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KEY CHANGES IN A NUMBER OF INDICATORS OF HEMODYNAMICS OF ARTERIAL AND VENOUS HEALTH IN PATIENTS WITH ACUTE PANCREATITIS

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КЛЮЧЕВЫЕ ИЗМЕНЕНИЯ РЯДА ПОКАЗАТЕЛЕЙ ГЕМОДИНАМИКИ АРТЕРИАЛЬНОГО И ВЕНОЗНОГО КРОВОТОКА У БОЛЬНЫХ С ОСТРЫМ ПАНКРЕАТИТОМ

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Abstract. Acute pancreatitis (AP) is one of the most common and serious diseases of the abdominal organs. Among the diseases that form an acute surgical pathology of the abdominal organs, AP takes 3rd place, and there are from 8% to 14.5% of cases. Ultrasound is the most important diagnostic method for AP, which opens up wide possibilities, but the information content in the study of arterial and venous blood flow in the liver in AP is not yet fully understood. The aim of the study was to study the key changes in hemodynamic parameters of arterial and venous blood flow in patients with acute pancreatitis. The study group included 23 patients with a diagnosis of acute pancreatitis who were hospitalized at the Republican Clinical Hospital no. 4 and the Republican Clinical Hospital no. 3 of the city district of Saransk from October 2016 to April 2017. Ultrasound examination the pancreas against the background of acute pancreatitis showed that in the edematous form of acute pancreatitis, the size of the test organ was increased on the 1st day of the study. Against the background of acute pancreatitis in the forms studied (edematous and pancreatonecrosis), an increase in the size of the liver was observed, indicating its involvement in the inflammatory process. Pancreatonecrosis was accompanied by endotoxicosis and deep systemic disorders in the form of multiple organ failure, manifested by the occurrence of portal hypertension, as evidenced by persistent changes during all periods of observation.

Аннотация. Острый панкреатит (ОП) одно из наиболее распространенных и тяжелых заболеваний органов брюшной полости. Из числа заболеваний, формирующих острую хирургическую патологию органов брюшной полости, ОП занимает 3 место, и наблюдается от 8% до 14,5% случаев. Ультразвуковое исследование — важнейший диагностический метод при ОП, открывающий широкие возможности, но информативность в исследовании артериального и венозного кровотока печени при ОП пока до конца не изучена. Целью исследования явилось изучение ключевых изменений показателей гемодинамики артериального и венозного кровотока у больных с острым панкреатитом. В группу исследования вошли 23 пациента с диагнозом: острый панкреатит, которые находились на стационарном лечении в ГБУЗ РМ «Республиканская клиническая больница №4» и «Республиканская клиническая больница №3» городского округа Саранск в период с октября 2016 по апрель 2017 г. Ультразвуковое исследование поджелудочной железы на фоне острого панкреатита показало, что при отечной форме острого панкреатита размеры исследуемого органа были увеличены в 1-й день исследования. На фоне острого панкреатита при исследуемых формах (отечной и панкреонекрозе) отмечалось увеличение размеров печени, свидетельствующее о ее вовлечении в воспалительный процесс. Панкреонекроз сопровождался явлениями эндотоксикоза и глубокими системными нарушениями в виде полиорганной недостаточности, проявляющимися возникновением портальной гипертензии, о чем свидетельствовали стойкие изменения во все сроки наблюдения.

Keywords: acute pancreatitis, hemodynamics, Doppler ultrasound.

Ключевые слова: острый панкреатит, гемодинамика, ультразвуковая допплерография.

Introduction

Acute pancreatitis (AP) is one of the most common and serious diseases of the abdominal organs. Among the diseases that form the acute surgical pathology of the abdominal cavity, AP takes 3rd place [3, p. 147], and there are from 8% to 14,5% of cases [6, p.10].

Endogenous intoxication and, respectively, developing in the result of this, macro- and microhemodynamic disorders are the key links of pathogenesis in various forms of AP, and in fact, they predetermine the severity and prognosis of the disease. Generalized macro- and microcirculatory disorders cause the pathological effects of pancreatogenic toxaemia [1, p. 13], which form the basis for the formation of multiple organ failure in AP [3, p. 146].

