

Concomitant Bilateral Proximal Pulmonary Embolism and Massive Pneumothorax with Fatal Outcome after Colon Cancer Surgery: A Case Report and Literature Review

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Abstract

Case Report

Venous thromboembolism is one of the leading causes of preventable death after abdominal cancer surgery, and its simultaneous occurrence with a massive pneumothorax is exceptional, confronting the clinician with a difficult therapeutic dilemma. We report the case of an 81-year-old man, classified as American Society of Anesthesiologists (ASA) physical status III, who underwent right hemicolectomy and liver metastasectomy for a caecal adenocarcinoma with a synchronous hepatic metastasis, under general anaesthesia with orotracheal intubation. Preanaesthetic assessment identified an elderly oncological patient at very high thromboembolic risk, with no renal impairment and no coagulation disorder. The anaesthetic strategy aimed at airway protection, controlled mechanical ventilation with protective targets, maintenance of adequate tissue perfusion, and structured monitoring of emergence and extubation. A left subclavian central venous catheter was inserted intraoperatively, and thromboprophylaxis with enoxaparin was started from the eighth postoperative hour. On the third postoperative day, in a context of haemodynamic instability and an intense inflammatory response, acute dyspnoea developed; computed tomography pulmonary angiography demonstrated a bilateral proximal pulmonary embolism associated with a large left pneumothorax and a residual pneumoperitoneum. Despite intensive care management, the outcome was fatal. This observation illustrates the occurrence of a fatal thromboembolic event despite guideline-concordant thromboprophylaxis in a patient at very high risk. It highlights the exceptional nature of the pulmonary embolism–pneumothorax association, the diagnostic pitfall of postoperative dyspnoea with several possible simultaneous causes, and the central importance of prevention. It also underlines the need to report perioperative anaesthetic data in a structured manner, since positive-pressure ventilation, subclavian catheterisation and post-extubation surveillance are plausible junction points between the anaesthetic pathway, the delayed pneumothorax and the fatal outcome.

Keywords: Pulmonary embolism; Pneumothorax; Colorectal cancer; Thromboprophylaxis; Central venous catheter; Postoperative complication; Case report.

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1. INTRODUCTION

Venous thromboembolism (VTE), which encompasses deep vein thrombosis and pulmonary embolism (PE), remains one of the most feared complications of digestive cancer surgery. Although relatively uncommon, acute perioperative PE can be devastating and ranks among the leading causes of preventable death in the surgical patient (Porres-Aguilar M *et al.*, 2020). This risk is particularly marked after colorectal cancer resection and extends well beyond the

hospital stay (Emoto S *et al.*, 2019; Sanderson B *et al.*, 2011).

Pneumothorax occurring remotely from any thoracic procedure is, for its part, most often iatrogenic in particular after the insertion of a central venous catheter or barotraumatic. Its association with PE is exceptional and raises a twofold difficulty. First, a diagnostic pitfall: both conditions present with dyspnoea and hypoxaemia, the cause of which is difficult to determine in the perioperative period (Porres-Aguilar M

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et al., 2020). Second, a therapeutic dilemma: PE mandates anticoagulation, which the pneumothorax and the recent postoperative status render hazardous. We report such an association, with a fatal outcome, in order to draw preventive lessons from it.

2. MATERIALS AND METHODS

2.1. Study design and reporting standards

This is a retrospective, single-patient case report. Clinical, laboratory, radiological, operative, anaesthetic and histopathological data were retrieved from the patient's hospital record, the anaesthesia chart and the intensive care unit (ICU) chart. The report was prepared in accordance with the CARE (Case Report) guidelines (Gagnier JJ *et al.*, 2014). Written informed consent for publication was obtained from the patient's family. Thromboembolic risk was assessed using the Caprini risk assessment model (Caprini JA, 2005), and the severity of pulmonary embolism was graded according to the classification of the European Society of Cardiology (ESC) (Konstantinides SV *et al.*, 2020).

2.2. Literature search

A narrative review of the literature was performed in PubMed/MEDLINE, without date restriction, combining the terms "pulmonary embolism", "pneumothorax", "colorectal cancer surgery", "thromboprophylaxis", "central venous catheter" and "postoperative complication". Clinical practice guidelines, systematic reviews and case reports describing either the association of pulmonary embolism and pneumothorax, or pulmonary embolism occurring despite adequate prophylaxis, were selected.

