Conference paper

Results of controlled clinical examination of intraoperative reinfusion of blood, taken from pleural cavity in the slow and fast conditions

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Abstract: The controlled clinical examination showed that the decay of erythrocytes and leucocytes under blood reinfusion in experimental control (EC) after intraoperative blood reinfusion (IO RIC) is 35% in slow blood reinfusion, and 48% in fast blood reinfusion. Osmotic resistance is decreased by three times. In fast technical exfusion the blood-hemolysis is more than 28%, what needs to be taken into account in carrying out technical IO RIC. According to CCI results, the faster the technical exfusion is done, the more significant is decrease of protein and bilirubin; besides, in both EC and clinical control. There is a higher concentration of K+, residual nitrogen and urea in blood collected during fast technical exfusion. According to CCI results, the number of thrombocytes is reliably decreased, especially due to the fast blood exfusion. The process of aggregation in these conditions is reliably slowing down; besides, in the fast blood exfusion mode it slows down twice in contrast to the controlled one. The period of plasma recalcification is decreased to 40% due to the high-speed mode of blood exfusion in comparison to the controlled indexes, which is 3 times higher than in the application of the slow blood aspiration.

Key words: controlled clinical examinations, technical intraoperative reinfusion of blood, pleural cavity

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Introduction

According to some authors, decrease in fibrinogen concentration and number of blood plates is presumably tied up partially to their phagocytosis during the process of coagulation in cavity, and also in part to the destruction in the aspiration system (1-7). Meanwhile, increase of thromboplastic activity is seemingly the consequence of presence of tissue factors in blood resulted from tissues damaged during intervention. On the other hand, this can be the outcome of hemolysis (1, 8).

There is an extensive experience of use of technical IO RIC in domestic surgery practice. E.N. Kobzeva (2002) developed the differential tactics of intraoperative fractionation of abdominal and wound autologous blood (6). E.N. Kobzeva notes, that erythrocytes (Er.) used for intraoperative blood reinfusion (IO RIC) and extracted with the use of technical processing, have normal structural-functional properties, what makes them suitable for general functioning after IO RIC (6).

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Research objectives: Comparative characteristic of the results of the examinations listed below, done in focus of controlled clinical examinations (CCE):

1.Experimental control (EC) is an examination of blood collected from pleural and abdominal cavities before and after technical intraoperative blood reinfusion (IO RIC) in conditions of modeling abdominal and chest wounds in animals with formation of hemothorax and hemoperitoneum;

2.Clinical control (CC) – examination of blood, taken from abdominal and chest cavities before and after technical IO RIC from patients with traumas of chest and abdomen with corresponding formation of hemothorax and hemoperitoneum.

Methods

We have conducted series of examinations in 44 patients with abdominal blood losses, which makes 34.3% of the whole number of examined patients (n-128), in whom we used technical IO RIC. Some specimens have been examined during surgeries within first 2 hours as well. Distribution into clinical groups is presented in the Table 1.

The Table 1 shows, the fast blood collection is represented by samples from 18 (40.9%) patients (group A), and that done in the slow mode(Group B) by those from 26 (59.1%) patients. Besides, 18 patients were presenting the clinical group through the assessment of physical-chemical pleural blood condition, whereas 26 patients as regards the abdomen.

Table 1. Clinical groups by assessment of physical-chemical condition of blood collected from abdominal and pleural areas (A, B), also by assessment of effectiveness (C, D) IO RIC, in conditions of fast and slow blood collection modes for IO RIC (n-44)

Groups	CC	N (%)
Assessment of	blood suitability	
A	Assessment of physical and chemical blood conditions, aspirated from pleural and abdominal cavities in slow mode.	18 (40.9)
B	Assessment of physical and chemical blood conditions, aspirated from pleural and abdominal cavities in fast mode.	26 (59.1)
Assessment of IO	RIC effectiveness	
C	Assessment of IO RIC effectiveness under slow blood exfusion from cavity	26 (59.1)
D	Assessment of IO RIC effectiveness under fast blood exfusion from cavity	18 (40.9)

Effectiveness assessment of IO RIC is done to all 44 patients. Their blood is taken in different modes. In the fast mode (group C) the assessment is made in 18 (40.9%) patients, whereas in the slow mode (group D) – in 26 (59.1%) patients.

We have developed a simplest technique of technical IO RIC. The device consists of programmed time relay, connected to micro-vibro-compressor and suction-device. The compressor has adjustment knobs for regulation of vacuum-level. The compressor on its part is connected to a hermetic, sterile tube blood-collector with scale.

