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Case Report

Two case reports of two interventional radiology techniques for the treatment of stage II empyema: Hydrodissection and guidewire-dissection ☆,☆☆

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ABSTRACT

Empyema is an infection of the pleural space that is classified into 3 stages. Video-assisted thoracoscopic surgery is recommended as the first-line approach for stage II acute empyema. The purpose of video-assisted thoracoscopic surgery is also achieved with hydrodissection and guidewire-dissection by breaking the septa mechanically in the pleural cavity. Hydrodissection and guidewire-dissection are techniques in which a contrast medium is administered at high pressure and a guidewire is inserted into the pleural cavity to break the septa, respectively. Hydrodissection and guidewire-dissection might be minimally invasive alternatives for the treatment of septated empyema.

Introduction

Empyema is an infection of the pleural space that often occurs following bacterial pneumonia and subsequently parapneumonic effusion. Empyema is classically subdivided into 3 stages: I, simple exudate stage; II, fibrinopurulent stage; and III, later organizing stage [1]. In general, thoracentesis without pleural drain tube placement is recommended for treatment of stage I, while tube thoracostomy should be performed in cases of purulence of the pleural fluid or positive Gram stain or culture results [2]. Moreover, pleural pH <7.2, pleural fluid glucose value <40 mg/dL, and lactate dehydrogenase (LDH) value >1000 IU/L are indications for tube thoracostomy [2]. In a previous meta-analysis, a statistically significant difference in the mortality rates following primary surgical and nonsurgical management of pleural empyema could not be observed [3]. Furthermore, the American Association for Thoracic Surgery consensus guidelines recommend Video-assisted thoracoscopic surgery (VATS) as the first-line approach for stage II

Abbreviations: CXR, Chest X-ray; IPFT, Intrapleural fibrinolytic therapy; LDH, Lactate dehydrogenase; NECT, Noncontrast-enhanced CT; VATS, Video-assisted thoracoscopic surgery.

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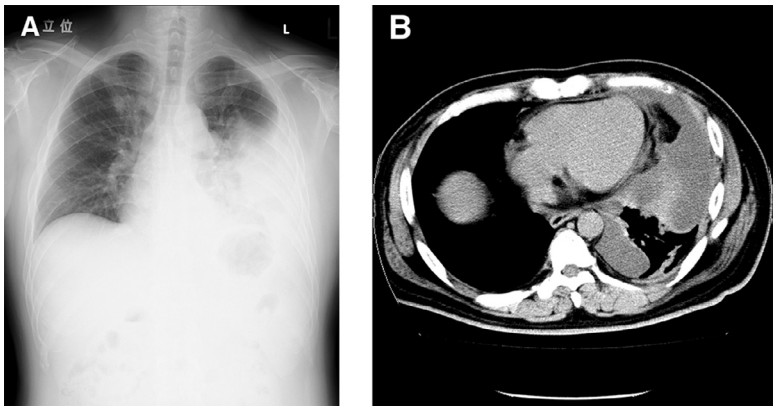

Fig 1 – CXR demonstrated a significant left pleural effusion (A). NECT showed left loculated pleural effusions (B).

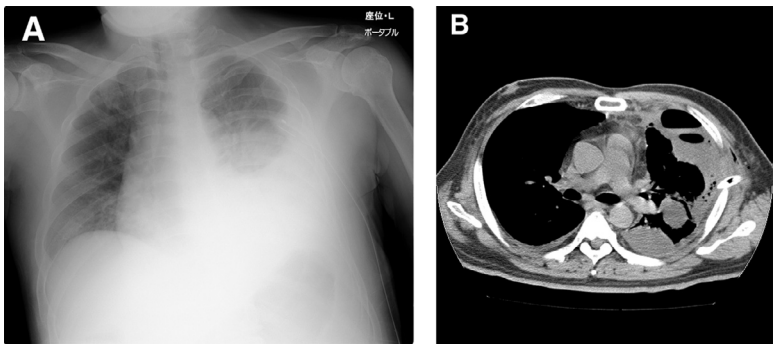

Fig. 2 – CXR revealed an increased left pleural effusion in comparison to Figure 1A, despite tube thoracostomy (A). NECT demonstrated multiple loculi with an air-fluid level that were inadequately drained (B).