2.3. Patient information and clinical findings

An 81-year-old man, functionally independent (WHO performance status I), was admitted for chronic colicky abdominal pain and melaena that had been present for almost one year, in a context of general deterioration with anorexia, asthenia and weight loss. His medical history was limited to treated iron-deficiency anaemia and benign prostatic hyperplasia; he was a non-smoker and reported no previous thromboembolic event.

Physical examination revealed a firm, irregular mass of the right iliac fossa, fixed to the deep planes, and melaena on digital rectal examination. Thoraco-abdomino-pelvic computed tomography (CT) showed a caecal tumour invading the terminal ileal loop and the right abdominal wall, with no detectable distant metastasis. Endoscopy with biopsy concluded to a moderately differentiated adenocarcinoma.

2.4. Preoperative assessment and surgical management

The preoperative work-up was favourable: body mass index 22 kg/m², normal renal function and normal coagulation. Under general anaesthesia, an oncological right hemicolectomy was performed through a midline laparotomy, with a hand-sewn ileo-transverse anastomosis; a central venous catheter was inserted

intraoperatively through a left subclavian approach. Exploration found a caecal tumour adherent to the lateral abdominal wall and to a small-bowel loop, without ascites or peritoneal carcinomatosis nodules, together with a subcentimetric hepatic nodule of segment II, which was resected during the same procedure (metastasectomy).

2.5. Anaesthetic management

The preanaesthetic profile corresponded to an ASA physical status III, on account of advanced age, colon cancer with synchronous liver metastasis and the major nature of the abdominal surgery, with neither renal impairment nor documented coagulation disorder. Preoperative evaluation combined assessment of the systemic impact of the neoplastic disease, screening for cardiopulmonary comorbidities, verification of renal function, haemoglobin and coagulation, and estimation of thromboembolic risk. The preoperative objectives were to secure vascular access, to anticipate the need for vasopressors, to limit hypovolaemia and hypothermia, and to plan early postoperative thromboprophylaxis while taking the surgical bleeding risk into account.

The indication for general anaesthesia with orotracheal intubation was based on the major oncological laparotomy, the expected duration of the procedure, the need for surgical immobility and for controlled ventilation, and airway protection. After preoxygenation and titrated intravenous induction adapted to the elderly patient, intubation was confirmed by continuous capnography. Intraoperative monitoring included, as a minimum, electrocardiography, arterial blood pressure, pulse oximetry, capnography, temperature, and neuromuscular monitoring whenever neuromuscular blocking agents were used. A left subclavian central venous catheter was inserted intraoperatively in order to secure the administration of fluids and, if required, of vasopressors.

The intraoperative targets were the maintenance of a mean arterial pressure of at least 65 mmHg or close to the patient's usual value, an SpO₂ ≥ 94%, an end-tidal CO₂ between 35 and 45 mmHg, normothermia, multimodal analgesia, and a fluid and electrolyte balance adapted to surgical losses. Mechanical ventilation was conducted according to protective targets: target tidal volume of 6–8 mL/kg of predicted body weight, minimal effective positive end-expiratory pressure, plateau pressure < 30 cm H₂O, and FiO₂ adjusted to oxygenation, in order to limit atelectasis and barotrauma. Emergence was assessed against explicit criteria: stable or stabilised haemodynamics, temperature ≥ 36 °C, absence of active bleeding, reversal and complete neuromuscular recovery (train-of-four ratio ≥ 0.9 when available), resumption of effective spontaneous ventilation, satisfactory oxygenation with a decreasing FiO₂, consistent capnography, a level of consciousness allowing airway protection, and controlled pain. Extubation was performed or deferred according to these

criteria, and was followed by close monitoring in the post-anaesthesia care unit or in the ICU, including early screening for hypoxaemia, atelectasis, bleeding, haemodynamic instability and mechanical complications related to the central venous catheter, in particular pneumothorax.

