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Studies on human bile

III. Composition of duodenal bile from healthy young volunteers compared with composition of bladder bile from surgical patients with and without uncomplicated gallstone disease

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With 3 figures and 6 tables

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Studies on the influence of diet or pharmaca on the composition of human bile have been carried out in healthy young volunteers whose duodenal bile was collected after injection of cholecystokinin (1, 2, 3).

Since duodenal bile is a mixture of bladder bile with other secretions, primarily pancreatic juice, and changes in the composition may occur during the collection procedure through hydrolysis and absorption of certain of the components, it is of interest to compare the composition of duodenal bile collected from healthy young volunteers not receiving treatment with the composition of bladder bile from certain well defined groups of surgical patients.

In the present study, duodenal bile from 42 healthy young volunteers (Group V) was compared with bladder bile from 27 surgical patients not having gallstones or diseases of liver and biliary tract (Group A) and with bladder bile from 26 surgical patients having gallstones with known content of cholesterol and ash constituent, functioning gall bladder, essentially normal values in the usual liver function tests, and no icterus (group B, subgroups B_1 and B_2).

The components of the bile examined were: (besides pH) dissolved dry matter, cholesterol, lipid-soluble phosphorus, bile acids, and for part of the biles also the fatty acid composition of bile lecithin.

Experimental

Duodenal bile was collected (from the second to fourth part of the duodenum) as described in our previous study (1). This procedure was performed in the Gastroenterological Laboratory of the University Hospital. The several fractions of the volunteer's duodenal content, collected in centrifuge tubes packed in ice, were speedily brought to the Department of Biochemistry and Nutrition of the Polytechnic Institute. After rapid centrifugation, the pH was quickly determined, and those fractions having pH above 6.9 were combined for analysis.

Determination of the concentrations of dry matter, cholesterol, lipid-soluble phosphorus and the different fractions of glycine- and taurine-conjugated bile acids were carried out as

described previously (4), using SJÖVALL's paper chromatographic methods for determination of the bile acids.

For isolation of bile lecithin, the phosphatides were originally separated from non-phosphatidic lipids on a short column of silicic acid, whereafter lecithin was separated from other phosphatides by thin-layer chromatography as described in reference 1. Later it was found that separation on silicic acid column was unnecessary, i. e. the chloroform solution containing both phosphatides and non-phosphatidic lipids can be applied directly to the thin-layer plate. Methylation of the fatty acids of the lecithin and gas-liquid-chromatography of the methyl esters were carried out as previously described (1).

Bladder biles from surgical patients undergoing cholecystectomy and from patients being operated for duodenal or gastric ulcer were obtained by puncture of the vesica fellea. The samples were brought to the Department of Biochemistry and Nutrition as quickly as possible, centrifuged immediately upon arrival and analyzed as described.

Results and Discussion

The results are presented in tables 1–6 and figs. 1, 2 and 3.

From tables 1, 2 and 3 it is seen that the mean values for the concentrations of dissolved Dry Matter, Cholesterol, Lipid-soluble Phosphorus and Total Bile Acids[1] are lower for the duodenal biles (group V) than for the bladder biles from patients not having gallstones or other diseases of the liver and biliary tract (group A) and from patients having gallstones but functioning gall bladder (group B) although the mean values for these components are lower in group B than in group A. (A closer consideration of the figures in group A shows that the mean values of the concentrations of dry matter, cholesterol (C) lipid-soluble phosphorus (P) and total bile acids (TBA) were somewhat higher for the bladder biles from patients having duodenal ulcer than for the bladder biles from patients having gastric ulcer. Likewise, the mean values of the concentrations of dry matter, C, P and TBA were somewhat higher for the 17 men than for the 10 women but here the differences were less pronounced).

The mean value of the ratio between Glycine-conjugation and Taurine-conjugation (ratio G/T) is somewhat lower in group V (1.81) than in group A (2.44) and in group B (2.53). Values above 4.0 occur only in one case in group V but in 5 cases in group A and in 3 cases in group B. High values of the ratio G/T are known to be favored by certain abnormal conditions, e. g. insufficient supply of sulfur-containing amino acids (HELLSTRÖM & SJÖVALL (6), BARRY et al. (7)), deficiency of vitamin B_6 (BERGERET & CHATAGNER (8), DOISY et al. (9)) and by hypothyroidism (SJÖVALL (5), HELLSTRÖM & SJÖVALL (6)). Therefore, the somewhat lower mean value of ratio G/T in group V probably more nearly represents a normal value than do the mean values found in Groups A and B.

The mean value of the ratio between Dihydroxycholanoic acids and Trihydroxycholanoic acids (ratio Di/Tri) is slightly lower in group V than in groups A and B but the difference is not significant.

The molar ratios Total Bile Acids/Cholesterol (TBA/C), Lipid-soluble Phosphorus/Cholesterol (P/C) and Total Bile acids/Lipid-soluble Phosphorus (TBA/P) in the

[1] Apart from small amounts of certain bile acids not determined by the methods used, the amount of total bile acids (TBA) is equal to the sum of glycocholic acid (GC), glycochenodeoxycholic acid (GCD), glycodeoxycholic acid (GD), taurocholic acid (TC), taurochenodeoxycholic acid (TCD) and taurodeoxycholic acid (TD). The method used does not separate the latter two bile acids from each other. They are determined as (TCD + TD).

three groups are most conveniently compared when the values are represented graphically as in figs. 1, 2 and 3 (logarithmic scale).

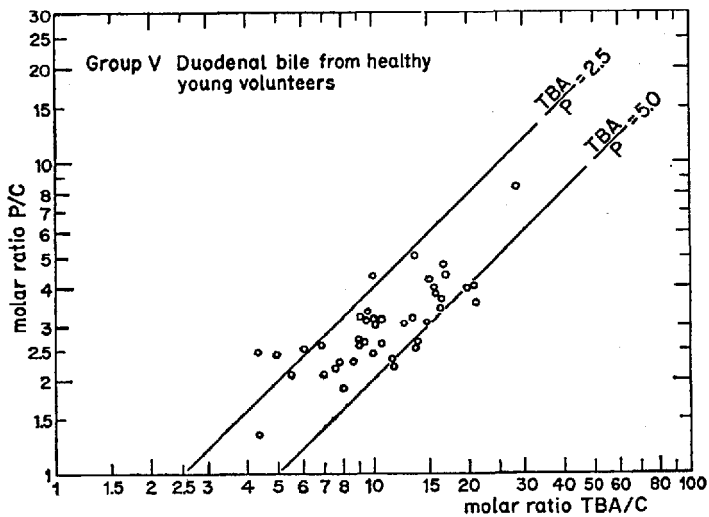

Fig. 1. Duodenal bile from healthy young volunteers (Group V). 42 volunteers.
Abscissa: molar ratio Total Bile Acids/Cholesterol (ratio TBA/C).
Ordinate: molar ratio Lipid-soluble Phosphorus/Cholesterol (ratio P/C) Logarithmic scale.

