ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

SCHOOL OF MEDICINE DEPARTMENT OF SURGERY

THIRTY DAY PERIOPERATIVE OUTCOME OF SEGMENT III BYPASS SURGERY FOR MALIGNANT HILAR BILIARY OBSTRUCTION: MULTICENTER COHORT RETROSPECTIVE STUDY, Ethiopia, 2025.

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A research thesis submitted to department of surgery, school of medicine, College of Medicine and Health Science for the partial fulfillment of the requirements for subspeciality training in Hepatopancreatic Biliary surgery.

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Declaration

This is to certify that the thesis work entitled “Thirty-day perioperative outcome of segment III bypass surgery for malignant hilar biliary obstruction” multicenter study at Addis Ababa, Ethiopia, submitted in partial fulfillment of the requirements for certificate of subspecialty in HPB surgery. It is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates.

Dr. Nebiat Embiale SIGNATURE_____

Name of investigator Date_____

Approval for Thesis submission

I hereby certify that I have supervised, read, and evaluated this Thesis entitled "Thirty-day perioperative outcome of segment III bypass surgery for malignant hilar biliary obstruction" multicenter study at Addis Ababa, Ethiopia. I recommend the thesis to be submitted for final thesis dissertation.

Dr. Henok Seife	_____	_____
Advisor's name	Signature	Date

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ABBREVIATIONS

AAU: Addis Ababa University

BMI: Body Mass Index

CEB: Cholangio Enteric Bypass

CMHS: College of Medicine and Health Science

DC: Data Collector

ERCP: Endoscopic Retrograde Cholangiopancreatography

GP: General Practitioner

HPB: HepatoPancreatic and Biliary system

HC: Hilar Cholangiocarcinoma

LAP: Lymph Adenopathy

MHBO: Malignant Hilar Biliary Obstruction

MOH: Ministry of Health

NOD: Non-Operative Drainage

PTBD: Percutaneous Transhepatic Biliary Drainage

REC: Research Ethics Committee

SEMS: Self Expandable Metallic Stent

SSI: Surgical Site Infection

TASH: Tikur Anbessa Specialized Hospital

UK: United Kingdom

USA: Unites State of America

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ABSRACT

Background: Segment 3 bypass surgery, which was once the most commonly done procedure, is the construction of biliary enteric anastomosis between segment 3 intrahepatic bile duct and proximal jejunum. Mostly it is done as palliative treatment for Malignant Hilar Biliary Obstruction (MHBO). This procedure has been done worldwide starting from the early 20th century but rarely being done nowadays. The 30- day perioperative mortality of this procedure falls in the range between 0-31%. There is no study in Ethiopia, to the best of author knowledge, assessing clinical profile and 30- day perioperative outcome of segment III bypass surgery.

Objectives: The objective of this study was to assess thirty-day perioperative outcomes (effectiveness, morbidity, mortality, complication rates) of patients after Segment 3 bypass surgery and its contributing factors after bypass surgery.

Method: Multicenter retrospective cohort study was conducted in Addis Ababa, Ethiopia. Data was collected from medical records of patients with a structured questionnaire and data was entered into SPSS version 27. Descriptive analysis and non-parametric dependent (Wilcoxon) related sample test were done to know the effect of bypass surgery on liver enzymes and serum bilirubin level. Variables with P-value less than 0.05 were considered to know and declare the effect size of bypass surgery.

Result: A total of 35 cases has undergone segment III bypass surgery from January 2020 to December 2024. Out of these it was possible to retrieve the data of 25 cases and 2 of the cases were having incomplete data and were not included in the analysis. The mean age of the patients was 52.87 years. More than half of (56.5%) the cases were males. Hilar cholangiocarcinoma accounts for the majority (78.3%) of causes for hilar biliary obstruction followed by gallbladder cancer. The median duration of surgery was 180.0 (70.0) minutes and the median intraoperative bleeding was around 700.0 (600.0) ml. Three patients (13.0%) patients were died within 30-day of operation and 4 (17.4%) patients developed allover morbidity rate within 30 days of operation. Serum bilirubin and ALP level significantly dropped after the bypass surgery ($z=3.724$ $p= <0.001$ and $z= 2.659$ $p=0.008$ respectively). Only 1 (4.3) patient developed major complication requiring re operation. The common surgical complications identified were bile leak, surgical site infection, and bleeding.

Conclusion: Segment III bypass surgery gives effective palliation of cholestatic symptoms with acceptable 30-day perioperative mortality and morbidity rate.

Keywords: Segment III bypass surgery, perioperative outcome, Ethiopia.

1. INTRODUCTION

1.1.Background

Segment three bypass surgery, which is a biloenteric anastomosis with lateral intrahepatic segment three bile duct with the proximal jejunal loop, is done for unresectable hilar obstruction of different causes (1-5). Segment III bypass surgery, which was once done frequently predating the advent of endoscopic and radiologic drainage procedures, is now being done as salvage procedure when endoscopic and percutaneous drainage options failed and when the tumor is found unresectable at laparotomy (6,7). Segment III bypass surgery is usually done with ligamentum teres approach which gives easy access to the segment III bile duct. Usually, it requires division of the bridging liver tissue between left lateral segment and segment IVb of liver to get easy access to segment III bile duct. (3,6,8,9).

Hilar Biliary Obstruction (HBO) can be caused from a variety of causes (5-7). Majority of hilar biliary obstruction is caused by malignant conditions of different causes (5,10,11). The most common tumor for hilar obstruction is cholangiocarcinoma of the bile duct but can also be caused by other tumors like gallbladder cancer, hepatocellular cancer, pancreatic cancer, gastric cancer or metastasis from other primaries (2,3,10,11).

Majority of patient with Malignant Hilar Biliary Obstruction (MHBO) patients are unresectable at the time of presentation due to tumor and patient factors. Most of the patients with malignant hilar obstruction present with at advanced stage and jaundice with its associated pruritus (5,12,13). Palliative treatment is the main stay of management for malign hilar biliary obstructions as most of the patients are unresectable at the time of presentation. Palliating the effective of obstructive jaundice and pruritus gives better quality of life and increased quantity of life. Around 30-40% of healthy liver parenchyma should be drained to get adequate relief from the effect of jaundice and pruritus (3,5,14-16).