2.6. Thromboembolic risk assessment and prophylaxis

The Caprini score, estimated at at least nine points (age ≥ 75 years, malignancy, major surgery and central venous catheter), placed the patient in the highest thromboembolic risk category (Caprini JA, 2005). Thromboprophylaxis with enoxaparin 40 mg subcutaneously was started from the eighth postoperative hour and was continued daily thereafter.

3. RESULTS AND DISCUSSION

3.1. Histopathological findings

Histopathological examination of the colectomy specimen showed a moderately differentiated colonic adenocarcinoma measuring 5 cm in its largest

dimension, infiltrating the bowel wall as far as the subserosa (pT3), with perineural invasion but without tumour vascular emboli; none of the thirteen lymph nodes examined was involved (0/13) and the colonic resection margins were free (R0). Examination of the hepatic nodule confirmed a secondary localisation of the same adenocarcinoma, the section plane passing immediately adjacent to the lesion (limiting hepatic resection margin). The tumour stage was therefore pT3 N0 (0/13) M1, indicating metastatic disease at presentation.

3.2. Early postoperative course

The ICU stay was marked from the outset by haemodynamic instability requiring norepinephrine support and by an intense inflammatory response: neutrophilic hyperleucocytosis ($24,280/\text{mm}^3$), a rise in C-reactive protein and metabolic acidosis (bicarbonate 13 mmol/L), while coagulation remained normal (Table 1). A progressive fall in oxygen saturation was noted over the first forty-eight hours.

Table 1: Changes in the main laboratory parameters between the preoperative period and the first postoperative day (D1). Values in bold denote the main abnormal results. CRP: C-reactive protein; INR: international normalised ratio; aPTT: activated partial thromboplastin time

Parameter (reference range)	Preoperative	Postoperative (D1)
White blood cells /mm ³ (4,000–10,000)	7,600	24,280
Neutrophils /mm ³	5,016	22,095
Lymphocytes /mm ³ (1,000–4,000)	1,596	971
Haemoglobin g/dL (13–17)	12.7	13.0
Platelets /mm ³ (150,000–450,000)	240,000	211,000
CRP mg/L (< 5)	16.5	61.6
Bicarbonate mmol/L (23–27)	27	13
Sodium mmol/L (135–145)	133	139
Creatinine mg/L (7–12.5)	7.9	8.0
Prothrombin time % / INR	88 / 1.07	79 / 1.13
aPTT, patient, s (25–36)	25.7	26.2

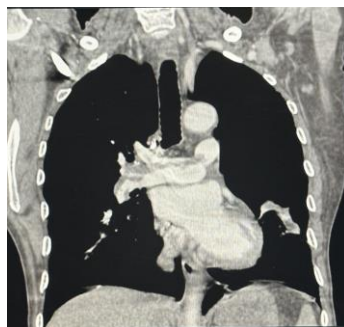
3.3. Acute respiratory deterioration and imaging findings

On the third postoperative day, acute dyspnoea with hypoxaemia developed abruptly. CT pulmonary angiography (Figure 1) demonstrated a large left pneumothorax collapsing the left upper lobe, bordered by a thin layer of ipsilateral pleural fluid, a bilateral proximal pulmonary embolism, and features of recent abdominal surgery in the form of a pneumoperitoneum.

The right lung parenchyma was intact, with no right pleural or pericardial effusion and no mediastinal lymphadenopathy.

3.4. Outcome

Despite intensification of intensive care management, the course remained unfavourable and led to death during the same hospital stay. The timeline of the clinical course is summarised in Figure 2.



