

Balancing Thrombosis Prevention and Bleeding Risks: Intricate Management of a Patient with Advanced Cardiac Disease and Gastric Malignancies Post Gastrectomy

Gadisa Musa Wako^{1*}, Melat Adugna Asnake², Eman Musa Wako³, Feven Birara Tesfaye⁴

¹Department of General Surgery, Nanjing First Hospital, Nanjing Medical University, No. 919 Yingtian Street, Nanjing, Jiangsu Province, P.R. China.

²Department of Gastroenterology, The Second Affiliated Hospital of Nanjing Medical University, No. 121 Jiangjiayuan Road, Nanjing, 210000, Jiangsu Province, P.R. China.

³Lorcan Medical College, Cmc, Addis Ababa, Ethiopia.

⁴Department of Plastic Surgery, Zhujiang Hospital, Southern Medical University, Guangzhou 510280, Guangdong Province, P.R. China.

*Corresponding Author:

Gadisa Musa Wako

General Surgery Center, Department of Gastrointestinal Surgery, Zhujiang Hospital of Southern Medical University, Guangzhou 510280, Guangdong Province, P.R. China, Email: gadimw101@gmail.com

Author contributions:

GMW and MAA came up with the study's concept and design, collected and analyzed the data, and wrote the manuscript. GMW supervised the project, made revisions, gave advice, and reviewed the article. EMW and FBT helped with data collection for the manuscript's editing and concept assistance. All authors have read and approved the final version of the manuscript.

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1. Abstract

We report a challenging case of a 68-year-old man with advanced gastric adenocarcinoma and severe dilated cardiomyopathy (DCM; EF 25%), highlighting perioperative management complexities to balance thrombosis prevention and bleeding risk. Preoperative evaluation revealed significant systolic dysfunction and coronary artery disease. A multidisciplinary team planned an open Roux-en-Y total gastrectomy to optimize oncological outcomes while minimizing anesthesia-related cardiac risks. Key interventions

included heart-friendly anesthesia, continuous intraoperative cardiac monitoring, goal-directed fluid management, and dynamic anticoagulation adjustments. Postoperatively, the patient developed left leg intermuscular vein thrombosis, pneumonia, and gastrointestinal bleeding. Management included temporary discontinuation of enoxaparin, hemostatic therapy (tranexamic acid 1 g IV, batroxobin 5 IU IV, somatostatin 250 µg/h infusion), delirium control with dexmedetomidine 0.2–0.7 µg/kg/h and olanzapine 5 mg daily, and supportive transfusions (RBC 1.5 units, FFP 250 ml). Recovery was uneventful; follow-up at 3 months demonstrated stable cardiac function, no recurrent bleeding, and no disease recurrence. This case underscores the importance of individualized, dynamic perioperative strategies in patients with concurrent high-risk cardiovascular disease and advanced gastric malignancy, emphasizing careful anticoagulation, hemodynamic optimization, and multidisciplinary coordination to achieve favorable outcomes.

2. Keywords: Thrombosis prevention₁, Bleeding risk management₂, Advanced gastric cancer₃, Dilated cardiomyopathy (DCM)₄, Perioperative care₅, Roux-en-Y gastrectomy₆.

3. Abbreviations: DCM – Dilated Cardiomyopathy; EF – Ejection Fraction; RBC – Red Blood Cells; FFP – Fresh Frozen Plasma; TXA – Tranexamic Acid; DVT – Deep Vein Thrombosis; VTE – Venous Thromboembolism; LMWH – Low-Molecular-Weight Heparin; TEE – Transesophageal Echocardiography; PT – Prothrombin Time; APTT – Activated Partial Thromboplastin Time; BNP – B-type Natriuretic Peptide; CEA – Carcinoembryonic Antigen; CT – Computed Tomography; ICU – Intensive Care Unit

4. Introduction

The simultaneous occurrence of advanced gastric cancer and severe DCM presents unique perioperative challenges. Gastric adenocarcinoma is a leading malignancy worldwide, predominantly affecting older adults [1–3]. While surgery remains the cornerstone of curative treatment, patients with significant cardiac comorbidities face increased perioperative morbidity and mortality [4].

