

Research Article

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X-ray Surgery for Iatrogenic Bile Duct Injury After Laparoscopic Cholecystectomy (Single Center Experience)

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AIM OF STUDY To show the possibilities of antegrade X-ray surgical techniques in the treatment of iatrogenic bile duct injuries after videolaparoscopic cholecystectomy.

MATERIAL AND METHODS The study included 24 patients with "minor" and 20 patients with "major" (according to Strasberg) iatrogenic injuries of the extrahepatic biliary tract. Antegrade endobiliary intervention was performed in 26 patients, including the "bridge-procedure" variant preceding the reconstructive surgery. Endobiliary drains were maintained during the reconstructive surgery and in the early postoperative period to control the viability of the anastomosis. When a stricture of the biliodigestive anastomosis (BDA) was detected, balloon dilatation of the anastomotic area was performed. In the subgroup of "minor" injuries, external drainage of the subhepatic biloma in 18 people were supplemented with endoscopic papillotomy in 12 cases.

RESULTS In all patients with "minor" injuries of the biliary tree, X-ray surgical techniques were effective. In 11 patients with "major" bile duct injuries, cholangiostomy drainage was gradually transformed into external-internal drainage. In 2 trauma cases of classes D and E temporary antegrade stenting of the duct injury area with a coated self-expanding endobiliary stent was performed. The follow-up period after removal of the antegrade frame drainage ranged from 8 months to 14 years. There were no stricture or failure of BDA.

CONCLUSION Short-term external biliary drainage, including the use of rendezvous techniques, may be sufficient to eliminate the failure of the cystic duct stump. Cholangiostomy drainage, temporary endobiliary stent allow preparing the patient for reconstructive intervention. Drainage marking of the damaged area facilitates the verification of tubular structures in the reconstruction area. Preservation of drainage after reconstructive intervention is the prevention of failure of the biliodigestive anastomosis in the early postoperative period, the development of its stricture in the long term.

Keywords: iatrogenic injury, bile ducts, cholangiostomy drainage, antegrade endobiliary drainage, biliodigestive anastomosis

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BDA – biliodigestive anastomosis
EPST – endoscopic papillosphincterotomy
LC – laparoscopic cholecystectomy
MDP – major duodenal papilla
PTC – percutaneous transhepatic cholangiostomy
RPCG – retrograde cholangiopancreatography

INTRODUCTION

Intraoperative injuries of the biliary tract during laparoscopic cholecystectomy (LC) occur with a frequency of 0.4–0.6% [1, 2]. Therefore, it remains relevant to conduct international studies aimed at identifying the most important predisposing factors for possible damage to the biliary tract during surgery and its prevention [3]. However, a systematic review of 90 studies on the prevention of intraoperative biliary injury, including data from 203 368 patients worldwide as of June 2018, found that, despite the promising methods discussed in the papers to prevent damage to the biliary tree, studies lack the necessary power for a reliable conclusion about the effectiveness of prevention methods.

It is concluded that it is necessary, but extremely difficult, to conduct a multicenter study of a large volume with a high level of evidence to formulate reasonable ways to prevent intraoperative bile duct injury, in addition, obviously, there remains a serious problem in determining the true incidence of iatrogenic biliary injury [4].

Surgical repair of the biliary tree in its iatrogenic damage is a common practice and depends on the severity of the anatomical damage to the bile ducts, the duration of the injury, as well as the experience and individual preferences of the surgeon. Reconstructive intervention involves the formation of a biliodigestive anastomosis (BDA) in the diagnosis of "major" (classes B-E according to Strasberg) damage to the extrahepatic biliary tree both intraoperatively and in the early postoperative period (up to 5 days) [5].

In case of late (more than 5 days) diagnosis of a "major" injury to the bile ducts, it is advisable to postpone the application of BDA for several weeks [6]. In addition, when an injury to the biliary tract is detected in the postoperative period, radiological tactics are considered reasonable, assuming the first stage of transhepatic X-ray surgical or retrograde endoscopic drainage of the biliary tree, associated according to indications with endoscopic or X-ray surgical correction of iatrogenic pathology, including the use of rendezvous techniques [7, 8].

At the same time, as a rule, the rendezvous methods are illustrated by a limited number of observations and are more often presented in the form of case reports, albeit with very interesting suggestions, for example, how to use fully covered self-expanding metal stents to restore the continuity of a partially excised common bile duct [9].

