CLINICAL RESEARCH

Percutaneous cholecystolithotomy

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Abstract

A percutaneous method was used to remove stones from otherwise normal gall bladders, as assessed by cholecystography and ultrasonography. The procedure was performed in a single stage under general anaesthesia, adopting the method and instruments used for one stage percutaneous nephrolithotomy. A Foley catheter was left in the gall bladder and the system checked with contrast at 10 days to ensure free drainage and exclude residual calculi. Seven out of eight patients had a successful percutaneous cholecystolithotomy. An adequate track could not be secured in one man; he had an uneventful cholecystectomy under the same anaesthetic. Follow up at three months of the seven patients showed no calculi and no complications.

Percutaneous cholecystolithotomy may prove complementary to extracorporeal shockwave lithotripsy in patients in whom there is difficulty focusing the shock waves on the gall bladder or who have had incomplete disintegration of stones.

Introduction

Alternative techniques to surgical removal of gall stones were introduced in 1972 by Burhenne, who performed percutaneous extraction of residual stones in the common bile duct through the tract left by the T tube used to explore the duct after cholecystectomy.¹ With impending implementation of extracorporeal shockwave lithotripsy for gall stone fragmentation and with our considerable experience with percutaneous nephrolithotomy² we decided that it was almost mandatory that before we attempted extracorporeal shockwave lithotripsy alone for gall stones there should be a fail safe method of averting possible dangerous

obstructive complications arising. We find that percutaneous nephrolithotomy is a vital adjunct to renal extracorporeal shockwave lithotripsy³ and we believe strongly that it is unethical to treat patients with gall stone lithotripsy without having a percutaneous method of drainage and stone retrieval to avert severe obstruction or cholangitis. With ultrasound guidance percutaneous drainage of an obstructed gall bladder has become routine.⁴ Stones in the gall bladder have been removed along the track of the tube by baskets⁵ or dissolved with methyl tributyl ether or mono-octanoin.⁶ Single stage cholecystolithotomy has not been attempted; this report extends our experience with percutaneous nephrolithotomy to the gall bladder.

Patients and methods

Three men and five women aged 31-73 (mean age 41) were selected on the criteria of having symptomatic gall stones in a functioning gall bladder. All eight patients were free of other medical complaints and elected to have the percutaneous procedure after an explanation of the alternatives. Each patient agreed to have an immediate cholecystectomy under the same anaesthetic if the procedure could not be completed satisfactorily. The function of the gall bladder was assessed by oral cholecystography. Ultrasound examination of the gall bladder was undertaken to determine the number of gall stones, the size and accessibility of the gall bladder, and the line of approach to the gall bladder by percutaneous needle. Six to eight hours preoperatively each patient was given oral contrast (calcium ipodate 3 g) to aid fluoroscopic localisation of the gall bladder. Metronidazole 500 mg, gentamicin 80 mg, and cephalosolin 1 g were given intravenously immediately before the procedure.

TECHNIQUE

The patient was anaesthetised on a fluoroscopic table in the x ray department. Drapes were placed on the patient to collect the endoscopic irrigant, as for percutaneous nephrolithotomy. With use of fluoroscopy and ultrasound to localise the gall bladder a 1 cm puncture was made subcostally and a 152 mm long dwell sheathed needle passed into the gall bladder. A guide wire was introduced through the sheath and a 7 Ch pigtail catheter advanced to aspirate bile from the gall bladder and minimise spillage. The gall bladder was flushed with saline and filled with dilute contrast. Under fluoroscopic control the tract was dilated with a 28 Ch balloon on a 9 Ch catheter (William Cook Europe). On removal of the balloon catheter an Amplatz dilator was passed followed by a 28 Ch Teflon sheath, which was

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advanced well into the gall bladder under fluoroscopic control (fig 1), taking care not to invaginate the muscular wall of the gall bladder.

After removal of the dilator, but not the guide wire, which was maintained in the gall bladder throughout the procedure, a Wolf nephroscope was introduced and small stones removed under direct vision with alligator forceps. Larger stones were disintegrated with either an electrohydraulic probe or an ultrasound lithotripter (Richard Wolf LTD) and small fragments aspirated or removed with forceps. Once the gall bladder was

FIG 1—Contrast injected through 28 Ch sheath to outline gall bladder after balloon dilatation of percutaneous track.

completely cleared of all visible fragments a spot film was taken with dilute contrast to exclude residual calculi. The guide wire was removed and a 14 Ch Foley catheter introduced down the Amplatz sheath. The balloon was inflated under fluoroscopic control to check that the position of the balloon was satisfactory. The Teflon sheath was cut away from the catheter, which was then sutured to the skin. The catheter was placed on free drainage for 7-10 days, when a tubogram (fig 2) was performed to ascertain that no calculi were present in the gall bladder, that no extravasation of contrast had occurred into the peritoneal cavity, and that there was free flow of contrast into the common bile duct and duodenum with no evidence of calculi within the common bile duct.

Results

Seven of the eight patients had their calculi successfully removed. Four patients had multiple small calculi between 3 and 8 mm diameter; these were removed intact by alligator forceps, one gall bladder containing 135 calculi. In three patients the calculi were over 1 cm diameter and had to be disintegrated. Initial use of the electrohydraulic probe resulted in rapid disintegration of the stones with the formation of multiple "dust" particles. Ultrasound lithotripsy was used in the second patient to cleave the stone into large fragments that were easily removed with alligator forceps. In the unsuccessful procedure a suitable track to the gall bladder could not be established; the patient was of large, thick set build, such that when he was anaesthetised the gall bladder was too far from the skin surface for the dilators and sheath available. The balloon failed adequately to dilate the wall of the gall bladder, which was invaginated on passage of the dilator. Immediate cholecystectomy was therefore performed and the patient made a good recovery. At operation there was a correctly positioned puncture in the gall bladder just below the fundus with no hepatic or other injury.