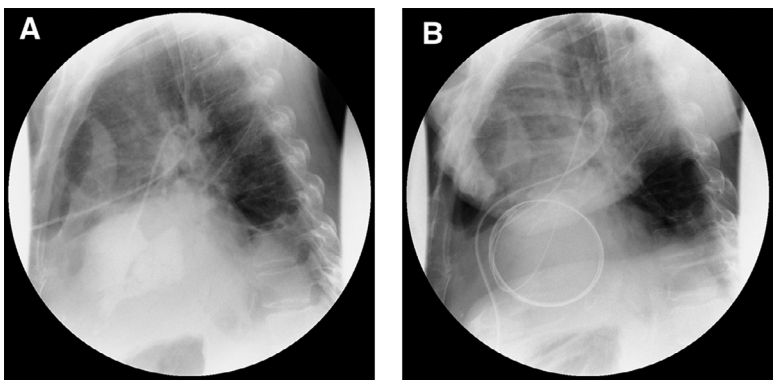

Fig. 3 – The chest drain tube was replaced by a 7-French pig-tail catheter and hydrodissection was performed on lateral fluoroscopy (A). The pig-tail catheter was advanced to the new loculus and 0.035-inch Radifocus Guidewire M; Terumo was used for guidewire-dissection (B).

acute empyema [2] because VATS may reduce the length of hospital stay compared to that observed following thoracostomy drainage [3]. However, tube thoracostomy with or without intrapleural fibrinolytic therapy (IPFT) administration is frequently conducted, as invasive surgery cannot be performed in case of the patients' advanced age, poor health conditions, and based on their preferences. In clinical practice, VATS is performed when drainage is ineffective in patients with stage II acute empyema [4]. Although a meta-analysis showed that IPFT administration reduced the requirement for surgical intervention and led to overall treatment failure, the evidence was inconclusive [5]. However, IPFT might increase the incidence rates of serious adverse events such as chest pain, fever, or allergy [6]. Thus, at present, it is unclear whether VATS is superior to IPFT; a randomized controlled trial is being conducted to verify the efficacy of these techniques [7].

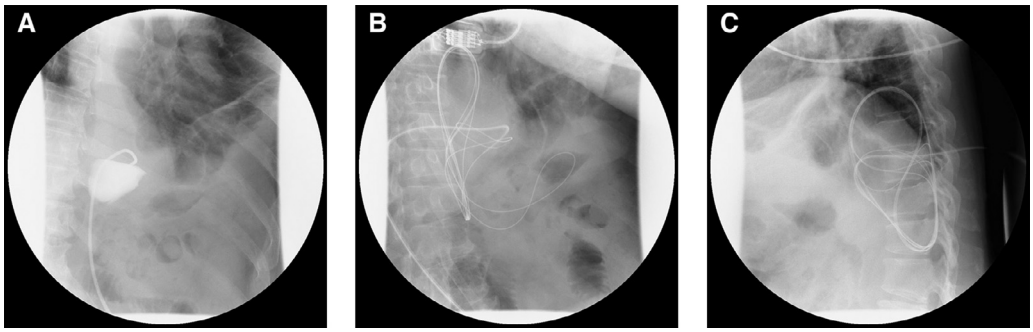

Fig. 4 – Hydrodissection and guidewire-dissection were performed on anterior-posterior fluoroscopy (A and B) and on lateral fluoroscopy (C).

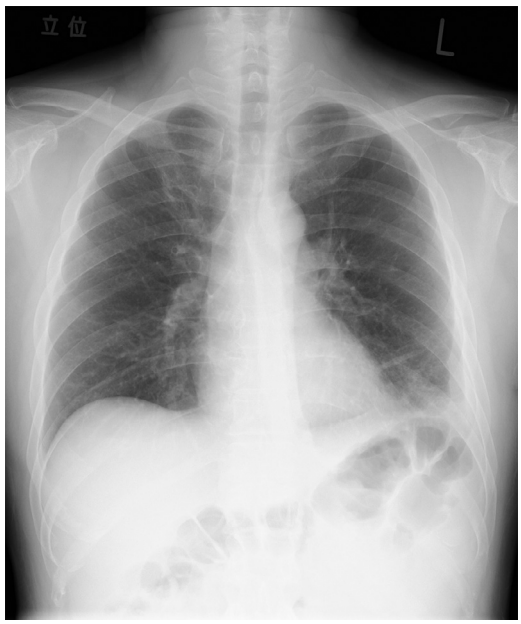

Fig. 5 – On day 25, CXR demostrated almost complete resolution of pleural fluid.