Thus, despite the large number of studies devoted to various aspects of intraoperative biliary injury, the problem of a non-discriminatory interdisciplinary approach to the treatment of this pathology remains relevant.

MATERIAL AND METHODS

In 2005–2020 under observation were 24 patients with "minor" (class A) and 20 patients with "major" (classes B-E) iatrogenic injuries of the extrahepatic bile ducts, who underwent staged antegrade X-ray surgical intervention on the bile ducts, including the bridge procedure, which preceded the reconstructive surgical aid – BDA and hepatico (bihepatico) jejunostomy on the R-loop of the small intestine (Fig. 1 a–d) (Table 1).

In all cases, primary external drainage of the biliary tree was performed urgently or under combined sono-fluoroscopic control with drain No. 8 Fr according to Seldinger, including 17 patients with non-dilated bile ducts in combination with external biliary fistula.

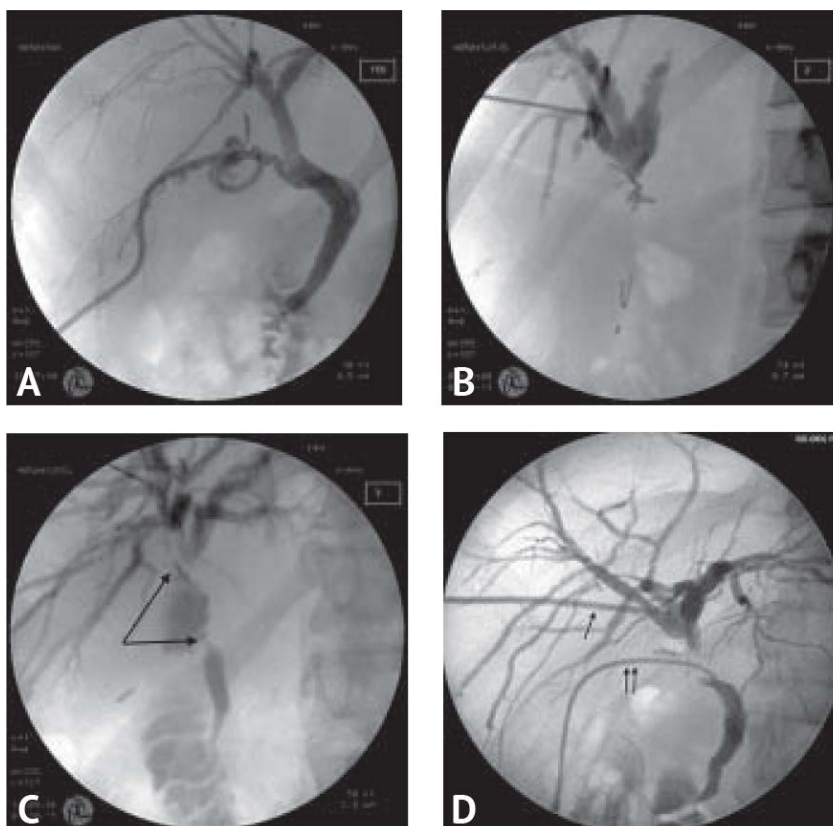


Fig. 1. A — condition after percutaneous drainage of subhepatic biloma after laparoscopic cholecystectomy. Fistulography through drainage with shape memory — failure of the cystic duct stump (“minor” injury, Strasberg class A); B — percutaneous transhepatic cholangiography — partial clipping of the bile tree (“major” lesion, Strasberg class B); C — percutaneous transhepatic cholangiography — lateral injury to the common hepatic and bile duct (arrows) (“major” injury, Strasberg class D); D — percutaneous transhepatic cholangiography through percutaneous cholangiostomy (single arrow) and intraoperative drainage (double arrow) — excision of the common hepatic duct (“major” lesion, Strasberg class E)

Table 1

X-ray surgical treatment and diagnostic tactics in patients with iatrogenic bile tree injury

No.	Trauma class	Treatment and diagnostic tactics	Result
1	A (n=24)	External drainage of the subhepatic biloma	6
		External drainage of the subhepatic biloma + EPST	12
		PTC	4
		PTC + antegrade balloon dilatation MDP	2
2	B (n=6)	PTC + BDA	2
		PTC + external-internal drainage	2*
		PTC + external-internal drainage + BDA	2
3	D (n=3)	PTC + external-internal drainage + BDA	2
		PTC + external-internal drainage + temporary self-expanding covered endobiliary stent + BDA	1
4	E (n=11)	PTC + BDA	7
		PTC + external-internal drainage + BDA	3
		PTCS + external-internal drainage + temporary self-expanding covered endobiliary stent + BDA	1
	Bcero		44

