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ORIGINAL ARTICLE

# Surgical management of patients with post-cholecystectomy benign biliary stricture complicated by atrophy–hypertrophy complex of the liver

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## Abstract

**Background:** Atrophy–hypertrophy complex (AHC) of the liver rarely complicates post-cholecystectomy benign biliary strictures (BBS). This study aimed to analyse the effect of AHC on the surgical management of patients with BBS.

**Methods:** Between 1989 and 2005, 362 patients underwent surgical repair for BBS at a tertiary referral centre in northern India. A total of 36 (10%) patients had AHC. Patients with AHC ($n = 36$) were compared with those without ($n = 336$) to define the factors associated with the development of AHC.

**Results:** Overall, 35 patients with AHC underwent Roux-en-Y hepaticojejunostomy; right hepatectomy was performed in one patient. The interval between bile duct injury and stricture repair did not influence the development of AHC (mean 24 months in AHC patients vs. 19 months in non-AHC patients; $P = 0.522$). Of the 36 patients with AHC, 26 (72%) had hilar strictures (Bismuth's types III, IV, V), as did 163 of the 326 (50%) patients without AHC ($P = 0.012$). Patients with AHC had more blood loss at surgery (mean blood loss 340 ml in the AHC group vs. 190 ml in the non-AHC group; $P = 0.004$) and required more blood transfusion (mean blood transfused 300 ml vs. 120 ml; $P = 0.001$). Surgery was prolonged in AHC patients (mean duration of operation 4.2 hours in the AHC group vs. 2.8 hours in the non-AHC group; $P = 0.001$). Over a mean follow-up of 43 months (range 6–163 months), three of 36 (8%) AHC patients required re-intervention for recurrent strictures, compared with nine of 326 (3%) non-AHC patients ($P = 0.006$).

**Conclusions:** Iatrogenic injury at the hepatic hilum predisposes for the development of AHC. Surgery is more difficult and blood transfusion requirements are higher in patients with AHC during surgical repair of BBS. Atrophy–hypertrophy complex is a risk factor for recurrent stricture formation after hepaticojejunostomy.

## Keywords

bile duct injury, biliary stricture, hepaticojejunostomy, liver atrophy

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## Introduction

Atrophy of the hemiliver or a segment is usually a sequel of vascular occlusion, especially of the portal vein, or of prolonged biliary obstruction. Atrophy of the hemiliver along with compensatory hyperplasia of the non-affected part, termed 'atrophy–hypertrophy complex' (AHC), causes rotation of the liver with the hilum as the axis. Patients who sustain bile duct injury (BDI) during cholecystectomy occasionally present with AHC along with benign biliary stricture (BBS) and the gross deformation of normal anatomical relations at the hepatic hilum adds to the difficulty of surgical repair of the post-cholecystectomy BBS in an

 

already injured, inflamed and scarred area. These difficulties may eventually affect the final outcome of BBS repair. As most vascular injuries go undetected and because atrophy develops within a few weeks following the injury, AHC may be fully established by the time the patient presents for repair of BBS. We have previously published our longterm results of surgical repair of BBS.[1] Here, we review our experience with surgical repair of BBS complicated by AHC.

## Materials and methods

Between 1989 and 2005, 362 patients were operated for BBS at a tertiary care referral hospital in northern India. The details of these patients were maintained prospectively in a database. Patients referred immediately after BDI with bile leak underwent emergency non-surgical (endoscopic and/or percutaneous) interventions to drain bile collections or to control bile leak. Elective surgical repairs were delayed, usually for a minimum of 6 weeks. Patients with BBS who were definitively managed with endoscopic or percutaneous intervention were excluded from the study. Liver function tests (LFT) and ultrasonography (US) of the abdomen were performed in all patients before the surgical repair. Preoperative stricture evaluation was undertaken with percutaneous transhepatic cholangiography (PTC), magnetic resonance cholangiography (MRC) or endoscopic retrograde cholangiography (ERC). Strictures were classified according to Bismuth's types. Preoperative insertion of catheters into the biliary system was required in some patients with high biliary strictures and ductal separation, either in anticipation of difficulty in intraoperative ductal identification or as part of biliary drainage in patients with severe uncontrolled cholangitis.

