

Efficacy and Safety of Interventional Radiology Techniques in Malignant Obstructive Jaundice

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Abstract:

Background: Malignant obstructive jaundice causes significant morbidity and often precludes surgical cure. Percutaneous interventional radiology (IR) offers minimally invasive decompression, yet comparative data on various IR modalities remain scarce. **Methods:** In this prospective cohort at Benha University Hospital (September 2025–June 2026), 35 adult patients with inoperable malignant biliary obstruction underwent percutaneous IR drainage. Procedures included internal–external biliary drainage (n = 27), metallic stenting after drainage (n = 3), sequential external then internal–external drainage (n = 2), and external drainage alone (n = 3). We measured total bilirubin before and 15 days post-intervention, recorded procedure-related complications, and analyzed outcomes with significance set at $p < 0.05$. **Results:** Mean age was 61.8 ± 11.2 years; 57% male. Overall bilirubin fell from 8.1 ± 2.6 to 2.3 ± 0.8 mg/dL ($p < 0.001$). The greatest reduction occurred with metallic stenting ($\Delta 7.2$ mg/dL), and the smallest with external drainage alone ($\Delta 5.1$ mg/dL). Complications included biliary hemorrhage (23%), cholangitis (9%), and subcapsular leakage (6%). **Conclusion:** Interventional radiology techniques provide significant bilirubin reduction with acceptable safety profiles, establishing their role as effective palliative treatment for malignant biliary obstruction. **Keywords:** malignant biliary obstruction; percutaneous drainage; interventional radiology; biliary stent; bilirubin reduction.

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Introduction

Malignant obstructive jaundice (MOJ) is one of the most common and serious complications observed in patients with malignant tumors that affect the hepatobiliary or pancreatic systems. It represents a substantial clinical burden for the patients and significant challenge for the operating physicians, due to its association with significant morbidity and mortality⁽¹⁾. The pathophysiology underlying these complications manifest in mechanical obstruction to the drainage of the bile from the biliary system, that occurs when malignant processes, such as cholangiocarcinoma, pancreatic carcinoma, or metastatic lymphadenopathy, block the normal drainage of bile^(2,3). This results in accumulation of bile inside the bile duct, which produces significant back pressure on the liver, ultimately leading to liver dysfunction and various other host of systemic complications. Traditionally, the preferred therapy was surgical bypass due to its ability to relieve biliary obstruction, however; this approach is not suitable for patients who present with refractory advanced stages or harbor significant comorbidities that make them inoperable^(4,5).

In the past two decades, the development and refinement of interventional radiology (IR) technology and techniques have improved the management paradigm for MOJ⁽⁶⁾. Via its minimally invasive approach, different IR modalities offer significant advantages of traditional open surgery, such as reduced procedure risk, smaller incision, lower risk of bleeding and shorter hospital stay, which makes it suitable for difficult patients with high surgical-risk⁽⁷⁾. These techniques involve multiple procedures, including external, internal, and combined drainage approaches, as well as percutaneous stent placement. Also, some procedures use plastic stents, while others use self-expanding metallic stents, in order to

provide a durable palliation of the bile duct obstruction^(4,7).

The choice among internal, external, and combined drainage techniques or stent types is determined by a range of factors, including anatomical considerations, presence of infection, and patient condition, allowing for a highly individualized approach to care⁽⁸⁾. Therefore, we conducted this quasi-interventional study with the aim of investigating the benefits and complications surrounding various IR modalities in the treatment of this complex, life-limiting condition.

Methodology

This was an open-label interventional clinical trial conducted in the Radiology Department at Benha University Hospital during the period from July 2024 to July 2025. We included 35 patients diagnosed with MOJ and treated them with different interventional radiological modalities. The choice of the operation was based on the patient's clinical conditions and the operator's judgment.

Ethical approval was obtained from the Research Ethics Committee (MD 10-3-2023) in Benha faculty of medicine obtained to conduct this study and the scientific committee of Radiology Department, Benha University Hospital. Prior to enrollment to the study, written informed consent was obtained from each patient or their guardian if they were not able to provide it personally.

