ON THE QUESTION OF THE "WHITE" BILE

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 52, No. 10,
pp. 21-25, October, 1961.
Original article submitted July 22, 1961.

Despite the fact that the "white" bile has interested clinicians and researchers for a long time, there is no unified opinion in the literature on the nature of this bile.

In the opinion of a number of authors [3, 5, 6, 10, 11], the imperative condition for the formation of "white" bile is a disruption of the outflow of liver bile as a result of the presence of obstructions in the biliary ducts. The majority of these authors consider that the "white" bile is formed in the intrahepatic biliary ductules through increased mucus secretion, depression of biliary secretion by the liver cells under the influence of the elevated pressure in the biliary ductules, and reabsorption of the bile pigments.

Certain investigators [2, 4, 9, 12] explain the appearance of "white" bile as coming from an overworked liver, or the result of toxic injury to the liver tissue, with an intact outflow along the bile ducts. In this case, in the opinion of Soejima [12], a disturbance occurs in the bilirubin-forming capacity of the liver.

Some authors suggest the secretion of a special colorless bile pigment – leukobilin [9]. The majority of investigators give the following description of the "white" bile : clear, colorless, viscous fluid, with a larger or smaller mucin content, a low specific gravity, and in which the bile acids, bilirubin and cholesterin, are completely absent or are found in traces. According to the description of B. P. Solopaev [4], the "white" bile contains a precipitate of protein origin, with all its component parts present in it.

Comparative Characteristics of Normal and "White" Bile in Dogs after Being Fed 50 g of Egg Yolk

Component	Amount of normal bile (in ml)					
	before feeding (starting level)	hours after feeding				total
		1st	2nd	3rd	4th	
	Amount of bile obtained from the					
	2,5	9,5	9,0	6,0	12,0	36,5
	Biochemical					
Dense residue	(8,33) 208,3	(4,96) 471,3	(3,24) 292,0	(2,42) 145,6	(2,4) 253,3	(3,18) 1 162,2
Organic substances	(7,28) 182,2	(4,35) 414,3	(2,8) 252,2	(2,21) 132,6	(1,68) 202,4	(2,74) 1 001,5
Inorganic substances	(1,05) 26,15	(0,61) 57,02	(0,44) 39,81	(0,21) 12,94	(0,43) 51,6	(0,44) 161,4
Bile acids	(1 480) 37,0	(1 050) 99,75	(1 690) 152,1	(1 130) 67,8	(1 050) 126,0	(1 220) 445,65
Bilirubin	(77,26) 1,93	(62,91) 5,97	(26,33) 2,36	(42,16) 2,52	(58,12) 6,97	(49,3) 17,82

Note: In parentheses – dense residue, organic and inorganic substances in percents;

S. O. Portugalov describes four varieties of a dilute state of bile, associated with changes in the function of the liver and bile ducts :

1. "Dropsy" – extremely clear fluid with a low mucus content, and devoid of protein, bile pigments and sugar; absolutely sterile.

2. "White" bile – clear fluid of a watery consistency, with a greater or lesser mucus content.

3. "Milk-lime" bile – opaque white fluid, rather resembling milk of lime, with a high concentration of carbonates, a low concentration of sulfates, and a still lower concentration of chlorides. Bilirubin is weakly positive. Microscopically, there is a large accumulation of lime crystals.

4. "Irrigating" bile – absolutely clear fluid, with a light yellow-green coloring, containing all the elements of normal bile, but in a state of dilution by a factor of two or more as compared with the normal.

Kummel [11] notes that the "irrigation" bile is more coarsely diluted, with gross flocculent masses.

Our experimental observations on the extrasecretory function of the liver serve as a foundation for advancing some of our conclusions on this question.

EXPERIMENTAL METHOD AND RESULTS

In experiments on 4 dogs (Ryzhii, Belyi, Shustryi, Mal'chik), operated on according to the method of I. P. Pavlov, and 2 dogs (Dzhek and Pushok), by the method of Fol'bort, we observed the following phenomena.

After a food stimulus was given (100 g of meat, 600 ml of milk, 50 g of egg yolk), the bile secreted on an empty stomach through a fistula in the bladder, was directed into the common bile duct, and after a certain latent period, entered the duodenum. At this time, bile was obtained through the bladder fistula which was absolutely colorless, viscous, and slightly cloudy, representing mucus containing a varying amount of admixed inflammatory exudate, formed as a result of an inflammatory reaction around the metallic fistulla of the bladder.

These observations coincide with the investigations of G. V. Fol'bort [7], V. M. Shaverin [9], and E. D. Buglov [1].

Sometimes, after the food stimulus was given, we observed the outflow of a mucus sample through the terminal fistula of the duct. The latent period in these trials was elongated by 2-3 times, due to the more difficult slow extrusion of the mucus sample, after which secretion of the normal bile began. The presence of a mucus-

(Table continued from preceding page)

Amount of "white" bile (in ml)					
before feeding (starting level)	hours after feeding				total
	1st	2nd	3rd	4th	
fistula in the duct and bladder (in ml)					
7,0	6,2	16,0	10,5	15,0	47,7
data					
(4,89)	(13,35)	(5,83)	(3,93)	(4,30)	(5,91)
342,7	828,0	933,3	413,4	645,7	2 820,4
(3,99)	(12,21)	(4,95)	(3,46)	(3,83)	(5,18)
279,6	747,2	791,1	364,1	566,2	2 468,6
(0,90)	(1,14)	(0,88)	(0,47)	(0,53)	(0,73)
63,14	80,78	142,22	49,34	79,47	351,81
(1 590)	(1 210)	(870)	(2 320)	(1 390)	(1 394,7)
111,3	74,02	139,2	243,6	208,5	665,32
(37,37)	(32,58)	(15,03)	(13,63)	(12,04)	(16,04)
2,61	2,02	2,4	1,43	1,8	,65

bile acids and bilirubin in mg %.

containing sample in the duct of dogs with a fistula in the gall bladder, where the possibility of mucus from the bladder entering the duct was excluded, serves as evidence for its formation in the biliary ductules themselves.

