

Water-Air Sequential Infusion Assisted Ultrasound-Guided Percutaneous Gastrostomy in a Patient with Complete Esophageal Obstruction

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Received December 25, 2025; revision requested January 29, 2026; accepted February 11, 2026

Objective: To evaluate the feasibility and safety of water–air sequential infusion assisted Ultrasound-Guided Percutaneous Gastrostomy (UGPG) in a patient with complete esophageal obstruction.

Methods: A 72-year-old male patient with esophageal squamous cell carcinoma presented with complete esophageal obstruction and severe malnutrition. Endoscopic and fluoroscopic gastrostomy were not feasible, and the patient was unable to tolerate general anesthesia. A purely ultrasound-guided percutaneous gastrostomy was performed. The procedure consisted of initial infusion of a small volume of normal saline into the gastric antrum to facilitate identification of the gastric lumen and placement of a pigtail drainage catheter, followed by continuous air insufflation through the catheter to achieve adequate gastric distension and close apposition of the anterior gastric wall to the abdominal wall. Under real-time ultrasound guidance, gastric wall fixation and gastrostomy tube placement were successfully completed.

Results: The procedure was completed smoothly with satisfactory gastric distension and a clear, safe puncture pathway. The gastrostomy tube was accurately positioned, and no perioperative complications, including bleeding, infection, or peritonitis, were observed. Enteral nutrition was initiated 24 hours after the procedure and was well tolerated.

Conclusion: Water–air sequential infusion–assisted UPGP is a feasible and safe alternative for gastrostomy in patients with complete esophageal obstruction who are unsuitable for endoscopic or fluoroscopic approaches. This radiation-free, minimally invasive technique avoids the need for general anesthesia and may represent a valuable option for high-risk or critically ill patients. Further studies with larger sample sizes are warranted to validate its clinical utility.

Key words: Ultrasound-guided percutaneous gastrostomy; Water-air sequential infusion; Esophageal obstruction; Enteral nutrition

Advanced Ultrasound in Diagnosis and Therapy 2026; 02: 123-126

DOI: [10.26599/AUDT.2026.250117](https://doi.org/10.26599/AUDT.2026.250117)

Percutaneous gastrostomy provides enteral nutritional support for patients who are unable to tolerate oral intake. Conventionally, gastrostomy is performed using percutaneous endoscopic gastrostomy (PEG) or percutaneous radiologic gastrostomy (PRG)

under fluoroscopic guidance [1,2]. However, these techniques require specialized equipment and dedicated procedural facilities. In patients with severe esophageal stenosis or complete obstruction, PEG is often not feasible because the endoscope or catheter cannot traverse

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the obstructed segment, and adequate gastric insufflation cannot be achieved [3]. PRG, although effective, involves exposure to ionizing radiation.

Percutaneous ultrasound-guided gastrostomy (PUG) has emerged as a radiation-free alternative that relies entirely on ultrasound imaging for guidance [4]. In this report, we describe a novel water-air sequential infusion technique to facilitate UGPG in a patient with complete esophageal obstruction, achieving successful gastrostomy without the use of endoscopy, fluoroscopy, or general anesthesia.

Case Presentation

A 72-year-old male patient was admitted with progressive dysphagia and poor oral intake for one month. He had a history of esophageal carcinoma treated with radiotherapy 10 years earlier. Chest computed tomography revealed marked thickening of the upper esophageal wall, suggestive of tumor recurrence (Fig. 1). The X-ray indicates that the contrast agent cannot pass through the esophagus (Fig. 2). Gastroscopy demonstrated an irregular, friable mass located approximately 18 cm from the incisors, causing complete luminal obstruction; the endoscope could not be advanced beyond the lesion (Fig. 3). Histopathological examination of biopsy specimens confirmed squamous cell carcinoma.

The patient was elderly, severely malnourished, and unable to tolerate oral feeding. Due to complete esophageal obstruction, PEG and PRG were not feasible. In addition, the patient was unable to cooperate with or tolerate general anesthesia. Therefore, ultrasound-guided percutaneous gastrostomy was selected.

Procedure

The patient was placed in the supine position. After routine skin preparation and sterile draping, ultrasound was used to identify the optimal puncture site. Local anesthesia was administered with 1% lidocaine hydrochloride.

Under real-time ultrasound guidance, a 20-gauge needle was advanced through the anterior abdominal



Figure 1 Chest computed tomography revealed marked thickening of the upper esophageal wall.



Figure 2 The X-ray indicates that the contrast agent cannot pass through the esophagus.



Figure 3 Endoscopy indicated complete obstruction of the esophageal lumen.

wall into the gastric antrum via a subxiphoid transverse approach. Approximately 200 mL of 0.9% sodium chloride was injected to partially distend the gastric antrum, allowing clear identification of the gastric lumen. Subsequently, an 18-gauge needle was inserted into the stomach, and a guidewire was advanced through the needle. A 6-French pigtail drainage catheter was then placed over the guidewire into the gastric cavity (Fig. 4).

To confirm intragastric positioning, sulfur hexafluoride microbubble contrast agent was injected through the catheter, and contrast-enhanced ultrasound demonstrated uniform filling of the gastric lumen (Fig. 5). The catheter was secured, and continuous air insufflation

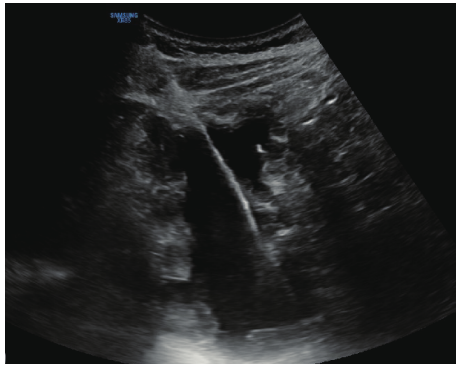


Figure 4 Under real-time ultrasound guidance, the pigtail catheter passes through the anterior abdominal wall and enters the gastric cavity.