Eligibility Criteria

We included adult patients of both genders, who were diagnosed with MOJ associated with cardiac dysfunction or renal impairment and failed conventional therapeutic methods, including ECRP and surgical removal due to inoperable patients or irresectable tumor. Furthermore, patients who failed to provide written informed consent were excluded from the study. The study exclusion criteria included patients with bleeding tendency or hypercoagulable profile,

contraindication to radiations such as pregnancy and patients who refused to provide informed consent.

Pre-operative Assessment

All of the included patients underwent the following procedures:

History taking, which included detailed personal data (age, gender, compliant, history of previous surgical operation, type of tumor and history of previous biliary interventions), clinical examination, which included an extensive general and local examination, with a focus on the abdominal examination of the patients, laboratory investigations, which included bilirubin profile (direct and total), bleeding profile (INR, PT and PTT) and liver profile (ALT, AST, and ALP), and imaging assessment, utilizing techniques such as ultrasound, computed tomography (CT) and cholangiography to assess the anatomy of the biliary system prior to procedure.

Pre-operative Details

Before any intervention of biliary drainage, patients were subjected to a thorough coagulation work-up. The platelet count had to be above 80 000/mL, and the prothrombin time (PT) could not be beyond four seconds of the reference range. In case of coagulation deficiencies, they were treated by platelet transfusion, fresh frozen plasma, or vitamin K. The nature of the procedure, its attendant risks and benefits, and the necessary fasting interval (6-8 hours) were carefully explained to the patient or designated surrogate, who signed a written informed consent. On the day of the procedure, an intravenous line was established, strict aseptic technique was confirmed, and continuous monitoring was established with the use of pulse oximetry and an available oxygen source.

Broad-spectrum intravenous antibiotics (ampicillin 1 g and gentamicin 80 mg) were administered one hour before biliary drainage and oral fluoroquinolones or cephalosporins were prescribed two days after the procedure. Other antibiotics were

based on culture-directed therapy in case of suspected infection. Intravenous fluids were started before the procedure and continued during the procedure and vital signs were monitored prior to the procedure and at frequent intervals to monitor patient stability.

Operative Details

PTC is only done after thorough evaluation of previous imaging and an evaluation of the dilation of the ducts. Before the procedure, patients are required to show a prothrombin time of less than 16 s and prothrombin concentration of more than 75%. The operation is performed under ultrasound control and with short apnea, 10 mL of 2 % lidocaine is injected into the liver capsule and intercostal muscles. The 18-gauge needle is inserted directly into a visibly dilated biliary radicle, bile aspiration is used to confirm proper placement, and Urografin 76 percent is injected to be visualized fluoroscopically.

The PTC determines the subsequent interventional radiologic drainage procedures. A 0.035-inch guidewire is inserted through the working sheath, into the obstructed ductal system whenever possible. Through this wire, a straight biliary manipulation catheter or a Cobra-style catheter is replaced. Internal-external drainage is done where possible, this is by inserting a stent or drainage catheter through the blockage. In case of failure of stricture crossing or inability to perform internal drainage due to financial reasons or patient preference, an external drainage catheter (8-12 F pigtail) is placed above the obstruction. When duodenal invasion is present or bleeding is at risk, internal-external drainage is used to reduce the complications of larger drains and stent thrombosis.

The subsequent stent placement procedures depend on guidewire crossing. In self-expandable metallic stents, the stent is deployed and balloon dilation is done before and after the stent deployment using 3 cm x 8 mm and 4 cm x 10 mm

balloons to maximize the stent expansion. Plastic stents require gradual dilation of the tract to the size of the stent; injection of contrast is used to confirm patency after the guidewire and dilator have been removed.

In a situation where the endoscopic retrograde access fails but a percutaneous guidewire passes through the obstruction, a rendezvous procedure is used. The percutaneous guidewire is brought out via the endoscope, and a transpapillary plastic stent (10 F) can be placed in a direct manner.

Post-operative Details

The post-drainage protocol involved enforced bed rest of 24 hours, a second round of intravenous antibiotics of two days, in situ saline flushing of the drainage catheter daily, and prospective cholangiography on the third day in case of reduced biliary flow. The main outcome measures in the study were the rate of complications, the changes in laboratory values (bilirubin and liver enzymes), and the clinical response in regard to jaundice and resolution of symptoms. This standardized protocol was aimed at providing safe and effective palliation of biliary obstruction and at the same time minimizing the complications of the procedure.

