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## Percutaneous Miniinvasive Technologies: History, Traditions, Negative Trends and Perspectives

Vetshev P.S.<sup>1</sup>, Musaev G.Kh.<sup>2</sup>, Bruslik S.V.<sup>1</sup>

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The issue highlights the history of miniinvasive percutaneous surgery. Some negative trends and bias, though developed in the field, are discussed. Authors point out the achievements and perspectives of modern technologies, warning against the unreasonable euphoria of method's possibilities, and call upon the use of the past experience and lessons learned by previous generation.

**Key words:** miniinvasive percutaneous surgery, tendency, perspective, endobiliary procedure.

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## Main Pancreatic Duct Stenting for Acute Pancreatitis Induced by Endoscopic Transpapillar Procedures\*

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**Aim.** To assess retrospectively the clinical outcomes of retrograde endoscopic pancreatic duct stenting for acute post-procedure pancreatitis.

**Materials and Methods.** 2192 endoscopic retrograde procedures were performed during the period of 1<sup>st</sup> January 2009 – 1<sup>st</sup> July 2013. Acute post-procedure pancreatitis (APPP) has developed in 26 (1.33%) cases – in 24 (92.3%) females and in 2 (7.7%) males. Average age in these patients was 57.9 ± 14.8 years.

**Results.** Stenting of MPD was successful in 19 (90.5%) cases, resulting in full recovery. No complications of stenting procedure were observed. Average hospital stay in these patients was 11.8 ± 3.7 days. Conservative management in remaining 7 (26.9%) cases resulted in average hospital stay of 23.8 ± 7.5 days and 28.6% mortality rate.

**Conclusion.** Endoscopic MPD stenting for APPP was technically possible in 90.5% cases. Pancreatic stenting is an effective therapeutic modality, providing definitive cure in some patients and reduced hospital stay.

**Key words:** pancreas, pancreatitis, endoscopic retrograde cholangiopancreatography, stenting.

\* full text in english

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## Innovative Instrumentation and Techniques for Pancreonecrosis and Diffuse Parapancreatitis Transcutaneous Management

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**Aim.** To develop a set of innovative surgical instruments for percutaneous management of pancreonecrosis and diffuse parapancreatitis and validate this instrumentation in clinical practice.

**Materials and Methods.** Percutaneous puncture approach was tested in 53 patients, among them alcoholic pancreatitis was diagnosed in 40 cases, alimentary – in 6, biliary – in 6 and post-traumatic – in 1. By types of cellulitis (following A.D. Tolstoy classification) all cases were distributed as follows: type D – 31 cases, type C – 11, type E – 11. 2–3 retroperitoneal cellular spaces were involved in 32 patients, 4–5 spaces – in 19, and 6&7 retroperitoneal cellular spaces – in 1 patient each. Infected pancreonecrosis was verified prior to initiation of treatment in 41 patients. Percutaneous draining of involved retroperitoneal spaces and focal accumulations of liquid, replacing initial drainage-system with larger diameter tubes and transcutaneous sequestrectomies (necrotomies) were the modalities of choice in this group of patients. All procedures were performed with invented surgical instruments.

**Results.** There were no failures, technical issues or complications, either during primary draining procedures or drainage-system replacements. Only 2 complicated cases due to large diameter of primary draining systems were seen. In 33 (62.3%) cases surgeries were avoided, although 2 (6.1%) of these patients died. In 20 (37.7%) cases surgical procedures were performed, 7 (35%) patients from this subgroup died. Totally 44 (83%) out of 53 patients recovered and 9 (17%) died.

**Conclusion.** Percutaneous puncture providing access for surgical and therapeutic management of pancreonecrosis and diffuse parapancreatitis is a promising technique. The set of innovative surgical instruments and techniques developed for this purpose allow to simplify transcutaneous procedures, making them more safe and reliable while reducing the incidence and severity of complications, and making it technically feasible to effectively remove retroperitoneal fat sequestrators.

**Key words:** pancreas, pancreonecrosis, parapancreatitis, percutaneous draining, instruments, transcutaneous sequestrectomy.

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## Retrograde Transpapillar Stenting of Main Pancreatic Duct in Multimodality Treatment of Chronic Pancreatitis

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**Aim.** To verify the role of endoscopic transpapillar procedures in management of stenotic lesions and impaired continuity of main pancreatic duct (MPD) in patients with chronic pancreatitis.

