

## A Case of Peritoneal Dialysis-related Acute Hydrothorax, Which Was Successfully Treated by Thoracoscopic Surgery, Using Collagen Fleece

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Peritoneal dialysis (PD) is an established renal replacement therapy for patients with end-stage renal disease (ESRD), and it is an effective mean of treatment for maintaining patients' residual renal function and their quality of life (QOL). However, acute hydrothorax is one of the complications of PD that can lead to discontinuation of PD and a switch to hemodialysis.

We report a case of a 51-year-old woman with ESRD secondary to chronic glomerulonephritis who was placed on intermittent PD (IPD) and developed right-sided acute hydrothorax one month later. Scintigraphy with technetium-99 m macroaggregated human albumin (Tc-99 m MAA) revealed presence of a pleuroperitoneal communication, and treatment by autologous blood pleurodesis was performed twice. However, the treatment was ineffective, and two months after the onset of the hydrothorax, we performed video-assisted thoracoscopic surgery (VATS), using collagen fleece coated with fibrin glue to seal off the communication. The surgical procedure was followed by complete resolution of the hydrothorax. It was possible to resume the PD about one month postoperatively, and there has been no evidence of recurrence of the hydrothorax. VATS with collagen fleece was effective in treating acute hydrothorax secondary to a pleuroperitoneal communication that developed as a complication of PD.

**Key words:** peritoneal dialysis, acute hydrothorax, thoracoscopic surgery, collagen fleece

### INTRODUCTION

The incidence of acute hydrothorax in patients on peritoneal dialysis (PD) has been reported to range from 1.6% [1] to 6.0% [2], and the hydrothorax is right-sided in 88% of cases [1]. The most common cause of acute hydrothorax is pleuroperitoneal communication due to a partial defect in the muscle fibers in the hemidiaphragm [3, 4]. The missing muscle fibers are replaced with a disordered net work of collagen. It has been reported that the defect can exist at one to up to several sites in the diaphragm [3-6].

Conventionally, pleuroperitoneal communication was most commonly treated as follows: with intermittent automated peritoneal dialysis (IAPD) using a cyclor device, performed by gradually decreasing the volume of the dialysate at each exchange [7]; or with pleurodesis using tetracycline [1, 8] or autologous blood [9]. However, in 46% of cases, PD could not be restarted and the treatment had to be changed to hemodialysis [1].

In recent years, there have been reports showing that thoracoscopic pleurodesis using talc is effective [10-13]. This time, we performed thoracoscopic surgery, using collagen fleece coated with fibrin glue (TachoComb<sup>®</sup>; Product manager: Nycomed Pharmaceutical Co., Ltd.,

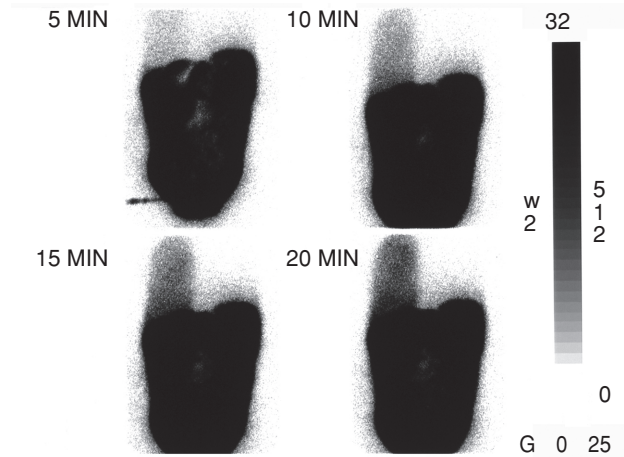
Denmark; Sales department: Torii Pharmaceutical Co., Ltd., Tokyo, Japan), which enabled restart of PD. Furthermore, PD could safely be continued for 7 years until the treatment was switched to hemodialysis because of onset of fungal peritonitis. Literature is scarce in pleuroperitoneal communication complicating PD treated with thoracoscopic surgery using collagen fleece coated with fibrin glue (TachoComb<sup>®</sup>) have been reported. Therefore, we report here the usefulness of collagen fleece with reviews on pleuroperitoneal communication based on some reports published to date.

