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Composition of Renal Lymph and Its Significance.* (24633)

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Various concepts of the function of renal lymph have been evolved, based largely on indirect evidence(1). The present report deals chiefly with electrolyte concentrations in renal lymph, preliminary data from a study designed to obtain more direct and definitive evidence of its function.

Procedure. Healthy mongrel dogs of both sexes were anesthetized with sodium pentobarbital (25 mg/kg). A polyethylene catheter was inserted into jugular vein *via* 15 gauge needle and utilized for plasma sampling and administration of fluids and drugs. The thoracic duct was cannulated and thoracic duct lymph collected in most experiments. Both ureters were catheterized at their junction with the bladder and urine collected separately from each kidney. Femoral arterial pressure was recorded with a mercury manometer. A left flank incision was employed to expose the kidney. The fat at both poles was usually ligated to engorge the capsular lymphatics and permit their cannulation with #50 polyethylene tubing. Renal lymph was collected in small glass tubes capped with one-hole stoppers to prevent evaporation and volumes estimated to the nearest .05 ml. During the prolonged period of exposure the kidney was covered with saran wrap to prevent evaporation. Sodium and potassium were analyzed with a Baird flamephotometer using internal standards, and chlorides by the method of Schales and Schales(2). Serum, renal lymph, and thoracic duct lymph proteins were analyzed with a Spinco paper electrophoresis apparatus while total protein was determined by the falling drop method(3). Heparin prevented clotting in blood and thoracic duct lymph samples.

Results. Concentrations of Na, Cl, and K in plasma, thoracic duct lymph and renal lymph are given in Table I. Na concentrations of plasma and thoracic duct lymph are similar (averages = 145.7 ± .77 and 145.6 ± 2.6 meq/l. Renal lymph, however, has an average concentration of 162.1 ± 2.8 meq/l, 11.3% higher than the average plasma value, a difference which is significant (P value = <.001). The average value for thoracic duct lymph Cl of 121.3 ± 2.5 meq/l is 9.8% higher than average plasma Cl value of 110.5 ± 4.3 meq/l. This difference is not statistically significant. However, the average Cl concentration of renal lymph is 140.2 ± 3.8 meq/l, 26.9% higher than the average plasma Cl concentration; a significant difference (P value = <.001). There is no apparent correlation between lymph flows and Na concentration as judged by data from 14 dogs or Cl concentration from 6 dogs. The mean K values for all 3 fluids are similar: 4.03, 3.95, and

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TABLE I. Control Values (meq/l) for Renal Lymph, Plasma, and Thoracic Duct Lymph, in 30 Dogs.

Lymph flow, ml/min.	Sodium			Chloride			Potassium		
	R.L.	P.	T.D.L.	R.L.	P.	T.D.L.	R.L.	P.	T.D.L.
	151.6	140.0		125.6	99.3		4.0	4.0	
	190.0	148.4		159.3	100.8				
	153.2	145.2		126.2	84.5		3.6	3.2	
	206.2	146.8	155.2	152.0	132.0	106.5			
	171.0	151.6	146.8	144.0	122.0	115.5			
	164.0	148.4	148.4	152.0	122.0	132.0			
	180.0	151.4	152.8				3.5	3.7	4.4
	172.5	144.3	152.0	164.1	119.5	126.2	3.9	4.5	4.1
		144.0	153.3		80.6	120.9	3.8	4.0	4.4
				151.4	80.6	124.2			
.025	155.0	139.0	146.0	138.2	119.1	122.2	3.9	4.1	3.9
	158.0	140.9	116.6				4.1	4.0	3.5
.015	167.5	146.1	147.3						
	153.5	143.7	139.5						
	169.3	141.3							
	161.3	147.1	152.1	129.7	119.7	123.1			
	152.9	137.7	127.4						
	156.6	140.0	145.9						
	167.3	142.6	148.5				4.2	3.8	3.9
.003	164.3	139.5							
.007	157.3	145.8							
.026	156.0	150.9	152.6				3.9	3.7	4.1
	126.3	144.8							
	149.3	142.4							
	171.7	159.7					5.5	4.8	
.001	150.0	147.5		147.0	125.5				
.04	147.3	148.9		124.6	110.1		4.3	4.1	
.002				133.7	124.2		3.6	3.5	
	164.8	153.2		114.4	118.0				
	160.0	148.5							
Avg	162.1	145.7	145.6	140.2	110.5	121.3	4.03	3.95	4.04

4.04 meq/l for renal lymph, plasma, and thoracic duct lymph, respectively.

