

# Buttressing hepaticojejunostomies with hepatic round ligament flap may be beneficial

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## ABSTRACT:

**Background:** Bile leaks and anastomotic strictures are important complications of hepaticojejunostomy (HJ). Evidence suggests that the use of hepatic round ligament (HRL) to buttress HJ may be beneficial. This study evaluates the feasibility of this approach.

**Methods:** HJs performed over 2 years (Jun 2014- May 2016), with HRL reinforcement, were analyzed. Operative outcomes measured included technical difficulty, blood loss, time necessary for flap harvest, and reinforcement of HJ. The postoperative outcomes measured were the presence of bile leak and anastomotic stricture.

**Results:** Forty-one patients (27 M: 14 F), aged 2-79 years, median age of 61 years, underwent HJ with HRL buttress; 27 for periampullary/head of the pancreas carcinoma; 4 for choledochal cysts; 4 for chronic pancreatitis; 3 for gallbladder carcinoma; 3 for benign biliary stricture. The time for harvesting HRL flaps and buttressing HJ was <10 minutes. No blood was lost during harvesting the flaps. One patient (2.5 %) had grade A leak following radical cholecystectomy, and strictures were not observed during a median follow-up of 18 months (6 months to 2 years).

**Conclusion:** HRL-based buttressing of HJ can reduce the bile leak and/or stricture rate.

## KEYWORDS:

hepatic round ligament/ ligamentum teres hepatis; Bilioenteric anastomosis; Hepaticojejunostomy; Bile leak; Anastomotic stricture; Autologous hepatic round ligament flap.

## INTRODUCTION

Bile leak [1-5] and anastomotic stricture [6,7] are the main early and late complications, respectively, after hepaticojejunostomy (HJ). [7] Both complications cause significant morbidity and mortality [1-8] and therefore need effective treatment.

Buttressing anastomoses with vascularized flaps has been conclusively proven to reduce leak and stricture rates. The best example is the omental wrap for esophago-gastrostomies. [9-11]

However, studies on the effect of vascularized tissue wraps/ buttress on bilioenteric anastomoses are scarce. [12] Therefore, this study evaluated the efficacy of hepatic round ligament (HRL) flap reinforcement for HJs.

## METHODS

HJs performed over 2 years (Jun 2014- May 2016), with HRL flap reinforcement, were analyzed in a prospectively maintained database.

The study was registered with the Research Registry, following clearance of the ethical committee of the hospital, and bears a unique identification number (*researchregistry1820*).

### Technique

Upon entering the abdomen, the falciform ligament was sharply dissected off the anterior abdominal wall (Fig.1A), and the round ligament was detached from the umbilical insertion. This provided a well-vascularized, wide HRL (Fig.1B) that was kept aside and covered with a moist abdominal swab. Hepaticojejunostomy was performed in an end-to-side fashion with 4/0 PDS suture (Fig.2A). On completion of the bilioenteric anastomosis, a wet gauze piece

was wrapped around the anastomosis for 5 minutes to look for signs of bile leak. If no major leak was observed, the round ligament was wrapped around the anastomosis (Fig.2&3) so as to completely envelop it. The flap was sutured at multiple places to the surrounding structures and to the jejunal loop (Fig.3B) The tip of the HRL was also tacked onto the proximal HRL to prevent its migration (Fig. 3B). A drain was placed in the right paracolic gutter and the abdomen was closed.

### Outcome measures

Intra-operative outcome measures included technical difficulty, blood loss, time of flap harvest, and reinforcement of HJ. Postoperative outcome measures were bile leak, delayed gastric emptying - as per International Study Group of Liver Surgery (ISGLS) grading; [13,14] anastomotic stricture - using the grading system of McDonald et al., [15] and pancreatic leak - as per International study group of pancreatic fistula (ISGPF); [16] other complications were also recorded and graded as per Dindo et al. [17]

### Follow up

Patients were followed up with clinical assessment, liver function tests, and with imaging 3-monthly after discharge.

## RESULTS

Forty-one patients (27 M: 14 F), aged 2-79 years, median age of 61 years, underwent HJ with HRL buttress; 27 for periampullary/head of the pancreas carcinoma; 4 for choledochal cyst; 4 for chronic pancreatitis; 3 for gallbladder carcinoma; 3 for benign biliary stricture. The time necessary for harvesting HRL flaps and buttressing HJ was <10 minutes. No blood was lost during harvesting the flap. Three patients (2 following HJ for choledochal cyst and 1 following HJ for biliary stricture) had evidence of minor bile leak

intra-operatively (yellow bile on the white gauze piece). However, only one of them (following HJ for choledochal cyst) resulted in bile leak post-operatively, which spontaneously resolved by the 2nd postoperative day. One patient (2.5%), following radical cholecystectomy, was found to have grade A bile leak during postoperative follow-up. Strictures were not observed during a median follow-up of 18 months (range: 6 months to 2years).

