Background: Bronchial fistula is a severe complication following pneumonectomy with a high mortality rate. Therefore, a safely effective procedure for bronchial closure is required to prevent bronchial fistula. Several surgical techniques for preventing bronchial fistula have been reported, including coverage using different types of autologous tissues [4, 5] and surgical glues [6] that are commonly used to close bronchial stumps. We previously reported a technique for bronchial closure to prevent bronchial fistula in a canine model [7]. We indicated that mucosal ablation could result in primary wound healing and involve mucosal tight adhesions histologically. In this paper, the pathologic findings of one patient, who underwent autopsy 4 years after surgery, were reviewed.

Case presentation: A 70-year-old Japanese man was diagnosed with malignant pleural mesothelioma and underwent right extra-pleural pneumonectomy. The right main bronchus was cut using a scalpel. When closing the bronchial stump, the bronchial mucosa was ablated by electric cautery and sutured manually using 3-0 absorbable sutures. The bronchial fistula was not found after pneumonectomy. Four years after surgery, the patient died of recurrent malignant pleural mesothelioma and underwent autopsy. Macroscopic evaluation showed tight adhesions and white scars on the bronchial stump. Microscopic findings showed few inflammatory cells and α-smooth muscle actin (α-SMA)-positive cells.

Conclusions: The results from this case suggested that bronchial mucosal ablation leads to robust agglutination of bronchial stump over years. This technique is not only simple but also reliable to prevent bronchial fistula.

Keywords: Bronchial stump, Bronchial mucosal ablation, Bronchial fistula
surface of the bronchial stump was ablated with electrocautery (Monopolar Cut, blend, at 30 W × 30 W, for 1–2 seconds. Valleylab, ForceTriad™ Energy Platform) with a width of 1 mm (Fig. 2a). The bronchial stump was then sutured manually using 3-0 absorbable monofilament sutures (PDS® II, ETHICON, Inc., Somerville, NJ, USA.). The single ligation suturing technique was used with Sweet’s method (Fig. 2b). No bronchial fistula developed post-operatively.

Four years after surgery, he died of recurrent malignant pleural mesothelioma, and he underwent autopsy. Macroscopic evaluation showed tight adhesions and white scars on the main bronchial stump and the intervals between the sutured stitches (Fig. 3a). Microscopic findings showed fewer inflammatory cells that were identified around the lesion of mucosal tight adhesion, except for the innermost layer part of the sutured bronchial mucosa (Fig. 3b, c). Furthermore, there were also fewer α-smooth muscle actin (α-SMA)-positive cells in the tight adhesion area (Fig. 3c).

**Discussion and conclusion**

Manual suturing techniques, such as the Sweet suture [8] method, have been used for treatment of the bronchial stump for a long time. With the development of surgical devices, mechanical auto-suture techniques are used more recently [9]. However, these techniques could not prevent development bronchial fistula, as seen in conventional techniques [10]. Previous studies in experimental animals indicated that bronchial mucosal adhesion did not occur after both the conventional Sweet manual suture and staple suture techniques. When we ablated the bronchial mucosa before applying the conventional bronchial stump closure technique, a complete union of the mucosa was observed. Our previous method demonstrated that the primary wound healing could provide a robust mucosal agglutination after ablation. It showed that mucosal ablation could trigger the wound healing process and achieve primary closure of the bronchial stump. However, the limitation to our animal study was that we could not observe the long-term outcomes of bronchial ablation.

In this case report, we used the bronchial ablation technique in a patient who underwent extra-pleural pneumonectomy with manual suture. A robust mucosal tight adhesion without inflammation was observed at autopsy (Fig. 3). This suggested that in the remodeling phase following mucosal ablation, neither excess inflammation nor granulation was observed, either clinically or histologically. Although we could not observe this case’s inner appearance postoperatively, we used bronchoscopy to
examine the mucosal healing process in some cases. It was clear that inner appearance showed tight adhesions and a white scar at the ablation site (Fig. 4a). Figure 4b indicates a non-ablated bronchial stump with manual suture. This inner space was also adhered; however, an obvious mark of the manual suture remained.

Further studies with a higher number of clinical cases are required to confirm our findings. Bronchial mucosal ablation is a potentially beneficial technique for mucosal adhesion. Our clinical findings show that
bronchial mucosal ablation resulted in tight adhesion over time.

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Authors’ contributions
MO and KM contributed to the study design and conception. KM and YM analyzed and interpreted the data. KM, YM, YK, TI, YT, KK, and YT collected and assembled the data. KM and YM drafted the manuscript. All authors read and approved the final manuscript. MO issued the final approval of the article.

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Ethics approval and consent to participate
Written informed consent for publication of this paper was obtained from the patient.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests
The authors declare that they have no competing interests.

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