

# Management of Post Endoscopic Retrograde Cholangio-Pancreatography (ERCP) Duodenal Perforation, Experience of a University Hospital

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**Background:** Duodenal perforation is an uncommon complication of endoscopic retrograde cholangio-pancreatography (ERCP). Most cases are minor perforations that can be managed with conservative management. A few cases may result in life-threatening retroperitoneal collection and necrosis requiring surgical intervention. There is a relative paucity of references specifically describing the surgical interventions required for this eventuality.

**Methods:** Ten cases of post-ERCP duodenal perforation were referred to our department at Ain Shams university Hospital between 2015 and 2019. Clinical features of our cases were analyzed, and the management plan was tailored to each case after discussion in multidisciplinary team (MDT) and review of the latest available literatures.

**Results:** Seven patients recovered with conservative management. Three patients needed surgical intervention. All patients were successfully discharged home. There were no mortalities.

**Conclusions:** Post-ERCP duodenal perforation is an uncommon complication of endoscopy, but when it does occur, it is potentially life-threatening. Early diagnosis may lead to a better outcome through early intervention. Most cases need only conservative treatment. A variety of surgical techniques may need to be employed according to the individual circumstances of the case.

**Key words:** Duodenum, perforation, ERCP, pancreatic necrosis, retroperitoneal collection.

## Background

Endoscopic retrograde cholangiopancreatography (ERCP) is an important diagnostic and therapeutic modality in the management of obstructive jaundice (OJ) cases. One of the uncommon complications of ERCP is duodenal (DU) perforation which ranges from 0.4% to 1%. It carries a mortality rate of 16% to 18%.<sup>1,2</sup>

Surgical intervention has been the standard practice in managing both traumatic and atraumatic duodenal perforations; however, in the past decade, management of limited and contained duodenal perforations (especially post-ERCP) has shifted toward a more conservative approach. Arguments have been made for both surgical and nonsurgical management of ERCP-related duodenal perforations, but consensus is lacking.<sup>3</sup>

In this study, we present our hospital experience in the management of post-ERCP DU perforation, trying to suggest a management strategy based on clinical and radiological features, anatomical details of the perforation, and treatment outcomes.

## Methods

Our study is a case series discussing our experience in the management of post-ERCP duodenal perforation. This study includes 10 patients with post-ERCP DU perforation referred to our surgical unit at Ain Shams University hospitals -a tertiary referral center in Egypt- between 2015 and 2019.

History taking, general assessment including vital data and local abdominal examination were routinely done on admission. All cases underwent full blood tests along with abdominal x-ray erect and supine position and a pelvi-abdominal computerized topography (C.T.) scan with contrast. Duodenal perforation was confirmed by presence of air under diaphragm or dye extravasation from DU with or without retroperitoneal collection.

As regard the management, two cases underwent immediate surgical intervention, one of them was explored after failure of ERCP to extract a large stone causing OJ with cholangitis, while the other case had major dye extravasation in peritoneal cavity. The other 8 cases underwent conservative treatment

in the form of nil per os (N.P.O.), intravenous (IV) fluids, intravenous antibiotics, monitoring vital data, frequent abdominal examination, serial blood tests and a follow up C.T. which didn't show further changes (collection or major dye leak) except for one case, which developed a retroperitoneal collection and underwent an ultrasound guided pigtail catheter drainage with no clinical improvement. A follow up CT, 48 hours later, showed a regressive course with a decrease in the collection size; however, the stent was found to be piercing the junction between the 2<sup>nd</sup> and 3<sup>rd</sup> parts of the duodenum, hence surgery was warranted. Another patient (from the group managed conservatively) presented with an agonizing abdominal pain (not responding to analgesics) due to severe distension; subsequently, a percutaneous decompression with a wide bore cannula, inserted subcostally at left midclavicular line, managed to decompress air and ease the pain.

### **Description of surgical management in operated cases:**

All our three operated cases were explored via a midline laparotomy. Initially, Kocherization of the duodenum was performed; this was primarily to assess and identify the type, site and size of the perforation and to allow for better drainage of collection and debridement of necrotic tissue. Subsequently, a cholecystectomy with an intraoperative cholangiogram was done to rule out bile duct pathologies as impacted stone or stricture.

As regard the case (1), after failure of the conservative treatment, a midline laparotomy was done revealing a large perforation at the posterior wall of DU between the 2<sup>nd</sup> and 3<sup>rd</sup> part of Du > 50% of circumference (with migrated piercing stent) along with a retroperitoneal collection. We did drainage of collection, resected the 3<sup>rd</sup> and 4<sup>th</sup> part of duodenum, then mobilization of duodenojejunal (D.J) flexure with proximal jejunal loop was done, then we passed it through D.J flexure aperture in the transverse mesocolon and we performed a hand sewn, double layered duodenojejunostomy using a continuous 3/0 polydioxanone (PDS) suture and patient passed well.