**Materials and Methods.** 215 endoscopic procedures for the obstruction of pancreatic ducts were performed in 95 patients with chronic pancreatitis during the period from January 1998 – December 2013. The study group included 52 (54.7%) patients with pancreatic duct strictures and 43 (45.3%) patients with pancreatic fistula. Pancreaticoduodenal endoprotheses were implanted in all cases.

**Results.** Endoscopic prostheses were successfully implanted in 64 (67.4%) patients, and in 45 (70.3%) cases this procedure has become the definitive treatment. Temporary stenting of MPD was required in 19 (29.7%) patients as an intermediate procedure before definitive surgery. Complications of endoscopic procedures were observed in 6 (2.8%) cases, there was also 1 (0.5%) death.

**Conclusion.** Pancreatic stenting was technically possible in 67.4% cases, while endoscopic correction could be used as definitive surgery in the majority of patients, yielding low complication and mortality rate.

**Key words:** pancreas, chronic pancreatitis, main pancreatic duct stricture, pancreatic fistula, endoscopic retrograde cholangiopancreatography, stenting.

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## Irreversible Electroporation with "NanoKnife" in Management of Pancreatic Cancer (Clinical case)

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**Aim.** To demonstrate the first experience in Russian Federation with new non-thermal ablation modality for management of pancreatic cancer, i.e. non-thermal irreversible electroporation (NTIRE) of pancreatic head tumor.

**Materials and Methods.** Pancreatic head cancer T4N0M0 was diagnosed in a 56 y.o patient "A". Surgical revision on 24.04.2013 identified a non-resectable cancer of pancreatic head invading duodenum and v. cava inferior. NTIRE procedure, 80 pulses – 70  $\mu$ sek, 30 A, 8 minutes total exposure was done via 4 mono-polar "NanoKnife" electrodes, introduced into the tumor tissue at a 1.5 cm distance.

**Results.** No intra-op procedural complications were observed. Acute pancreatitis was diagnosed on day 7 postop, successfully managed with conservative treatment. Control multimodal imaging in November 2013, including US, MRI, and computerized X-ray did not reveal any signs of recurrent disease. Total FU duration is 7 months, and follow up will be continued.

**Conclusion.** Irreversible electroporation (IRE) can be viewed as a safe and effective non-thermal ablation procedure. This particular ablation modality allows multiple use in an individual patient, therefore offers an extended capacity of medical assistance for patients with initially non-resectable pancreatic cancer. Further studies will help to outline strict indications for IRE-procedures, as well as optimize the number of required NTIREs.

**Key words:** irreversible electroporation, pancreatic cancer, non-thermal ablation, minimally invasive surgery.

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## Bio-Impedance Analysis of Liver Parenchyma after Major Liver Resection in Experimental Setting

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**Aim.** Assessment of liver parenchyma biophysical characteristics before and after major liver resection.

**Materials and Methods.** Measurements of liver parenchyma electrical impedance values before and after major liver resection was performed on 27 white Vistar rats of both genders weighing 180–230 grams.

**Results.** Electrical impedance values of intact liver were  $3.2 \pm 0.2$  k Ohms at 2 kHz frequency,  $2.3 \pm 0.1$  k Ohms at 10 kHz and  $1.7 \pm 0.11$  k Ohms at 20 kHz. In 72 hours postop the impedance value has definitely increased up to  $4.0 \pm 0.13$  k Ohms at 2 kHz frequency. During this period consistent increase of  $D_{2\text{kHz}/20\text{kHz}}$  coefficient value up to  $2.45 \pm 0.10$  as compared with baseline  $1.95 \pm 0.12$  was observed.

**Conclusion.** Obtained data indicate the possible use of bio-impedance tool for assessment of liver parenchyma functional activity.

**Key words:** liver, major liver resection, electrical impedance, bio-impedancemetry.

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## Nonparasitic Hepatic Cysts Treatment

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**Aim.** To optimize indications for different miniinvasive surgical (MIS) procedures in management of nonparasitic hepatic cysts and polycystic liver disease.

