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Longmire Procedure for Proximal Malignant Biliary Obstruction in a Resource-Limited Setting: A Case Series from Two Referral Hospitals in Yaoundé, Cameroon

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Abstract

Background: When endoscopic or percutaneous drainage is unavailable or has failed, proximal malignant biliary obstruction may require surgical bypass. The Longmire procedure, an intrahepatic cholangiojejunostomy performed after limited non-anatomical peripheral hepatic resection, is rarely reported, especially from Africa. We describe its indications, technique and 30-day outcomes in Yaoundé, Cameroon. **Methods:** Descriptive case series with retrospective (September 2021-August 2025) and prospective (September 2025-August 2026) data collection at the Yaoundé University Teaching Hospital and Yaoundé General Hospital. Consecutive patients whose records contained the core data (diagnosis, operative report, postoperative day 5 laboratory values and 30-day status) were included. Outcomes were technical success, clinical and biochemical response on postoperative day (POD) 5, complications (Clavien-Dindo) and 30-day mortality. **Results:** Five of six identified patients were included (one man and four women; median age 51 years, range 46 - 60).

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All had malignant obstruction: hilar cholangiocarcinoma (n = 2), hepatocellular carcinoma, pancreatic head carcinoma and ovarian cancer metastasis (n = 1 each); four had stage IV disease. The anastomosis was performed on a left intrahepatic duct in four patients and a right duct in one, with a Roux-en-Y loop (n = 3) or an omega loop with jejunojejunostomy (n = 2). One patient died on POD 1 after 1600 mL intraoperative haemorrhage. In the four survivors, cholestatic symptoms regressed by POD 5 and total bilirubin fell by 62% - 88%. Complications in survivors were Clavien-Dindo grade I-II, including bile leakage (2/4), managed without reoperation. Median hospital stay was 12.5 days. **Conclusion:** The Longmire procedure was feasible with local resources and achieved rapid biliary decompression, at the cost of frequent bile leakage and one haemorrhagic death. Careful patient selection, after exclusion of non-surgical drainage and extrahepatic bypass options, intraoperative ultrasonography and larger studies with longer follow-up are needed.

Keywords

Longmire Procedure, Hepaticojejunostomy, Klatskin Tumour, Palliative Care, Cameroon

1. Introduction

1.1. Proximal Malignant Biliary Obstruction and Current Management

Malignant obstruction of the proximal biliary tree, caused by hilar cholangiocarcinoma, gallbladder carcinoma, hepatocellular carcinoma or hilar nodal and hepatic metastases, produces jaundice, pruritus, cholangitis, malnutrition and progressive hepatic dysfunction. Persistent hyperbilirubinaemia also compromises access to systemic therapy: the gemcitabine-cisplatin doublet, established as the standard of care by the ABC-02 trial [1], is now combined with durvalumab following the phase III TOPAZ-1 trial [2], and these pivotal trials enrolled only patients with preserved liver function and bilirubin below a predefined threshold, after biliary drainage when needed. Resection offers the only chance of cure, but most patients are unresectable at presentation because of vascular involvement, bilateral ductal extension or metastatic disease [3]-[5]. In well-resourced settings, palliation therefore relies on endoscopic or percutaneous transhepatic drainage [6] [7]; the American Society for Gastrointestinal Endoscopy (ASGE) guideline suggests either route according to patient preference, disease characteristics and local expertise, and favours bilateral drainage in the absence of liver atrophy [7]. Surgical bypass is reserved for patients in whom stenting is impossible or has failed, or who are found to be unresectable at laparotomy [8] [9].

1.2. Context in Sub-Saharan Africa and Cameroon

The situation differs in many sub-Saharan African countries. In Cameroon, most cases of obstructive jaundice are malignant [10], digestive cancers are usually diagnosed at an advanced stage [11], and in a recent Yaoundé series of 71 patients with malignant common bile duct obstruction, 88.7% received palliative surgery, with a 30-day morbidity of 55.7% [12]. Endoscopic retrograde cholangiopancreatography and percutaneous transhepatic drainage are available only intermittently in our setting and are costly for patients who pay out of pocket. Surgery therefore remains the main route to biliary decompression.

1.3. Intrahepatic Biliary-Enteric Bypass Options

When the tumour occupies the hepatic duct confluence, a distal bypass such as a choledochoduodenostomy is not possible and the anastomosis must be performed upstream, on an intrahepatic duct. Recognised options include the extrahepatic approach to the left hepatic duct at the base of segment IV described by Hepp and Couinaud [13] [14], the segment III duct approached through the umbilical fissure [9] [15], and the peripheral approach described by Longmire and Sanford in 1948: resection of the peripheral left lateral liver to expose dilated segment II/III ducts, which are anastomosed to a jejunal loop [16]. The principle of intrahepatic cholangioenteric anastomosis for hilar carcinoma was extended by Bismuth and Corlette [17], and right-sided variants on segment VI or right anterior sectoral ducts have been described [18]. Although the Longmire operation has been largely displaced by stenting, it remains a salvage option when the hilum cannot be approached.

1.4. Objective of the Study

Contemporary data on this procedure are scarce, and we found no report from Central Africa. We therefore aimed to describe the indications, technical adaptations and short-term outcomes of the Longmire procedure in two referral hospitals in Yaoundé, Cameroon.

2. Methods

2.1. Study Design, Setting and Reporting

We conducted a descriptive case series with retrospective and prospective data collection in the visceral surgery departments of the Yaoundé University Teaching Hospital (Centre Hospitalier Universitaire de Yaoundé, CHUY) and Yaoundé General Hospital (Hôpital Général de Yaoundé, HGY), two university-affiliated referral hospitals. The study period ran from 1 September 2021 to 31 August 2026: the retrospective phase covered 1 September 2021 to 31 August 2025 and the prospective phase 1 September 2025 to 31 August 2026. The report follows the Preferred Reporting Of Case Series in Surgery (PROCESS) 2023 guideline [19].

