USING THE ULTRASONIC ELASTOGRAPHY BY SHEAR WAVE FOR THE DIAGNOSTICS OF CHRONIC PANCREATITIS**

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**Key words:** diagnostics of chronic pancreatitis, elastography, shear wave, pancreas, fecal elastase

**Introduction.** Chronic pancreatitis (CP) can be confidently attributed to the number of diseases related to the so-called "diseases of civilization" [1, 8]. All researchers in this field have noticed a steady increase in CP patients, the number of which has almost doubled in the past 25 years. CP is currently developing at the average in 1 per 10,000 population [4], making up 5-9% in the structure of the overall incidence of digestive organs [2, 5]. In addition to the digestive disorders, CP represents a serious problem for the patient in connection with possible serious complications. So, it leads almost every tenth patient to the diabetes, and every twentieth ― to the pancreatic cancer [3, 4, 10]. It should be added that CP often causes organ fibrosis [7, 9], which brings the possibility of CP cure to almost nothing [6, 11]. It is obvious that only early detection of disease may contribute to the full and high-quality treatment aimed at the preventing organ fibrosis.

It must be recognized that CP diagnostics using ultrasound diagnostics (USD) is ineffective. Only with the recent introduction of new technology ― ultrasound elastography and elastometry based on measuring the rate of movement in the tissues of shear waves (ESW), professionals acquired a real tool capable of moving this issue forward.

**Aim of research** is to determine the diagnostic capabilities of the elastometry of pancreatic parenchyma in patients with CP, to identify regularities of changes in the pancreatic tissue stiffness depending on the degree of the organ’s exocrine function disorder.

**Materials and methods.** In order to pursue the given objectives we examined 102 patients (47 men and 55 women) with clinical, instrumental and laboratory-confirmed CP in remission. Study did not include the results of a survey of patients with combined pathology of pancreas (diabetes of various types, pseudotumor changes, evident pancreatic lipomatosis and obesity).

Age of the examined patients ranged from 28 to 73 (mean age 43±5 years). Duration of disease was from 3 to 22 years (at the mean 8±2.5 years). Depending on the severity of violations of exocrine pancreatic function, all the patients were divided into three groups: group 1 (27 patients) with normal exocrine function (elastase level more than 200 mcg/g); group 2 (65 patients) with a moderately reduced exocrine function (elastase level of 100 to 200 mcg/g); group 3 (10 patients) with an evident decrease of exocrine function (elastase level less than 100 mcg/g).

Control group consisted of 30 persons (15 men and 15 women) with normal clinical and laboratory data. The mean age of the control group was 33±2.5 years. All the patients in the control group had the elastase level of more than 300 mcg/g. Indicator of the pancreatic amylase averaged 16.7±1.2 U/L, lipase ― 27.5±0.9 U/L.

Assessment of exocrine pancreatic function was carried out by determining the fecal elastase by ELISA on the analyzer Digi Scan. Biochemical studies (including analysis of pancreatic enzymes: total and pancreatic amylase and serum lipase levels) were conducted on the apparatus ASCA AG II (automatic biochemical analyzer) and Humalyser 2000 (semi-automatic biochemical analyzer). 14 patients additionally underwent endoscopic ultrasound examination. All patients underwent computed and magnetic resonance imaging of the pancreas.

Ultrasonography, elastography and pancreatic parenchyma elastometry were carried out on the ultrasound scanner Aixplorer using broadband convex sensor 6-1 MHz. Echographic examination of the pancreas was performed according to the standard procedures, in the morning, on an empty stomach, without any special preparations. When conducting ESW, color scale was in the range of 0-40 or 0-70 kPa. Q-box (measuring area) with diameter 6-8 mm was used. Pancreatic elastography and elastometry were carried with the patient supine during quiet breathing with moderate sensor compression on the abdominal wall.

Statistical analysis was conducted with the use of the software package "Microsoft Excel 2003". Statistical processing of the results determined M ― arithmetic mean value, m ― arithmetic average of the error. Comparison of indicators was performed by means of Student t-test.

**Results.** USD in the control group demonstrated no abnormal enlargement of the pancreas in any of the observations. Expressed contour irregularities of the pancreas were not noted, 8 (26.7%) patients had not clear enough organ contour. In 21 (70%) patients pancreatic echostructure was homogeneous, echogenicity was not changed. In 9 (30%) cases there was a slight increase in the pancreatic parenchyma echogenicity without violating the homogeneity; in 5 (16%) ― structure inhomogeneity occurred along with increased echogenicity. Wirsung’s duct extension was not observed. Upon elastometry in the control group, pancreatic tissue stiffness ranged in all 30 examined persons, not exceeding 6.3 kPa, and averaged 5.1±0.2kPa (Fig. 1).

