The role of percutaneous radiological guided interventions in the management of biliary leakage

A. Elkamry[a], A. Mohallel[a], S.S. Bessa[b], S.E. Hegab[a], M.M. El Shafey[a]

[a]Radiodiagnosis and Intervention Department, Faculty of Medicine, Alexandria University, [b]Surgery Department, Faculty of Medicine, Alexandria University

Correspondence to Ahmed Mohamed Reda Fathy Elkamry, Alexandria, Sidi gaber. Tel: +01220318902; Fax: 002-03-4869754; e-mail: ahmed_alkmry@yahoo.com

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Background
Percutaneous image-guided biliary interventions is an important tool to deal with bile leaks. This prospective study was conducted from March 2021 to April 2023 aiming to clarify the role of image-guided interventions in the management of bile leaks, preventing its devastating consequences.
Patients and methods
We prospectively studied 30 patients diagnosed with bile leakage referred to our department between March 2021 to April 2023. We analyzed cause and time of bile leak presentation, percutaneous biliary drainage technique, and additional procedures when required, the technical and clinical success of the procedures, leak healing timing, and complication rates.
Results
Bile leak was suspected within a mean of 7 days (range from day 0–17 days) after the initial incident. In all patients image-guided biliary tree percutaneous access was attempted. An external biliary drain was inserted in 13 cases, 17 patients had an internal-external biliary drain crossing the leaking site. Complete leakage healing following PTBD was achieved in 20 of 30 patients (66.7%) which occurred in an average of 87 days (range 45–130 days). No major complications were encountered after the procedure.
Conclusions
PTBD is an effective, safe and feasible approach to deal with biliary leaks. It can be an alternative to tedious complex surgical attempt when ERCP is not applicable, which entails higher burden regarding patient morbidity and mortality.

Keywords:
bile leak (BL), Endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic biliary drain (PTBD), Percutaneous transhepatic cholangiogram (PTC)

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Background

Disruption of the biliary tree integrity is a devastating complication during the management of hepatobiliary pathologies [1,2]. Iatrogenic injury is by far the most common cause, mainly after cholecystectomy and panctreaticodudenectomy [3]. It initiates a vicious circle of inflammatory reactions, sepsis and subsequent morbidity and mortality [4]. ERCP when applicable should be considered the first line of management when the minor leak is encountered especially in postcholecystectomy peripheral injuries [5,6].

Surgical repair is extremely difficult in such cases because of on-going inflammation and non-healthy biliary radicles hindering adequate tissue environment for repair [7,8].

The percutaneous management plays an important established role in the management of biliary stenosis and obstruction [9,10]. However, when bile leak occurs, the biliary tree is decompressed. In the absence of peripheral intrahepatic biliary dilatation, access of the biliary tree through the percutaneous approach is technically challenging [11,12].

In large or high level bile injuries or when the anatomy is altered, ERCP is not applicable [13].

Thus the percutaneous approach is the mainstay to access the biliary tree, confirm the presence of leak and determine its origin and extent [14].

With usual accompanying morbidities of such patients, internal or external biliary diversion is essential to allow bile tree healing and to restore of its normal continuity or at least in attempt to reduce underlying ongoing inflammation and fibrosis allowing surgical repair in complex cases [15,16].

For some cases, more image-guided procedures, such as embolization that can address any persistent leak or exclude the leaking duct may be necessary [17].

In the management of such leaks, the interventional radiologists role has grown in significance [16].

Aim of the present work was to: highlight the potential role and possible outcomes of percutaneous guided interventions in patients with biliary tree leakage.

Study population

Patients who were referred to the interventional radiology unit of Alexandria University Hospitals during the study time for image-guided management of bile leaks following hepatobiliary surgeries or less commonly post-traumatic. All patients either had altered anatomy or had non-successful ERCP. Patient records were revised. All patients had pre-procedural imaging in attempt to verify the status and reports any associated drainable collections. Patients were suitable for percutaneous access if they had the following criteria; (i) clinical picture suggesting bile leak, based on bile drainage from the surgical wound or drains and/or radiological evidence of fluid collections suggesting biloma formation, (ii) associated signs of fever, elevated white blood count, and (iii) degradation in blood chemistry (cholestasis markers and liver function tests).