Intraoperatively, the liver was inspected for atrophy, hypertrophy and cirrhosis. Atrophy was defined as a reduction of at least 50% in the size of a segment (segmental atrophy) or a hemiliver (hemiliver atrophy).[2] Tissue for liver biopsy was taken in patients with suspicion of cirrhosis. Roux-en-Y hepaticojejunostomy (RYHJ) with anastomosis extended to the left hepatic duct (Hepp–Couinaud approach) was the standard surgical procedure. Anastomosis was stented in selected patients depending upon the stricture type, ductal diameter, technical difficulty at operation and the anticipated need for future percutaneous intervention.

Follow-up information was collected by outpatient visits, postal questionnaires and telephone interviews. Follow-up evaluation was carried out by investigating the clinical history, physical examination, LFT and US. Mebrofenin nuclear scintigraphy was performed to demonstrate the patency of bilio-enteric anastomosis in the presence of abnormal LFT or US findings. Cholangiography (PTC or MRC) was undertaken if there was biliary dilatation on US or delayed clearance and pooling of the radioactivity above the anastomosis on Mebrofenin scan. Those who had demonstrable stricture of the hepaticojejunostomy on cholangiography were offered re-intervention. The outcome of the surgical repair was graded as per the categories suggested by McDonald and colleagues,[3] where: grade A = asymptomatic, normal LFT; grade B = asymptomatic, mild LFT derangement or occasional episodes of pain or fever; grade C = pain, cholangitis defined as fever with jaundice and abnormal LFT, and D = surgical revision or dilatation required. Patients with McDonald grades A and B were classified as treatment successes and those with grades C and D were classified as treatment failures.

Detailed analysis of patients who had AHC along with BBS was performed retrospectively. In an attempt to identify the differences between patients with and without AHC, various factors were compared using univariate analysis. Chi-square test, Fisher's exact test or Student's *t*-test were used for univariate analysis as appropriate.

## Results

The 362 patients included 303 (84%) males and 59 (16%) females with a median age of 37 years (range 10–70 years). Patients were referred after injuries sustained during laparoscopic cholecystectomy in 52 (14%) cases and during open cholecystectomy in 310 (86%). In 13 patients, the laparoscopic procedure had been converted to an open procedure once the BDI had been detected. A total of 88 (24%) patients had undergone emergency re-explorations before they were referred to our centre, mainly to control bile extravasation. By the time patients were referred, 15 (4%) had cirrhosis and 13 (4%) had portal hypertension. A total of 142 (39 %) patients were referred to our department after ERC. Percutaneous transhepatic cholangiography was performed in 174 (48%) patients and MRC in 89 (25%) patients. Fifty (14%) patients had undergone preoperative biliary drainage to control cholangitis that was unresponsive to antibiotics. Stricture types were type I in 37 (10%), type II in 137 (38%), type III in 148 (41%), type IV in 24 (7%) and type V in 16 (4%) patients.

Thirty-six of 362 (10%) patients with BBS were found to have AHC at operation. In 12 patients, preoperative US or cholangiography could not detect AHC although it was evident at operation. A total of 33 (91%) patients had right hemiliver atrophy and left hemiliver hypertrophy. Two patients had left hemiliver atrophy and another had isolated atrophy of segment 4. These 36 patients with AHC were referred to us after a median delay of 7 months (range 7 weeks to 16 years) after the BDI. Six (17%) patients had sustained injuries during laparoscopic cholecystectomy and the remaining 30 (83%) during open cholecystectomy. Nine patients had undergone re-exploration for bile extravasation, four had undergone attempted primary repair of the BDI and two had undergone stricture repair at a later date before referral to us. Four (11%) patients had Bismuth's type I, six (17%) had type II, 20 (56%) had type III and six (17%) had type IV strictures. Five (14%) patients required percutaneous transhepatic biliary drainage (PTBD) before operation to control cholangitis. Two patients had portal hypertension. Sixteen (44%) patients had spontaneous internal fistula to the duodenum. Fifteen (42%) patients underwent preoperative percutaneous