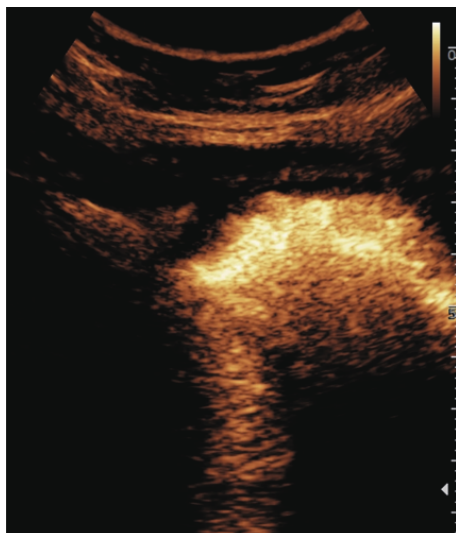


Figure 5 Contrast-enhanced ultrasound demonstrated uniform filling of the gastric lumen.

(approximately 800-1000 mL) was performed through the pigtail catheter under ultrasound monitoring. Adequate gastric distension was achieved, with close apposition of the anterior gastric wall to the anterior abdominal wall.

After selecting the gastrostomy puncture site, additional local anesthesia was administered. Using the selected puncture point as the center, gastric wall fixation points were marked approximately 1 cm to the left and right. A double-lumen gastric wall fixation device was used to anchor the gastric wall to the abdominal wall with surgical sutures.

A small skin incision (~5 mm) was made at the gastrostomy site. Under real-time ultrasound guidance, a trocar with a sheath was advanced vertically into the stomach. Upon removal of the trocar, escape of intragastric air confirmed successful entry. The gastrostomy tube was introduced through the sheath, and 3 mL of sterile water was injected into the retention balloon. The sheath was then withdrawn while gently rotating it to facilitate removal. Ultrasound confirmed that the balloon was

securely apposed to the anterior gastric wall. The external fixation plate was positioned 1-2 cm from the skin surface, and the tube was secured.

Results

The procedure was completed successfully without technical difficulty. Adequate gastric distension and a safe puncture pathway were achieved. No immediate or delayed complications, including bleeding, infection, or peritonitis, were observed. Enteral feeding was initiated 24 hours after the procedure and was well tolerated.

Discussion

In patients with complete pharyngeal or esophageal obstruction, conventional PEG and PRG may be impossible to perform. Percutaneous ultrasound-guided gastrostomy offers a minimally invasive, radiation-free alternative that can be performed at the bedside without the need for endoscopy or general anesthesia.

Previous studies have demonstrated the feasibility of PUG using magnetic gastropexy systems such as PUMAG, which rely on external magnets to approximate the stomach to the abdominal wall [4,5]. Other investigators have combined ultrasound with fluoroscopy or saline infusion to assist gastric localization and puncture [6,7]. However, fluoroscopy introduces radiation exposure, and saline-only gastric distension may be inadequate due to rapid gastric emptying and gravitational separation of the stomach from the abdominal wall.

In the present case, we introduced a water-air sequential infusion technique. Initial saline infusion into the gastric antrum facilitated accurate identification of the gastric lumen and stable placement of the pigtail catheter. Subsequent continuous air insufflation through the catheter achieved sustained gastric distension and close apposition of the gastric and abdominal walls, enabling safe puncture and tube placement.

Several technical considerations were identified during the procedure. The gastric antrum is highly mobile; therefore, a fine needle (≤ 20 G) and gentle needle manipulation improve puncture success. Injection of a small volume of saline after successful puncture provides temporary support to the gastric wall and helps prevent displacement during catheter insertion. The temperature of 0.9% sodium chloride should be controlled between 30-35°C to avoid gastric spasm. Air insufflation should be performed under continuous ultrasound monitoring to avoid under- or overdistension.

The curved tip of the pigtail catheter provides stability after air insufflation and reduces the risk of catheter displacement, while its flexibility minimizes the risk of gastric wall injury.

Conclusion

Water–air sequential infusion–assisted percutaneous ultrasound-guided gastrostomy is a feasible and safe technique for patients with complete esophageal obstruction who are unsuitable for endoscopic or fluoroscopic gastrostomy. This approach eliminates radiation exposure, avoids general anesthesia, and can be performed at the bedside. Although this represents an initial exploratory application, the technique shows promise and warrants further evaluation in larger patient cohorts. It may offer a safer and more economical alternative for gastrostomy in critically ill or high-risk patients.

Acknowledgments

The authors thank the patient and his family for their understanding and support during the treatment and publication of this report. All individuals who contributed substantively to this work are listed as authors; no additional acknowledgments are required.

Funding

None.

Authors' Contributions

Conceptualization and design: Changsong Xu. Surgical procedure: Changsong Xu and Rui Xie. Data collection and organization: Muyang Yang and Qin Zhou. Imaging analysis: Zhengqing Mu and Ru Feng. Drafting of the manuscript: Ru Feng. Critical revision of the manuscript: Changsong Xu. Final approval of the version to be published: All authors.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Raw imaging data and any information that could identify the patient are not publicly available to protect patient privacy.

Declarations

Ethics approval and consent to participate

This study was approved by the the Ethics Committee of the Affiliated Huaian No.1 People's Hospital of Nanjing Medical University (KY-2026-325-03).

Consent for publication

Not applicable.

Conflict of interest

The authors declare that they have no competing interests.

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