Methods

This study was conducted prospectively from March 2021 to April 2023 aiming for evaluating the role percutaneous biliary interventions in the management of the biliary leakage. This study was approved by our University ethics committee, and consents were obtained from all the patients.

Image-guided management protocol

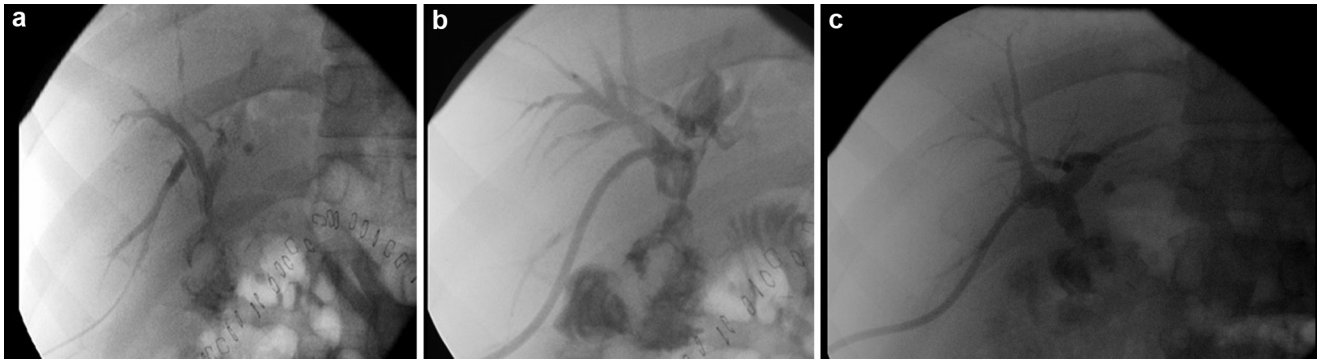
All patients enrolled in the study received conscious sedation and a local anesthesia was administered to the access site till the hepatic capsule before the puncture. The procedure protocol was carried out using a standard right-sided biliary approach, puncturing right-sided central bile duct under ultrasonographic guidance. Alternatively, a direct peripheral biliary radicle attempted if any accessible one was observed. In some tough clinical scenarios ultrasonography guidance was used, especially in the left approach. Afterwards, percutaneous transhepatic cholangiogram (PTC) was done. An external-internal percutaneous transhepatic biliary catheter (PTBC) of adequate caliber (10–12F) was attempted in all cases to cross the leakage site, if nonsuccessful external biliary drain was inserted, its tip just proximal to the site of the leak to allow complete diversion of the bile to allow its healing (Fig. 1b).

The patient condition was checked every 2 weeks and the amount of bile was revised, the catheter may be exchanged to reduce the risk of occlusion or superadded infection under antibiotic coverage. Catheter caliber upgrade to 12F or 14F if a larger gauge was thought essential for the healing of the leak.

In case of persistent leakage from peripheral biliary duct, embolization was done through the percutaneous established access either by coils or histoacryl or a mixture between them.

After each procedure, prophylaxis with short-term systemic antibiotics was used.

Figure 1



(a) PTBC revealed lateral leakage at the site of bilioenteric anastomosis. (b) Completion cholangiogram revealed external biliary drain just proximal to the leakage site. (c) PTBD cholangiogram showed complete resolution of the leakage.

The biliary catheter was removed after ensuring complete healing of the leak (Fig. 2b). Complete resolution was considered when patients had been asymptomatic with normal liver function tests for the last 14 days with a cholangiogram confirming the resolution of leakage. Stenting was considered in patients who showed the persistent high output of bile from the surgical drain despite drainage. Removable covered stents were deployed. The follow-up consisted of regular clinical assessment every 2 months following the catheter removal.

Outcome measures

Technical success was defined as the successful insertion of the catheter within the biliary tree either internal-external or external only.

Clinical success was defined as complete absence of bile discharge from any surgical drain or wound with disappearance of presenting symptoms, along with a cholangiogram ensuring the resolution of leakage (Fig. 1c, Fig. 3c).

Follow up was done by the referring surgeons. For the purposes of the outcomes of the study, medical records were revised and direct contact with the patients was done.

Results

This prospective study was conducted on 30 patients (17 females, 13 males) whose age ranged from 16 to 67 years (with a mean age of 48 years). During the study period, a total of 30 patients was diagnosed with bile leaks. Patient characteristics are summarized in Table 1.

