

## Case Report

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# Biliary complications: the Achilles' heel of ALPPS

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## ABSTRACT

ALPPS (associated liver partition and portal vein ligation for staged hepatectomy) is a novel procedure enabling rapid hypertrophy of the future liver remnant (FLR) in less than a week. However, it is associated with a high morbidity of 33 - 64% mostly biliary. We report a 37-year-old female with sigmoid colon cancer and synchronous liver metastasis occupying the right liver including segment 4 managed by colonic resection with ALPPS enabling an extended right hepatectomy. Postoperatively the patient had a gradual rise in bilirubin and MRCP revealed biliary stricture which was managed by PTBD followed by internalization. Biliary complications seem to be a major determinant of perioperative outcomes and success of ALPPS. Important preventive measures include accurate preoperative imaging, careful dissection of porta, use of vessel loops and transcystic stents during ALPPS-1. Treatment of biliary complications mainly centres around appropriate use of endoscopic and interventional radiological procedures.

**Keywords:** ALPPS, Biliary stricture, Colonic liver metastasis,

## INTRODUCTION

ALPPS (associated liver partition and portal vein ligation for staged hepatectomy) is a modified two stage liver resection described by Schnitzbauer in 2012.<sup>1</sup> This new surgical technique combines unilateral portal vein ligation (PVL) and in situ splitting of the liver (ISS) to enable resectability by inducing rapid hypertrophy of the future liver remnant (FLR) in a short duration of time.<sup>1</sup> However, recent analyses have suggested a higher incidence of morbidity, mostly biliary (33-64%) and higher mortality (7-9%) with this procedure.<sup>2</sup> Hence, several technical modifications have been proposed to improve the outcomes of the procedure.<sup>3</sup>

We report a case of Carcinoma sigmoid colon with liver metastasis managed by simultaneous colonic resection with liver resection by ALPPS. However, the case was complicated by biliary leak and stricture which was managed by PTBD and internalisation. The case is presented for the feasibility of ALPPS in selected cases

of colonic liver metastasis and the importance of prevention and prompt management of biliary complications which are the major determinant of morbidity and mortality of the procedure.

## CASE REPORT

A 37-year-old female presented with pain abdomen in the right hypochondrium for 4 months duration and altered bowel habits. She had no vomiting, jaundice or fever. She did not have any comorbidities or previous surgeries. Her vitals were stable, anicteric and no pallor with ECOG performance status of 1.

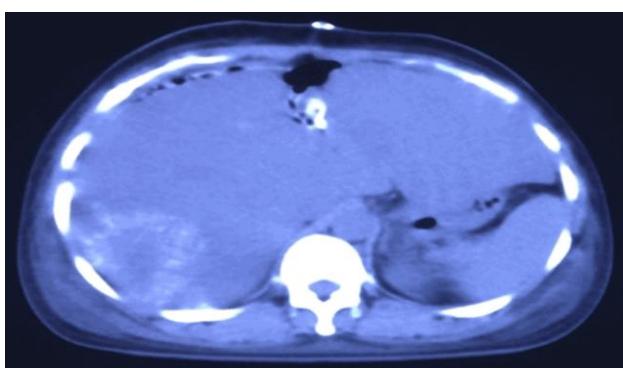
Abdominal examination revealed mild hepatomegaly. There was no free fluid and per rectal examination revealed no growth or deposits. Ultrasonogram demonstrated a large heteroechoic lesion in the right lobe of liver. A CECT Abdomen revealed an irregular circumferential wall thickening of sigmoid colon with pericolic fat stranding and lymphadenopathy and

moderate hepatomegaly with large heterodense lesion occupying segments 4,5,6,7,8 (Figure 1).



