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Intraoperative assessment of tissue oxygen saturation of the remnant stomach by near-infrared spectroscopy in two cases of pancreatectomy following gastrectomy



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ABSTRACT

INTRODUCTION: Objective and quantitative intraoperative methods of bowel viability assessment could decrease the risk of postoperative ischemic complications in gastrointestinal surgery. Because the remnant stomach and the pancreas share an arterial blood supply, it is often unclear whether the remnant stomach can be safely preserved when performing pancreaticoduodenectomy (PD) or distal pancreatectomy (DP) post gastrectomy. We herein report two cases in which the remnant stomach was safely preserved using near-infrared spectroscopy to assess the regional saturation of oxygen (rSO₂) in the remnant stomach during operation.

PRESENTATION OF CASE: The first patient, a 68-year-old man, was diagnosed with cancer of the pancreatic head and underwent PD a year after proximal gastrectomy for gastric cancer. The remnant stomach was safely preserved by evaluation of the rSO₂ before and after reconstruction of the arteries. The second patient, an 82-year-old woman with a history of distal gastrectomy for gastric cancer 40 years previously, was diagnosed with a main duct intraductal papillary mucinous neoplasm of the pancreatic body, requiring DP. As in the previous case, we could safely preserve the remnant stomach through assessing the intraoperative rSO₂ of the remnant stomach.

DISCUSSION: Through comparing changes in the rSO₂ during surgery, near-infrared spectroscopy provides objective and quantitative assessments of intestinal viability to predict ischemic complications.

CONCLUSION: This method may be a viable option to evaluate the blood supply to the alimentary tract.

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1. Introduction

Pancreatic cancer is the fourth leading cause cancer deaths [1] and has a poor prognosis; surgery is the only potentially curative

treatment [2]. It has been reported that partial gastrectomy may be a risk factor for pancreatic cancer [3,4]. In such cases, standard pancreatectomy is associated with potential loss of blood supply to the remnant stomach, which may lead to postoperative ischemic complications. However, there is no consensus on how to manage the remnant stomach most effectively when performing pancreatectomy in these patients. Intraoperative assessment of bowel viability has been performed using Doppler ultrasonography, indocyanine green (ICG) fluorescence angiography, and near-infrared spectroscopy [5–8]. The In Vivo Optical Spectroscopy (INVOS) system (Covidien, JAPAN) allows real-time monitoring of regional saturation of oxygen (rSO₂) in the brain or body tissue directly beneath the sensor through near-infrared spectroscopy [9,10]. We herein report two cases of pancreatectomy in patients who had previously undergone gastrectomy, in which intestinal viability was objectively assessed and the remnant stomach was safely preserved using this system.

Abbreviations: PD, pancreaticoduodenectomy; DP, distal pancreatectomy; rSO₂, regional saturation of oxygen; ICG, indocyanine green; CT, computed tomography; RGA, right gastric artery; RGEA, right gastroepiploic artery; PET, positron emission tomography; SUV, standardized uptake value; GDA, gastroduodenal artery; DG, distal gastrectomy; EUS, endoscopic ultrasonography; MRI, magnetic resonance imaging; ERCP, endoscopic retrograde cholangiopancreatography; CHA, common hepatic artery.

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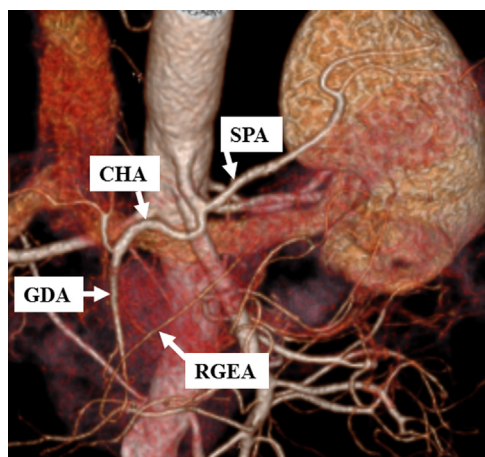


Fig. 1. Preoperative 3D-CT (Case 1). The right gastroepiploic artery (RGEA) was preserved in the prior surgery.