**Materials and Methods.** 62 patients with nonparasitic hepatic cysts and 38 patients with polycystic liver disease were subjected to different types of surgery, such as laparotomic (31.7%) and MIS procedures (68.3%), including: laparoscopic, MIS-assisted cyst fenestration and liver resection, percutaneous puncture and sclerotherapy. Long-term outcomes and QOL assessment with multipurpose short-form health survey SF-36 were performed in 6–12 months postop.

**Results.** Laparoscopic fenestration was the modality of choice in 76.5% of all cases for cysts localized in anterior and posterior liver segments with favorable postop course, short-term hospital stay and rehabilitation period, as well as low recurrence rate (6.6%). In cases where laparoscopic procedures were contraindicated, available options for management of nonparasitic hepatic cysts included: MIS-assisted fenestrations – for management of thick-walled cysts in anterior liver segments, and percutaneous puncture and aspiration modalities – for management of thin-walled and intra-parenchymal cysts. QOL has definitely improved in patients with polycystic liver disease ( $p < 0.001$ ;  $R^2 = -0.29$ ) after surgery, except for physical functioning scaled scores, which is indicative of MIS palliative procedures superiority in management of this particular type of lesions.

**Conclusion.** MIS procedure of choice for nonparasitic hepatic cysts and polycystic liver disease management would depend on localization of a particular lesion, comorbid status of a patient and types of surgeries performed prior to planned intervention. Laparoscopic and MIS – assisted fenestration is associated with recurrence rate of 0–10%, which is comparable with that after open surgeries.

**Key words:** nonparasitic hepatic cysts, polycystic liver disease, laparoscopic and MIS-assisted fenestration, percutaneous puncture and sclerotherapy.

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## Minilaparotomic Cholecystostomy in Elderly Patients with Acute Cholecystitis

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**Aim.** To optimize short-term outcomes in management of acute cholecystitis in elderly patients.

**Materials and Methods.** Mini-incision cholecystostomy was performed in 53 patients aged over 75 y.o. Charlson comorbidity index in all patients varied within 6–9, attributing all cases to high and extremely high lethal outcome risk. In all cases destructive cholecystitis was verified, accompanied by jaundice in 40% of patients.

**Results.** Gallbladder draining period varied from 13 to 16 days. 8 (15%) patients were subjected to 2-stage surgical procedure, i.e. cholecystostomy at the first stage to achieve full control of inflammation with a mini-incision cholecystectomy at the second stage. Nine (17.1%) patients were discharged with functional cholecystostoma. Seven (13.2%) patients died after surgery, although immediate post-op mortality in extremely high risk patients with acute cholecystitis did not exceed 1.2%.

**Conclusion.** Our results allow us to recommend the wide use of two-stage procedure in patients with destructive cholecystitis and very high surgical and anaesthesiological risk – as a good alternative for decreasing post-op mortality.

**Key words:** acute cholecystitis, elderly age, comorbidity, high surgical risk, cholecystostomy.

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## Surgical Management of "Fresh" Extrahepatic Bile Duct Injuries

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**Aim.** To improve surgical outcomes in management of iatrogenic extrahepatic bile duct injuries (IBDI).

**Materials and Methods.** The authors share their experience in management of 107 cases of inadvertent iatrogenic extrahepatic bile duct injuries during the period 1989–2011 yy. In 96 (89.7%) patients this iatrogenic injury occurred during cholecystectomy procedure. For early diagnosis of iatrogenic trauma the following diagnostic modalities were helpful: US, ERCPG, PTHC, CT, MR-cholangiography and re-laparoscopy.

**Results.** Proximal IBDI were diagnosed in more than 57% of cases. Delayed (in respect to timing of injury) surgical treatment was performed in 65.4% of all patients. Location of injury, time of diagnosis and associated complications predefined surgical tactics of choice in each case. Two-step strategy was used in patients who developed peritonitis. In 65.5% of all cases biliary-digestive anastomosis with replaceable percutaneous transhepatic drainages was the preferred procedure.

**Conclusion.** Longterm carcass bile ducts drainage prevents formation of recurrent anastomosis strictures. Surgery without drainages is possible only when fresh injuries of CBD or hepatic duct are identified.

**Key words:** extrahepatic bile ducts, iatrogenic injury, bile duct stricture, cholecystectomy, cholelithiasis, results.

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## Pancreatodigestive Anastomosis in Radical Operations of Periapullar Tumors

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**Aim.** To evaluate the impact of various types of pancreatodigestive anastomoses on early postop course after pancreatoduodenal resection.