Notes: * — 2 patients with B-class injury were sanitized by X-ray surgery and did not require BDA. BDA — biliodigestive anastomosis; MDP — major duodenal papilla; RCPG — retrograde cholangiopancreatography; PTC — percutaneous transhepatic cholangiostomy; EPST — endoscopic papillosphincterotomy

The criteria for inclusion of patients in a prospective study were:

1. Clinical and instrumental manifestations of obstructive jaundice in the early postoperative period after LC and (or) the presence of an external biliary fistula with the impossibility or lack of information of retrograde cholangiopancreatography (RCPHG).
2. Identification by RCPG or magnetic resonance cholangiography (MR cholangiography) of signs of "major" (classes B-E) damage to the bile ducts.
3. The presence of subhepatic biloma according to the results of postoperative ultrasound screening of the abdominal cavity and targeted diagnostic puncture of fluid accumulation.

The sonographic state of the intrahepatic biliary tree (presence or absence of dilatation) was not used as a limiting criterion.

The study did not include cases of external biliary fistula after LS with informative data from RCPG, which allowed us to confidently identify the failure of the cystic duct stump, in combination with adequate endoscopic elimination of the diagnosed pathology of the distal common bile duct (EPST, lithoextraction), as well as widespread biliary peritonitis.

The subgroup of "minor lesions" (class A according to Strasberg) consisted of 24 patients with a biloma of gallbladder bed (18 cases) or external bile leakage through the guard drainage (6 cases). In 18 patients, the subhepatic gallbladder bed was drained with pig tail drain 8 Fr under ultrasound guidance according to the Seldinger method. At the same time, in 6 patients, external drainage of the biloma became the final method of treatment, and in 12 cases, fistulography revealed choledocholithiasis with stenosis of the MDP, which required endoscopic intervention.

In 6 cases of postoperative external biliary fistula, in case of impossibility of retrograde endoscopic access or non-informative RCPG, percutaneous transhepatic cholangiostolium (PTS) was performed on non-dilated bile ducts. In 4 patients, such drainage proved to be the definitive treatment for external biliary fistula. Another 2 patients underwent antegrade balloon dilatation of the MDP with dislocation of the choledochal calculus into the duodenum (Fig. 2 a, b).

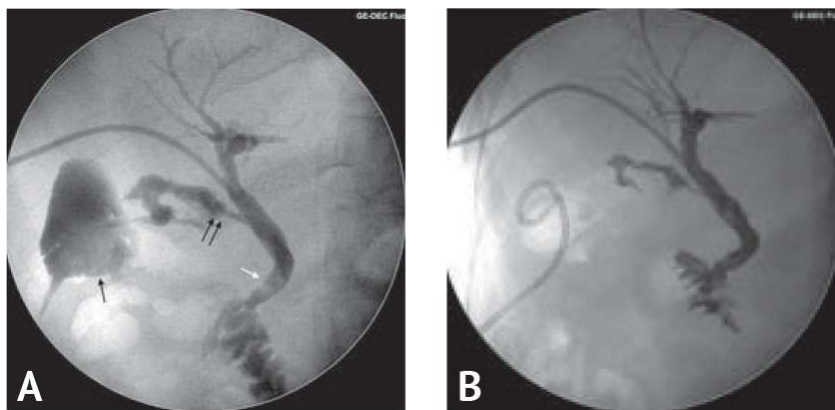


Fig. 2. A — percutaneous transhepatic cholangiography through a percutaneous cholangiostoma — subhepatic biloma (single black arrow) against the background of cystic duct stump failure (double black arrow) due to unrepaired choledocholithiasis (white arrow); B — the same observation. Lack of contrasting subhepatic biloma after the resolution of choledocholithiasis

In the subgroup of patients with "major" lesions (classes B-E according to Strasberg), 18 patients were operated in a staged manner after percutaneous X-ray surgery. In 3 cases, a "major" lesion of the biliary tree was diagnosed within 5 days, and these patients were operated on urgently, within a day from the moment of PTC and the final radiation verification of the nature of the damage — a hepatico(bihepatico) jejunooanastomosis was formed. In 15 cases, patients were admitted to the surgical department of the KRCH from other medical organizations later than 5 days after the trauma of the biliary tree. These patients were operated on in a planned manner after the minimally invasive antegrade stage of bile outflow correction ? after 3–6 months.