Ratios TBA/C are plotted horizontally, ratios P/C vertically. Points representing identical values of ratio TBA/P are located on strainght lines forming angles of 45° with the axes. Two such lines are drawn in the figures, one representing TBA/P = 2.5 and another representing TBA/P = 5.0.

In group A, all the points are located either between the said two lines or close to the line representing TBA/P = 5. The mean value of the ratio TBA/P in group A is 3.98 (3.94 for the 17 men, and 4.04 for 10 women, i. e. the same for the two sexes).

Compared with group A, the points in group B, as a whole, seem to be displaced somewhat to the left, i. e. toward lower values of the ratio TBA/C and also toward lower values of the ratio TBA/P. The mean value of ratio TBA/P in group B is 2.97 (Since there are only 4 men in group B, calculation of mean values for men and women separately is of little interest).

The distribution of the points in group V resembles the distribution of the points in both of the groups A and B, but is closer to the distribution in group A than to that in group B. The mean value of the ratio TBA/P is 3.75 for both sexes as a whole; (3.92 for the 7 men, 3.72 for the 35 women).

The scattering of the individual values of the ratios TBA/C and P/C is much greater than the scattering of the individual values of the ratio TBA/P. Moreover, the graphical representations of the three groups contain a few extremely situated points, the occurrence of which may be somewhat incidental, and renders the scattering of the individual values of the ratios TBA/C and P/C irregular. Therefore, these ratios are less suited for calculation of characteristic mean values. However, the following considerations are of interest.

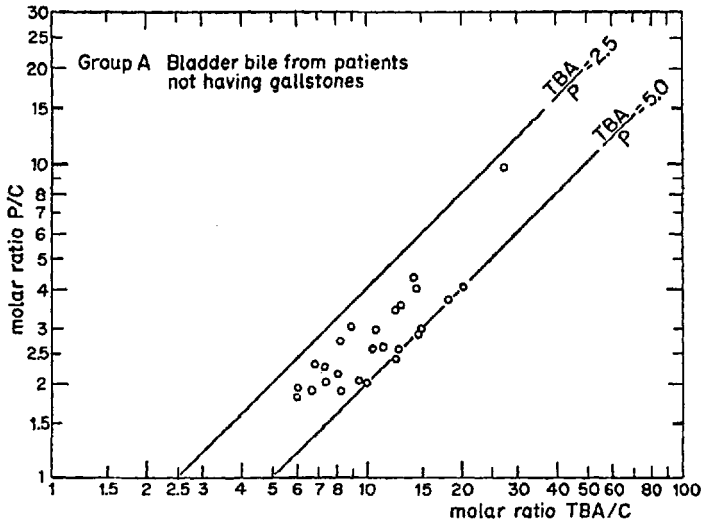

Fig. 2. Bladder bile from patients not having gallstones or diseases of liver or bile ducts. (Group A). 27 patients.
Abscissa: molar ratio Total Bile Acids/Cholesterol (ratio TBA/C).
Ordinate: molar ratio Lipid-soluble Phosphorus/Cholesterol (ratio P/C) Logarithmic scale.

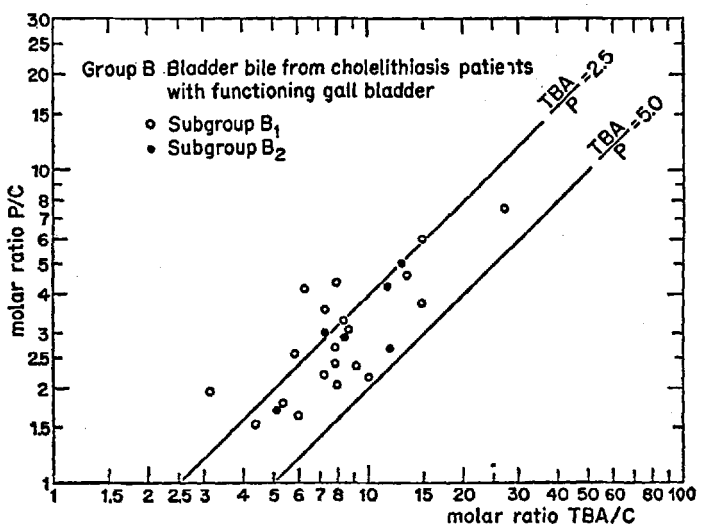

Fig. 3. Bladder bile from cholelithiasis patients having functioning gall bladder. (Group B). 26 patients.
o Subgroup B_1: Cholesterol content of gallstones 54.7—97.5%, 20 patients.
● Subgroup B_2: Cholesterol content of gallstones 0.1–43.0%, 6 patients.
Abscissa: molar ratio Total Bile Acids/Cholesterol (ratio TBA/C).
Ordinate: molar ratio Lipid-soluble phosphorus/Cholesterol (ratio P/C) Logarithmic scale.

In studies to be reported later, we have determined the solubility of cholesterol at pH 7.3 in aqueous solutions of lecithin from human bile and the sodium salts of GC, GCD, GD, TC, TCD and TD in proportions corresponding to their occurrence in human bile.

In that region in figs. 1, 2 and 3, where the points representing the human biles are found, the limit of solubility is not far from the horizontal line indicating the ratio P/C = 3. This means that if the solubility of cholesterol in bile is determined only by the concentrations of lecithin and bile salts, roughly half of the biles in groups A, B and V would be supersaturated with respect to cholesterol.

In groups A and B the mean values of the percentages by weight of cholesterol, lipid-soluble phosphorus (as lecithin) and bile acids in the dry matter, with standard deviation of the mean, are as follows:

	Cholesterol	Phospholipid	Bile acids	Balance
Group A	3.66 ± 0.20	19.49 ± 0.51	46.59 ± 1.41	30.37 ± 1.47
Group B	3.72 ± 0.24	20.16 ± 0.81	35.93 ± 1.39	40.26 ± 1.59
difference	+ 0.06	+ 0.78	— 10.66	+ 9.89

Thus, the two groups did not differ significantly with respect to cholesterol and phospholipid, whereas group B had considerably less bile acids and contained more balance substance than group A. The deficit in bile acids was nearly equal to the excess of „balance". A similar results was found in our first study on human bile (reference 4) part of which was based on a smaller and less uniform material approximately corresponding to the present groups A and B.

The present study does not show how the composition of the bile may vary from time to time for the same person. Information about the variation of the composition of bile samples taken at intervals of 1 to 2 weeks from a small group of volunteers is presented in a following study (3).