Hemodynamic disorders that appear in the early stages of the disease are diverse and can manifest themselves as an increase in vascular resistance, a decrease in circulating blood volume, as well as other microcirculation disorders. Microcirculatory disorders acquire a generalized character while having a clear staging and, as a rule, determined by the severity of destructive changes in the gland [2, p. 297], [4, p. 29], [5, p. 1232].

Ultrasound is the most important diagnostic method for AP, which opens up opportunities, but the information contained in the study of arterial and venous blood flow in the liver in AP has not been fully studied. As such, there is no single, generally accepted technique of ultrasound angiography of the liver vessels, different authors interpret the values of hemodynamic parameters in their own way, and the value of ultrasound angiography in the diagnostic algorithm is not fully determined examinations of such patients.

All the above facts mainly substantiate the urgency of the problem, predetermining the goals and objectives of the study.

Material and research methods

We conducted a study of 23 patients with a diagnosis of acute pancreatitis who were hospitalized at the Republican Clinical Hospital № 4 and the Republican Clinical Hospital № 3 of the city district of Saransk from October 2016 to April 2017.

The criterion for the selection of patients was the presence of a well-established diagnosis: acute pancreatitis, age from 20 to 70 years. The study was performed on 1, 3, 6, 9 and 12 days from the onset of the disease.

The study group included 23 people. Among them, 13 (57%) men and 10 (43%) women aged from 2 to 70 years. The average age for men is 47,19±3,35, for women — 56,25±2,25 years. The control group consisted of 5 practically healthy individuals, in whom clinical and anamnestic data excluded the presence of an acute pathology of the abdominal organs.

Ultrasound examination was performed on admission or in the coming hours of the patient's stay in the emergency surgery department in order to preliminarily determine the nature of pathological changes in the pancreas and surrounding anatomical structures. A complex ultrasound study was performed on an empty stomach on ultrasound scanners Toshiba Aplio 400 (Japan) and Aloka SSD 3500 (Japan) with a 3,5 MHz convex sensor.

The ultrasound technique included 2 stages: at the 1st stage, an ultrasound examination was performed in the B-mode (general abdominal examination), at the 2nd stage - the blood flow in the main vessels of the abdominal cavity (celiac trunk, common hepatic, splenic arteries and portal Vienna) methods of color and pulse-wave Doppler.

Based on the assessment of the Doppler spectrum, the quantitative parameters of blood flow in arterial vessels were determined: peak systolic blood flow velocity (Vps), final diastolic blood flow velocity (Ved), volumetric blood flow velocity in the vessels under study. In the portal vein, the vessel diameter was evaluated, the linear blood flow velocity (LBFV) and the volumetric blood flow velocity (VBFV) were also evaluated.

Statistical processing of the results was carried out using Microsoft Excel software and «STATISTICA 6.0.». In this case, parametric methods for evaluating the results were used - the calculation of the arithmetic mean, the standard deviation, the mean arithmetic mean error. Evaluation of differences between the compared groups according to the selected criteria was carried out according to the student's criterion. The reliability of changes was recognized when the probability of error $p<0,05$.

Results and discussion

With the edematous form of AP on the first day, the size of the right lobe of the liver increased: antero-posterior size (AP) — 106,5±6,27 mm (106,5%) ($p <0,05$), upper-lower size (UL) — 124,1±1,78 mm (104,02%) ($p <0.05$), and already from 3 days the dimensions of the right lobe reliably decreased to almost normal values of AP — 105,6 ± 3,1 mm (105,6%), UL — 121,0±3,29 mm (101,00%), which indicates a gradual restoration of the microcirculation of the liver and normalization of the function of hepatocytes against the background of adequate treatment during the initial stage of acute pancreatitis (Table 1).

In pancreatic necrosis, the size of the right lobe of the liver was increased throughout the entire observation period, the maximum organ size was fixed for 3 days AP-114,8±2,1 mm (114,8%) ($p <0,05$); UL-127,2 ±5,15 mm (105,8%) ($p <0,05$). (Table 1).

In the study of the size of the pancreas, it was found that in an edematous form on the first day the size of the gland is enlarged and consists of: head — 36,63±4,11 mm (122,1%) ($p <0,05$), body — 24,25±1,43 mm (97,00%), tail — 23,77±1,68 mm (118,00%) ($p <0,05$). On the third day, the size of the gland comes to almost normal values: the head — 31,74±2,02 mm (105,1%), the body

23,22±2,96 mm (93,2%), the tail — 20,13±2,68 mm (100,1%), which indicates a more favorable course of the edematous form of AP (Table 2).

