

CLINICAL RELEVANCE OF COMPRESSION ELASTOGRAPHY IN DIFFERENTIAL DIAGNOSIS OF PANCREATIC CYSTIC MASSES

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The aim of the investigation was to assess the capabilities of compression elastography in differential diagnosis of pancreatic cystic tumors.

Materials and Methods. 15 patients with pancreatic cystic masses were examined. There were the following clinical forms: pancreatic pseudocysts in chronic pancreatitis — 9 (60%), pancreatic cystadenocarcinoma — 4 cases (26.7%), pancreatic cyst in intraductal papillary-mucinous adenoma — 2 cases (13.3%). The patients underwent pancreatic and hepatic sonography, fibrogastroduodenoscopy and compression elastography with endosonography. Referential techniques were helical computed tomography and ultrasound-guided pancreatic paracentesis. The patients were operated on within 3–4 months, the diagnoses were histologically verified.

Compression elastographic strain ratio (SR) was calculated by the program in ultrasonic apparatus, i.e.: the image was fixed in “an interest area” (a focal lesion), from two to three measuring points were established using a special cursor, and the program calculated SR.

Results. We determined optimal threshold values of compression elastography indices, when diagnostic sensitivity, specificity and accuracy of the technique were maximum; and showed significant clinical capabilities and prospects of compression elastography applied in endosonography. SR in cystadenocarcinoma was 34.1–42.5 RU, in solid pseudopapillary tumor — from 44.7 RU, in postnecrotic cysts — from 13 to 25 RU.

Conclusion. The data analysis showed that the application of compression elastography in endosonography enabled to increase the informative value of clinical laboratory examination of patients with pancreatic cystic masses.

Key words: endosonography; compression elastography; pancreatic diagnostics.

Importance of an adequate and well-timed assessment of pathological process severity in pancreatic parenchyma does not raise doubts: it is necessary in clinical practice for definition of disease stage, prognosis, and early improvement of patient treatment tactics [1–8].

However there are difficulties in diagnostics of small malignant tumors so far. The technical impossibility of survey of the zones inaccessible by transabdominal ultrasonic detection, a transitional elastometry, and for puncture biopsy remains. The traditional diagnostic algorithm of pancreatic pathology identification consists in use of ultrasonography, helical computed tomography, magnetic resonance tomography, magnetic resonance cholangiopancreatography and endosonography [2, 3, 5, 8–13].

The main criteria for visualization methods are informational content, availability, potential danger and the price efficiency [2, 5, 9, 14–16].

The aim of the investigation was to assess the capabilities of compression elastography in differential diagnosis of pancreatic cystic tumors.

Materials and Methods. The investigation was carried

out in Smolensk Clinical Hospital No.1. 15 patients were examined. All of them were performed pancreatic and hepatic sonography, fibrogastroduodenoscopy and compression elastography with endosonography by the same doctor in the same room. Referential techniques were helical computed tomography and ultrasound-guided pancreatic paracentesis. There were the following clinical forms: pancreatic pseudocysts in chronic pancreatitis — 9 (60%), pancreatic cystadenocarcinoma — 4 cases (26.7%), pancreatic cyst in intraductal papillary-mucinous adenoma — 2 cases (13.3%). The patients were operated on within 3–4 months; the diagnoses were histologically verified.

The research complies with the Declaration of Helsinki (adopted in June, 1964 (Helsinki, Finland), revised in October, 2000 (Edinburgh, Scotland)) and approved by Ethical committee of Samara State Medical University. Written informed consent was obtained from all patients.

All patients suffering from a cystadenocarcinoma and pseudocysts complained of pain in pancreas projection area, weight loss, weakness, skin yellowness, palpated abdominal tumor. Patients with solid pseudopapillary

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tumor noticed only a periodic abdominal pain not associated with eating.

Preliminary transabdominal analysis was carried out on HITACHI-525 (Japan), and then on endoscope PENTAX FG 34US (Japan) for the subsequent endosonographic research. The endoscope AOHUA VME-N98 (China) was used for preliminary gastroscopic study to rule out accompanying pathology (peptic ulcer, malignancy, gastritis, duodenitis, etc.), and to determine “regions of interest” before the endosonography. The ultrasonic device HITACHI Preirus (Japan) and endoscope with the convex sensor PENTAX EG 387OUTK (Japan) were used for complex ultrasonic investigation: transabdominal and endosonographic studies.

