# Metastatic colorectal carcinoma to the thyroid gland: A case report and literature review

JIE CHEN, ANSHENG WANG, LINTING GUO, QINGQING MENG, XINGHAI ZHANG and CHENGQUAN MA

Department of General Surgery, Wanbei Coal and Electricity Group General Hospital, Suzhou, Anhui 234000, P.R. China

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**Abstract.** Although thyroid metastasis from colorectal carcinoma (CRC) is exceedingly rare, with a reported clinical incidence of ~0.1-0.3%, its detection typically signifies advanced-stage systemic disease. This atypical metastatic pattern generally correlates with a terminal stage and a historically poor prognosis, with a reported 5-year survival rate of <15%. A 78-year-old female presented with advanced sigmoid adenocarcinoma complicated by a thyroid mass that caused significant tracheal compression and was accompanied by multiple pulmonary metastases. The patient's initial clinical manifestations included chronic hematochezia and diarrhea. Given the patient's advanced age and poor baseline status, a palliative thyroidectomy was performed to alleviate acute airway obstruction, followed by levothyroxine replacement therapy. Postoperative histopathological examination and immunohistochemical profiling, including SATB2 and CK19 positivity together with PAX8 and TTF-1 negativity, supported a diagnosis of metastatic adenocarcinoma of colorectal origin. In conclusion, clinicians should maintain a low threshold of suspicion for secondary malignancies when evaluating new thyroid nodules in patients with a known history of CRC. Although the findings from a single case study have limited generalizability, this report underscores the potential value of multidisciplinary systemic staging and individualized palliative management in optimizing supportive care for patients with rare metastatic patterns.

*Correspondence to:* Dr Chengquan Ma, Department of General Surgery, Wanbei Coal and Electricity Group General Hospital, 125 Huaihe West Road, Suzhou, Anhui 234000, P.R. China
E-mail: machengquan1970@163.com

*Abbreviations:* CRC, colorectal carcinoma; CT, computed tomography; CTCs, circulating tumor cells; EMT, epithelial-mesenchymal transition; TMC, thyroid metastasis of colorectal origin; FNA, fine-needle aspiration; PTC, papillary thyroid carcinoma

*Key words:* colorectal carcinoma, thyroid metastasis, hematogenous dissemination, molecular mechanisms, immunohistochemistry

## Introduction

Colorectal carcinoma (CRC) ranks as the third most prevalent malignant neoplasm, with ~1.88 million new cases annually and ~930,000 associated deaths, accounting for 9% of all cancer-related deaths (1). The incidence markedly increases with increasing age, particularly in individuals >50 years of age. Elderly patients often demonstrate low screening adherence due to subjective neglect or objective barriers such as familial, socioeconomic and social determinants. Current research indicates a strong correlation between tumor stage, prognosis and screening compliance (2).

Clinically, ~20-25% of patients with CRC present with distant metastases or recurrence at initial diagnosis, with an additional 30-50% developing metastasis or recurrence during disease progression (3). While the majority of metastases occur at common sites, such as the liver and lungs, atypical metastatic locations-including the thyroid gland and brain-are observed in ~0.1-0.3% of cases (4). Concurrently, the clinical landscape of primary thyroid lesions has markedly evolved; recent population-based data in China highlight a substantial surge in the detection of thyroid nodules and malignant epithelia, heavily shaped by advanced diagnostic screening and potential overdiagnosis registries (5). In this era of heightened primary thyroid lesion detection, identifying true secondary occult metastases amidst a rising baseline of native thyroid pathologies presents a formidable and high-stakes diagnostic challenge for clinicians.

The invasion and metastasis of CRC are orchestrated by a complex network of molecular mechanisms. Recent frontiers have highlighted the critical regulatory roles of non-coding RNAs within competitive endogenous RNA networks. For instance, the long non-coding RNA LINC01836 has been shown to promote CRC proliferation and invasion by targeting solute carrier family 17 member 9 (6), while the circular RNA hsa_circ_0005939 exerts robust oncogenic effects via the bridge-like lipid transfer protein family member 3B axis (7). Additionally, the microRNA-1204/MASPIN pathway has been deeply implicated in the tumorigenic transformation of CRC (8). Therapeutically, targeted blockade of specific signaling cascades, such as inhibiting the ERK/p65 pathway to downregulate MMP9 expression, has demonstrated significant potential in curtailing CRC invasiveness (9). Despite these advancements in mapping the primary CRC molecular

landscape, the precise mechanisms directing hematogenous dissemination to rare target organs, such as the thyroid gland, remain a critical blind spot in current clinical oncology.

## Case report

*Case presentation*. A 78-year-old female presenting with a 6-month history of hematochezia and diarrhea was evaluated in the colorectal clinic of Wanbei Coal and Electricity Group General Hospital (Suzhou, China) in October 2024. The patient's medical history included >20 years of hyperthyroidism. The patient denied hypertension, diabetes mellitus, coronary artery disease, hepatitis, tuberculosis, typhoid, drug or food allergies, and a history of transfusions.

The patient consented to the publication of medical information and images in the case report, the preparation of which was approved by the ethics committee of Wanbei Coal and Electricity Group General Hospital (approval no. WBZY-LLWYH-2025-16).

*Physical examination*. Cachexia with weight loss, an alert mental status, cyanosis of the lips with decreased peripheral capillary oxygen saturation of 88% (normal range, 95-100%) and no jugular venous distention were observed. The cardiac silhouette appeared normal. The neck was soft without jugular venous engorgement or cervical lymphadenopathy, and showed a slight rightward tracheal deviation (Fig. 4A). The left thyroid lobe was markedly enlarged, extending posteriorly to the anterior border of the trapezius, firm in consistency and mobile with swallowing. The right thyroid lobe was unremarkable. There was no significant bilateral cervical lymphadenopathy. Chest examination revealed symmetrical respiratory movements, mild tachypnea, tactile fremitus within normal limits, resonant percussion over the lungs, clear bilateral breath sounds, localized dullness and a pleural friction rub suggestive of pleuritis. The abdomen was flat, without hepatomegaly, splenomegaly or abnormal bowel sounds; there were no abdominal wall varices, surgical scars or rashes. A firm, irregular, nodular mass was found measuring ~5x6 cm with ill-defined borders and limited mobility and was adherent to surrounding tissues and palpable in the left lower quadrant. Anorectal examination revealed irregular perianal skin, no foreign bodies on digital rectal examination, intact anal sphincter strength and no bleeding upon withdrawal.

*Ancillary examinations*. A 128-slice chest computed tomography (CT) scan revealed mediastinal lymphadenopathy and a thyroid mass causing tracheal compression and stenosis (Fig. 1A), with multiple pulmonary nodules (Fig. 1B-D).

A 128-slice contrast-enhanced neck CT scan revealed abnormal thyroid density (Fig. 2), bilateral cervical lymphadenopathy and multiple pulmonary masses, and a fine-needle aspiration (FNA) biopsy was recommended.