2.2. Participants

All patients, of any age and sex, who underwent a Longmire procedure during the study period were eligible. The procedure was defined as a hepaticojejunostomy performed on an intrahepatic duct exposed by limited peripheral hepatic parenchymal resection. This resection was non-anatomical: a peripheral wedge resection performed by parenchymal crushing, without prior Glissonean pedicle control and without regard to segmental boundaries, rather than a complete anatomical segmentectomy. The number of segments reported refers to the segments whose periphery was crossed by the transection line. Sampling was consecutive. Retrospective cases were identified from operating theatre registers and operative reports; inclusion required a medical record containing the core data needed for analysis: diagnosis, operative report, preoperative and POD 5 laboratory values, and 30-day status. Other missing variables were sought (operative photographs and videos, telephone contact) and, failing that, are reported as not documented. Prospective patients were included after written informed consent if their 30-day outcome was known. Patients with missing core data or lost to follow-up before postoperative day (POD) 30 were excluded.

2.3. Data Collection and Variables

Data were recorded on a pre-tested standardised form. Variables included age, sex, medical history, symptoms, World Health Organization (WHO) performance status, body mass index, laboratory values (total and conjugated bilirubin, gamma-glutamyl transferase [GGT], alkaline phosphatase [ALP], albumin, haemoglobin, prothrombin time and creatinine), imaging findings (ultrasonography and computed tomography), histological diagnosis, TNM stage according to the 8th edition of the AJCC staging manual [20], Bismuth-Corlette type for hilar cholangiocarcinoma [17] and American Society of Anesthesiologists (ASA) class. For each patient, the method of confirmation of malignancy was recorded and classified as histological (specifying the specimen: intraoperative biopsy, peripheral liver resection specimen or previous biopsy), cytological (bile or ascitic fluid), or based on imaging combined with clinical and laboratory findings. The rationale for choosing an intrahepatic bypass was also extracted from the records: availability, feasibility or failure of endoscopic and percutaneous drainage, and the reason why a simpler extrahepatic bypass was not feasible. Operative variables were incision, intraoperative findings, side of the anastomosis, number of segments involved by the resection, type of reconstruction, number of anastomoses, associated procedures, estimated blood loss, transfusion and operative time. Postoperative variables were clinical and biochemical cholestasis on POD 5, complications, abdominal drain duration, length of hospital stay and 30-day mortality. For retrospective cases, operative photographs and videos were reviewed and patients or relatives were contacted by telephone when information was missing. In prospective patients, the first author assisted at surgery, reviewed patients daily during admission and weekly after discharge until POD 30.

2.4. Perioperative Management and Operative Technique

2.4.1. Preoperative Preparation and Anaesthesia

Preoperative preparation included correction of coagulation disorders with parenteral vitamin K (Koller test) and availability of packed red blood cells.

All operations were performed by laparotomy under general anaesthesia with endotracheal intubation, with the patient supine and the arms abducted.

2.4.2. Incision and Abdominal Exploration

A bilateral subcostal, right subcostal or midline incision was chosen by the operating surgeon. Exposure was obtained with a Gosset retractor and subcostal blades fixed to an overhead frame. The abdomen was explored for resectability, peritoneal carcinomatosis, hepatic metastases and invasion of adjacent organs.

2.4.3. Hepatic Transection and Identification of the Target Duct

For the left-sided procedure, the falciform and left triangular ligaments were divided to mobilise the left lateral section. The transection line was scored with diathermy on the anterior and posterior surfaces of Glisson's capsule at the junction of segments II and III (**Figure 1**). With gentle traction on segments IV and II, the peripheral left lateral liver was transected by clamp-crushing (kellyclasia) along a non-anatomical line, and intraparenchymal vessels were ligated as they were encountered. A vascular clamp placed across the left lobe, to the left of the round ligament, was released intermittently to identify bleeding vessels. A dedicated intraoperative ultrasound transducer was not available; when possible, a portable ultrasound machine with a transabdominal probe in a sterile sleeve was used, together with fine-needle aspiration of bile, to locate a dilated duct (**Figure 2**). When no suitable left duct could be found, the tip of segments VI/VII was resected to expose a right sectoral duct, and the anastomosis was performed according to the same principles (**Figure 3**).

2.4.4. Biliary-Enteric Anastomosis, Intestinal Reconstruction and Postoperative Care

The hepaticojejunostomy was performed with interrupted 3/0 slowly absorbable sutures, taking extramucosal bites on the jejunum and bites incorporating Glisson's capsule on the hepatic side to secure the anastomosis around the small duct orifice. Intestinal reconstruction used either a Roux-en-Y loop or an omega loop with a side-to-side jejunojejunostomy at the foot of the loop (**Figure 4**), according to the surgeon's preference; the jejunojejunostomy was stapled when a stapler was available. Both configurations therefore comprised two anastomoses: the hepaticojejunostomy and a jejunojejunostomy (at the foot of the Roux limb, or side-to-side at the foot of the omega loop). A gastrojejunostomy was added in the presence of duodenal obstruction. An abdominal drain was left close to the anastomosis. Postoperative care included intravenous fluids, paracetamol and nefopam, ceftriaxone and metronidazole, omeprazole, and thromboprophylaxis with low-molecular-weight heparin and compression stockings.