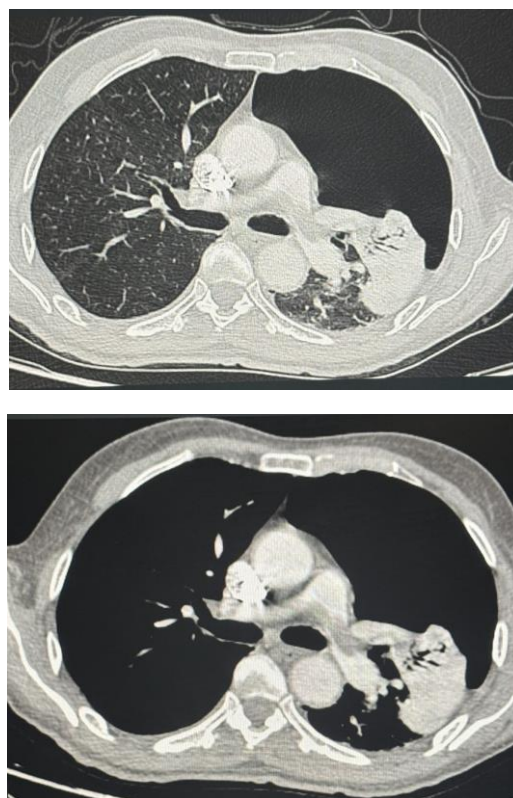


Figure 1: CT pulmonary angiography, from top to bottom. (A) Coronal section showing endoluminal hypodense material in the right and left pulmonary arteries and their segmental branches, consistent with bilateral pulmonary embolism. (B) Axial section in lung window showing a large left pneumothorax. (C) Axial section showing endoluminal hypodense material in the right and left pulmonary arteries and their segmental branches

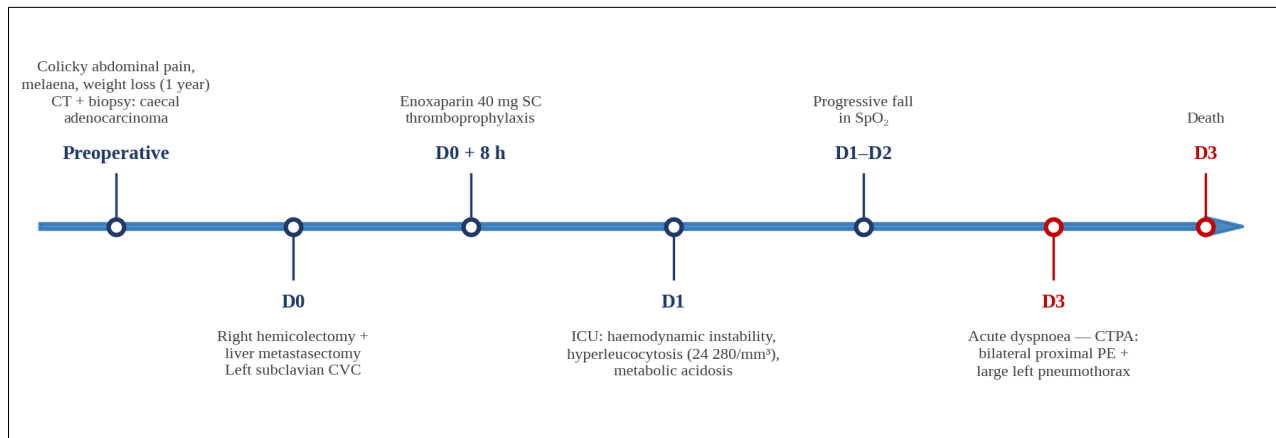


Figure 2: Timeline of the clinical course (D0 = day of surgery). CVC: central venous catheter; CTPA: computed tomography pulmonary angiography; PE: pulmonary embolism; ICU: intensive care unit; SC: subcutaneous

3.5. A patient at very high thromboembolic risk

The situation observed — metastatic colon cancer, major abdominal surgery combining colectomy and metastasectomy, age of 81 years and bed rest — combined several of the most powerful risk factors for VTE. In the presence of cancer, the risk of postoperative VTE is approximately twice as high, and that of fatal PE three times as high, as for a comparable procedure performed for benign disease, VTE being the leading cause of 30-day mortality after abdominopelvic cancer surgery (Fagarasanu A *et al.*, 2016). After colorectal resection, the incidence of VTE remains high and most

events occur in patients with advanced tumours and multiple comorbidities (Sanderson B *et al.*, 2011) — precisely the situation illustrated here, since the discovery of a synchronous liver metastasis classified the disease as metastatic, which is regarded as more thrombogenic. The incidence of symptomatic VTE is estimated at between 1.1% and 2.5% in this population (Emoto S *et al.*, 2019), with advanced age, malignancy and operative duration as recognised determinants (Sanderson B *et al.*, 2011).