A 128-slice abdominal CT scan revealed a hypodense lesion in the left hepatic lobe, cholecystitis with gallbladder wall thickening and increased density, bilateral adrenal hypertrophy and an abnormal density in the left lower abdomen suggestive of a sigmoid colon mass (Fig. 3A), and colonoscopy was recommended. The scan also revealed partial bowel distension with contents, retroperitoneal and regional mesenteric lymphadenopathy, pelvic effusion, rectal and anal wall thickening, asymmetric sclerosis of the right sacrum, heterogeneously decreased density of the T11 vertebral body, and multiple soft tissue masses in both lungs. Colonoscopy revealed a colonic mass and multiple polyps (Fig. 3B) and biopsy pathology indicated high-grade intraepithelial neoplasia of the descending colon mucosa (Fig. 3C and D).

Echocardiography revealed ascending aortic dilation, left ventricular diastolic dysfunction and aortic calcification with mild to moderate regurgitation.

*Preoperative assessment*. The patient, an elderly female, presented with moderate anemia, compromised cardiopulmonary function and CRC with pulmonary metastases. Although a formal frailty score was not recorded, the patient was clinically considered frail because of advanced age, cachexia, moderate anemia and compromised cardiopulmonary function. No Child-Pugh class was assigned, as the available records did not indicate cirrhosis or decompensated chronic liver disease. There was suspicion of metastatic cervical lymphadenopathy involving tracheal invasion and airway compression. Owing to the patient's poor baseline status, the family requested palliative intervention to alleviate airway compression and improve respiratory function. The preoperative plan included palliative thyroidectomy without cervical lymphadenectomy. During the surgical procedure, severe airway compression caused by the enlarged thyroid mass was confirmed. Following the palliative resection and decompression of the thyroid gland, the trachea successfully returned to a central anatomical position (Fig. 4B and C).

*Postoperative pathology*. Histopathological examination in October 2024 revealed (right side) adenocarcinoma consistent with metastatic CRC on the basis of the clinical history and an immunohistochemical profile, and (left side) a follicular neoplasm with indeterminate malignant potential. For histological evaluation, formalin-fixed, paraffin-embedded thyroid tissue was sectioned at 4 $\mu$m and stained with hematoxylin and eosin at room temperature. For immunohistochemistry, the sections were deparaffinized, rehydrated and subjected to heat-mediated antigen retrieval, followed by blocking of endogenous peroxidase activity, incubation with primary antibodies, incubation with a horseradish peroxidase-conjugated secondary antibody, visualization with 3,3'-diaminobenzidine and hematoxylin counterstaining. All primary antibodies were obtained from Guangzhou Anbiping Medical Science and Technology Co., Ltd. and are ready-to-use: Galectin-3 (cat. no. IHC-R365), SATB homeobox 2 (SATB2) (cat. no. IHC-R393), cytokeratin (CK)19 [cat. no. LBP-IHC(M).M378-2], Hector Battifora mesothelial-1 (HBME-1) [cat. no. LBP-IHC(B).M104-2], CD56 [cat. no. LBP-IHC(B).M040-2], paired box 8 (PAX8) [cat. no. LBP-IHC(M).R191-2], CK7 [cat. no. LBP-IHC(M).M061-2], CK20 [cat. no. LBP-IHC(M).R38-2] and thyroid transcription factor-1 (TTF-1) [cat. no. LBP-IHC(M).M301-2]. The secondary antibody was obtained from Leica Biosystems, which is a ready-to-use rabbit antibody (cat. no. DS9800). Immunohistochemistry revealed the presence of the following: Galectin-3(+), SATB2(+), CK19(+), HBME-1(-), CD56(-), PAX-8(-), CK7(-), CK20(-) and TTF-1(-) (Fig. 5).