### CASE REPORT

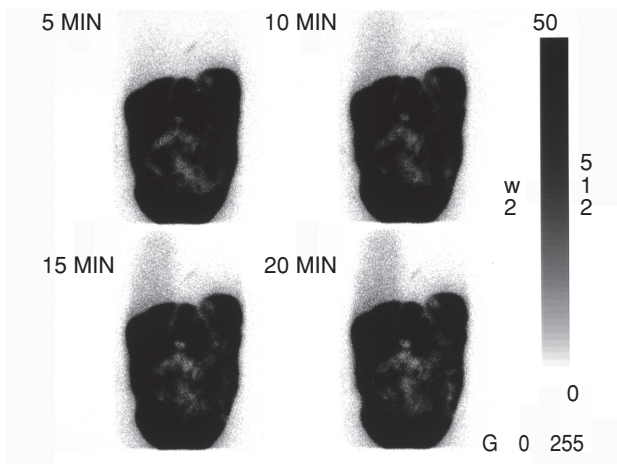
The patient was a 51 year-old woman with ESRD due to chronic glomerulonephritis who was placed on PD. The initial prescription was incremental PD using Dianeal PD-4<sup>®</sup> (Baxter<sup>®</sup>) 1.5 L retained for 6 h, 2 bags per day. About a month after the dialysis induction, the patient experienced dyspnea and visited our hospital. Physical findings included decreased breath sounds on the right side. Arterial oxygen saturation (SaO<sub>2</sub>) was 96%. Chest X-ray examination revealed right-sided pleural effusion, which strongly suggested pleuroperitoneal communication (Fig. 1). PD was continued with the dialysate retention volume reduced



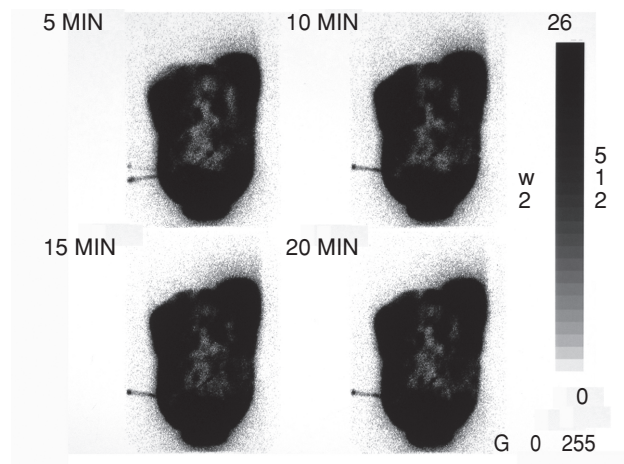
**Fig. 1** Chest X-ray film obtained when the patient visited our hospital with the complaint of dyspnea revealed right-sided pleural effusion.



**Fig. 2** Scintigrams by technetium - 99 m macroaggregated human albumin (Tc-99 m MAA) revealed the leakage of the peritoneal dialysis fluid into the right thoracic cavity.



**Fig. 3** Scintigrams by technetium - 99 m macroaggregated human albumin (Tc-99 m MAA) obtained after autologous blood pleurodesis performed twice. The leakage of the peritoneal dialysis fluid into the right thoracic cavity remained.



