



No-touch isolation technique in emergency pancreaticoduodenectomy for neoplastic hemorrhage: Two case reports and review of literature

Akihiro Cho, Satoshi Katagiri, Masao Ota, Shunsuke Onizawa, Ryota Higuchi, Toshiya Sugishita, Yukiko Niwa, Takeshi Ishita, Toshihiko Mouri, Akita Kato, Moe Iwata

Specialty type: Gastroenterology and hepatology

Provenance and peer review:

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's classification

Scientific Quality: Grade C

Novelty: Grade C

Creativity or Innovation: Grade B

Scientific Significance: Grade B

P-Reviewer: Tang H, China

Received: January 26, 2024

Revised: April 8, 2024

Accepted: April 30, 2024

Published online: June 27, 2024

Processing time: 156 Days and 3.8 Hours



Akihiro Cho, Satoshi Katagiri, Masao Ota, Shunsuke Onizawa, Ryota Higuchi, Toshiya Sugishita, Yukiko Niwa, Takeshi Ishita, Toshihiko Mouri, Akita Kato, Moe Iwata, Division of Gastroenterological Surgery, Tokyo Women's Medical University, Yachiyo Medical Center, Chiba 276-8524, Japan

Corresponding author: Akihiro Cho, MD, PhD, Associate Professor, Doctor, Surgeon, Division of Gastroenterological Surgery, Tokyo Women's Medical University, Yachiyo Medical Center, 477-96 Owadashinden, Yachiyo, Chiba 276-8524, Japan. acho5184@gmail.com

Abstract

BACKGROUND

Emergency pancreaticoduodenectomy (EPD) is a rare event for complex periampullary etiology. Increased intraoperative blood loss is correlated with poor postoperative outcomes.

CASE SUMMARY

Two patients underwent EPD using a no-touch isolation technique, in which all arteries supplying the pancreatic head region were ligated and divided before manipulation of the pancreatic head and duodenum. The operative times were 220 and 239 min, and the blood loss was 70 and 270 g, respectively. The patients were discharged on the 14th and 10th postoperative day, respectively. Thirty-two patients underwent EPD for the treatment of neoplastic bleeding. The mean operative time was 361.6 min, and the mean blood loss was 747.3 g. The complication rate was 37.5%. The in-hospital mortality rate was 9.38%.

CONCLUSION

The no-touch isolation technique is feasible, safe, and effective for reducing intraoperative blood loss in EPD.

Key Words: No-touch isolation technique; Pancreaticoduodenectomy; Emergency pancreaticoduodenectomy; Neoplastic bleeding; Superior mesenteric artery first approach; Case report

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Core Tip: Emergency pancreaticoduodenectomy (EPD) has been rarely reported as a life-saving procedure. Morbidity and mortality rates remain very high for EPD. Increased intraoperative blood loss has been linked to worse postoperative results. The non-touch isolation technique is feasible, safe, and effective in minimizing intraoperative blood loss in EPD.

Citation: Cho A, Katagiri S, Ota M, Onizawa S, Higuchi R, Sugishita T, Niwa Y, Ishita T, Mouri T, Kato A, Iwata M. No-touch isolation technique in emergency pancreaticoduodenectomy for neoplastic hemorrhage: Two case reports and review of literature. *World J Gastrointest Surg* 2024; 16(6): 1910-1917

URL: <https://www.wjgnet.com/1948-9366/full/v16/i6/1910.htm>

DOI: <https://dx.doi.org/10.4240/wjgs.v16.i6.1910>

INTRODUCTION

Emergency pancreaticoduodenectomy (EPD) is rarely performed in cases of trauma, endoscopic and/or postoperative complications, perforation, uncontrollable hemorrhage, or progressive multiple-organ failure in severe necrotizing pancreatitis. While the mortality rate of elective PD has shown a significant decrease during the last three decades, it remains higher for EPD[1]. Increased intraoperative blood loss can be correlated with poor postoperative outcomes in PD [2], and there is clearly a higher in-hospital mortality rate for patients with higher intraoperative blood loss in EPD[3]. Therefore, minimizing intraoperative blood loss during EPD is crucial. This report describes a no-touch isolation technique in which all arteries supplying the pancreatic head region are first ligated and divided before manipulation of the pancreatic head and duodenum in the early phase of resection during EPD.

