CHANGES LYMPH FLOW, HEART AND TRANSCAPILLARY EXCHANGE FLUID AND PROTEINS REFLEX-HUMORAL INFLUENCES

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Abstract:
This report presents the results of a study lymph, lymph pressure, heart, arterial and venous pressure, state transcapillary exchange of fluid and protein in normal and correlation analysis. In addition, data on changes in the heart and lymph flow if the pressure in the lymphatic vessels and with intramuscular kallekreina. To study the reflex influences of lymphatic vessels to the lymph vessels and the heart of chronic experiments were carried out in 26 sheep with lymph-venous anastomosis and the catheter according to our methodology. We have also revealed the presence of interceptive reflexes and set intralymphatics reflex effect of receptor lymph vessels in the heart. Thus, these data suggest that each region of the body and the body as a whole is determined by multiparametric lymph circulation relationship between different functional systems (lymph, blood, heart activity, the state of biological barriers), providing homeokinesis.

Key Words: Lymph Formation, Perfusion, Intralyuminalny Pressure, Transcapillary Exchange

1. Introduction

Existing concepts of the processes lymph formation, lymph circulation and mechanisms of their regulation primarily composed on the data obtained in dogs and small laboratory animals (1, 2, 3, 4). So far are single (5) research conducted of large mammals, including domestic animals. There is evidence that the experiments carried out on mammals with unique morphological and physiological homeostatic organization will bring some clarity to the knowledge of the general laws of lymph hemodynamics.

This report presents the results of a study lymph flow, lymph pressure, heart, arterial and venous pressure, state transcapillary exchange of fluid and protein in normal and correlation analysis. In addition, data on changes in heart activity and lymph flow with increasing pressure in the lymphatic vessels and with intramuscular injection kallekreina.

2. Materials And Methods

To study the reflex influences of lymphatic vessels to the lymph vessels and the heart of chronic experiments were carried out in 26 sheep with lymph-venous anastomosis and the catheter according to our methodology (6).

Stimulation of receptors perfused lymphatic vessel increased pressure produced by the introduction of warm physiological solution through leading the catheter with a closed deferent catheter (with increasing intralyuminalny pressure). The pressure in the mesenteric lymph vessel increased to 5-8, and in the cervical and liver - to 3-6 mm mercury column.

Duration of exposure to receptors ranged from 30 seconds to 2 minutes.

The value of the maximum and minimum blood pressure was determined by the method (7), and venous - water manometer. The pressure in the lymphatic vessels also measured water manometer by connecting it to a tee area lympho-venous anostomoza. Lymph flow velocity was measured in ml / min through the collection of lymph in about 5-10 minutes, and sometimes drops the lymph flowing from the cannula, which is recorded on the tape elektrokimografa.

For preventing clotting of blood and lymph intravenously administered heparin rate of 1500-2000 ME per 1 kg of body weight.

Blood was taken from the carotid artery, jugular and common mesenteric vein before the morning feeding ("fasting") and it was determined by the total protein content (refractometric) and hematocrit. By arterio-venous difference of protein and hematocrit were determined character transcapillary exchange fluid and plasma proteins (8). Pancreatic kallekrein (firm Vantrop, England) was injected intramuscularly at a rate 40ed, previously dissolved in prolongators.

Accounting for volumetric flow rate of colon and cervical lymph heartbeat, salivation and total protein content made prior to drug administration and at 15, 30, 60, 75 and 90 minutes after injection kallekreina.

All digital material processed by variation statistics methods(9).

3. Results

Experiments have shown that in the rest of the intestinal lymph flow and cervical lymph ducts varies considerably from animal to animal (table.1). However, these variations in terms of lymph flow per 1 kg of body weight practically smoothed and average 0,732 ml/min/kg in the case of intestinal and 0,009 ml/min/kg in respect of cervical lymph.