In all 18 patients with "large" bile duct injuries, preoperatively installed endobiliary drains were preserved perioperatively to monitor and correct BDA, as well as after the patient was discharged from the hospital for up to 6 months, if correction of the patency of the formed anastomosis was necessary.

Postoperative BDA revision was performed using a 5 Fr balloon catheter with a balloon diameter of 8 mm at a target pressure of 1–1.5 atm. When the balloon waist appeared, the anastomotic zone was dilated until it disappeared at a pressure of 4–5 atm and an exposure time of 5 minutes.

RESULTS

In all 24 patients with “small” injuries of the biliary tree, the used X-ray surgical techniques were effective either in the solo version or in combination with endoscopic rendezvous techniques. The applied isolated percutaneous drainage of the subhepatic biloma (6 patients) and bile ducts (2 patients) was effective in 8 cases. In 2 more cases, PTC was combined with antegrade dilatation of the MDP and dislocation of the calculus into the duodenum. Thus, in 10 patients (41.7%) out of 24, the use of temporary external biliary drainage or its combination with non-destructive intervention on the BDA proved to be minimally sufficient to eliminate “small” bile duct injuries.

In 6 patients (50.0%) out of 12 after EPST, a clinical picture of acute post-procedure pancreatitis developed, which required conservative therapy. Antegrade balloon dilatation of MDP in 1 case (patient) was accompanied by transient amylasemia without clinical manifestations of acute pancreatitis. Percutaneous transhepatic drainage of subhepatic bilomas in 10 patients out of 18, and extraparenchymal drainage via subhepatic access was performed in 8 patients without complications.

In 11 out of 20 patients with “major” bile duct injuries, primary PTS was gradually transformed into one of the variants of external-internal bile diversion, including its partial excision in 4 cases (class E). In 2 cases of patients with class injury D and E temporary antegrade stenting of the partially excised right lobular duct and confluence zone with a covered self-expanding endobiliary stent was successfully performed, which was retained for 6 months after manipulation and removed intraoperatively during reconstructive surgery (Fig. 3, 4 a–c).



Fig. 3. Temporary endobiliary stenting of the right lobar and common hepatic duct with a covered self-expanding stent (black arrow) and external drainage of the left lobar duct (white arrow). “Major” damage, Strasberg class D

In addition, in 2 cases of observation in class B injury, it was possible to restore the patency of the common hepatic duct by percutaneous balloon dilatation without subsequent reconstructive surgery.

Of the 20 patients with “major” injuries of the bile ducts, 18 were operated on in a staged manner after antegrade X-ray surgery. They underwent hepaticojejunostomy (in 2 cases (died?) - bighepaticojejunostomy) with temporary preservation of preoperatively installed drains. There was no BDA failure in the early postoperative period. After removal of transhepatic drainage patients were followed up from 8 months to 14 years. None of the 18 patients during this period were found to have BDA strictures. At the same time, the average follow-up period was 68 months (5.7 years), and the median was 49 months (4.1 years).

There was no hospital mortality in the observed patients.