The fatty acid composition of bile lecithin from groups V, A and B are shown in tables 4, 5 and 6 respectively. These tables also show the content of other phosphatides as molar per cent of the total phosphatides in the cases where other phosphatides than lecithin were detected in the thin layer chromatograms. This is of particular importance in connection with the duodenal biles where lysolecithin may be formed by the action of enzymes from pancreatic juice on lecithin during collection of the bile samples when the collection does not occur rapidly. (If the aim had been to detect and determine exactly quite small amounts of other phosphatides than lecithin, these would have been found more frequently than shown in the tables).

Table 4 shows the fatty acid composition of lecithin in duodenal bile (group V) in 17 cases where formation of lysolecithin during collection of the bile samples was nil or slight, and in 6 cases where the content of lysolecithin amounted to more than 10% of the total phosphatides.

Table 5 shows the fatty acid composition of lecithin in bladder bile from 16 patients (8 men, 8 women) from group A.

Table 6 shows the fatty acid composition of lecithin in bladder bile from 13 patients from group B.

It is seen that there is scarcely any systematic difference in fatty acid composition of bile lecithin between the duodenal biles collectected without material formation of lysolecithin and the bladder biles from groups A and B. Neither is there any obvious

difference in fatty acid composition of bile lecithin between the 8 men and the 8 women from group A or between the 8 cases with high and the 5 cases with low cholesterol content in the gallstones from group B.

The mean values for the three major fatty acids, palmitic (16:0), oleic (18:1) and linoleic (18:2) fluctuate around 46%, 11% and 28% respectively. For the three fatty acids next in importance, palmitoleic (16:1), stearic (18:0) and arachidonic (20:4) the mean values fluctuate around 4%, 3%, and 4% respectively. Five or six other fatty acids are represented with mean values of less than one per cent each.

Among the six cases in group V in which formation of considerable amounts of lysolecithin occurred during collection of the bile samples, two had percentages of linoleic acid (19.6% and 18.0% resp.) that were lower than the lowest percentage of linoleic acid (21.0% in group A) found in any of the bladder biles or in any of the duodenal biles collected without material formation of lysolecithin.

According to DE HAAS et al. (10), three pancreatic enzymes are capable of producing lysolecithin from lecithin, viz. a phospholipase which splits off the fatty acid in the alpha-position of lecithin (predominantly a saturated fatty acid), another phospholipase which splits off the fatty acid in the beta-position of lecithin (predominantly an unsaturated fatty acid), and the lipase which is capable of splitting off the fatty acid in alpha-position of lecithin. The finding of a somewhat lower percentage of linoleic acid in the above-mentioned two samples of duodenal bile may have been due to a predominant action of the enzyme attacking the beta-position in these cases.

A practical consequence of these observations is that determinations of the fatty acid composition of lecithin from duodenal bile should be made with bile samples collected without material formation of lysolecithin. This affects some of the data presented in our previous paper (1) but not the conclusions drawn.

Linoleic acid is the dietary fatty acid capable of influencing the fatty acid composition of lecithin (from bile or tissues) to the greatest extent. If groups A and B (tables 5 and 6) and that part of group V (table 4) where formation of lysolecithin was low are considered as one group, then the highest value for the percentage of linoleic acid in bile lecithin among 46 cases was 34.9, and the lowest 21.0. These figures may be compared with some of the results from our previous paper (1) viz. the finding of maximally 36.6 and 37.1% linoleic acid in lecithin from duodenal bile (collected with formation of 4.2 and 5.4% lysolecithin resp.) from two volunteers receiving a high linoleic acid margarine as the only visible dietary fat during 6 weeks, and with the finding of 22.7% linoleic acid in lecithin (collected with formation of 13.2% lysolecithin) from a volunteer subejct receiving butter as the only visible dietary fat during 9 weeks.

Parts of the present investigations form the basis for an evaluation of the changes in the composition of the bile following a highly increased cholesterol intake (2) and administration of cholestyramine in healthy subjects (3).

Acknowledgement

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Table 1. Data for duodenal bile from young healthy volunteers not receiving treatment (Group V)

Volunteer's initials	Sex	Age Yrs.	pH	Dry matter % (w:v)	C mM	P mM	TBA mM	Mol per Cent in TBA of GC	GCD	GD	TC	TCD +TC	G/T M:M	Di/Tri M:M	TBA/C M:M	P/C M:M	TBA/P M:M
FA	m	25	7.0	4.7	1.5	6.0	23.7	30.5	10.9	19.6	15.4	23.6	1.56	1.18	15.57	3.95	3.94
LG	f	21	7.4	3.0	1.2	4.2	19,9	22.7	18.8	20.3	15.7	22.5	1.62	1.61	16.21	3.40	4.78
UM	f	22	7.7	7.0	2.9	11.5	59.0	39.1	18.3	10.5	16.3	15.6	1.56	1.17	20.00	3.93	5.11
KAM	f	18	7.4	5.5	2.2	7.9	35.6	19.8	17.6	14.6	14.7	33.0	1.09	1.88	16.49	3.65	4.52
BS	f	21	7.7	5.3	1.4	5.0	29.7	30.6	36.4	11.1	8.4	13.7	3.54	1.57	21.11	3.53	5.97
SR	f	22	7.6	3.9	2.2	4.8	16.6	32.6	20.5	9.9	13.4	23.5	1.71	1.17	7.64	2.19	3.49
LS	f	19	7.7	6.7	5.8	14.3	40.0	27.1	23.3	11.1	11.3	27.1	1.60	1.60	6.93	2.58	2.79
JDS	f	24	7.4	7.5	4.7	19.7	71.0	24.8	25.4	16.5	11.5	21.8	2.00	1.76	15.16	4.22	3.59
JDS	m	27	7.7	4.6	2.0	7.9	41.0	33.5	27.5	8.4	13.7	16.9	2.26	1.12	20.81	4.02	5.18
ALP	f	21	7.6	7.6	6.0	16.1	55.1	21.0	23.4	16.0	16.3	23.0	1.54	1.67	9.26	2.70	3.43
SCN	f	28	7.5	6.2	4.5	12.0	42.1	24.0	24.2	21.8	11.1	19.0	2.34	1.86	9.35	2.66	3.56
JK	f	28	7.6	5.3	3.9	8.8	30.1	29.3	19.2	12.3	16.6	22.5	1.55	1.19	7.77	2.28	3.40
ST	f	31	7.9	3.1	1.3	4.1	12.8	14.9	23.4	16.4	16.4	28.9	1.19	2.24	9.72	3.12	3.12
IRC	f	22	7.4	5.2	5.6	13.6	27.6	23.6	8.5	11.5	31.7	24.7	0.77	0.81	4.96	2.44	2.03
AGC	f	20	7.6	4.2	1.6	6.8	26.4	32.2	18.3	11.8	14.0	16.8	2.25	1.17	17.05	4.37	3.91
FH	m	25	7.4	6.1	4.8	12.5	44.2	30.8	23.1	15.7	9.5	20.9	2.28	1.48	9.13	2.59	3.53
EUJ	f	20	7.8	5.4	2.9	13.6	47.9	31.1	31.4	13.0	11.7	12.9	3.08	1.34	16.74	4.76	3.92
ALK	f	22	7.2	10.0	10.3	33.0	94.4	35.5	26.9	11.5	11.8	14.3	2.83	1.11	9.14	3.19	2.86
LLH	f	21	7.2	5.1	1.1	8.7	30.1	21.9	26.8	11.9	16.0	23.4	1.54	1.64	28.30	8.18	3.47
LK	f	21	7.1	6.6	4.4	19.3	44.5	31.7	18.8	16.7	14.4	18.4	2.05	1.17	10.01	4.36	2.31

