The treatment of retained stones in the common bile duct with sodium cholate infusion

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SUMMARY Six patients with stones retained in the common bile duct after cholecystectomy and common duct exploration were treated by intraductal infusion of a sodium cholate solution. In the five patients whose stones were between the T-tube and the duodenum the treatment was successful within a few days. A stone became transiently impacted in the ampullary region soon after beginning therapy in three patients and produced mild pancreatitis in two. The only failure was in a patient whose stone was between the T-tube and the liver.

Gallstones are retained in the biliary tree after cholecystectomy with common bile duct exploration in approximately 10% of patients (Bartlett and Dreyfuss, 1960). Since a second operation upon the bile duct is hazardous, several non-surgical approaches to therapy, including dissolution of the stones by instillation of substances through the T-tube (Pribram, 1947; Torresyap, 1958) and removal of the stones by instrumentation through the T-tube, have been proposed (Bean and Mahorner, 1972; Burhenne, 1973).

The purpose of this report is to describe our experiences in six patients with retained common bile duct stones treated by sodium cholate infusions through the T-tube, as described by Way, Admirand, and Dunphy (1972).

Patients and Methods

The patients were studied at least four weeks after operation. Their ages and sex are shown in the table. They were fully informed and agreed to participate in the experimental procedure. They were asymptomatic and tests of liver function were normal at the time of study.

The solution used contained 100 mM sodium cholate in saline, buffered to pH 7.5, and sterilized by millipore filtration. It was allowed to drip into the duct at the rate of 30 ml per hour for a maximum of 10 days.

A central venous pressure manometer, connected to the tubing between the solution and the patient, was kept open to provide an overflow valve. The tube extended 30 cm above the bile duct, a height judged to be equivalent to maximal pressure normally obtained in the common bile duct (Hallenbeck, 1967). When the stone was lying free between the T-tube and the duodenum, the infusion was directed into the T-tube. When the stone was impacted in the distal common bile duct, a small catheter was passed under fluoroscopic control through the T-tube to a position adjacent to the stone and the solution introduced through the catheter. If the common bile duct was occluded distally, bile and infusate could drain through the T-tube around the small catheter, thus allowing continuous infusion and continuous drainage. When the stone was between the liver and the T-tube, the catheter was passed to a position 'upstream' from the stone so that the infusion flowed back over the stone.

Cholangiograms were taken before beginning treatment and at three-day intervals, or more frequently if indicated. Cholestyramine was administered orally at the first sign of diarrhoea. The dose was regulated by the patient's symptoms, and did not exceed 2 g every two hours.

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Patient Age and Sex	Duration of Perfu- sion (Days)	Number of Stones	Location of Stones	Results	Side Effects	Comments
VB 37,F	4	1	Impacted in distal bile duct	Successful	Mild pancreatitis, haematuria, diarrhoea	See text
KA 56,M	10	1	Above T-tube in common hepatic duct	Failure	Minimal diarrhoea	Combination cholate-deoxycholate infusion Complete obstruction few hours after infusion began
	3	1	Above T-tube in common hepatic duct	Failure	Severe diarrhoea	
CW 19,F	3	2 (or more)	Distal common bile duct, partially obstructed	Successful	Diarrhoea, nausea, pancreatitis	Complete obstruction few hours after infusion began
AR 60,M	4	1	Distal common bile duct, partially obstructed	Successful	Diarrhoea	
PC 58,F	5	3	Free in distal common bile duct	Successful	Mild diarrhoea	Stone became impacted within first six hours of infusion
MF 28,F	3	2	Free in distal common bile duct	Successful	Diarrhoea	

Table Results of treatment with sodium cholate infusion

Results

In all five patients in whom the stone or stones were distal to the T-tube, the stones passed (table).