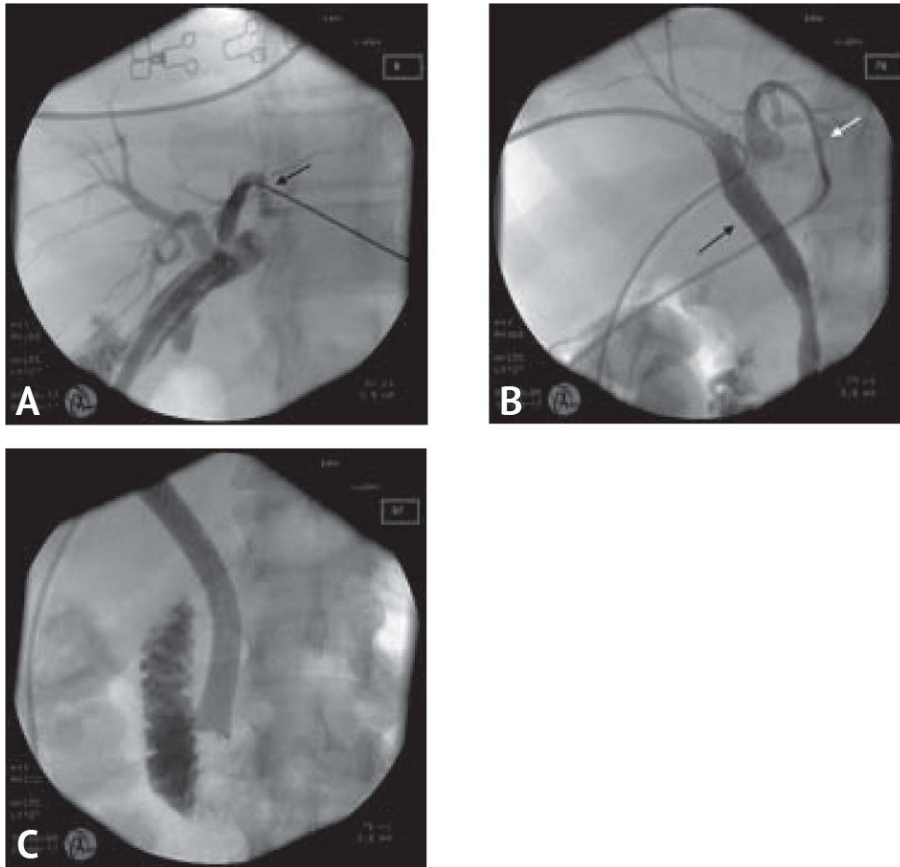


Fig. 4. A — antegrade cholangiography through the left lobar duct (arrow) on the background of iatrogenic excision of hepatic duct confluence. “Major” damage, class E according to Strasberg; B — the same observation. Temporary endobiliary stenting of the right lobar duct with a covered self-expanding stent (black arrow) and external drainage of the left lobar duct (white arrow); C — the same observation. The endobiliary stent is placed in the suprapapillary position

DISCUSSION

Postoperative bile leakage after cholecystectomy is most often caused by failure of the cystic duct stump and open Luschka’s ducts. These causes are traditionally treated as “minor” bile duct injury (Strasberg class A). In this case, bile leakage may be limited to the gallbladder bed or subhepatic space, less often to the free abdominal cavity and (or) leakage of bile through the insuring drainage.

Postoperative accumulation of fluid in the gallbladder bed may not be accompanied by clinical manifestations and be detected during postoperative radiation screening, while it is not possible to reliably determine the nature of the exudate only by visual characteristics. As a rule, the nature of the exudation is determined according to the data of the targeted diagnostic puncture of the fluid accumulation zone.

External bile leakage along the safety drainage is the most alarming symptom of trouble in the postoperative period and indicates leakage of the bile ducts. External bile leakage in the early postoperative period requires immediate radical revision of the bile ducts (MRI cholangiography, direct cholangiography with retrograde or antegrade access), since the allowable time for early reconstruction of “large” biliary iatrogenic trauma is limited to 5 days from the moment of damage.

Limited exudation in the gallbladder bed and (or) subhepatic space, regardless of the clinical equivalent, suggests a fine-needle diagnostic puncture, and if bile accumulation is detected, regardless of its volume, small-caliber percutaneous drainage is advisable. It should be borne in mind that post-drainage fistulography from the biloma cavity does not guarantee contrasting of the cystic duct, and even more Luschka’s ducts and other rare variants of “small” bile duct injuries.

“Small” injuries of the bile ducts are usually not associated with fatal complications and are managed by minimally invasive methods that are aimed at adequate biliary decompression, elimination of its cause and sealing of the bile leakage zone. Extraductal bile evasion in the postoperative period is determined primarily by excess pressure in the bile ducts of an organic or transient nature, and then by the break of the ductal system.

In addition to organic disorders of bile duct patency (stenosis, calculus) that have not been eliminated before and during surgery, transient biliary hypertension may be associated with transient functional changes in bile dynamics after the loss of the compensating function of the gallbladder and associated disorders in the coordinated activity of the sphincters of the biliary tract [10].

Biliary decompression is achieved by papillotomy, lithoextraction, as well as nasobiliary drainage or retrograde stenting of the common bile duct [11]. To close the zone of bile leakage, in addition to relaparoscopy and coagulation or clipping, adhesive compositions and embolization coils are used.