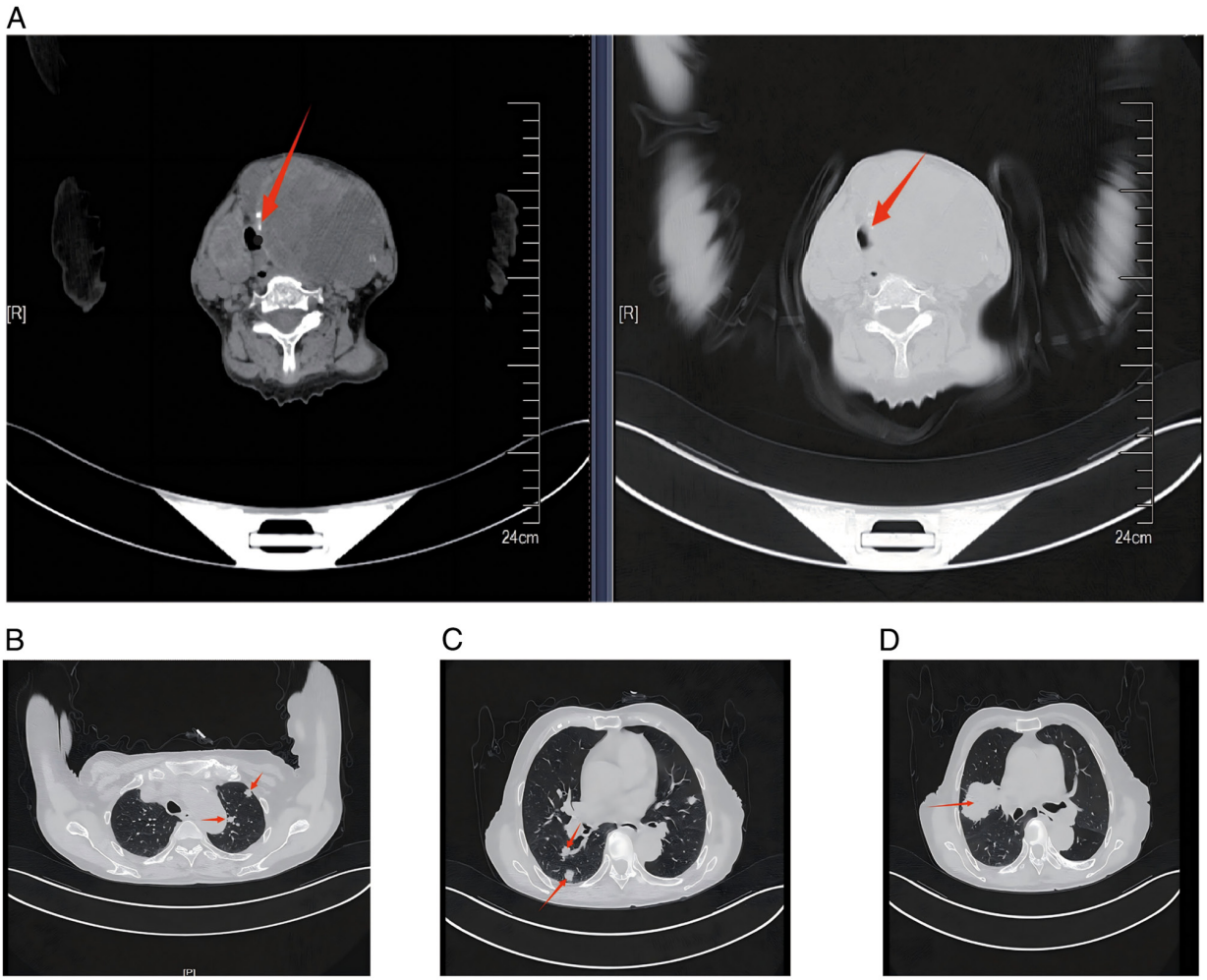


Figure 1. CT findings of the thyroid mass and pulmonary metastases. (A) Paired axial CT images of the neck obtained using different window settings showing a markedly enlarged left thyroid mass causing severe compression, narrowing and rightward displacement of the tracheal lumen; the arrows indicate the compressed trachea. (B-D) Representative axial chest CT images showing multiple bilateral pulmonary nodules and masses (arrows), suggestive of metastatic disease. CT, computed tomography.

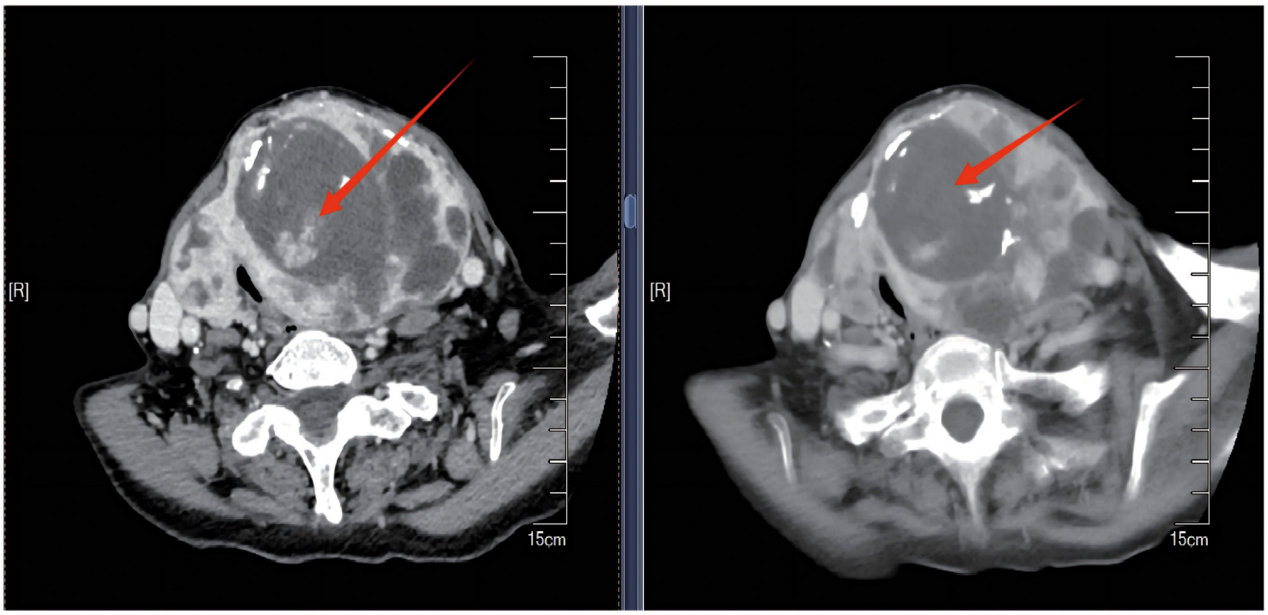


Figure 2. Contrast-enhanced CT findings of the thyroid mass. Representative axial contrast-enhanced CT images of the neck showing a large heterogeneous mass arising from the left thyroid lobe, with internal low-attenuation areas and calcific foci. The mass caused marked compression, narrowing and rightward displacement of the trachea. The arrows indicate representative portions of the thyroid mass. CT, computed tomography.