Table 1.

DYNAMICS OF THE SIZE OF THE RIGHT LOBE OF THE LIVER

Time	*Dimensions*	*Pancreatonecrosis*	*Edematous form*
1 сутки	AP	108,3±2,23*	106,5±6,27 #
	UL	126,5±1,54*	124,1±1,78 #
3 сутки	AP	114,8±2,18*	105,6±3,1 #*
	UL	127,2±5,15*	121,0±3,29 #
6 сутки	AP	111,8±5,72*	104,4±5,03 #*
	UL	124,1±3,54*	118,2±3,42#
9 сутки	AP	110,5±2,99*	102,3±1,59 #
	UL	120,8±4,27	117,6±6,02
12 сутки	AP	109,3±3,17*	99,4±4,72 #
	UL	119,4±2,09	116,6±4,7

Note: * — the difference between the values of the 1st study, reliable at p <0,05; # — difference from patients in the 1st group in the corresponding observation period, reliable at p <0,05.

Table 2.

DIMENSIONS OF THE PANCREAS IN PATIENTS WITH ACUTE PANCREATITIS

Time day/ days	*Pancreas (mm)*	*Pancreatonecrosis*	*Edematous form*
1	head	41,14±4,56 *	36,63±4,11 #*
	body	32,65±2,78*	26,25±1,43 #
	tail	27,47±1,13 *	23,77±1,68 #*
3	head	37,48±2,25 *	31,74±2,02 #
	body	38,96±3,99 *	23,22±2,96 #
	tail	28,12±1,89 *	20,13±2,68 #
6	head	41,47±1,18 *	30,67±1,70 #
	body	50,78±2,98 *	24,85±2,32 #
	tail	30,13 ±4,89*	22,35±2,96 #*
9	head	39,24±2,69*	27,56±2,17 #
	body	47,45±2,98 *	20,98±1,15 #
	tail	31,47±3,07 *	17,18±1,19 #
12	head	38,48±2,31*	25,74±1,15 #
	body	45,89±2,79 *	19,07±1,08 #
	tail	32,01±2,57 *	16,58±1,44 #

Note: * — the difference between the values of the 1st study, reliable at p <0,05; # — difference from patients in the 3rd group in the corresponding observation period, reliable at p <0,05.

With pancreatonecrosis, edema of the pancreas is observed throughout the entire observation period, indicating deep damage to the gland. The maximum indicators were recorded on day 6 of the onset of the disease: head — 41,47±1,18 mm (138,15%) (p <0,05), body — 50,78±2,98 mm (203,12%) (p <0,05), tail — 30,13±4,89 mm (150,23%) (p <0,05). (Table 2).

It was found that in patients with edematous pancreatitis the following dynamics was observed: the maximum figures of the peak systolic blood flow velocity relative to the control group were recorded in the celiac trunk — 126,2±3,7 cm/s (102,59%) (p <0, 05) and in the common hepatic artery — 99,3±2,3 cm/s (107,93%) (p <0,05) on the first day of the disease. By the third

day, the indicators returned to normal. The volumetric rate of blood flow in the celiac trunk in relation to the comparison group in the edematous form of the OP significantly increased from the third day of the disease — 1512,86±152,23 ml/min (118,72%) (p <0,05), reaching a maximum on the sixth day — 1625,75 ml/min (127,61%) (p <0,05), and by the twelfth day 1214,27 ml/min (95,31%) returned to normal (Table 3).

Table 3.

