Am J Transl Res 2026;18(4):3403-3407
www.ajtr.org /ISSN:1943-8141/AJTR0171754

Case Report

Non-clostridial gas gangrene involving the thyroid gland complicated by multiple infections in a diabetic patient: a case report

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Received January 29, 2026; Accepted March 30, 2026; Epub April 15, 2026; Published April 30, 2026

Abstract: The thyroid gland is usually resistant to infection due to its nature, including rich blood supply and lymphatic drainage. Gas gangrene involving the thyroid is extremely rare and may be related to preexisting thyroid disease or diabetes. Few related cases have been reported, among which non-clostridial gas gangrene (NCGG) is particularly uncommon. Here, we briefly describe the diagnosis and treatment of a rare NCGG case involving the right lobe of the thyroid gland. A 60-year-old female patient presented with neck pain accompanied by discomfort during eating, which acutely worsened with sudden neck swelling one day before admission. Laboratory examination revealed fever, significantly elevated blood glucose, restricted neck movement, increased local skin temperature, and palpable crepitus in the cervical region. Based on clinical assessment, the patient was diagnosed with acute suppurative thyroiditis complicated by gas gangrene and poorly controlled diabetes. Intraoperative findings and post-operative histopathologic examination supported the diagnosis of NCGG. A right thyroid lobectomy was performed, along with resection of the isthmus and the left inferior thyroid pole, followed by vacuum sealing drainage with polyurethane. The patient recovered well, with no evidence of recurrence or complications at the 4-month follow-up. Successful management of this condition requires early debridement, resection of necrotic tissue, appropriate drainage, and close monitoring for potential airway complications, such as tracheomalacia.

Keywords: Gas gangrene, thyroid gland, Escherichia coli, thyroidectomy, case report

Introduction

Gas-producing infections are rare diseases manifested primarily as subcutaneous or intramuscular gas accumulation [1]. These infections typically progress rapidly and are difficult to diagnose based on initial clinical manifestations [2]. If not treated properly and appropriately, they can be life-threatening. Gas-producing infections can be broadly categorized into three categories: gas gangrene caused by *Clostridium* species (predominantly *Clostridium perfringens*), non-clostridial gas gangrene (NCGG) caused by other bacteria such as *Escherichia coli* and *Klebsiella* species, and other infectious diseases, including necrotizing fasciitis, cellulitis, and subcutaneous emphysema [3]. Clostridial gas gangrene is mainly caused by open traumatic injuries, whereas NCGG is typically related to blood source infection, which can be spontaneous or atraumatic and related to factors such as low immunity, and especially, diabetes mellitus [2]. The thyroid gland is a highly vascularized endocrine gland [4] that is rarely susceptible to bacterial infection [5]. Although gas formation can occur in the thyroid gland and its surrounding soft tissues in conditions such as acute suppurative thyroiditis or infected thyroid cyst, reports of such cases remain scarce. In this case report, we briefly describe the diagnosis and treatment of a rare NCGG case involving the thyroid gland.

This study was approved by the hospital's Medical Ethics Committee. The case was reported in accordance with the SCARE 2020 Guideline: Updating Consensus Surgical CAse REport (SCARE) Guidelines [6].

Case report

A 60-year-old female patient was admitted to Wuzhou Gongren Hospital on June 10th, 2023,

https://doi.org/10.62347/JHCU2388

presenting with right-sided neck pain accompanied by dysphagia, discomfort during eating, sore throat, cough, and sputum production. She had previously sought treatment at a local private clinic and received oral medication; however, the symptoms progressively worsened. One day prior to admission, she developed a sudden neck swelling with rapidly progressive pain, accompanied by swallowing and breathing difficulties, hoarseness, and a strong foreign body sensation.

Her past medical history included hypertension, which is controlled with regular oral antihypertensive drugs, and years of diabetes with poor glycemic control. On admission, her blood glucose levels ranged between 13.3 and 21.9 mmol/L.