USD in group 1 revealed normal size of the pancreas in all 27 patients, but various increased parenchymal echogenicity along with heterogeneity of structure was detected. 8 (29.6%) patients were reported to have blurred contours of the organ. Wirsung’s duct extension was not observed.

Size of the pancreas was also normal in group 2. However, 49 (75.3%) patients had already had blurred contours and roughness, heterogeneity and increased echogenicity of the structure of the pancreas. Wirsung’s duct extension was not observed too.

In group 3, 6 (60%) patients had sonographic changes in the pancreas not differing from pancreatic echopicture of group 2 ― normal size, contour irregularities, increased echogenicity and heterogeneity of the structure. 4 (40%) patients had expressed hyperechogenic structure and contour irregularities, reducing size of the pancreatic head to 11.2±0.4 mm, body ― to 7.6±0.2 mm, tail ― to 6.2±0.2 mm. None of the patients in group 3 had Wirsung’s duct enlarged.

Patients with CP had increasing tissue stiffness index upon elastometry as exocrine function was decreasing (Table 1).

Table 1

**Stiffness of pancreatic parenchyma depending on the severity of reduction of exocrine function**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Groups of CP patients** | **Total** | **Elastase level, mcg/g**  **(M±m)** | **Stiffness level,**  **kPa**  **(M±m)** | **Reliability the difference of results assessment** |
| Group 1 with normal exocrine function | 27 | More than 200 | 7, 8±0,34 | Between control group and group 1  P<0,001 |
| Group 2 with slightly decreased exocrine function | 65 | From 100 to 200 | 10,6±0,46 | Between groups 1 and 2  P<0,01 |
| Group 3 with moderately decreased exocrine function | 10 | Less than 100 | 16,3±0,63 | Between groups 3 and 2  P<0,01 |

Thus, pancreatic tissue stiffness indices did not exceed at the average 7.8±0.34 kPa in patients of group 1 (Fig. 2). The average index was 10.6±0.46 kPa in group 2 (Fig. 3), and 16.3±0.63 kPa in patients of group 3 (Fig. 4). Statistical analysis showed a significant difference of pancreatic stiffness assessment results in control group and group 1 (P<0.001), and also a significant difference upon the comparison of the pancreatic parenchyma stiffness average index in groups 1 and 2 (P<0.01), and in groups 2 and 3 (P<0.01).

**Discussion.** Therefore, we identified certain connection between the change of exocrine pancreatic function and the change (increasement) of organ’s elastometric stiffness (density). At the same time, follow-up research in the dynamics should be conducted to establish the most accurate result. Obvious correlation of echographic and elastographic data was not received.

Correlation of increasing pancreatic parenchyma stiffness and severity of violations of its exocrine function, which was identified during the study, gives us reason to hope that sonographers acquired a new ultrasound method for assessing the state of the organ. Certainly, further research is needed to show the real ESW effectiveness in everyday clinical practice, but it became apparent that sonographer’s conclusion "chronic pancreatitis" first starts to be based on the objective data.

**Conclusions.** Using the new ESW method revealed statistically significant correlation between increased pancreatic parenchyma stiffness indices and severity of violations of its exocrine function, pointing out the possibility of an objective USD assessment of CP.

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Examination of the pancreas with the use of elastography by shear wave was conducted in 102 patients with confirmed chronic pancreatitis. It’s the first time the correlation between the degree of exocrine pancreatic dysfunction and increasing stiffness of its parenchyma has been studied. Elastometry and standard echography data have been compared. As a result, we obtained significantly valid (P<0.001) difference between stiffness of pancreatic tissue in normal state and upon various types of course of chronic pancreatitis: in the control group ― 5,0±1.1 kPa; in patients with normal exocrine function ― 7,8±1.3 kPa; in patients with slightly reduced exocrine function ― 10,6±1,4 kPa; in patients with a moderate reduction in exocrine function ― 16,3±2,6 kPa. Obvious correlation between echographic and elastographic data wasn’t obtained.

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Fig. 1. Pancreatic ESW. Patient Ash-na, 37 years (control group). Elastase level 440 mcg/g. Average pancreatic tissue stiffness 5.75 kPa.

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Fig. 2. Pancreatic ESW. Patient Vakh-v, 42 years (group 1). Elastase level 426 mcg/g. Average pancreatic tissue stiffness 7.23 kPa.

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Fig. 3. Pancreatic ESW. Patient St-ova, 45 years (group 2). Elastase level 156 mcg/g. Average pancreatic tissue stiffness 10.74 kPa.

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Fig. 4. Pancreatic ESW. Patient Per-v, 64 years (group 3). Elastase level decreasing to 56 mcg/g. Average pancreatic tissue stiffness 21.60 kPa.