DOPPLER PARAMETERS IN THE STUDY OF THE CELIAC TRUNK, COMMON HEPATIC ARTERY AND SPLENIC ARTERY IN PATIENTS WITH THE EDEMATOUS FORM OF AP

Blood flow indicators	*Day*	*Investigated vessel*		
		Tr. cel.	*A. hep. com.*	*A. lien.*
Vps, см/с	1	126,2±3,7#	99,3±2,3#*	87,4±9,7#
	3	125,5±2,4#	98,4±2,7#*	86,2±7,3#
	6	122,5±3,7#*	95,4±2,3	86,6±2,8#
	9	121,1±5,5#*	93,3±1,8	83,8±5,2#
	12	119,7±6,5#*	92,7±5,3	83,2±1,7#
Ved, см/с	1	36,2±7,2#*	24,8±2,6#	35,5±4,8
	3	35,6±4,5#*	23,4±1,6#	35,7±8,2
	6	34,3±2,8#*	23,2±1,9#	34,4±2,4
	9	35,8±2,5#	22,8±1,1#	33,2±6,7
	12	34,4±7,4#*	22,0±2,0#	32,9±8,1

Note: Vps, cm/s — peak systolic blood flow velocity, Ved, cm/s — peak diastolic blood flow velocity, * — the difference between the values of the 1st study, reliable at p <0,05; # — difference from patients in the 1st group in the corresponding observation period, reliable at p <0,05.

When conducting vascular Doppler in patients with pancreatic necrosis, a significant increase in the indices of peak systolic blood flow velocity was found in all studied arteries in the first six days from the onset of the disease. The maximum values were recorded on the first day of the study and were: in the celiac trunk — 142,3±3,7 cm/s (111,17%) (p <0,05), the total hepatic artery — 117,8±2,5 cm/with (128,04%) (p <0,05), splenic artery — 101,4±8,7 (116,09%) (p <0,05), which indicates an increase in blood flow through the celiac trunk, splenic, total hepatic arteries (Table 4).

Table 4.

DOPPLER PARAMETERS IN THE STUDY OF THE CELIAC TRUNK, COMMON HEPATIC ARTERY AND SPLENIC ARTERY IN PATIENTS WITH PANCREATIC NECROSIS

Показатели кровотока	Day	Исследуемый сосуд		
		Tr. cel.	A. hep. com.	A. lien.
Vps, см/с	1	142,3±3,7*	117,8±2,5*	101,4±8,7*
	3	141,5±1,8*	109,4±2,4*	97,2±4,3#*
	6	140,2±3,7*	95,4±1,5	95,6±3,6
	9	138,5±5,5*	94,3±2,2	93,3±2,3
	12	138,0±1,2*	93,7±8,6	92,3±1,9
Ved, см/с	1	46,2±7,2*	29,8±2,6*	37,5±4,8*
	3	45,6±2,8*	29,4±3,6*	37,2±1,4*
	6	42,4±1,8*	29,2±1,9*	36,8±2,7*
	9	41,7±9,8*	28,1±8,1*	35,8±2,9
	12	41,4±1,7*	27,4±4,2*	35,2±1,7

Note: Vps, cm/s — peak systolic blood flow velocity, Ved, cm/s — peak diastolic blood flow velocity, * — the difference between the values of the 1st study, reliable at p <0,05; # — difference from patients in the 1st group in the corresponding observation period, reliable at p <0,05.

The volumetric rate of blood flow in the celiac trunk with pancreatic necrosis increased over the entire observation period, reaching a maximum on the ninth day — 2014,45 ml/min (158,12%) (p <0,05), which indicates massive endotoxicosis accompanying this form of AP (Table 5).

In the study of patients with edematous pancreatitis, it was revealed that the diameter of the portal vein on the first day of the study also significantly exceeded the control group and was 13,52±0,15 mm (112,67%) (p <0,05), and from 3-day diameter of the portal vein returned to normal — 12,03 ±0,25 mm (100,25%).

In the studied with the edematous form of AP, the linear and volumetric blood flow velocity reached a maximum on the sixth day of 24,25±2,65 cm/s (142,64%) (p <0,05), 2487,17±115,35 ml/min (207,26%) (p <0,05), respectively, further blood flow indicators returned to normal, which indicates the restoration of microcirculation disorders in the liver tissue and the occurrence of hemodynamic conditions for the elimination of portal hypertension.

Table 5.

VOLUMETRIC BLOOD FLOW VELOCITY IN THE CELIAC TRUNK IN THE DYNAMICS IN PATIENTS WITH ACUTE PANCREATITIS

Day	*Pancreatonecrosis*	*Edematous form*
1	1578,14±147,98*	1353,18±165,17
3	1728,98±169,18*	1512,86±152,23#*
6	1965,32±158,19 *	1625,75±112,21 *
9	2014,45±123,58 *	1324,51±144,85 #*
12	1901,42±172,65 *	1214,27±114,52 #*

Note: * — the difference between the values of the 1st study, reliable at p <0,05; # — difference from patients in the 3rd group in the corresponding observation period, reliable at p <0,05.