In case (2), cholecystectomy was done with CBD exploration and extraction of 2 large stones. Then Kocherization of duodenum was done revealing retroperitoneal air with minor collection, and a leakage from the medial wall of duodenum upon injection of dye through the CBD, confirming perforation. No trial to repair the perforation

were undertaken and we decided to do duodenal exclusion by:

- T-tube CBD drainage.
- Tube duodenostomy.
- Pyloric exclusion by antrotomy and closure of pyloric ring by non-absorbable proline 2/0 in a continuous manner followed by hand sewn gastrojejunostomy (omega loop, 50 cm distal to D-J junction).

As regard case (3), immediate surgical intervention through a midline laparotomy was done revealing a large 3cm perforation at the lateral wall of the 2<sup>nd</sup> part of Du. Trimming of the edge was done followed by a primary repair in a transverse direction (With 2/0 PDS continuous manner) with serosal patch.

Morison and pelvic wide bore drains were applied in all patients. The three operated patients were admitted to the intensive care unit (ICU) postoperatively to be monitored.

All data related to our cases were retrospectively collected including age, sex, indication for endoscopy, timing of diagnosis, definitive management, type of perforation, type of surgical management with postoperative complications, length of hospital stay, and comorbidities for each case.

### **Results**

Between 2015 and 2019, 10 cases of post-ERCP Du perforation were admitted to our unit. As regard our cases' demographics data and comorbidities, 5 cases were male and 5 cases were female. The age ranged from 28 to 60 years old with a median age of 44.2 years old. One case was diabetic on insulin (case 9) and another case had hypertension (Case 6) (**Table 1**).

Regarding the indication of ERCP, it was calculi OJ for 5 cases, biliary pancreatitis for another 2 (Cases 3,6), cholangitis with CBD stone for case (2), CBD stricture for case (4) and biliary pancreatitis with stricture for case (7) (**Table 1**).

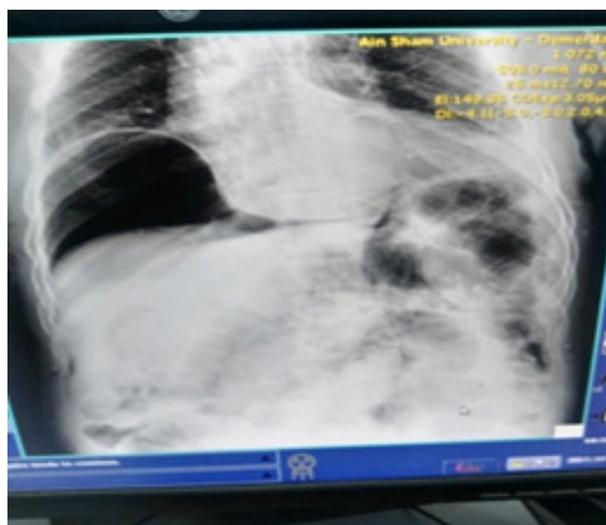
All cases underwent sphincterotomy and only one needed plastic stent insertion (Case 1), the cannulation of papillae was difficult in all cases except cases (9,10) and no further ERCP-related complications, such as bleeding, occurred in our cases. No biliary anomalies (as periampullary diverticulum) were noted (**Table 1**).

**Table 1: Personal characteristics of endoscopically induced Du injury in our study**

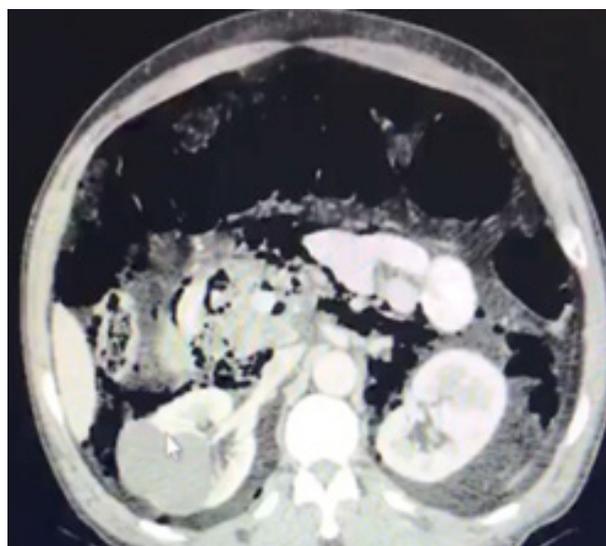
	Case 1	2	3	4	5	6	7	8	9	10
<b>Age</b>	32 years	45 years	38 years	42 years	60 years	52 years	28 years	58 years	51 years	36 years
<b>Gender</b>	Female	Male	Male	Male	Female	Female	Female	Male	Female	Male
<b>Comorbidities</b>						Hypertension			Diabetes mellitus	
<b>Indication of ERCP</b>	Calcular O.J	Calcular OJ+ cholangitis	Biliary pancreatitis	CBD stricture	Calcular O.J	Biliary pancreatitis	Biliary pancreatitis + stricture	Calcular O.J	Calcular O.J	Calcular O.J
<b>ERCP procedures</b>	Sphincterotomy, difficult papilla cannulation, plastic stent	Sphincterotomy, difficult papilla cannulation	Sphincterotomy	Sphincterotomy						