DCM, defined by left ventricular dilation and systolic dysfunction (EF <40%), predisposes patients to thrombosis and complicates anticoagulation strategies [5,6]. Balancing thrombosis prevention and bleeding risk in such high-risk surgical patients is rarely reported.

This report describes a systematically managed case of advanced gastric cancer in a patient with severe DCM. The novelty lies in the integration of cardiac optimization, individualized anticoagulation, and hemostatic management, providing practical insights for clinicians encountering similar high-risk surgical scenarios.

5. Case Report

5.1. Clinical Presentation

A 68-year-old Chinese male presented with a 1-month history of postprandial choking and slight weight loss. Medical history included hypertension, left bundle branch block, diabetes, and chronic alcohol consumption. No prior surgical history or familial hereditary diseases were reported. Physical examination revealed a soft upper abdomen with mild tenderness, stable vital signs, and no percussion pain.

5.2. Diagnostic Workup

Gastroscopy revealed a cardia lesion; biopsy confirmed moderately differentiated adenocarcinoma (pT3N3a). Enhanced CT identified gastroepiploic lymphadenopathy without liver metastasis. Cardiac evaluation showed severe DCM (EF 25%), left ventricular enlargement, mild valvular regurgitation, and coronary calcifications (max stenosis 60–70%).

5.3. Laboratory findings:

- WBC $7.45 \times 10^9/L$ (4.5–10.0)
- RBC $4.59 \times 10^{12}/L$ (4.3–5.8)
- Hemoglobin 154 g/L (130–175)
- HCT 45.1% (40–50)
- Platelets $238 \times 10^9/L$ (100–300)
- CEA 7.42 ng/ml (<5.0)
- BNP 463 pg/ml (<100)

Differential diagnoses included proximal gastric tumor and esophageal carcinoma, which were excluded via endoscopic evaluation, imaging, and histopathology.

5.4. Diagnostic Assessment

The patient presented with postprandial choking sensation and mild weight loss, raising concern for an upper gastrointestinal obstructive or infiltrative process. Initial diagnostic priorities were to establish the **primary pathology**, determine **tumor extent**, and assess **cardiovascular operability** given the patient's significant comorbidities.

Upper gastrointestinal endoscopy demonstrated a lesion involving the gastric cardia, and histopathological examination of biopsy specimens confirmed **moderately differentiated gastric adenocarcinoma**. Contrast-enhanced computed tomography (CT) revealed regional gastroepiploic lymphadenopathy without evidence of hepatic or distant metastases, supporting a diagnosis of **locally advanced gastric cancer**.

Given the patient's advanced age and history of cardiovascular disease, comprehensive cardiac evaluation was performed. Transthoracic echocardiography revealed marked left ventricular dilation with severely reduced systolic function (ejection fraction 25%), consistent with **severe dilated cardiomyopathy**. Coronary computed tomography angiography demonstrated coronary artery calcification with moderate-to-severe stenosis (60–70%), indicating concomitant ischemic heart disease. Elevated B-type natriuretic peptide (463 pg/mL) further supported the diagnosis of advanced heart failure.

The diagnostic assessment therefore established two concurrent high-risk conditions: **advanced gastric adenocarcinoma requiring radical surgical management and severe cardiomyopathy significantly increasing perioperative risk**.