Imaging 2.0 program was used for the analysis. Complex instrumental analysis allows obtaining the complete image of interesting parts of a hepato-biliary-pancreatic zone, namely: radial scanning of AOHUA VME-N98 gastroscope provides the circular endoscopic image (140°), and directional scanning of convex sensor PENTAX EG 387OUTK enables to receive the restricted sector or linear image that is quite similar to the image received by transabdominal examination. The direction of a convex sensor scanning coincides with an endoscope axis, considerably facilitating the interpretation of the image.

Under local anesthesia of 10% Lidocainum aerosol a tube of an endoscope was inserted into duodenum. Simultaneously with the endosonography pancreatic compression elastography was carried out by sequential installation of the convex sensor in the descending part, a top of a bulb and in the duodenal bulb — in a place of a pancreatic head projection; in body and antral region of stomach — in a place of a pancreatic body view; in gastric fundus — in a place of pancreatic tail view. Compliance with the above analysis stages was necessary for the proper assessment of parenchyma condition and focal lesions detection. The use of compression elastography mode at endosonography enabled to distinguish the subsequent stages of elastometric research. Particularly,

when ultrasonic signs of focal lesions in pancreatic parenchyma are detected the endoscope convex sensor should be alternately installed in focal lesion, in perifocal and extra perifocal zones (Fig. 1).

By means of the screws on the echoendoscope, compression (jerky) movements were made against a digestive tube wall, in the places of the viewed anatomical pancreatic parts.

Results and Discussion. Compression elastography at endosonography was carried out in two stages: 1) qualitative estimation of the elastographic image of pancreas parts and the revealed lesions; 2) elaboration of the elastographic diagnostics — an assessment of elastographic ratio in the regions of interest by calculation of a difference coefficient of strain ratio (SR) in relative units (RU).

Qualitative estimation of the elastographic image under endosonographic study included the detection of the structure inhomogeneity in head, body and tail of pancreas of all patients.

SR was calculated by the program in the ultrasonic apparatus, i.e.: the image was fixed in a “region of interest” (a focal lesion), two or three measuring points were established using special cursors, and the program calculated SR difference coefficient. SR difference coefficient in cystadenocarcinoma was 34.1–42.5 RU (Fig. 2), in solid pseudopapillary tumor — from 44.7 RU (Fig. 3), in postnecrotic cysts — from 13 to 25 RU (Fig. 4).

The analysis of the obtained results enabled to establish basic values of SR difference coefficient for different clinical forms of pancreatic cystic masses: for benign neoplasms — up to 25 RU, for the malignant ones — more than 31 RU.

The statistical hypotheses for comparison of three groups of data by one characteristic — compression elastographic coefficient — was evaluated by Mann–Whitney nonparametric criteria. Three groups of elastographic data were compared by one quantitative parameter — the SR difference coefficient. The data on pancreas were obtained from one population. The data acquisition techniques in each group had no effect on the data acquisition efficiency in other groups. As SR distribution in three nosological forms is not normal, the SR intervals are various ($p > 0.05$). Paired comparison of the groups by Mann–Whitney nonparametric test confirms the compression elastography findings to differ in different nosological forms.

Diagnostic efficiency of pancreatic endosonography was expressed by the following parameters: sensitivity — 90.4%, specificity — 83.2%, accuracy — 86.7%, positive predictive value — 63%, negative predictive value — 100%. Diagnostic efficiency of compression elastography at pancreatic endosonography was estimated as follows: sensitivity — 96.7%, specificity — 89.2%, accuracy — 94.5%, positive predictive value — 78%, negative predictive value — 100%.

