Clinical significance of white bile in the biliary tree

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'White bile' is a clear, colourless, watery fluid found occasionally in the biliary tree proximal to an extra-hepatic biliary obstruction. Thus it is neither white nor bilious; and it is not viscid and opaque like the fluid found in the obstructed gall bladder.

With the exception of the paper by Judd and Lyons (1923) previous reports on white bile dealt either with a single patient (Edington and McCallum, 1930; Lake, 1934; Flint, 1937; Griffiths, Haber, Rees, and Smith, 1963; Bouchier and Cooperband, 1965), or with several patients (Aronsohn, 1936; Hawthorne and Sterling, 1955), or with experiments carried out in animals (Rous and McMaster, 1921; McMaster, Broun, and Rous, 1923; Cameron and Oakley, 1932; Aronsohn, 1935; Haber and Rees, 1963). These reports contain certain generalizations about the possible clinical significance of white bile. It could be assumed that it is found most frequently in those obstructions due to stone (Flint, 1937; Hawthorne and Sterling, 1955) or either stone or stricture (Judd and Lyons, 1923); that it will be found only when the gall bladder is either distal to the obstruction or when it is not functioning (Rous and McMaster, 1921; McMaster *et al*, 1923; Judd and Lyons, 1923; Lake, 1934; Griffith *et al*, 1963); that it occurs only when there is infection in the fluid (Aronsohn, 1935 and 1936); that total obstruction is always present (Aronsohn, 1936); and that it signifies severe liver damage and a grave immediate prognosis (Flint, 1937). In this paper we report the findings in nine patients admitted to Prince Henry Hospital each with obstructive jaundice and each with clear, colourless, watery fluid in the biliary tree. The findings in these patients have been examined to appraise the clinical significance of finding white bile at operation.

METHODS

Since 1965 we have treated nine patients who had white bile in the major bile ducts (Table I). In seven patients the specimen was collected from a major hepatic duct by aspiration of the catheter inserted into the liver at pre-operative percutaneous transhepatic cholangiography before injecting the radioopaque dye. In two patients,

the fluid was obtained during the early phase of operation, on one occasion (case 8) from the common bile duct and in another (case 5) from the gall bladder which communicated normally with the biliary tree. Five specimens were Gram stained and cultured by plating out on blood agar plates and incubating under aerobic and anaerobic conditions. Each specimen of white bile was examined for bilirubin (Malloy and Evelyn, 1937), bile salts (Varley, 1962), alkaline phosphatase (AutoAnalyzer, Technicon Corporation, method N-6P), and cholesterol (Abell, Levy, Brodie, and Kendall, 1952). Sodium, potassium, and chloride (AutoAnalyzer, Technicon Corporation, method N-219) were estimated in each specimen of white bile except that obtained from case 9.

The serum bilirubin (Malloy and Evelyn, 1937) level was estimated before operation (usually on the day preceding operation, and always within four days of operation) and at irregular intervals (usually every four to five days) after operation.

RESULTS

The results of the biochemical examination of white bile are recorded in Table II. Certain clinical features were common to the nine patients in this study (Table I). All were over 40 years of age, all had been jaundiced for some time and all survived an operation to relieve biliary obstruction. In six of the seven patients submitted to percutaneous transhepatic cholangiography the obstruction was judged to be radiologically complete. In the other patient (case 4) the dye appeared in the duodenum after one and a half hours (Fig. 1). In seven patients the obstruction was a malignant tumour, in one patient it was probably a cancer of the head of the pancreas (although a stone was also found in the common duct), and in the remaining patient it was a stone impacted at the lower end of the common duct (Table I).

