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CASE REPORT Open Access

Successful treatment of pleuroperitoneal communication with pleurodesis using autologous blood in a patient with severe heart failure undergoing peritoneal dialysis: a case report and brief literature review

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Abstract

Background: Pleuroperitoneal communication is a potential complication of peritoneal dialysis (PD). Of the various treatment strategies for pleuroperitoneal communication, successful treatment with pleurodesis using autologous blood has rarely been reported.

Case presentation: A 58-year-old man with end-stage kidney disease secondary to diabetic nephropathy and severe heart failure was placed on PD. He developed right-sided hydrothorax after the commencement of PD. Technetium-99m macro-aggregated human serum albumin peritoneal scintigraphy revealed pleuroperitoneal communication. PD was temporarily discontinued and substituted with hemodialysis. Subsequently, the levels of pleural fluid decreased. However, the resumption of PD exacerbated the hydrothorax. After thoracentesis, 50 mL of autologous blood was instilled into the right pleural cavity. There were no complications related to the procedure. PD was reinitiated 5 days after pleurodesis. Repeated chest X-rays did not depict any evidence of recurrent hydrothorax over the subsequent 10 months.

Conclusions: Pleurodesis using autologous blood was effective for pleuroperitoneal communication and was evidently safe in our patient. It should be considered in patients with severe heart failure since it is minimally invasive.

Keywords: Autologous blood, Hydrothorax, Peritoneal dialysis, Pleurodesis, Pleuroperitoneal communication, Severe heart failure

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Background

Pleuroperitoneal communication (PPC) is one of the potential complications of peritoneal dialysis (PD). It causes retention of pleural fluid by the transfer of dialysate injected into the abdominal cavity into the thoracic cavity. It is speculated that the mechanisms underlying the development of hydrothorax include the presence of congenital or acquired diaphragmatic defects, bleb rupture in the fragile part of the diaphragm, increased intra-abdominal pressure, lymphatic drainage disorders, and malpositioning of a PD catheter [1–6]. Hydrothorax often develops at the beginning of PD and presents chiefly in the right hemithorax [7, 8]. Its incidence reportedly ranges from 1.6 to 10% in patients undergoing PD [9]. Some patients remain asymptomatic, while others experience coughing, dyspnea, chest pain, and/or reduced ultrafiltration. PD must be replaced by hemodialysis in approximately 50% of patients [7, 8].

The treatment for hydrothorax complicating PD includes cessation of treatment, pleurodesis with sclerosing agents, and surgical intervention. However, the ideal management strategy remains undetermined. Pleural adhesion with autologous blood is advantageous, since it is safe and has almost no adverse effects. However, there are few case reports of successful treatment of PPC with autologous blood. Herein, we present a case of PD-related hydrothorax successfully treated using pleurodesis with autologous blood in a patient with severe heart failure.

Case presentation

A 58-year-old man with end-stage kidney disease secondary to diabetic nephropathy and severe heart failure was placed on PD. The PD prescription was three exchanges of 1 L of 2.5% glucose dialysate. He was treated with telmisartan, carvedilol, furosemide, trichlormethiazide, atorvastatin, low-dose aspirin, lansoprazole, ferrous citrate, calcium polystyrene-sulfonate, and bixalomer. He was hospitalized because the chest X-ray revealed right-sided pleural effusion at a regular visit 4 months after the commencement of PD. On admission, his height was 161.1 cm and his weight was 53.2 kg. The body temperature was 37.1 °C, the blood pressure was 116/66 mmHg, and the heart rate was 93 beats per min. The arterial oxygen saturation was 96% at room air. Physical examination revealed attenuated breathing sounds in the right lung. There was no edema in the legs. The results of the blood tests on admission are shown in Table 1. He had anemia and hypoalbuminemia, and the chest X-ray revealed right-sided pleural effusion (Fig. 1).

Thoracentesis was performed on the second day of hospitalization. The glucose level of the pleural fluid was 181 mg/dL and the plasma glucose level was 83 mg/dL. Bacterial cultures and cytology were negative. These results suggested leakage of peritoneal dialysate into the right pleural cavity. The ejection fraction was approximately 25–30% on echocardiography, which did not differ substantially from the previous result. The diameter of the inferior vena cava was 7 mm. Plasma levels of brain natriuretic peptide exhibited a declining trend. Therefore, heart failure was not considered to be a major cause of the right-sided hydrothorax.