The device has the following modus of work: a free end of a trunk line is connected to a tip, with use of which a surgeon during surgery obtains the blood drawn out of abdominal or pleural cavity. The modification contains of silicon 1000ml tube with a scale connected to the vacuum-suction device.

The withdrawn blood is poured into a scaled reservoir with blood-stabilizer. We recommend using the traditional tube CIPK with COLIPK-7b for extensive practice. During the use of modern disposable systems for intravenous infusions, the blood is filtered well enough and by gravity comes into patient's vein.

Table 2. CC and EC parallels in hematological indexes subject to various speeds of blood aspiration for IO RIC				
Control	Indexes	Initial	1st Group	2nd Group
CC	Er.	3.3(0.8)	2.8(0.2)*	2.3(0.3)*,**
	CP	0.7(0.02)	0.5(0.02)	0.5(0.04)*
	Hb	66.2(5.5)	54.4(2.8)*	51.0(2.2)*,**
	Ht	32.2(2.2)	31.5(2.2)*	29.5(2.1)*,**
	Leuc.	4.8(0.2)	4.2(0.1)*	4.2(0.2)*
EC	Er.	3.5(0.3)	2.8(0.1)*	2.2(0.2)*,**
	CP	0.8(0.01)	0.6(0.01)	0.5(0.02)*
	Hb	98.6(7.4)	80.1(3.6)*	56.3(5.5)*,**
	Ht	30.2(3.1)	20.2(2.0)*	14.8(2.2)*,**
	Leuc.	6.6(0.4)	3.4(0.2)*	2.5(0.1)*,**
	Note: * - p<0.05 is significant in contrast to the initial level; ** - p<0.05 is significant in contrast to the 1st group. CC- clinical control, Er. – erythrocyte, EC- experimental control, HB-hemoglobin, Ht – hematocrit, IO RIC – intraoperative blood reinfusion, Leuc. - leucocyte			

Results and discussion

Table 2 shows the dynamics of blood morphology, which is reproduced from the chest area under slow (1st group) and fast (2nd group) modes.

As it is shown in the Table 2, in both EC and CC, number of Er. in the 2nd group is more significantly decreased in comparison to the 1st group (p<0.05). In CC and EC, the same dynamic is observed in relation to CP, hemoglobin (Hb), and hematocrit (Ht). Values of all hemogram indexes in the 2nd group are decreased in contrast to the same of the 1st group. For instance, in EC the Ht index in the 4th group is 2 times lower, than in initial value (p<0.05). On the other hand, in CC, reduction gradient of this index is lower, but the tendency is maintained, as in EC. i.e. it is more salient in the 2nd group than in the 1st one.

Thus, reduction-level of form-elements of blood (Er., leucocytes), in both – EC and CC, is more salient in the 2nd group (48% for EC), (32% for CC).

According to EC leucocytes' number is decreased in the 1st group almost twice, and in the 2nd group almost three times as less (p<0.05 and p<0.05). According to CC, the reduction in leucocytes is in the 1st and the 2nd groups are by 0.8 times respectively.

Table 3 shows physical and blood colloid characteristics, collected from chest cavity in relation to speed of its technical exfusion (slow and fast modes).

Table 3. CC and EC parallels of physical and blood colloid indexes due to different speeds of blood aspiration for IO RIC				
Control	Indexes	Initial	1st Group	2nd Group
CC	Osmotic Resistance Er., %	0.8(0.01)	0.7(0.01)*	0.3(0.02)*
	Hemolysis, % to com. Hb	3.1(0.4)	8.2(0.02)*	10.8(0.3)*,**
	Free Hb of plasma, mg%	1.0(0.01)	6.6(0.6)*	10.4(1.0)*,**
EC	Osmotic Resistance Er., %	0.8(0.003)	0.6(0.02)*	0.4(0.02)*
	Hemolysis, % to com. Hb	6.3(0.3)	8.8(0.07)*	12.3(1.2)*,**
	Free Hb of plasma, mg%	3.3(0.03)	7.7(1.1)*	31.2(2.5)*,**
	Note: * - p<0.05 significant in contrast to the initial level; ** - p<0.05 significant in contrast to the 1st group. CC- clinical control, Er. – erythrocyte, EC- experimental control, Hb-hemoglobin IO RIC – intraoperative blood reinfusion			

As it is shown in the Table 3, osmotic resistance of Er. in EC during technical exfusion is decreased: in the group 1 – by 1.5 times, in group 2 – by 2 times (p<0.05 and p<0.05). Specific weight of free Hb of plasma is reliably and sharply increased in both groups (p<0.05). Meanwhile, in comparative aspect, increase of free Hb in CC has lower salience, than in EC.

