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Successful Identification and Closure of an Occult Pleuroperitoneal Communication Using Intraoperative Indocyanine Green Fluorescence in a Patient Undergoing Peritoneal Dialysis: A Case Report

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Abstract

Pleuroperitoneal communication (PPC) is a rare complication of peritoneal dialysis that often necessitates discontinuation due to recurrent pleural effusion. In some cases, the diaphragmatic defect is not visible under standard thoracoscopic inspection, making intraoperative localization challenging. Indocyanine green (ICG) fluorescence has emerged as a useful method for detecting occult fistulas. We report the case of a 51-year-old man undergoing peritoneal dialysis for end-stage renal disease who developed right pleural effusion and poor dialysate outflow three months after initiation. Radionuclide peritoneal scintigraphy demonstrated tracer accumulation in the right hemithorax, confirming PPC. Thoracoscopic inspection revealed no visible diaphragmatic defects. Following intraperitoneal injection of 1,500 mL of dialysate mixed with 25 mg of ICG, near-infrared imaging identified two focal fluorescence points on the diaphragmatic dome. These sites were closed using pledget-reinforced horizontal mattress sutures and covered with a polyglycolic acid sheet and fibrin glue. Peritoneal dialysis was successfully resumed on postoperative day seven, and the patient has remained free of recurrent effusion for two years. ICG fluorescence imaging enables rapid and minimally invasive identification of subtle diaphragmatic fistulas that may not be detectable under standard thoracoscopy. This technique may improve intraoperative localization and increase the success of surgical repair in PPC.

Categories: Nephrology, Cardiac/Thoracic/Vascular Surgery, Pulmonology

Keywords: indocyanine green, intraoperative imaging, peritoneal dialysis, pleural effusion, pleuroperitoneal communication, thoracoscopic surgery

Introduction

Pleuroperitoneal communication (PPC) is a rare complication in patients undergoing peritoneal dialysis (PD), characterized by leakage of dialysis fluid into the pleural cavity [1]. This condition often results in reduced dialysis efficacy and necessitates transition to hemodialysis. While surgical closure is a promising option for preserving PD, the intraoperative identification of fistulous sites remains a major challenge. In particular, small or occult fistulas without apparent diaphragmatic defects are difficult to localize [2]. Recent reports have explored the use of indocyanine green (ICG) fluorescence to visualize such lesions [3]. We report a case in which intraoperative ICG imaging enabled the successful closure of an otherwise unidentifiable PPC, allowing the patient to continue PD.

Case Presentation

The patient was a 51-year-old man who had initiated PD for end-stage renal disease secondary to chronic glomerulonephritis. Three months after starting PD, he developed poor drainage of dialysate. Although he was asymptomatic and there was no impairment of oxygenation, a routine chest X-ray revealed right-sided pleural effusion. CT showed a moderate right pleural effusion with associated atelectasis (Figure 1). Abdominal scintigraphy was performed using dialysate mixed with technetium-99m macroaggregated albumin, which demonstrated tracer accumulation in the right thoracic cavity, leading to the diagnosis of PPC (Figure 2).

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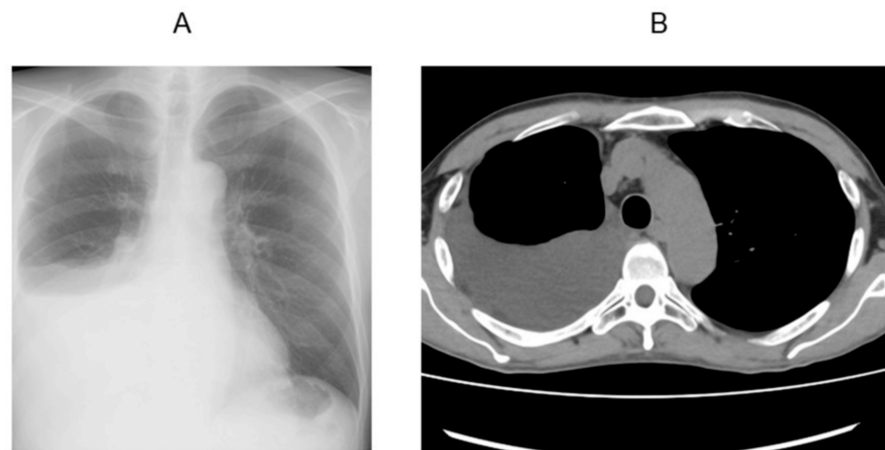


FIGURE 1: Preoperative imaging findings.