As soon as the patients presented to our unit, general assessment was done. All patients were vitally stable except for cases (1,2) who were tachycardic and feverish and case (3) who was tachycardic with no fever and all cases were normotensive. As regard the clinical manifestation, all cases presented with severe abdominal pain and jaundice associated with severe abdominal distension (tense abdomen) and 3 cases (2,4,5) had surgical emphysema reaching to the chest wall, neck and scrotum. On abdominal examination, there were no signs of peritonitis in all cases except for case (3) which had generalized peritonitis. Regarding time of presentation, apart from case (1) who presented 48 hours after ERCP, all other cases presented early within 24 hours. Case (3) was referred immediately by endoscopist after direct visualization of a perforation at the lateral DU wall. **(Table 2).**

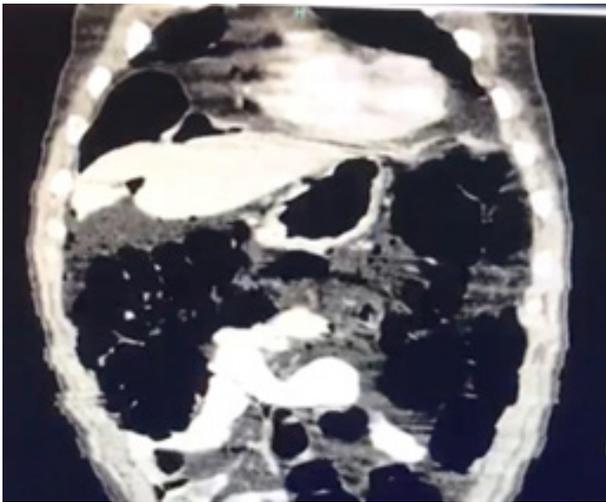
All cases had full blood tests with 2 cases (1,2) showing leukocytosis. Moreover, the all cases underwent an abdominal x-ray erect and supine position along with pelvi-abdominal C.T. scan with contrast. Duodenal perforation was confirmed by the presence of air under diaphragm **(Figure 1)**. One case showed a retroperitoneal collection (Case 1) **(Figure 2)** while another case showed a free intra-peritoneal dye extravasation from the lateral wall (Case 3) **(Figure 3)** and from the group of patients managed conservatively, 2 cases (Cases 9,10) showed minimal dye leak from the medial wall. **(Table 2).**



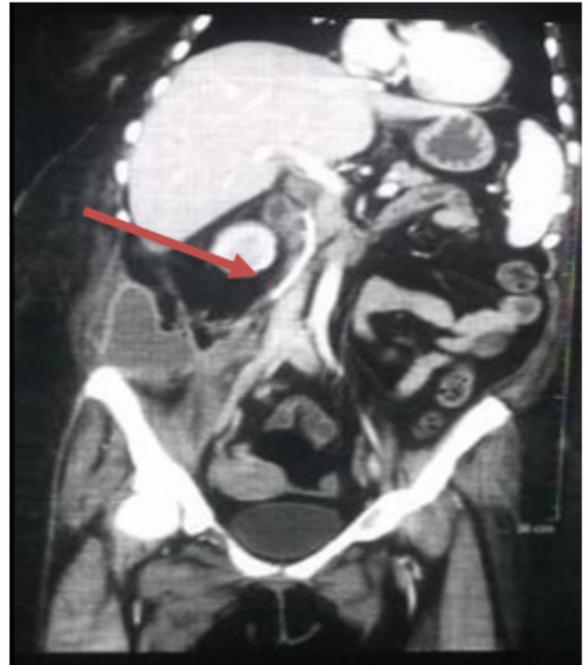
**Fig 1a: Air under diaphragm in X-ray.**



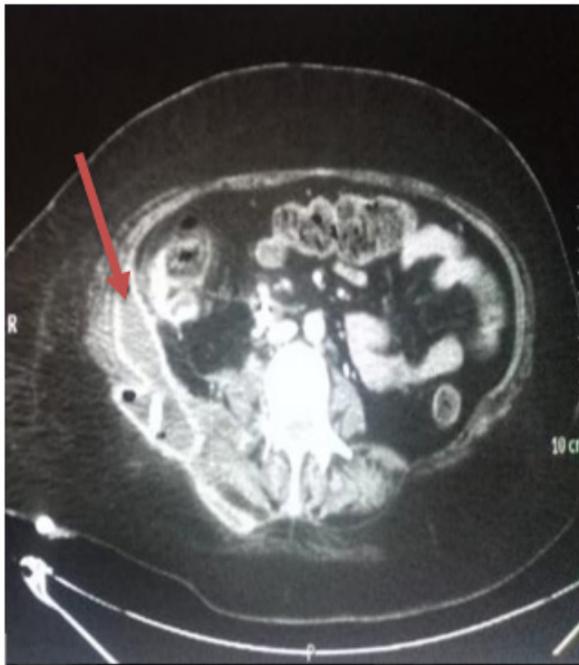
**Fig 1b: C.T axial view with retroperitoneal air.**