**Materials and Methods.** Radical surgeries for periapullar tumors were performed in 106 patients during the period 1983–2013, among them 100 procedures were pancreatoduodenal resections (PDRs), and 6 – pancreatodudenectomies (PDEs). One-stage surgery was possible in 38 patients, biliary decompression procedures were necessary in 68 cases before going for radical surgery. Blind closure of pancreatic stump was carried in 15 cases, pancreatoenteroanastomosis was formed in 23 cases, pancreatoenteroanastomosis – in 32, pancreatogastroanastomosis – in 30 patients.

**Results.** Adherence to two-step surgery in patients with severe cholestasis and to differentiated approach in formation of pancreatodigestive anastomosis while securing pancreatic anastomosis with external drainage to maintain external diversion of bile in early postoperative period allowed to reduce postoperative complication and mortality rates to 10.8%.

**Conclusion.** The most common complications of PDR are associated with pancreatic stump closure and formation of pancreatodigestive anastomosis. Pancreatogastric anastomosis seems to have a number of sound advantages. External diversion of pancreatic juice through MPD drainage system and simultaneous maintenance of percutaneous transhepatic cholangiostomy for partial external biliary diversion (PEBD) in early postop period significantly reduces the risk of specific PDR- and PDE-associated postop complications.

**Key words:** periapullary tumor, pancreas, pancreatoduodenal resection, pancreatodigestive anastomosis, pankreatogastroanastomosis, pancreatic necrosis, anastomotic failure, two-stage operation.

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## Acute Pancreatitis: Morphological Issues in Development of the Disease

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**Aim.** To study ultrastructural pancreatic parenchyma changes in different types of acute pancreatitis.

**Materials and Methods.** Morphological including histological and ultrastructural examination of pancreas was performed in 11 patients with severe acute pancreatitis. Intraop biopsy samples at different disease stages, as well as autopsy material were used in this study.

**Results.** Different mechanisms of pancreatic cells death are involved at the initial stage of the disease, i.e. necrosis and apoptosis. Predominant necrosis is usually associated with extremely severe course of the disease and rapid multiorgan failure progression. Apoptosis can alternate into necrosis in the natural course of acute pancreatitis, manifesting clinically in aggravation of systemic inflammation and severity of symptoms. Destructive process in the pancreas is sustained for a long period of time. After 2.5 months from the onset of the disease the majority of acinar cells still demonstrate substantial signs of damage, which should be taken into account in treatment plans.

**Conclusion.** Presented findings are indicative of morphological heterogeneity in acute pancreatitis, encompassing both – volume of tissue destruction and different types of cell death involved. Further studies are required to elucidate particular roles of necrosis and apoptosis in destructive pancreatitis, their input into severity of the disease, development of complications and clinical outcomes.

**Key words:** acute pancreatitis, destructive pancreatitis, pancreonecrosis, necrosis, apoptosis.

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## Radical Pancreatic Resections for Periapillary Carcinoma in Elderly Patients

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**Aim.** To assess surgical outcomes after radical surgical procedures for periapillary tumors in elderly patients (aged 75 and more).

**Materials and Methods.** 56 radical surgeries for periapillary carcinomas, including 13 procedures in elderly patients aged  $\geq 75$  y.o. were performed during 2010–2012 yy. Short- and long-term surgical outcomes were compared between the groups of elderly and younger patients. Clinical and demographic characteristics were comparable in both groups except for age.

**Results.** There were no statistically significant differences between the two groups in terms of surgery duration, intraop blood loss, mortality and complications rates, as well as postop hospital stay. The mortality was 2 out of 13 in the elderly group and 4 out of 43 patients – in the control group. Lower median survival and one-year survival rates were observed among the elderly, although 3 patients continue to demonstrate relapse-free survival.

**Conclusion.** Surgical outcomes after radical periapillary carcinoma resections in the elderly are comparable with the results in younger patients, thus justifying wider indications for such procedures in tertiary clinical centers.

**Key words:** pancreatic cancer, periapillary carcinomas, old age, pancreatoduodenal resection.

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## Experimental Model of Pancreonecrosis

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**Aim.** To develop a model of pancreonecrosis with increased release of cytokines into peripheral circulation.