There are a variety of palliative therapy options for malignant hilar biliary obstruction. They can generally be classified as surgical and non-surgical mechanisms (15,17). The management of malignant biliary obstruction requires consideration of different factors prior to decision. Expected

survival, location of tumor and underlying malignancy and proper patient selection is mandatory to get proper result from the palliative treatment (2,3,7,18).

Patients managed by Non-Operative Drainage (NOD) procedure had more frequent medical problems and lower serum albumin levels on admission than patients managed by Cholangio Enteric Bypass (CEB) ($p < 0.03$). There was no qualitative survival difference between patients managed by bypass and drainage procedure (7).

1.2. Statement of the problem

Management of hilar cholangiocarcinoma is challenging as most of patients are at advanced stage by the time of diagnosis (10,13,19). Palliative treatment is the most commonly provided treatment as resection will not be possible in most of patients with malignant bile duct obstruction. Palliative treatment has the advantage of palliating the patient from the most disturbing compliant and also it has the added advantage of increased survival and could make the patient comfortable to undergo further treatment with chemotherapy and radiotherapy (5,19).

There are a variety of palliative treatment options for malignant hilar bile duct obstruction (4,5,19,20). Because of the increasing experience, increased availability, short survival, underlying medical condition and the poor performance status of the patients, most of the patients with hilar biliary obstruction will not be candidate for the more morbid surgical palliative biliary bypass procedure (21-23). Sometimes palliative biliary decompression performed either surgically, endoscopically or percutaneously provides effective palliation but has no survival advantage (24).

Endoscopic and percutaneous palliative biliary decompression is most commonly done nowadays. Preoperative weight loss and hyperbilirubinemia strongly predicts poor quality of life. Successful biliary drainage after stent insertion is associated with improvement in quality of life in patients whose preoperative bilirubin level of 13 mg/dl and above (15,21-23). Percutaneous transhepatic endoprosthesis give effective biliary drainage with 30-day mortality rate of 12% and stent obstruction and migration rate of 12.3% and 5.2% respectively with mean stent patency period of 4.3 months. Bilirubin level dropped from its preoperative level of 17.3mg/dl to 4.9 mg/dl within 4 weeks of the procedure but associated with increased risk of acute cholangitis (25,26). Percutaneous biliary drainage is associated with increased perioperative death rate (4).

Percutaneous stenting can be done either with plastic or metallic stents that could be covered or uncovered Self Expandable Metallic Stent (SEMS). Plastic stents are associated with shorter stent patency period, increased rate of stent occlusion and frequent admission and increased overall all cost (23). Stent obstruction/occlusion is the main problem in management of malignant biliary obstruction and probability of occlusion is related with the level of the tumor rather than the type of tumor (21). Percutaneous transhepatic duct stenting can be unilateral or bilateral. Bilateral

stenting has no added advantage than unilateral stenting but slight modest increased risk of cholangitis and complications in bilateral stenting and increased success rate in unilateral stenting (27,28).

Patients with proximal malignant bile duct obstruction can also be managed by Percutaneous Transhepatic Bile duct Drainage (PTBD). Patients managed by PTBD are relatively at advanced stage and associated with shortest survival and increased priprocedure complications and mortality rate. PTBD is also associated with increased rate of peritoneal recurrence and peritoneal metastasis (29,30).

Palliative biliary drainage for malignant hilar biliary obstruction can also be provided by endoscopic stenting. Endoscopic Retrograde Cholangio Pancreatography (ERCP) stenting gives equivalent rates of adverse events and 30-day mortality rate but decreased success rate when compared with PTBD (27). Endoscopic biliary stenting is also associated with increased rate of stent occlusion (31).

Palliative treatment for such group of patients can also be provided via the more invasive surgical cholangioenteric bypass procedure. Segment III cholangioenteric bypass gives effective drainage for patients with malignant hilar biliary obstruction. Patents who are managed with cholangioenteric bypass have modest survival advantage and increased stent patency rate and decreased rate of re admission for complications. Proper patient selection is important as patients who are expected to survive more than 6 months are benefiting more from surgical biliary bypass procedure (11,13,32).

Segment III bypass surgery is associated with increased rate of 30 day post operative mortality rate (0-17%). Mortality is attributed by renal failure, liver failure, upper gastrointestinal bleeding, sepsis, cardiac failure, bile leak and biliary sepsis among the lists. (4,11,32).

Segment III cholangioenteric bypass surgery is associated with increased length of hospital stay and a variety of post procedure complications and morbidities. Post operative bile leakage and biliary infection, intrabdominal sepsis, wound sepsis, enterocutaneous fistula and ascitic fluid leak, hematemesis, blood loss, pulmonary complications, cholangitis and recurrence of jaundice are among the list of morbidities and complications that can occur post operatively (1,2,9,14,32).

The 30 day post operative outcome is affected by level of serum bilirubin, serum albumin level, the type of tumor, preoperative biliary drainage, preoperative weight loss and performance status of the patient (2,13,15).

As to the best of the researcher, there is no study in Africa in general and in Ethiopia in particular evaluating and assessing the post operative outcome of patients who has undergone segment III bypass surgery where the endoscopic and radiological intervention mechanisms not yet well developed. In this study all potential socio demographic variables, preoperative, intra operative and postoperative determinants were analyzed. The study analyzed sociodemographic and clinical characteristics of patients and the 30- day perioperative outcome of segment III bypass patients as primary outcome.

1.3. Significance of the study

Surgeons, HPB surgeons, in particular may use the output of the research work for treatment recommendation in a particular group of properly selected patients. The study showed that segment III bypass gives excellent drainage of the obstructed bile and will be useful for the oncologists to administer adjuvant chemotherapy for this group of patients and for the HPB surgeons to provide this palliative procedure for a selected group of patients.

The hospital and the department can work further to improve the infrastructure so that the perioperative mortality and morbidity can be further improved. The generated result can also serve to draft treatment protocol at hospital and national level.

2. Literature review

2.1. **Surgical Pathologies, Technique and Indications**

Hilar Chaongiocarcinoma uncommon tumor but prevalence is increasing recently due to the increased awareness and increased precision achieved with the imaging modality (12,34). Malignant hilar biliary obstruction could be caused by a variety of tumors and the most common being hilar cholangiocarcinoma (10,35).