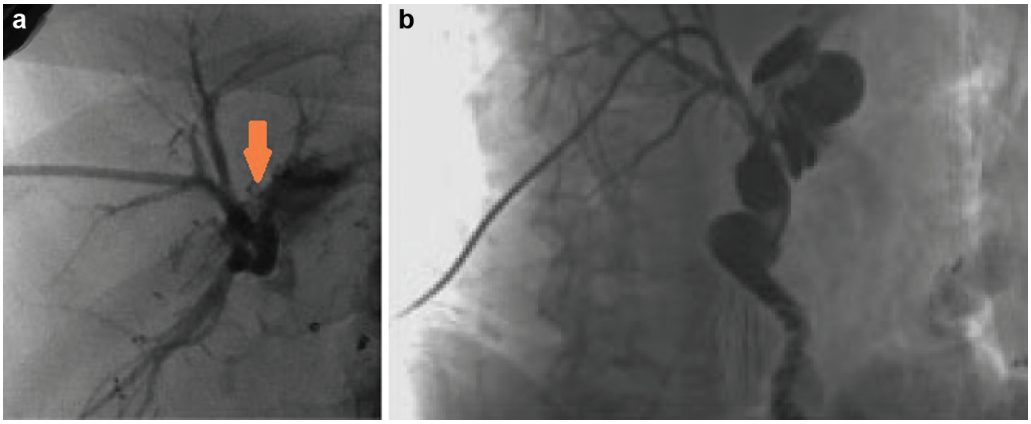
Iatrogenic injury is by far the most common cause of bile leak, seventeen patients were presented after cholecystectomy which represents about 56.7%, ten patients demonstrate biliary leakage after pancreaticoduodenectomy (30%) (Fig. 2) while one patient had biliary leak during balloon dilatation during percutaneous stenting for malignant obstructive jaundice for metastatic moderately differentiated pancreatic adenocarcinoma. Two patients presented with biliary leakage after road traffic accident showed grade III hepatic injury (Table 1).

Fifteen out of seventeen patients presented after laparoscopic cholecystectomy while the remaining cases had an open approach.

Diagnosis of bile leakage was based on drainage of bile from the surgical drains and wounds in 16 (53.3%) patients and on postoperative imaging showed fluid collections in 14 (46.6%) patients. No intrahepatic biliary dilatation was found in 27 (90%) patients because of continuous decompression of the biliary system. In this study, the biliary drain was successfully inserted in all patients (technical success of 100%). The overall clinical success rate of percutaneous treatment was 20/30 (66.7%) (Fig. 1), and failure was reported in 10 (33.3%) patients (Table 2).

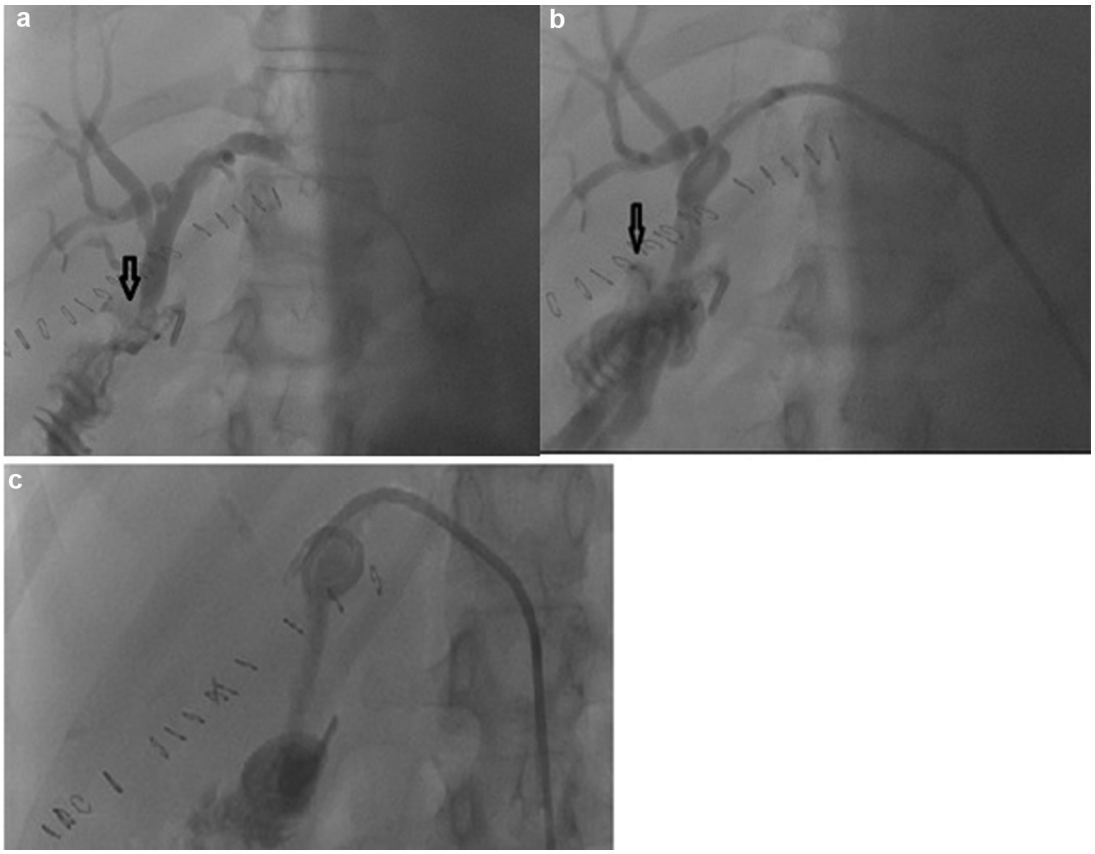
Among these 10 patients, 7 (23.3%) required surgical intervention for anastomosis revision, and 3 (10%) died before the resolution of leak. The mean (range) time from biliary catheter placement to leak resolution was 87 (45–130) days. Multiple sessions and interventions were required in 24 (80%) patients. Stenting was done