**Fig 1c: (c) C.T coronal view with air under diaphragm. (Case 2).**



**Fig 2b: C.T coronal view with retroperitoneal collection and migrated piercing stent (Arrow) (Case 1).**



**Fig 2a: C.T axial view with retroperitoneal collection.**



**Fig 3: C.T axial view with a later DU wall dye leak (Type I) (Case 3).**

**Table 2: Clinical characteristics of endoscopically induced Du injury in our study**

	Case 1	2	3	4	5	6	7	8	9	10
<b>Complain</b>	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension	Severe abdominal pain, jaundice, abdominal Distension
<b>General sign and examination</b>	Tachycardic feverish, no peritonitis	Tachycardia feverish, no peritonitis	Tachycardia, genelazided peritonitis	NAD						
<b>Surgical emphysema</b>		✓		✓	✓					
<b>C.T finding</b>	Retroperitoneal air, retroperitoneal collection	Retroperitoneal air	Retroperitoneal air, Large intraperitoneal dye leak	Retroperitoneal air	Retroperitoneal air, minimal dye leak	Retroperitoneal air, minimal dye leak				
<b>Type of perforation</b>	Type IV large, retroperitoneal between 2 <sup>nd</sup> , 3 <sup>rd</sup> part of Du	Type II tiny unidentified at medial wall of 2 <sup>nd</sup> part of DU	Type I large 3cm at lateral wall of 2 <sup>nd</sup> part of DU	Suggested type II	Type II	Type II				
<b>Time of presentation</b>	After 48 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs	Early within 24 hrs

According to Stapfer classification (for post-ERCP DU perforation), case (1) was type IV , case (2) was type II, case (3) was type I and the other 7 cases ( of conservative group) were suggested to be type II (due to it is the most common type and C.T. did not show an anterolateral or posterior Du wall perforation) (Table 2).

As regard management, 7 cases (Cases 4,5,6,7,8,9,10) underwent conservative treatment and passed well with follow up C.T. showed no further changes (collection or major dye leak). All cases of conservative group stayed in the hospital for 3 to 4 days and then discharged to home (Table 3).

Case (1), which had retroperitoneal collection, not improved clinically with still tachycardic and feverish after pig tail insertion then, follow up C.T. scan after 48 hours showed regressive course of collection but

the stent was migrated and piercing the junction between the 2nd and 3rd part of duodenum and so, surgery was indicated (Table 3).

Two cases underwent an immediate surgical intervention, one of them (Case 2) was explored due to OJ with failed extraction of large stone by ERCP with cholangitis, and another case (Case 3) had major dye extravasation in peritoneal cavity (Table 3).

**As regard postoperative data:**

Case (1) passed well with mild wound seroma and discharged to home after 10 days. Case (2) complained of minor leak from the duodenostomy with ileus, was managed conservatively and discharged after 3 week. Case (3) passed well with no postoperative complication and discharged after 7 days. There were no mortality cases in our study (Table 3).

**Table 3: Management Characteristics of endoscopically induced Du injury in our study**

	Case 1	2	3	4	5	6	7	8	9	10
<b>Man- age- ment</b>	Surgery af- ter failure of conser- vative treat- ment	Surgery due to chole- angitis, impact- ed CBD stone	Surgery due to large de- fect at lat- eral wall with free intraperi- toneal dye leak	Conser- vative treat- ment						
<b>Time of surgery after presen- tation</b>	2 days	Imme- diately within 24 hrs	Immedi- ately within 24 hrs							
<b>Postop- erative compli- cation</b>	Mild wound seroma	ileus with minor leak from duode- nostomy	No							
<b>Hospi- tal stay</b>	10 days	3 weeks	7 days	3 days	3 days	4 days	3 days	3 days	4 days	3 days

**Discussion**

ERCP is considered the best diagnostic and therapeutic tool in patients with OJ. So, with its widespread use nowadays, the experience of endoscopists with ERCP related complications (even uncommon ones) increased. This experience has reflected the early referral of suspected complicated cases to our tertiary hospital and led to good prognosis in the management of such cases.<sup>1,2</sup>

In general, the indications of ERCP are OJ, biliary pancreatitis, biliary injury and stricture.<sup>4,5</sup> In our study, all of 10 cases had indications for ERCP, 5 cases for calculi OJ, 2 cases for biliary pancreatitis (case 3&6), case (2) for cholangitis with CBD stone, case (4) for CBD stricture and case (7) for biliary pancreatitis with stricture.

Post-ERCP abdominal pain is almost always mild pain and so, once patient complains of severe abdominal pain you must suspect complications such as pancreatitis or even perforation especially if sphincterotomy was done as in all our cases in which reports of ERCP documented sphincterotomy.<sup>6</sup> So, sphincterotomy is a considerable risk factor for duodenal perforation after ERCP. Another risk factor for injury is difficult cannulation of the papillae which is documented in 8 cases (80%) of our study.<sup>2,7</sup>

Another risk factor for post-ERCP complication is altered duodenal papillae anatomy as diverticulum

but according to our cases' ERCP reports, there was no altered anatomy.<sup>2</sup>

Post-ERCP abdominal distention is an uncommon complaint and mostly due to bowel insufflation by air but you must exclude duodenal perforation in which abdominal distention is well marked due to over insufflation of air.<sup>6</sup>

In all our cases, there was marked abdominal distention (tense abdomen) which was very annoying to the patient.