Initial assessment on admission revealed a body temperature of 39°C, heart rate of 114 bpm, respiratory rate of 24/min, blood pressure of 90/75 mmHg, and oxygen saturation of 99% on pulse oximetry. Physical examination demonstrated marked swelling of the lower jaw and anterior neck, with difficulty in mouth opening and swallowing. Cervical range of motion was restricted, and the midline structures were shifted to the left. Increased local skin temperature and palpable crepitus were noted, especially in the right neck and lower jaw. The affected area extended from the anterior platysma muscle border of right neck to the anterior border of the left sternocleidomastoid muscle, superiorly to the lower jaw and inferiorly to the supraclavicular fossa, as shown in **Figure 1A**. The thyroid gland and carotid artery were not palpable due to extensive swelling. Laboratory findings are summarized in **Table 1**. Computer tomography (CT) revealed extensive gas accumulation in the region of the right thyroid gland, as well as at the skull basis and within the tissue space around the posterior pharyngeal wall, as shown in **Figure 1B**, **1C**. The primary diagnosis was gas gangrene of the right thyroid gland with extensive involvement of the cervical soft tissue spaces, accompanied by septic shock and uncontrolled diabetes.

The patient was admitted to intensive care unit (ICU) on the day of admission. After endotracheal intubation, emergency surgery was performed. A longitudinal incision was made in the right anterior neck to expose the fascia layer, after which a large amount of gas was released. Further exploration revealed that the entire right thyroid gland was gangrenous, with extension of necrosis to the isthmus and the left inferior thyroid pole nearby. A right thyroidectomy was performed, along with the removal of the involved isthmus and the affected portion of the left inferior thyroid gland, as shown in **Figure 1D-F**. Upward exploration showed extensive gas accumulation in the inter-tissue space of the chin. Blunt finger dissection was carefully performed along the necrotic tissue planes. The wound was repeatedly irrigated with diluted hydrogen peroxide and normal saline using a syringe, followed by placement of vacuum sealing drainage (VSD) with polyurethane (PU) material. The wound was sealed with a semipermeable film and connected to a vacuum device, with negative pressure maintained at -50 to -150 mmHg. After the operation, the patient was transferred back to the ICU. Mechanical ventilation using endotracheal intubation was continued, and intravenous meropenem (0.5 g every 8 hours) was administered.

Immediate postoperative CT reexamination revealed a small epidural hemorrhage on the right side and multiple small lymph nodes in the bilateral cervical and submandibular regions. A small amount of newly detected pleural effusion was observed, which resolved spontaneously the next day. CT performed on day 5 showed inflammatory changes in the paranasal sinuses and nasal cavity and slightly enlarged bilateral cervical and submandibular lymph nodes. Most laboratory values improved after surgery (**Table 1**).

Postoperative histopathology demonstrated extensive degeneration and necrosis of the right thyroid tissue, residual thyroid tissue in the left cervical region, and surrounding connective tissue, with obvious neutrophil infiltrations, consistent with acute gangrene. Special staining result was negative. Focal areas of the right thyroid exhibited an increased nuclear-to-cytoplasmic ratio in follicular epithelial cells; therefore, immunohistochemical analysis was performed to exclude neoplastic lesions. Immunohistochemistry results showed CD56 (+), CK19 (+), Galectin-3 (focally weak +), HBME-1 (-), suggesting reactive changes rather than malignancy. Sputum smears for acid-fast bacilli and bacterial culture were negative.

On the 6th day of admission (June 15), the patient underwent repeat surgical debridement. VSD was removed, revealing a substan-