Differential Diagnosis

Differential Diagnosis	Supporting Features	Exclusion Rationale
Gastric adenocarcinoma	Weight loss, cardia lesion on endoscopy, positive biopsy	Confirmed histologically
Esophageal carcinoma	Dysphagia-like symptoms, proximal lesion location	Endoscopy and biopsy localized tumor to stomach
G a s t r i c lymphoma	Weight loss, gastric mass	Histopathology inconsistent
Benign peptic stricture	Postprandial symptoms	Malignant features on biopsy and imaging
Cardiac cachexia	Weight loss, heart failure	Presence of obstructive gastric lesion
Ischemic cardiomyopathy	Coronary stenosis	Predominant ventricular dilation DCM

Table 1: Differential diagnoses considered during diagnostic assessment

5.5. Diagnostic Challenges

Several diagnostic challenges were encountered in this case. First, the patient's **nonspecific gastrointestinal symptoms** could be attributed to either upper gastrointestinal malignancy or advanced cardiac disease, potentially delaying diagnosis. Second, determining **surgical eligibility** was complex due to the coexistence of severe dilated cardiomyopathy and coronary artery disease, both of which substantially increased perioperative mortality risk.

Third, assessment of thromboembolic risk was complicated by overlapping factors, including malignancy, reduced cardiac output, immobility, and hypoalbuminemia, while simultaneously maintaining awareness of the elevated bleeding risk associated with radical gastrectomy. Finally, accurate staging and perioperative planning required close multidisciplinary coordination to balance oncological benefit against cardiovascular safety.

These challenges underscore the importance of structured diagnostic reasoning and multidisciplinary evaluation when managing patients with concurrent advanced malignancy and severe cardiovascular disease.

5.6. Treatment Plan

A multidisciplinary team, including general surgery, cardiology, anesthesiology, and critical care, was assembled to develop an individualized perioperative plan addressing the dual challenges of advanced gastric malignancy and severe DCM (EF 25%). The primary goals were oncological completeness, cardiac safety, prevention of thrombosis, and minimization of bleeding risk.

5.7. Preoperative Preparation

Cardiac optimization: Coronary CTA was performed to assess coronary lesions. Rate- and blood-pressure-controlling medications were continued to maintain hemodynamic stability. Preoperative discussions focused on fluid status, anesthesia risk, and anticoagulation timing.

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Thrombosis risk assessment: High thromboembolic risk due to DCM and immobility was evaluated using the Caprini score. Enoxaparin was held preoperatively.

Anemia and nutrition: Baseline labs revealed mild hypoalbuminemia (33.4 g/L), corrected with albumin supplementation. RBC transfusion plans were prepared for anticipated perioperative blood loss.

5.8. Surgical Strategy:

5.8.1. Procedure: Open Roux-en-Y total gastrectomy was chosen to ensure oncological completeness and minimize anesthesia-related cardiac risk. Laparoscopic approach was deemed higher risk given potential hemodynamic fluctuations with pneumoperitoneum.

5.8.2. Anesthesia management: Heart-friendly anesthetic agents were used, including careful titration of induction and maintenance medications. Continuous intraoperative monitoring included transesophageal echocardiography (TEE), systemic vascular resistance, pulmonary artery pressure, cardiac output, and oxygen saturation. Vasopressors were prepared for rapid correction of hypotension.

5.8.3. Fluid management: Goal-directed therapy was implemented using colloid-dominant IV fluids to maintain colloid osmotic pressure and reduce third-space fluid accumulation. Urine output and central venous pressure were closely monitored.

5.8.4. Hemostasis and anticoagulation: Precise surgical techniques minimized intraoperative bleeding. Enoxaparin was restarted postoperatively with dose adjustments based on coagulation parameters. Hemostatic agents (batroxobin, TXA) were available if needed.

5.9. Postoperative Course

On postoperative day 1, CT showed pneumonia and bilateral pleural effusion; Doppler revealed left leg inter-muscular vein thrombosis. Lab tests: D-dimer 1.4 µg/ml (0.01–0.50), fibrinogen 6.51 g/L (2–4). High Caprini score (6), low EF, hypoalbuminemia (33.4 g/L), and immobility required albumin supplementation and adjusted anticoagulation (enoxaparin). Urine output 1440 ml; abdominal drainage 60 ml.

