

4951

Calcium and Phosphorus Content of Epithelial Lined Cysts From
Transplantation of Mucosa of Urinary Bladder to Rectus
Sheath in Dogs.*

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(Introduced by Edmund Andrews.)

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In a preliminary report, one of us¹ described the formation of bone around a portion of a cyst lined by transitional epithelium resulting from transplantation of bladder mucosa to certain connective tissue areas (one of which is the sheath of the rectus abdominis muscle) in the dog. Similar transplantation in the rabbit is rarely followed by bone formation. The cysts contain a sero-sanguinous fluid in small amounts, rarely more than 4 cc., usually about 2 cc. when a circular area of bladder mucosa 2 cm. in diameter is transplanted.

It seemed of interest to determine the calcium and phosphorus content and the hydrogen ion concentration of this fluid and to compare these values with similar simultaneous determinations of the blood serum. In 3 rabbits in which bone did not occur around the transplant, determinations were made of the inorganic phosphates and hydrogen ion concentration of the cyst fluid and of the blood serum.

The fluid was aspirated through the skin with an 18 gauge needle and was drawn under oil. Calcium was determined by the Clark and Collip² modification of the Kramer and Tisdall³ method in most instances. In 3 of the determinations the organic material was destroyed by heating with concentrated sulfuric acid before using the above method, with approximately the same results. Phosphorus was determined by the method of Fiske and Subbarow.⁴ Carbon dioxide content of the serum and cyst fluid was determined by the manometric method of Van Slyke and Neill.⁵ The bicolorimetric method suggested by Myers⁶ and Hastings⁷ was used for determining the hydrogen ion concentration.

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¹ Huggins, *Proc. Soc. Exp. Biol. and Med.*, 1930, xxvii, 349.

² Clark and Collip, *J. Biol. Chem.*, 1925, lxxiii, 461.

³ Kramer and Tisdall, *J. Biol. Chem.*, 1921, xlvii, 475.

⁴ Fiske and Subbarow, *J. Biol. Chem.*, 1925, lxvi, 375.

⁵ Van Slyke and Neill, *J. Biol. Chem.*, 1924, lxi, 523.

⁶ Myers, *J. Biol. Chem.*, 1922, liv, 675. Myers, Schnitz and Booher, *Ibid.*, 1923, lvii, 209.

⁷ Hastings and Sendroy, *J. Biol. Chem.*, 1924, lxi, 695.

TABLE I.

Dog No.	Date	Days Transp.	Cyst Fluid				Blood Serum				Ossification in Cyst	
			cc. of Fluid	Ca*	P*	CO ₂ †	pH	Ca*	P*	CO ₂ †		pH
256	9-10-29	62	3.0	15.9	11.0		6.32	10.4	5.16	43.16	7.51	++
212	9-10-29	47	3.6	15.6	9.6		6.45	10.98	3.44	49.2	7.57	++
215	9-14-29	80	5.4	10.77	8.23		6.35	10.77	4.91		7.43	++
543	11-18-29	29	2.6	13.35			7.35	10.34			7.42	++
543	12-18-29	59	10.0	10.72	5.9		6.97	11.07	5.33		7.53	++
689	2- 3-30	33	2.2			16.4	7.27	11.6	5.3	45.3	7.44	++
724	2- 3-30	57	5.0	11.04	4.4	18.3	7.02	10.8	5.71	51.5	7.45	++
986	2- 3-30	35	9.0	16.3		28.6	7.17	11.2	5.16	51.3	7.44	++
821	3-10-30	62	0.5					11.6	6.15			++
986	3-10-30	69	0.8	15.2				11.6	6.2			++

*Milligrams for each 100 cc.

†Volume per cent carbon dioxide content.

TABLE II.

Dog No.	Date	Days Transp.	Cyst Fluid				Blood Serum				Ossification in Cyst	
			cc. of Fluid	Ca*	P*	CO ₂ †	pH	Ca*	P*	CO ₂ †		pH
928	2- 3-30	100	6.0			114.7	7.69	12.20	6.66	55.9		+
873 & 506	3-10-30	49 & 62	0.65	17.4				11.86	6.25			Cyst grossly infected
212	6-24-29	267	3.0	23.5	5.22			10.5				++
821	4-16-30	113	1.5	18.2	3.0			12.6	6.67			++
689	4-16-30	118	1.8	16.6	3.0			12.6	6.67			++
869	4-11-30	67	2.4	16.0	16.8			10.46	6.4			++
Rabbit No.												
348	12-30-29	50	0.75		7.16		7.32		7.02		7.35	No ossification
353	12-30-29	50	0.6		7.4		7.34		6.7		7.39	No ossification
362	12-30-29	50	1.0		6.7		7.35		7.04		7.34	No ossification

*Milligrams for each 100 cc.

†Volume per cent carbon dioxide content.

The results are tabulated in Tables I and II. In 10 of 13 determinations, the calcium was higher in the cyst fluid than in the blood serum. In 5 of 8 determinations of phosphorus, it was higher than in the serum. In 8 of 9 determinations, the cyst fluid was more acid than the blood serum.

In 2 cases the cysts were grossly infected and here the calcium was lower than in the blood serum. In the rabbits, no bone was formed and the hydrogen ion concentration and phosphorus content of the cyst fluid did not differ markedly from similar values in the blood serum.

4952

Effect of Bile Salts on the Blood Calcium.*

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The relation of calcium metabolism to jaundice has long been a matter of clinical observation. Changes in the bones following both cholemia and prolonged loss of bile are a matter of common knowledge.

More recent work by Walters¹ and Heyd² and others has put the therapy of jaundice by the intravenous injection of calcium chloride on a very firm clinical basis so that it is used as a routine in many clinics today. While the effect aimed at has generally been the decrease in the coagulation time of the blood as a preparation for surgical therapy, the results achieved have gone further than that, and it is without a doubt true that there is also a marked temporary detoxification produced by the intravenous injection of large amounts of calcium chloride.

The studies of Still³ have shown clearly that it is the bile salts which are the offending factor in cholemia as the other elements of the bile are nontoxic.

Buchbinder and Kern⁴ have shown that in animals and man the

* This work was done in part under a grant from the Douglas Smith Foundation for Medical Research of the University of Chicago.

¹ Walters, W., *Minnesota Med.*, 1925, vi, 25.

² Heyd, C. G., *Am. J. Obst. and Gyn.*, 1930, xix, 203.

³ Still, E. U., *Am. J. Physiol.*, 1929, lxxxvii, 728.

⁴ Buchbinder, W. C., and Kern, R., *Am. J. Physiol.*, 1927, lxxx, 273.