(A) Chest radiograph demonstrating right-sided pleural effusion.

(B) Chest CT showing pleural effusion in the right thoracic cavity with associated atelectasis of the right lower lobe.

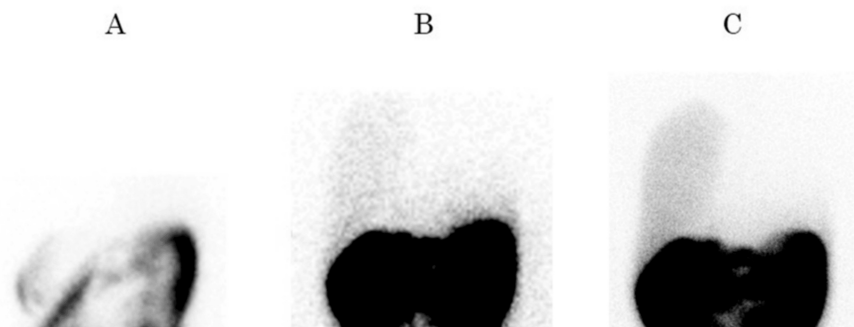


FIGURE 2: Scintigraphy findings.

Abdominal scintigraphy performed after intraperitoneal administration of 1,500 mL of dialysate mixed with technetium-99m macroaggregated albumin. Progressive tracer accumulation in the right thoracic cavity was observed over time: (A) 5 minutes, (B) 35 minutes, and (C) 2 hours after administration.

The patient was referred to our department after expressing a preference for surgical exploration and closure of the fistula to continue PD. The procedure was performed by a thoracoscopic approach. The patient was placed in the left lateral decubitus position. A 12-mm camera port was introduced at the seventh intercostal space along the mid-axillary line, and two 5-mm working ports were inserted at the fifth intercostal space on the anterior axillary line and the eighth intercostal space on the posterior axillary line. The diaphragm was carefully inspected from the thoracic side, but no obvious defects, cystic lesions, or identifiable communication sites were found (Figure 3A). To identify the fistula, the patient was placed in a slight Trendelenburg position to facilitate the distribution of the dialysate toward the diaphragm. Then, 1,500 mL of dialysate mixed with 25 mg of ICG was infused through the PD catheter. Under near-infrared fluorescence imaging, two punctate fluorescent spots were observed near the diaphragmatic apex (Figure 3B). These sites were considered the communication sites and were closed with pledget-reinforced 4-0 polypropylene horizontal mattress sutures. The area was then reinforced with a polyglycolic acid sheet and fibrin glue (Figure 3C).

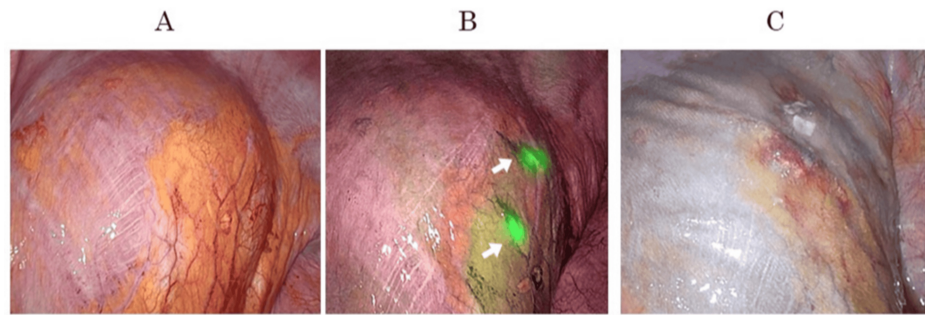


FIGURE 3: Intraoperative thoracoscopic view.

