solution droplet, the oil is not moved from the tubular walls, and that the area over which absorption takes place is less than that which is measured because of the presence of oil microdroplets. One of the more striking features of the solution droplet is the fact that it is sharply curved inward. This shows that the tubule walls are strongly hydrophilic. It does not seem reasonable therefore, that interference by residual oil is likely. Tubule hydrophilia may, however, be responsible for introducing an error into the results. Because the contact angle is small, the effective area over which water movement is taking place may actually be greater than that which is measured, thereby causing overestimation of the reabsorption rate.

Two kinds of control experiments have been done. In animals which have died during preparation for an experiment, a steady state size has not been observed to be attained within a surface loop at a time which is at least 10 minutes after time of death. This shows that water movement had been depressed. When infusion solution was lightly colored with trypan blue, it was seen that color intensity of the intratubular droplet increased as time passed. These experiments showed that removal of fluid did not result from infusion solution slipping past the oil column. It has now become standard practice to color slightly the infusion solution with dye to make the solution droplet more apparent. Furthermore, if excessive damage is done in the puncturing process, intense local staining of the cells around the pipette tip is usually observed. As might be expected, certain proximal cells show some cellular staining(3).

Summary. A method has been described for measuring net rate of water movement across single tubules of rat kidney *in situ*. Water is reabsorbed at a rate of 9.3 $\pm$ 1.3 μ^3/μ^2 proximal tubular surface/hr. Possible criticisms of the method have been discussed.

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Received April 8, 1959. P.S.E.B.M., 1959, v101.

Secretion of Cholesterol by Intestinal Mucosa in Patients with Complete Common Bile Duct Obstruction.* (24890)

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A mixture of endogenous and exogenous cholesterol is absorbed from the lumen of intestine. The endogenous portion (total secretion) normally consists of one fraction secreted by liver in bile and a second secreted by the intestine. It has been determined in normal man under standard conditions of food intake that there is a total secretion of approximately 2 g/day of cholesterol into the gut(1,2, unpublished). The method by which these results were obtained is summarized below. Two other groups of investigators, one using a special balance method(3), the other by determining dilution of fed C^{14}-cholesterol in chyle collected from urinary fistula(4), have obtained similar results. Such determinations indicate the *sum* of quantities secreted in bile and by intestinal mucosa since in normal man contributions from the 2 sources can not be separated. This paper reports results of such studies in 3 patients with complete obstruction of common bile duct due to carcinoma of the head of the pancreas. In these patients the fraction usually gaining access to gut *via* the bile had been excluded so that all of endogenous cholesterol in the lu-

* Aided by grants from Nat. Inst. of Arthritis and Metabolic Dis., N.I.H., P.H.S.

TABLE I. Results of Intestinal Cholesterol Exchange Studies in 3 Patients with Complete Biliary Obstruction Due to Carcinoma of Head of Pancreas.

			Cholesterol					
				Excretion		Absorption		
Patient	Age	Sex	Intake, mg/day	C^{14}, %	Total, mg/day	C^{14}, %	Total, mg/day	Secretion, mg/day
J.J.	49	♀	45	91.5	400	8.5	37	392
J.P.	47	♀	60	63	292	37	171	403
O.M.	73	♀*	45	>99	300	<1		255

* This patient had diarrhea during the study. The others had formed stools throughout.

men had been secreted by intestinal mucosa. Under these conditions intestinal secretion equals total secretion and quantification of the latter is equivalent to measurement of intestinal secretion. Determination of quantity of cholesterol secreted by intestinal mucosa, either in animals or in man, has not previously been reported.

Methods and material. The method was previously described(1,2). In brief, each patient was fed a low-cholesterol, semi-synthetic liquid diet containing an inert nonabsorbable indicator; to food fed the second day a small quantity of free C^{14}-cholesterol was added. Fecal excretions of unabsorbed C^{14}-cholesterol and of stable cholesterol were estimated with the aid of inert indicator and verified by calculations of the sum of the quantities of these compounds contained in total collections of stools. It was assumed that free C^{14}-cholesterol fed in food and the cholesterol secreted into gut lumen were metabolized in the same manner and that the same proportions of each that had originally been present in intestinal contents were excreted in the stools. Under these conditions size of total cholesterol "pool," or total cholesterol available for absorption (TCAA) $= \frac{C_s}{C_1} \times 100$, where C_s is rate of stable cholesterol excretion (g/day) in stools and C_1 is percentage of administered C^{14}-cholesterol unabsorbed and excreted in the stools. TCAA-intake = daily secretion into the gut. Our studies were carried out immediately preoperatively in 3 patients with carcinoma of the head of pancreas that led to obstruction of the common bile and pancreatic ducts. In all 3, absence preoperatively of urobilinogen in urine and observations at operation indicated that obstructions to the biliary and pancreatic ducts were complete. Examination of surgical specimens removed from 2 patients confirmed this; resection was not done in the third patient (O.M.).