The next step, once we suspect ERCP related complication, is to order blood tests including serum amylase, lipase, abdominal x-ray (erect and supine views) and even computerized tomography (CT) with contrast. These investigations are the gold standard for assessment of ERCP related complication.<sup>8</sup>

There was leukocytosis in 2 cases of our study (case 1 for retroperitoneal collection, case 2 for cholangitis).

Presence of air under diaphragm, retroperitoneal air, and collection or dye extravasation in CT are the diagnostic data in the images for duodenal perforation.<sup>8</sup>

If endoscopist suspected DU perforation, limited contrast study through endoscope can confirm the perforation and so, early referral of case with good

prognosis of early management.<sup>3</sup>

In our study, only one case (3) was diagnosed for perforation by endoscopist by direct inspection of a lateral perforation by the endoscope.

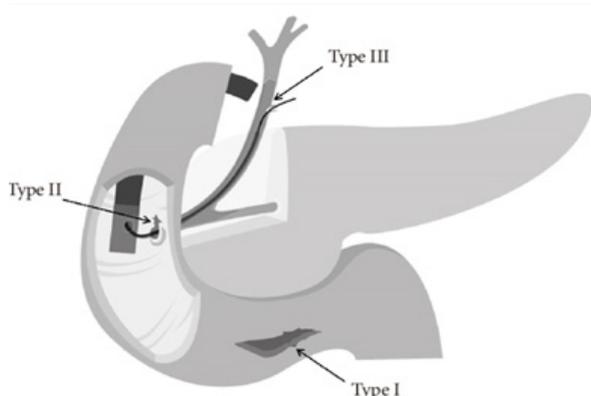
Stapfer et.al. classified post-ERCP duodenal perforation according to anatomical site, mechanism of injury and severity into four types:

Type I: duodenal wall (lateral or even medial) away from the papillae.

Type II: perivaterian duodenum.

Type III: bile duct.

Type IV: tiny retroperitoneal perforation caused by use of compressed air of endoscopy (**Figure 4**).<sup>3</sup>



**Fig 4: Classification of duodenal perforations into types I through IV based on anatomical location and mechanism of injury (type IV not shown).**<sup>9</sup>

Type I (lateral duodenal wall) is the least common and the most serious one due to it tends to be large with early extravasation of bile, duodenal and gastric fluid to both the intraperitoneal and retroperitoneal spaces with a risk of pancreatic necrosis and even abdominal wall fasciitis if neglected. So, this type needs early detection with immediate aggressive intervention (mostly surgical) to improve prognosis and avoid mortality.<sup>10</sup>

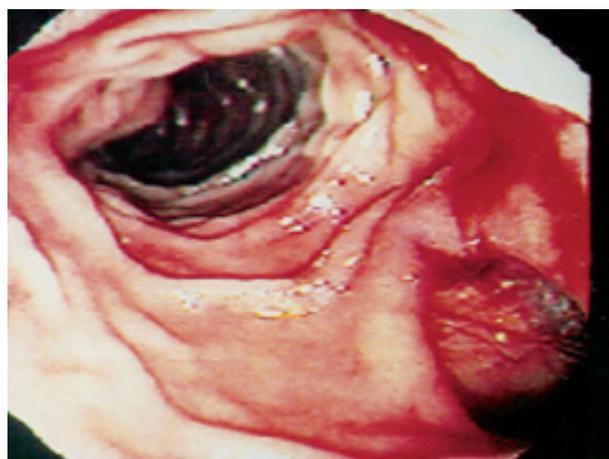
Type I DU perforation is caused by the endoscope itself and usually diagnosed during the endoscopic procedure and in the presence of available facilities and experienced endoscopists it can be managed immediately by endoloop or endoscopic clip (**Figure 5**).<sup>11</sup>

In our study, case (3) was type I duodenal perforation. CT image showed a large lateral wall perforation in the 2nd part of duodenum with free extravasation of dye in the intraperitoneal space so, no role for conservative treatment and decision was

an immediate laparotomy.

Type II duodenal perforation is the most common type as it is the target site of maneuver (papillae cannulation). This type is related to procedure difficulties and mostly caused by sphincterotomy especially if there is difficult cannulation or distorted papillae anatomy by mass or periampullary diverticulum. It has the best prognosis because it is mostly tiny and concealed in the retroperitoneal space.<sup>12</sup>

If endoscopist suspects this type of perforation during procedure, a biliary stent or even nasobiliary tube can be applied to settle the condition.<sup>3</sup>



**Fig 5: ERCP view of a lateral DU wall perforation (Type I).**<sup>3</sup>

Most cases of type II are diagnosed by exclusion by the presence of air under diaphragm or retroperitoneal air in CT (which is marked air due to endoscopic insufflation and may results in even emphysema in the abdominal wall reaching the scrotum as in cases (2,4,5) with no major collection or major dye leakage or even noticeable perforation in CT image (even intraoperatively this perforation is mostly tiny and couldn't be seen).<sup>12</sup>

So, conservative treatment is very effective in this type of perforation and the indications of surgery in type II are persistent stone, stricture in bile duct, cholangitis with failed drainage by ERCP or sizeable retroperitoneal collection with failed external drainage which is rare in this type.<sup>13</sup>

In our study, most cases (2,4,5,6,7,8,9,10) were thought to be type II and so, conservative treatment was done in form of N.P.O, IV fluids, IV antibiotics, analgesic and one case (6) needed subcostal air evacuation by wide bore cannula to relieve pain of compressed air, then follow up CT for these cases (there was no significant collection to be drained) and all cases of conservative group passed well.