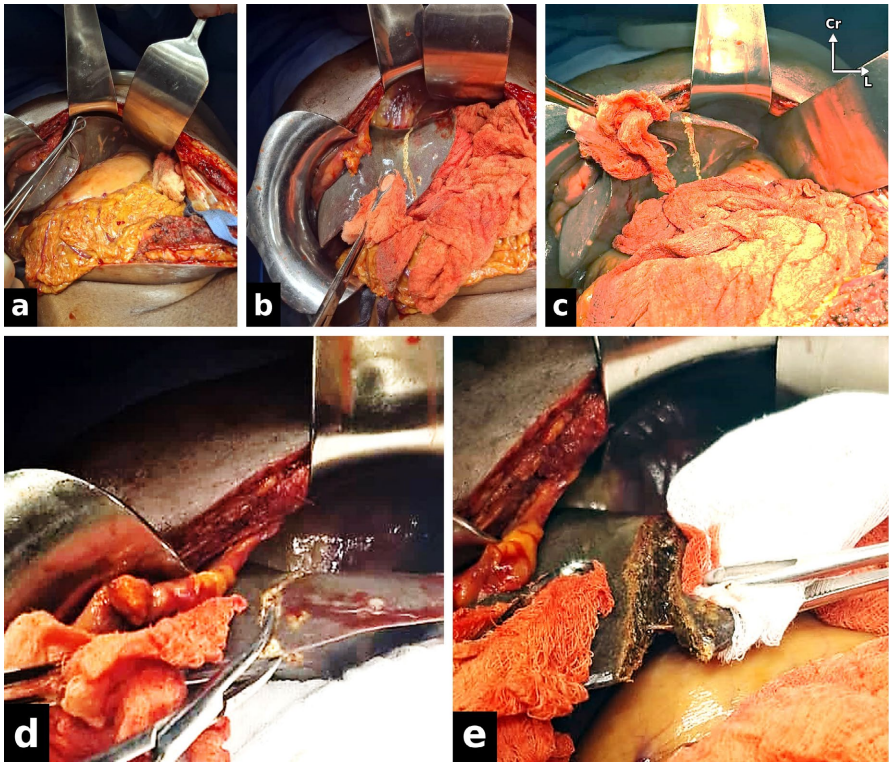


Figure 1. Left-sided Longmire procedure (CHUY). (a) Exposure through a bilateral subcostal incision with subcostal blades fixed to an overhead frame. (b, c) Diathermy scoring of Glisson's capsule along the planned transection line on the anterior (b) and posterior (c) surfaces of the left lateral section. (d, e) Non-anatomical transection of the peripheral left lateral liver by clamp-crushing, with ligation of intraparenchymal vessels. Cr, cranial; L, patient's left. Photographs reproduced with permission of Prof. G.A. Bang.

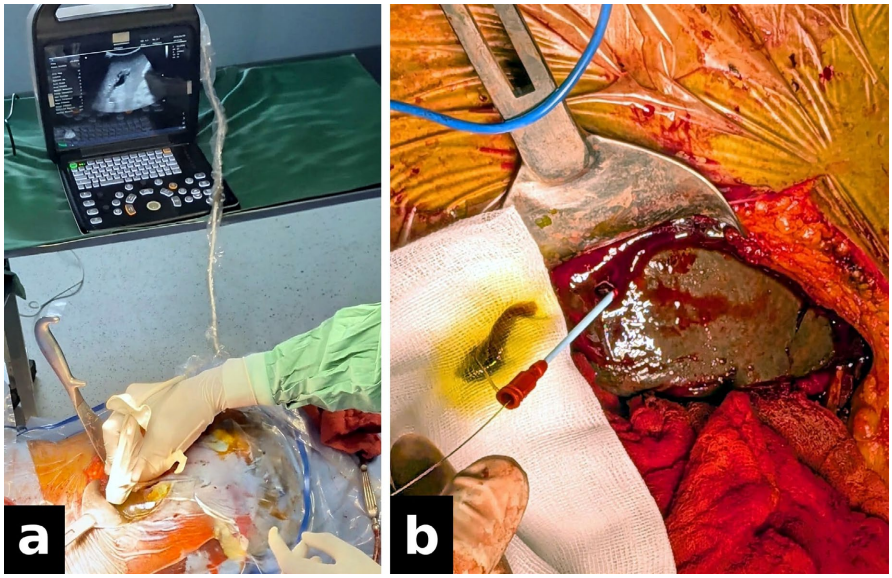


Figure 2. Localisation of the target intrahepatic duct. (a) Portable ultrasound machine with a transabdominal probe in a sterile sleeve, used in the absence of a dedicated intraoperative transducer. (b) Fine-needle puncture of the hepatic parenchyma with aspiration of bile (bile-stained gauze), confirming the position of a dilated duct before transection.

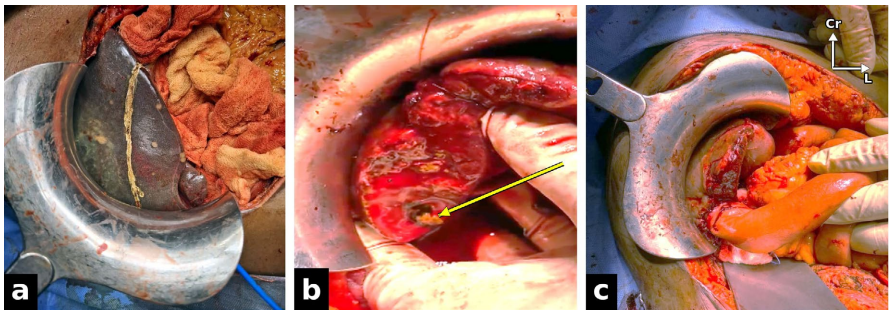


Figure 3. Right-sided Longmire procedure (CHUY), performed after an unsuccessful search for a suitable left duct. (a) Transection line marked on Glisson's capsule. (b) Right sectoral duct exposed on the transection surface after non-anatomical resection of the tip of segments VI/VII (arrow). (c) Jejunal loop brought up for the hepaticojejunostomy. Cr, cranial; L, patient's left. Photographs reproduced with permission of Prof. G.A. Bang.