In this patient, the Caprini score placed him from the outset in the highest risk category (Caprini JA, 2005). Moreover, the haemodynamic instability that required vasopressor support, combined with a bilateral proximal pulmonary embolism, corresponded to high-risk PE according to the ESC classification, a category associated with high early mortality (Konstantinides SV *et al.*, 2020).

3.6. Guideline-concordant thromboprophylaxis that was nevertheless overwhelmed

International recommendations are convergent: the International Initiative on Thrombosis and Cancer recommends extended four-week thromboprophylaxis with low-molecular-weight heparin (LMWH) after major abdominopelvic surgery for cancer (Farge D *et al.*, 2022), a position shared by the American Society of Clinical Oncology — which recommends continuing prophylaxis for up to four weeks in high-risk, elderly or poorly mobile patients, and points out that postoperative VTE is detected after discharge in more than half of cases (Key NS *et al.*, 2020) — and by the American Society of Hematology (Lyman GH *et al.*, 2021). The efficacy and the safety of this extended strategy have moreover been demonstrated (Fagarasanu A *et al.*, 2016).

The patient had received prophylaxis conducted according to these recommendations, with enoxaparin 40 mg daily started from the eighth postoperative hour, without coagulation abnormality or accumulation related to renal impairment. The thromboembolic event nevertheless occurred as early as the third day, while on treatment: this was therefore a breakthrough VTE, which illustrates the limitations of standard prophylaxis in patients accumulating the heaviest risk factors. Indeed, severe thromboembolic events have been described despite guideline-concordant prevention (Ahmed MB *et al.*, 2025), a reminder that well-conducted prophylaxis does not abolish all risk, and an argument in favour of an individualised assessment in the most vulnerable patients. At the population level, however, the main issue remains the implementation of the recommendations, since a recent audit found complete extended prophylaxis in only half of operated patients (Iqbal H, 2024).

3.7. Postoperative pulmonary embolism: a high-risk diagnosis and a high-risk treatment

Postoperative PE remains frequently unrecognised, its non-specific manifestations being easily overlooked, and its diagnosis is particularly difficult in the perioperative period (Porres-Aguilar M *et al.*, 2020). Once recognised, its immediate management after surgery constitutes a genuine dilemma: anticoagulation must be given while weighing the bleeding risk, whereas therapeutic recommendations generally do not encompass the freshly operated patient, in whom the decision ultimately rests on the clinician's judgement (Beatty AS *et al.*, 2022). In this context, unfractionated heparin may be preferred for its short

half-life, its easy titration and its reversibility with protamine, and the insertion of a temporary caval filter may be discussed when anticoagulation has to be withheld (Porres-Aguilar M *et al.*, 2020; Konstantinides SV *et al.*, 2020). A systematic review of massive intracardiac or pulmonary emboli occurring during surgery confirms that these are rare events but ones that carry a heavy burden of morbidity and mortality, and sets out the available options — surgical embolectomy, thrombolysis, anticoagulation or supportive care alone (Visnjevac O *et al.*, 2014). Successful systemic thrombolysis has moreover been reported very early after abdominal surgery (Beatty AS *et al.*, 2022). The difficulty culminates when a second complication imposes an opposite course of action, as illustrated by a case of PE presenting simultaneously with a pericardial effusion after oncological oesophagectomy (Jou-Valencia D *et al.*, 2020).

3.8. A probably iatrogenic pneumothorax

The concordance between the side of the subclavian central venous catheter (left) and that of the pneumothorax (left) makes an iatrogenic origin highly probable, although a causal link cannot be formally established. Pneumothorax is indeed the most frequent non-septic mechanical complication of central venous catheterisation, its incidence being higher with the subclavian than with the internal jugular approach (of the order of 0.5–2% versus 0.2–0.5%) (Tsotsolis N *et al.*, 2015). This risk increases in the event of failure of the first puncture, of repeated attempts, and of positive-pressure ventilation (Vinson DR *et al.*, 2015) — the latter being the rule under general anaesthesia with intubation, as in our observation.