CASE PRESENTATION

Chief complaints

A 67-year-old woman and an 88-year-old woman presented to emergency department with a complaint of melena and dyspnea, respectively.

History of present illness

Symptoms developed just before emergency transport in both patients.

History of past illness

Case 1: The first patient was scheduled to undergo pylorus-preserving PD (PPPD) because of a duodenal gastrointestinal stromal tumor (GIST).

Case 2: The second patient had painless mass that was gradually increasing in size over a period of six months.

Personal and family history

Both two patients denied any family history of malignant tumors.

Physical examination

Case 1: On physical examination, the vital signs were as follows: Body temperature (35.9 °C); blood pressure (75/34 mmHg); heart rate (124 beats per min); respiratory rate (28 breaths per min).

Case 2: On physical examination, the vital signs were as follows: Body temperature (36.4 °C); blood pressure (70/40 mmHg); heart rate (140 beats per min); respiratory rate (36 breaths per min).

Laboratory examinations

Case 1: Levels of serum hemoglobin were 3.7 g/dL.

Case 2: Levels of serum hemoglobin were 5.4 g/dL.

Imaging examinations

Case 1: Contrast-enhanced computed tomography demonstrated a duodenal hyper vascular mass, sized 5.0 cm × 6.0 cm (Figure 1A).

Case 2: A complex, septate cystic mass in the pancreatic head measuring 17 cm, with solid components and adjacent hematoma (Figure 1B).

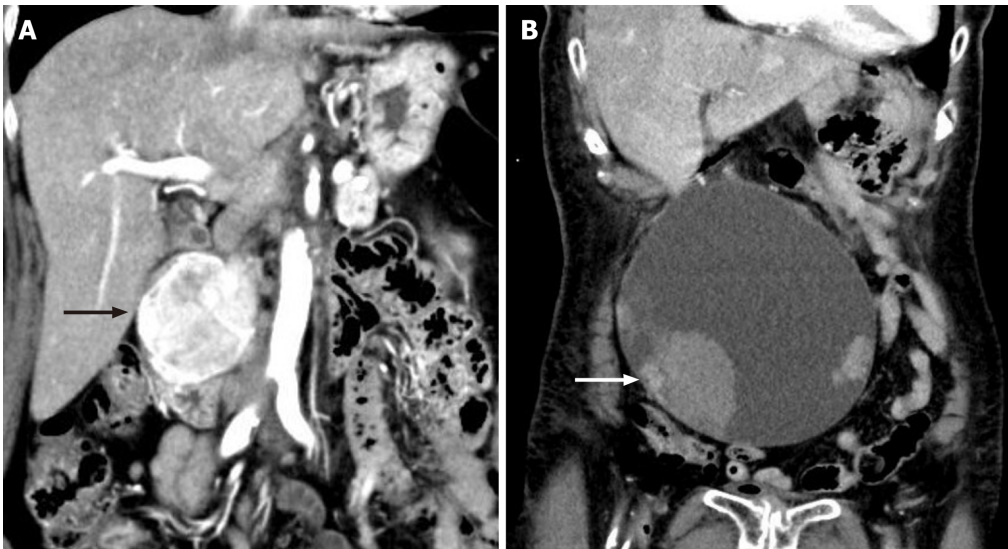


Figure 1 Imaging of the duodenal tumor and pancreatic tumor. A: Imaging of the duodenal tumor and pancreatic tumor. Contrast-enhanced computed tomography showed a well-defined, enhancing masse, sized 5.0 cm × 6.0 cm, with heterogeneous density at the second portion of the duodenum (arrow); B: Imaging of the pancreatic tumor. Contrast-enhanced computed tomography showed a huge cystic mass measuring 17 cm, with some solid components and adjacent hematoma (arrow).

Further diagnostic work-up

A diagnosis of GIST was made in the case 1 by ultrasound-guided fine-needle aspiration.

FINAL DIAGNOSIS

The final diagnosis was a GIST and an intraductal papillary mucinous neoplasm (IPMN).