Figure 2



(a) Cholangiogram revealed a large distal common bile duct leak is seen at the biliary-enteric anastomosis (orange arrow). (b) PTBD cholangiogram revealed complete resolution of the leakage.

Figure 3



(a) Left Sided PTBC revealed lateral leakage (open arrow) at the site of choledochoenteric anastomosis post pancreaticodudoenectomy. (b) Completion cholangiogram revealed external biliary drain just proximal to the leakage site (open arrow). (c) PTBD cholangiogram showed complete resolution of the leakage.

Table 1 Demographic cause of leak, and site of leak of enrolled in the study

Patient characteristics	Number (%)
Sex	
Male /female	13 (43.3%)/17 (57.7%)
Cause of leak	
Postcholecystectomy	17 (56.6%)
Postwhipple	10 (30%)
Post-traumatic	2 (6.6%)
During PTD	1 (3.3%)
Site of leakage	
Common bile duct	9 (30%)
Choledochojejunal anastomosis	10 (33.3%)
Peripheral biliary radicle	4(13.3%)
Cystic duct remnant	7 (23.3%)

in one (3%) patient, after 6 days due to persistent high output of leak from the surgical drain with on-going noncontrolled sepsis. unfortunately the patient passed away despite adequate positioning and deployment due to severe sepsis and multiorgan failure. Embolization of the leaking was done in 4 (13.3%) patients with complete technical and clinical success.

Table 2 Patients outcome after biliary intervention

Outcome	Number (%)
Leakage resolution without recurrence or residual stricture	20 (66.6%)
Surgical intervention	7 (23.3)%
Sepsis and death	3 (10%)

In our study, no major complications were encountered. Minor complications occurred in four (13.3%) patients. Hemobilia was observed in one (3%) patient which settled within two days with no need to blood transfusion. There were three (10%) cases of severe postintervention pain in the puncture sites. They were successfully controlled by analgesics.

Discussion

Bile leak is one of the fearful complications during the management of hepatobiliary diseases, not only because of associated morbidities but it also degrades the patient's quality of life regarding the need for repetitive investigations as well as long journey during the attempt to deal with such incident [18].

High index of suspicion should be raised when dealing with any nonspecific symptoms after hepatobiliary surgeries especially when the laparoscopic approach is used [19,20].

Due to the widespread introduction of laparoscopic approach, the incidence of bile leak was significantly increased from 0.1% to 1–3% since the introduction of laparoscopic cholecystectomy as reported by *BV. MacFadyen et a1*. [21] *& DR. Flum et a1*. [22].

In the current study, 56.67% developed bile leak after cholecystectomy about 82.3% of them following laparoscopic approach.