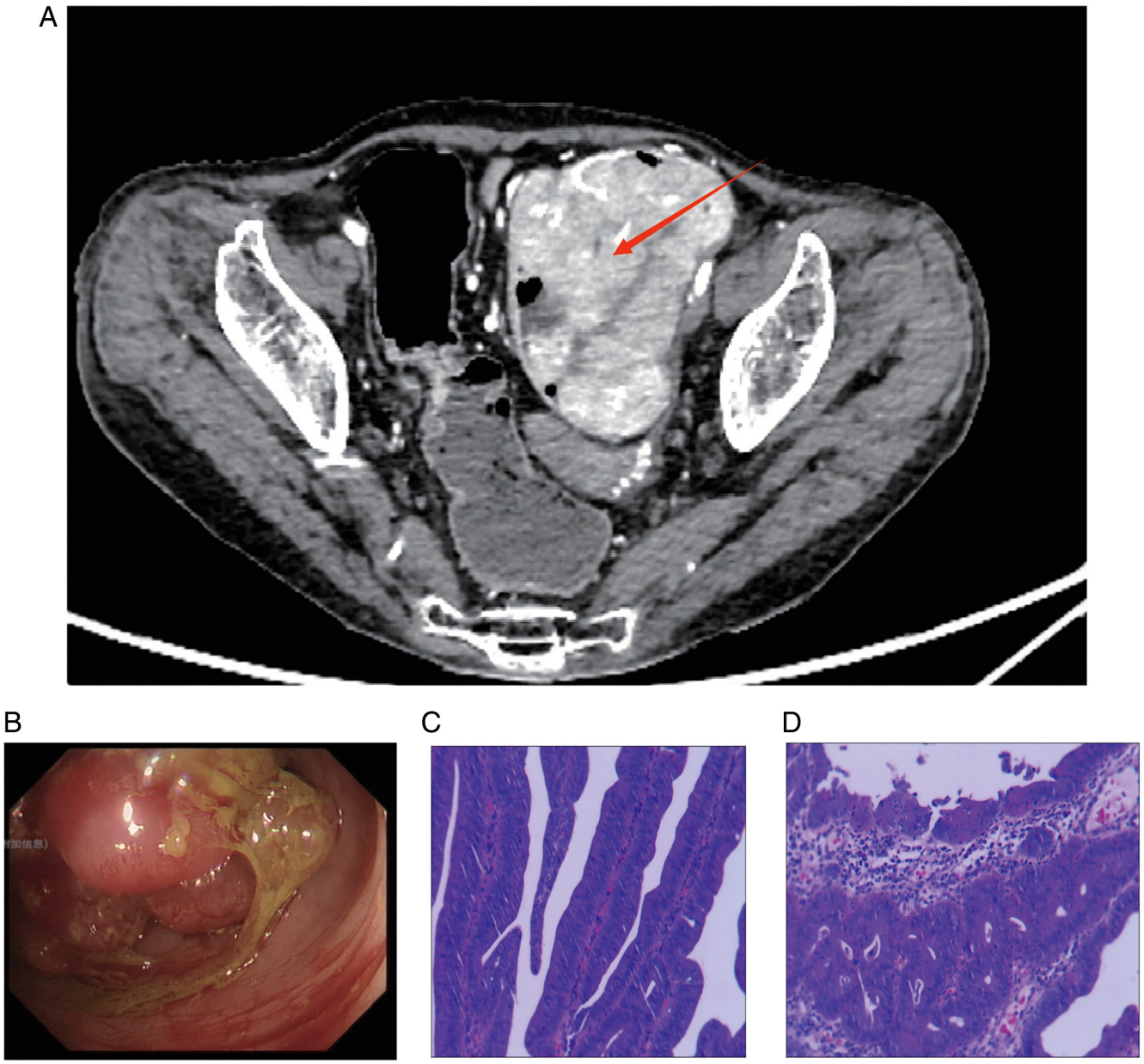


Figure 3. Imaging, endoscopic and histopathological findings of the colorectal lesion. (A) Abdominal CT image showing an abnormal soft-tissue lesion in the left lower abdomen, suspicious for a colorectal tumor; the arrow indicates the lesion. (B) Colonoscopic image showing a colorectal mass with adjacent polypoid lesions; the arrow indicates the representative lesion. (C) H&E-stained section of the colonoscopic biopsy specimen showing high-grade intraepithelial neoplasia within adenomatous colonic epithelium (original magnification, x100). (D) Higher-magnification H&E-stained section showing marked epithelial atypia and high-grade intraepithelial neoplasia (original magnification, x200). CT, computed tomography; H&E, hematoxylin and eosin.

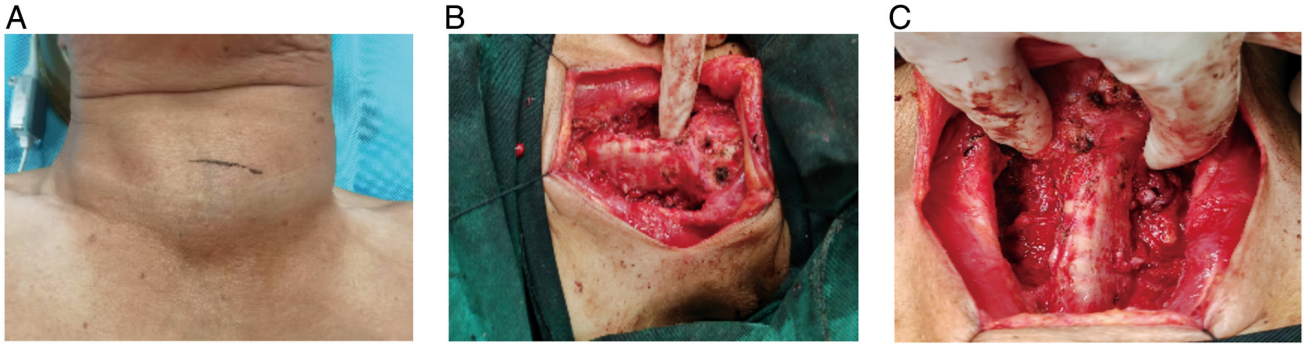


Figure 4. Preoperative and intraoperative findings of the enlarged thyroid gland. (A) Preoperative anterior neck photograph showing prominent anterior neck swelling caused by the markedly enlarged left thyroid mass. (B) Intraoperative view during palliative resection and decompression of the thyroid mass. (C) Intraoperative view after palliative thyroidectomy and decompression, showing the exposed trachea restored to a near-midline position.