Technetium-99m macro-aggregated human serum albumin peritoneal scintigraphy was performed on the ninth day of hospitalization. It depicted leakage of peritoneal dialysate into the right thoracic cavity, and a diagnosis of PPC was made (Fig. 2). PD was suspended and hemodialysis via a right internal jugular vein catheter was initiated instead. The pleural effusion subsequently diminished and PD was reinitiated 11 days after suspension, with one exchange of 1 L of 2.5% glucose dialysate. A large right-sided pleural effusion was demonstrated on the chest X-ray 4 weeks after the resumption of PD. Accordingly, the patient was re-hospitalized to treat the PPC 2 weeks after the recurrence of hydrothorax. Given that he had severe heart failure, pleurodesis with autologous blood was used to treat the PPC, since it is minimally invasive and has almost no adverse effects. On the fourth day of the second admission, a 28 Fr chest tube was placed in the right thoracic cavity and the pleural fluid was completely discharged. Fifty milliliters of autologous blood was instilled into the right thoracic cavity by bolus injection immediately after drawing blood, followed by 50 mL of sterile normal saline. He took various postures initially, and then maintained Fowler's position until the next day in accordance with previously published case reports [10, 11]. PD was reinitiated on the ninth day of the second admission. No evidence of

Table 1 Blood test data on admission

WBC count	7400/mm^3	Albumin	2.7 g/dL	AST	14 U/L
RBC count	3.41 × 10^6/mm^3	Na	146 mEq/L	ALT	10 U/L
Hemoglobin	10.6 g/dL	K	4.8 mEq/L	ALP	175 U/L
Hematocrit	32.4%	Cl	103 mEq/L	γGTP	20 U/L
Platelet count	321000/mm^3	BUN	60 mg/dL	Total cholesterol	165 mg/dL
		Creatinine	10.50 mg/dL	HDL cholesterol	42 mg/dL
		Uric acid	7.2 mg/dL	LDL cholesterol	109 mg/dL
				Triglyceride	70 mg/dL

ALP alkaline phosphatase, *ALT* alanine aminotransferase, *AST* aspartate aminotransferase, *BUN* blood urea nitrogen, *HDL* high-density lipoprotein, *LDL* low-density lipoprotein, *RBC* red blood cell, *WBC* white blood cell, *γGTP* gamma-glutamyl transferase