TREATMENT

Two patients underwent EPD using a no-touch isolation technique as a lifesaving procedure for massive pancreaticoduodenal neoplastic bleeding at our institution between May and June 2023 (Table 1). All procedures were performed in accordance with the ethical guidelines of the World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964, and revised in Tokyo 2004. Appropriate written informed consent was obtained for the publication of these case reports and accompanying images.

Case 1

Eight units of red blood cell concentrate were transfused, and emergency PPPD was performed using a no-touch isolation technique. The operative time was 220 min, and blood loss was 70 g.

Case 2

Ten units of red blood cell concentrate were transfused before surgery. Intraoperative findings showed that the superior mesenteric artery (SMA) and superior mesenteric vein (SMV) and the transverse colon and mesentery firmly adhered to the huge cystic tumor over its entire length, which made dissection difficult, and intraoperative blood loss was increased. Finally, PPPD was performed using a no-touch isolation technique. The operative time was 239 min, and blood loss was 270 g.

Surgical procedure

First, the gastrocolic ligament was divided and the omental bursa was opened to visualize the anterior surface of the pancreas. Dissection along the inferior surface of the pancreatic neck exposed the SMV. The SMA with nerve plexuses surrounding the SMA is taped just to the left side of the SMV. Dissection was performed along the superior surface of the pancreas and between the distal duodenum and the pancreas to isolate the common and proper hepatic arteries and the gastroduodenal artery (GDA), which was ligated and divided. After the pancreatic neck was separated from the SMV, it was taped. The hepatoduodenal ligament was dissected to isolate the portal vein and the common bile duct (CBD). Next, the ligament of Treitz was dissected and opened to visualize the aorta. The taped SMA was visualized immediately superior to the left renal vein. The inferior pancreaticoduodenal artery (IPDA) arises from the first jejunal artery (FJA) or

Table 1 Details of patients who underwent emergency pancreaticoduodenectomy using a no-touch isolation technique

Patients	1	2
Age/sex	67/female	88/female
Pathology	Duodenal-GIST	IPMN
Hb (g/dL) transfusion, U	3.7, 8	5.4, 10
Tumor size (cm)	5	17
Procedure	PPPD	PPPD
Operative time (m)	220	239
Blood loss (g)	70	270
Complication	No	No
Length of stay (d)	14	10

GIST: Gastrointestinal stromal tumor; PPPD: Pylorus-preserving pancreaticoduodenectomy; IPMN: Intraductal papillary mucinous neoplasm; Hb: Hemoglobin.

the SMA. The IPDA usually branches from the left dorsal side of the SMA[4]. The proximal jejunum was pulled to the right and the SMA was rotated counterclockwise. The IPDA was visualized and then ligated and divided. The superior and inferior pancreaticoduodenal arteries were blocked (Figure 2). The inferior pancreatic artery (IPA) forms the arterial arcade between the GDA and the dorsal pancreatic artery (DPA)[5]. Therefore, ligation of the IPA is important. Early ligation of the IPA at the inferior border of the body of the pancreas or the arterial arcade of the DPA can be controlled by stay sutures on both the cranial and caudal sides of the remnant pancreas and amputation of the pancreas if the IPA cannot be isolated.

OUTCOME AND FOLLOW-UP

No patients required intra- or postoperative blood transfusions, and no complications were encountered. Patients were discharged on the 14th and 10th postoperative day, respectively. All lesions had clear surgical margins. The patients were still alive without recurrence.