On day 2, urine output was 800 ml; abdominal drainage 30 ml. Labs showed normal PT/APTT, fibrinogen 4.87 g/L, indicating persistent hypercoagulability.

5.10. Therapeutic Intervention

Therapeutic management was planned and implemented in a stepwise, chronological manner, guided by oncological principles, cardiovascular risk stratification, and dynamic reassessment of thrombotic and bleeding risks.

5.11. Preoperative Interventions

Given the diagnosis of locally advanced gastric adenocarcinoma and severe dilated cardiomyopathy (EF 25%), a multidisciplinary team formulated an individualized perioperative strategy. Chronic cardiovascular medications for rate and blood pressure control were continued to maintain hemodynamic stability. Anticoagulation with low-molecular-weight heparin (LMWH) was withheld

preoperatively to reduce surgical bleeding risk, following risk-benefit assessment based on the Caprini score and anticipated operative blood loss. Nutritional optimization was initiated, including albumin supplementation for hypoalbuminemia (33.4 g/L), to improve wound healing and reduce postoperative complications.

5.12. Intraoperative Interventions

An open Roux-en-Y total gastrectomy was selected to avoid the hemodynamic instability associated with pneumoperitoneum in laparoscopic surgery. Heart-protective anesthesia was employed with cautious induction and maintenance to minimize myocardial depression. Advanced hemodynamic monitoring, including transesophageal echocardiography and continuous cardiac output assessment, was used to guide vasopressor support and goal-directed fluid therapy. Colloid-dominant fluids were administered to preserve intravascular volume while avoiding fluid overload.

5.13. Postoperative Interventions

Postoperatively, thromboprophylaxis with LMWH was reinitiated and adjusted based on coagulation parameters and evolving clinical status. On postoperative day 1, the detection of left lower limb intermuscular vein thrombosis prompted continued anticoagulation under close monitoring. Concurrent pneumonia and pleural effusion were treated with antibiotics and supportive respiratory care.

On postoperative day 3, the patient developed acute delirium, fever, tachycardia, and hematochezia, accompanied by a significant drop in hemoglobin. In response, LMWH was immediately discontinued due to suspected gastrointestinal bleeding. Hemostatic therapy was initiated, including tranexamic acid (1 g IV), batroxobin (5 IU IV), and continuous somatostatin infusion (250 µg/h). Blood loss was corrected with transfusion of 1.5 units of packed red blood cells and 250 mL of fresh frozen plasma. Delirium was managed with dexmedetomidine infusion (0.2–0.7 µg/kg/h) and oral olanzapine (5 mg daily). These interventions led to stabilization of hemodynamics, resolution of bleeding, and improvement in mental status.

6. Follow-up and Outcomes

6.1. Short-term Outcomes

Objective clinical and laboratory parameters demonstrated progressive improvement following therapeutic adjustments. Hemoglobin levels stabilized without further transfusion requirements, coagulation indices normalized, and no recurrent gastrointestinal bleeding was observed. Delirium resolved within several days, and inflammatory markers improved with antibiotic therapy. Repeat clinical assessment showed resolution of pneumonia and pleural effusion without respiratory compromise.

6.2. Adverse Events

Documented adverse events included postoperative pneumonia, intermuscular vein thrombosis, acute gastrointestinal bleeding, and delirium. All complications were promptly identified and managed without progression to organ failure or need for reoperation. No anticoagulation-related catastrophic bleeding or thromboembolic progression occurred after therapy modification.

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6.3. Treatment Adherence

The patient demonstrated full adherence to prescribed medical therapy during hospitalization. Medication adjustments were made exclusively under medical supervision, with no evidence of noncompliance. Post-discharge, the patient reported adherence to recommended cardiac medications and follow-up schedules.

6.4. Long-term Functional and Clinical Outcomes

At 3-month follow-up, the patient remained clinically stable. Cardiac function showed no further deterioration compared to baseline, with preserved functional capacity for daily activities (NYHA class II). There was no recurrence of gastrointestinal bleeding or thromboembolic events. Oncological follow-up revealed no evidence of tumor recurrence or metastasis on imaging and clinical evaluation.