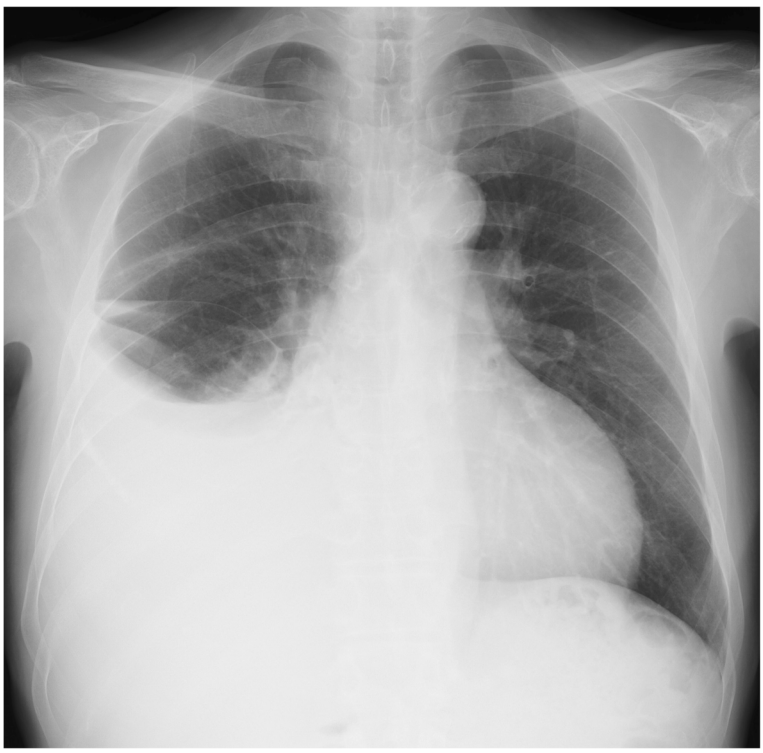

Fig. 1 Chest X-ray revealing massive right-sided pleural effusion

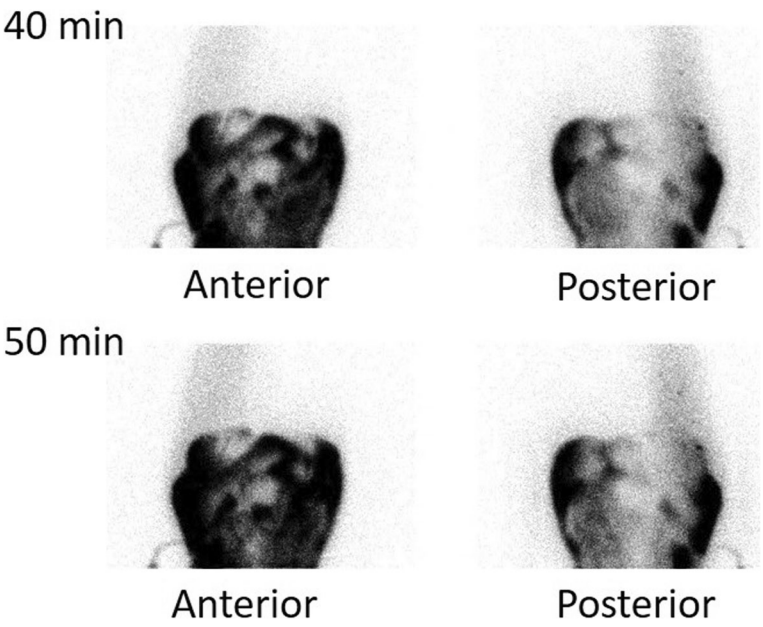

Fig. 2 Technetium-99m macro-aggregated human serum albumin peritoneal scintigraphy showing leakage of peritoneal dialysate into the right thoracic cavity

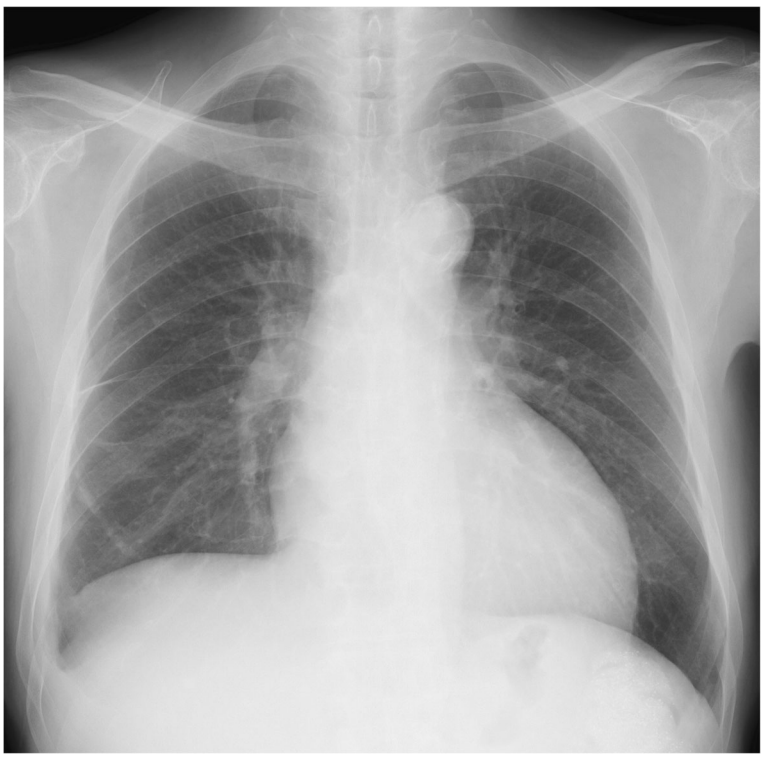

Fig. 3 Chest X-ray performed 6 months after pleurodesis with autologous blood depicting apparent resolution of the hydrothorax

recurrence of hydrothorax was observed on repeated chest X-rays conducted over the subsequent 10 months (Fig. 3).

