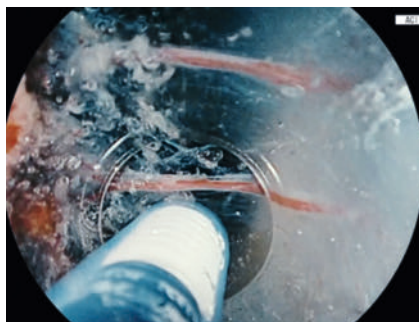


## A bubble-free strategy for saline-immersion endoscopic submucosal dissection: optimized electrosurgical settings and continuous low-pressure saline perfusion

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► **Fig. 1** A nasogastric tube is in place for continuous low-pressure saline perfusion (CLPSP).

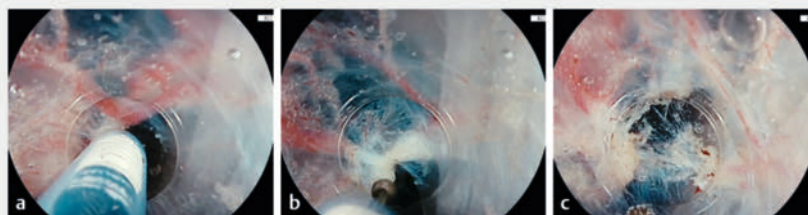


► **Fig. 3** Combination of optimized high-frequency settings with CLPSP enables bubble-free ESD under saline immersion, maintaining a clear view even during active dissection. CLPSP, continuous low-pressure saline perfusion; ESD, endoscopic submucosal dissection.

Saline-immersion therapeutic endoscopy and the water pressure method have recently gained attention as novel approaches for endoscopic submucosal dissection (ESD [1, 2]). These techniques offer multiple advantages, including stable visualization of the submucosal layer, improved scope maneuverability, and controlled submucosal expansion by buoyancy and hydrostatic pressure. However, during saline-immersion ESD, visibility is often impaired by bubble formation resulting from vaporization and electrolysis during the use of high-frequency devices [3].

Set 1	endoCUT I (effect 1, duration 2, interval 1) For mucosal incision	forcedCOAG (effect 3.0) +high-flow saline irrigation For hemostasis in bleeding event
Set 2	endoCUT I (effect 4, duration 1, interval 2) For submucosal dissection including coagulation and dissection of small vessels	softCOAG (effect 6–10, QuickStart off) For pre-coagulation of larger vessels

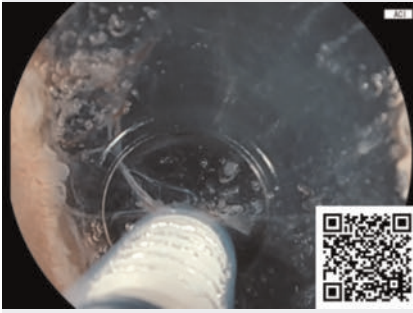
► **Fig. 2** Optimized high-frequency settings used for bubble-free ESD under saline immersion. ESD, endoscopic submucosal dissection.



► **Fig. 4** Pre-coagulation of larger vessels using softCOAG under saline immersion. Stable current conduction allows uniform coagulation without bubble formation. **a** Large submucosal vessel. **b** Pre-coagulation using softCOAG (effect 6–10, QuickStart off). **c** Bleeding prevention and safe cutting during dissection.

To overcome these issues, we developed continuous low-pressure saline perfusion (CLPSP; ► **Fig. 1** [4, 5]). CLPSP rapidly expels bubbles from the endoscopic field, maintaining a clear view even during active dissection. Nevertheless, when high-voltage modes such as swiftCOAG and forcedCOAG are applied, which are often applied during submucosal dissection to achieve hemostasis, the generation of bubbles remains pronounced because of spark-induced vaporization and electrolysis. Even with continuous saline perfusion, these bubbles can temporarily impair visibility. Based on these findings, we designed an optimized electrosurgical strategy for

bubble-free ESD under saline immersion (► **Fig. 2**, ► **Fig. 3** and ► **Video 1**). All procedures were performed using a VIO3 electrosurgical generator (Erbe Elektromedizin, Tübingen, Germany). Submucosal dissection is performed using endoCUT I (effect 4, duration 1, and interval 2), whereas softCOAG (effect 6–10, QuickStart off) is used for pre-coagulation of larger vessels. Under saline immersion, unlike in air, softCOAG ensures stable current conduction and uniform coagulation, even with a needle-type knife (► **Fig. 4**). SoftCOAG delivers a low-voltage continuous current without spark or bubble formation. In the event of bleeding, high-flow saline irrigation



**Video 1** A bubble-free strategy for saline-immersion endoscopic submucosal dissection: optimized electrosurgical settings and continuous low-pressure saline perfusion.

maintains visibility, and forced COAG achieves hemostasis while suppressing vaporization and spark formation. In addition, CLPSP using automatic water irrigation synchronized with the electrosurgical unit (EIP2; Erbe, Tübingen, Germany) is useful for this technique. This combination of optimized high-frequency settings with CLPSP enables bubble-free ESD under saline immersion, preventing inadvertent bleeding and allowing smooth, efficient, and safe dissection.

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### Contributors' Statement

Masafumi Kitamura: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. Yuji Ino: Conceptualization, Investigation, Writing – review & editing. Kosei Hashimoto: Conceptualization, Methodology, Writing – review &

editing. Hisashi Fukuda: Conceptualization, Writing – review & editing. Mayo Tanabe: Resources, Writing – review & editing. Haruhiro Inoue: Resources, Writing – review & editing. Hironori Yamamoto: Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing.

### Conflict of Interest

H. Yamamoto: Consultant, Fujifilm Corporation; honoraria, grants, and royalties. H. Inoue: Advisor, Olympus Corporation and TOP Corporation. The other authors declare no financial conflicts of interest. The funding source had no role in this study's design, conduct, or analysis.

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