Results. In these 3 patients (Table I) fecal excretion of unabsorbed ingested C^{14}-cholesterol was large and varied from more than 99% in O.M. who had diarrhea, to 63% in J.P. Concurrently the stable cholesterol excretion varied from 292 to 400 mg/day. As diminution of absorption of stable cholesterol was assumed to correspond to that of C^{14}-cholesterol it was calculated that from 255-403 mg/day had been secreted into the gut.

Discussion. As expected if the major source of cholesterol secreted into the gut were bile, under these conditions there was marked diminution of secretion from normal values of 2 g or more to 400 mg or less/day. As evidence was quite definite of completeness of obstruction to bile flow into the intestine, the conclusion that these reduced quantities of cholesterol were "secreted" solely by mucosa was justified. These amounts were evidently the sum of secreted cholesterol plus quantity of this sterol contained in desquamated epithelial cells. It is not known how abnormalities that accompanied obstruction of the common bile duct (complete exclusion of bile and pancreatic secretion from intestine; general impairment of digestion and absorption; increased serum concentrations of bile acids, bilirubin and free cholesterol; decreased serum concentration of ester cholesterol) influenced normal mucosal secretion of cholesterol. However, it has been established that a constituent of pancreatic secretion, presumably cholesterol esterase, and normal enterohepatic circulation of bile are both necessary for normal transfer of cholesterol from lumen of gut to the chyle(5). As cholesterol absorptive

function was demonstrably markedly deranged, presumably as a result of abnormalities induced by exclusion of bile and pancreatic secretion from the gut, the secretory function of the mucosa may also have been modified. Hence no conclusions as to quantity of cholesterol normally secreted by the mucosa can be drawn.

The sum of biliary and intestinal cholesterol secretions totals more than 2 g/day in normal persons under our conditions(1,2). If mucosal secretion normally were not greater than 400 mg/day, found in 2 of our subjects then there is more than 1.5 g/day of cholesterol normally secreted in the bile. This is a larger quantity than is usually estimated from studies carried out in bile fistula patients (6). Results obtained by the latter method may vary from normal, because of error in estimating the proportion of bile diverted into the fistula, because of partial exclusion of bile from the gut, and because studies were carried out in patients with diseases of the biliary tract.

Summary. In 3 patients with complete obstruction of biliary and pancreatic ducts cholesterol "secretion" by intestinal mucosa was 250-400 mg/day. Quantification of this function in either man or animals has not been reported previously.

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Received March 9, 1959. P.S.E.B.M., 1959, v101.

The Dwarf Mouse—An Animal with Secondary Myxedema.* (24891)

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It has been concluded that dwarfism in the house mouse is inherited as a recessive Mendelian characteristic dependent upon a single gene(1). Dwarfism results from hypofunction of the hypoplastic pituitary gland(2,3). It has been reported that there is an almost complete lack of eosinophil cells in the anterior pituitary, accompanied by deficiency in growth hormone production(2,3). Snell(4) first demonstrated that thyroid of the dwarf mouse was defective. Later(2,3) morphology of dwarf-mouse thyroid was investigated more thoroughly. Smith and MacDowell(2) and Kemp and Marx(3) found that thyroid tissue was interspersed with adipose and fibrous connective tissue which made it impossible to dissect and weigh the gland as a separate organ. Gland tissue present showed signs of delayed function. In addition, 30-40% lower basal metabolism occurred in dwarf mice as compared to normal mice of same age(5). A histological study of the thyroid from a few thyrotropin-stimulated dwarf mice showed no structural changes to indicate increased activity(3), but by daily transplants of fresh rat pituitaries into dwarf animals, small body size, sterility, and associated endocrine abnormalities, including thyroid changes of hereditary dwarfism, were corrected(2). All available data suggest secondary deficiency of the thyroid, but which pituitary hormone insufficiency is responsible has not been clarified. With modern technics, it is possible to obtain more exact information as to the cause of thy-

* Aided by grants from Danish State Research Fn. and Sigrid Juselius Stiftelse, Finland.

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