Conjugacy changes listed in Table 1 of indicators identified in their correlation analysis. Found significant (P <0,001-0,05) positive correlation between the rate of lymph flow from the intestinal lymphatic trunk and minimal blood pressure, or pressure in the common mesenteric vein, or pressure in the lymph vessels. The correlation between the current lymph from cervical of lymph vessel and the above indicators were below the limits of reliability first threshold. Phonocardiogram analysis showed that the short duration of the sheep, and especially long pauses more volatile than the duration of the first and second tones. Long pause less long in sheep with rapid pulse, and conversely, longer in sheep with a rare heart rate.

Found that systolic rate in sheep is directly related to frequency heart rate. Calculations to determine the permeability of the blood vessels based on the testimony the total protein and hematocrit showed that both in the vessels of the systemic circulation, and in the vessels of the intestinal region, the transition is not only fluid but also proteins in the main direction of the fabric → blood, and (in lesser extent) in the direction of the fabric ← blood. Less common state of equilibrium (table.2).

The data in Table 2 show that the loss of fluid and protein is much higher in the vessels of the systemic circulation than in the vessels of the intestinal region. Correlation analysis did not reveal any relationship between systole and movement of water and protein in the direction of the blood → tissue. However, was a significant relationship (P <0.05-0.001) between the loss of fluid from the blood vessels and lymph pressure. Similar connection speed in the intestinal lymph flow and cervical lymph vessels could not be identified (table.1,2).

Table 1

The value of lymph flow, arterial, venous and intra lymphatic pressure in normal sheep

Sheep	lymph flow, ml/min		lymph pressure, mm. water column		arterial pressure, mm. mercury column		pressure in the common mesenteric vein, mm. water column
	intestinal	cervical	intestinal	cervical	intestinal	cervical	
1	0,44	0,09	38	20	120	40	10
2	0,82	0,19	12	8	110	45	9
3	0,90	0,25	20	13	107	57	10
4	1,00	0,22	36	17	110	55	9
5	1,30	0,31	10	16	130	60	14
6	1,40	0,26	68	21	104	62	16
7	1,50	0,36	42	18	108	62	18
8	1,56	0,37	43	20	120	65	18
9	1,60	0,57	48	24	110	65	10
10	1,80	0,85	40	23	104	70	20
M±	1,23	0,34	36	18	121	58	13

Table 2
Indicators of capillary permeability in healthy sheep in normal

sheep	Loss of fluid and protein per 100 ml of arterial blood			
	In vessels of the great circle		In the vessels intestinal region	
	for fluid, ml	for protein,%	for fluid, ml	for protein,%
1	+8	+0,11	-14	-0,10
2	-8	+0,18	-11	-0,06
3	-25	-0,23	-0	-0,16
4	-19	+0,06	-11	-0,24
5	-35	-0,3	-20	-0,12
6	-35	-0,69	-16	-0,18
7	-20	-0,31	-4	-0,19
8	-11	-0,40	-11	-0,21
9	-24	-0,21	-11	-0,13
10	-30	-0,43	-4	-0,08
M±	-23 3,3	-0,34 5,5	-10,2 1,6	-14,4 1,8

Note: Phase (+) represents the water pressure and protein in the direction of tissue-blood (-) blood-tissue and (0) the equilibrium state.

In chronic experiments on 23 animals were studied reflex influences from one to the other lymph lymphatic vessels and heart function (ECG). Increasing intralyuminalny and end pressure in the lymphatic vessels - a receptor in most of the experiments was accompanied by inhibition of lymph flow in the other lymphatic vessels and slowing of heart rate. If prior to stimulation of the lymph flow from cervical lymphatic vessel was 0,32 ± 0,07 ml/min, in a period of increased pressure in the mesenteric lymph vessel he stopped equal 0,09±0,04 ml/min (п=10, P<0,01). This is not by the nature the reaction was observed by the intestinal lymphatic trunk during stimulation of baroreceptors of the cervical lymph trunk. Changes in cardiac function with increasing pressure in the lymphatic vessels (the cervical, mesenteric, hepatic) expressed significant elongation (P <0.01) of the cardiac cycle (P = P), the of unreliable change intervals PQ, PR, TP.