Time Point	Clinical Event	Key Findings and Interventions
1 month pre-admission	Symptom onset	Postprandial choking sensation and mild weight loss
Day 0 (Admission)	Diagnostic evaluation	Gastroscopy revealed cardia lesion; biopsy confirmed moderately differentiated gastric adenocarcinoma. Contrast-enhanced CT showed regional lymphadenopathy without distant metastasis
Day 1 (Preoperative)	Cardiac and risk assessment	Severe dilated cardiomyopathy (EF 25%), coronary artery calcifications (60–70% stenosis), BNP 463 pg/mL. Multidisciplinary consultation (surgery, cardiology, anesthesia, ICU)
Day 2	Surgical intervention	Open Roux-en-Y total gastrectomy performed under heart-protective anesthesia with advanced hemodynamic monitoring
Postoperative Day 1	Early complications	CT demonstrated pneumonia and bilateral pleural effusion. Doppler ultrasound detected left lower limb intermuscular vein thrombosis. Anticoagulation adjusted
Postoperative Day 2	Laboratory reassessment	Persistent hypercoagulable state (elevated fibrinogen), stable PT/APTT. Continued close monitoring and supportive care
Postoperative Day 3	Acute complications	Delirium, fever, tachycardia, and hemochezia (~100 mL). Hemoglobin dropped to 96 g/L. Enoxaparin discontinued

Postoperative Day 3–4	Therapeutic intervention	Hemostatic therapy (tranexamic acid, batroxobin, somatostatin), blood transfusion (RBC and FFP), delirium management (dexmedetomidine, olanzapine), antibiotics for pneumonia
Postoperative Days 5–9	Recovery phase	Resolution of bleeding and delirium, stabilization of hemoglobin and coagulation parameters
Day 10	Discharge	Patient discharged in stable condition
3-month follow-up	Outcome assessment	Stable cardiac function, no recurrent bleeding, no thromboembolic progression, and no evidence of tumor recurrence

Table 2: Chronological timeline of clinical presentation, perioperative management, complications, and outcomes

7. Complications

Despite maintaining the treatment regimen, the patient developed sudden delirium on the third postoperative day, accompanied by an elevated heart rate (105 bpm), fever (38.2 °C), and hemochezia (100 ml). CBC results revealed elevated WBC ($10.57 \times 10^9/L$), and a decline in Hgb (96 g/L), RBC ($2.92 \times 10^{12}/L$), and HCT (28.50%), indicating anemia due to bleeding. These symptoms indicated new complications, necessitating immediate medical intervention.

The response involved promptly discontinuing enoxaparin, administering Dexmedetomidine 0.2–0.7 µg/kg/h and olanzapine 5 mg daily for delirium, and employing hemostatic treatments like TXA 1g IV, batroxobin 5 IU IV, somatostatin 250 µg/h infusion to control bleeding. An infusion of 1.5 units of RBC and 250 ml of fresh frozen plasma was given to correct blood loss and anemia. Moreover, antibiotics were administered to address the concurrent pneumonia with pleural effusion. Continuous monitoring of coagulation tests and bleeding, along with supportive measures, led to the patient's stability and discharge after recovery.

8. Discussion

The perioperative management of patients with advanced gastric cancer complicated by severe dilated cardiomyopathy (DCM) represents a substantial clinical challenge due to competing risks of thromboembolism, bleeding, and cardiovascular decompensation. This case highlights the importance of individualized, multidisciplinary decision-making and dynamic reassessment throughout the perioperative course.

8.1. Coherence Between Clinical Decisions and Evidence

Radical gastrectomy remains the cornerstone of curative treatment for locally advanced gastric adenocarcinoma [1–3]. However, severe left ventricular systolic dysfunction (EF 25%) significantly increases perioperative morbidity and mortality [4,5]. In this context, the decision to proceed with open rather

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than laparoscopic gastrectomy was guided by evidence indicating that pneumoperitoneum may adversely affect venous return, cardiac output, and systemic vascular resistance in patients with compromised cardiac function [6,7]. This approach aligns with published recommendations favoring hemodynamic stability over minimally invasive benefits in high-risk cardiac patients.