IB	f	22	7.3	4.4	1.6	8.7	21.4	31.3	23.5	20.9	10.9	13.4	3.13	1.37	13.55	5.51	2.46
AR	f	23	7.9	4.8	3.9	7.5	31.7	24.7	15.2	4.6	27.0	28.5	0.80	0.93	8.05	1.90	4.23
LT	f	22	6.9	4.2	1.9	5.9	28.2	13.2	17.6	21.4	14.1	33.8	1.10	2.67	14.83	3.09	4.79
TH	f	18	7.7	1.7	0.4	1.4	5.6	20.6	19.3	32.8	10.6	16.7	2.66	2.20	15.67	3.86	4.06
IM	f	20	7.9	3.9	2.2	4.5	24.8	12.5	13.7	2.3	37.6	33.9	0.40	1.00	11.51	2.33	4.95
HH	f	21	7.1	2.3	2.2	4.5	11.9	15.0	18.7	12.5	20.9	32.8	0.86	1.79	5.52	2.10	2.63
NM	f	20	7.5	4.7	3.0	9.2	38.2	34.7	20.0	9.7	14.4	21.3	1.82	1.04	12.62	3.03	4.15
LVM	f	20	8.0	10.5	8.6	19.9	74.5	35.1	18.5	3.6	21.7	21.2	1.33	0.76	8.68	2.31	3.76
JJ	f	21	7.5	4.9	2.3	5.8	31.1	19.9	13.2	13.7	15.0	38.2	0.88	1.87	13.64	2.53	5.39
KT	f	21	7.4	9.2	6.9	18.1	73.1	14.4	3.3	9.9	30.9	41.5	0.38	1.21	10.63	2.63	4.03
EJ	m	22	7.5	3.4	2.1	6.6	22.5	38.8	22.1	13.2	9.0	16.9	2.87	1.09	10.61	3.12	3.40
EO	f	22	7.9	5.0	3.6	9.6	49.8	14.7	14.6	10.5	7.9	52.2	0.66	3.41	13.84	2.67	5.19
MJ	f	21	7.8	9.3	10.3	26.2	62.0	35.2	14.0	15.3	17.9	29.5	1.80	0.88	6.01	2.53	2.37
AN	m	21	7.0	4.5	2.9	9.5	27.3	43.2	36.3	3.6	10.1	6.8	4.94	0.77	9.59	3.35	2.87
SL	m	21	7.4	4.4	3.7	8.2	43.4	20.1	26.2	32.7	10.5	10.5	3.77	2.26	11.67	2.21	5.28
RE	f	21	7.5	5.2	4.0	8.4	27.8	20.7	36.6	18.2	11.1	13.4	3.09	2.15	6.96	2.10	3.31
HP	f	20	7.4	4.4	3.4	10.3	34.5	28.1	4.3	19.7	21.7	26.2	1.09	1.01	10.20	3.04	3.36
LRH	f	20	7.6	5.4	4.7	11.6	20.1	12.5	20.6	16.5	19.4	31.0	0.98	2.13	4.29	2.48	1.73
SMJH	f	23	7.4	7.9	11.3	15.2	49.2	14.2	14.0	14.4	25.0	32.5	0.74	1.55	4.34	1.34	3.24
SÅJH	m	21	7.5	9.1	8.6	27.1	86.6	24.1	24.0	9.1	14.6	28.2	1.33	1.58	10.08	3.14	3.20
ILE	f	22	7.8	6.4	4.7	14.7	63.0	21.8	14.4	24.2	14.9	24.7	1.52	1.77	13.55	3.15	4.30
IVB	f	22	7.3	2.5	1.6	4.0	16.3	19.9	19.5	20.6	12.8	27.1	1.51	2.06	10.01	2.45	4.03
	mean			5.5	3.9	11.1	38.9	25.5	20.3	14.5	15.9	23.9	1.81	1.53	11.84	3,17	3.75
	st. d. of mean			0.31	0.41	1.06	0.32	1.26	1.16	1.02	1.01	1.38	0.15	0.09	0.78	0.18	0.20

Table 2. Data for bladder bile from surgical patients not having gallstones or diseases of liver and bile ducts (Group A)