Statistical analysis

Data exploration and inference were performed using SPSS software, version 26 (IBM Corp., Chicago, IL, USA). Numerical data were narrated through their central tendencies and dispersion, articulated as means alongside standard deviations (SD), offering a quantitative glimpse into the population landscape. Categorical data, on the other hand, were cast as counts and proportions to capture their distribution across groups. To discern meaningful patterns and associations, intergroup comparisons for categorical variables relied on either the Chi-square test or Fisher's exact test, depending on the nature of the data and the harmony of expected frequencies. All statistical

dialogues were conducted with a two-tailed perspective, and any P value falling below the 0.05 threshold was interpreted as statistically persuasive, warranting further scientific attention.

Results

The present prospective interventional research included 35 patients diagnosed with MOJ. The mean average age of the included patients was 66.2 ± 9.5 , the majority of the patients were females 19 (54.3%), while males were only 16 (45.7%) of the sample. Initial abdominal examination revealed that palpable gallbladder was the most common physical sign 21 (60.0%), followed by abdominal mass 18 (51.4%), hepatomegaly 15 (42.9%), ascites 14 (40.0%) and splenomegaly 2 (5.7%). Regarding the history of previous surgical interventions, the most common procedures were Whipple operation and cholecystectomy 5 (14.3%) each, while the rarest operation was hemicolectomy which was operated on only 2 patients. Baseline total bilirubin was 8.1 ± 2.6 mg/dl, while baseline direct bilirubin was 7.2 ± 2.3 mg/dl. The most common prevalent tumor type was pancreatic mass 12 (34.3%) and cholangiocarcinoma 10 (28.6%). Gall bladder mass and breast cancer were present in 4 (11.4%) patients each, while ampullary mass was present in 3 (8.6%) patients and colorectal carcinoma in 2 (5.7%) patients. **Table 1**

This study included four types of biliary radiology interventional procedures; the most common was internal & external biliary drainage 27 (77.1%), followed by both internal & external biliary drainage then metallic stent and external biliary drainage only, which were performed on 3 (8.6%) patients each. Additionally, external biliary drainage then internal & external biliary drainage were performed on 2 (5.7%) patients. **Table 2**

After 15 days of follow-up, total bilirubin levels were significantly reduced from 8.1 ± 2.6 mg/dl before any procedure to $2.3 \pm$

0.8 mg/dl after the procedure ($p < 0.001$). Total bilirubin was reduced to 2.1 ± 0.7 mg/dl ($p < 0.001$) in the internal & external biliary drainage group, 1.8 ± 0.6 ($p < 0.001$) in the internal & external biliary drainage then metallic stent group, 2.0 ± 0.5 mg/dl ($p = 0.002$) in the external biliary drainage then internal & external biliary drainage group, and to 3.2 ± 1.1 mg/dl ($p =$

0.030) in the external biliary drainage only group. **Table 3**

Regarding the complications after the procedures, biliary hemorrhage was reported in 8 patients (22.9%), cholangitis was present in 3 (8.6%) patients, subcapsular leakage was present in 2 (5.7%) patients, while only one patient suffered from blocked and upsized complication. **Table 4**

Table 1. Baseline Demographic, Clinical and Laboratory Characteristics of Study Patients (n = 35)

Variables		Patients (n = 35)
Age (years)		66.2 $\pm$ 9.5
Gender	Male	16 (45.7%)
	Female	19 (54.3%)
Abdominal examination	Hepatomegaly	15 (42.9%)
	Splenomegaly	2 (5.7%)
	Ascites	14 (40.0%)
	Abdominal masses	18 (51.4%)
Laboratory investigation	Palpable gallbladder	21 (60.0%)
	Total bilirubin (mg/dL)	8.1 $\pm$ 2.6
	Direct bilirubin (mg/dL)	7.2 $\pm$ 2.3
	Cholecystectomy	5 (14.3%)
Previous operations	Hemicolectomy	2 (5.7%)
	ERCP	4 (11.4%)
	Rendezvous procedure	2 (5.7%)
	Whipple operation	5 (14.3%)
Previous biliary interventions	Breast surgery	3 (8.6%)
	Cholecystectomy	2 (5.7%)
	Biliary stent	2 (5.7%)
	ERCP	3 (8.6%)
Type of tumour	ERCP with biliary stent	2 (5.7%)
	Hepatobiliary anastomosis	2 (5.7%)
	Rendezvous procedure	2 (5.7%)
	Cholangiocarcinoma	10 (28.6%)
	Colorectal tumour	2 (5.7%)
	Pancreatic mass	12 (34.3%)
	Ampullary mass	3 (8.6%)
	GB mass	4 (11.4%)
	Breast cancer	4 (11.4%)

Data are presented as mean $\pm$ SD or frequency (%), ERCP; Endoscopic Retrograde Cholangiopancreatography.