DISCUSSION

EPD, which has been rarely reported mostly in complex pancreaticoduodenal trauma, perforations, life-threatening hemorrhage, and severe infection is still a very uncommon procedure[1]. Recent rapid developments in technological innovations, improvements in surgical skills, progress in perioperative management, and the extensive experience of surgeons have proven the feasibility and safety of PD[6]. While the mortality rate of elective PD has shown a significant decrease during the last three decades, it remains higher for EPD[7]. EPD has been reported mostly in trauma settings, while non-trauma cases have been also reported, although rarely, which include bleeding, complicated tumors of the pancreaticoduodenal complex, endoscopic complications, and caustic ingestion[1]. Emergent pancreatic resection for neoplastic disease also is associated with significantly higher mortality and morbidity rates compared to elective pancreatic resections[8]. In patients with upper gastrointestinal tract bleeding, including pancreaticoduodenal, endoscopic or radiological procedures can achieve hemostasis in most patients. However, conservative management with interventional radiologic coiling of feeding arteries may momentarily salvage the situation but does not treat the underlying disease, especially in cases of malignancies. Moreover, interventional angiography with embolization of the pancreaticoduodenal arcade might not solve the problem in the presence of erosive tumors. It could also be ineffective because of the notable collateral blood supply of the pancreaticoduodenal area from the celiac and superior mesenteric arterial circulation[5], and the rich extra-blood supply, especially in patients with huge extra-growing tumors[9]. Therefore, in cases of bleeding of neoplastic origin, emergency pancreatoduodenectomy can be a definite therapeutic option. The literature review was performed *via* MEDLINE and PubMed with the key words, “emergency/emergent” and “pancreaticoduodenectomy/pancreatoduodenectomy”. In addition, we manually searched the reference lists of all the identified articles to identify further relevant articles. We selected only literature with full texts published between January 2001 and December 2022. All recorded cases of EPD performed for neoplastic bleeding in an emergency setting were extracted. Thirty-two patients[1,10-32] were reported to undergo EPD for neoplastic bleeding causes (Table 2): Seven cases of pancreatic carcinomas, five GISTs, four IPMNs, three duodenal carcinomas, two ampullary carcinomas, two liposarcomas, two lymphomas, and seven others (four cases of metastases from renal cell carcinoma, adrenal cancer, colon cancer, or neuroendocrine tumor, one duodenal sarcoma, one gastric cancer, and one paraganglioma). There were

Table 2 Reported patients that underwent emergency pancreaticoduodenectomy for neoplastic hemorrhage

Characteristic		
Sex, <i>n</i> (female/male)		15/17
Age, yr (mean)		20-93 (61.2)
Pre-operative TAE, <i>n</i> (%)		2 (6.25)
Operative time, min (mean)		210-553 (361.6)
Blood loss, g (mean)		20-1600 (747.3)
Morbidity, <i>n</i> (%)		12 (37.5)
Mortality, <i>n</i> (%)		3 (9.38)
Hospital stay, d (mean)		7-63 (25.5)
Underlying diagnosis, <i>n</i> (%)	Pancreatic carcinoma	7 (21.8)
	GIST	5 (15.6)
	IPMN	4 (12.5)
	Duodenal carcinoma	3 (9.4)
	Ampullary carcinoma	2 (6.3)
	Liposarcoma	2 (6.3)
	Lymphoma	2 (6.3)
	Others	7 (21.8)

GIST: Gastrointestinal tumor; IPMN: Intraductal papillary mucinous neoplasm; TAE: Transcatheter arterial embolization.

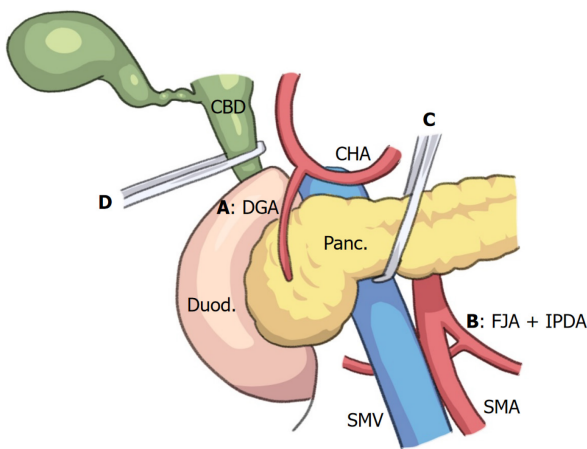


Figure 2 Illustration of no-touch isolation technique in emergency pancreaticoduodenectomy. All arteries (A-D) that supply the pancreatic head region are isolated before manipulation of the pancreatic head and duodenum in the early phase of resection during emergency pancreaticoduodenectomy. A: The gastroduodenal artery; B: First jejunal artery, inferior pancreaticoduodenal artery; C: Intrapancreatic arterial arcade, including the inferior pancreatic artery. D: The para-biliary arterial plexus, including the 3 or 9 o'clock arteries, anastomoses to the posterior superior pancreaticoduodenal artery. Panc: Pancreas; Duod: Duodenum; SMV: Superior mesenteric vein; SMA: Superior mesenteric artery; CHA: Common hepatic artery; CBD: Common bile duct; GDA: Gastroduodenal artery; IPDA: Inferior pancreaticoduodenal artery; FJA: First jejunal artery.