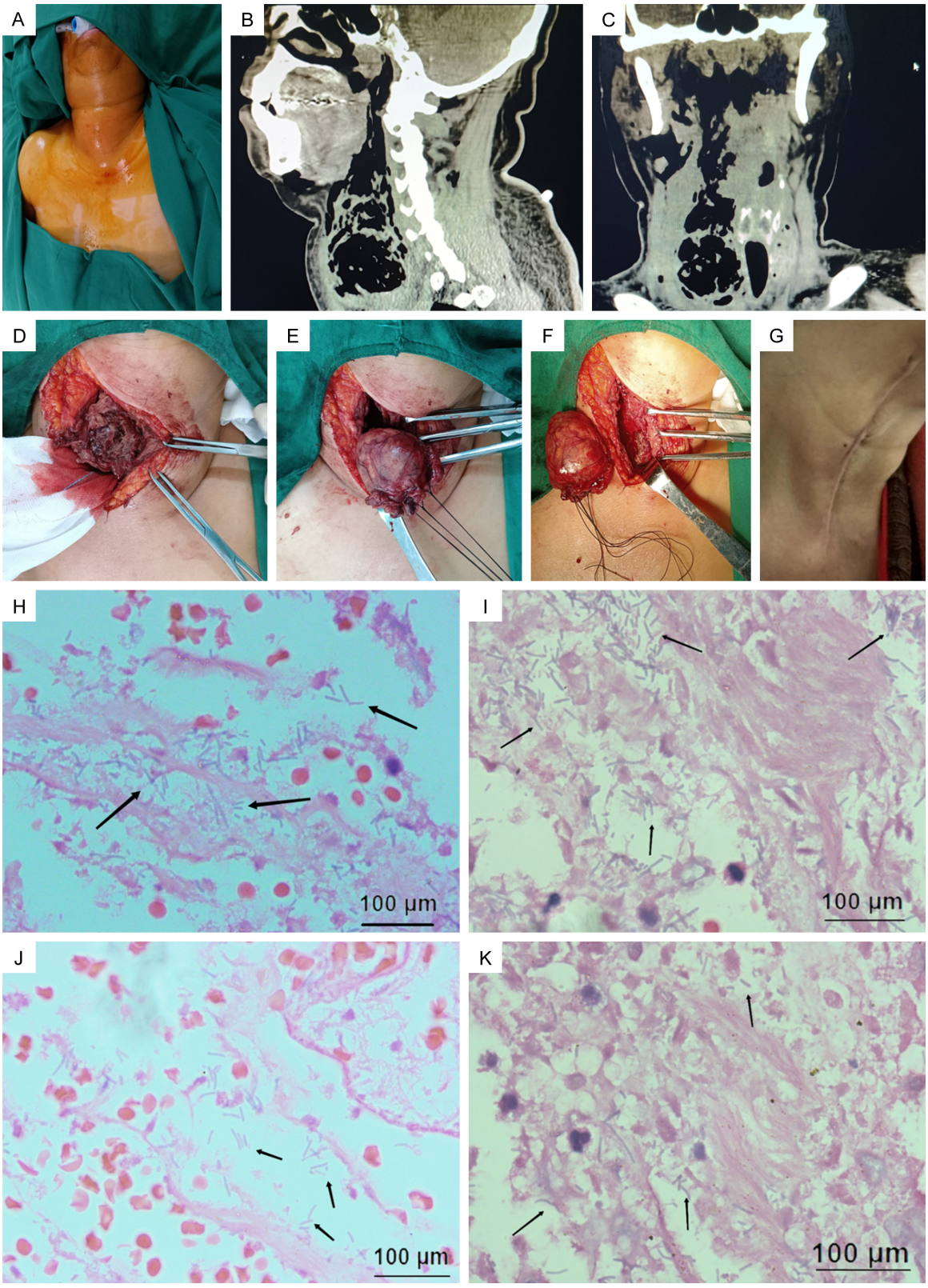

Figure 1. (A) Initial view of the gas gangrenous area. (B, C) Preoperative computed tomography scans showing gas accumulation in the cervical region: (B) sagittal view; (C) coronal view. (D-F) Intraoperative findings during emergency thyroidectomy. (G) Clinical appearance at 4-month follow-up after initial treatment. (H-K) Immunohistochemical images. The thyroid tissue structure was extensively disrupted, with large, patchy, map-like areas of coagulative necrosis. Slender rod-shaped structures, occasionally arranged in chains, were observed within the necrotic tissue or areas of inflammatory cell infiltration.