Electrophoretic analyses of 5 samples indicate no significant differences between renal lymph and serum in relative proportions of albumin, alpha one, alpha two, beta and gamma globulins. Renal lymph concentration of total proteins is about 60% that of serum while thoracic duct concentration is about 70%. Fibrinogen is present in renal and thoracic duct lymph but the amounts have not been quantified.

Discussion. Our findings lend support to an hypothesis suggested by our data and that of others that renal lymph in the normal functioning kidney is derived from 2 sources: capillary filtrate and tubular reabsorbate. If renal lymph were derived solely from capillary filtrate, there should be no significant differences in electrolyte concentrations of renal lymph and plasma except perhaps that Cl might be slightly higher due to the Donnan effect. Smith(4) suggests that the distal tubule may be able to reabsorb solute independent of water. Thus, in the absence of antidiuretic hormone stimulation, distal tubule reabsorbate containing a concentrated solution of Na and Cl may be mixed with capillary filtrate to form renal lymph. Recent work of Wilde and Malvin(5) indicates the existence of a distal area of very active Na reabsorption. The distal tubule is further implicated as a source of renal lymph by the finding of lower glucose concentrations in renal lymph than in plasma(6) suggesting that renal lymph glucose is derived solely from capillary filtrate and its lower value is due to slight dilution by concentrated reabsorbate. Although we have no measure of total renal lymph flow, the small flows (0.001-0.04 ml/min) obtained from the single capsular lymphatic studied make it unlikely that renal lymphatics play a major role in transporting reabsorbate in the normal kidney.

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Fall in Uterine Histamine Associated with Ovum Implantation in Pregnant Rat.* (24634)

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A role for histamine as decidual cell inducer in the mechanism of ovum implantation has been proposed(1-4). Evidence includes: 1) induction of deciduomata (DCM) by intraluminal histamine(1,5). 2) inhibition of DCM by intraluminal histamine-antagonists (1). 3) induction of DCM by traces (30 $\mu\mu$) of intraluminal histamine releaser 48 '80(6). 4) induction of DCM by systemic (i.p. and i.v.) injections of histamine and of histamine releasers(6), 5) inhibition of systemically induced DCM by intraluminal histamine antagonists(6), 6) inhbiition of natural ovum implantation by intraluminal antihistamine(2). 7) mast cell depletion of rat endometrium immediately before nidation, and 8) intense infiltration of eosinophilic polymorphs before nidation (unpublished). This report measures histamine of uteri of rats during period of ovum implantation.

Methods and materials. Forty-five multiparous female rats (200 ± 20 g) were mated and examined for vaginal sperm before 9 a.m. the next morning. At intervals of 96, 120, and 144 hr after detection of sperm, groups of 5 rats were killed and their uteri removed and weighed. Histamine was extracted in 10% TCA(7). Uteri of 5 rats were pooled for each time-sample. Bioassays (4-pt) were carried out on atropinized guinea pig gut. Confirmation of histamine was by use of histamine antagonist (tripelennamine) at termination of assay. Three groups were done, all under same conditions.

Results. Figure shows values obtained; histamine concentration (μg/g) and total content (μg). Histamine concentration and content of uteri were markedly reduced between 96 hr and 120-144 hr.

Discussion. Since ovum implantation occurs in rats of this colony around 120-135 hrs after mating, and sperm were detected about 8 hr following mating, reduction in histamine concentration and content of gravid uteri took place just prior to implantation. This correlates with the fact that mast cell population of endometrium is reduced to almost zero during 80th to 120th hr after mating. Moreover this time interval fits the period between provocation of progravid endometrium and appearance of first nests of decidual cells(8). These findings add evidence for a role of histamine in the mechanism of nidation related to induction of decidual cell reaction. The release of histamine is effected by estrogens. Limited and preliminary histamine assays of 10% TCA extracts of uteri of spayed rats, 90 and 180 min after injection of 20 μg of estradiol show relase of histamine by estrogen(9). Spaziani and Szego(10) have recently demonstrated significant decrease of uterine histamine following single injection of estradiol-

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