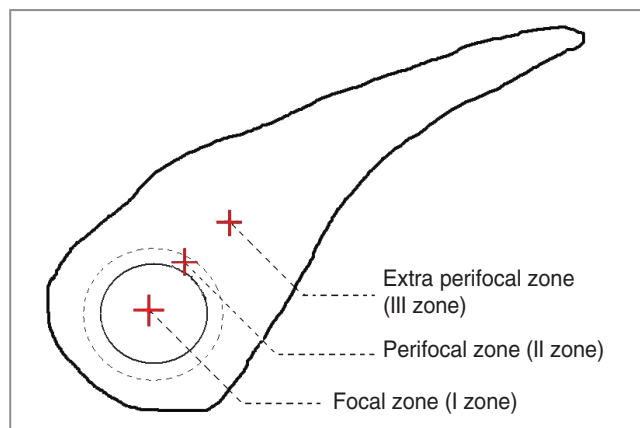
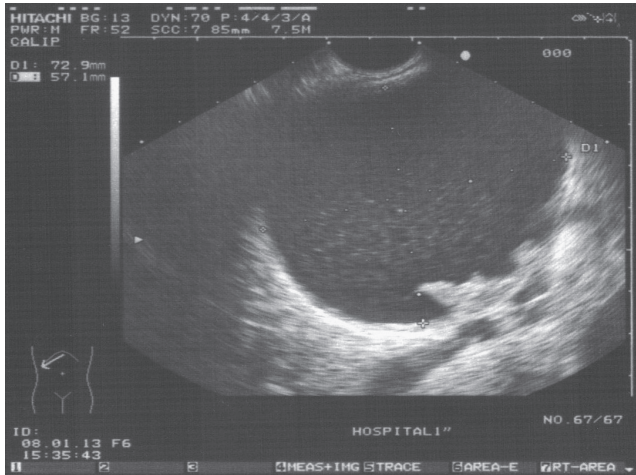
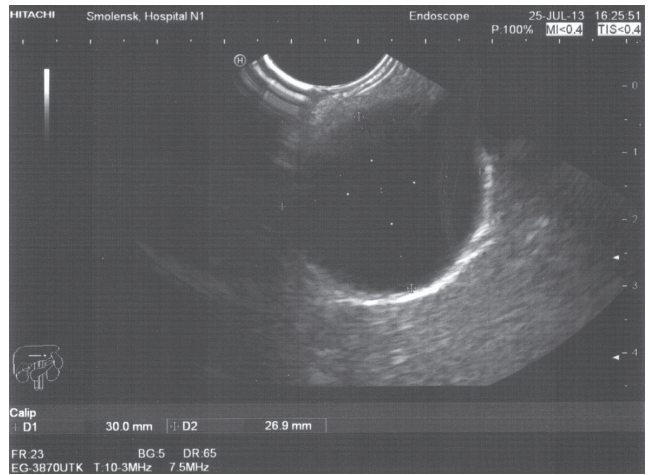


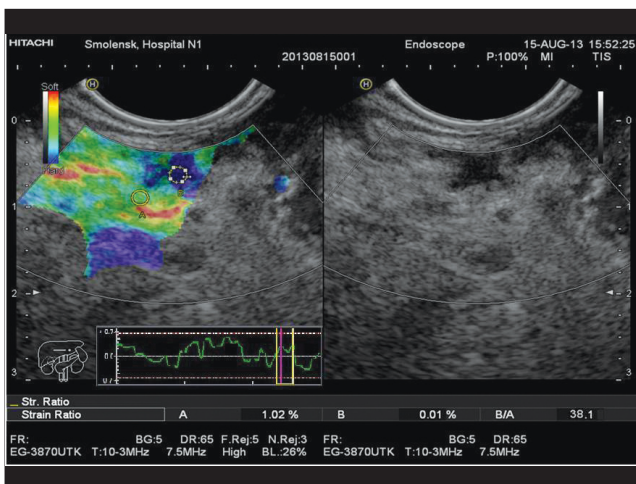
Fig. 1. Procedure of compression elastography at endosonography of pancreatic cystic masses



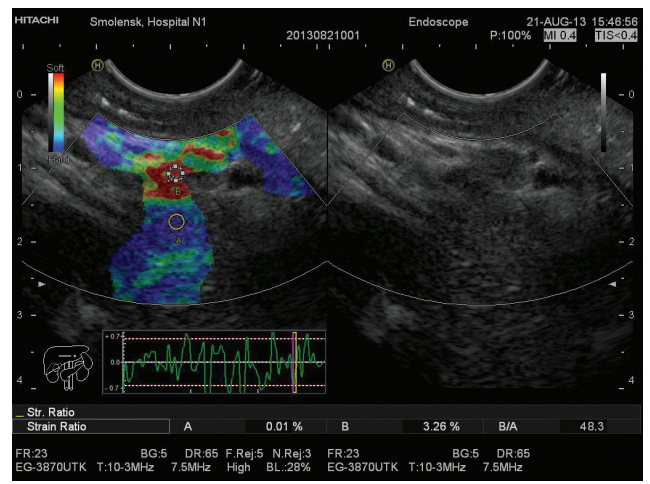
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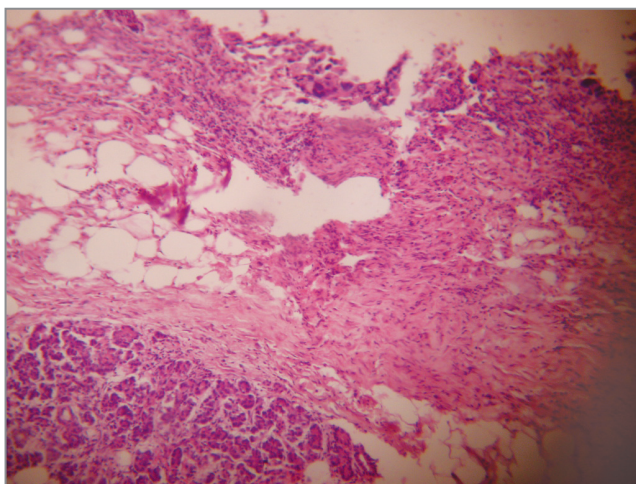
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c