Six of the seven patients made a completely uneventful recovery, but in one the tubogram on the 10th day outlined a haustum within the transverse

colon. The Foley catheter was left in situ and the patient given oral metronidazole and ampicillin and allowed home without symptoms after the fourth day. A subsequent tubogram showed no fistula and after removal of the Foley catheter the track healed. At three months all patients were well and symptom free.

Discussion

The technique and safety of percutaneous nephrolithotomy are well established.⁷ Application of the procedure to the gall bladder, however, has been delayed because the gall bladder is less accessible than the kidney and lies within the peritoneal cavity. Furthermore, spillage of bile within the peritoneal cavity may cause systemic illness. The key to cholecystolithotomy is the placement of a guide wire by direct puncture under ultrasound control. A transhepatic route is often used for simply draining a gall bladder, but for endoscopy of the gall bladder a subcostal approach through the peritoneal cavity is preferable to avoid hepatic bleeding on dilating the track.

The principal technical problem encountered was in trying to dilate the gall bladder with techniques employed in the kidney. The gall bladder wall would not accept a dilator greater than 16 Ch and merely invaginated, making insertion of the sheath and nephroscope impossible. Use of the balloon dilator was an important advance. Alternative techniques which we explored in animals and cadavers including using a laparoscope with direct puncture of the gall bladder by diathermy and insertion of the nephroscope under direct vision; unfortunately, the gall bladder tended to tear with subsequent leakage of bile. The fundus of the gall bladder is much more mobile than that of the kidney, particularly at laparoscopy; hence we believe that the transperitoneal approach under ultrasound control with balloon dilatation is the way forward.

FIG 2—Contrast injected through Foley catheter showing free drainage and no residual stones one week after removal of multiple stones.

We think that the technique will prove complementary to extracorporeal shockwave lithotripsy,⁸ for those patients in whom it proves difficult to focus the shock waves on the gall bladder and for those who have had incomplete disintegration of their stones

with residual fragments. The delayed techniques of percutaneous drainage with subsequent stone removal will be valuable for patients with a blocked cystic duct, so completing the repertoire of the operator but begging the question whether the gall bladder itself requires removal to avoid subsequent stone formation.

Over the past 36 years 23 publications have reviewed the results of open surgical cholecystolithotomy carried out on 2053 patients without recourse to cholecystectomy. The overall recurrence rate has been 34.6% (J Dempsey, paper in preparation) and the range 0-83% over follow up periods of 1-19 years. Further, patients treated by endoscopic sphincterotomy for stones in the common bile duct have had only a 14% incidence of cholecystectomy in follow up periods extending to five years.^{9,10} Thus cholecystectomy is not a definite requirement for patients with stones, and with the use of non-invasive imaging such as ultrasound the early reformation of the gall stone can be detected and eliminated by extracorporeal shockwave lithotripsy.

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Reduced concentrations of potassium, magnesium, and sodium-potassium pumps in human skeletal muscle during treatment with diuretics

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Abstract

Animal studies have shown that potassium depletion induced by diuretics or potassium deficient fodder leads to a selective decrease in the concentrations of potassium and in the concentration of sodium-potassium pumps in skeletal muscle. In 25 patients who had received diuretics for 2-14 years the mean concentrations of potassium, magnesium, and sodium-potassium pumps were measured in skeletal muscle biopsy specimens and were significantly lower than in those from a group of age matched controls. The reductions in all three variables were significant in those patients receiving diuretics for arterial hypertension as well as in those being treated for congestive heart failure. In 14 patients the mean muscle potassium concentration was below the control range, but only one of those was hypokalaemic (3.4 mmol/l), and 13 were receiving potassium supplements. In 15 patients the mean muscle magnesium concentration was below normal, and the mean muscle potassium and magnesium concentrations showed a linear correlation. In 12 patients in whom the mean muscle potassium concentration was below 80 µmol/g wet weight there was a linear correlation between the cellular potassium:sodium ratio and the concentration of ³H-ouabain binding sites indicating that potassium deficiency also leads to a down regulation of sodium-potassium pumps in human skeletal muscle.

In spite of potassium supplements long term treatment with

diuretics may lead to potassium and magnesium deficiencies, which are not detectable using the standard methods of serum analysis. The changes in concentrations of electrolytes and sodium-potassium pumps associated with treatment with diuretics may impair muscle function and potassium homeostasis and interfere with the distribution of digitalis glycosides.

Introduction

Thiazides and loop diuretics facilitate the loss of potassium and magnesium through the kidneys leading to deficiencies that may require treatment with supplements.¹⁻⁵ These losses are often overlooked, however, because plasma concentrations may remain normal even when the total body pools of potassium and magnesium are appreciably reduced. Animal studies have shown that deficiencies in potassium and magnesium are associated with a selective reduction in the concentration of potassium and in the concentration of sodium-potassium pumps in skeletal muscle.⁶⁻⁹ The concentration of sodium-potassium pumps determines the maximum capacity for the uptake of potassium by cells¹⁰ and plays an important part in the distribution of acutely administered digitalis glycosides.¹¹ The skeletal muscles are of particular importance because they contain the largest single pool of sodium-potassium pumps in the body.¹²

The present study was undertaken to assess the prevalence of magnesium and potassium deficiency among patients receiving long term treatment with diuretics and potassium supplements that were regarded as adequate for maintaining normal potassium homeostasis.

Subjects and methods

The study, which was approved by the local ethical committee, was performed in 25 consecutive patients undergoing outpatient treatment of hypertension or congestive heart failure at a department of internal medicine. There were 10 men and 15 women aged 44-83 years (median 67)

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