In experiments with intramuscular introduction kallekreina 3 sheep intestinal catheters, cervical lymph ducts and the parotid gland found that in response to the administration of the drug is increased lymph separated, increased heart rate and profuse salivation.

The effect of the lymph flow and heart rate were the highest for 60 minutes, and saliva for 30 minutes (table. 3). Correlation analysis revealed a significant association between intestinal, cervical lymph flow and pulse rate (P<0,001). Analysis of the total protein content showed that 45-60 minutes is a noticeable increase in his intestinal (in 3,2-5,9%) and in the cervical (at 7,9-9,9%) in the lymph (table.3).

Table 3
Change in lymph flow, pulse, salivation and total protein with intramuscular injection kallekrina

Indicators of		Time, min						
		norm	15	30	45	60	75	90
Lymph flow, ml/min	intestinal	1,90±0,08	1,22±0,17	0,78±0,11	1,58±0,35	2,40±0,50	2,30±0,35	1,06±0,12
	cervical	0,46±0,09	0,78±0,18	0,61±0,23	0,70±0,11	1,46±0,28	1,49±0,34	1,51±0,11
Total protein,%	intestinal	3,34	3,32	3,36	3,45	3,54	3,36	3,26
	cervical	2,91	2,56	2,57	3,14	3,20	2,54	2,76
Pulse beats per minute		44,0±1,4	42,0±1,6	51,0±0,08	62,0±2,2	60,0±1,6	52,0±2,1	46,0±0,8

Salivation, ml/min	0,65±0,07	1,30±0,09	1,46±0,15	1,34±0,02	1,07±0,05	0,82±0,06	0,60±0,08

4. Conclusion

Our results show that in normal sheep, there is some association between changes in lymph circulation and blood circulation and transcapillary exchange of fluid and plasma proteins. This relationship was not always clear, which confirms the presence or absence of correlations, the degree of reliability. Apparently, we have identified a positive relationship between the amount having withdrawn from the blood vessels and the pressure of the fluid in the lymphatic vessels in the absence of any correlation between the systole and release fluid from the blood vessels and plasma proteins can be explained. It is known that the pressure of the lymph, which provide its current depends not only on the pressure within the lymphatic vessels, and a number of other supporting factors (10). As for the lack of correlation between the systole and transcapillary exchange of fluid and proteins, there is evidence that the formation of lymph depends not only on the hydrostatic forces, but also on the level of permeability of biological barriers (10). This is also demonstrated by our experiments with intramuscular introduction kallekreina, which caused not only a rapid heart rate, and increased vascular permeability, which is consistent with the literature (11).

We have also revealed the presence of interceptive reflexes and set intra lymphatic reflex effect of lymphatic vessels on cardiac function.

It is known that gematolymphatics balance is maintained and constantly maintained, if there is a balance between transport of fluid from the blood into the tissues and venous and lymphatic return(10).

Comparison of the nature of reflex influences from the lymphatic vessels to the lymph vessels and the heart strongly suggests that the increase in pressure in the lymph collectors, causes inhibition of cardiac activity, apparently, reduce filtration of blood capillaries and thus has a regulating effect gematolymphatics equilibrium body. The same idea is confirmed by experiments with the introduction of pancreatic kallekreina when in 3 cases after a sharp increase in cervical lymph flow (15 min.) reported slowing of heart activity, it is very obvious due to the reduction of intestinal lymph flow for 30 minutes. The same seems to indicate we have identified in these experiments is a direct positive correlation between the cervical and intestinal lymph flow ($P<0,01$).

Thus, these data suggest that each region of the body and the body as a whole is determined by multiparametric lymph circulation relationship between different functional systems (lymph, blood, heart activity, the state of biological barriers), providing homeokinesis.

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