R0 surgical resection with/without liver resection and resection with liver transplantation are the best management options that give long term survival and possibility of cure in patients with hilar cholangiocarcinoma. Patients managed by concomitant partial liver resection and bile duct resection have improved survival (34-36). Liver transplantation (LT) with neoadjuvant chemoradiotherapy in a properly selected patients gives longer survival advantage (37,38).

Segment III bypass may not be able to relieve jaundice if the left lobe of liver is atrophied or if it is involved by multiple tumor deposits and if complete isolation of second order left and right hepatic ducts are infiltrated by tumor (3,14,32).

Segment III bypass surgery is done for tumors that obstruct at the hilar region. Malignant hilar obstruction is most commonly caused by cholangiocarcinoma but can also be caused by other tumors like gallbladder cancer, pancreatic cancer, gastric cancer, lymphoma, hepatocellular cancer and metastasis with Lymph Adenopathy (LAP). Most of patients with advanced gallbladder cancer develop jaundice secondary to hilar infiltration or secondary LAP (10,11,14). Segment III can be accessed by using round ligament and it gives excellent palliation. The procedure effectively relieves jaundice and pruritus even when the hilar obstruction isolates the left and right hepatic ducts and around 30-40 % functioning liver parenchyma drained. The procedure is contraindicated if the left lobe of liver is atrophied and involved by metastasis (3).

Segment III bypass surgery is a satisfactory palliative option in patients whose hilar cancer is unresectable. Knowledge of the ductal and vascular anatomy of the liver is important for proper construction of cholangioenteric bypass (8,14,39). Abdomen can be accessed either by bilateral subcostal incision or right subcostal incision. The ligamentum teres is retracted caudally and to the patient's right to expose the left border of segment III, which is retracted with segment IV cranially.

The bridging liver tissue between the lateral segment III lobe and segment IV will be divided to expose the duct. The proximal 60cm of jejunum is used to construct the loop (9,13,10).

2.2. **Clinical Characteristics of Patients in Segment III Bypass Surgery**

A retrospective study in India of patients with gallbladder cancer who were undergone segment III bypass surgery the median age of the patients was 54 years with 30 female and 18 male patients. Jaundice was present in all patients and of less than 3 months' duration in 30 (63%) patients, 3 to 6 months in 11 (23%), and more than 6 months in 7 (15%) patients. About 14 (29%) of patients were having cholangitis and 11 (23%) were having history suggestive of gastric outlet obstruction (GOO) and the mean serum bilirubin was 17.98 mg/dl (6.80- 31.40 mg/dl) (32). Another study in Hong Kong, China the mean age of the patients were 68.3 years (46-91 years) (7). In another retrospective study in France, the median age of the patients was 59 with median preoperative bilirubin level of 13.5 mg/dl (09-34.7 mg/dl) (1).

A prospective study in USA, the median age of the patients was 52 (35-83) years and more than half of the patients were stage IV at diagnosis (2). Another study in India, the median age of the patients was 58 years and average duration of symptoms was 32 days (14-62 days) with mean serum bilirubin level of 13.3 mg/dl (7-26 mg/dl). A study in India evaluating segment III bypass surgery in gallbladder patients, all patients were having jaundice with mean serum bilirubin level of 19.9 mg/dl (4-35.2 mg/dl) and mean age of 51 years with age range of 30-76 years (14). In another study in UK the median age of the patients were 60 years which was younger than patients undergone non-surgical palliation (17).

2.3**. Efficacy of Segment III Bypass Surgery and Patient Outcomes**

A retrospective study done in Germany showed treating patients with non resectable hilar cholangiocarcinoma with surgical palliation did show equal 30- day mortality and survival with non-surgical palliation and median survival of 6.7 months (40). For patients with expected survival of 6 months and above surgical palliation gives better quality of life, long term patency and proper drainage when compared with either percutaneous or endoscopic palliation with equal morbidity and mortality (13).

A study reviewing the effect of segment III by done on 26 patients with malignant hilar obstruction 18 of 23 surviving patients showed complete resolution of jaundice for at least 3 months (41).

Review of 55 hilar cholangiocarcinoma patients with surgical bypass procedures in USA, segment 3 bypass yields best results with 1 year patency rate of 80% in surviving patients (5). A retrospective study in Nepal showed effective palliation with a decrease in preoperative serum bilirubin level and symptom relief in 80% of patients with accepted perioperative mortality and morbidity (42).

A randomized control study in UK comparing patients managed by endoscopic stenting and surgical drainage showed equal technical success and functionality in both groups with modest increase in procedure associated mortality and morbidity in the surgical biliary drainage group (43). Patients who are being managed by surgical palliative biliary bypass do have less frequent readmission for procedure associated problems (17). A retrospective cohort study in Thailand comparing the outcome of palliative surgical bypass versus percutaneous transhepatic biliary drainage showed equivalent late and early perioperative complication rate in unresectable hilar cholangiocarcinoma patients (4).

2.4. **Magnitude of 30-Day Mortality and Morbidity of Segment III Bypass Surgery**

A retrospective cohort study in UK in the management experience of hilar Chaongiocarcinoma showed no conclusive evidence of the best palliative treatment option for hilar obstruction patients (44). Patients managed by cholangioenteric bypass surgery has less mortality when compared with percutaneously managed patients due to patient characteristics (7). Palliation of non resectable hilar cholangiocarcinoma either with surgical (segment III bypass) or non-surgical mechanisms did have almost equal 30-day mortality and morbidity with median survival of 6.7 months (40).

A comparative study in France showed patients being managed by surgical palliation are younger than those managed by non-surgical palliative drainage mechanisms but with equal 30-day mortality and readmission rate (13). Segment III bypass surgery gives adequate drainage of the biliary tree with 30-day mortality range of 0% to 31 % and morbidity that ranges from 4 % to 50%. A small group of patients require re operation for complications that develop after segment III bypass surgery. The cause of death in the majority of cases is not procedure related and procedure specific. General medical conditions were the most common cause of death. There are a variety of complications that develop following segment III bypass surgery. Myocardial infarction, acute renal failure, wound infection, GOO, Upper GI Bleeding (UGB), bile leakage and biloenteric

anastomosis leak, cholangitis and sepsis were the most frequent complications encountered (1-4,7,9-11,14,17,32).