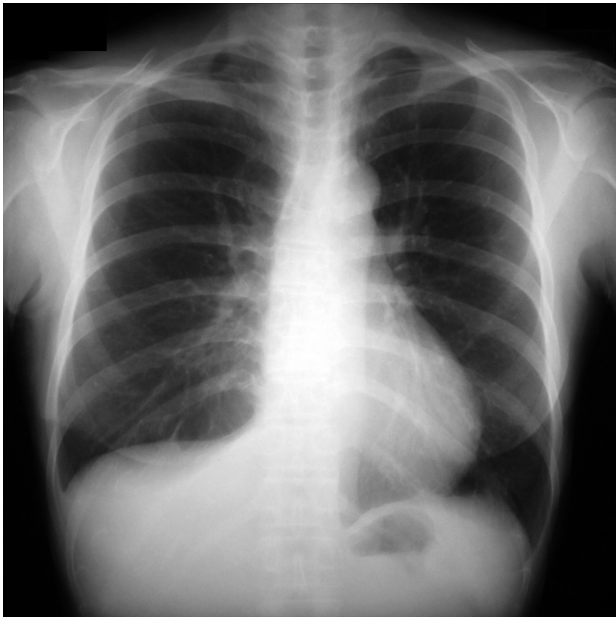
**Fig. 4** Scintigrams by technetium - 99 m macroaggregated human albumin (Tc-99 m MAA) obtained after video-assisted thoracoscopic surgery (VATS). The leakage of the peritoneal dialysis fluid into the right thoracic cavity completely disappeared.

to 500 mL because the patient did not have dyspnea when the peritoneal cavity was empty and had more than 1400 mL/day of residual renal function. Two days later, scintigraphy using technetium-99 m macroaggregated human albumin (Tc-99 m MAA) led to the diagnosis of pleuroperitoneal communication (Fig. 2). We performed pleurodesis using 40 mL of autologous blood twice at 4-week interval. Subsequently, the pleural effusion decreased and the subjective symptom was improved. However, although Tc-99 m MAA scintigraphy confirmed the reduced speed of transdiaphragmatic leakage, autologous blood pleurodesis proved unsuccessful (Fig. 3). As the last-resort treatment, video-assisted thoracoscopic surgery (VATS), was performed under general anesthesia.

There were slit regions that had become thin in the central region of the right hemidiaphragm, outside

of which communication pores measuring 2 mm in diameter were present. The thin regions of the diaphragm including the communication pores were resected, and suture was performed. The sutures were then reinforced by applying collagen fleece coated with fibrin glue (TachoComb®; Product manager: Nycomed Pharmaceutical Co., Ltd., Denmark; Sales department: Torii Pharmaceutical Co., Ltd., Tokyo, Japan) onto them. VATS was completed in 45 min.

The postoperative course was uneventful. PD was substituted with hemodialysis for two weeks. Then, the dialysate retention volume was gradually increased from 500 mL. At the time when the retention of 1.5 L dialysate became tolerable, Tc-99 m MAA scintigraphy was performed, which confirmed disappearance of the pleuroperitoneal communication (Fig. 4). About one month after operation, the patient was able to return



**Fig. 5** Chest X-ray film obtained after video-assisted thoracoscopic surgery (VATS) and restart of peritoneal dialysis. Right-sided pleural effusion disappeared.

to PD.

The patient's post-discharge course was also uneventful, demonstrating effectiveness of PD to recover and maintain patient's normal life subsequently, however, the frequency of excessive fluid retention increased as the residual renal function decreased, necessitating continuous ambulatory peritoneal dialysis (CAPD) five times daily in five years after PD induction. Nevertheless, hydrothorax did not recur throughout the course. Seven years after PD induction, the catheter had to be removed because of an onset of fungal peritonitis, and the treatment was switched to hemodialysis.

## DISCUSSION

The incidence of acute hydrothorax in PD patients has been reported to range from 1.6% [1] to 6.0% [2]. According to the results from a multicenter study involving 3,195 Japanese patients, the hydrothorax is right-sided in 88% of cases, without sex difference [1]. The most common cause of acute hydrothorax is pleuroperitoneal communication due to a partial defect in the muscle fibers in the hemidiaphragm [3, 4]. The missing muscle fibers are replaced with a disordered net work of collagen. It has been reported that the defect can exist at one to up to several sites in the diaphragm [3-6]. In addition to anatomical issues, a physiological mechanism is heavily involved in the etiology of acute hydrothorax. Physiologically, the pleural cavity is under negative pressure. Furthermore, the intraperitoneal pressure becomes positive when the dialysate is injected into the peritoneal cavity. This pressure gradient between the pleural cavity and the peritoneal cavity results in the passage of the dialysate into the thoracic cavity [14]. The pressure gap is also considered to account for the fact that a rapid remission of hydrothorax cannot be obtained even after discontinuation of PD, and the tamponade action of