Hospital	Initials	Patient's Sex	Age Yrs.	Diagnosis	pH	Dry matter % w:v	C mM	P mM	TBA mM	Mol per cent in TBA of GC	GCD	GD	TC	TCD +TD	G/T	D/Tri	TBA/C	P/C	TBA/P
RH	AHG	m	44	U. duod.	7.2	23.4	24.1	72.5	215.3	27.0	18.8	3.9	16.6	33.7	0.99	1.29	8.95	3.02	2.96
RH	JBCH	m	39	U. duod.	6.6	23.4	26.4	53.3	252.6	35.4	24.7	9.4	12.7	17.8	2.28	1.08	9.58	2.02	4.74
RH	AKS	m	49	U. duod.	7.7	11.1	13.6	24.2	81.0	23.3	12.1	36.9	10.3	17.7	2.57	1.98	5.97	1.78	3.34
RH	SOC	m	43	U. duod.	7.3	16.1	9.5	38.8	193.0	18.5	20.7	14.7	15.4	30.7	1.17	1.95	20.35	4.09	4.98
KH	BM	m	25	U. doud.	7.8	13.3	11.3	29.2	127.9	38.2	36.4	9.3	7.7	8.4	5.19	1.18	11.32	2.58	4.38
KH	CJA	m	59	U. duod.	7.1	21.3	23.1	63.1	193.0	26.2	28.2	13.4	8.0	24.2	2.11	1.91	8.35	2.73	3.06
RH	KWP	m	45	U. duod.	8.1	21.1	28.6	66.6	194.3	35.7	28.0	17.0	8.1	11.2	4.17	1.29	6.80	2.33	2.92
BH	OLAO	m	46	U. duod.	7.4	18.0	17.2	45.5	218.5	28.9	27.7	5.5	15.0	22.9	1.64	1.28	12.68	2.64	4.80
BH	JHH	m	65	U. duod.	7.3	13.4	17.0	32.3	113.0	31.8	28.7	13.6	8.0	17.8	2.86	1.51	6.65	1.90	3.47
BH	MT	m	49	U. duod.	7.4	14.3	11.8	35.0	126.2	16.2	26.0	6.0	20.4	31.4	0.93	1.72	10.70	2.97	3.61
RH	SKM	m	50	U. duod.	7.4	18.3	16.7	48.7	240.7	30.1	19.0	11.5	3.6	35.8	1.54	1.96	14.64	2.92	4.94
RH	FLP	m	29	U. duod.	7.3	16.0	9.9	43.0	138.8	31.6	17.3	20.7	8.7	21.7	2.28	1.48	14.07	4.35	3.23
BH	LHM	m	42	U. duod.	7.5	19.8	24.4	46.5	203.4	34.1	14.9	16.7	12.7	21.6	1.92	1.14	8.35	1.91	4.38
SJ	EH	f	53	U. duod.	7.6	14.0	10.3	36.5	131.3	12.9	19.1	9.5	18.4	40.1	0.71	2.20	12.78	3.55	3.60
SJ	JHJ	f	42	U. duod.	7.8	13.3	7.9	31.6	113.1	17.7	20.9	38.2	5.1	18.1	3.31	3.39	14.39	4.02	3.58
BH	KLC	f	32	U. duod.	7.2	17.6	15.3	36.6	190.7	19.2	17.2	10.0	23.5	30.0	0.87	1.34	12.46	2.39	5.22
SJ	JGP	f	48	U. duod.	8.0	22.1	29.3	58.7	217.6	31.6	23.2	12.8	11.3	21.1	2.09	1.33	7.44	2.01	3.71
SJ	IKT	f	51	U. duod.	7.6	15.9	18.2	41.4	133.4	18.5	24.8	21.2	10.0	25.3	4.72	2.50	7.32	2.27	3.22
RH	JHLN	f	74	U. duod.	7.8	10.5	10.6	27.2	133.1	11.5	30.3	16.4	4.6	37.2	1.39	5.20	12.59	2.57	4.89
	mean of 19 U. duod.					17.0	17.1	43.7	169.3	25.7	23.1	15.1	11.6	24.6	2.25	1.89	10.81	2.74	3.95
	s. d. of mean					0.92	1.59	3.17	11.22	1.90	1.39	2.12	1.26	2.01	0.30	0.22	0.84	0.17	0.18

KH	AJR	m	54	U. ventr.	7.2	14.1	15.1	30.3	152.0	25.3	29.3	18.1	8.3	18.9	2.67	1.97	10.07	2.01	5.01
KH	EWF	m	56	U. ventr.	7.5	11.6	9.2	32.0	114.0	32.1	15.9	14.3	18.4	19.3	1.65	0.98	12.35	3.47	3.56
KH	HPL	m	62	U. ventr.	7.2	10.5	16.3	23.2	113.8	44.9	30.1	12.3	6.6	6.2	6.85	0.94	18.18	3.71	4.90
KH	CAS	m	46	U. ventr.	7.8	16.4	5.6	54.7	151.0	24.7	23.9	13.1	12.6	25.6	1.62	1.68	27.16	9.84	2.76
BH	EMS	f	61	U. ventr.	7.4	14.2	20.4	37.7	123.8	32.6	40.8	8.4	5.3	12.9	4.49	1.64	6.07	1.85	3.29
KH	EMF	f	47	U. ventr.	7.7	11.9	8.3	24.9	124.1	28.3	15.6	6.0	22.7	27.4	1.00	0.96	14.98	3.01	4.98
BH	ASFH	f	55	U. ventr.	7.2	16.6	15.5	40.4	163.1	28.5	21.3	23.8	8.7	17.7	2.78	1.69	10.51	2.60	4.04
BH	EAJ	f	53	U. ventr.	7.8	17.0	15.8	33.6	128.3	24.4	21.4	23.0	10.2	21.0	2.20	1.89	8.12	2.13	3.82
	mean of 8 U. ventr.					14.0	13.3	34.6	133.8	30.1	24.8	14.9	11.6	18.6	2.91	1.47	13.43	3.58	4.05
	s. d. of mean					0.89	1.77	3.53	6.68	2.39	2.97	2.26	2.14	2.39	0.67	0.15	2.38	0.93	0.30
	mean of the whole group					16.1	16.0	41.0	158.8	27.0	23.6	15.0	11.6	22.8	2.44	1.76	11.59	2.99	3.98
	s. d. of mean					0.74	1.27	2.56	8.82	1.54	2.52	1.29	1.07	1.85	0.28	0.17	0.92	0.30	0.15
	mean of 17 m.					16.6	16.2	43.5	166.4	29.6	23.6	13.9	11.4	21.5	2.50	1.49	12.13	3.19	3.94
	s. d. of mean					1.01	1.67	3.61	12.36	1.73	1.59	1.81	1.12	2.04	0.37	0.08	1.34	0.46	0.20
	mean of 10 f.					15.3	15.2	36.9	145.9	22.5	23.5	16.9	12.0	25.1	2.36	2.21	10.67	2.64	4.04
	s. d. of mean					1.04	2.05	2.96	10.71	2.41	2.32	3.08	2.25	2.76	0.46	0.40	1.01	0.22	0.23

Table 3. Data for bladder bile from cholelithiasis patients having functioning gallbladder (Group B).