2.5. **Length of Hospital Stay and Factors Responsible for Morbidity and Mortality**

Segment III bypass surgery for malignant hilar bile duct obstruction gives adequate palliation for jaundice and pruritus with success rate of 60 % to 100%. The median hospital stays after segment III by surgery ranges from 10 days to 26 days (2,4,11,17,32,45).

Preoperative biliary drainage is associated with increased risk of intra operative blood loss, increased rate of positive bile culture and increased infected bile collection (2). Another study in Canada showed patients who have significant weight loss and high-level preoperative bilirubin level had poor quality of life after operation (15). Patient survival after segment III bypass surgery is also affected by the type of tumor for hilar obstruction (2,11). In another study in UK non-operative biliary palliation has superior survival advantage than surgical palliation (44). In a retrospective cohort study in France, the preoperative use of biliary stenting in patients undergoing surgical biliary bypass did not affect perioperative morbidity, mortality, frequency of readmission and time to readmission (17).

2.6. **Conceptual framework**

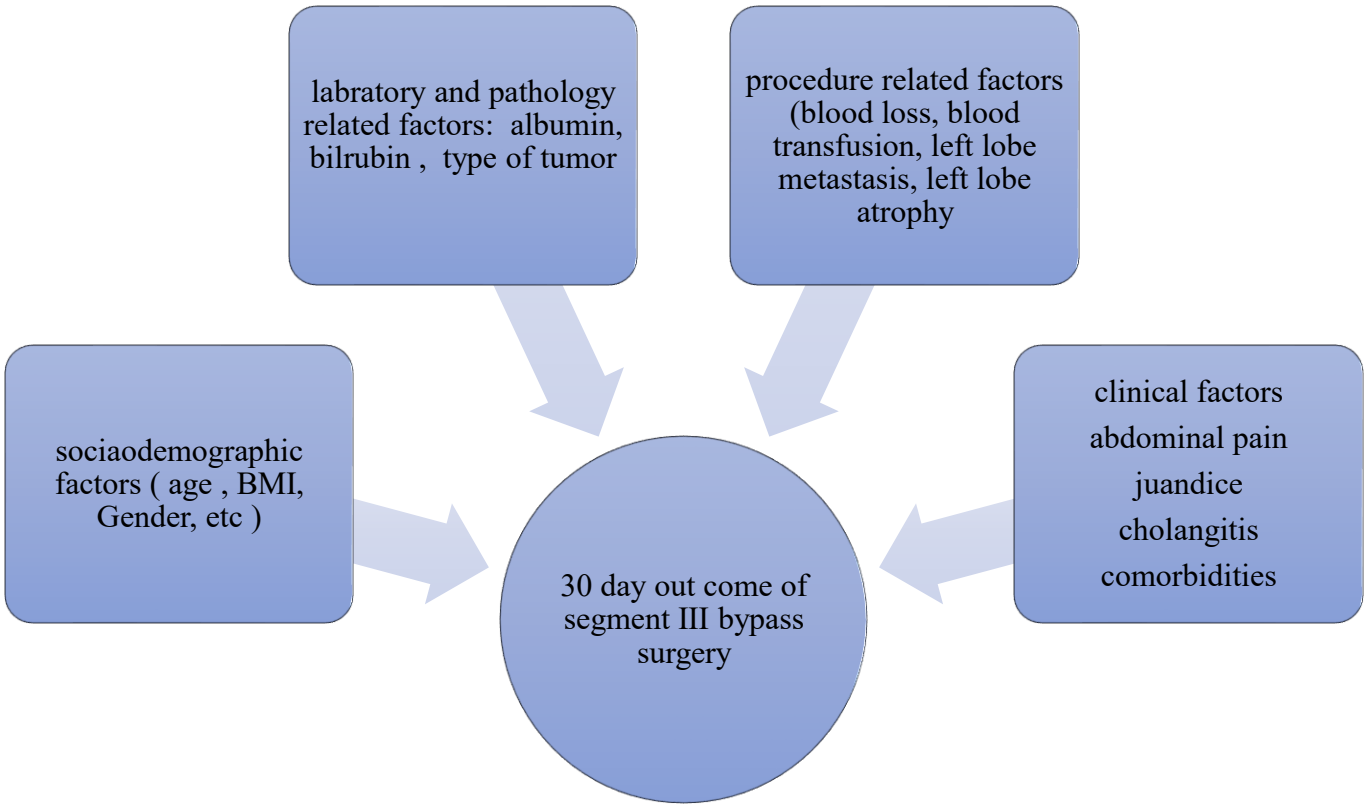

Figure I: Conceptual framework of the study on segment III bypass surgery

3. Objective

3.1. General Objective

- To assess the 30-day perioperative morbidity and mortality and factors affecting morbidity and mortality
- To assess the effective of segment III bypass surgery in relieving of cholestatic symptoms and serum liver enzymes and serum bilirubin level.

3.2. Specific Objectives

- To assess the 30-day post operative mortality and morbidity after segment III bypass surgery.
- To describe clinicopathological features of patients who undergone segment III bypass surgery.
- To describe sociodemographic features of patients who undergone segment III bypass surgery.
- To assess length of Hospital, stay after surgery and time to recovery of liver enzymes and serum bilirubin level after bypass surgery.
- To assess the effectiveness of segment III bypass surgery in palliation of cholestatic symptoms and liver enzymes.

4. Methods and Materials

4.1. Study area

The study was conducted in multiple hospitals in Addis Ababa, Ethiopia where the procedure is being practiced. Addis Ababa is the capital city of Ethiopia and hospitals in Addis Ababa are serving as the final destination for patient referral and where experienced and trained surgeons are located. Among these hospitals, TASH is one of the giant hospitals under Addis Ababa University (AAU) with bed capacity of 700 and a dedicated HPB surgery unit under the department of surgery.

4.2. Study period

The study was conducted From January 2025 to April 2025.

4.3. Study design

Institutional based cross sectional retrospective study was conducted

4.4. Source population

All patients for whom segment III bypass surgery was done at different hospitals in Addis Ababa

4.5. Study population

All patients for whom segment III bypass surgery was done at different hospitals in Addis Ababa.