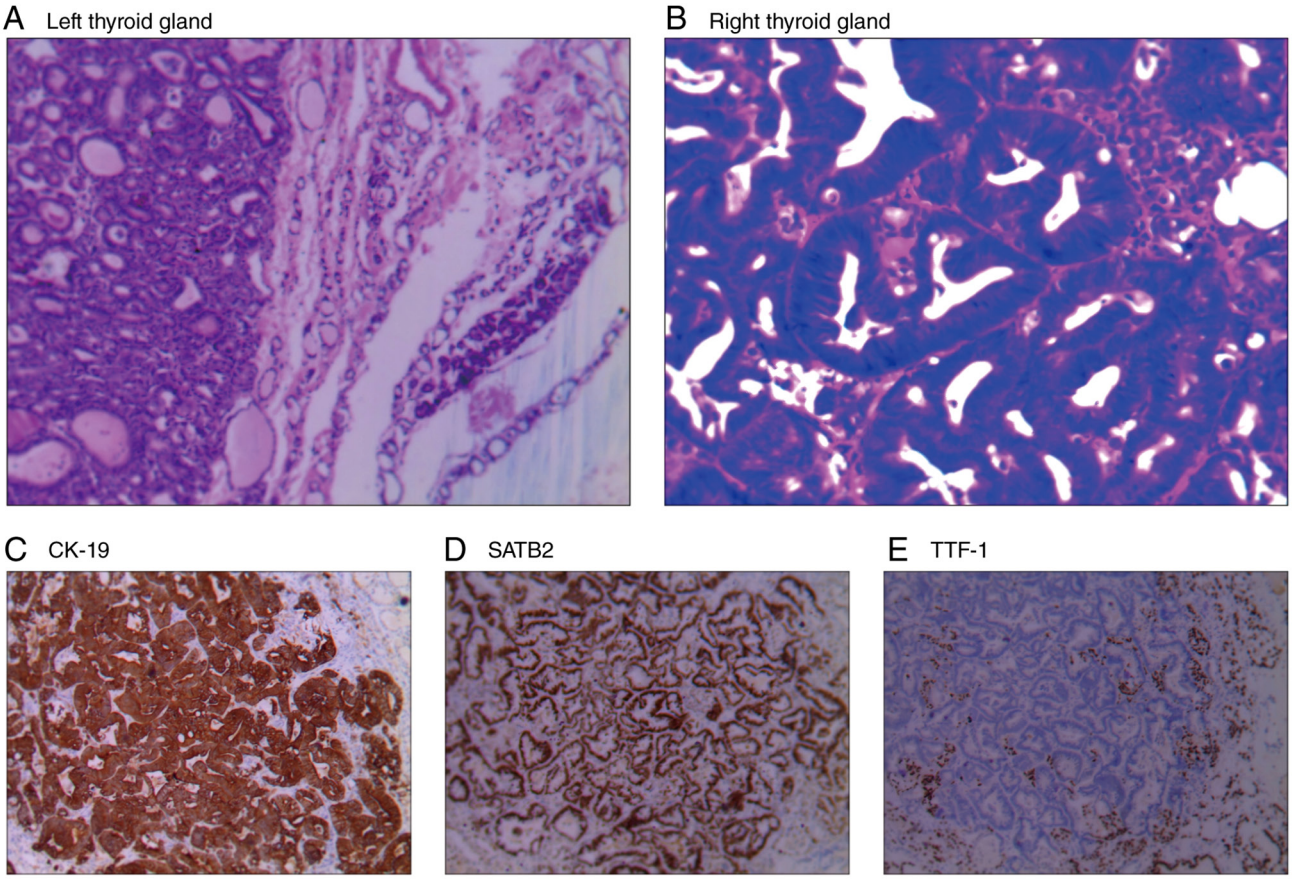


Figure 5. Postoperative pathological examination. (A) H&E-stained section showing a follicular neoplasm with indeterminate malignant potential in the thyroid gland (original magnification, x100). (B) H&E-stained section showing adenocarcinoma consistent with metastatic colorectal carcinoma (original magnification, x200). (C) Immunohistochemical staining showing CK19 positivity in the adenocarcinoma. (D) Immunohistochemical staining showing SATB2 positivity in the metastatic adenocarcinoma. (E) Immunohistochemical staining showing absence of TTF-1 expression in the metastatic adenocarcinoma cells (original magnification, x100). CK, cytokeratin; H&E, hematoxylin and eosin; SATB2, SATB homeobox 2; TTF-1, thyroid transcription factor-1.

*Postoperative management*. Considering the advanced age and compromised cardiopulmonary status, the patient was initiated on oral levothyroxine replacement therapy at a starting dose of 100 $\mu$g/day, with dose adjustment planned according to serum thyroid function tests. Further systemic evaluation, multidisciplinary team (MDT) consultation and comprehensive treatment planning were recommended. The patient and the patient's family declined aggressive therapy, opting instead for palliative care. At the most recent documented follow-up in April 2025, 6 months after surgery, the patient was alive and receiving best supportive care. The patient had recovered satisfactorily from thyroid surgery and thyroid function remained within the reference range during levothyroxine replacement therapy. The patient had not received any systemic anticancer treatment because the patient and the patient's family had declined aggressive therapy.

## Discussion

The primary objective of this discussion and literature review is to systematically synthesize the clinical, radiological, pathological and therapeutic landscapes of CRC metastasizing to the thyroid gland, thereby establishing a structured diagnostic paradigm for this rare clinical entity. While the thyroid gland is an anatomically uncommon site for CRC secondary deposits, maintaining clinical vigilance regarding its metastatic potential is imperative to prevent underdiagnosis. Rather than broadly shifting between CRC systemic recurrence and non-specific thyroid tumors, this section anchors its focus tightly on thyroid metastases of colorectal origin (TMC). By evaluating its localized mechanistic pathways and multi-modality criteria, the present study aimed to provide an evidence-based framework to guide clinicians through tailored therapeutic strategies.

In the broader research context of rare metastatic CRC, this case contributes practical clinicopathological evidence in three aspects. First, it illustrates that a new thyroid mass in a patient with advanced CRC and pre-existing thyroid disease should not be presumed to represent a primary thyroid lesion without systemic staging and pathological verification. Second, the combined immunohistochemical profile, including SATB2 and CK19 positivity with TTF-1 and PAX8 negativity, highlights the diagnostic value of marker panels for distinguishing metastatic colorectal adenocarcinoma from primary thyroid malignancy. Third, the use of palliative thyroidectomy for airway compression in a frail elderly patient demonstrates how treatment goals may appropriately shift from oncological clearance to symptom relief and quality-of-life preservation. Therefore, although the evidentiary strength of a single case is limited, the present report adds to the small body of literature on thyroid metastasis from CRC and supports multidisciplinary,

Table I. Case reports describing colorectal cancer metastases in the thyroid gland since 2019.

| First author(s), year | Age, years/sex | Cancer Origin | Time to metastasis[a], years | Involved site of the thyroid | Examinations | Other metastatic sites | (Refs.) |
|---|---|---|---|---|---|---|---|
| Takada *et al*, 2019 | 65/F | Rectal cancer | 1.5 | Left lobe | US, FNA | Liver and mediastinum | (31) |
| Rojo-Abecia *et al*, 2020 | 85/F | Colorectal cancer | 14 | Left lobe | PET | Lung | (32) |
| Luo *et al*, 2020 | 34/F | Rectal cancer | 6 | Left lobe | FNA | Lung | (33) |
| Hussain *et al*, 2023 | 64/F | Colorectal cancer | - | Left lobe | FNA/CT | Lung | (34) |
| Sullivan *et al*, 2023 | 78/M | Colon cancer | 2 | Left lobe | US, FNA | Liver | (35) |
| Wang *et al*, 2024 | 46/F | Rectal cancer | - | Right lobe | US, FNA | - | (36) |
| Zhao *et al*, 2024 | 45/F | Rectal cancer | 2 | Right lobe | US, FNA | Lung | (37) |

[a]The number of years to develop thyroid metastases after initial diagnosis of colorectal cancer. Investigations and diagnostic studies performed to evaluate thyroid metastases were included. Met, metastases; US, ultrasonography; FNA, fine-needle aspiration; PET, positron emission tomography; CT, computed tomography; F, female; M, male.