The purpose of VATS is the complete evacuation of potentially infected fluid and the complete re-expansion of the lungs [2]. This purpose is achieved by breaking the septa mechanically in the pleural cavity; for this reason, hydrodissection and guidewire-dissection have been conducted in Japan as these techniques are less invasive than VATS [8], although to our knowledge, the findings obtained using these techniques have not been reported in articles published in English. In this case series; therefore, we describe these techniques in detail.

Case 1

A 54-year-old woman visited our hospital with a 2-week history of left back pain that worsened when she breathed. Her initial vital signs were normal, except for a body temperature of 37.2°C. She had type 2 diabetes mellitus. Physical examination revealed decreased respiratory sounds on the left side. Chest X-ray (CXR) showed a massive left pleural effusion (Fig. 1A), which was found to be septate on ultrasonography. Noncontrast-enhanced CT (NECT) revealed multiple left pleural effusions (Fig. 1B). Pleural fluid analysis revealed exudative effusion (pH 6.985, glucose 262 mg/dL, and LDH value 780 IU/L). Pleural effusion culture revealed the presence of group B Streptococcus; therefore, empyema was diagnosed. Ampicillin/sulbactam was administered via tube thoracostomy. IPFT with 120,000 IU/d of urokinase was started on day 3 postadmission because the drainage volume had decreased despite an increase in the pleural fluid volume on CXR; however, the pleural fluid volume was not decreased due to loculation (Fig. 2). On day 5, the chest drain tube was

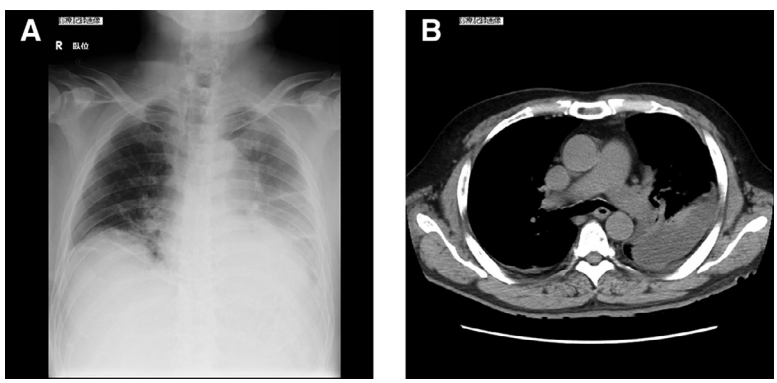

Fig. 6 – CXR revealed a left pleural effusion (A) and NECT showed left encapsulated effusions (B).

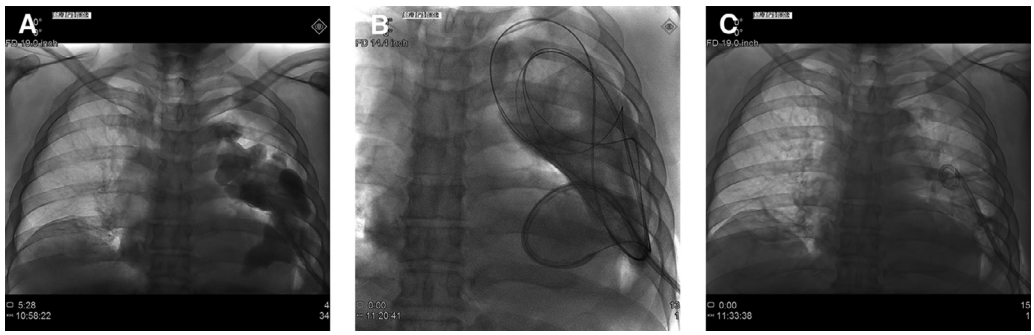

Fig. 7 – Hydrodissection and guidewire-dissection were performed on anterior-posterior fluoroscopy (A and B) and the pleural fluid was adequately drained (C).