4.6. Study variables

4.6.1. Dependent variables

- Thirty day post operative outcome after segment III bypass surgery (mortality, morbidity, length of hospital stays, serum liver enzymes and serum bilirubin level).
- Serum liver enzymes and bilirubin level post operatively

4.6.2. Independent variables

- Sociodemographic factors (age, sex)
- Clinical factors (jaundice, ascites, cholangitis, comorbidities, PTB)
- Laboratory and pathologic factors (serum bilirubin, liver enzyme levels, serum albumin, type of tumor)
- Procedure related factors (length of procedure, bleeding, left liver lobe atrophy, left liver lobe metastasis, distant metastasis, blood transfusion)

4.7. Sample size and sampling technique

4.7.1. Sample size

With the assumption of single population formula and with 95% confidence level and 5 % margin of error. As there was no study done in Ethiopia with related topic, proportion of 50% will be considered.

$$\boldsymbol{n_o = \frac{(Z\alpha/2)^2 p\,(1-p)}{d^2}}$$

$$\boldsymbol{n_o = \frac{(1.96)^2 0.5\,(1-0.5)}{0.05^2} = 384}(aproximated)$$

Where: n_o is the maximum possible sample size

$Z_{\alpha/2}$ is standard score value for 95 % confidence level for two sides normal distribution

p = is the proportion of population (The magnitude of thirty-day postoperative mortality and morbidity of segment III bypass. p = 0.5)

d = is margin of error tolerated

Za/2 = the standard and normal variable at (1-a) % with 95% (1.96) confidence level

Thirty-six cases were done in the past 8 years. Among these it was only possible to get the medical records 23 of patients. Data for 3 patients were incomplete and were not included in the study. Finally, 23 cases analyzed in the study.

4.7.2. Sampling technique/ procedure

Consecutive sampling of all patients for whom segment III bypass surgery was done used.

4.8. Inclusion and exclusion criteria

4.8.1. Inclusion criteria

All patients for whom segment III bypass surgery was done in the study period

4.8.2. Exclusion criteria

Patients for whom segment III bypass surgery was done for benign biliary stricture

Patients for whom the necessary clinical, operative, laboratory parameters were missed.

4.9. Data collection procedure

Data was collected by trained General Practitioners (GP). Sociodemographic data, clinical related factors and laboratory values, intraoperative features, post operative variables was collected from patients' medical records.

4.10. Data quality control

The questionnaire was prepared in English and 1-day training was provided for data collectors. Pretest was done in one of the hospitals in 5% of the cases to check the completeness and

consistency of the questionnaire. The data was collected by using structured questionnaire by trained GP in close supervision by the investigator. The data was checked by investigators for completeness and consistency. The collected data was kept with hard disk and maintained confidentially.

4.11. Data analysis

Data was cleaned for accuracy, consistency and missing variables and values. The cleaned data was entered and analyzed using SPSS version 27. Descriptive analysis was conducted using frequency tables and percentages. Because the sample size was small it was not possible to multivariable binary logistic regression but binary logistic regression and non-parametric (Wilcoxon) dependent test was done to know the effect of the bypass surgery and r values less than 0.3 was considered as having small effect, r value 0.30-<0.5 as moderate effect and r value >=0.5 as having large effect. Variables that have P- value of below 0.05 was considered statistically significant on Wilcoxon test.

4.12. Data dissemination

The thesis is going to be disseminated to concerned bodies of the hospital managers, professional associations and MOH. Hard copy will be submitted to the department of surgery and library. Finally, the research will be published in indexed journals and will be presented to professional seminars and conferences.

4.13. Operational definition

Thirty-day mortality: death within 30 days of surgery

SSI: if the diagnosis is established by the treating physician

Proper biliary drainage: bilirubin drops of 25% and above after 1 week of surgery

Major complications will be defined as Clavien – Dindo class 3 or 4 complications

Minor complications will be defined as Clavien – Dindo class 1 or 2 complications

4.14. Ethical considerations

Ethical clearance was obtained from college of medicine and health science department of surgery research and ethical committee. Formal letter of cooperation was obtained from TASH administrators and respective private hospitals in Addis Ababa under protocol number; ***DOS/REC/135/2025/2017***.

5. RESULT

5.1. Sociodemographic and Clinical Characteristics of Patients

A total of 35 cases has undergone segment III bypass surgery from January 2020 to December 2024. Out of these it was possible to retrieve the data of 25 cases and 2 of the cases were having incomplete data and were not included in the analysis. A total of 23 cases were included in the study. The mean age of the patients was 52.87 (range:32-82) and more than half of (56.5%) the patients were males. All patients were having yellowish discoloration of eye and dark colored urine whereas abdominal pain was there in the majority of patients (60.9%) and the median duration of abdominal pain was 37.50 (IQR; 30) days and with median duration of yellowish discoloration of eye of 30.00 (IQR; 30.50) days. About 17 (73.9%) of patients were having performance status of ECOG 1. The majority of patients were having history of pruritus and weight loss which is unquantified,78.3% and 73.9% respectively. Only one patient was having preoperative PTBD trial (table1).

Table 1: Sociodemographic and clinical characteristics of segment III bypass surgery patients, Addis Ababa, Ethiopia, July 2025.

Variables	Yes, n (%)	No, n (%)
Abdominal pain	14 (60.9)	9 (39.1)
Pruritus and itching	18 (78.3)	5 (21.7)
Weight loss history	17 (73.9)	6 (26.1)
Clay colored stool	14 (60.9)	9 (39.1)
Nausea and anorexia	20 (87)	3 (13)
Comorbidities	17 (73.9)	6 (26.1)
Preoperative PTBD or ERCP	1 (4.35)	22 (95.65)

PTBD; percutaneous transhepatic biliary drainage ERCP; endoscopic retrograde cholangiopancreatography

5.2. Pathologic and Imaging Features of Participants

Hilar cholangiocarcinoma was the most common cause for hilar obstruction 18 (78.3%) in the study participants and one patient was due to advanced duodenal cancer with hilar infiltration. Contrast enhanced CT scan was the most commonly used imaging modality 17 (73.9%) used to stage the patients and plan the treatment modality. Only 2 patients (8.7%) were having distant metastasis other than liver during intraoperative exploration. All the four patients with gallbladder cancer were having stage 3 disease at the time of exploration. In 2 of the patients (8.7%) the left liver was involved by tumor deposits and preoperative cholangitis was there in 3 (13.0%) of patient. Side to side Bilioenteric anastomosis was done in all of the study participants.