Hospital	Patient's Initials	Sex	Age Yrs.	pH	Dry matter % w:v	C mM	P mM	TBA mM	Mol per cent in TBA of GC	GCD	GD	TC	TCD +TC	G/T	Di/Tri	TBA/C	P/C	TBA/P	Cholest. in gallstones %	Ash in gallstones %
Subgroup B_1: Content of cholesterol in gallstones 54,9–97,5%																				
RH	TAB	m	48	7.6	5.5	6.5	10.6	38.5	30.5	27.0	29.1	5.4	8.0	6.50	1.79	5.96	1.63	3.64	92.9	—
RH	EGBO	f	59	7.6	8.0	12.0	18.5	52.5	23.4	21.1	44.1	3.6	7.9	7.72	2.71	4.37	1.54	2.84	82.8	2.0
RH	JOG	f	51	7.6	18.0	23.8	42.9	127.7	29.4	36.9	16.5	5.6	11.6	4.82	1.86	5.36	1.80	2.98	54.7	35.0
RH	GO	f	44	8.2	10.5	6.3	19.5	55.0	20.5	16.8	15.2	19.5	28.0	1.11	1.50	8.72	3.09	2.82	87.8	0.5
RH	JK	m	41	7.3	19.9	12.7	47.5	189.3	18.4	21.3	21.0	8.3	31.0	1.55	2.75	14.97	3.75	3.96	80.5	6.8
GL	EJ	m	60	7.5	14.1	13.0	43.0	107.8	33.4	18.6	16.5	10.6	20.7	2.18	1.27	8.27	3.30	2.50	87.6	1.0
SL	KL	f	54	7.9	8.0	6.1	13.1	61.1	24.9	23.9	26.8	8.6	15.7	3.11	1.99	10.11	2.16	4.65	85.8	1.5
KH	LS	f	50	7.9	7.0	9.4	20.7	67.5	18.6	7.9	12.8	31.6	29.1	0.65	0.99	7.19	2.21	3.26	59.7	4.7
SL	BK	f	33	7.8	5.8	5.4	22.3	33.6	32.8	6.3	23.1	12.3	25.5	1.64	1.22	6.27	4.17	1.51	56.2	14.5
SL	AJ	f	55	7.5	14.9	13.6	37.0	105.6	31.7	18.8	9.0	17.9	22.6	1.47	1.02	7.76	2.72	2.86	79.4	5.9
SL	MN	f	63	6.9	15.5	9.0	41.4	118.5	29.1	22.7	18.3	13.0	17.0	2.33	1.38	13.18	4.60	2.87	88.5	2.5
SL	ER	f	51	7.0	18.5	6.2	45.5	170.7	30.5	23.4	17.2	9.9	19.0	2.46	1.47	27.40	7.30	3.93	86.5	2.0
SJ	IMJ	f	33	8.5	4.6	4.2	8.8	33.6	27.3	24.3	1.2	17.7	29.5	1.12	1.22	7.96	2.09	3.82	54.9	32.2
RH	KS	f	24	7.5	13.3	13.6	32.0	125.4	23.6	23.7	12.6	16.1	24.0	1.49	1.52	9.20	2.35	3.92	82.6	1.5
SL	TMA	f	38	8.0	7.3	5.6	19.6	40.8	26.9	25.1	24.5	9.2	14.4	3.25	1.78	7.35	3.53	2.08	76.7	6.6

SL	GN	f	45	7.1	9.8	4.0	24.1	59.7	21.8	19.5	18.6	14.6	25.5	1.49	1.75	14.99	6.04	2.48	74.2	10.7
SL	ABA	f	66	7.2	5.9	6.7	17.2	39.1	13.2	18.7	25.4	13.9	28.8	1.34	2.69	5.81	2.56	2.27	91.4	0.5
SJ	KAEJ	f	60	7.5	7.8	9.7	17.3	76.0	40.1	24.5	14.0	11.1	10.3	3.67	0.95	7.87	4.39	1.79	97.5	1.6
BH	OMFS	f	56	7.9	15.3	23.3	45.1	73.9	27.0	28.6	11.0	12.8	20.6	1.99	1.51	3.17	1.94	1.64	88.0	3.0
BH	SHB	m	52	7.4	11.2	12.1	29.1	95.8	19.5	27.4	19.4	4.1	29.7	1.96	3.24	7.93	2.41	3.30	97.0	0.7
	mean:				11.1	10.2	27.8	83.6	26.1	21.8	18.8	12.3	20.9	2.59	1.73	9.19	3.18	2.96		
	st. d. of mean				1.07	1.08	2.88	10.13	1.43	1.51	1.99	1.45	1.71	0.37	0.14	1.19	0.34	0.19		
	Subgroup B_2: Content of cholesterol in gallstones: 0.1–43.0%																			
SL	MKN	f	61	7,4	13.1	13.2	40.1	92.8	38.8	32.8	6.9	9.3	12.2	3.65	1.08	7.24	3.03	2.39	39.1	54.1
RH	EMESB	f	41	8.1	16.6	12.0	60.3	152.6	26.9	22.4	10.8	17.0	22.9	1.50	1.28	12.71	5.03	2.53	0.5	37.8
SJ	WC	f	59	8.1	14.5	12.5	33.3	146.9	29.5	24.2	13.7	13.9	18.8	2.06	1.31	11.71	2.66	4.41	0.3	83.5
SJ	BLSO	f	42	8.2	15.1	10.3	43.8	118.8	22.4	29.2	27.0	7.8	13.5	3.69	2.30	11.57	4.26	2.71	4.9	39.4
BH	KIZ	f	73	6.8	16.9	16.1	46.4	134.6	15.0	20.0	32.0	6.4	26.6	2.03	3.68	8.35	2.88	2.90	0.1	37.8
BH	ÅHT	f	40	7.8	13.7	19.6	33.2	98.9	11.3	24.6	11.7	16.4	36.0	0.91	2.61	5.06	1.70	2.98	43.0	24.3
	mean:				15.0	14.0	42.9	124.1	24.0	25.5	17.0	11.8	21.7	2.31	2.04	9.44	3.26	2.99		
	st. d. of mean				0.63	1.37	4.12	10.14	4.09	1.91	4.11	1.86	3.63	0.46	0.41	1.23	0.49	0.29		
	mean for all 26 cases:				12.0	11.0	31.2	93.0	25.6	22.7	18.4	12.2	21.1	2.53	1.80	9.25	3.20	2.96		
	st. d. of mean				0.89	1.05	2.60	8.74	1.42	1.26	1.76	1.18	1.52	0.33	0.14	0.95	0.28	0.16		

Table 4. Fatty acid composition of lecithin (PC) in duodenal bile from healthy volunteers not receiving treatment (Group V).[1)2)3)]

Volunteer's Initials	Sex	Age Yrs.	14:0	15:0	16:0	16:1	16:2	18:0	18:1	18:2	18:3	20:2	20:3	20:4	20:5	22:6	Molar percentage in total phospholipids of PC	PE	LP	Sp
Samples collected without material formation of lysolecithin (LP):																				
FH	m	25	t	t	42.1	4.3		2.8	9.7	34.7			2.8[4)]	3.7	t		96.4		3.6	
EUJ	f	20			48.6	4.0		3.4	9.8	30.9	0.6		0.7	1.4	0.3		92.3		7.7	
ALK	f	22			37.8	5.2		3.5	12.8	34.9	1.6		0.3	4.3	0.5	t	93.4		6.6	
LLH	f	21	t	t	48.0	1.8		2.9	9.0	33.3	0.8		0.5	2.8	0.3	0.7	95.2		4.8	
LK	f	21	t	t	47.2	4.7		3.1	8.6	31.6	t		0.5	3.4	t	0.9	97.9	1.3	0.8	
IB	f	22	t	t	47.3	4.9		3.3	11.1	24.6	0.3		0.8	4.9	0.8	1.8	97.8		2.2	
AR	f	23	t	t	48.9	3.2	t	2.9	9.5	28.8	0.6		0.6	4.8	0.7	t	97.6		2.4	
LT	f	22	t	t	45.1	5.6	2.2	3.4	9.5	29.7	1.0		t	3.5	t	t	99.1		0.9	
TH	f	18	t	t	45.1	5.3	1.5	3.1	10.0	28.3	0.6		t	5.0	1.1	t	94.2		5.8	
IM	f	20	t	t	45.0	5.8	1.8	1.5	12.5	26.7	0.9		1.0	4.8			97.8		2.2	
HH	f	21	t	t	44.2	6.7	2.7	3.8	11.5	23.3	1.0		1.0	3.7	0.9	1.2	94.3		5.7	
NM	f	20	t	t	47.4	6.3	1.6	3.2	10.8	23.1	2.3		1.3	4.0	t		100.0			
LVM	f	20	t	t	45.5	5.0	1.5	3.0	10.1	26.0	1.5		0.9	4.2	1.5	1.0	100.0			
JJ	f	21	t	t	45.0	7.1	1.6	5.0	12.8	23.0	1.4	1.5	t	2.6	t	t	95.0		5.0	