Perioperative thromboprophylaxis in patients with malignancy and heart failure remains controversial. Malignancy, reduced cardiac output, immobility, and hypoalbuminemia are all well-established risk factors for venous thromboembolism (VTE) [8–11]. Current guidelines recommend low-molecular-weight heparin (LMWH) as first-line thromboprophylaxis in high-risk surgical oncology patients [12–14]. In this case, LMWH was reintroduced postoperatively once surgical hemostasis was secured, consistent with guideline-recommended initiation within 24–72 hours after surgery [13,15]. The subsequent occurrence of intermuscular vein thrombosis despite early anticoagulation underscores the hypercoagulable state associated with advanced malignancy and severe cardiomyopathy.

The development of gastrointestinal bleeding necessitated prompt discontinuation of anticoagulation, consistent with consensus recommendations that emphasize bleeding control and hemodynamic stabilization as priorities in acute hemorrhagic events [16,17]. Hemostatic measures, transfusion support, and close laboratory monitoring were applied in accordance with standard practice, resulting in stabilization without further thromboembolic progression. This dynamic adjustment reflects current guidance advocating individualized anticoagulation strategies rather than rigid protocols in complex patients [14,18].

8.2. Scientific Context and Support for Key Claims

Existing studies demonstrate that prolonged LMWH use reduces postoperative VTE risk but increases bleeding incidence following gastrectomy [19–21]. While randomized trials support extended thromboprophylaxis in selected patients, real-world application often requires modification based on bleeding risk and patient-specific factors [22,23]. Importantly, this case does not suggest superiority of short-term anticoagulation but rather illustrates the feasibility of tailored, closely monitored thromboprophylaxis in a patient with competing risks.

Advanced hemodynamic monitoring and goal-directed fluid therapy have been associated with improved outcomes in high-risk surgical populations [24,25]. In patients with DCM, avoidance of fluid overload and maintenance of adequate preload are critical to prevent heart failure exacerbation. The favorable cardiac outcome in this patient supports the role of individualized hemodynamic optimization as an adjunct to surgical and anticoagulation strategies.

8.3. Strengths of the Case

This case has several strengths. First, it presents a rare and clinically relevant scenario involving the coexistence of advanced gastric cancer and severe DCM, a combination infrequently reported in the literature. Second, it provides a detailed chronological account of perioperative decision-making, medication adjustments, and complication management, offering practical insights for clinicians managing similar high-risk patients. Third, the case

demonstrates the value of multidisciplinary collaboration and dynamic reassessment rather than fixed treatment algorithms.

9. Limitations

Several limitations should be acknowledged. This is a single case report and therefore cannot establish causal relationships or generalizable treatment recommendations. The absence of anti-factor Xa monitoring limits objective assessment of anticoagulation intensity. Additionally, long-term oncological outcomes beyond three months were not available at the time of reporting. Finally, while intermuscular vein thrombosis was clinically relevant in this patient, its prognostic significance compared with proximal DVT remains uncertain.

10. Implications for Clinical Practice

Despite these limitations, this case reinforces the principle that perioperative management in patients with concurrent malignancy and severe cardiac disease must be individualized, flexible, and guided by continuous clinical reassessment. Careful balancing of thrombosis prevention and bleeding risk, supported by multidisciplinary coordination and evidence-based decision-making, is essential to achieving favorable outcomes in this complex population.

11. Lessons Learned

This case emphasizes the importance of multidisciplinary perioperative management, individualized anticoagulation, vigilant hemodynamic monitoring, and rapid response to complications in high-risk patients. The approach illustrated here provides practical guidance for balancing thrombosis prevention and bleeding risk in similar complex cases.

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