Conclusions

1. Ultrasound examination of the pancreas against the background of acute pancreatitis showed that in the edematous form of acute pancreatitis, the size of the test organ was increased on the 1st day of the study (on the 1st day — head by 22,1%, tail by 18,0%), and from 3 days the size of the pancreas was reduced to normal values. With pancreatic necrosis, the size of the organ was increased during all periods of observation with maximum values on the 6th and 12th day of the study.

2. Against the background of acute pancreatitis in the forms studied (edematous and pancreatonecrosis), an increase in the size of the liver was observed, indicating its involvement in the inflammatory process. The maximum values of the size of the organ were recorded on the 1st and 3rd day from the onset of the disease.

3. Pancreatonecrosis was accompanied by symptoms of endotoxemia and deep systemic disorders in the form of multiple organ failure, manifested by the appearance of portal hypertension, as evidenced by persistent changes during all periods of observation: an increase in the diameter of the portal vein, as well as acceleration of the linear and volumetric blood flow velocity along the celiac trunk with a maximum of The 9th day (LBFV by 7,2% and VBFV by 58,1% respectively) and veins of the portal system (LBFV by the portal vein by 89,3% and VBFV by the portal vein by 162.3% respectively).

References:

1. Lelyuk, V. G., & Lelyuk, S. E. (2003). Ul'trazvukovaya angiologiya. Moscow, Real'noe vremya, 322. (in Russian)

2. Kuntsevich, G. I., & Belolapotko, E. A. (2004). Tsvetovoe dopplerovskoe kartirovanie i impul'snaya dopplerografiya abdominal'nykh sosudov. Ul'trazvukovaya doplerovskaya diagnostika

sosudistykh zabolevanii. Ivanovo: MIK, 496. (in Russian)

3. Korobkov, D. (2016). Acute intestinal obstruction — a modern vision of the mechanism of development and debated in the range of diagnostic and treatment policy. *Bulletin of Science and Practice,* (12), 147-170 (in Russian)

4. Pugaev, A. B. (2007). Ostryi pankreatit. Moscow. Profil', 335. (in Russian)

5. Buxbaum, J. L, Quezada M., Da B., Jani N., Lane C., Mwengela D., Kelly T., Jhun P., Dhanireddy K., Laine L. (2017). Early aggressive hydration hastens clinical improvement in mild acute pancreatitis. *The American journal of gastroenterology,* 112(5), 797.

6. Manohar, M, Verma, AK, Venkateshaiah, SU, Sanders, NL, Mishra, A. (2017). Pathogenic mechanisms of pancreatitis. *World J Gastrointest Pharmacol Ther,* 8(1). 10-25.

Список литературы:

1. Лелюк В. Г., Лелюк С. Э. Ультразвуковая ангиология. М.: Реальное время, 2003. 322 с.

2. Кунцевич Г. И., Белолапотко Е. А. Цветовое допплеровское картирование и импульсная допплерография абдоминальных сосудов // Ультразвуковая доплеровская диагностика сосудистых заболеваний. Иваново: МИК, 2004. 496 с.

3. Коробков Д. М. Острая кишечная непроходимость - современное видение механизмов развития и дискутабельность в выборе диагностической и лечебной тактики // Бюллетень науки и практики. 2016. №12 (13). С. 147-170.

4. Пугаев А. В. Острый панкреатит. М.: Профиль, 2007. 335 с.

5. Buxbaum J. L, Quezada M., Da B., Jani N., Lane C., Mwengela D., Kelly T., Jhun P., Dhanireddy K., Laine L. Early aggressive hydration hastens clinical improvement in mild acute pancreatitis // The American journal of gastroenterology. 2017. Vol. 112. No. 5. P. 797.

6. Manohar M, Verma AK, Venkateshaiah SU, Sanders NL, Mishra A. Pathogenic mechanisms of pancreatitis // World J Gastrointest Pharmacol Ther. 2017. Vol. 8 No 1. P. 10-25. doi: 10.4292/wjgpt.v8.i1.10.

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