c

Fig. 2. Pancreatic cystadenocarcinoma: a — elastography (on internal surface of a lesion capsule the solid tissue overgrowth is defined); b — endosonographic signs of perifocal and extra perifocal zones; c — pancreatic tissue: a capsule is presented by connective tissue with lipomatosis, a cyst is lined by glandular epithelium; hematoxylin and eosin staining; $\times 40$

Fig. 3. Cyst from the major pancreatic duct in intraductal papillary mucinous adenoma: a — compression elastography findings: solid lesion is located in a dense fibrous capsule; b — endosonographic signs of perifocal and extra perifocal zones of the pancreatic cyst; c — lack of an ovarian-like stroma and a capsule, branching and fibrovascularity of various sized nipples; hematoxylin and eosin staining; $\times 200$

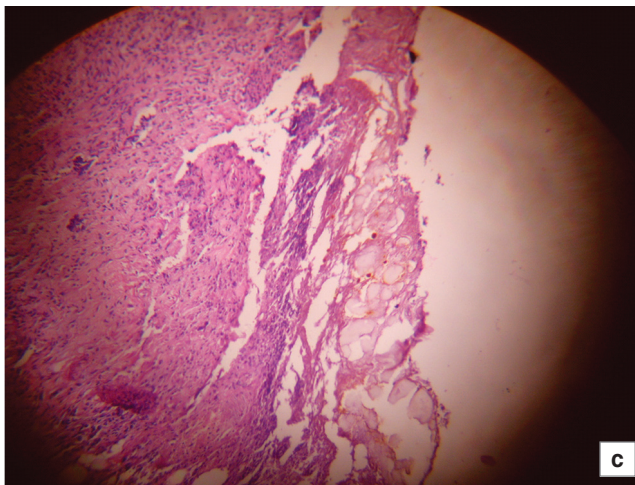
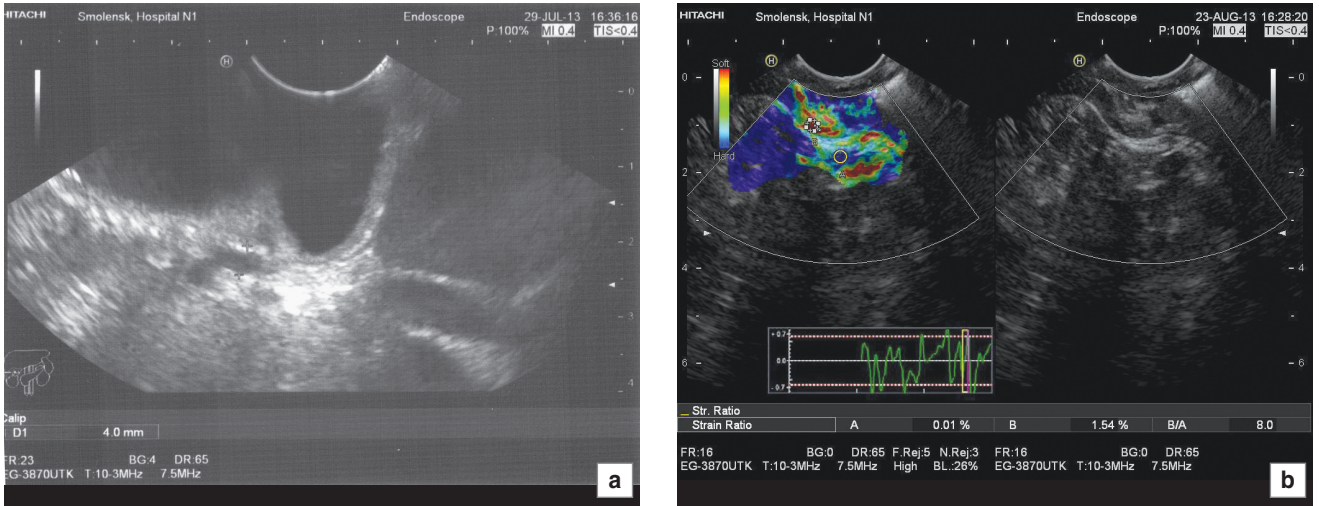