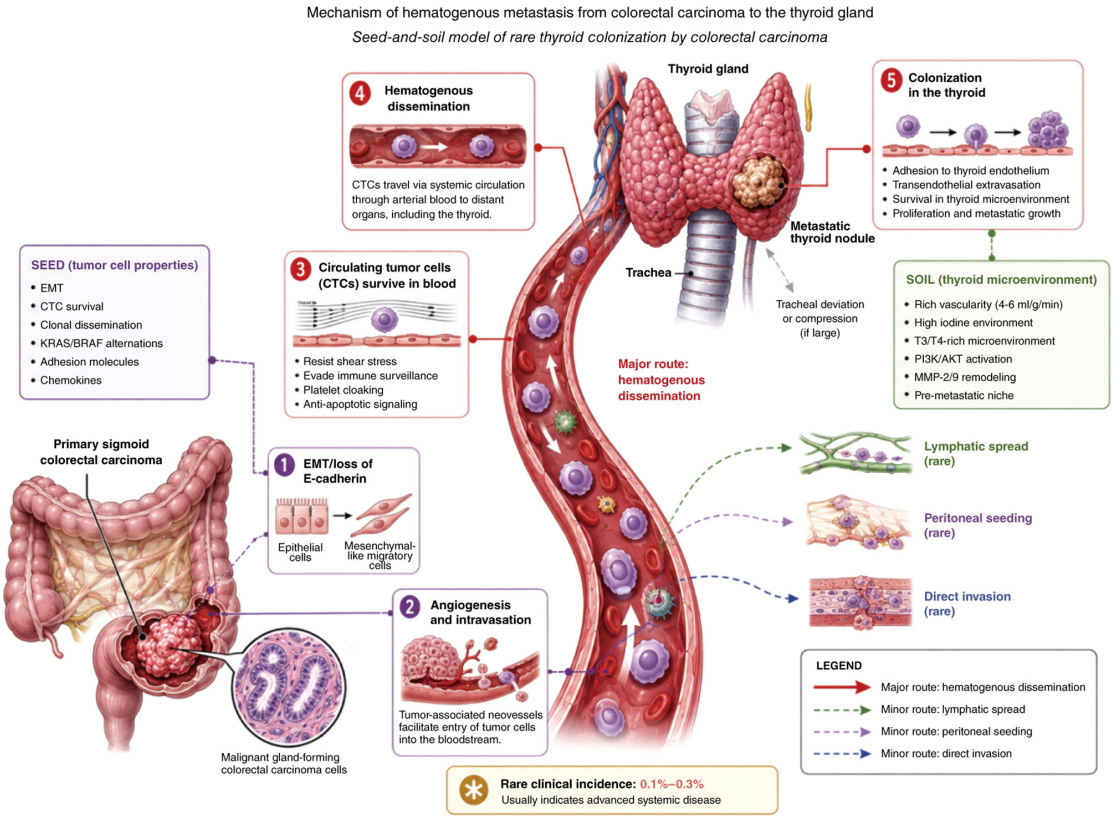


Figure 6. Proposed mechanism of hematogenous metastasis from colorectal carcinoma to the thyroid gland under the 'seed-and-soil' hypothesis. The schematic illustrates the proposed sequential process of epithelial-mesenchymal transition and loss of E-cadherin, tumor-associated angiogenesis and intravasation, survival of circulating tumor cells in the bloodstream, systemic hematogenous dissemination, and subsequent adhesion, extravasation and colonization within the thyroid microenvironment. Hematogenous dissemination is depicted as the principal metastatic route, whereas lymphatic spread, peritoneal seeding and direct invasion are shown as rare theoretical alternative routes. The potential roles of rich thyroid vascularity, the iodine- and thyroid hormone-rich microenvironment, PI3K/AKT signaling and MMP-mediated extracellular matrix remodeling remain hypothetical and require further molecular validation. CRC, colorectal carcinoma; CTCs, circulating tumor cells; EMT, epithelial-mesenchymal transition; PI3K, phosphoinositide 3-kinase; AKT, protein kinase B; MMP, matrix metalloproteinase.

individualized decision-making in advanced rare metastatic disease.

To systematically evaluate the clinical characteristics, chronological latency and therapeutic outcomes of CRC metastasizing to the thyroid gland, a rigorous and structured literature search was performed across international and national electronic databases, including PubMed/MEDLINE (https://pubmed.ncbi.nlm.nih.gov/), Web of Science (https://www.webofscience.com/) and the China National Knowledge Infrastructure (CNKI; https://www.cnki.net/), covering the publication period from January 2019 to October 2024. The search syntax utilized a combination of Medical Subject Headings terms and relevant free-text key words with Boolean operators as follows: ('colorectal neoplasms' OR 'colorectal carcinoma' OR 'rectal cancer' OR 'colon cancer') AND ('thyroid neoplasms' OR 'thyroid metastasis' OR 'secondary thyroid tumor'). To ensure scientific objectivity and minimize reporting bias, study selection was strictly governed by predefined, explicit eligibility rules. The inclusion criteria were as follows: i) Patients with histopathologically or cytologically confirmed secondary thyroid adenocarcinoma uniquely originating from a primary colorectal malignant neoplasm; ii) availability of granular individual patient data, including demographics, clinical presentation, diagnostic profiles and follow-up tracking; and iii) original case reports or series published in peer-reviewed English- or Chinese-language journals. The following exclusion criteria were applied: i) Primary thyroid malignancies, synchronous double primaries or secondary thyroid metastases derived from non-colorectal primary sites; ii) abstract-only publications, conference proceedings, expert editorials or duplicate literature registries; and iii) cases characterized by ambiguous pathological validation or critically missing survival/clinical endpoints. The literature screening process was conducted independently by two investigators (QM and XZ) to eliminate investigator bias, with any discrepancies resolved through consensus or consultation with a third senior author (CM). For all eligible studies meeting the criteria, a standardized data extraction template was employed to capture critical clinical parameters: Patient age, sex, primary tumor anatomical site, disease-free survival interval (latency), localized lobe involvement, core diagnostic modalities, concurrent metastatic burden and implemented therapeutic regimens. Adhering to this exhaustive selection framework, a total of 7 representative cases were identified and included for subsequent comparative pooled analysis. The findings are summarized in Table I.

The detection rate of thyroid metastases in autopsy studies varies significantly among different cohorts, ranging from ~1.25-24%, whereas clinically evident metastases to the thyroid gland remain uncommon (10). Clinically, non-thyroid malignancies metastasizing to the thyroid gland have been reported to account for ~1.4-3% of malignant thyroid tumors, suggesting that thyroid metastases may be underdiagnosed or misdiagnosed in routine clinical practice (11).

The primary tumor types responsible for thyroid metastases differ across geographic regions and study populations. In large literature reviews, renal cell carcinoma has been reported as the most common non-thyroid malignancy metastasizing to the thyroid gland, followed by colorectal, lung and breast carcinomas. In Chinese institutional series, lung, gastrointestinal, breast, and kidney cancers have been identified as common primary sources of secondary thyroid tumors, further supporting regional and cohort-related heterogeneity (10-13). Therefore, patients with a present or prior history of malignancy who develop new thyroid nodules should be evaluated with a high index of suspicion for metastatic disease (13).

Thyroid metastases exhibit a wide range of latency periods. Previous clinical series have shown that the interval from diagnosis of the primary tumor to thyroid metastasis may range from synchronous presentation to more than a decade, with renal cell carcinoma often showing a longer latency period and relatively better post-metastatic survival than more aggressive primary tumors such as lung or esophageal cancer (10-13). These findings indicate that both tumor biology and the extent of systemic disease strongly influence the clinical course and prognosis of thyroid metastases. In conclusion, diagnosing thyroid metastasis requires a comprehensive approach, including a detailed medical history, imaging studies, and histopathological evaluation. For patients with a history of malignant tumors, the differential diagnosis of thyroid nodules should include the possibility of metastatic disease, particularly when imaging features, clinical progression, or immunohistochemical findings are inconsistent with a primary thyroid neoplasm.