2. Presentation of case

2.1. Case 1

A 68-year-old man underwent proximal gastrectomy for additional resection following endoscopic submucosal dissection of gastric cardia cancer. A solid mass was detected at the head of the pancreas on follow-up computed tomography (CT) a year after the surgery. Serum biochemistry was as follows: aspartate aminotransferase (AST), 18 U/L; alanine aminotransferase (ALT), 15 U/L; total bilirubin, 0.9 mg/dL; amylase (AMY), 150 U/L; carcinoembryonic antigen (CEA), 5.6 ng/mL; cancer antigen 19-9 (CA 19-9), 143 U/mL; and s-pancreas-1 antigen (SPAN-1), 32 U/mL. CT imaging showed a low-enhanced mass with a diameter of 15 mm × 12 mm at the pancreatic head. Lymph node swelling and vascular invasion were not detected. The right gastric artery (RGA) and right gastroepiploic artery (RGEA) were preserved in the prior operation (Fig. 1). On positron emission tomography (PET)-CT, abnormal fludeoxyglucose uptake was seen (standardized uptake value (SUV)-max: 3.1–4.0) at the head of the pancreas. Endoscopic ultrasound-guided fine needle aspiration revealed adenocarcinoma. Therefore, pancreaticoduodenectomy (PD) with lymph node dissection was planned. During the PD procedure, we needed to divide the gastroduodenal artery (GDA). We needed to know whether the remnant stomach could be safely preserved by reconstructing the circulation

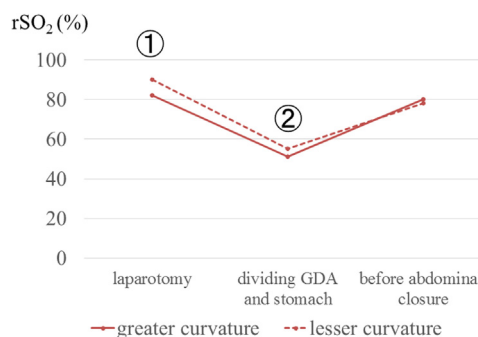


Fig. 3. Intraoperative rSO₂ (Case 1). After the reconstruction of the arteries, rSO₂ level improved.

between the GDA and RGEA (Fig. 2). The intraoperative rSO₂ of the greater curvature of the remnant stomach was assessed using the INVOS system. At the time of laparotomy, the rSO₂ of the remnant stomach was 82%. After dividing the GDA and stomach, it decreased to 51%. Reconstruction of the arteries was performed, and at the end of the operation, it increased to 80% (Fig. 3). We judged that the remnant stomach could be safely preserved. Pathological examination showed invasive ductal carcinoma of the pancreas, pathological stage T4N1M0 Stage IVa (TNM classification). The postoperative course was uneventful, and the patient was discharged on the 17th postoperative day.

2.2. Case 2

An 82-year-old woman was initially admitted to a nearby hospital for a periodical medical examination. Ultrasound examination revealed a cystic mass at the body of the pancreas, and she was referred to our hospital for further investigation. On admission, she had no specific symptoms, with poor performance status. Physical examination was within the normal limits. She had a history of distal gastrectomy (DG, Billroth-II) for gastric cancer 40 years ago. Serum biochemistry was as follows: AST, 27 U/L; ALT, 24 U/L; total bilirubin, 0.4 mg/dL; AMY, 79 U/L; CEA, 3.7 ng/mL; CA19-9, 13 U/mL; and SPAN-1, 8.3 U/mL. CT scan showed a cystic mass with a diameter of 50 mm × 30 mm in the pancreatic body. The cystic mass did not invade the splenic artery or vein, but had a connection with the main pancreatic duct. Lymph node swelling and metastases were not detected. Early phase imaging revealed that the left gastric, right gastric, and right gastroepiploic arteries and veins

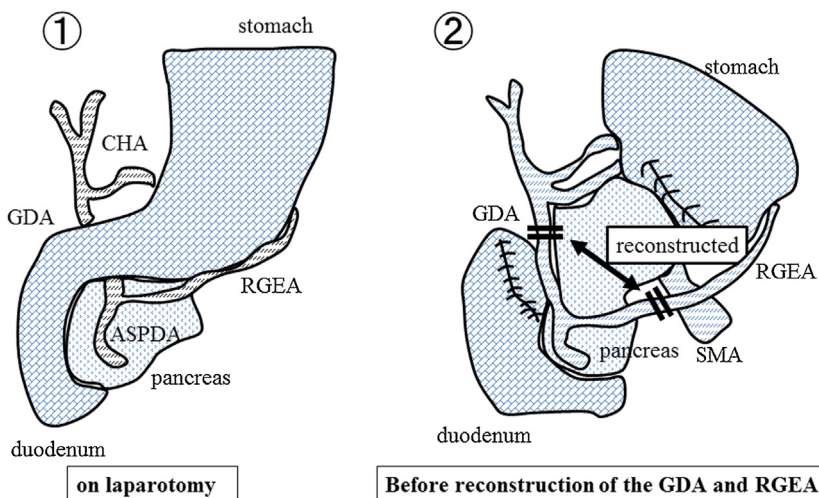


Fig. 2. Scheme of the operative findings (Case 1).

Reconstruction between the GDA and RGEA was performed.

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