Table 2: Pathologic and imaging features of segment III bypass surgery patients, Addis Ababa, Ethiopia, July 2025.

Variables	Values
Type of tumor	
Hilar cholangiocarcinoma, n (%)	18 (78.3)
Gallbladder cancer, n (%)	4 (17.4)
Other, n (%)	1 (4.3)
Imaging used	
CT scan, n (%)	17 (73.9)
CT and MRI, n (%)	6 (26.1)
HCC Bismuth Carlote staging	
Not known, n (%)	3 (16.7)
Type 2, n (%)	7 (38.9)
Type 3, n (%)	8 (44.4)
Metastasis other than liver	
Yes, n (%)	2 (8.7)
No, n (%)	22 (91.3)
Left lobe status intraoperatively	
Only congestion, n (%)	22 (91.3)
Involved by tumor, n (%)	2 (8.7)
Preoperative cholangitis	
Yes, n (%)	3 (13.0)
No, n (%)	20 (87.0)

CT; computed tomography MRI; magnetic resonance imaging HCC; hilar cholangiocarcinoma

5.3. Preoperative and Post Operative Laboratory features of patients

The median serum albumin level was 3.3 (IQR: 0.41) mg/dl and the preoperative median serum total and direct bilirubin level was 28.0 (IQR; 11.7) and 18.0 (IQR; 3.9) mg/dl respectively. The serum total and direct bilirubin drops post operatively with median serum total and direct bilirubin level of 12.4 (IQR; 9.2) and 8.7 (IQR; 3.9) mg/dl respectively after 1 week of the surgery. Serum Liver enzymes were elevated in the majority of patients with median preoperative serum ALP level of 138.9 (SD; 154.9) which drops to 85.4 (SD; 65.7) U/L postoperatively. CA 19-9 was determined in nearly one third of patients and the median serum CA 19-9 was 450.0 (IQR; 1381.3) U/ml.

Table 3: Preoperative and post operative laboratory features of Segment III bypass surgery patients, Addis Ababa, Ethiopia July 2025.

Variables	Mean (Sd)	Median (IQR)
Pre-operative Albumin, g/dl	3.15 (0.58)	3.3 (0.41)
Total bilirubin, mg/dl		
Pre-operative	29.3 (8.2)	28.0 (11.7)
Post-operative day 7	14.3 (5.8)	12.4 (09.2)
Post- operative day 30	06.9 (7.6)	04.5 (3.5)
Direct bilirubin, mg/dl		
Pre-operative	18.2 (4.0)	18.0 (3.9)
Post-operative day 7	8.7 (3.1)	08.7 (04.3)
Post-operative day 30	6.9 (7.6)	2.8 (2.2)
ALT, U/L		
Pre-operative	141.8 (105.6)	114.1 (123.0)
Post-operative	123.0 (176.9)	85.4 (65.7)
AST, U/L		
Pre-operative	145.0 (84.3)	138.9 (154.9)
Post- operative	155.2 (299.6)	89.6 (61.1)
ALP, U/L		
Pre-operative	1378.3 (1113.4)	1170.0 (806.0)
Post-operative	930.4 (721.5)	760.0 (956.8)
Serum INR	1.9 (1.4)	1.4 (0.9)
WBC, $x10^3$	7.6 (2.5)	8.0 (2.7)
Hgb, mg/dl	11.9 (1.2)	12.0 (1.7)
Platelet, $x10^6$	354.9 (149.2)	326.0 (152.0)
Creatinine, mg/dl	0.7 (0.3)	0.6 (0.2)
CA 19-9, U/ml	1480.4 (2625.1)	450.0 (1381.3)
CEA, ng/dl	4.5 (4.8)	2.3 (7.7)

ALT; alanine amino transferase AST; aspartate amino transferase ALP; alkaline amino phosphatase INR; international normalized ration WBC; white blood cell counts CEA; carcinoembryonic antigen CA 19-9; carbohydrate antigen

5.4. Intraoperative and Post Operative Course of Patients

The median duration of surgery was 180.0 (IQR; 70.0) minutes and median amount of bleeding intraoperatively was 700.0 (IQR; 600.0) ml. Drain was left in all of the patients postoperatively and the median duration of drain stay was 7.0 (IQR; 22) days. Within 30th post operative day 3 (13.0%) patients have died and only one patient was died due to procedure related complication and in the other patient's medical complications following the procedure were the cause of death (MI and PTE). Bile leak was developed in 4.0 (18.2%) of the patients survived to document bile leak and all of the bile leaks were managed conservatively with percutaneous drain. SSI was developed in 4.0 (18.2%) of patients and half of them were organ space infections who demanded surgical exploration. The median, minimum and maximum duration of post operative hospital was 7.0 (IQR; 4.5), 4 and 30 days respectively. All of the surviving patients were having both subjective and objective improvement of their clinical complaints.

Table 4: Intraoperative and post operative course of Segment III bypass surgery patients, Addis Ababa, Ethiopia July 2025.

Variables	Values
Duration of surgery (minutes), median (IQR)	180.0 (70.0)
Amount of bleeding intraoperatively (ml), median (IQR)	700.0 (600.0)
Drain duration (days), median (IQR)	7.0 (22)
Post op hospital stays (days), median (IQR)	7.0 (4.5)
30th day outcome	
Death, n (%)	3.0 (13.0)
Alive with/out complication, n (%)	20.0 (87.0)
Cause of death	
Surgical, n (%)	1.0 (33.0)
Medical, n (%)	2.0 (67.0)
Post operative bile leak	
Yes, n (%)	4.0 (18.2)
No, n (%)	18.0 (81.8)

Post operative bleeding	
Yes, n (%)	1.0 (4.7)
No, n (%)	21.0 (95.3)
SSI	
No SSI, n (%)	18.0 (81.8)
Deep SSI, n (%)	2.0 (9.1)
Organ space SSI, n (%)	2.0 (9.1)

IQR: interquartile range; SSI: surgical site infection

5.5. Comparison of Liver Enzymes and Serum Bilirubin among Study Participants

As the scale variables were not normally distributed, non-parametric related sample (Wilcoxon) test was done to know the effect of the surgical intervention on the level of serum liver enzymes and bilirubin preoperatively and post operatively. Wilcoxon signed rank test revealed both serum total and direct bilirubin level was significantly lower after segment III bypass surgery (Md=12.4, n=18) compared to before surgery (Md=28.0, n=23), z=3.724, p= <0.001 with a large effect size r=0.58 on post operative day 7. A Wilcoxon signed rank test was also performed to know the effect of bypass surgery on serum ALP. The test revealed a significantly lower lever of ALP after surgery (Md= 760.0, n=21) compared to before surgery (Md=1170.0, n=23), z=2.66, p=0.008 with a moderate effect size r=0.40 on post operative day 7.