The organ-specific dissemination of CRC to the thyroid gland can be conceptualized through the classic 'seed and soil' hypothesis, which involves a highly orchestrated, multi-step molecular cascade (Fig. 6) (14). The 'seed' (invasive potential and dissemination): Epithelial-mesenchymal transition serves as a primary driver, wherein primary tumor cells shed epithelial adhesive markers (such as E-cadherin downregulation) to acquire a migratory mesenchymal phenotype (15). Circulating tumor cells (CTCs) that successfully survive hemodynamic stress and immune surveillance frequently harbor specific oncogenic alterations, such as *KRAS* or *BRAF* mutations. These mutations potentially confer clonal survival advantages and enhance their capacity for distant colonization (16). The 'soil' (thyroid microenvironmental receptivity): The thyroid gland's unique physiological environment provides an intriguing 'soil' for CRC sequestration. Its profuse arterial vascularity (4-6 ml/g/min) intrinsically increases the probability of physical arrest and microvascular retention of migrating CTCs (14,17). Beyond mere mechanical trapping, it is hypothesized that the localized chemical microenvironment-characterized by high iodine levels and rich concentrations of thyroid hormones (T3/T4)-may support metastatic cell metabolism. These factors aberrantly activate downstream signaling cascades, such as the PI3K/AKT pathway, and upregulate matrix metalloproteinases (MMP-2/9) to remodel the extracellular matrix, thereby establishing a hospitable pre-metastatic niche. Regarding limitations and future directions, it is critical to acknowledge that the application of the 'seed and soil' model to TMC is currently predicated on retrospective clinical observations and theoretical extrapolation, lacking direct *in vivo* molecular validation. To resolve these speculative elements, future research utilizing single-cell RNA sequencing or spatial transcriptomics is highly warranted. Such advanced modalities will facilitate the meticulous mapping of spatial interactions between CRC surface adhesion molecules (e.g., specific integrins) and

Table II. Differential diagnosis of diseases related to thyroid metastasis (38).

| Pathology | Core identification points | Diagnostic criteria |
|---|---|---|
| Primary thyroid cancer | Papillary thyroid carcinoma: Suspicious ultrasound features and BRAF V600E mutation may support primary thyroid carcinoma. Follicular thyroid carcinoma: Capsular or vascular invasion supports follicular thyroid carcinoma. | Bethesda category VI cytology, thyroid-specific immunohistochemistry and molecular alterations may support the diagnosis of primary thyroid malignancy. |
| Metastatic carcinoma | Lung cancer: Lung lesions on CT and thyroid transcription factor-1 positivity may support a pulmonary origin. Breast cancer: Estrogen receptor/progesterone receptor/HER2 profile may assist in identifying a breast origin. | Correlation with the primary tumorhistory, systemic imaging and immunohistochemical marker panels can help identify the metastatic origin. |
| Benign lesion | Cystic changes, inflammatory markers and thyroid function tests may support benign thyroid disease. | Benign thyroid disease should be assessed using ultrasound risk stratification, thyroid function tests, inflammatory markers and cytological findings when clinically indicated. |
| Rare diseases | Lymphoma or ectopic thyroid tissue should be assessed using flow cytometry, thyroglobulin evaluation and radionuclide imaging when clinically indicated. | Flow cytometry, thyroglobulin evaluation, radionuclide imaging and histopathological confirmation may assist in diagnosing thyroid lymphoma, ectopic thyroid tissue and other rare entities. |

thyroid parenchymal ligands, thereby elucidating the definitive mechanisms driving this rare organotropism (17).

Early detection and diagnosis of CRC and its metastases are vital for developing comprehensive treatment strategies and achieving favorable outcomes. Therefore, selecting appropriate and comprehensive imaging and pathological examination methods is crucial for accurate diagnosis and differential diagnosis.

Clinically, thyroid metastases typically present as painless neck masses. Imaging often reveals hypoechoic nodules, which are frequently misdiagnosed as nodular goiters (18). Imaging modalities include ultrasound, CT, MRI and positron emission tomography (PET)-CT, each with distinct features and advantages. Ultrasound reveals metastases as hypoechoic nodules with ill-defined, irregular borders, often accompanied by microcalcifications or cystic changes, with a sensitivity ranging from 82 to 91%. Metastatic cervical lymph nodes may display structural disruption and cystic or calcified alterations. On CT, metastases appear as solid masses with uneven enhancement after contrast agent administration (diagnostic specificity of 76% when enhancement exceeds 25 HU), with the characteristic 'biting pie sign'-a straight interface between the tumor and thyroid gland-having a specificity of 88% (19). MRI reveals heterogeneous signals on T2-weighted images, especially high signals in central necrotic areas, and dynamic contrast-enhanced MRI reveals the 'tumor capsule interruption sign', with a positive predictive value of 94% (20). PET-CT assesses lesions on the basis of the maximum standardized uptake value (SUVmax), where an SUVmax ≥2.5 effectively distinguishes differentiated ($^{131}$I-whole-body scan-positive) from undifferentiated metastases, with an area under the curve of 0.87 (21).

Pathologically, FNA combined with the Bethesda system achieves a diagnostic sensitivity of up to 72% for Bethesda category VI thyroid nodules (22). The identification of nuclear grooves or intranuclear inclusions is indicative of papillary thyroid carcinoma (PTC). Immunohistochemical profiling demonstrated a high expression rate of TTF-1 and PAX8 in primary thyroid malignancies (up to 98%), whereas metastatic lesions exhibited only 12% positivity (23). Metastatic origin tracing utilizes standardized immunomarkers, such as CK7+/CK20- for lung origin metastases and estrogen receptor+/progesterone receptor+/HER2± for breast origin metastases. Molecular assessment of thyroid nodules, including evaluation of BRAF, RAS, RET/PTC and PAX8-peroxisome proliferator-activated receptor γ alterations, may assist in distinguishing primary thyroid neoplasms from metastatic lesions when interpreted together with morphology, imaging findings and immunohistochemical profiles (18,22,23).

The diagnosis of CRC and its metastatic spread necessitates the integration of advanced imaging modalities and histopathological evaluation. The utilization of multimodal imaging techniques-such as ultrasonography, computed tomography, magnetic resonance imaging and PET-CT-augments diagnostic precision. Histopathological analysis, including FNA cytology, immunohistochemistry and molecular profiling, further refines diagnostic certainty and informs therapeutic decision-making (18-23).

Crucially, establishing an unambiguous diagnosis through this multi-modality framework is not merely a diagnostic endpoint but the clinical cornerstone that directly dictates subsequent management. Because the presentation of TMC frequently mimics primary thyroid malignancies or signifies

widespread systemic progression, definitive pathological and radiological confirmation is a prerequisite for navigating the therapeutic transition. Striking a balance between aggressive oncological clearance and palliative symptom relief requires absolute diagnostic clarity; this clarity directly informs the multidisciplinary resectability assessment, thereby seamlessly guiding clinicians from initial staging to tailored therapeutic interventions (24-26). The detailed differential diagnosis classification system is summarized in Table II.

The management of CRC metastasis to the thyroid gland involves stratification on the basis of resectability. Resectable lesions-such as solitary metastases, stable primary tumors for at least 6 months and an Eastern Cooperative Oncology Group (ECOG) performance status of ≤2-are candidates for total thyroidectomy with central neck lymphadenectomy, with intraoperative frozen section analysis confirming negative margins (24-26).