EJ	m	22	1.5	0.6	46.3	3.5	0.5	4.5	10.4	25.5	1.5	2.0[4]	2.5	1.2	t	93.9		2.4	3.8
KT	f	21	t	t	48.2	3.4	0.8	3.2	9.8	25.7	1.6	1.4	5.8	t		100.0			
EO	f	22	t	t	43.2	4.5	1.1	2.2	11.6	31.5	0.9	1.4	3.5	0.2		100.0			
	mean:				45.6				10.6	28.3									
	st. d. of mean				0.67				0.32	0.97									
	Samples collected with concomitant formation of more than 10 per cent lysolecithin (LP):																		
SCN	f	28	t	t	49.6	5.3		2.8	8.2	26.3	t	0.3	4.7	1.9	0.9	89.1	0.7	10.2	
ST	f	31	2.4	t	43.3	5.2		2.3	17.8	19.6	3.0	t	3.9	2.5	t	78.0		22.0	
IRC	f	22	t	t	50.3	5.9		2.6	13.2	18.0	1.1	1.9	4.9	0.6	1.4	64.0		36.0	
AGC	f	20	t	t	41.5	4.6		4.7	11.5	32.3	0.9	0.7	2.8	t	0.9	72.0		28.0	
JK	f	28	t	t	47.6	4.2		3.0	11.1	21.8	1.2	3.3[4]	3.4	0.5	t	56.4		43.6	
MJ	f	21	t	t	46.4	4.3	1.4	3.3	10.3	28.2	1.7	1.2	3.2	t	t	83.3		16.7	
	mean:				46.5				12.0	24.4									
	st. d. mean				1.42				1.34	2.25									

[1]) The fatty acids are indicated by number of carbon atoms and number of double bonds.
[2]) t = trace.
[3]) PC = Phosphatidylcholine (lecithin) PE = Phosphatidylethanolamine LP = Lysolecithin Sp = Sphingomyeline.
[4]) The accuracy of these figures is low. Probably, the true value is lower.

Table 5. Fatty acid composition of lecithin (PC) in bladder bile from surgical patients not having gallstones or diseases of liver or bile ducts (Group A)[1)2)3)]

Hospital	Patient's Initials	Sex	Age Yrs.	Diagnosis	14:0	15:0	16:0	16:1	16:2	18:0	18:1	18:2	18:3	20:2	20:3	20:4	20:5	22:6	Molar percentage in total phospholipids of PC	PE	LP	Sp
KH	EWF	m	56	U. ventr.	t	t	44.9	4.6	t	4.6	11.6	25.1	t		0.4	4.8	1.1	3.0	100.0			
KH	HPL	m	62	U. ventr.	t		48.8	5.4	t	2.8	11.5	23.4	t		1.0	5.9	1.1	t	100.0			
KH	CAS	m	46	U. ventr.	t	t	48.2	5.6	t	2.0	9.8	28.2	t		0.7	3.9	0.7	1.0	93.3	2.9	3.8	
RH	KWP	m	45	U. duodeni	t	t	47.6	5.1		3.4	11.0	27.6	t		0.7	4.7	t		97.7	2.3		
BH	OLAO	m	46	U. duodeni	t	t	39.6	8.3	2.0	2.6	12.6	26.6	0.6		1.1	4.2	1.4	1.5	99.0	1.0		
BH	JHH	m	65	U. duodeni	t	t	45.9	6.2	2.2	2.1	11.3	28.5	0.7		0.7	2.5	t		100.0			
BH	MT	m	49	U. duodeni	t	t	46.8	1.3	0.3	2.4	12.9	29.2	1.1		0.9	3.4	0.7	1.0	98.5	1.5		
RH	SKM	m	50	U. duodeni	0.8	0.3	43.2	3.1	0.5	3.1	10.6	28.4	1.8		1.8	4.8	1.5	t	94.0	2.0	2.0	2.0
	mean:						45.6				11.4	27.1										
	st. d. of mean						1.08				0.36	0.70										
SJ	EH	f	53	U. duodeni	0.5	0.4	42.7	4.8		3.9	14.5	27.8	0.9		1.2	2.7	0.4		100.0			
SJ	JHJ	f	42	U. duodeni	t	t	52.5	1.5		2.2	9.8	27.8	0.6		0.6	3.1	0.6	1.1	100.0			
BH	KC	f	32	U. duodeni			46.3	4.2		2.7	9.5	26.6	0.7		0.8	5.3	1.6	2.3	100.0			
BH	ASFH	f	55	U. ventr.			53.0	3.4		2.5	11.9	21.0	0.4		1.0	4.6	0.4	1.8	97.9		2.1	
SJ	IGP	f	48	U. duodeni			45.1	4.2	1.1	2.8	9.7	32.1	0.6		0.8	3.7	t		98.4	1.3	0.3	
SJ	IKT	f	51	U. duodeni	t	t	45.0	4.3	1.3	2.4	9.4	32.2	0.5		0.9	3.2	0.3		99.7		0.3	
BH	EAJ	f	53	U. ventr.	t	t	45.5	1.2	0.3	2.4	11.3	32.8	0.8		1.0	3.2	0.7	0.9	97.3	2.7		
RH	JHLN	f	74	U. duodeni	0.1	0.1	43.2	4.1	1.1	2.5	12.2	31.6	0.8	0.8	0.6	2.2	0.3	t	100.0			
	mean:						46.7				11.0	29.0										
	st. d. of mean						1.39				0.63	1.46										
	mean of the whole group:						46.1				11.2	28.1										
	st. d. of mean						1.78				0.73	1.66										

[1)] The fatty acids are indicated by number of carbon atoms and number of double bonds.
[2)] t = trace.
[3)] PC = Phosphatidylcholine (lecithin) PE = Phosphatidylethanolamine LP = Lysolecithin Sp = Sphingomyeline.