Table 1. Laboratory values

Indicator	Value on admission	Best value in 6 days after surgery	Reference range
White blood cell count	21.25*10^9/L	14.45*10^9/L	3.50-9.50*10^9/L
Red blood cell count	3.07*10^{12}/L		3.8-5.1*10^{12}/L
Hemoglobin	90 g/L		115-150 g/L
Neutrophils	19.7*10^9/L	12.7*10^9/L	1.8-6.3*10^9/L
α-hydroxybutyric dehydrogenase	195 U/L		72.0-182.0 U/L
C-reactive protein	217.62 mg/L	87.08 mg/L	0.00-6.00 mg/L
Fibrinogen	9.09 g/L	6.00 g/L	2.00-4.00 g/L
D-dimer	3.010 μg/ml		0.000-0.550 μg/ml

tial amount of residual necrotic tissue, which was then excised. VSD was then re-applied for drainage. Due to oxygen desaturation and the development of tracheomalacia, attempts at extubation failed. The patient was transferred to a tertiary care center for further treatment.

On August 5 (day 57 after the first admission), the patient was re-admitted due to fluid accumulation in the right thyroid fossa following right thyroidectomy (a nasogastric tube was in place at admission). CT demonstrated abnormal soft tissue density in the right submandibular region and right anterior neck, with evidence of focal fistula formation, infectious lesions, and local abscess formation. Five days later, drainage of the right cervical thyroid fossa was performed under local anesthesia. The drained fluid was thick, purulent, and bloody. Bacterial culture of the drainage fluid was positive for *Escherichia coli* (**Figure 1H-K**). Follow-up CT examination showed a reduction in the lesion area, and the drainage tube was removed one week after surgery. At the 4-month follow-up, the patient exhibited no hoarseness, choking, dysphagia, or limited range in neck mobility, and the incision had healed into a linear longitudinal scar (**Figure 1G**).

Discussion

This report has shown successful management of a diabetic patient with gas gangrene involving the right lobe of the thyroid gland, highlighting the importance of early diagnosis and individualized surgical management. The thyroid gland is typically resistant to infection due to its rich vascular supply and good extensive lymphatic drainage [5]. However, poorly controlled diabetes predisposes patients to non-clostridial gas-forming infections, as microorganisms can ferment glucose and other substrates in necrotic tissues [7]. In this case, uncontrolled diabetes likely created a metabolic environment for rapid bacterial proliferation and gas formation. This aligns with the report by Takazawa et al. [8], in which 83.3% of NCGG cases occurred in diabetic patients, with nearly half of whom had no prior glycemic control.

The extensive necrosis observed intraoperatively necessitated aggressive resection beyond standard thyroidectomy. The gangrenous process had also spread widely to the surrounding soft tissue spaces, requiring blunt dissection and copious irrigation. During the procedure, meticulous dissection was performed to preserve critical structures, including the superior laryngeal nerve. Although routine drainage is not required after thyroidectomy, it may be indicated in cases involving extensive resection or when there is a high risk of postoperative fluid collection [9]. In this case, adequate intraoperative drainage was performed to evacuate necrotic debris and exudate to prevent further expansion of infection. Given the severity of infection, a VSD system was applied to continuously remove necrotic debris and inflammatory exudate.

A critical complication in this case was tracheomalacia, which developed secondary to extensive infection and inflammation. Despite multiple extubation attempts, the patient remained ventilator-dependent due to airway collapse. This necessitated transfer to a tertiary care center for tracheal suspension surgery, a rare but serious sequela of deep neck space infections that warrants heightened clinical vigilance.

Both aerobic and anaerobic bacteria can cause gas-producing infections, among which *Proteus*, *enterococcus*, and *Escherichia coli*

are common [10]. Postoperative cultures confirmed *E. coli*, validating our empirical use of meropenem. The choice of a broad-spectrum antibiotic was appropriate given the severity of sepsis and the polymicrobial potential of non-clostridial infections.

In summary, this case underscores that NCGG should be considered in diabetic patients with rapidly progressive neck infection accompanied by crepitus. Favorable outcomes depend on early and aggressive debridement, complete removal of necrotic tissue, appropriate drainage, and close monitoring for airway complications such as tracheomalacia.

Disclosure of conflict of interest

None.

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