Table 5: Comparison of liver enzymes and serum bilirubin among Segment III bypass surgery patients, Addis Ababa, Ethiopia July 2025.

Variables	Number	Q_1	Median	Q_3	Mean Rank	Z value	P value	Effect size (r)
Preop TB	23	22.5	28.0	34.2	9.5	3.724	<0.001	0.58
Postop TB Day 7	18	9.7	12.4	18.9				
Preop TB	23	22.5	28.0	34.2				
Post Op TB Day 30	14	3.2	4.5	6.8	7.5	3.296	<0.001	0.54
Preop DB	23	15.8	18.0	19.7				
Post Op DB Day 7	18	6.4	12.4	18.8	9.5	3.724	<0.001	0.58

Preop DB	23	15.8	18.0	19.7				
Post Op DB Day 30	13	1.3	2.8	3.5	7.0	3.180	0.001	0.53
Preop ALT	23	68.0	114.0	191.0				
Post Op ALT	21	55.4	85.4	121.1	10.61	1.147	0.251	0.17
Preop AST	23	63.5	138.9	218.3				
Post Op AST	21	53.4	89.6	114.5	11.79	1.721	0.085	0.26
Preop ALP	23	710.0	1170.0	1516.0				
Post Op ALP	21	419.2	760.0	1376.5	10.67	2.659	0.008	0.40

Q; quartile TB; total bilirubin DB; direct bilirubin ALT; alanine amino transferase AST; aspartate amino transferase ALP; alkaline amino phosphatase

5.6. Factors affecting morbidity and mortality

As the sample size was small, it was not possible to do multivariable binary logistic regression. Patients with comorbidities do have the odds of developing complication/death 1.4 times than patients with no comorbidities even if it is not statistically significant. Weight loss, prolonged duration of abdominal pain, older age, low albumin and high preoperative bilirubin also increase the likely hood to develop complication that is not statistically significant.

Table 6: bivariable logistic regression table for factors affecting morbidity and mortality among Segment III bypass patients, Addis Ababa, Ethiopia, July 2025.

Variables	P _value	COR	95% CI	
			Lower	Upper
Age	0.762	1.010	0.947	1.077
Sex	0.533	0.769		
Comorbidities	0.708	1.429	0.220	9.262
Weight loss	0.708	0.700	0.108	4.538
Abdominal pain duration	0.263	1.026	0.981	1.073
Performance status-ECOG	0.773	0.727	0.840	6.314
Albumin	0.663	1.394	0.313	6.211
Bilirubin	0.521	1.034	0.913	1.147
Surgery duration	0.785	1.003	0.981	1.026
Amount of bleeding	0.279	0.999	0.997	1.001

6. DISCUSSION

Hilar biliary obstruction is caused by a variety of malignant conditions with hilar cholangiocarcinoma the most common cause for obstruction (10,35). In our study hilar cholangiocarcinoma was the causative factor for hilar biliary obstruction in majority of cases (78.3%) which is consistent with other studies identifying it as the principal cause for hilar obstruction (10,35). Gallbladder cancer was the 2nd most common cause for hilar biliary obstruction which is consistent with studies done in India and Southeast Asia (14,32).

Jaundice, pruritus, weight loss, and dark urine were the main presenting complaints in our cohort study which aligned with the classic clinical manifestations of malignant biliary obstruction (3,10,14,32). The mean age of our patients was 52.87 years which is within the range in most of the studies but slightly younger than the mean age of patients in the Western series (7,17). This age difference may reflect tumor biology, health care access, life expectancy difference or genetic difference.

In our study all of the surviving patients reported both subjective and objective improvement of their complaints providing adequate relief of their cholestatic symptoms. The median serum preoperative bilirubin level (28.0mg/dl) dropped to 12.4 mg/dl on postoperative day 7 and further down to 4.5 mg/dl on day 30. This is comparable to other studies which showed significant drop in serum bilirubin level after segment III bypass surgery (14,32,4). The median Serum alkaline phosphatase (ALP) level also dropped significantly after the bypass surgery from 1170.0 U/L to 760.0 which is superior than a study done to assess the effectiveness of endoscopic and percutaneous palliative options (5,13,41).

Segment III bypass surgery carries a significant risk of perioperative morbidity and mortality. In our study the 30- day mortality rate was 13.0% which aligned with reported ranges of 0-31% in various literatures (1-4,7,14,17,40). Only one patient was died due to procedure associated complication. The major of cause of death was medical complications as it is reported in various studies (1,14,17,32). Our observed morbidity rates—including bile leak (18.2%), surgical site infections (18.2%), and postoperative bleeding (4.7%)—fall within published ranges (1-4, 9-11, 14, 17, 32). Half of the SSIs in our cohort were organ-space infections requiring reoperation, underscoring the complexity of these procedures and the importance of meticulous surgical technique and postoperative care.

The median post operative hospital stay was 7 days which is shorter than duration reported in other studies which ranges from 10 to 26 days (2,4,11,17,32,45). This might be because of advancement in perioperative cares in recent years, better patient selection and other studies have been done long time ago.

In one of our patient segment III bypass surgery was done as a salvaged procedure after failed attempt of ERCP. Preoperative biliary drainage is a debated topic as some argue, it increases the risk of infection and bile contamination without the added advantage (2,15,17) whereas as others argue it positively affect the outcome of segment III bypass surgery by improving the general condition of the patient (2,11,17). Preoperative biliary drainage was not done in our study might be due to unavailability of the service and institutional practice.

7. CONCLUSION

Our finding supports that segment III bypass surgery as a viable option for palliation of malignant hilar biliary obstruction especially where and when non-surgical options to relieve malignant hilar biliary obstruction are unavailable in a carefully selected individual. Careful patient selection based on tumor extent, patient performance status and patient comorbidity is essential to get satisfactory result.