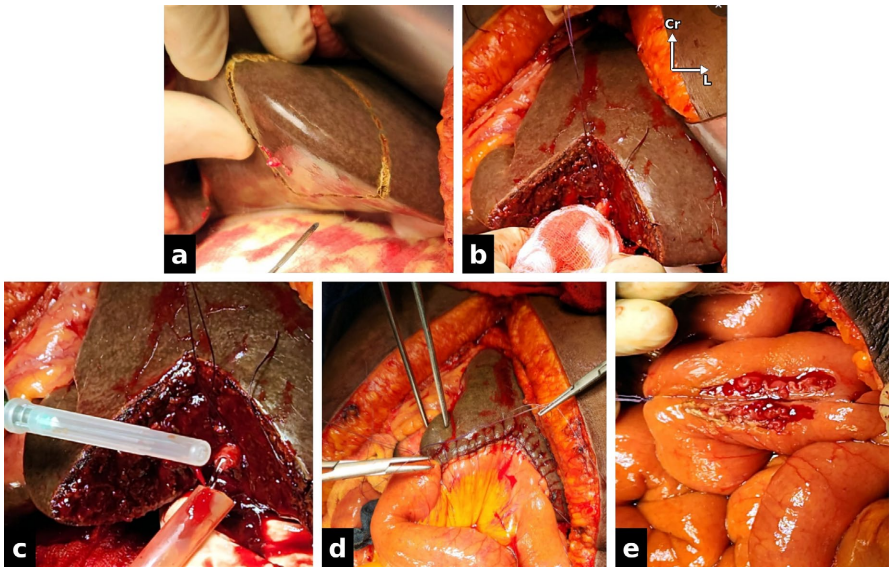


Figure 4. Omega-loop reconstruction (HGY). (a) Transection line marked on Glisson's capsule. (b) Non-anatomical peripheral (wedge) resection. (c) Identification of the bile duct on the transection surface. (d) Hepaticojejunostomy. (e) Side-to-side jejunojejunostomy at the foot of the loop. Cr, cranial; L, patient's left. Photographs reproduced with permission of Dr G. Bwelle.

2.5. Outcomes and Definitions

The primary outcomes were technical success, defined as completion of an intrahepatic biliary-enteric anastomosis, and early relief of cholestasis. Clinical response was defined as regression of jaundice, pruritus, dark urine and pale stools on POD 5. Biochemical response was expressed as the percentage reduction from the preoperative value to POD 5: (preoperative − POD 5)/preoperative × 100; a positive value therefore indicates a decrease. Secondary outcomes were estimated blood loss, transfusion, operative time, postoperative complications graded according to the Clavien-Dindo classification [21], drain duration, length of hospital stay and 30-day mortality. Bile leakage was defined as bile in the abdominal drain

and graded retrospectively according to the International Study Group of Liver Surgery (ISGLS) from its effect on management [22]. Short-term outcome referred to the first 30 postoperative days.

2.6. Statistical Analysis

Data were entered in Microsoft Excel and analysed with SPSS version 23 (IBM Corp., Armonk, NY, USA). Because of the small sample, the analysis was descriptive only: categorical variables are presented as counts and quantitative variables as medians and ranges, and individual patient data are reported. No inferential tests were performed.

2.7. Ethical Considerations

The study was approved by the Institutional Ethical Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I (reference No. 0376/UY1/FMSB/VDRC/DAASR/CSD/CSDA, 23 June 2026), and administrative authorisation was obtained from both hospitals. It was conducted in accordance with the Declaration of Helsinki. Prospective participants gave written informed consent. Data were anonymised and stored on a password-protected computer accessible only to the principal investigator.

3. Results

3.1. Participants and Baseline Characteristics

Six Longmire procedures were identified during the study period. One record could not be retrieved, leaving five patients for analysis (CHUY, n = 3; HGY, n = 2). There were one man and four women, with a median age of 51 years (range 46 - 60). Three patients had a relevant medical or oncological history (hypertension, chronic viral hepatitis, diabetes mellitus, and previous breast or ovarian cancer); none had a family history of digestive cancer. Jaundice was present in all patients, together with weight loss (4/5), dark urine (4/5), pruritus (3/5), pale stools (2/5), abdominal pain (1/5) and vomiting (1/5). Four patients had WHO performance status 2 and one had status 3. Median body mass index was 18 kg/m^2 (range 17 - 31) and was below 18.5 kg/m^2 in three patients.

All patients had a marked biochemical cholestatic profile (total bilirubin and GGT ≥15 times and ALP ≥6 times the upper limit of normal) and hypoalbuminaemia (median 25 g/L, range 22 - 28), which was severe (<25 g/L) in two. Four were anaemic; prothrombin time and creatinine were normal in all. Imaging showed intrahepatic biliary dilatation in all five patients, hepatic nodules in four, hepatomegaly in three and extrahepatic bile duct dilatation in two. All five had malignant obstruction: hilar cholangiocarcinoma Bismuth-Corlette type I (n = 1) and type II (n = 1), hepatocellular carcinoma (n = 1), pancreatic head carcinoma (n = 1) and hepatic metastasis from ovarian carcinoma (n = 1). Four patients had stage IV disease and one had stage III disease (**Table 1**). The method of confirmation of each cancer and the specimen used are detailed in **Table 2**.

Table 1. Baseline characteristics of the five patients.