Other complication encountered were 3 pancreatic leaks (2 grade A and 1 grade B), delayed gastric emptying in 4 patients (2 grade I; 2 grade II). One patient developed cholangitis, which resolved with antibiotics (grade II). The same patient had surgical site infection (grade I), in addition to the one patient who had grade A bile leak, mentioned in the previous paragraph. Two patients developed seromas necessitating pigtail drainage (grade IIIa). One patient developed abdominal wall hematoma at the drain site (grade I). Two patients developed incisional hernia 6 months following surgery.

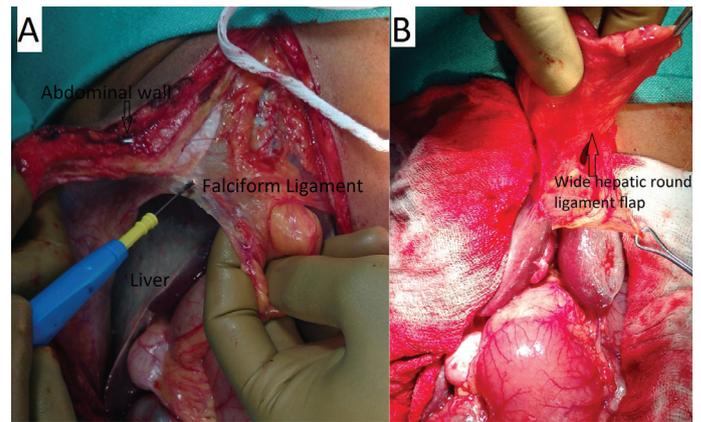
There were 4 deaths (grade V). Two patients (gallbladder carcinoma, 53 years, male; head of the pancreas carcinoma, 77 years, male) developed myocardial infarction during the postoperative period, and died on the 5th and 12th postoperative day, respectively. The latter patient was the one who had grade B pancreatic leak and grade II DGE. One patient (79 years, male), with head of the pancreas carcinoma, preoperatively stented for cholangitis, developed hemiplegia due to a cerebrovascular accident and consequent ventilator dependence and ventilator-associated pneumonia; he died on the 25th postoperative day. One patient (55 years, female), a case of locally advanced carcinoma of the head of the pancreas who was operated upon after neoadjuvant chemotherapy and preoperative stenting, developed sepsis and died on the 15th postoperative day.

## DISCUSSION

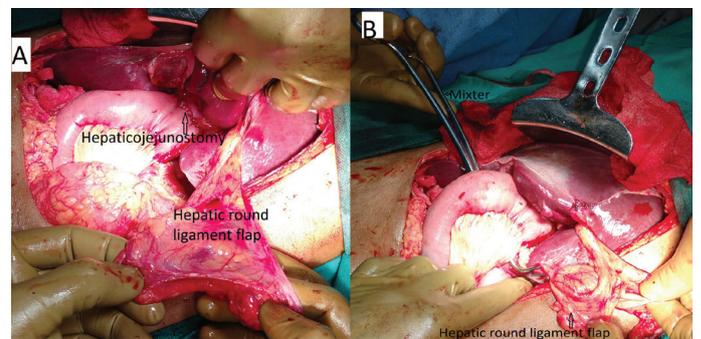
Bilioenteric anastomosis is performed for a variety of conditions, such as benign/malignant stricture, hepatolithiasis, choledochal cyst, or as a part of pancreatoduodenectomy or radical cholecystectomy.[3] Although being a safe procedure, it is not devoid of complications, such as leaks (0.9%- 30%) and strictures (2%- 5%). [1–8] The causes of these complications are multi-factorial; however, the most important include local ischemia, small-caliber ducts, weak and thin duct wall, friable duct wall, leak through needle holes, cholangitis, and liver resection.[2-4]

Once a bile leak occurs, it initiates a vicious cycle by forming a local collection/abscess, which further disrupts the anastomosis and promotes subsequent formation of strictures. [4] A similar issue is faced in the case of patients who have pancreatic leaks following pancreatoduodenectomy. [4,18] The pancreatic juice predisposes to disruption of other anastomoses, especially of HJ that is performed using absorbable sutures. [4,18] Even in patients with isolated biliary anastomotic leaks, the leak seldom remains isolated. [4] Bile leaks also contain pancreatic juice in patients who undergo pancreato-jejunostomy. [4,18] This mixture is more injurious as the pancreatic juice gets activated by the bile and intestinal mucosa.