**Figure 1: Preoperative CECT abdomen showing a large heterodense lesion occupying segments 4,5,6,7,8.**

Segments 1, 2 and 3 were free with an FLR of 15%. CT features were suggestive of sigmoid growth with liver metastasis. CT chest did not reveal any metastasis. Colonoscopy revealed an ulceroproliferative lesion 20 cm from anal verge with luminal narrowing and scope could not be passed beyond. The biopsy from colonic lesion was moderately differentiated adenocarcinoma. The serum CEA level was 15.7 ng/ml. The patient was planned for Subtotal colectomy with ALPPS. Laparotomy revealed a growth in sigmoid colon and a large metastatic lesion in the right lobe of liver extending into segments 4a and 4b. Left lateral segments 2 and 3 were free. Since the patient had subacute intestinal obstruction and proximal colon was not evaluated it was decided to do a Subtotal colectomy. Stage 1 ALPPS was done by division and suture ligation of right branch of portal vein and parenchymal transection to the right of falciform ligament. The patient had intraoperative hypotension during parenchymal transection hence ileorectal anastomosis was deferred and an end ileostomy was fashioned. Bile staining was noted at the insertion site of segment 4 duct into LHD which was primarily repaired. A repeat CT was taken by 6th postoperative day which showed hypertrophy of left lateral segments to about 25% FLR (Figure 2).



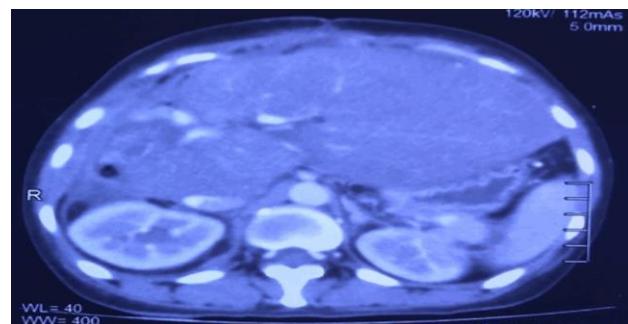
**Figure 2: CECT Abdomen on 6<sup>th</sup> POD following ALPPS-1 showing hypertrophy of left lateral segments to about 25% FLR.**

The patient was taken up for stage 2 ALPPS on 7th postoperative day. Re-laparotomy revealed hypertrophied left lateral segments and relative atrophy of right trisection of liver. There was Bile leak with flakes covering transection surface of liver with bile leak at segment 4 duct insertion site. LHD continuity was found intact. An Extended Right hepatectomy was completed. T tube drainage of the CBD and drainage of the segment 4 duct insertion site using a 6 Fr tube was done. Histopathological examination of colon revealed well differentiated Infiltrating adenocarcinoma T3N1M1 with free margins and positive for angiolympathic and perineural invasion.

The Liver specimen showed a 19x10 cm fairly circumscribed unencapsulated nodule with necrotic areas suggestive of metastatic carcinomatous deposits. Post operatively the patient had a gradual rise in bilirubin to 22.8 mg/dl. The total count was 19.5 x 10<sup>9</sup> cells/L. An MRCP revealed left hepatic duct stricture (Figure 3).



**Figure 3: MRCP following ALPPS-2 revealed left hepatic duct stricture.**



**Figure 4: CECT abdomen at 6 months follow-up revealed good hypertrophy of the remnant liver to almost 80% of the preoperative volume.**

ERCP was attempted and failed. PTBD of the left hepatic duct was done which was subsequently internalised with 7 Fr catheter. At 6 months followup the bilirubin had come down to 2.0 mg/dl. A CECT abdomen revealed good hypertrophy of the remnant liver to almost 80% of the preoperative volume (Figure 4) and also multiple small nodules in both lungs suspicious of metastases. The patient was started on FOLFOX chemotherapy and is under regular follow-up at 11 months postop.

## DISCUSSION

Surgical resection is the cornerstone for the treatment of resectable Colorectal liver metastases with a 5-year survival of 50-60%. The volume and function of the future liver remnant (FLR) is an important determinant of perioperative outcomes. Strategies to improve the FLR include Portal Vein Embolisation (PVE), TSH - Two staged hepatectomy or more recently, ALPPS - Associated Liver Partition and Portal Vein ligation for Staged Hepatectomy.