In two instances (cases 1 and 7) the site of the obstruction was proximal to the entry of the cystic duct into the biliary tree. In six patients (cases 2, 3, 4, 5, 6, and 8) the site of the obstruction was distal to the entry of the cystic duct into the biliary tree and in four of these (cases 2, 4, 5, and 6) the gall bladder, although it shared in the biliary distension, was not

TABLE I

CLINICAL DETAILS OF PATIENTS WITH WHITE BILE

Case No.	Age	Sex	Diagnosis	Site of Obstruction	State of Gall Bladder	Operation	Outcome
1	56	M	Cancer of gall bladder	Common hepatic duct	Infiltrated with cancer	Hepaticojejunostomy	Died 3/12 ^a
2	47	M	Cancer of pancreas	Common bile duct	Distended; apparently normal ^b	Cholecystjejunostomy, enteroanastomosis	Died 8/12
3	67	M	Impacted stone in common bile duct	Distal common bile duct	Distended; chronic cholecystitis	Cholecystectomy, choledocholithotomy, sphincterotomy, choledochoduodenostomy	Alive and well 16/12
4	41	F	Periampullary cancer	Distal common bile duct	Distended; cellular infiltration	Pancreaticoduodenectomy	Died 9/12
5	69	M	Cancer of pancreas	Common bile duct	Distended; apparently normal ^b	Cholecystenterostomy with Roux-Y loop	Died 5/12
6	77	F	Periampullary cancer	Distal common bile duct	Distended; apparently normal ^b	Cholecystjejunostomy with Roux-Y loop	Died 5/12
7	43	F	Cancer of common hepatic duct	Common hepatic duct	Collapsed; apparently normal ^b	Insertion of trans-hepatic tube	Died 10/52
8	68	M	Cancer of pancreas ¹	Common bile duct	Small; packed with stones	Cholecystectomy, choledocholithotomy, choledochoduodenostomy	Survived ⁴ 5/52
9	53	M	Cancer of pancreas	Common bile duct	Distended; apparently normal ^b	Hepaticojejunostomy, enteroanastomosis, cholecystostomy	Died 18/52

¹Diagnosis not proven.²Gall bladder not examined histologically.³A necropsy was performed on all patients who died.⁴Lost to follow up.

TABLE II

RESULTS OF INVESTIGATIONS ON WHITE BILE

Case No.	Source	Culture	Alkaline Phosphatase (King-Armstrong units)	Cholesterol (mg %)	Na (m-equiv/l)	K (m-equiv/l)	Cl (m-equiv/l)
1	Percutaneous transhepatic cholangiography	Sterile	1.2	Nil	138	3.6	152
2	Percutaneous transhepatic cholangiography	Sterile	0.8	Nil	138	4.3	131
3	Percutaneous transhepatic cholangiography	—	Nil	Nil	137	3.9	130
4	Percutaneous transhepatic cholangiography	Enterobacteriaceae	Nil	Nil	118	3.4	99
5	Gall bladder ¹	Sterile	Nil	Nil	132	4.1	140
6	Percutaneous transhepatic cholangiography	Sterile	1.3	26	141	3.8	107
7	Percutaneous transhepatic cholangiography	—	2.2	Nil	139	4.0	145
8	Common bile duct	—	Nil	Nil	136	2.3	136
9	Percutaneous transhepatic cholangiography	—	Nil	Nil	Not done	Not done	Not done

¹This patient had free communication between the gall bladder and the biliary tree proximal to the obstructing cancer of the pancreas.

grossly abnormal. In the final patient (case 9) a carcinoma of the pancreas had obstructed both the cystic and the common hepatic ducts; the gall bladder contained yellow bile while the common bile duct contained white bile.

In the only instance where the apparently normal gall bladder was available for histological examination (case 4) it was found to have a normal epithelium

but plasma cells and lymphocytes had infiltrated the muscle and submucosa. Four of the five specimens cultured were sterile and free of cells and organisms on Gram staining. The other specimen, from case 4, grew *Enterobacteriaceae*, and Gram staining showed numerous pus cells and Gram-positive rods.