Fig. 4. Pancreatic pseudocyst in chronic pancreatitis: *a* — mature postnecrotic cyst visualized by compression elastography; *b* — endosonographic signs of perifocal and extra perifocal zones of the pancreatic cyst; *c* — the internal surface of the cyst wall is presented by necrotic masses in which the grains of “a golden pigment” (bilirubin) are seen, mixed inflammatory infiltration; hematoxylin and eosin staining; $\times 40$

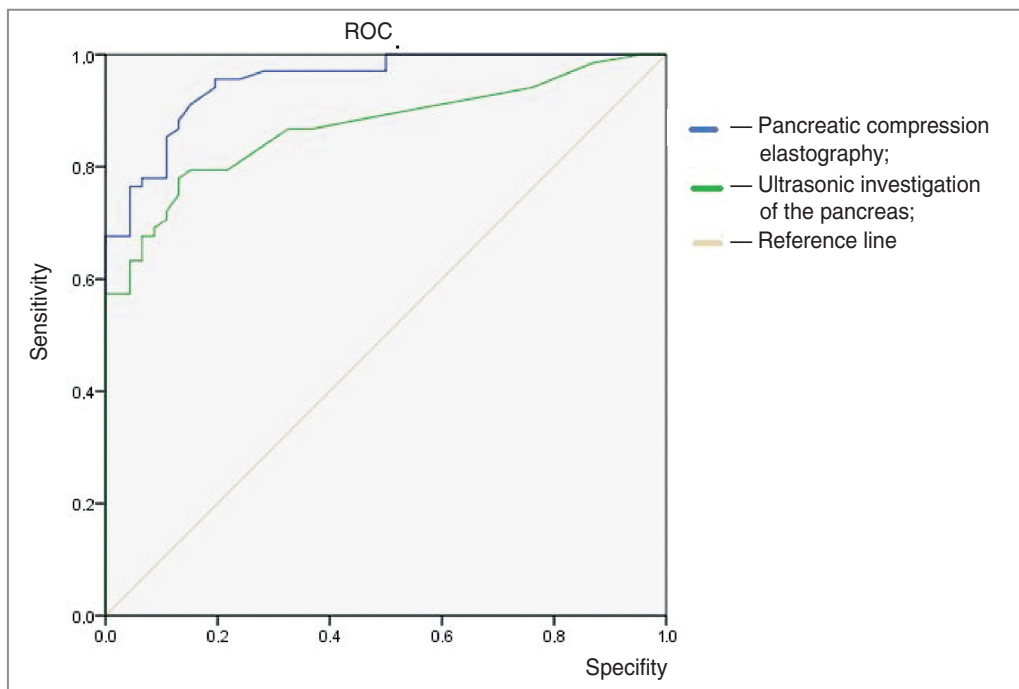


Fig. 5. The diagnostic and prognostic significance of pancreatic compression elastography at endosonography. Diagonal segments are formed by coincidence

The hypothesis of the obtained data compliance to the developed diagnostic criteria was verified by ROC curve construction and calculation of the area under the curve — AUROC that also enabled to estimate the characteristics of a tested parameter: sensitivity, specificity, diagnostic and prognostic significance (Fig. 5)

The test showed excellent quality of the model in pancreatic compression elastography under endosonography and high quality of the model in transabdominal sonography.

The quality of the test can be assessed by the AUROC expert scale:

AUROC range	The model quality
0.9–1.0	Perfect
0.8–0.9	Very good
0.7–0.8	Good
0.6–0.7	Ordinary
0.5–0.6	Inadequate

So, it is clearly seen that the application of the compression elastography in endosonography is of great importance for early verification of the pancreatic pathological processes diagnosis that will allow preventing disease progressing and its further development. Moreover, the present research can be used for follow-up of patients for the purpose of early detection of pathological process recurrence.

Conclusion. The application of compression elastography in endosonography enables to visualize all anatomic structures of a pancreas that is not always inaccessible under transabdominal sonography and is always inaccessible at transitional elastometry.

Compression elastographic strain ratio in cystadenocarcinoma was 34.1–42.5 RU, in solid pseudopapillary tumor — from 44.7 RU, in postnecrotic cysts — from 13 to 25 RU.

Sensitivity of pancreatic compression elastography at endosonography was 96.7%, specificity — 89.2%, accuracy — 94.5%.

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