Characteristic	n/N or median (range)
Age, years	51 (46 - 60)
Male sex	1/5
Body mass index, kg/m^2	18 (17 - 31)
Body mass index < 18.5 kg/m^2	3/5
Clinical presentation	
Jaundice	5/5
Weight loss	4/5
Dark urine	4/5
Pruritus	3/5
Pale stools	2/5
WHO performance status 2/3	4/5, 1/5
ASA class II/III	3/5, 2/5
Laboratory and imaging findings	
Marked cholestatic profile[a]	5/5
Hypoalbuminaemia (<35 g/L)	5/5
Severe hypoalbuminaemia (<25 g/L)	2/5
Anaemia	4/5
Intrahepatic biliary dilatation	5/5
Hepatic nodules	4/5
Hepatomegaly	3/5
Extrahepatic bile duct dilatation	2/5
Diagnosis and stage	
Hilar cholangiocarcinoma (Bismuth-Corlette I/II)	1/5/1/5
Hepatocellular carcinoma	1/5
Pancreatic head carcinoma	1/5
Hepatic metastasis of ovarian carcinoma	1/5
T3/T4	2/5, 3/5
N+/Nx	2/5, 3/5
M1/Mx	3/5, 2/5
TNM stage III/IV	1/5, 4/5

ASA, American Society of Anesthesiologists; WHO, World Health Organization; Nx, Mx, nodal or metastatic status not assessable. [a]Total bilirubin and gamma-glutamyl transferase ≥15 × and alkaline phosphatase ≥6 × upper limit of normal.

3.2. Rationale for the Indication

Table 2 summarises, for each patient, the method of diagnostic confirmation and the reasons for choosing an intrahepatic bypass. Malignancy was confirmed histologically on an intraoperative biopsy in all five patients. In both patients with hilar cholangiocarcinoma, resection was precluded by locally advanced or metastatic disease, and no endoscopic or percutaneous stenting was available at the time of management. In hepatocellular carcinoma and ovarian metastasis, obstruction resulted from hilar compression by intrahepatic tumour, making the confluence inaccessible; non-surgical drainage was not attempted. In the patient with pancreatic head carcinoma, duodenal invasion compromised endoscopic access to the papilla and required a gastrojejunostomy; percutaneous drainage was unavailable, and tumour extension to the hepatic pedicle led the surgeon to abandon an extrahepatic hepaticojejunostomy.

Table 2. Diagnostic confirmation and rationale for intrahepatic bypass, by patient.

Pt	Diagnosis	Confirmation of malignancy (specimen)	Endoscopic/percutaneous drainage	Reason extrahepatic bypass was not performed
P1	Hilar CCA, Bismuth-Corlette I	Intraoperative biopsy	Unavailable at the time of management	Unresectable (locally advanced or metastatic disease)
P2	Hilar CCA, Bismuth-Corlette II	Intraoperative biopsy	Unavailable at the time of management	Involvement of the confluence
P3	Hepatocellular carcinoma	Intraoperative biopsy	Not attempted	Hilar compression by intrahepatic tumour; confluence inaccessible
P4	Pancreatic head carcinoma	Intraoperative biopsy	Endoscopic access to the papilla compromised by duodenal invasion	Tumour extension to the hepatic pedicle, precluding extrahepatic hepaticojejunostomy
P5	Hepatic metastasis of ovarian carcinoma	Intraoperative biopsy	Not attempted	Hilar compression by intrahepatic tumour; confluence inaccessible

CCA, cholangiocarcinoma; Pt, patient.

3.3. Operative Findings and Technique

3.3.1. Operative Approach, Side of Anastomosis and Reconstruction

A bilateral subcostal incision was used in two patients, a midline incision in two and a right subcostal incision in one. Exploration found ascites, hepatic metastases and invasion of adjacent organs in two patients each (omentum and duodenum in P4, stomach in P5), and peritoneal carcinomatosis in one. A left hepaticojejunostomy was performed in four patients (Figure 1 and Figure 2). In the fifth, no left duct of adequate calibre could be found and the exploration was extended to the right liver, where a satisfactory sectoral duct was exposed (Figure 3). In all cases, the hepatic resection was a non-anatomical peripheral (wedge) resection rather than an anatomical segmentectomy; the transection line involved the periphery of a single segment in three patients (P1, P3 and P5), one and a half segments in P4 and two segments (VI/VII) in the patient operated on the right side

(P2). Reconstruction used a Roux-en-Y loop in three patients and an omega loop with jejunojejunostomy at the foot of the loop in two (Figure 4). A gastrojejunostomy was added in the patient with pancreatic head carcinoma, who had duodenal and omental invasion. Regardless of the configuration, two anastomoses were performed in four patients; the patient who also had a gastrojejunostomy had three. Technical success was achieved in all five patients (Table 3).

Table 3. Operative characteristics.

Variable	n/5 or median (range)
Incision	
Bilateral subcostal	2/5
Midline	2/5
Right subcostal	1/5
Intraoperative findings	
Ascites	2/5
Hepatic metastases	2/5
Invasion of adjacent organs	2/5
Peritoneal carcinomatosis	1/5
Procedure	
Left hepaticojejunostomy	4/5
Right hepaticojejunostomy	1/5
Non-anatomical peripheral resection: segments involved, 1/1.5/2	3/5, 1/5, 1/5
Number of anastomoses, 2/3	4/5, 1/5
Roux-en-Y reconstruction	3/5
Omega loop with jejunojejunostomy at the foot of the loop	2/5
Associated gastrojejunostomy	1/5
Technical success	5/5
Perioperative variables	
Estimated blood loss, mL	300 (200 - 1600)
Blood loss ≤ 400 mL	4/5
Intraoperative transfusion	4/5
Packed red cell units	1 (0 to ≥3)
Operative time, hours	3 (2.5 - 4)

No anatomical segmentectomy was performed; the figure indicates the number of segments whose periphery was crossed by the transection line.