Cholangiograms before and after treatment in one patient (CW) are shown in figure 1. In four patients, the stones passed after three to five days of infusion, but in the fifth (VB) the stone passed two weeks

Fig 1 Patient C.W. The left panel shows a cholangiogram before treatment. Arrows point to two definite stones. The right panel shows a cholangiogram after the stones had passed.

Fig 2 *Patient V. B. The stone is impacted at the ampulla (A), free in the duct (B), not visible, but completely occluding the duct (C), and no longer present (D). The T-tube was withdrawn and the patient did well. Arrows indicate the stone.*

after a four-day infusion had been completed.

There were minor, but potentially important complications in three of the five patients who were treated successfully. In all three, a stone became transiently impacted in the distal bile duct associated with a rise in intraductal pressure and pain in the epigastrium and back. Mild pancreatitis developed in two; both had slightly elevated serum and urinary amylase levels, and one had an elevated white blood count. In two patients, the stone was free in the distal duct at the beginning of the infusion. In the other patient (VB) it was impacted initially, and after four days of cholate infusion, there developed mild mid-epigastric pain and a small amount of blood appeared

in the bile. A cholangiogram showed the stone to be free in the duct (figure 2). The infusion was stopped, she became asymptomatic, and was discharged. Two weeks later, upon readmission to hospital, a cholangiogram showed that the stone was again impacted in the distal bile duct. The next day before the cholate infusion could be reinstituted, the signs and symptoms of pancreatitis developed and after two days, the stone passed and the patient became asymptomatic. In all three patients the obstruction lasted less than 48 hours and was followed by passage of the stone into the duodenum.

In the one failure (KA), the stone was proximal to the tube. That patient was treated for 10 days.

with a sodium cholate infusion and later for three days with a 100 mM mixture of 70% sodium cholate and 30% sodium deoxycholate. The second infusion had to be terminated because of uncontrollable diarrhoea.

Discussion

In four of the five patients with retained stones in the common bile duct distal to the T-tube, the stones passed out of the duct within five days of beginning the sodium cholate infusion. In the fifth patient the stone passed two weeks after the infusion. Was this the natural history of the disease, the mechanical effect of bile duct perfusion, or a specific effect of the bile salt solution.

Common bile duct stones do pass into the duodenum spontaneously, but since they had not passed in these patients during the preceding four to six weeks of observation, spontaneous passage seems unlikely.

A non-specific effect of bile duct perfusion cannot be excluded in these patients because we did not use a control saline solution, but other studies suggest that bile duct perfusion alone would not give these results. Way *et al.*, (1972) used saline in four patients for six days without passage of the stones but in all four the stones passed during the sodium cholate infusions. Furthermore, since maximum intraductal pressure was maintained at a level no greater than normal intraductal pressure, it seemed very doubtful that the stones were forced or flushed out of the duct.

Small (1970) and Earnest and Admirand (1971) showed that incubation of cholesterol stones in bile salt solutions *in vitro* dissolves some cholesterol out of the stones and decreases their size. In our patients the stones did not dissolve nor was it possible to detect radiographically a decrease in size. It is highly probable, however, that a decrease in size sufficient to allow passage into the duodenum did occur. This view is supported by the impaction of stones in the ampullary region in two patients only a few hours after beginning the infusions. In those patients the stones had remained free in the bile duct without

entering the narrower intraduodenal portion for four to six weeks before the bile salt infusions.

The only complications of therapy were diarrhoea in all patients and the transient impaction of the stone in the ampulla of a Vater, causing mild pancreatitis in two patients. The diarrhoea was easily controlled with cholestyramine in all patients except the one who was given a mixture of sodium cholate and sodium deoxycholate. The deoxycholate was employed because of its greater cholesterol solubilizing capacity (Earnest and Admirand, 1971). Pancreatitis is a potentially serious complication, but in these patients it was mild and transient.

On the basis of our experience we recommend continued use of sodium cholate infusion into the common bile duct to treat retained stones, especially when the stones are between the T-tube and the duodenum.

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