Bearing in mind that assuming the possibility of temporary functional biliary hypertension after cholecystectomy, in about half of the patients, short-term external drainage of the biloma is sufficient to close the postoperative biliary fistula, even without concomitant endoscopic papillotomy. In patients with persistent bile leakage through drainage from the subhepatic biloma, there are organic causes of biliary hypertension (residual choledocholithiasis, stenosis of the MDP, parapapillary diverticulum, etc.), which requires elimination of its cause.

Against the background of a functioning external biliary fistula, when retrograde endoscopic access to the biliary tree is impossible, cholangiostomy is associated with technical difficulties due to the absence of expansion of the biliary tree and requires some experience [12–14].

Antegrade biliary access in such cases has certain advantages. First, cholangiostomy is better than nasobiliary drainage in controlling biliary decompression, which effectiveness seems to be a decisive factor in the closure of the external biliary fistula. Secondly, antegrade access is polymodal in the choice of therapeutic manipulations. Thirdly, the antegrade approach gives the surgeon the freedom to choose between destructive and non-destructive manipulations on the MDP, so its antegrade dilatation with dislocation of the calculus into the duodenum is possible.

If a postoperative external bile fistula against the background of cystic duct incompetence functions without obvious organic obstruction of MDP according to cholangiography, a short-term external biliary drainage may be enough to manage the failure of cystic duct stump. Usually the duration of such drainage is 3–5 days, and the daily debit of bile through the cholangiostomy does not exceed 300 ml.

If the cystic duct is contrasted according to the data of antegrade transhepatic cholangiography, and if there is an external discharge of bile through the fistula, minimally invasive interventions on the MDP are appropriate.

First stage in the treatment of “large” iatrogenic damage to the bile ducts seems to be bile excretion by transhepatic access, regardless of the duration of the iatrogenic damage to the bile tree. At the same time, external, external-internal drainage, temporary, coated self-expanding endobiliary stent allows you to choose and implement the optimal variant of transient bile duct for a particular patient and prepare the patient for reconstructive intervention. Drainage marking of the damaged area not only facilitates the verification of tubular structures in the area of reconstruction, but also prevents the failure of the subsequent BDA in the perioperative period and its stricture in the long-term period, especially since it is during the reconstruction of biliary iatrogeny that the risk of developing BDA stricture is maximum and is up to 30% [15].

The current strategy of biliary reconstruction does not involve the use of transhepatic replaceable drains, but in the situation under discussion, the frame function of the preoperatively installed biliary drain seems to be an additional bonus within the pragmatic tactics of external or external-internal biliary drainage in the staged treatment of patients with “large” iatrogenic lesions of the biliary tree. Perioperatively preserved primary percutaneous transhepatic biliary drainage provides antegrade access to the BDA zone for an objective assessment of the patency of the created anastomosis during its balloon revision both in the early postoperative period and in a delayed period. In this case, the diameter of the BDA is usually about 8 mm, so a standard 8 mm balloon in its zone should expand without forming a waist, or the waist of the balloon should be inconspicuous and disappear by 1–1.5 atm. In the case of the formation of a BDA stricture, its staged balloon plasty is indicated with an interval of 2–3 months until a stable patency is achieved.

The relatively small experience cited is largely descriptive in nature and does not allow formulating conceptual recommendations within the framework of the pathology under discussion, particularly because the number of such patients within the regional, as well as the federal center, a priori cannot be large enough for serious generalizations. But the seriousness of the problem of iatrogenic injury of the biliary tree makes one pay attention even to the descriptions of individual observations of the successful correction of such a pathology.

CONCLUSION

The encouraging results of the use of minimally invasive X-ray surgical interventions in the staged treatment of iatrogenic lesions of the biliary tree determine the expediency of having non-vascular interventional radiology techniques in the arsenal of a clinic dealing with such pathology.

Regardless of the period of detection of biliary tract injury in the postoperative period, a staged tactic of radiological treatment is pragmatically preferable, involving drainage of the subhepatic biloma and (or) biliary tree, combined with endoscopic or X-ray surgical correction of iatrogenic pathology according to indications. The use of preoperatively installed endobiliary drains in patients with “large” iatrogenic lesions of the biliary tree in the early and late postoperative periods of surgical reconstructive interventions provides an opportunity both for the prevention of failure of the biliodigestive anastomosis in the early postoperative period, and objective monitoring, timely detection and adequate correction its stenotic lesion in the distant.

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