**Materials and Methods.** Sixty (60) 12–14 weeks-old outbred SD male-rats of SPF category were used in this experiment. Levels of pro-inflammatory IL-6, TNF- $\alpha$  and anti-inflammatory IL-10 cytokines were monitored, and the results were compared with respective values in the control group of intact rats. To create the cerulean-induced pancreonecrosis (PN) model a single or triple intraperitoneal administration of 20, 40, 50, 60, and 80  $\mu\text{g}/\text{kg}$  cerulean solution was used. To induce alcoholic PN all animals were watered with 10% ethanol solution for a long period of time (from 14 days to 2.5 months). In 9 rats from this group alcohol was additionally potentiated with 40  $\mu\text{g}/\text{kg}$  of cerulean. The mechanical model of PN encountered partial CBD occlusion enhanced by single intraperitoneal administration of 40  $\mu\text{g}/\text{kg}$  cerulean.

**Results.** PN has not been achieved in a single animal after intraperitoneal cerulean administration in a range of indicated experimental dosages. This model was not associated with statistically significant increase of circulating cytokines. Alcohol model also failed to achieve PN and was not associated with increase of cytokine levels. Increase of IL-6 was noticed only in the subgroup with combined use of alcohol and cerulean ( $224.24 \pm 5 \text{ pg}/\text{ml}$ ), while TNF- $\alpha$  did not show any increase ( $16.66 \pm 7 \text{ pg}/\text{ml}$ ). Pronounced inflammation and necrosis of pancreatic parenchyma were predominant morphological characteristics of mechanical PN model. Additional cerulean resulted in total PN. Moreover, the mechanical PN model was associated with considerable increase in cytokine secretion as compared with cerulean and alcohol PN models.

**Conclusion.** Mechanical PN model with partial CBD occlusion can be recommended for evaluation of cytokine-inhibiting potential in medicinal drugs.

**Key words:** pancreas, pancreonecrosis, experimental model, cytokines, cerulean.

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## Noninvasive Ultrasound Ablation of Liver Tumours

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The review elucidates advanced approaches to local treatment of hepatic tumors. Such modalities as super-selective intra-arterial chemoembolization, cryoablation, laser and radio-frequency ablation, as well as most modern technique based on high intensity focused ultrasound (HIFU) for distant local tumor destruction are presented in a comparative format. A classification of local ablation techniques based on degree of invasiveness (factor of local tumor destruction) is proposed. The authors present through analysis of published data, describing benefits and disadvantages of all local ablation techniques, indications and contraindications, associated complications and long-term clinical outcomes.

**Key words:** liver, metastases, minimally invasive technologies, chemoembolization, cryodestruction, cryoablation, ultrasound ablation, HIFU.

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## CASE REPORTS

## Multimodal Management of Hepatocellular Carcinoma in Liver Cirrhosis Patients

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A clinical case of hepatocellular carcinoma in cirrhosis with massive bilobar tumor involvement is presented. Intra-arterial chemoembolization and following left lobectomy with simultaneous SI and atypical SVI resections were performed. Chemoembolization yielded partial tumor response, but at the same time triggered intensive tumor neoangiogenesis. Limited capacity of hepatic artery chemoembolization predetermined the necessity of major surgical interventions, allowing to achieve favorable outcome with multimodality approach in management of a complicated clinical case.

**Key words:** hepatocellular carcinoma, chemoembolization, hepasphere, liver cirrhosis, tumor neoangiogenesis, BCLC classification.

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## Liver Transplantation in Androgen-Induced Hepatocellular Carcinoma: a Report of Two Clinical Cases

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Hepatocellular carcinoma (HCC) is a relatively common case of cancer, which occurs mainly in patients with liver cirrhosis and chronic viral hepatitis. About 10% of HCC occurs in normal liver among young and healthy patients. Anabolic and other sex steroids have been known to induce hepatic lesions in some cases, including HCC. Liver transplantation (LT) can be performed to patients with unresectable tumors in non-cirrhotic liver. Large size of the tumor should not to be seen as a contraindication for LT for the patients with non-cirrhotic liver in contrast to HCC for liver cirrhosis (Milan criteria). In this study we will show two our own cases of successful treatment of unresectable HCC via liver transplant with good follow-up and tumor-free survival.

**Key words:** *hepatocellular carcinoma, anabolic steroids, liver transplantation.*

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## ***Abstracts of Current Foreign Publications***

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