8. LIMITATIONS OF THE STUDY

It was retrospective study and involved a relatively small group of patients which might limit its generalizability of its findings. It was a 30- day operative outcome study and it was not possible to assess long term survival and quality of life assessment. It was single arm study and comparison of segment III bypass surgery with non-surgical methods of palliation options was not done. Future prospective study with large populations is recommended to list out factors responsible for perioperative complications and to know the effect of segment III bypass surgery in these group of patients.

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Annex: Questionnaire

Part I: sociodemographic data

No.	Sociodemographic factors		Remark
1.	Age in years	.....	
2.	Sex	1. Male 2. Female	
3.	Address, district	.....	
4.	BMI, if possible	.....Kg/m2	

Part II: clinical signs and symptoms

No.	Clinical sign and symptoms	Response	Remark
1.	Abdominal pain	1. Yes 2. No	
1.1.	If yes, duration of abdominal pain	..... days	
2.	Yellowish discoloration of eye	1. Yes 2. No	
2.1.	If yes duration	.....days	
3.	Pruritus and itching	1. Yes 2. No	
4.	Weight loss	1. Yes 2. No	
4.1.	If yes how much in Kg	.....Kg over.....months	
5.	Nausea, anorexia	1. Yes 2. No	
6.	Clay colored stool	1. Yes 2. No	
7.	Dark colored urine	1. Yes 2. No	
8.	Other known medical illness	....	
9.	Self or family history of cancer	1. Self-history.....organ 2. Family history 3. No	
10.	History of smoking or alcohol	1. Smoking 2. Alcohol 3. No	
11.	History of PTBD or ERCP	1. Yes 2. No	
12.	Other symptoms	.....specify	
13.	Abdominal swelling/mass	1. Yes 2. No	
13.1.	If yes, Duration of swelling	.....days	
14.	Performance status of patient	ECOG.....	
15.	Clinical ascites	1. Yes 2. No	

Part III: laboratory and radiological data

No	Laboratory and imaging variables	Response	Remark
1.	Type of imaging used	1. CT 2. 2. MRI 3. 3. Both	
2.	Type of tumor	1. Hilar cholangiocarcinoma 2. Gall bladder cancer 3. Other.....specify	Specify stage using Bismuth Carlote
4.	Distant metastasis other than liver	1. Yes 2. No	
5.	Left liver lobe metastasis	1. Yes 2. No	
6.	Ascites	1. Yes 2. No	
7.	Size of segment III if possible	.....mm	
8.	Preoperative Serum albumin	.....mg/dl	
9.	Preoperative Serum bilirubin total/direct	.....mg/dl	Post op.....mg/dl .....date done
10.	Preoperative INR	.....	
11.	Preoperative WBC count		
12.	Preoperative Hgb	.....mg/dl	
13.	Preoperative Plt		
14.	Preoperative ALT		Post op.....date
15.	Preoperative AST		Post op.....date
16.	Preoperative ALP		Post op.....date
17.	Preoperative Creatine	.....mg/dl	Postop....mg/dl
18.	Preoperative Tumor markers	1. CA 19-9 ..... 2. CEA ..... 3. AFP	
19.	Any confirmed cholangitis	1. Yes 2. No	
20.	Preoperative biopsy	1. Yes 2. No	Histology.....
20.1.	If yes how it is taken	1. US guided FNAC 2. Core needle biopsy 3. ERCP brush	

Part 4: Intra operative findings and pathology results

No.	Intraoperative variables	Response	Remark
1.	Type of Bilioenteric anastomosis	1. Side to side 2. End to side	
2.	Duration of surgery	.....minutes	
3.	Amount of bleeding intraoperatively	.....ml	
4.	Origin of tumor intraoperatively		
5.	Stage of tumor intraoperatively	1. Hilar cholangiocarcinoma.....Bismuth C. 2. Gallbladder cancer .....TNM 3. Other.....	
6.	Status of left liver lobe	1. Only congestion/normal 2. Atrophied 3. Involved by Metastasis	
7.	Was drain left intraoperatively?	1. Yes 2. No	
7.	If yes for how long drain was insitu?	.....days	
8.	Ascites	1. Yes 2. No	
9.	Another distant metastasis site	Yes 2. No	Out of liver and hilar region
10	Length of preoperative hospital stay	.....days	
11	Length post operative hospital stay	.....days	
12	Total length of hospital stays	.....days	

Part 5: post operative variables

No.	Post operative variables	Response	Remark
1.	Post operative outcome on day 30	1. Smooth with no complication 2. Alive with complication 3. Death	
2.	Did the patient died within 30 days?	1. Yes 2. No	
2.1.	If yes, cause of death	.....mention	
2.2.	When was the time of death postoperatively?	.....days	
3.	Post operative biliary leak	1. Yes 2. No	
3.1.	Date of bile leak detected	.....day	Post operative

3.2.	How it is managed?	1. Conservatively with drain 2. PTBD 3. Relaparotomy	Other specify.....
4.	Was there post operative bleeding?	1. Yes 2. No	
4.1.	If yes, time of bleeding	1. Early within 24 hours 2. Late after 24 hours	
4.2.	Site of bleeding	1. Intraluminal (melena, hematemesis) 2. Extraluminal (intraabdominal collection, coming via drain)	
4.3.	How was the bleeding managed?	1. Observation 2. Blood transfusion 3. Endoscopic 4. Relaparotomy	
5.	Was there surgical site infection?	1. Yes 2. No	
5.1.	If yes, date of diagnosis?	.....days	Post operative day
5.2.	Type of surgical site infection	1. Superficial SSI 2. Deep surgical site infection 3. Organ space	
5.3.	How was the surgical site infection managed?	1. Wound care 2. Re operation	
6.	Any other complication postoperatively?	1. Yes 2. No	Specify.....
7.	Level of bilirubin postoperatively in mg/dl	1. Within 1 week..... 2. Within 4 weeks	
8.	Level of liver enzymes postoperatively	ALP..... AST ..... ALT	Specify the week it is done
9.	Was there subjective improvement of pruritus?	Yes No	Specify period of improvement
10.	Was there clinical improvement of jaundice?	Yes No	