

Indocyanine Green-Fluorescent Pancreatic Perfusion-Guided Resection of Distal Pancreas in Solid Pseudopapillary Neoplasm: Usefulness and Feasibility During Pancreaticobiliary Surgery

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ICG is widely applied in real-time imaging during abdominal surgery, plastic surgery, as well as oncologic staging and treatment. A twenty-eight year-old female patient was found to have a 4.5 cm solid pseudopapillary neoplasm in the tail of the pancreas. Under ICG-fluorescent pancreatic perfusion-guidance, we easily defined the margin of the pancreatic tumor and secured the resection margin when performing laparoscopic distal pancreatectomy in the patient. No clinically relevant complications, including postoperative pancreatic fistula, were noted. Intravenous ICG can be very easily and quickly detected in the pancreas under near infrared light. This enhanced vision gives strong contrast to the organ compared to a necrotic tumor with poor blood perfusion, such as solid pseudopapillary neoplasm. Based on our current experience, ICG pancreatic perfusion-guided determination of appropriate resection margin is useful and feasible during pancreaticoduodenectomy.

Keywords: Fluorescent dyes, Indocyanine green, Pancreatectomy, Perfusion, Solid pseudopapillary neoplasm

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INTRODUCTION

Indocyanine green (ICG) is a fluorescent dye that has been approved by the Food and Drug Administration (FDA) for clinical and research use in humans since 1956.¹ Initially, ICG was used for quantitative measurements of hepatic and cardiac function.² When ICG is injected intravenously, it binds to plasma proteins, such as albumin, and lipoproteins.³ It is generally excited between 750 and 800 nm, and fluorescence emission is detected near the maximum peak of 832 nm.⁴ Due to this physiologic property and the advancement of instru-

mental camera technology, ICG is now widely applied in real-time imaging during abdominal surgery, plastic surgery, as well as oncologic staging and treatment.⁵ However, there are few examples of clinical applications using ICG in pancreatic surgery.⁶ We recently experienced a very interesting case that supports potential application of ICG in pancreatectomy.

CASE REPORT

Patient characteristics

A 28-year-old female patient visited outpatient department of gastrointestinal internal medicine, and underwent computed tomography (CT) scan. She did not have any past or current medication history. CT showed that the patient had a mass in the tail of pancreas. (Fig. 1A). Pancreaticobiliary endoscopic ultrasonography was also performed, and 44-mm sized eccentric calcification solid mass was presumed as solitary pseudopapillary neoplasm.

Method of ICG injection during surgery

We used 25.0 mg of DID Indocyanine Green® injection, produced by Doingungdang Pharmaceutical. One vial was mixed with 10cc normal saline and administrated in peripheral intravenous site. Approximately 3 minutes before confirmation of margin, 2 cc (5 mg of ICG) was injected. The ICG imaging system we used was a product of NOVADAQ Technologies Inc. Under the ICG-fluorescent pancreatic perfusion-guidance, we easily defined the margin of pancreatic tumor and secured the resection margin while performing laparoscopic distal pancreatectomy in the patient (Fig. 1B, C).

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Pathologic findings

Final pathologic examination reported that the tumor was a 4.5-cm solid pseudopapillary neoplasm of the pancreas. (Fig. 1D) Distance from resection margin to tumor was reported as 1.5 cm, and the tumor extended beyond the pancreas (pT3). No lymphovascular or perineural invasion was noted. A total of six regional lymph nodes were retrieved, and all of the nodes were free of tumor.