In unresectable or disseminated metastatic CRC, systemic treatment should be individualized according to the patient's performance status, metastatic burden, treatment goals and molecular profile. Standard systemic options include fluoropyrimidine-, oxaliplatin- or irinotecan-based chemotherapy, such as FOLFOX (folinic acid, fluorouracil and oxaliplatin) or FOLFIRI (folinic acid, fluorouracil and irinotecan), with or without anti-angiogenic therapy (25,26). Anti-epidermal growth factor receptor (EGFR) therapy may be considered in selected patients with rat sarcoma viral oncogene homolog (RAS) wild-type disease, particularly in the context of left-sided primary tumors, whereas microsatellite instability-high/deficient mismatch repair tumors may benefit from immune checkpoint inhibitor-based treatment (26). For B-Raf proto-oncogene serine/threonine kinase (BRAF) V600E-mutant metastatic CRC, molecularly guided regimens should be considered according to current clinical guidelines and prior treatment exposure (26). However, for frail elderly patients or those with extensive systemic disease, aggressive systemic therapy may not be feasible. In such cases, management should prioritize life-threatening local complications, symptom relief, airway protection and quality-of-life preservation through multidisciplinary assessment (26).

In the present case, the patient was of an advanced age and had compromised cardiopulmonary function, multiple pulmonary metastases and clinically significant tracheal compression caused by the thyroid mass. Therefore, palliative thyroidectomy was performed to relieve airway obstruction rather than to achieve oncological clearance. After surgery, systemic evaluation and multidisciplinary treatment planning were recommended, but the patient and the patient's family declined aggressive therapy and chose palliative care. This clinical course highlights that treatment strategies for rare thyroid metastasis from CRC should be individualized, balancing disease control with surgical risk, functional status and patient preference.

The diagnosis and treatment of thyroid metastases in CRC present unique challenges, necessitating MDT collaboration. Given the rarity of this metastatic pattern (0.1-0.3%) and its frequent association with advanced disease, MDT collaboration is crucial for accurate diagnosis, optimized treatment planning and improved patient outcomes (4,27).

Thyroid metastases from CRC are frequently misdiagnosed as primary thyroid tumors due to overlapping imaging and cytological features. A structured MDT team comprising endocrinology, radiology, pathology and oncology specialists ensures: i) Precise histopathological differentiation via an immunohistochemical panel, including SATB2 positivity and TTF-1/PAX8 negativity, to support metastatic colorectal origin and distinguish it from primary thyroid malignancy (18,23). ii) Advanced imaging correlation analysis (enhanced CT, PET-CT and MRI) to assess metastatic burden and exclude synchronous lesions (18-21). iii) Molecular profiling (e.g., KRAS/NRAS/BRAF testing) to guide targeted therapy decisions (26,28).

Given that most cases require primarily palliative treatment, multidisciplinary discussions are crucial for balancing oncological efficacy with patient quality of life. Surgical oncology may consider a thyroidectomy to alleviate symptoms (e.g., tracheal compression), but surgical risks in elderly or frail patients require multidisciplinary assessment. Medical oncology systemic therapy, including FOLFOX or FOLFIRI with or without bevacizumab or other targeted agents, should be individualized based on performance status and molecular markers (26,28,29). Radiation oncology may employ stereotactic body radiotherapy for oligometastatic disease. Post-thyroidectomy levothyroxine replacement therapy requires endocrinological management.

MDT collaboration enables comprehensive follow-up strategies, including standardized imaging protocols (e.g., quarterly CT/PET-CT) to monitor treatment response. Trend monitoring of tumor markers, including carcinoembryonic antigen (CEA) and thyroglobulin, may facilitate the early detection of disease progression. Integrated palliative care alleviates symptom burden in advanced disease (27,30).

The case reports summarized in Table I illustrate diverse clinical presentations of CRC metastasis to the thyroid gland. Takada *et al* (31) reported left-lobe thyroid metastasis from rectal cancer 1.5 years after the primary diagnosis, accompanied by liver and mediastinal metastases. Rojo-Abecia *et al* (32) described thyroid metastasis 14 years after CRC diagnosis with concurrent pulmonary metastasis. Luo *et al* (33) reported rectal cancer metastasis involving a papillary thyroid carcinoma 6 years after the primary diagnosis, together with lung metastases. Hussain *et al* (34) described left-lobe thyroid metastasis from CRC in a patient with pulmonary metastatic disease. Sullivan and Chahfe (35) identified metastatic colon cancer in the thyroid incidentally during excision of a parathyroid adenoma, with concomitant liver metastasis. Wang *et al* (36) reported thyroid metastasis presenting primarily as a neck mass. Zhao *et al* (37) described rectal cancer metastasis to the right thyroid lobe 2 years after the primary diagnosis, accompanied by pulmonary metastases. The differential diagnostic categories in Table II were adapted from Orlandi *et al* (38).

Studies suggest that MDT-based management may improve diagnostic accuracy, facilitate individualized treatment planning, and optimize coordination of surgery, systemic therapy, radiotherapy, endocrine management, and palliative care in patients with CRC and rare metastatic patterns (29).

This study was limited by its case report nature, involving a single patient, which constrains the generalizability of the findings. The causal relationship between the patient's long-standing hyperthyroidism-over two decades- and the

development and metastasis of CRC remains uncertain, and there is a lack of supporting molecular or epidemiological evidence. Additionally, owing to the extensive metastatic burden and compromised baseline health, only palliative thyroidectomy was performed. Systemic treatments such as surgery, chemotherapy or targeted therapy were not feasible, resulting in a poor prognosis. This underscores the critical importance of multidisciplinary collaboration in managing advanced, rare metastatic malignancies.

Metastasis of CRC to the thyroid is exceedingly rare and involves complex mechanisms, primarily hematogenous dissemination influenced by adhesion molecules, chemokines and the tumor microenvironment. This case highlights that in patients with a history of malignancy, thyroid nodules should prompt suspicion of metastatic disease, with a differential diagnosis incorporating imaging features-such as contrast-enhanced CT patterns-FNA cytology and immunohistochemical analysis. Treatment strategies should be individualized; in this case, only palliative surgery was performed because of the patient's poor health status. Future research should focus on refining screening protocols for thyroid metastasis, establishing diagnostic criteria based on imaging and molecular pathology, and identifying novel biomarkers to improve diagnostic accuracy and therapeutic efficacy.

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**Availability of data and materials**

The data generated in the present study may be requested from the corresponding author.

**Authors' contributions**

JC and CM conceived and designed the case report and performed the palliative thyroidectomy. QM and XZ acquired the clinical data and analyzed the patient's clinical course; they also confirm the authenticity of all the raw data. AW and LG analyzed and interpreted the imaging and pathological data, prepared the tables and figures and contributed to the literature review. JC drafted the manuscript. CM supervised patient management and project administration. All authors contributed to data interpretation, revised the manuscript critically for important intellectual content, and have read and approved the final manuscript.

**Ethics approval and consent to participate**

This study was approved by the ethics committee of Wanbei Coal and Electricity Group General Hospital (Suzhou, China; approval no. WBZY-LLWYH-2025-16). The study was performed in accordance with the principles of the Declaration of Helsinki and later amendments.

**Patient consent for publication**

Written informed consent for publication of the patient's clinical details and accompanying images was obtained from the patient.

**Competing interests**

The authors declare that they have no competing interests.

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