15 females (46.88%) and 17 males (53.12%), with a mean age of 61.2 years. Two of the 32 patients (6.25%) underwent trans-catheter arterial embolization before EPD. Operative time and intraoperative blood loss were described in 11 and 13 patients, respectively. The mean operative time was 361.6 min, and mean blood loss was 747.3 g. The complication rate was 37.5% (*n* = 12). Pancreatic fistula was the most common complication, occurring in six patients (18.75%). The in-hospital mortality rate was 9.38% (two patients). The mean length of hospitalization was 25.5 d. The overall mortality rate of EPD for tumor bleeding was 9.38%. Blood loss during EPD was 20-1600 g (mean 747.3 g). Increased intraoperative blood loss can be correlated with poor postoperative outcomes in PD[2]. There was a higher in-hospital mortality rate in patients with higher intraoperative blood[3]. Therefore, minimizing intraoperative blood loss during EPD is crucial. A no-touch isolation technique was originally recommended for operations on periampullary cancer to prevent the scattering of cancer cells into the portal blood[33,34]. To the best of our knowledge, this is the first report of a no-touch isolation

technique performed to reduce intraoperative blood loss in EPD. In this procedure, all arteries that supply the pancreatic head region are first ligated and divided before manipulation of the pancreatic head and duodenum[6,33,34]. In conventional PD using Kocher's maneuver, the GDA is usually ligated and divided during surgery; however, IPDA ligation and division are performed in the final stage of resection, which might induce further tumor bleeding. Early ligation of the IPDA is an effective technique for minimizing intraoperative blood loss during PD[33]. Recently, the SMA first approach has been proposed[35]. Using this approach, we identified the origin of the IPDA arising from the posterior aspect of the SMA without mobilization of the duodenum or colon[4,35]. Rotating the SMA counterclockwise facilitates easy identification of the origin of the FJA or IPDA because these arteries arise from the left dorsal aspect of the SMA[4,35]. The arterial supply of the pancreas is marked by numerous anastomoses. Arterial arcades are formed by branches from different main supplying arteries, and between branches from each main artery. Major branches anastomose within the substance of the pancreas[5]. Moreover, the para-biliary arterial plexus, including the 3 or 9 o'clock arteries, anastomoses the posterior superior pancreaticoduodenal artery[36]. Therefore, both the pancreas and CBD should be divided before Kocher's maneuver if bleeding cannot be controlled after ligation of the GDA and IPDA. Due to our limited experiences, a larger cohort should be evaluated in a prospective, randomized study to elucidate appropriate indications and effects of this novel procedure.

CONCLUSION

Despite our limited experience, and pending future studies to establish appropriate indications, we believe that a non-touch isolation technique is feasible, safe, and effective in minimizing intraoperative blood loss in EPD. The benefits of this approach, however, require further validation, understanding the importance of careful patient selection for successful treatment.

FOOTNOTES

Author contributions: Cho A selected the associated data and edited the article; Cho A, Onizawa S, Sugishita T, Niwa Y, and Kato A participated in the surgery; Higuchi R, Ishita T, Mouri T, and Iwata M contributed to patient treatment; Katagiri S and Ota M revised the manuscript; and all authors have read and approved the final manuscript.

Informed consent statement: Informed written consent was obtained from the patients for publication of this report and any accompanying images.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

CARE Checklist (2016) statement: The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

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Country of origin: Japan

ORCID number: Akihiro Cho [0009-0007-6385-7959](https://orcid.org/0009-0007-6385-7959).

S-Editor: Wang JJ

L-Editor: A

P-Editor: Zhang YL

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