One point deserves attention: the pneumothorax may be delayed. Its incidence after central venous catheter insertion is estimated at approximately 0.4%; it predominates after the subclavian approach, may initially remain asymptomatic and then progress to a tension form, positive-pressure ventilation being liable to render it life-threatening (Plewa MC *et al.*, 1995). The revelation of the pneumothorax on the third postoperative day, whereas the left subclavian catheter had been inserted on the day of surgery, corresponds precisely to this profile of delayed pneumothorax, which has already been described with a left subclavian catheter (Girgin NK *et al.*, 2010). This eventuality justifies the use of ultrasound guidance during insertion, radiographic control after the procedure, and prolonged clinical surveillance, particularly in the ventilated patient.

3.9. Lessons for anaesthetic management

Methodological rigour in a perioperative case requires the explicit reporting of the anaesthetic elements that condition causal interpretation: ASA status, justification of intubation, type of ventilation, haemodynamic and ventilatory targets, modalities of venous access, thromboembolic prevention strategy, emergence criteria, and criteria for extubation or for

prolonged postoperative ventilation. In this observation, these elements are essential because positive-pressure ventilation, the insertion of a subclavian catheter and post-extubation surveillance constitute possible junction points between the anaesthetic pathway, the delayed pneumothorax and the postoperative dyspnoea.

Emergence should therefore not be regarded as the end of anaesthetic care. In an elderly, oncological patient at very high thromboembolic risk, the immediate post-extubation period is a critical transition phase: persistent hypoxaemia, increasing oxygen requirements, tachycardia, hypotension or acidosis should prompt a simultaneous search for respiratory, haemodynamic, thromboembolic and mechanical causes. After subclavian catheterisation, pleuropulmonary ultrasound or early chest radiography may contribute to the detection of a pneumothorax, in particular before or after extubation in a patient ventilated with positive pressure.

3.10. A rare association with a poor prognosis

The coexistence of PE and pneumothorax is exceptional and complicates the diagnosis, since both entities manifest as dyspnoea and hypoxaemia that are difficult to distinguish from one another (Ikeda K *et al.*, 2025). A recent case of postoperative pneumothorax followed by the discovery of a bilateral PE made it possible to formulate three directly applicable principles: not to anchor on the first diagnosis, since hypoxaemia persisting after drainage should lead to early CT pulmonary angiography; to integrate explicitly the reciprocal therapeutic interactions when two severe complications are combined; and to give priority to prevention (Ikeda K *et al.*, 2025). A presentation very close to ours — a left pneumothorax and a bilateral PE occurring several days after the procedure despite adequate thromboprophylaxis — has also been described, underlining both the possibly delayed nature of these events and the limitations of preventive protocols (Ahmed MB *et al.*, 2025). Here, these two complications with a high lethal potential were superimposed, each treatment counteracting the other: the anticoagulation required by the bilateral proximal PE conflicted with the postoperative bleeding risk and with the need for chest drainage. On the preventive side, guidelines advise that, in the cancer patient requiring a central venous catheter, implantable ports should be preferred and mechanical risk factors reduced (Farge D *et al.*, 2022).

4. CONCLUSION

This fatal case is a reminder that the association of a bilateral proximal pulmonary embolism with a massive pneumothorax, rare though it may be, is formidable in the aftermath of colon cancer surgery. Above all, it shows that a fatal thromboembolic event may occur despite guideline-concordant thromboprophylaxis, in a patient accumulating risk factors — metastatic colon cancer, major surgery and advanced age. Three lessons emerge from it: to recognise

these patients at very high risk, in whom standard prophylaxis may be overwhelmed and in whom an individualised strategy deserves to be discussed; to report anaesthetic management in a structured manner, from ASA assessment to extubation criteria; and, when faced with postoperative dyspnoea, to consider several simultaneous causes, including an iatrogenic pneumothorax on a central venous catheter, and to resort without delay to CT pulmonary angiography when the clinical condition requires it. Vigilance, prevention and the traceability of perioperative objectives remain the surest weapons against a potentially preventable complication.

5. Acknowledgment

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6. Declarations

Reporting guideline. This case is reported in accordance with the CARE (CAse REport) guidelines (Gagnier JJ *et al.*, 2014).

Ethics and consent. Written informed consent for publication of this case report and the accompanying images was obtained from the patient's family.

Conflicts of interest. The authors declare that they have no conflict of interest.

Data availability. The data supporting the findings of this case report are available from the corresponding author upon reasonable request.

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