the subphrenic hepatic capsule is one of the contributing factors [15]. The etiology of delayed hydrothorax involves the intraperitoneal positive pressure as an acquired mechanism. The intraperitoneal pressure reaches up to 120-150 cmH<sub>2</sub>O. Therefore, it has also been said that weak parts of the connective tissue rise and split, leading to the onset of acute hydrothorax [1, 6].

As for diagnosing pleuroperitoneal communication, if plain chest X-ray examination or chest computerized tomography (CT) reveals the presence of pleural effusion in the right side alone, the finding is strongly suggestive of this disease. For the definitive diagnosis, sequential scintigraphy after intraperitoneal injection of a Tc-99 m-MAA-added or Tc-99 m-sulfur-colloid-added peritoneal dialysis fluid is useful. The definitive diagnosis can be made if signals from the right thorax are confirmed. The definitive diagnosis can also be made if the glucose concentration of the pleural fluid is similar to that of the dialysate or far higher than the blood glucose [16], or if methylene blue diluted in the peritoneal dialysis fluid is detected from the pleural fluid [12]. Indigocarmine seems to have advantages for intraoperative identification of communication pores.

In the present case, we selected Tc-99 m MAA with which we could assess the treatment effect by comparing the change in the degree of peritoneal dialysis fluid transfer. The transfer rate was shown to have decreased after autologous blood pleurodesis. On the basis of this experience along with other evidence, we consider that Tc-99 m MAA scintigraphy has advantages for assessment of treatment effect.

Conventionally, pleuroperitoneal communication was most commonly treated either: with intermittent automated peritoneal dialysis (IAPD) using a cyclor device, performed by gradually decreasing the volume of the dialysate at each exchange [7]; or with pleurodesis using tetracycline [1, 8] or autologous blood [9]. However, in 46% of those cases, PD could not be restarted and had to be replaced with hemodialysis [1]. Furthermore, pleurodesis with tetracycline or autologous blood entailed the risk of recurrence and always required low-volume intermittent PD. These pleurodesis may be applicable as maintenance dialysis while the residual renal function is preserved. However, the dialysate volume would have to be increased, had the residual renal function decreased.

In recent years, there have been some reports showing that thoracoscopic pleurodesis was effective for treatment of pleuroperitoneal communication complicating PD, but in most of the cases, the surgery involved use of talc [10-13]. Talc is widely used in pleurodesis, mostly for treatment of hydrothorax associated with malignant disease, in expectation of extensive pleural adhesion. This time, we successfully repaired pleuroperitoneal communication by VATS using collagen fleece coated with fibrin glue (TachoComb<sup>®</sup>), thus enabling the long-term continuation of full-time (24 h a day) CAPD. TachoComb is a tissue sealing sheet made of spongiform collagen coated with fibrinogen and thrombin and has recently been used in thoracic surgeries such as pulmonary fistula, bullectomy, or pulmonary lobe fixation [17-19].

The etiology of pleuroperitoneal communication involves the combination of the presence of histologically vulnerable spots and the non-physiological increase of intraperitoneal pressure. Therefore, its repair must be robust enough to bear the non-physiological intraperitoneal pressure. When there are slit regions that have become weak as in the present case, the possibility arises that new communication pores appear after repairment under abdominal pressure. Therefore, the repairment procedure requires not only simple reefing or adhesion but also sufficient reinforcement to bear the high intraperitoneal pressure.

In conclusion, we performed VATS using collagen fleece for treatment of PD-related pleuroperitoneal communication that permitted long-term stable PD treatment. VATS using collagen fleece is useful in treatment of pleuroperitoneal communication complicating PD.

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