According to EC there is a 2 times increase of Hb in the 1st group, and almost 10 times increase in the 2nd group, containing 31.2(2.5) mg% (p<0.05). According to CC free Hb-level in the 1st group is 6.6(0.6) mg%, and in the 2nd group – 10.4(1.0) mg%. Thus, the gradient of concentration-increase of free Hb subject to the fast mode is more salient, in contrast to the slow one. Moreover, in CC this process is less salient, than in EC.

Therefore, blood-hemolysis in the slow mode of exfusion (1st group) is 8.8(0.07)%, and in the 2nd group – 12.3 (1.2)% (p<0.05 and p<0.05). In CC, respectively, 8.2±0.02 and 10.8(0.3)% (p<0.05 and p<0.05).

Thus, the specific weight of formal blood elements' (Er., leucocytes) destruction in view of to the fast technical exfusion mode reaches 48% in EC and 35% in CC.

Table 4 shows the dynamics in values of protein and blood fractions, collected from pleural cavity for IO RIC during the slow (1st group) and fast (2nd group) modes.

Table 4. Parallels of CC and EC protein indexes in various speeds of blood aspiration for IO RIC

Control	Indexes	Initial	1st Group	2nd Group
CC	Protein	54.2(6.6)	50.2(2.2)*	43.2(2.0)*,**
	Albumin	30.2(6.2)	42.5(2.3)*	32.8(6.6)
	Globulin	42.5(2.2)	58.8(2.5)*	55.3(3.8)*
	Albumin/Globulin ratio	1.0(0.05)	0.7(0.01)*	0.6(0.05)*,**
EC	Protein	59.2(4.1)	53.4(3.3)*	41.6(5.1)*,**
	Albumin	41.4(3.9)	40.0(5.1)*	33.5(2.8)
	Globulin	59.2(8.1)	59.4(4.4)*	65.9(3.6)*,**
	Albumin/Globulin ratio	0.7(0.01)	0.6(0.01)*	0.5(0.05)*,**
	Note: * - p<0.05 significant in contrast to the initial level; ** - p<0.05 significant in contrast to the 1st group. CC- clinical control, EC- experimental control, IO RIC – intraoperative blood reinfusion			

As it is shown in the Table 4, in EC decrease of the total protein concentration, as well as its albumin fraction is more salient in the group 2 (p<0.05 and p<0.05). CC traces the same (p<0.05 and p<0.05). This dynamic is common for concentration of albumin too, in both EC and CC. Besides, the gradient of reduction of this protein fraction in plasma is more salient in the group 2, i.e. in the fast mode of blood aspiration (p<0.05 and p<0.05).

The only difference in comparing EC to CC data that the globulin fraction in the group 2 has tendency to increase, while in CC there is a decrease in contrast to the group 1. Thus, the more intensive mode of exfusion leads to more salient reduction of protein and its fractions.

Table 5 shows the dynamics of some biochemical blood indexes, when blood is collected from pleural cavity under the slow (1st group) and the fast (2nd group) modes of exfusion.

Table 5. Parallels of CC and EC biochemical indexes as for various speeds of blood aspiration for IO RIC

Control	Indexes	Initial	1st Group	2nd Group
CC	Bilirubin	15.3(2.4)	18.8(1.2)*	21.5(2.2)*,**
	Residual urea nitrogen	19.3(1.01)	28.2(1.5)*	33.4(2.1)*,**
	Urea	4.8(0.4)	25.8(2.6)*	36.2(2.0)*,**
	Na++	140.2(5.5)	142(2.2)	145(3.1)
	K+	4.1(0.2)	5.0(0.1)*	5.0(0.3)*
EC	Bilirubin, mmol/l	5.2(0.3)	5.6(0.4)	5.2(0.1)
	Residual urea nitrogen	31.4(9.2)	33.6(2.3)*	56.2(6.2)*,**
	Urea	8.2(0.9)	23.6(251)*	66.7(7.7)*,**
	Na++	144.4(3.8)	136(8.8)	144(5.9)
	K+	5.1(0.3)	5.3(0.1*	5.9(0.3)*,**
	Note: * - p<0.05 significant in contrast to the initial level; ** - p<0.05 significant in contrast to the 1st group. CC- clinical control, EC- experimental control, IO RIC – intraoperative blood reinfusion			

As it is shown in the Table 5, there is almost the same bilirubin concentration in compared groups, while residual nitrogen and blood-urea are grown by several times in contrast to initial indexes ($p<0.05$ and $p<0.05$). Besides, the tendency in the 2nd group is more obvious, than in the 1st one.