Table 2. Types and Frequencies of Interventional Radiology Procedures Performed

Type of Procedure	n=35
Internal & external biliary drainage	27 (77.1%)
Internal & external biliary drainage then metallic stent	3 (8.6%)
External biliary drainage then internal & external biliary drainage	2 (5.7%)
External biliary drainage only	3 (8.6%)

Data is presented as frequency (%).

Table 3. Total Bilirubin Levels Before and 15 Days After Intervention Across Procedure Types

Procedure	Before intervention	15 days after intervention	P value
All procedures	8.1 ± 2.6	2.3 ± 0.8	< 0.001*
Internal & external biliary drainage	8.0 ± 2.5	2.1 ± 0.7	< 0.001*
Internal & external biliary drainage then metallic stent	9.0 ± 3.0	1.8 ± 0.6	< 0.001*
External biliary drainage then internal & external biliary drainage	7.5 ± 2.2	2.0 ± 0.5	0.002*
External biliary drainage only	8.3 ± 2.8	3.2 ± 1.1	0.030*

Data are presented as mean ± SD, *, significant as P value<0.005.

Table 4. Incidence of Post-Procedural Complications Among Patients

Complication	n (%)
Biliary hemorrhage	8 (22.9%)
Blocked and upsized	1 (2.9%)
Cholangitis	3 (8.6%)
Subcapsular leakage	2 (5.7%)

Data is presented as frequency (%).

Case No. 1 Figure1**Clinical Summary:**

A 64-year-old male was diagnosed with periampullary carcinoma.

Laboratory Findings:

- Initial total bilirubin: 8 mg/dL
- Follow-up after 15 days: 1.8 mg/dL

Intervention:

An internal–external biliary drainage procedure was performed.

Case No. (2) Figure2**Clinical Summary:**

A 73-year-old male was diagnosed with distal common bile duct (CBD) cholangiocarcinoma.

Laboratory Findings:

- Initial total bilirubin: 9.3 mg/dL
- Follow-up after 15 days: 2.9 mg/dL

Intervention:

A percutaneous plastic biliary stent was inserted via a left hepatic duct approach.