3.3.2. Blood Loss, Transfusion and Operative Time

Median estimated blood loss was 300 mL (range 200 - 1600); it was ≤400 mL in four patients and 1600 mL in the patient with pancreatic head carcinoma. Four patients received an intraoperative transfusion (median 1 unit of packed red cells, range 0 to ≥3); only P3, who was not anaemic, was not transfused. Median operative time was 3 hours (range 2.5 - 4); it was 3 h 45 min for the right-sided procedure and 4 hours for the patient with major bleeding and gastrojejunostomy.

3.4. Short-Term Outcomes

3.4.1. Mortality and Early Clinical and Biochemical Response

The patient with pancreatic head carcinoma, who had diabetes and chronic viral hepatitis and the most extensive resection, died on POD 1 of haemorrhagic shock and multiorgan failure after 1600 mL intraoperative blood loss (Clavien-Dindo grade V). In the four survivors, jaundice, pruritus, dark urine and pale stools had regressed by POD 5. Total bilirubin decreased by 62.2% - 87.9%, conjugated bilirubin by 62.5% - 89.3%, GGT by 55.6% - 75.1% and ALP by 58.9% - 89.5% (Table 4).

Table 4. Biochemical response on postoperative day 5 in the four survivors.

Pt	Total bilirubin, mg/L (pre → POD 5)	Δ	Conjugated bilirubin, mg/L	Δ	GGT, U/L	Δ	ALP, U/L	Δ
P1	265 → 32	87.9%	206 → 22	89.3%	1178 → 293	75.1%	1102 → 453	58.9%
P2	169 → 48	71.6%	135 → 38	71.9%	2439 → 1082	55.6%	1079 → 113	89.5%
P3	259 → 98	62.2%	160 → 60	62.5%	797 → 250	68.6%	1252 → 430	65.7%
P5	164 → 40	75.6%	138 → 30	78.3%	698 → 250	64.2%	800 → 310	61.3%

Pt, patient; ALP, alkaline phosphatase; GGT, gamma-glutamyl transferase; POD, postoperative day; Δ, relative reduction = (preoperative − POD 5)/preoperative × 100; a positive value indicates a decrease. To convert bilirubin from mg/L to μmol/L, multiply by 1.71.

3.4.2. Postoperative Complications, Drainage and Hospital Stay

Each survivor had at least one complication. The most severe complication was grade II in three patients (P1, P2 and P5) and grade I in one (P3) (Table 5); in P5, it was a superficial surgical site infection. Bile leakage occurred in two patients, both of whom had a Roux-en-Y reconstruction; both leaks resolved with the abdominal drain left in place and without reintervention (ISGLS grade A-B). Two patients required postoperative transfusion for anaemia, and one patient also developed an enterocutaneous fistula and a surgical site infection, both managed conservatively. No patient required reoperation. Median drain duration was 7.5 days (range 6 - 15), the longest drainage being in the patient with both fistulas, and median hospital stay was 12.5 days (range 9 - 17). All four survivors were alive with a favourable course at POD 30; 30-day mortality was 1/5.

Table 5. Individual 30-day outcomes.

Pt	Diagnosis	Blood loss (mL)/units	Complications	Clavien-Dindo	Drain/stay (days)	Day-30 status
P1	Hilar CCA, Bismuth-Corlette I	300/1	Bile leak, anaemia requiring transfusion, enterocutaneous fistula, SSI	II	15/17	Alive
P2	Hilar CCA, Bismuth-Corlette II	400/1	Bile leak, anaemia requiring transfusion	II	8/9	Alive
P3	Hepatocellular carcinoma	200/0	Minor deviation from normal course	I	7/10	Alive
P4	Pancreatic head carcinoma	1600/≥3	Haemorrhagic shock, multiorgan failure	V	-	Died (POD 1)
P5	Ovarian cancer liver metastasis	300/2	Superficial SSI	II	6/15	Alive

Pt, patient; CCA, cholangiocarcinoma; POD, postoperative day; SSI, surgical site infection. Units, packed red cell units transfused intraoperatively.

4. Discussion

4.1. Principal Findings

This series describes five Longmire procedures performed for proximal malignant biliary obstruction in two referral hospitals in Yaoundé. To our knowledge, it is the first report of this operation from Central Africa. The procedure was completed in all patients, on a left intrahepatic duct in four and a right duct in one, with either a Roux-en-Y or an omega-loop reconstruction. All four survivors had rapid clinical and biochemical relief of cholestasis, but bile leakage was frequent and one patient died of intraoperative haemorrhage. These results show what the operation can achieve, and what it costs, when less invasive drainage is not an option.

4.2. Place of Surgical Bypass in Our Setting

Current guidelines favour endoscopic or percutaneous drainage for unresectable malignant hilar obstruction and recommend draining an adequate volume of functional liver [6] [7]. According to the ASGE guideline, endoscopic and percutaneous drainage are both acceptable options in unresectable patients, the choice depending on patient preference, disease characteristics and local expertise; bilateral drainage is suggested in the absence of atrophy, and plastic stents are suggested when the optimal drainage strategy has not yet been established [7]. These recommendations assume reliable access to therapeutic endoscopy and interventional radiology, which is not the case in our setting.