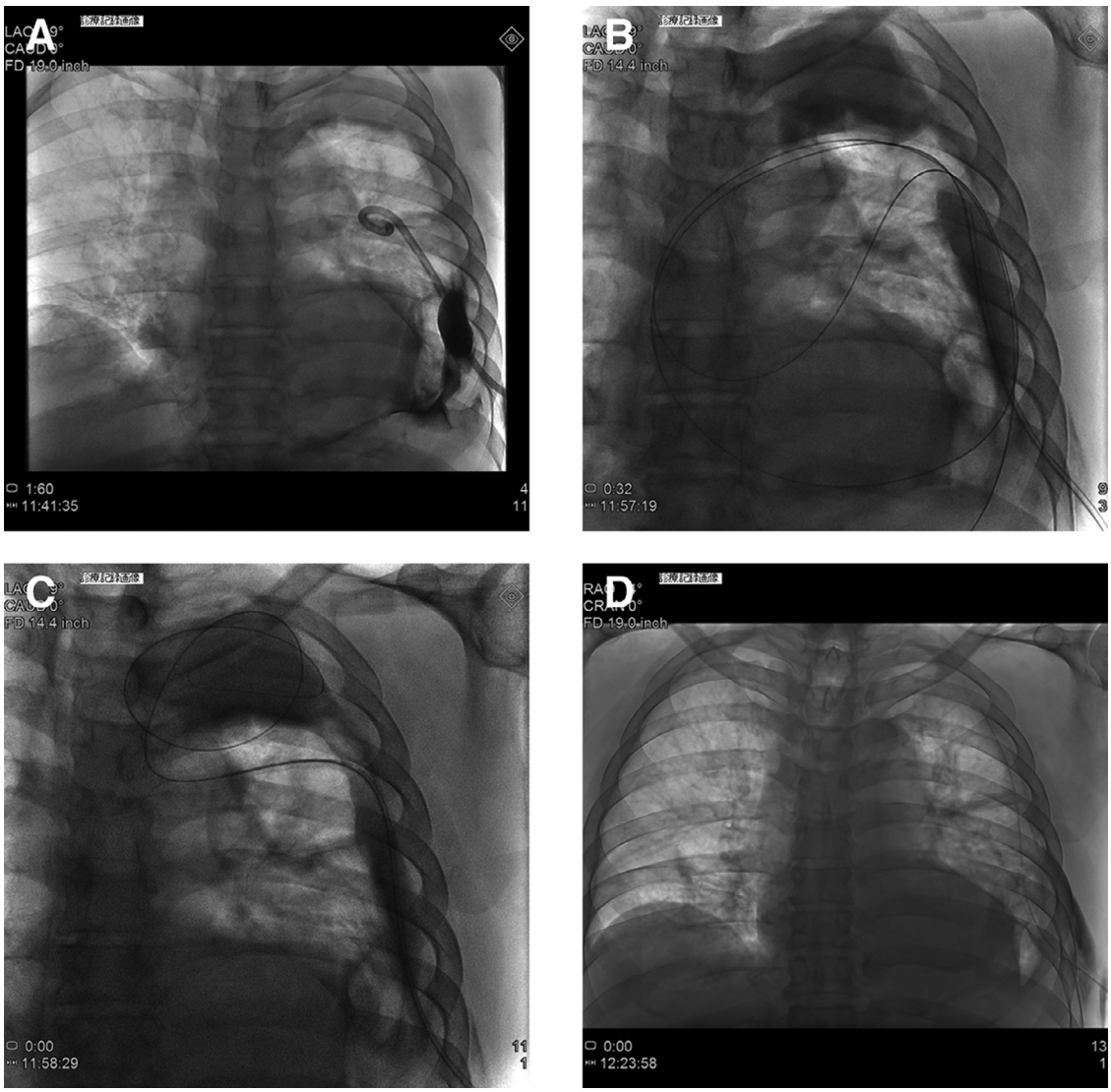

Fig. 8 – Hydrodissection and guidewire-dissection were repeated on anterior-posterior fluoroscopy (A, B, and C) and pleural fluid was almost fully drained (D).

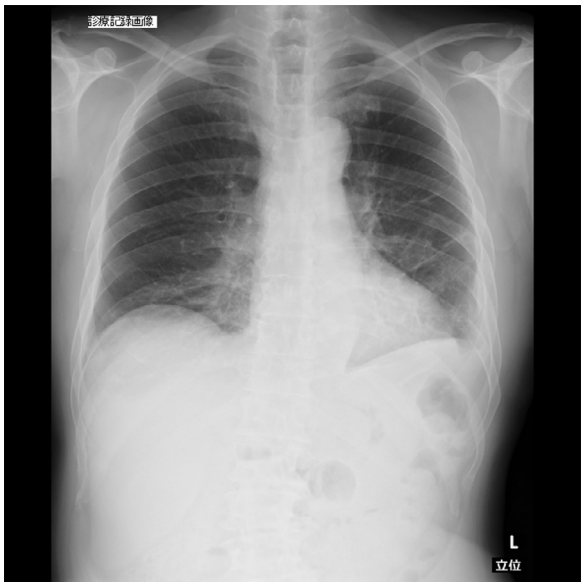

Fig. 9 – CXR revealed complete resolution of the left pleural effusion.