Discussion

Several options exist for treating hydrothorax complicating PD, including interruption of PD, conventional pleurodesis, and surgical intervention. However, to date, no controlled trials comparing different therapeutic approaches have been reported. Therefore, there is no significant data available to guide the choice of therapy, and treatment strategies are based on experts' opinions and physicians' preferences [12].

Generally, the management of hydrothorax complicating PD should start with the cessation of PD or reduction of peritoneal dialysate volume. Interruption of PD is evidently associated with a rate of spontaneous resolution of approximately 50% [8]. Therapeutic thoracentesis should be performed if patients develop dyspnea due to moderate to large pleural effusion. In the present case, the first intervention was PD cessation for 11 days, which was ineffective. It is recommended that PD should be suspended for 2–6 weeks [8], suggesting that the approach utilized in the current case would likely have been successful if we had waited longer before recommencing PD.

Conventional pleurodesis is considered when a previous conservative approach is ineffective or recurrent hydrothorax occurs. In the process of pleurodesis, the instillation of sclerosing agents causes inflammation, pleural coagulation-fibrinolysis imbalance, fibroblast proliferation, and collagen production [13], leading to obliteration of PPC. Several agents, such as talc, tetracycline, fibrin glue, OK-432, and autologous blood have been used for pleurodesis for treating PPC [12]. The most efficacious agent has not been determined to date. Chow et al. [8] reviewed 104 consecutive cases of hydrothorax complicating continuous ambulatory peritoneal dialysis (CAPD) and concluded that the success rate of chemical pleurodesis via a thoracostomy tube was only 48%, suggesting that the method is not reliably effective. Autologous blood is believed to be a weak adhesive agent compared with other adhesive agents [14]. However, adhesive agents except for autologous blood often cause side effects such as chest pain, pyrexia, and fibrotic changes in the peritoneum adjacent to the pleura. We opted for autologous blood as an adhesive agent for the present patient because there was a possibility that the side effects reportedly associated with alternative agents may have resulted in deterioration of heart failure. He experienced no side effects and his heart failure did not worsen after pleurodesis using autologous blood.

In contrast with closed pleurodesis, the surgical approach enables the detection and repair of diaphragmatic defects under direct visualization. Diaphragmatic breaches can be sutured with or without reinforcement with patches. Pleurectomy or pleural abrasion can also be conducted during open thoracotomy. In the literature, all cases undergoing open thoracotomy were successful and were able to resume CAPD [8]. Although open thoracotomy has a high success rate, it was deemed inadvisable in the present case due to the associated perioperative risk.

Diagnostic and therapeutic procedures incorporating video-assisted thoracoscopy (VAT) for PPC in a PD patient were first performed in 1996 [15], and it has since become the standard treatment. The approach requires minimal incisions, yet it facilitates direct visualization of the entire diaphragm. VAT surgery enables the direct application of talc, abrasion of the parietal pleura, and closing of flaws in the diaphragm. Two reviews of the relevant published literature suggest that the success rate of treatment with VAT surgery is sufficiently high, ranging from 72 to 88% [8, 16], although it falls short of that of open thoracotomy. Some authors have reported the successful performance of thoracoscopy for talc pleurodesis under local anesthesia [17–19], although general anesthesia is required in most cases. Hemodialysis with an arteriovenous fistula should be avoided in patients with severely impaired cardiac function, such as the present patient; CAPD should be continued, and less invasive procedures should be utilized. Hence, if the treatment using pleurodesis with autologous blood had ultimately failed in the present patient, this approach would have been an appropriate option, considering his cardiac function. There is a concern that conventional pleurodesis may jeopardize the success of subsequent thoracoscopy; however, thoracoscopy can be performed without any complications after conventional pleurodesis with autologous blood [20].

Literature review

Successful treatment of PPC in patients with PD by pleurodesis using autologous blood has rarely been reported [10, 11, 21–23]. A summary of previously reported cases is shown in Table 2.