There is the tendency of increase in bilirubin concentration in CC. Particularly, 18.8(1.2) mmol/l (1st group) and 21.5(2.2) mmol/l (2nd group) ($p<0.05$ and $p<0.05$). This dynamic is typical for residual N, and urea. By the way, the tendency for hyperkaliemia is more perceptible for EC.

K+ concentration in EC of the group 1 is 5.3(0.1) mmol/l, and 5.9(0.3) mmol/l for the group 2 ($p<0.05$ and $p<0.05$). Contra wise, in CC there is the tendency for natriemia ($p<0.05$ and $p<0.05$).

Thus, there is a higher concentration of K+, urea, and residual N in blood collected during the fast technical exfusion, what needs to be considered at technical IO RIC.

On the basis of the extensive blood-hemostasiogram, collected from pleural cavity in dependence to technical exfusion speed (slow and fast modes of aspiration) in EC, we have found that thrombocytes' number is reliably decreased in both groups ($p<0.05$ and $p<0.05$). Besides, in the group 2 this process is more salient, than in the 1st one. Such dynamics and rule are common in aggregation and adhesion of thrombocytes ($p<0.05$ and $p<0.05$).

Thus, during the fast blood collection the process of coagulation is accelerated. It is supported by the fact that there is a fast pace of time shortening for Lee-White's coagulation in EC, in both silicon and non-silicon tubes. One essential note: In the 2nd group, this fact is more salient.

In the 2nd group recalcification of plasma is decreased by almost 2 times in contrast to the initial level ($p<0.05$), and kaolin & kaolin-kefalin plasma-period is >2 times ($p<0.05$ and $p<0.05$), relatively consisting of 30.1(1.9) sec (in contrast to the initial meaning – 64.4(3.8) sec) and 25.5(1.0) sec (in contrast to the initial meaning – 62.4(8.8) sec).

There is synchronic (simultaneous) shortening of thrombin and prothrombin time in both groups ($p<0.05$ and $p<0.05$). Moreover, there is the same regularity, which took place in relation to blood-coagulation time. I.e. the dynamic of time shortening in the group 2 is more noticeable, than in the group 2. Besides, prothrombin time is shortening faster than thrombin time.

Due to this, substance of fibrinogen increases in both groups. Particularly, in group 1 – to 2.4(0.3) g/l and in group 2 – to 3.1(0.2) g/l in contrast to the controlled value – 1.9(0.2) g/l ($p<0.05$ and $p<0.05$). It is found that duration of euglobulin fibrinogen is increased ($p<0.05$). Meanwhile, during all the periods ACT-reactions (6,8 and 10 min) are, in contrary, shortening time wise, especially this process is salient in group 2 ($p<0.05$).

On the basis of the extensive blood-hemostasiogram, taken of pleural cavity in dependence to technical exfusion speed (slow and fast modes of aspiration) in CC, we have found that thrombocytes' number is synchronically decreased in both groups, as well as their adhesion and aggregation ($p<0.05$ and $p<0.05$). In both groups there is observed shortening of thrombin and prothrombin times. Typically, this synchrony and regularity are same in relation to blood-coagulation. Such synchrony is observed in both EC and CC.

Thus, it is obvious in CC and EC, that the dynamic of time shortening in the group 2 is more intensive, than in the 1st one. At the same time as far as both materials, (experimental and clinical) prothrombin time is shortening faster than thrombin time.

As for the fibrinogen concentration, it is definitely increased in the compared groups by data of both – EC and CC. In detail, fibrinogen is increased up to 2.4(0.3)g/l in EC of the 1st group, and to 3.1(0.2) g/l in the EC of the 2nd group, in contrast to the controlled meaning – 1.9(0.2) g/l ($p<0.05$ and $p<0.05$).

In CC indexes have, relatively, 2.6(0.2) g/l and 3.3(0.6) g/l ($p<0.05$ and $p<0.05$). Duration of euglobulin fibrinogen is increased synchronically with that process ($p<0.05$) in both examination materials. It is found that the periods of ACT-reactions (6,8 and 10 min) are shortening, especially in group 2, in average, by 2 times ($p<0.05$).

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