The concept of ALPPS was first introduced as an accidental observation in 2007 by Hans Schiltt of Germany. Later a large series by Schnitzbauer et al. first described a 74% increase in the FLR following ALPPS over a duration of less than a week.<sup>1</sup> Other investigators have subsequently reported regeneration rate of 22–35 ml/day with ALPPS which allowed for an interval of only 7–13 days versus regeneration rate of 3–5 ml/day after PVE that necessitated 5–10 weeks' interval.<sup>4</sup>

ALPSS mitigates the disadvantages of PVE and TSH which necessitate a 4-week interval between procedures during which time the patients could experience tumor progression. Moreover, Sufficient FLR hypertrophy is not always achieved with PVE. Tumour growth sometimes precludes a second hepatectomy.<sup>5</sup> Technique of stage 1 ALPPS (ALPPS-1) includes the ligation of the Rt portal branch and partition of the liver at the site of the falciform ligament (in situ splitting). The right biliary duct and the hepatic veins are preserved. The Stage 2 ALPPS (ALPPS-2) is usually performed within 7 to 15 days. The tumoral hemiliver is removed by sectioning the right hepatic artery, the biliary duct and the systemic venous pedicle.

Several pathophysiological mechanisms have been proposed for this rapid hypertrophy. Portal Vein ligation increases the portal flow to the remnant liver thereby inducing rapid hypertrophy from reverse arterial buffer response induced by hypoxic conditions and increased hepatotrophic factors to FLR. The Liver partition induces systemic response leading to hepatocyte proliferation and remodeling. It also causes interruption of intrahepatic shunting of portal flow from FLR to Liver to be resected which augments the regenerative response.<sup>2</sup>

The current indications of ALPPS include a tumor margin close to the FLR or its vascular pedicles, contraindication for PVE or failure of PVE, unexpected tumor extension during surgical exploration with a larger than planned surgical resection and a need for a large hypertrophy (>65 %) in an extremely small FLR. From the pathology point of view, ALPPS for colorectal liver metastasis (CRLM) remains the indication of choice with the largest amount of data available. However cautious use of ALPPS can be employed for hepatocarcinoma (HCC), intrahepatic cholangiocarcinoma, and perihilar cholangiocarcinoma in view of related higher morbidity and mortality. ALPPS is

associated with a high morbidity of 33-64% which includes mainly biliary complications like bile leak /fistulas followed by vascular complications and perioperative infections. It is also associated with a mortality rate of 7-9 %.<sup>2</sup> Several measures have been suggested in literature to reduce the incidence of biliary complications.

Preoperatively, high quality imaging should be done before stage 1 to map out the biliary and hepatic vascular anatomy. The segment IV bile ducts are often the source of leak. According to the Smadja and Blumgart classification, there should be no increased risk of biliary problems in type A (normal anatomy) or type B (trifurcation) variations when a right trisegmentectomy is planned. Type C (aberrant drainage of right segmental ducts into common hepatic duct) and type D (aberrant drainage of right segmental ducts into left hepatic duct) variations have a potential higher risk of developing biliary complications after stage 1. Type E (absence of hepatic duct confluence) variation carries a greater risk of damage to the left bile duct during stage 2.<sup>6</sup>

Intraoperatively, dissection at the hilum should be minimized to preserve the arterial vascular plexus, which supplies blood to the bile duct system. Intraoperative cholangiography during stage 1 has the potential to define the biliary anatomy at the liver hilum and to identify anomalies and hence, helpful to minimize the incidence of postoperative complications. Use of vessel loops to surround the hepatic artery, the bile duct and the hepatic veins can aid in better identification of these structures during ALPPS-2. Routine use of a transcystic stent placed during ALPPS-1 which is kept open during the interval phase has also been observed to avoid biliary complications.<sup>7</sup>

Postoperatively, bile leaks and strictures should be immediately identified, evaluated and adequately managed, preferably by endoscopic and interventional radiological means. Biliary complications have a great bearing on the outcome as they can be really troublesome causing delay in starting chemotherapy resulting in occurrence of tumour recurrence or metastasis. Hence, it is imperative to best prevent them and promptly manage them, if they do occur. Further, several technical modifications of ALPSS have also been proposed to reduce the morbidity associated with ALPPS-1. Hybrid ALPPS, ALTPS-Associated Liver tourniquet and PV ligation for Staged Hepatectomy, RALPP-RF assisted Liver partition and PV ligation, partial-ALPPS and Laparoscopic ALPPS are some of them.<sup>8</sup>

## CONCLUSION

Biliary complications seem to be a major determinant of perioperative outcomes and success of ALPPS. Hence it is essential to avoid these complications by preoperative imaging, careful dissection of porta, use of vessel loops and transcystic stents during ALPPS-1. Treatment of

biliary complications mainly centers around appropriate use of endoscopic and interventional radiological procedures.

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