In the present work, 30% of patients presented after pancreaticoduodenectomy. This was in concert with *E. A. de Jong et al*. [23] who reported similar incidence of bile leakage during his study. *A.C. Henry et al*. [24] reported 2% incidence of bile leakage from hepaticojejunostomy after duodenopancreatectomy.

In the current study bile leak was diagnosed based on bile discharge from the surgical wound or drain and nonspecific postoperative symptoms warrant imaging revealed collections which revealed biliary nature upon aspiration. The following presentations were comparable to those recorded by *Oliva et al*. [25] *& Van Sonnenberg et al*. [26] who found that non-specific abdominal complaints, as well as biliary discharge from the surgical wound and drains was the initial clinical presentation of patients who had bile leaks.

In the current study, intrahepatic biliary dilatation was absent in 90% of cases. The absence of intrahepatic biliary dilatation added to the technical difficulty of such intervention as intrahepatic biliary dilatation is the mainstay of its percutaneous access.

In the current study technical success was achieved in all cases with successfully placing the biliary drain through the percutaneous access. This results were similar to that of F. Pedersoli *et al*. [27] and V. Pedicini *et al*. [28] who reported high technical success rate of PTBD in biliary leak despite the presence of nondilated decompressed biliary tree and rectify that a nondilated biliary system is no longer recognized as a contraindication for the percutaneous approach.

The clinical success rate of this study was 66.7%. Different studies showed more or less parallel results, reporting clinical success about 70 to 89, however, study by Mansueto *et al*. [29]. reported higher clinical success reaching 96%. The main causes of clinical failure in this study were the severe and complex condition of these patients, three patients dying from on-going noncontrolled sepsis and seven patients requiring surgical revision of the anastomotic site. Advancing stent technology can improve this number especially anastomotic stricture. More recent study with 157 patients, Poppet *et al*. [30] reported lower clinical success rate of 40%, mostly due to early surgical correction considered in such patients with associated co-morbidities.

In this study, we found that most of the studied patients needed additional interventions due to long time of the management journey and the need to explore various management options to deal with ongoing or persistent bile leak. Additional interventions were needed in about 80% of cases. Drain exchange with catheter size upgrading was the most common cause of additional interventions in 66.6% of the patients. Gwon *et al*. [31], G. Cozzi *et al*. [32] also reported the need for frequent catheter exchanges and size upgrading throughout the time of PTBD insertion.

Considering the time of indwelling catheter, the results of this study showed wide range from 21 to 731 days about 105 days in mean, this finding is attributed to the long lengthy time taken by the biliary tree to restore its exclusive continuity without any residual leak or stenosis.

This long time was in concert with *C. Mastier et al*. [33], *Kim et al*. [34], *Civelli et al*. [32] *& U. Stampfl et al*. [35] who reported similar long time, these results were in contrast with *K. May et al*. [36] *& B. Popat et al*. [30] who reported shorter time of indwelling catheter less than two months in mean which is attributed to the inclusion of post hepaticojejunal anastomosis leak only and lower threshold for surgical repair attempt respectively.

Regarding the procedure-related complications, the current study showed no major adverse effects. In our study, two cases reported hemobilia associated with the PTBD puncture site, which were successfully treated by conservative measures and did not warrant blood transfusion. These findings were in parallel with *Righi et al*. [37] who reported no significant complications in twenty-two patients who underwent percutaneous biliary drainage for biliary leakage after hepaticojejunostomy.

This study also showed that direct embolization was also effective and ensuring a speedy recovery. This is in agreement with *W. Saad et al.* [38] who suggested that bile leak embolscleorsis reduce the indwelling catheter time required to control the leak and therefore reduce morbidity. Similarly, in their systematic review on percutaneous embolization of bile leaks *Schmitz et al.* [17] reported that embolization was successful without strong preference for any embolic agent.

Conclusions

Bile leakage is a devastating complication especially when the complex or high injury occurs. The introduction of laparoscopic approach significantly increases its incidence due to the narrow vision field. High index of suspicion is indicated for early detection and timely intervention.

Despite treating biliary leaks remains a technical challenge in interventional radiology, high technical success rate can still be achieved. Recent advances like embolization and stenting can ensure speedy and complete recovery.

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Nil.

Conflicts of interest

No conflict of interest was reported by the authors

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