In malignant distal obstruction, a randomised trial found that stenting and surgical bypass gave similar relief of jaundice; surgery carried more early morbidity but fewer late episodes of recurrent jaundice and duodenal obstruction [8]. Intrahepatic biliary-enteric bypass has been shown to provide durable palliation in se-

lected patients with hilar obstruction found to be unresectable [9]. In Yaoundé the balance is different. Patients present late, with high bilirubin levels, malnutrition and advanced disease [10]-[12], and access to therapeutic endoscopy and interventional radiology is limited and costly. In the series of Savom *et al*., palliative surgery in Yaoundé mostly consisted of choledochoduodenostomy, choledochojejunostomy or cholecystojejunostomy [12]; these distal bypasses are not possible when the tumour occupies the confluence. Intrahepatic bypass is then the only surgical means of decompression, and our series represents the most proximal end of surgical palliation in this setting.

4.3. Patient Profile and Indications

Our patients were younger (median 51 years) than those in large Western series of cholangiocarcinoma [4] [5], although the small sample and mixed diagnoses limit this comparison. Their condition reflected late presentation: four had stage IV disease, all had hypoalbuminaemia (severe in two), four were anaemic and two were ASA III. In the Yaoundé series of Savom *et al*., poor performance status and high ASA class were associated with adverse postoperative outcomes [12], and these factors must be weighed when an operation of this magnitude is considered for palliation.

The indications were heterogeneous, and the case-by-case rationale is summarised in **Table 2**. Bismuth-Corlette type I and II cholangiocarcinomas are, in principle, candidates for resection and are usually easy to stent [3] [6] [7]; in our two patients, resection was precluded by locally advanced or metastatic disease and stenting was not available. In hepatocellular carcinoma and ovarian metastasis, obstruction resulted from hilar compression by intrahepatic tumour. The indication in pancreatic head carcinoma is more debatable, since distal obstruction can usually be bypassed at the level of the common hepatic duct. In this patient, duodenal invasion made endoscopic access to the papilla unreliable and warranted a gastrojejunostomy, and tumour extension to the hepatic pedicle was judged to preclude an extrahepatic hepaticojejunostomy on the common hepatic duct, which would otherwise have been technically simpler and less haemorrhagic. The patient died after major bleeding. We cannot determine retrospectively whether a less extensive bypass would have been possible, but this case suggests that the Longmire procedure should be reserved for patients in whom the hepatic duct confluence is truly inaccessible and in whom no non-surgical drainage is feasible.

4.4. Technical Considerations

4.4.1. Choice of Side and Volume of Liver Drained

The predominance of left-sided anastomosis is consistent with the anatomy. The left hepatic duct has a long extrahepatic course and constant branching, the left lateral section is easy to mobilise, and a jejunal loop reaches it without tension [13] [14] [18]. Right-sided ducts are shorter, deeper and more variable, and right-sided intrahepatic approaches are technically more demanding [15] [18]. In Bis-

muth-Corlette type I tumours, the confluence is spared and the right and left ducts communicate, so that unilateral drainage decompresses the whole liver. In type II tumours, by contrast, the tumour involves the confluence and communication between the right and left ducts may be reduced or interrupted; unilateral drainage is then effective only if this communication actually persists or if the drained territory represents a sufficient volume of functional liver. In type III and IV tumours, the drained segments may be isolated and the benefit may be limited [9]. Endoscopic guidelines aim to drain approximately 50% or more of the functional liver volume and advise against draining atrophic segments [6] [7]. Preoperative cross-sectional imaging, ideally including magnetic resonance cholangiopancreatography, should therefore be used to choose the side, verify communication between the right and left ducts and confirm that the target segment is functional.

4.4.2. Identification of the Duct and Anastomotic Technique

The main technical difficulty of the operation is finding a duct of adequate calibre on the transection surface without excessive parenchymal sacrifice, because ducts run with portal and arterial branches inside the Glissonean pedicles [16] [18]. Without a dedicated intraoperative ultrasound transducer, our surgeons performed non-anatomical peripheral resections involving the periphery of one or two segments, and in one patient the search on the left failed and a right-sided anastomosis was required, which lengthened the operation. The use of a portable transabdominal ultrasound machine in a sterile sleeve, combined with fine-needle aspiration of bile (**Figure 2**), is a low-cost adaptation that can help locate the duct. Even so, providing a dedicated intraoperative ultrasound transducer is a priority. When the duct is small, anchoring the jejunal bites to Glisson's capsule, as Longmire originally proposed [16], spreads tension over the parenchyma, but it probably contributes to bile leakage because the mucosa-to-mucosa apposition is imperfect.

4.4.3. Bleeding and Transfusion

Blood loss was ≤400 mL in four patients, yet three of them were transfused; only the non-anaemic patient (P3, haemoglobin 13 g/dL) was not. This reflects the high prevalence of preoperative anaemia and a liberal intraoperative transfusion policy. Clamp-crushing with intermittent clamping of the left lobe is cheap and reproducible. The patient who bled most had the most extensive resection, local tumour invasion and an additional gastrojejunostomy, so the haemorrhage cannot be attributed to a single factor. Inflow occlusion (Pringle manoeuvre), low central venous pressure anaesthesia, correction of vitamin K-dependent coagulopathy and adequate blood availability are simple measures that may reduce this risk.

4.4.4. Type of Intestinal Reconstruction

Roux-en-Y reconstruction is the standard after hepaticojejunostomy because a defunctioned limb of about 70 cm limits reflux of enteric content into the biliary tree [18]. The omega loop with a jejunojejunostomy at its foot avoids division of the jejunum and its mesentery but does not reduce the number of anastomoses: like

the Roux-en-Y loop, it requires a hepaticojejunostomy and a jejunojejunostomy; it diverts most of the enteric stream, and stapling the jejunojejunostomy shortened this step. Both bile leaks occurred after Roux-en-Y reconstruction, but with two events in five patients no association can be inferred: leakage depends mainly on duct calibre, tissue quality and anastomotic tension rather than on the configuration of the loop. We found no comparative data on the two configurations after intrahepatic bypass.