The volumes of blood instilled each time in previously reported cases range from 40 mL [10, 11, 23] to 100 mL [21, 22]. The number of times successful pleurodesis with autologous blood was performed ranges from one [10, 22] to three times [21]. The duration of PD cessation after the last blood instillation varies widely, from 24 h [22] to 8 weeks [23]. The duration of PD cessation was 5 days in the present case, which is relatively short compared with that in previous reports [10, 11, 23]. However, it has been reported that pleurodesis with autologous blood was successful in cases where PD was discontinued for only 24 h after pleurodesis [22]. Short discontinuation of PD is desirable to avoid intravenous catheter-related adverse events. Hence, we recommenced PD 5 days after pleurodesis. No adverse effects such as fever or chest pain were described in the cases reported to date including the present case for pleurodesis with autologous blood.

It has been speculated that blood pleurodesis exhibits its effect via a dual mechanism. Firstly, diaphragmatic breaches are directly sealed by the formation of a clot (sometimes referred to as a blood patch effect). Subsequently, the fibrinogenic activity of the blood generates pleurodesis through pleural irritation and inflammation [24]. Compared with talc powder or tetracycline, autologous blood can more rapidly cease air leaks in patients with persistent air leak because both talc powder and tetracycline are believed only to produce inflammation and scarring with no “patch” effect [25]. The same efficacy would be expected in the treatment of PPC in terms of the time to close flaws in the diaphragm.

The success rate of pleurodesis with autologous blood for PPC is unclear. Some authors have reported that pleurodesis with autologous blood was unsuccessful [20, 21, 26]. Some prospective studies have investigated the efficacy of pleurodesis with autologous blood versus other sclerosants for diseases other than PPC. One randomized controlled trial showed that autologous blood pleurodesis has

Table 2 Clinical features of previously reported pleuroperitoneal communication cases successfully treated by pleurodesis with autologous blood

Reference	Age (years)	Sex	Instilled blood volume per time	Number of times	Duration of PD cessation after the last blood instillation	Adverse effects
21	38	M	100 mL	3	N.D.	N.D.
10	24	F	40 mL	1	21 days	None
11	80	F	40 mL	2	4 weeks	None
22	54	M	100 mL	1	24 h	None
23	58	M	40 mL (first time) 50 mL (second time)	2	8 weeks	None
Present case	58	M	50 mL	1	5 days	None

F female, *M* male, *N.D.* not documented, *PD* peritoneal dialysis

equivalent efficacy compared to tetracycline pleurodesis with success rates of 83.4% and 87.5%, respectively, (p = 0.36) for the treatment of malignant pleural effusion [27]. Another randomized controlled trial showed that autologous blood pleurodesis also has equivalent efficacy compared to talc pleurodesis with success rates of 82.0% and 87.0%, respectively, (p = 0.12) for the treatment of malignant pleural effusion [28]. Moreover, a prospective study compared the efficacy of autologous blood pleurodesis with talcum powder and tetracycline in patients with persistent air leak resulting from primary and secondary spontaneous pneumothorax; the success rates were 75.0%, 84.2%, and 63.6%, respectively, for autologous blood, talc powder, and tetracycline. Thus, the efficacy of autologous blood is comparable to that of talc powder but superior to that of tetracycline [25]. Further studies are needed to clarify if autologous blood pleurodesis has equivalent or superior efficacy for PPC compared with other sclerosing agents.

Conclusions

Here, we described the case of a patient with hydrothorax complicating PD, who was successfully treated with pleurodesis with autologous blood after the failure of temporary cessation of PD. This treatment should be the next choice in patients with severe heart failure if more conservative options fail because it is safe and effective.

Abbreviations

CAPD: Continuous ambulatory peritoneal dialysis; PD: Peritoneal dialysis; PPC: Pleuroperitoneal communication; VAT: Video-assisted thoracoscopy

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Authors' contributions

ST, KH, and MR took care of this patient and decided the treatment. ST drafted the manuscript and is responsible for the final version of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The data and materials were all included in the manuscript.

Ethics approval and consent to participate

The case report was written in compliance with the Declaration of Helsinki.

Consent for publication

Written informed consent was obtained from the guardian to publish this case report and any accompanying images. A copy of the written consent form is available for review by the editor of this journal.

Competing interests

The authors declare that they have no competing of interests.

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