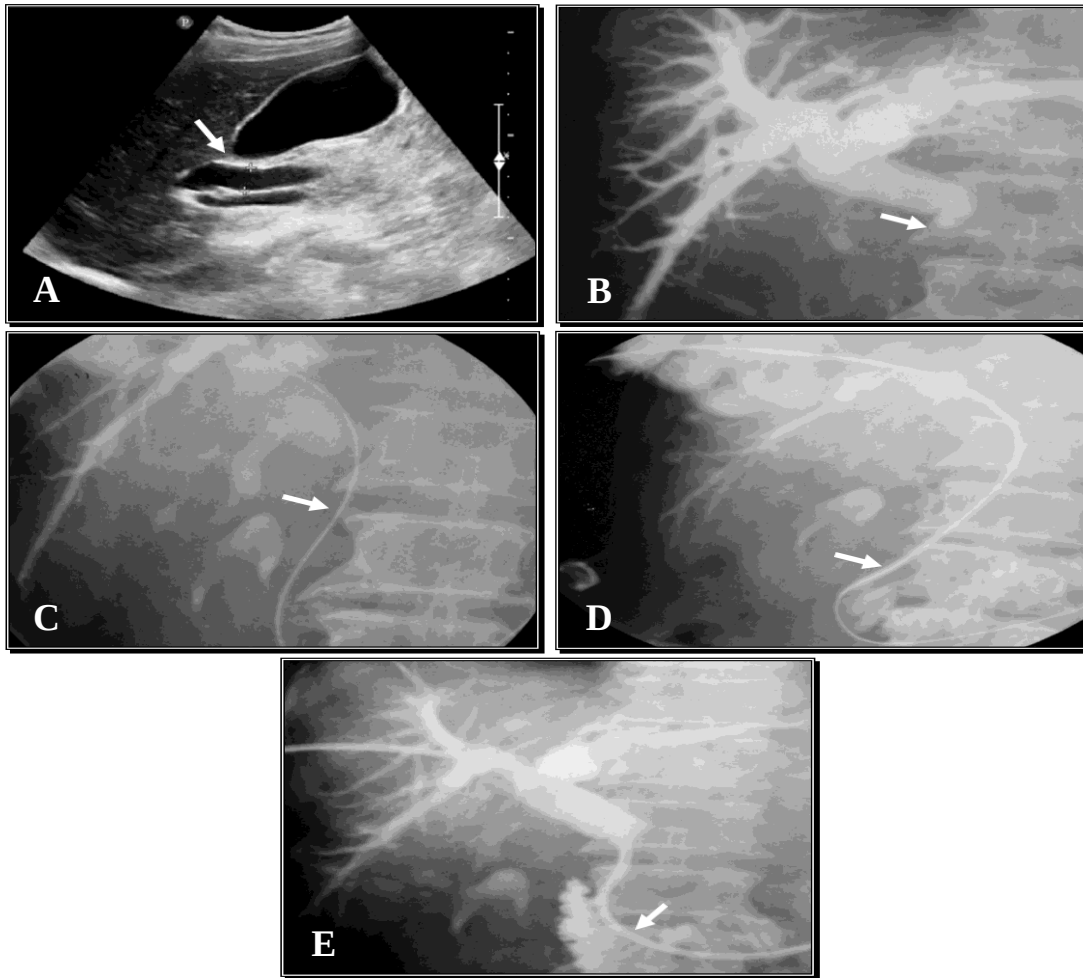


Figure (1): Percutaneous management of biliary obstruction in a 64-year-old male with periampullary carcinoma. Image (A) shows an ultrasound revealing a dilated common bile duct (CBD) measuring 11 mm (arrow), with no visible intraluminal stones or masses. In image (B), percutaneous transhepatic cholangiography (PTC) reveals dilated intrahepatic biliary radicals (IHBR) and CBD up to a tight distal stricture (arrow). Image (C) depicts successful passage of a guidewire across the stricture into the duodenum (arrow). In image (D), a catheter is advanced over the guidewire through the stricture (arrow). Image (E) shows the placement of an internal–external pigtail catheter, with free contrast drainage into the duodenum (arrow), indicating effective decompression.