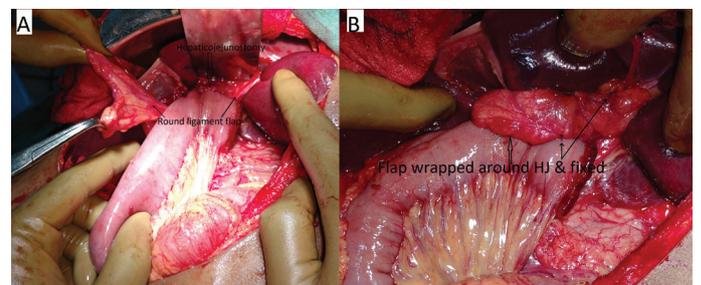
Bile leaks tend to occur in 2 phases, i.e., early and late phases.[4] Early leaks are, in general, due to technical problems, such as diffi-



**Fig. 1.** A Falciform ligament being sharply dissected off the anterior abdominal wall. B- Wide hepatic round ligament flap being harvested.



**Fig. 2.** A- Completed hepaticojejunostomy with a flap ready for buttressing. B- Right-angled mixer being used to bring the flap to the right side of the hepaticojejunostomy by coursing posteriorly to the anastomosis.



**Fig. 3.** A- Flap being brought to the right side of the anastomosis. B- Flap wrapped around the anastomosis and fixed to the surrounding structures and to itself to prevent migration.

cult anastomosis, giving away of suture, leak through needle holes etc.[2,4] These leaks tend to cease spontaneously or resolve with radiologic interventions.[2,4,8] Leaks that occur late have an ischemic component and follow the course mentioned in the previous paragraph and tend to be morbid due to consequent peritonitis or sepsis that can lead to death.[4] Most of these leaks are not amenable to interventions due to a non-dilated biliary system, and need formal re-exploration and repair, which is a formidable undertaking in patients with poor general condition and sepsis.[4,8] In addition, both interventions and repeat surgery carry their risks. [4,8] Hence, as the old adage goes- *prevention is better than cure*.

Vascularized flaps, such as the omentum, have been successfully used to buttress precarious esophagogastrotomies to prevent leaks and subsequent strictures.[9-11] Ligamentum teres hepatis or the HRL are well-vascularized structures similar to the omentum.[19] The HRL is available in the vicinity of the por-

ta hepatitis, and has been used for numerous purposes, such as patch closure of peptic perforation and bridging defects in bile ducts.[20,21] It has also been successfully used to reinforce the gastroduodenal stump and pancreatojejunal anastomoses.[22,23] Most importantly, this method has been shown to minimize bile leaks in 9 patients following hepaticojejunostomy for hilar cholangiocarcinoma.[12]

The benefits of the HRL buttress for HJs are supported by our observations. Although 3 patients had bile leaks from suture holes, one of which persisted until the 2<sup>nd</sup> postoperative day, we did not observe any bile leaks beyond the 3<sup>rd</sup> postoperative day so as to qualify them as postoperative bile leaks.[13] It is probably because the HRL, being similar to the omentum, adheres to anastomoses and acts as a biologic plug that seals the leaking holes and supports the thin-walled bile ducts by absorbing local fluid, thereby localizing the infective process and resolving it in a timely manner. [9,10,12] Spontaneous resolution of early bile leaks is often observed. However, the resolution is due to random adhesions to the surrounding structures, which is a matter of chance, takes time, and cannot be anatomically circumferential.[10] In contrast, the HRL is purposefully wrapped around HJ, and it is readily available as a viable biologic plug.[12] Therefore, a successful seal can be easily achieved.[12]

In the patient who had grade A bile leak, it was not certain whether the leak was from the bilioenteric anastomosis or the raw surface of non-anatomically resected liver. Most probably, the latter was true as the intra-operative leak test was negative. [3] However, one cannot be certain. Nevertheless, the leak rate observed was lower by a half than the average leak rate (5.6%) observed following HJ.[3] We did not observe any bile leaks in those patients who underwent pancreatoduodenectomy despite having local in-

flammatory issues related to pancreatic leaks, seroma formation, and cholangitis.[2,4,6] This is probably because the HRL, similar to the omentum, covers and walls off the anastomosis from the jeopardizing effects of the surrounding inflammatory processes and digestive juices. [9,10,12,20,22]

Anastomotic strictures develop within a month following surgery, and are obvious 13 months after surgery.[2,7] We did not observe any stricture during a median follow-up of 18 months. This is probably because HRL, similar to the omentum, adheres to anastomoses early and provides additional nutrition and oxygenation through the granulation tissue, which promotes healing. [10] It provides additional vessels by secreting vascular endothelial growth factor, which is potently vasculogenic; this effectively counteracts local ischemia that causes strictures.[10]

Since the described technique has been derived from the use of the omentum, it could be argued why use the HRL instead. The reason is ergonomics. The omentum and HJs are positioned in such a way that prevents circumferential wrapping of the anastomosis without traction. In contrast, the axis of HRL flaps is congruent to the axis of HJ and hence is more ergonomic.

It would take a large, randomized, controlled trial to conclusively prove or refute the benefit of HRL buttress. However, being a simple, safe, and scientifically sound procedure that has no side effects, it merits adoption for surgical practice.

## CONCLUSION

HRL-based buttressing of HJ may reduce biliary leak and/or stricture rate.

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