Appendix 1 The three-tube method for interventional therapy under fluoroscopy

Preoperative preparation

Obucaine hydrochloride gel was administered 10 min before the operation for local mucous membrane anesthesia in the nasal cavity, oral cavity, pharyngeal cavity, and esophagus. All operations were performed under fluoroscopy with local anesthesia and the patient in a conscious state. The procedures were performed with the patient lying on the back of the examination bed and undergoing electrocardiogram monitoring and oxygen inhalation, and a sputum aspirator was kept prepared. All catheters and drainage tubes utilized in the three-tube interventional approach were adequately lubricated with paraffin oil. Furthermore, preoperative topical anesthesia (obucaine gel) was systematically administered to the nasal cavity, oropharyngeal mucosa, and esophageal lining in all cases. No procedure-related discomfort was reported during the interventional procedures, with all patients demonstrating excellent compliance throughout the process.

Insertion of a nasal jejunal nutrition tube and a nasal gastrointestinal decompression tube

Under fluoroscopy, a 0.035-inch hard guidewire (Terumo Corporation, Japan) and a 5F vertebral artery catheter (Johnson & Johnson Cordis, USA) were introduced through one side of the nose. They were combined to enter the descending segment of the duodenum through the nasal cavity, pharynx, esophagus, and stomach, and iodofol was manually injected through the catheter to observe whether contrast agent overflow had occurred and to determine the location of contrast agent overflow, the size of the fistula, and the scope of the pus cavity. The catheter and guidewire were combined to enter the upper segment of the jejunum. The catheter was then removed, and a #14 nutrient tube was introduced along the guidewire into the jejunum. After imaging, the head of the nutrient tube was confirmed to be at least 50 cm away from the descending segment of the duodenum, and the nutrient tube was externally fixed. A catheter and guidewire were introduced through the opposite nostril, and the two were combined to enter the descending segment of the duodenum through the nasal cavity, throat, esophagus, and stomach. The #14 gastrointestinal decompression tube was replaced along the guide wire to the descending segment of the duodenum; the lateral orifice of the drainage tube was adjusted to cross the duodenal papilla area; and the nasal decompression tube was externally fixed.

Dyna CT-guided percutaneous placement of the pus-drainage tube

The position of the pus cavity was determined on the basis of the preoperative CT scan, usually in the left lateral position. After the Dyna CT scan, the skin puncture point, puncture path, and puncture depth were determined. The puncture area was disinfected and covered with tissue, and the puncture point was locally anesthetized with 2% lidocaine. An 18-G puncture needle was used to puncture the pus cavity using the navigation system. After the Dyna CT scan confirmed that the puncture point, puncture path, and needle tip position were correct, a 0.035-inch hydrophilic guidewire (Terumo Corporation, Japan) was introduced into the pus cavity through the puncture needle, and the puncture needle was withdrawn to introduce an 8.5F or 10.2F multi-lateral external drainage tube (Cook Medical, USA) along the guide wire, which was placed in the pus cavity. After drainage tube angiography, the head end of the drainage tube was confirmed to be located at the bottom of the pus cavity. After successful suction, the drainage tube was externally fixed (*Figure 2*).

Postoperative treatment

All patients underwent fasting, acid suppression, parenteral nutrition, and antibiotic administration after surgery. Enteral nutrition was provided through a nasaljejunal nutrition tube. The amount and concentration of food were increased from low to high to prevent patients from experiencing bloating, diarrhea, and food reflux into the descending segment of the duodenum. The gastrointestinal decompression tube was connected to a negative-pressure drum for continuous and effective negative-pressure suction of gastric and intestinal contents. The percutaneous pus-drainage tube was connected to the central negative-pressure device of the hospital for continuous negative-pressure suction, which was usually maintained at a range of 150–300 mmHg. At 3–5 days after the operation, pyogenic angiography was performed through the drainage tube to observe the changes in the scope of the pus cavity and the position of the head of

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the drainage tube, and to determine the effectiveness of suction. The position of the drainage tube was adjusted to ensure appropriate positioning. When the pus cavity at the head end of the drainage tube disappeared, the position of the drainage tube was adjusted in a timely manner, and the appropriate position of the drainage tube and effective suction were maintained.

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