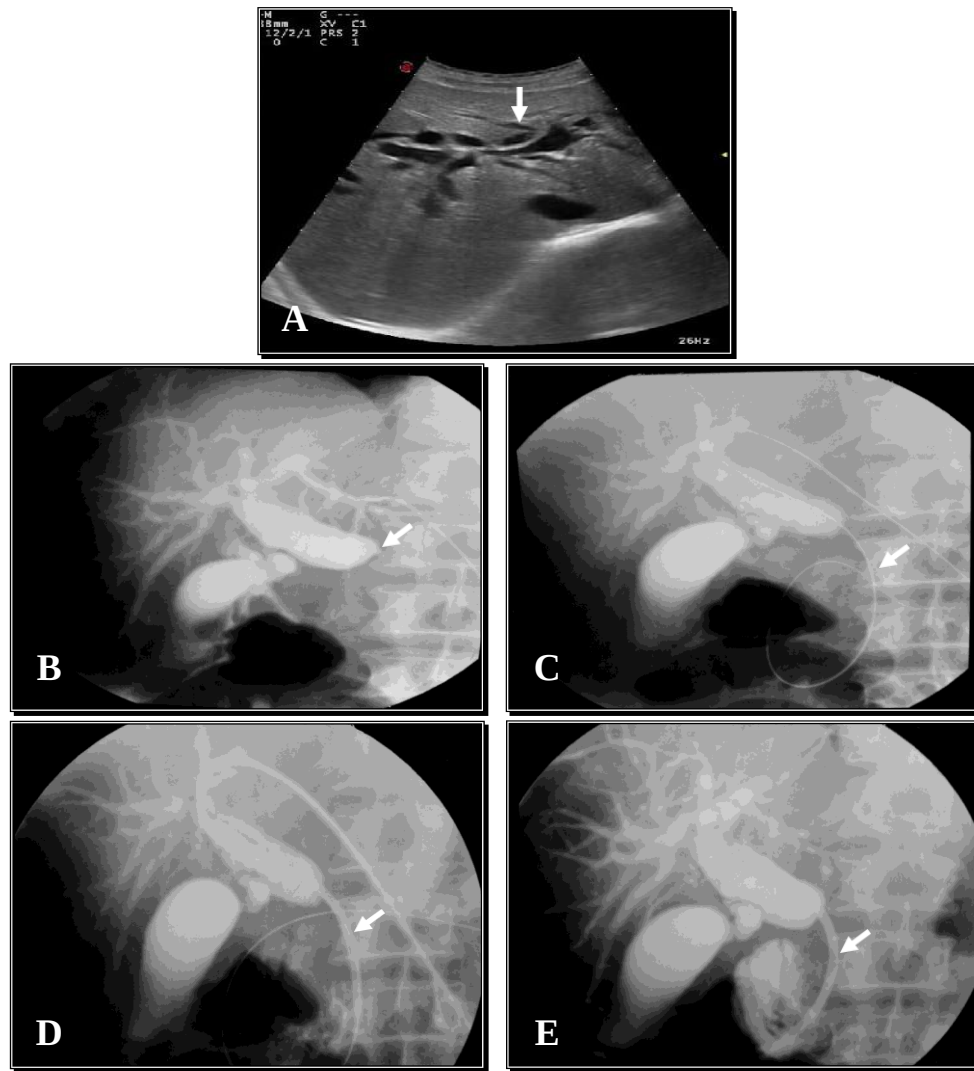


Figure (2): Percutaneous stent insertion in a 73-year-old male with distal CBD cholangiocarcinoma. Image (A) shows an ultrasound with dilated intrahepatic bile ducts, more prominent on the left side (arrow). Image (B) displays a PTC through the left hepatic duct, showing dilated IHBR and CBD up to a tight distal stricture (arrow), with no contrast flow into the duodenum. In image (C), a guidewire is seen successfully crossing the stricture into the duodenum (arrow). Image (D) shows a dilator being passed over the guidewire through the stricture (arrow). Finally, image (E) demonstrates the placement of a percutaneous plastic stent with restored contrast flow into the duodenum (arrow), confirming successful biliary drainage.

Discussion

In a systematic assessment of abdominal examination data, abdominal palpation of a palpable gallbladder was the most common physical finding, being present in 60.0 % of patients. Hepatomegaly was also found in 42.9 % of patients and is generally reported to be 40-60 % in malignant biliary obstruction literature.

Abdominal masses were detected in 51.4 % of the patients examined. The results of the current study are thus in line with previous reports that point at hepatomegaly as a characteristic of malignant biliary obstruction but stress the occurrence of nodular enlargement of the

liver in the presence of metastatic disease (9,10).

The findings of our study, which are similar to those published earlier, emphasize the diagnostic value of physical examination in malignant biliary disease. The higher rate of palpable gallbladder observed in the current study can be explained by the high rate of pancreatic masses in this group, most of which were large and allowed the formation of Courvoisier sign. Taken together, these results are indicative of the fact that a complete, methodical abdominal examination is essential in the assessment of patients suspected of having malignant biliary obstruction, as the combination of physical findings is not only beneficial in terms of increasing diagnostic precision but also in developing therapeutic strategies (11).

In the current study, the baseline bilirubin levels were 8.1 ± 2.6 mg/dL of total bilirubin and 7.2 ± 2.3 mg/dL of direct bilirubin. These results place the cohort in the bracket that is traditionally related to malignant etiology in the obstructive jaundice literature. The study of Garcea et al. was seminal in establishing that bilirubin levels above 100 μ mol/L (roughly 5.8 mg/dL) were optimal in terms of sensitivity and specificity in predicting malignancy in obstructive jaundice, with the sensitivity and specificity being 71.9 and 86.9 respectively (12). In a similar manner, Peng et al. reported that MOJ patients usually present with a median bilirubin level of approximately 160 μ mol/L (or 9.3 mg/dL) (2).