But in case (2) which is type II, due to failure of extraction of a large impacted stone and cholangitis so, surgery was indicated.

Type IV duodenal perforation (retroperitoneal perforation) is mostly a microperforation that occurs due to guidewire, sphincterotome and rarely endoscope, it is mostly related to the compressed air. It is the second common type and rarely needs surgical intervention. This type can be diagnosed by CT (retroperitoneal air, collection with dye leakage). The best management is conservative treatment with a pigtail drainage of collection if present and follow up. With follow up, if still undrained collection or extensive retroperitoneal necrosis or still toxic patient, surgery is indicated as in our study (case 1) in which we started follow up and pigtail drainage but with follow up CT., still there is inadequately drained collection and presence of migrated stent passing through the perforation.<sup>3</sup>

Type III duodenal perforation is mostly a minor one in the distal CBD and mostly associated with instrumentation of CBD by wire, dormia basket or stent especially with presence of an obstructing stone, stricture or cholangitis and if suspected by the endoscopist, immediate stenting or nasobiliary

tube is indicated and can resolve the problem. If the perforation missed, patient may present with collection. A pigtail drainage in association with ERCP stenting is enough and rarely needs surgery.<sup>14</sup>

So, the conservative treatment is successful in most cases of post-ERCP duodenal perforation and indications of surgery are:

- Persistent stone or stricture.
- Cholangitis with failed ERCP drainage.
- Large perforation with free intraperitoneal extravasation.
- Failed drainage of retroperitoneal collection.
- Extensive retroperitoneal necrosis.
- Presence of foreign body as stent.
- Presence of perforated neoplasm.<sup>3</sup>

As regard types of surgical intervention, there are no specific guidelines for surgical management of post-ERCP DU perforation but intervention is tailored from case to case (**Table 4**).

**Table 4: Reports in the literature of Type 1 and 2 duodenal injuries caused by endoscopic procedures**

Case/series	N	Different management of:			Average days of hospital stay	Mortality
		Duodenal injury	Retroperitoneal necrosis	Underlying etiology		
Stapfer et al. 2000 <sup>(3)</sup>	8	Pyloric exclusion and gastro-jejunostomy		Cholecystectomy	62.9	2 (25%)
		Tube duodenostomy	Drain placement	CBD exploration		
		Duodeno-antrectomy Primary repair		Hepatico-jejunostomy		
Preetha et al. 2003 <sup>(15)</sup>	13	Pyloric exclusion and gastro-jejunostomy	Not described	Cholecystectomy	23.8	3 (23.1%)
		T-tube		Hepatico-jejunostomy		
		Bowel decompression				
Morgan et al. 2009 <sup>(16)</sup>	10	Primary repair gastrojejunostomy	Drain placement		Not available	1 (10%)
Dubecz et al. 2012 <sup>(17)</sup>	4	Primary repair	Not described	Hepatico-jejunostomy	23	0 (0%)
		T-tube				
Wu et al. 2006 <sup>(18)</sup>	10	Primary repair	Drain placement	Cholecystectomy	31.4	4 (40%)
		Omental patch	Open abscess drainage	CBD exploration		
		Duodenostomy	Percutaneous abscess drainage	Cholecysto-jejunostomy		
Ercan et al. 2012 <sup>(19)</sup>	13	Primary repair	Percutaneous abscess drainage	Cholecystectomy	10.2	6 (46.2%)
		Pyloric exclusion		CBD exploration		
		Gastro-enterostomy		Open abscess drainage		
Avgerinos et al. 2009 <sup>(20)</sup>	15	Omental patch	Not described	Choledocho-duodenostomy	42	3 (20%)
		Pyloric exclusion				
		Gastro-enterostomy				
Fatima et al. 2007 <sup>(13)</sup>	22	Primary repair	Drain placement	Choledocho-jejunostomy	16	3 (13.6%)
		Omental patch				
Angiò et al. 2009 <sup>(21)</sup>	1	Kocherization and primary repair	Not described	CBD exploration	23	0 (0%)
Mao et al. 2008 <sup>(22)</sup>	3	Nil required	Drain placement	CBD exploration	50	0 (0%)
				T-tube		
Kalyani et al. 2005 <sup>(23)</sup>	1	Jejunal serosal patch	Not required	Nil required	> 15	0 (0%)
Melita et al. 2005 <sup>(24)</sup>	1	Nil required	CT-guided abscess drainage	Nil required	Not specified	0 (0%)
		Primary repair				
		T-tube				
Knudson et al. 2008 <sup>(25)</sup>	12	Omental patch	Drain placement	Hepatico-jejunostomy	45	0 (0%)
		Duodenostomy tube				
		Gastrostomy				
		Jejunostomy tube				
		Pyloric exclusion				
Caliskan et al. 2013 <sup>(26)</sup>	9	Primary repair	Not described	CBD exploration	22.6	4 (44.4%)
		Duodenostomy		T-tube		
		Pyloric exclusion, gastro-jejunostomy		Pancreatico-duodenectomy		