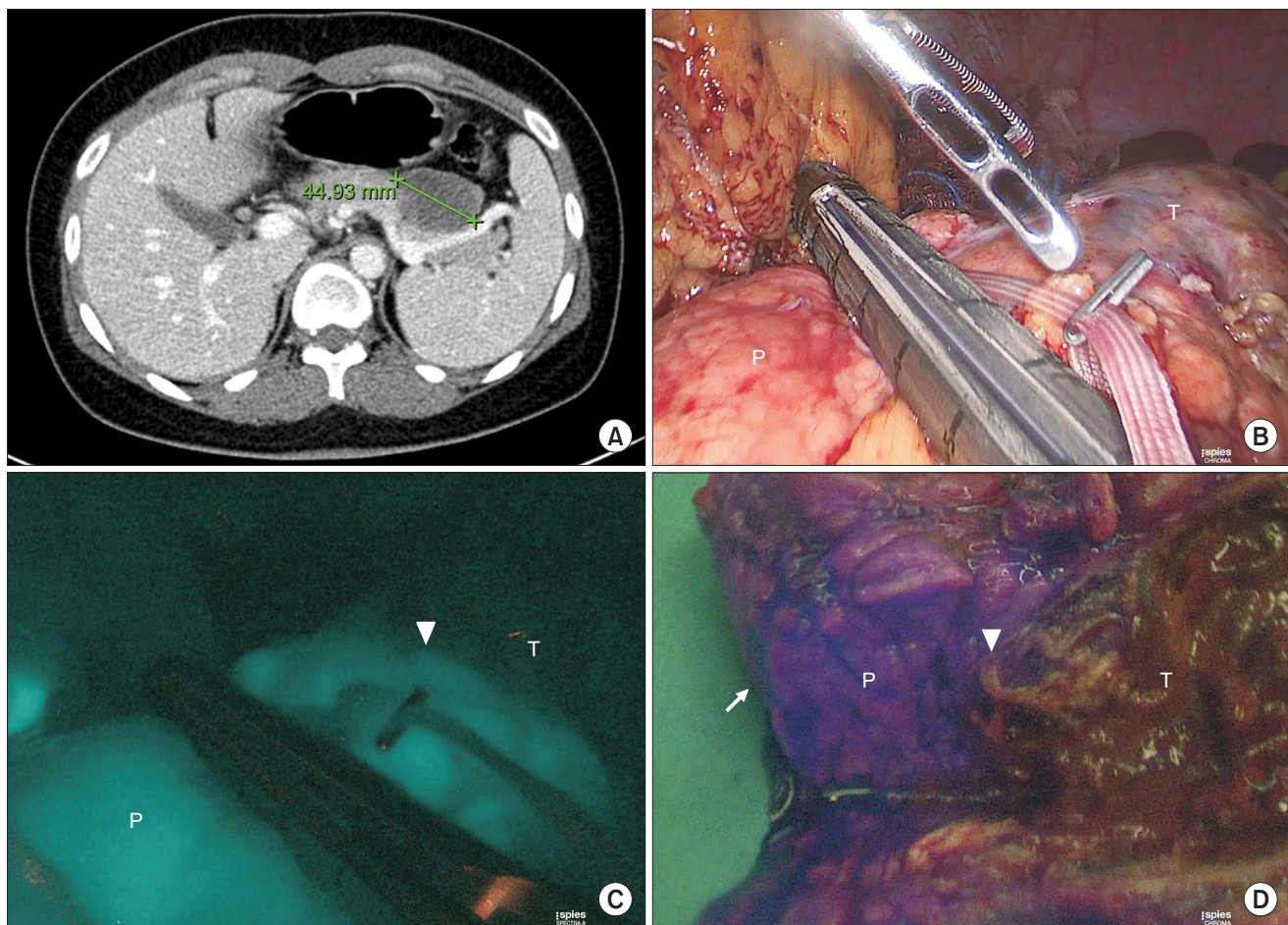


Fig. 1. (A) Preoperative image: 4.5 cm mass in the pancreas tail. (B) Before pancreas resection (bare eye view), (C) before pancreas resection (ICG-fluorescent pancreatic perfusion-guidance view), and (D) Immediate postoperative specimen (ICG-fluorescent pancreatic perfusion-guidance view). P = pancreas parenchyma; T = tumor; white arrow = resection margin; and white arrowhead = perfusion margin.

Postoperative recovery

It was noted that the length of hospital stay was seven days after surgery, during which no significant postoperative complication, such as pancreatic fistula, was reported. Patients received regular follow-ups in outpatient department of surgery.

DISCUSSION

The pancreas is an internal organ with high blood perfusion, ranging from 38.4 ml/min/100 ml to 356 ml/min/100 ml.⁷ Therefore, intravenous ICG can be very easily and quickly detected in the pancreas under near infrared light. This enhanced vision gives strong contrast to the organ compared to a necrotic tumor with poor blood perfusion, such as solid pseudopapillary neoplasm, which surgeons can take advantage of when determining the resection margin of the pancreas. Without this technology, an intraoperative ultrasound or a surgeon's intuition is used for securing the resection margin. In support of this technology, a previous study reported that determining the resection margin using pancreatic perfusion with Doppler techniques was useful in preventing anastomosis site leakage.⁸ Based on our current experience, ICG pancreatic perfusion-guided determination of appropriate resection margin is useful and feasible during pancreaticoduodenectomy.

To the best of our knowledge, this brief report is the first ICG-based real-time intraoperative visualization to determine the appropriate resection margin of the pancreas. Further experiences and clinical applications of ICG-fluorescent-based pancreatic surgery need to be undertaken.

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