In seven of the nine patients with white bile the

FIG. 1. Transhepatic cholangiogram (case 4). Film taken one and a half hours after instillation of dye. Some dye has passed through the obstruction and entered the duodenum.

level of bilirubin in the serum had fallen by more than 50% of the preoperative level by the twelfth postoperative day (Table III). One of the two exceptions was a patient with a transhepatic tube splinting the stricture of the common hepatic duct which probably provided inadequate decompression.

DISCUSSION

In a general way the biochemistry of the white bile

TABLE II

POSTOPERATIVE BILIRUBIN LEVELS IN PATIENTS WITH WHITE BILE

Case No.	Duration of Obstruction (wk)	Preoperative Serum Bilirubin (mg/100 ml)	Postoperative Period when Preoperative Serum Bilirubin Fell by More than 50% (days)
1	4	24.0	3-8
2	4	16.4	0-5
3	6	11.9	0-11
4	6	13.0	8-12
5	4	17.8	4-8
6	4	27.0	0-5
7	5	35.4	9-30
8	5	19.0	13-20
9	8	44.0	6-11

¹The first number in each period refers to the day when the bilirubin concentration was more than 50% of the preoperative level. The second number refers to the postoperative day when the bilirubin level had fallen by more than 50% of the preoperative level.

in our series resembled that found by others (Griffiths *et al*, 1963; Bouchier and Cooperband, 1965).

The reason why some patients with obstruction to the extrahepatic biliary tree develop white bile is unknown. Many years ago Rous and McMaster (1921) noted that bile became thick and pale when the bile and the bile ducts were infected. Aronsohn (1935), after studying the formation of white bile in rabbits and dogs, concluded that prolonged biliary infection was always responsible for the production of white bile. This does not apply to man; our results and those of others (Edington and McCallum, 1930; Bouchier and Cooperband, 1965) show that white bile can be sterile.

Rous and McMaster (1921), on the basis of animal experiments, suggested that white bile is formed only when the gall bladder is either not in the obstructed system or when it is so changed pathologically that its concentrating ability has been lost. Judd and Lyons (1923), after reviewing the histories of 19 patients with white bile, reached a similar conclusion. Yet four of our patients had distal obstruction and their gall bladders were normal except for mild swelling of the wall, and in three of them adequate decompression of the biliary tree was carried out by joining the bowel to the gall bladder. This demonstrates that obstructions distal to a normal gall bladder can result in the formation of white bile and that the distended gall bladder can be used to decompress the biliary tree.

Each of our patients survived the immediate postoperative period and in no instance was death directly attributable to the operation. We believe that the finding of white bile alone should not be taken as a signal to limit the scope of the operation.

The level of bilirubin in the serum fell after

operation usually at a rate exceeding the average rate suggested by Rundle, Perry, Cass, and Oddie (1958) for the relief of ordinary obstructive jaundice. Their calculations, based on observations made on 17 patients with obstruction of the common bile duct treated with tube drainage of the duct, suggested that if relief of the biliary obstruction was adequate the serum bilirubin level should be halved by an average of 17.4 days after the operation. We suspect that the fall is steeper and that the half value is reached sooner in patients with internal drainage. Certainly in seven of the eight patients with white bile treated by adequate internal drainage the pre-operative bilirubin fell by more than 50% by the twelfth postoperative day (Table III). Presumably in patients with white bile the ability of the liver to excrete bilirubin is not greatly impaired, the serum bilirubin falling more rapidly than it does in patients with ordinary obstructive jaundice treated by external biliary drainage.

SUMMARY

Observations were made in nine patients who were operated on for obstructive jaundice and who were found to have white bile in the biliary tree. The fluid was free of bilirubin and bile salts and the major cation composition resembled that found in serum. White bile is not necessarily infected bile. White bile can be found in both benign and malignant forms of jaundice; the gall bladder, although it may share in general dilatation of the biliary tree, may be used for decompression. White bile alone does not point to a grave immediate prognosis; an opera-

tion appropriate to the patient's general condition and to the nature of the obstruction should be considered. When white bile is found the function of the liver as measured by its ability to clear bilirubin after operation is not greatly impaired.

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