First step in the laparotomy surgery is Kocherization of duodenum to identify the type, site and size of perforation. The second step is drainage of the collection with debridement of the necrotic tissue. Then, intraoperative cholangiogram and CBD exploration is indicated if there is an impacted stone, stricture, undrained cholangitis or even part of duodenal exclusion to divert bile by T-tube.<sup>26</sup>

### The next step is according to type of perforation:

If type II (perivaterian): Mostly it is tiny one in the medial wall and cannot be seen and the surgery is mostly indicated due to persistent stone, stricture or undrained cholangitis. So, with CBD exploration, injection of methylene blue is done to confirm the perforation and duodenal exclusion is enough without any trial to search for and repair the perforation.<sup>27</sup>

As in our study case (2) which was diagnosed as type II perforation, surgery was indicated due to persistent impacted stone with cholangitis. CBD exploration, extraction of 2 large CBD stones with cholecystectomy then intra-operative cholangiogram were done followed by duodenal exclusion by T-tube CBD drainage, tube duodenostomy and pyloric exclusion with gastrojejunostomy.

In type I perforation (lateral wall), if early within 12 hours, a primary repair with patch (omental or serosal) is enough. If late diagnosis, repair of perforation is according to the site:

Second part of DU → repair with duodenal exclusion or side to side duodenojejunostomy.

Third part of DU

→ If more than 50% of the circumference → resection and anastomosis (duodenojejunostomy).

→ If less than 50% → repair with duodenal exclusion or side to side duodenojejunostomy.<sup>26,28</sup>

In case (3), with a lateral duodenal wall large extravasation, a midline laparotomy was done which showed a large perforation at the lateral wall of the 2nd part of duodenum, a trimming of the edge was done with a primary repair in a transverse direction followed by a serosal jejunal patch and pyloric exclusion with gastrojejunostomy.

In type IV perforation, if failed conservative treatment, the laparotomy is indicated and the intervention is according to the site (2<sup>nd</sup> or 3<sup>rd</sup> part of DU) and time of presentation as type I perforation.<sup>15</sup>

In our study, case (1) was type IV and after failure of conservative treatment, midline laparotomy was done revealing a large perforation at the the

posterior wall between the 2<sup>nd</sup> and 3<sup>rd</sup> part of Du > 50% of circumference (with migrated piercing stent) along with a retroperitoneal collection. We did drainage of collection, resected the 3<sup>rd</sup> and 4<sup>th</sup> part of duodenum, then mobilization of duodenojejunal (D.J) flexure with proximal jejunal loop was done, then we passed it through D.J flexure aperture in transverse mesocolon and we performed a hand sewn, double layered duodenojejunostomy using a continuous 3/0 polydioxanone (PDS) suture and patient passed well.

### Conclusion

ERCP with sphincterotomy is commonly used in the treatment of CBD stones or stricture. ERCP-related perforations is uncommon occur in about 1% of patients. Early diagnosis and prompt management are important to decrease morbidity and mortality. If it is not detected by the endoscopist, CT is the gold standard tool to diagnose this problem. Post-ERCP duodenal perforations include different types I, II, III, or IV. Conservative management is very effective in most of cases with no need to surgical intervention except in specific indications. The type of surgical management should be individualized on case-by-case basis depending on the site of perforation and timing of intervention with no specific guideline.

**Conflict of interest:** The authors declare that they have no conflict of interest.

### References

1. Habr-Gama A, Wayne JD: Complications and hazards of gastrointestinal endoscopy. *World J Surg.* 1989; 13(2): 193–201.
2. Turner RC, Steffen CM, Boyd P: Endoscopic duodenal perforation, surgical strategies in a regional center. *World Journal of Emergency Surgery.* 2014; 9:11.
3. Stapfer M, Selby RR, Stain SC, Katkhouda N, Parekh D, Jabbour N, et al: Management of duodenal perforation after endoscopic retrograde cholangiopancreatography and sphincterotomy. *Ann Surg.* 2000; 232(2): 191–198.
4. Cotton PB: Is your sphincterotomy really safe—and necessary? *Gastrointest. Endosc.* 1996; 44(6): 752–755.
5. Suissa A, Yassin K, Lavy A, Lachter J, Chermech I, et al: Outcome and early complications of ERCP, a prospective single center study. *Hepatogastroenterology.* 2005, 52(62):352–355.
6. Vikesh K. Singh: Managing perforations related to endoscopic retrograde

cholangiopancreatography, Current development in diagnostic and therapeutic Endoscopy, *Gastroenterology & Hepatology*. 2016; 12(4).