4.5. Short-Term Efficacy and Morbidity

4.5.1. Biliary Decompression and Access to Systemic Therapy

In all survivors, bilirubin and cholestatic enzymes decreased substantially within five days, confirming that the anastomosis drained bile effectively. This matters for palliation and for treatment: first-line treatment of advanced biliary tract cancer is based on gemcitabine-cisplatin [1], now combined with durvalumab, which improved overall survival in the TOPAZ-1 trial [2]. These trials enrolled only patients in good general condition, with preserved liver function and bilirubin below a predefined threshold, after biliary drainage when needed; TOPAZ-1 was further restricted to patients with an ECOG performance status of 0 - 1. Effective decompression is therefore necessary but not sufficient for access to systemic therapy: performance status, nutritional status and the absence of cholangitis also determine eligibility, and the applicability of these regimens to our patients, most of whom had a WHO performance status of 2, remains uncertain. Lu and Ren similarly reported technical success in all six patients treated by hepaticojejunostomy for Bismuth-Corlette type III cholangiocarcinoma [23]. Whether our patients went on to receive oncological treatment was not recorded, and this should be documented in future studies.

4.5.2. Bile Leakage

Bile leakage occurred in two of four survivors. This rate is higher than the 11.4% reported after hepaticojejunostomy following resection for perihilar cholangiocarcinoma [24], the single leak among six patients reported by Lu and Ren [23] and the 10% reported after laparoscopic hepaticojejunostomy for bile duct injury [25]. Bile fistula was also the most frequent complication after palliative biliary bypass in the Yaoundé series of Savom *et al.* [12]. Several factors probably explain the high rate in our series: small ducts on a raw transection surface, anastomoses partly anchored to Glisson's capsule, and universal hypoalbuminaemia. Both leaks resolved with the drain left in place (ISGLS grade A-B) [22], which supports routine drainage of the anastomosis in this context.

4.5.3. Late Outcomes

Late outcomes could not be assessed. After hepaticojejunostomy for benign disease, anastomotic stricture develops in 11% - 13% of patients and recurrent cholangitis in about 14% during long-term follow-up [26] [27]. After resection for perihilar cholangiocarcinoma, most anastomotic strictures are caused by tumour

recurrence [24]. In palliative intrahepatic bypass, recurrent jaundice from tumour progression is therefore the most likely late failure, and survival, rather than anastomotic patency alone, should be the main long-term endpoint.

4.5.4. Postoperative Mortality

The single death gives a 30-day mortality of 20%, but one event in five patients cannot be meaningfully compared with larger series. For context, about one quarter of patients died within 30 days of palliative surgery for malignant common bile duct obstruction in the same city [12]. Advanced disease, malnutrition and anaemia are common to both cohorts. They suggest that preoperative nutritional support, correction of anaemia and coagulopathy, and multidisciplinary selection of patients with a reasonable life expectancy should be part of any programme offering this operation.

4.6. Strengths and Limitations

The main strength of this study is that it documents, with operative illustrations, a rarely reported procedure performed with locally available resources, and combines retrospective and prospective data from two centres. Its limitations are substantial. The sample is very small, and one record could not be retrieved, which introduces possible selection bias. The diagnoses were heterogeneous, there was no comparison group, and the retrospective phase depended on the completeness of the records. Follow-up was limited to 30 days, so overall survival, quality of life, receipt of chemotherapy, late anastomotic stricture and recurrent cholangitis could not be assessed. Bile leakage was graded retrospectively, and drain bilirubin was not systematically measured.

4.7. Implications

In settings like ours, the Longmire procedure should be part of the hepatobiliary surgeon's repertoire for patients with hilar obstruction in whom stenting is unavailable or has failed, in whom a simpler extrahepatic bypass is not feasible, and whose life expectancy justifies a laparotomy. Its safety would probably be improved by preoperative mapping of the biliary tree, a dedicated intraoperative ultrasound transducer, standardised haemostatic techniques and better access to endoscopic and percutaneous drainage, which would also allow preoperative decompression or an alternative to surgery. A prospective multicentre registry with longer follow-up is needed to define survival, quality of life and the place of this operation relative to stenting.

5. Conclusion

In this small series, the Longmire procedure was feasible in two referral hospitals in Yaoundé and produced rapid clinical and biochemical relief of proximal malignant biliary obstruction. A left intrahepatic duct was used in most patients, but a right-sided approach was possible when needed, and both Roux-en-Y and omega-

loop reconstructions were used successfully. Bile leakage was frequent but resolved without reoperation, and one patient died after major haemorrhage. Where endoscopic and interventional radiological drainage are unavailable or ineffective and an extrahepatic bypass is not feasible, the Longmire procedure remains a useful salvage option, provided that patients are carefully selected and that intraoperative ultrasonography becomes available.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Ethical Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I (reference No. 0376/UY1/FMSB/VDRC/DAASR/CSD/CSDA, 23 June 2026), with administrative authorisation from CHUY and HGY. Written informed consent was obtained from prospective participants. Retrospective data were anonymised.

Consent for Publication

The intraoperative photographs contain no identifying information. They are reproduced with the permission of the operating surgeons (Prof. G.A. Bang, CHUY; Dr G. Bwelle, HGY).

Availability of Data and Materials

The anonymised dataset is available from the corresponding author on reasonable request.

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Author Contributions

PAAS collected and analysed the data and drafted the manuscript. GAB, GBM and EPS designed and supervised the study, performed operations and critically revised the manuscript. CME, NFT, ELB, TOO, HLZO, WDF, BLMA, EAA, JSNE, DLF, VASNM, DCPBB and MLG contributed to patient management and data acquisition and critically revised the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no competing interests.

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