Table 6. Fatty acid composition of lecithin in bladder bile from cholelithiasis patients having functioning gallbladder (Group B)[1)2)3)]

Hospital	Patient's Initials	Sex	Age Yrs.	14:0	15:0	16:0	16:1	16:2	18:0	18:1	18:2	18:3	20:2	20:3	20:4	20:5	22:6	Molar percentage in total phospholipids of PC	PE	LP	Sp	Gallstones' content of cholesterol %	ash %
Subgroup B_1: Cholesterol content in gallstones 54.9–97.5%																							
SJ	IMJ	f	33	0	0	53.6	2.8	0	3.5	10.9	25.3	0	0	0.6	3.9	0	0	100				54.9	32.20
RH	KS	f	24	t	t	42.4	3.7	0	2.3	8.7	33.8	0	0	0.7	3.8	2.7	1.9	100				82.6	1.46
SL	ABA	f	66	t	t	51.0	6.4	0	2.0	7.9	26.2	0.3	t	0.8	4.5	0.8	0.2	88		12		91.4	0.53
SL	TMA	f	38	t	t	49.6	3.7	0	3.2	10.0	24.1	0.3	t	1.5	6.4	1.0	t	100				76.7	6.56
SL	GN	f	45	0	0	48.1	3.0	0	2.8	10.6	29.3	0.3	0	0.5	3.8	0.6	1.1	100				74.2	10.70
SJ	KAEJ	f	60	t	t	37.4	5.5	1.7	3.2	12.2	29.4	0.5	0	1.4	5.6	1.1	1.9	100				97.5	1.64
BH	OMFS	f	56	t	t	47.1	1.9	0.7	3.5	14.0	25.8	0.7	0	1.0	3.2	0.9	1.1	99	1			88.0	2.98
BH	SHB	m	52	t	t	48.4	1.0	0.3	3.3	12.4	30.1	0.3	0	0.6	3.1	0.3	1.4	100				97.0	0.65
	mean:					47.2				10.8	28.0												
	st. d. of mean:					1.81				0.71	1.14												
Subgroup B_2: Cholesterol content in gallstones 0.1–43.0%																							
SJ	WC	f	59	0	0	43.9	4.8	0	4.2	12.3	26.1	0.6	0	1.5	5.3	1.4	0	100				0.28	83.5
RH	EMESB	f	41	0	0	39.0	8.0	0	3.3	9.6	31.1	0.5	0	0.7	5.5	1.1	1.4	100				0.45	37.8
SJ	BLSO	f	42	t	t	44.5	4.3	0	3.7	14.4	24.5	0.5	0	1.4	5.3	1.4	t	100				4.87	39.4
BH	KIZ	f	73	t	t	49.4	1.5	0.6	2.8	13.8	24.8	0.8	0	0.7	3.2	0.8	0	100				0.1	37.8
BH	ÅHT	f	40	0	0	37.1	4.1	0.8	4.8	11.8	32.0	0.8	0	1.4	2.9	0.5	1.5	78		22		43.0	24.3
	mean:					42.8				12.4	27.7												
	st. d. of mean:					2.18				0.84	1.60												
	mean of the whole group:					45.5				11.4	27.9												
	st. d. of mean:					1.48				0.56	0.89												

1) The fatty acids are indicated by number of carbon atoms and number of double bonds.
2) t = trace.
3) PC = Phosphatidylcholine (lecithin) PE = Phosphatidylethanolamine LP = Lysolecithin Sp = Sphingomyeline.

Summary

With the further purpose of studying the influence of diet and pharmaca on human bile, the composition of duodenal bile from 42 healthy young volunteers (group V, 7 men, 35 women) was compared with the composition of bladder bile from 27 peptic ulcer patients without diseases of the biliary tract and liver (group A, 17 men, 10 women), and with the composition of bladder bile from 26 patients having uncomplicated gallstone disease and functioning gall bladder (group B, 4 men, 22 women).

Generally, the duodenal biles had lower concentrations of the components determined (dry matter, cholesterol, lipid-soluble phosphorus and bile acids) than had the bladder biles, especially those in group A.

The mean value of the molar ratio between glycine-conjugation and taurine-conjugation was somewhat lower in group V than in groups A and B.

The mean value of the ratio between total bile acids and lipid-soluble phosphorus was almost the same in groups V and A, and higher than in group B.

Comparison of the individual values of the ratio between lipid-soluble phosphorus and cholesterol with yet unpublished studies of the solubility of cholesterol in aqueous solutions of lecithins and bile salts suggests that roughly half of the biles in all three groups would be supersaturated with respect to cholesterol if the solubility of cholesterol in bile depends only on the components determined in the present study.

The fatty acid composition of bile lecithin was determined in 23 cases from group V, 16 cases from group A and 13 cases from group B. The distribution of the fatty acids was almost the same in groups A and B as in 17 cases in group V, in which less than 10% lysolecithin was formed during collection of the bile samples.

Zusammenfassung

Mit dem weiteren Zweck, den Einfluß von Ernährung und Pharmaca auf die Zusammensetzung der menschlichen Galle zu untersuchen, wurde die Zusammensetzung der Duodenalgalle von 42 jungen gesunden Versuchspersonen (Gruppe V, 7 Männer, 35 Frauen) mit der Zusammensetzung der Blasengalle von 27 Ulcus pepticum-Patienten ohne Krankheiten der Leber und des Gallensystems (Gruppe A, 17 Männer, 10 Frauen) und mit der Zusammensetzung der Blasengalle von 26 Cholelithiasis-Patienten mit fungierender Gallenblase und ohne sonstige Komplikationen, verglichen.

Die Konzentrationen der untersuchten Bestandteile (Trockensubstanz, Cholesterin, lipid-löslicher Phosphor und Gallensäuren) waren niedriger in den Duodenalgallen als in den Blasengallen: Die höchsten Konzentrationen kamen in Gruppe A vor.

Der Mittelwert des molären Verhältnisses zwischen Glycin-Konjugation und Taurin-Konjugation war etwas niedriger in Gruppe V als in den Gruppen A und B.

Der Mittelwert des molären Verhältnisses zwischen Gesamtgallensäuren und lipid-löslichem Phosphor war beinahe derselbe in den Gruppen V und A und höher als in Gruppe B.

Vergleich der individuellen Werte des Verhältnisses zwischen lipid-löslichem Phosphor und Cholesterin mit noch nicht veröffentlichten Untersuchungen über die Löslichkeit von Cholesterin in wässerigen Lösungen von Lecithin und Gallensalzen deutet darauf, daß ungefähr die Hälfte der Gallen in allen drei Gruppen in Bezug auf Cholesterin übersättigt sind, falls die Löslichkeit des Cholesterins in der Galle nur durch die von uns untersuchten Bestandteile bedingt ist.

Das Fettsäuremuster des Gallenlecithins wurde in 23 Fällen von Gruppe V, 16 Fällen von Gruppe A und 13 Fällen von Gruppe B bestimmt. Die Verteilung der Fettsäuren war beinahe dieselbe in den Gruppen A und B wie in 17 Fällen von Gruppe V, bei welchen weniger als 10% Lysolecithin während der Aspiration der Duodenalgalle gebildet wurde.

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