replaced by a 7-French pig-tail catheter, and hydrodissection and guidewire-dissection (0.035-inch Radifocus Guidewire M; Terumo) were performed. For hydrodissection, 200 mL of diluted sodium amidotrizoate was administered through the catheter to break the septa with pressure. For guidewire-dissection, a guidewire was inserted into the pleural cavity through the catheter to destroy the septa and link the septated cavities to each other using the hard part of the wire (Fig. 3). IPFT with urokinase was continued until day 8. An NECT performed on day 8 revealed that the ventral pleural fluid had resolved, implying that the patient's condition had improved on day 8 compared to that on day 4. On day 9, an ultrasound-guided percutaneous drainage tube was inserted into the dorsal pleural space, the IPFT was performed, and the ventral drainage tube was extracted. On day 13, hydrodissection with contrast enhancement and guidewire dissection were performed for the dorsal pleural space (Fig. 4). IPFT was discontinued on day 14. Consequently, the drainage volume increased, and the patient was discharged on day 28 after complete resolution of the pleural fluid was observed via a CXR performed on day 25 (Fig. 5).

Case 2

A 70-year-old man visited our hospital with a 2-day history of chills and left flank pain. He had diabetes mellitus and hypertension. His body temperature was 37.2°C. The respiratory sounds on the left side were decreased, and the right upper abdominal quadrant was tender. CXR revealed a left pleural effusion (Fig. 6A). NECT also showed the left pleural effusions, which seemed to be encapsulated (Fig. 6B). Ultrasound-guided percutaneous drainage catheter insertion was performed on day 2 postadmission along with hydrodissection, guidewire-dissection, and administration of IPFT (60,000 IUs of urokinase) (Fig. 7). Hydrodissection and guidewire-dissection were again performed on day 6 along with IPFT administration (120,000 IUs of urokinase for 3 days) (Fig. 8). NECT performed on day 13 showed an adequate decrease in the extent of the pleural effusion; therefore, the catheter was removed. CXR performed on day 28 showed an almost complete resolution of the pleural effusion (Fig. 9).

Discussion

In this case series, we showed usefulness of hydrodissection and guidewire-dissection for the treatment of septated empyema. Hydrodissection is a fluoroscopic technique in which a diluted contrast medium is administered through an inserted catheter at high pressure to break the septa. In this study, while this procedure was being conducted, as the dose of the contrast medium was increased, new loculi were visualized via fluoroscopy. This technique is also useful for determining the location of the empyema based on CT images. For guidewire-dissection, a guidewire is inserted into the pleural cavity through the catheter to break the septa using the hard portion of the wire and link the septated cavities to each other. We believe that the 0.035-inch Radifocus is the best guidewire because of its hardness and resistance to kinking. Kinks in the spring might perforate the lung, leading to pneumothorax. With the help of fluoroscopy, a guidewire is inserted to form multiple loops in the loculus, and then, the wire is pushed with pressure to break the septa bluntly. However, pushing the wire with excessive pressure might lacerate the lung, and thus, it is important to consider the shape of the wire and the pressure applied. In this study, we used a seeking catheter to find a route that seemed to connect to the next loculus. Once the loculi were connected to each other, we expected that the lungs would be completely evacuated and re-expanded. This intervention should be performed as early as possible because the septum becomes too thick to break as the empyema stage progresses. Moreover, IPFT can be simultaneously performed. Previous studies have reported that pleural thickening is a predictive variable for IPFT failure [9,10], and it is sometimes impossible to connect all loculi by mechanically destroying the septa (by hydrodissection and guidewire-dissection); in such cases, another catheter should be inserted, or VATS should be performed.

In conclusion, hydrodissection and guidewire-dissection are minimally invasive techniques (as compared to surgery) for the treatment of septated empyema, and it is feasible to perform hydrodissection and guidewire-dissection following thoracostomy. Concomitant administration of intrapleural fibrinolytic therapy (IPFT) is plausible because mechanical and chemical destruction of septa of the empyema cavity increases the possibility of complete evacuation of the potentially infected fluid and complete re-expansion of the lungs. However, further prospective studies are required to validate these techniques' effectiveness before these are considered generally applicable.

Patient consent

I, Satoshi Yoshikawa, obtained written informed consent of all of 2 patients, which are documented in the paper. I retain written consent by myself.

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