A. L. Stukkheiand A. R. Chernyavskii [5], and E. D. Chernevich [8], observed a viscous, clear fluid in the bladder and duct of patients with calculus-forming cholecystitis and obstruction of the common bile duct; apparently, it was an accumulation of mucus.

In our investigations, after removal of the thyroid gland in the dog, Dzhek, where we excluded the effect of contents in the gall bladder, "white" bile was obtained in 10 trials out of 12 only by feeding egg yolk, this occurring in the setting of a high level of bile output.

As a rule, in the first 1-2 hours of observation after feeding the egg yolk the bile samples were normal, with the usual color and without sediment; then, in the 2nd, 3rd, or sometimes, 4th, hour, "white" bile was secreted. When the secretion of bile containing the white flocculent sediment ceased, at the end of the 4th or 5th hour of observation, the secretion of normal bile began again. In no instance did we obtain "white" bile in response to feeding milk or meat, even in those cases where the amount of bile secreted was great.

In the dog, Shustrii, "white" bile was obtained in the 3rd and 4th hour of observation after the egg yolk feeding in 6 trials out of 16, in the 4-5th hour after the meat feeding in 3 trials out of 32, and in the 4th hour of observation after the milk feeding in one trial out of 26. In two trials, "white" bile was obtained in Shustrii even before removal of the thyroid gland.

The "white" bile contained a large quantity of flocculent sediment, which reached up to 1/5 of the total volume of the bile after precipitation. After agitation of the bile it took on a milky, frosted appearance with a light yellow tint. Microscopically, isolated leukocytes were observed in the sediment, plus a minmal number of epithelial cells and a large quantity of a formless mass, more readily suggesting threads of fibrin than cells or crystals. The sediment almost completely burned in a muffle furnace. The fluid part of this bile had the color of light, moist, egg yolk, and was clear.

Below is presented a comparative table of the biochemical composition for normal and "white" bile, obtained after a feeding with 50 g of yolk.

As can be seen from this table, the absolute content of dense sediment, inorganic and organic substances, and the amount of bile acids in the "white" bile was higher than in the normal, while the concentration of bilirubin was considerably lower. Thus, in 36.5 ml of normal bile, in the trial performed on November 15, 1957, there were 17.82 mg of bilirubin, while in the experiment on January 17, 1958, in which "white" bile was secreted in the 2nd, 3rd, and 4th hour, there was 7.65 mg of bilirubin in 47.7 ml of bile, i. e., less than half. In this case the concentration of bilirubin in the normal bile, in the 2nd, 3rd, and 4th hour of observation, ranged from 26.33 to 58.12 mg% while the concentration of bilirubin in the "white" bile in these same hours was lowered to 15.03 - 12.04 mg%.

Hence, "white" bile is characterized by the presence of a large amount of flocculent sediment, protein in nature, and a decrease in both the relative and absolute concentration of bilirubin; it contains a normal concentration of bile acids.

Similar bile was obtained by B. P. Solopaev after partial resection of the liver in dogs whose common bile ducts were tapped to the outside.

S. O. Portugalov [3] and Kummell [12] call this bile "irrigating" type. In the opinion of S. O. Portugalov, irrigating bile is formed as a result of a complication in the outflow, an increased formation of mucus, and depression of bile formation.

In our opinion, "white" bile is derived from the liver itself, since it is produced only at the most active point in the digestive process, and in response to a strong food stimulus. Apparently, a transient exhaustion of the liver's capacity for bile formation takes place, secondary to the effect of an extreme stress on the liver tissue. This is also supported by the fact that the "white" bile appears when there is high intensity of bile formation.

The described phenomenon is probably related to an increase in the membrane permeability of the liver cells, allowing the passage of more coarsely dispersed protein; this enters into the flocculent sediment portion of the bile. Along with this, there occurs a decrease in bilirubin formation.

Thus, based on our observations and an analysis of the literature, we postulate that a number of investigators, dealing with mucus or with inflammatory exudate admixed with mucus, and associated with "dropsy" of the biliary ductules, cholecystitis, or cholangitis, are incorrectly calling it "white" bile.

SUMMARY

Experiments were performed on dogs with a gall bladder and common bile duct fistula. "White" bile obtained was characterized by the presence of much floccular precipitate of protein nature and by reduction of both relative and absolute bilirubin content with the normal bile acid content. "White" bile is a derivative of the liver itself, since it is secreted only at the height of digestion in response to intensive food stimulus. Evidently there is a momentary depression of the bile-forming function of the liver. This is confirmed by the fact that "white" bile appears during high intensity of bile formation with normal bile discharge.

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