7. Williams EJ, Taylor S, Fairclough P, Hamlyn A, Logan RF, Martin D, et al: Risk factors for complication following ERCP, results of a large-scale, prospective multicenter study. *Endoscopy*. 2007; 39(9): 793–801.
8. Tavusbay C, Alper E, Gökova M, Kamer E, Kar H, Atahan K, et al: Management of perforation after endoscopic retrograde Cholangiopancreatography. *Ulus Travma Acil Cerrahi Derg*. 2016;22(5).
9. Park SM: Endoscopic Management of Endoscopic Retrograde Cholangiopancreatography Related Duodenal Perforations. *Clin Endosc*. 2016; 49: 376-382.
10. Rabie ME, Mir1 NH, Al- Skaini MS, El-Hakeem I, Hadad A, Ageely H, et al: Operative and non-operative management of endoscopic retrograde cholangiopancreatography associated duodenal injuries. *Ann R Coll Surg Engl*. 2013; 95: 285–290.
11. Seibert D: Use of an endoscopic clipping device to repair a duodenal perforation. *Endoscopy*. 2003; 35: 189.
12. Kim BS, Kim IG, Ryu BY, Kim JH, Yoo KS, et al: Management of endoscopic retrograde cholangiopancreatography-related perforations. *J Korean Surg Soc*. 2011; 81: 195–204.
13. Fatima J, Baron TH, Topazian MD, Houghton SG, Iqbal CW, et al: Pancreaticobiliary and duodenal perforations after periampullary endoscopic procedure, diagnosis and management. *Arch Surg*. 2007; 142(5): 448–454.
14. Miller R, Zbar A, Klein Y, Buyeviz V, Melzer E, Mosenkis BN, Mavor E: Perforations following endoscopic retrograde cholangiopancreatography, a single institution experience and surgical recommendations. *Am J Surg*. 2013; 206: 180-186.
15. Preetha M, Chung YF, Chan WH, Ong HS, Chow PK, Wong WK, Ooi LL, et al: Surgical management of endoscopic retrograde cholangiopancreatography-related perforations. *ANZ J Surg*. 2003; 73(12): 1011–1014.
16. Morgan KA, Fontenot BB, Ruddy JM, Mickey S, Adams DB: Endoscopic retrograde cholangiopancreatography gut perforations: *When to wait! When to operate!* *Am Surg*. 2009; 75(6): 477–483.
17. Dubecz A, Ottmann J, Schweigert M, Stadlhuber RJ, Feith M, Wiessner V, et al: Management of ERCP-related small bowel perforations: The pivotal role of physical investigation. *Can J Surg*. 2012; 55(2): 99–104.
18. Wu HM, Dixon E, May GR, Sutherland FR: Management of perforation after endoscopic retrograde cholangiopancreatography (ERCP): A population based review. *HPB (Oxford)*. 2006; 8(5): 393–399.
19. Ercan M, Bostanci EB, Dalgic T, Karaman K, Ozogul YB, Ozer I, et al: Surgical outcome of patients with perforation after endoscopic retrograde cholangiopancreatography. *J Laparoendosc Adv Surg Tech A*. 2012; 22(4): 371–377.
20. Avgerinos DV, Llaguna OH, Lo AY, Voli J, Leitman IM: Management of endoscopic retrograde cholangiopancreatography: Related duodenal perforations. *Surg Endosc*. 2009; 23(4): 833–838.
21. Angiò LG, Sfuncia G, Viggiani P, Faro G, Bonsignore A, Licursi M, et al: Management of perforations as adverse events of ERCP plus ES. Personal experience. *G Chir*. 2009; 30(11–12): 520–530.
22. Mao Z, Zhu Q, Wu W, Wang M, Li J, Lu A, et al: Duodenal perforations after endoscopic retrograde cholangiopancreatography: Experience and management. *J Laparoendosc Adv Surg Tech A*. 2008; 18(5): 691–695.
23. Kalyani A, Teoh CM, Sukumar N: Jujenal patch repair of a duodenal perforation. *Med J Malaysia*. 2005; 60(2): 237–238.
24. Melita G, Currò G, Iapichino G, Princiotta S, Cucinotta E: Duodenal perforation secondary to biliary stent dislocation: A case report and review of the literature. *Chir Ital*. 2005; 57(3): 385–388.
25. Knudson K, Raeburn CD, McIntyre RCJ, Shah RJ, Chen YK, Brown WR, et al: Management of duodenal and pancreaticobiliary perforations associated with periampullary endoscopic procedures. *Am J Surg*. 2008; 196(6): 975–982.
26. Caliskan K, Parlakgumus A, Ezer A, Colakoglu T, Törer N, Yildirim S: Surgical management of endoscopic retrograde cholangiopancreatography related injuries. *Hepatogastroenterology*. 2013; 60(121): 76–78.
27. Chen ZB, Liang ZY, Zhang Y, Zhang SY, Zheng SS: "Surgical intervention of severe post-ERCP-pancreatitis accompanied with duodenal

---

perforation," *Journal of Zhejiang University Science B*. 2010; 11(1):17–21.

28. Malhotra A, Biffi WL, Moore EE, Schreiber M, Albrecht RA, Cohen M, et al: Western Trauma

Association Critical Decisions in Trauma: Diagnosis and management of duodenal injuries. *J Trauma Acute Care Surg*. 1096; 79(6).