The baseline values obtained in the present study are in close agreement with these set thresholds and are particularly striking considering that the whole sample was comprised of confirmed cases of malignancy. The comparatively consistent elevation among patients implies that the bilirubin levels were a good indicator of the severity of biliary obstruction that is typical of advanced malignant disease. This explanation highlights the use of

baseline bilirubin not only as a diagnostic tool but also as a tool to determine the severity of the disease that will determine the urgency of the intervention and the method to be applied (13,14).

The tumor distribution in our study demonstrated that pancreatic masses were the most common cause at 34.3%, followed by cholangiocarcinoma followed closely at 28.6%, while gallbladder, breast, and ampullary tumors made up the rest. This pattern is somewhat similar to published epidemiological data on malignant biliary obstruction causes. Large studies often find that pancreatic adenocarcinoma and cholangiocarcinoma are the main reasons, usually making up 60-70% of malignant biliary obstructions (15).

In our analysis of the total bilirubin level of the patients, we observed significant reductions across all procedure types, with overall level diminishing from 8.1 ± 2.6 mg/dL to 2.3 ± 0.8 mg/dL at 15 days post-intervention ($p < 0.001$). Further analysis of our findings revealed that the addition of metallic stenting to the drainage procedure achieved the most dramatic reduction to 1.8 ± 0.6 mg/dL, while external drainage alone showed the least improvement to 3.2 ± 1.1 mg/dL.

Our findings mirror the previous findings of Dawoud et al., (16). which reported significant reductions in the total bilirubin level post-operation, and similar to our study the most effective procedure was drainage with metallic stenting, while external drainage was the least effective. Same results were also reported by Salim et al., (17). which reported that the lowest total bilirubin level was associated with metallic stenting (3.8 mg/ml) after 15 days of observation, while the highest was associated with percutaneous drainage (10 mg/dl). Hemobilia, sub capsular leakage, dislodgement, stent occlusion, and cholangitis were noted as the most common problems, according to the study conducted by Hazem et al. (18).

The current research has shown that metallic stenting offers better efficacy compared to external drainage systems, a fact that supports theoretical benefits like increased internal lumen caliber and reduced occlusion rates of endoluminal devices. However, some studies show similar bilirubin decreases in different drainage modalities, which suggests that the selection criteria of patients and the time of intervention can have an equal or even stronger impact on outcomes as the method itself. As a result, although all interventional procedures have the ability to normalise serum bilirubin levels, metallic stenting is more likely to result in the best biochemical control in the right clinical situations^(19,20).

The post-procedural complications were observed in 37.1 % of the patients studied. The most common was biliary hemorrhage (22.9 %), then cholangitis (8.6 %) and subcapsular leakage (5.7 %). The frequency of the occurrence of these complications is in line with the thresholds suggested by professional guidelines and comparative literature. Society of Interventional Radiology suggests that a major complication rate of 10 % and hemorrhagic complication rate of 5 % are acceptable in percutaneous biliary drainage. The hemorrhage rate in the current series is higher than these guidelines but is consistent with the range of 3-26 % reported in high-risk studies^(21,22).

The 8.6 % rate of cholangitis is also quite good in comparison to some series that report rates as high as 15 % in percutaneous drainage procedures. The low percentage of subcapsular leakage (5.7 %) implies that the technical performance and patient selection were adequate. Together, these results indicate that although percutaneous interventions are associated with certain risks, the rates in the current study are within the acceptable limits in the high-risk cases of malignant biliary obstruction, especially considering

that the procedures are palliative in nature in end-stage diseases^(23,24).

This single-center retrospective study encompasses a relatively small sample size with inherent selection bias, potentially limiting generalizability of findings across diverse patient populations and healthcare settings. Future multicenter prospective studies with standardized intervention protocols and longer follow-up periods would enhance evidence quality and establish optimal treatment algorithms for malignant obstructive jaundice management.

Conclusion

Interventional radiology modalities for MOJ significantly reduced bilirubin levels, with combined drainage and metallic stenting achieving greatest improvement. Complication rates remained acceptable, confirming IR as a safe, effective palliative for inoperable biliary obstruction.

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Author contribution

All authors made substantial, equal contributions to the conception, design, execution, and critical revision of the research. Each author participated in the drafting and final approval of the manuscript and agrees to be accountable for all aspects of the work, ensuring its integrity and accuracy.

Conflicts of interest

The authors declare no conflicts of interest. There are no personal or financial relationships that could have inappropriately influenced or biased the content of this research

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