(A) Thoracoscopic view showing no apparent fistulous defect on the diaphragm under white-light observation.

(B) Near-infrared fluorescence imaging after intraperitoneal injection of 1,500 mL of dialysate mixed with 25 mg of indocyanine green, revealing two focal fluorescent points consistent with fistulous sites (arrows).

(C) The fistulous sites were closed with horizontal mattress sutures using pledgeted polypropylene sutures, followed by coverage with a polyglycolic acid sheet and fibrin glue.

PD was resumed on postoperative day seven. The initial PD dwell contained ICG, and the absence of drainage into the thoracic cavity via the chest tube was confirmed before its removal. No recurrence of pleural effusion was observed thereafter, and the patient was discharged on postoperative day eight. He has continued PD uneventfully for two years without recurrence of pleural effusion.

Discussion

PPC is a relatively uncommon complication, occurring in fewer than 2% of patients undergoing PD; however, approximately half of affected patients ultimately fail to continue PD, and most cases develop early after PD initiation [1]. Patients typically present with dyspnea due to increasing pleural effusion, although inadequate dialysate drainage may be the initial sign. Treatment consists of both conservative and surgical approaches. Conservative therapy, including temporary suspension of PD, reduction of dwell volume, or chemical pleurodesis, achieves a success rate of approximately 50% [4]. Surgical repair offers the advantage of direct inspection of the diaphragm, with a reported success rate of 81% when the fistula is identified intraoperatively. However, the success rate decreases to 38% when no defect is visualized [2]. Therefore, accurate intraoperative detection of the fistula is essential for successful repair.

Reported PPC lesions include diaphragmatic slits, blebs, and pinholes; however, PPC may also arise through an apparently intact diaphragm [5–7]. Various intraoperative detection techniques have been described, such as dye injection, pneumoperitoneum, and near-infrared fluorescence using ICG [3]. Recent studies have increasingly favored pneumoperitoneum and ICG fluorescence over dye injection due to higher detection sensitivity [8,9]. We previously reported our surgical strategy for PPC, focusing on laparoscopic pneumoperitoneum [6]. Pneumoperitoneum allows direct ventral visualization and detection of small defects but requires collaboration with general surgeons, peritoneal access, longer preparation time, and additional cost. In contrast, ICG administration via an existing PD catheter is simple and does not require any additional procedures or interdepartmental collaboration. Although ICG cannot be used in patients with iodine allergy, it is otherwise safe, minimally invasive, and capable of identifying even subtle defects rapidly. Previous reports have demonstrated the usefulness of ICG fluorescence; however, its potential may still be underrecognized. ICG provides real-time, high-contrast visualization and is particularly advantageous when the diaphragm appears macroscopically normal, offering a practical and effective method for fistula detection. In the present case, even though the diaphragm appeared macroscopically normal, the fistula was rapidly identified using fluorescence imaging. This method appears to be safe, simple, and effective. Even when no abnormalities are observed on the thoracic side, performing this technique before proceeding to an abdominal approach may be useful for localizing the fistulous site.

Conclusions

ICG fluorescence imaging is an invaluable tool for identifying occult fistulas in PPC. In this case, the technique enabled precise localization and successful closure of the leak, allowing uninterrupted continuation of PD. Intraoperative ICG use should be considered in the surgical management of PPC, particularly when the fistula is not macroscopically apparent.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Shinji Shinohara, Toshihiro Osaki

Acquisition, analysis, or interpretation of data: Shinji Shinohara, Koji Kuroda, Kenichi Saito

Drafting of the manuscript: Shinji Shinohara

Critical review of the manuscript for important intellectual content: Koji Kuroda, Kenichi Saito, Toshihiro Osaki

Supervision: Toshihiro Osaki

Disclosures

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