

Anesthetic Management of Emergency Cardiopulmonary Bypass during Radical Nephrectomy for Renal Cell Carcinoma with Level IV Right Atrial Tumor Thrombus: A Case Report

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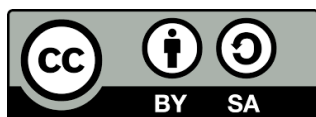
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Abstract

Renal cell carcinoma (RCC) extends into the venous system in 4–10% of cases, and in approximately 1% of cases, the tumor thrombus reaches the right atrium (Mayo level IV). We describe the anesthetic management of a 40-year-old man (53 kg, American Society of Anesthesiologists [ASA] physical status III) with cT3N0M0 right-sided RCC and a mobile cavoatrial tumor thrombus that intermittently obstructed the tricuspid valve. He was scheduled to undergo combined open radical nephrectomy and tumor thrombectomy, with cardiopulmonary bypass (CPB) on standby. Relevant comorbidities included anemia, hypoalbuminemia, hypokalemia, prolonged activated partial thromboplastin time, grade III right hydronephrosis, bilateral pleural effusions, and chronic hypertension. Intraoperative monitoring included invasive arterial blood pressure monitoring, internal jugular central venous access, and continuous transesophageal echocardiography (TEE). Midway through the nephrectomy, the patient's condition deteriorated abruptly; TEE demonstrated prolapse of the tumor thrombus into the right atrium, causing obstruction of right ventricular inflow. Emergency median sternotomy was performed, CPB was initiated, and the thrombus was removed. The patient was successfully weaned from CPB with dopamine at 10 µg/kg/min, heparin was reversed until the activated clotting time reached 160 seconds, and the nephrectomy was subsequently completed. He was extubated on the first postoperative day, transferred to the ward on postoperative day 2, and discharged on postoperative day 5 without neurological deficits. This case illustrates that, in patients with Mayo level IV RCC-associated tumor thrombus, continuous TEE surveillance, a rehearsed emergency conversion protocol to CPB, and a coordinated multidisciplinary team can facilitate the rapid recognition and treatment of a potentially fatal intraoperative event.



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INTRODUCTION

Renal cell carcinoma (RCC) accounts for the majority of primary renal malignancies and has a distinctive propensity for intraluminal venous extension. Tumor thrombus involving the inferior vena cava (IVC) is documented in approximately 4–10% of patients with renal neoplasms, and in roughly 1% of cases, the thrombus extends above the diaphragm to reach the right atrium. (Blute et al., 2004; Chen et al., 2024) The Mayo Clinic classification stratifies this extension into five levels, ranging from thrombus confined to the renal vein (level 0) to

supradiaphragmatic or intra-atrial extension (level IV), and remains a widely used framework for surgical and anesthetic planning (Blute et al., 2004; Shabunin et al., 2025).

Level IV disease occupies a unique position in surgical oncology. Although the tumor is anatomically advanced, it may remain nonmetastatic; therefore, complete resection can still offer curative potential, with reported 5-year survival after radical nephrectomy and thrombectomy ranging from approximately 30% to 60% in selected series (Khawaja et al., 2020; Shabunin et al., 2025). At the same time, an untreated mobile intracardiac tumor thrombus carries a persistent risk of sudden death due to tumor embolism or acute tricuspid inflow obstruction. Surgery is therefore both the principal potentially curative therapeutic option and the period of greatest perioperative risk.

For the anesthesiologist, these procedures combine several high-risk challenges in a single patient: major open abdominal surgery with the potential for massive hemorrhage, dynamic and position-dependent obstruction of right ventricular filling, the possibility of intraoperative tumor embolization into the pulmonary circulation, and the physiological consequences of cardiopulmonary bypass (CPB) with full systemic heparinization after the surgical field has already been opened. Intraoperative tumor embolization is uncommon, occurring in approximately 1.8–5.4% of IVC thrombectomies, but has been associated with mortality approaching 60% when it occurs. Survival depends largely on prompt recognition and the rapid initiation of extracorporeal circulatory support (“Management of Acute Intra-Operative Thromboembolism in Renal Cell Carcinoma,” 2015; Roberts et al., 2023).

Intraoperative transesophageal echocardiography (TEE) has become a pivotal monitoring modality in this setting. In addition to confirming and reassessing the extent of the tumor thrombus after induction of anesthesia, TEE can characterize its mobility and attachment, guide central venous cannulation and vascular clamping, and provide an immediate anatomical diagnosis when hemodynamic deterioration occurs (Calderone et al., 2018; Souki et al., 2016). In this context, TEE serves as the anesthesiologist's primary diagnostic tool for differentiating among potential causes of intraoperative hemodynamic instability, including hemorrhage, surgical compression, tumor embolization, and thrombus prolapse, each of which requires a distinct therapeutic approach. Most published reports of level IV RCC describe the elective, planned use of CPB. Reports describing anesthetic management when CPB must be instituted unexpectedly as a rescue intervention during nephrectomy are considerably less common. The present case report addresses this gap by detailing the anesthetic management of an emergency, unplanned conversion to CPB during the abdominal phase of surgery (Ajani et al., 2025).

We report the perioperative anesthetic management of a patient with cT3N0M0 RCC and a mobile Mayo level IV tumor thrombus in whom the thrombus prolapsed into the right atrium during the abdominal phase of surgery, necessitating emergency median sternotomy and CPB. The primary objective of this report is to describe the anesthetic strategy, the intraoperative crisis, and the clinical reasoning that guided each decision, with the aim of providing a practical framework for anesthesiologists managing similar high-risk scenarios. The surgical aspects of this case have been reported separately by the cardiothoracic and urology teams;⁹ therefore, the present report focuses specifically on the anesthetic strategy, intraoperative crisis management, and the clinical reasoning underlying each intervention.

METHOD

This single case report described the perioperative anesthetic management of a 40-year-old man with cT3N0M0 right renal cell carcinoma and a mobile cavoatrial tumor thrombus (Mayo level IV) who underwent open radical nephrectomy with emergency conversion to median sternotomy and cardiopulmonary bypass (CPB) at Cipto Mangunkusumo Hospital, Jakarta. Data were retrospectively obtained from the patient's medical records, including preoperative assessments, relevant investigations, intraoperative anesthetic and transesophageal echocardiographic records, surgical and CPB perfusion records, and the postoperative clinical course through hospital discharge. The report was prepared in accordance with the CARE guidelines. Written informed consent for publication of clinical information and accompanying images was obtained from the patient, and institutional ethical approval was obtained where applicable. Because the surgical aspects of the case had been reported separately by the cardiothoracic and urology teams, the present report focused on the anesthetic strategy and perioperative clinical decision-making.

RESULTS AND DISCUSSION

Case Illustration

Preoperative assessment

A 40-year-old man (53 kg, 170 cm, body mass index 18.3 kg/m²) was admitted with progressive exertional dyspnea that had begun approximately two months earlier and had worsened to occur with light activity. He slept on a single pillow and denied chest pain, orthopnea or cough. He was initially hospitalized for symptomatic anemia (hemoglobin 6 g/dL) and subsequently developed an intermittent fever, unexplained weight loss and abdominal distension. He had a four-year history of hypertension but no diabetes, asthma, chronic pulmonary or hepatic disease, and no previous surgery. His father had coronary artery disease. He had stopped drinking alcohol one year earlier and had never smoked.

On examination he was fully alert and moderately ill-appearing, with a blood pressure of 132/75 mmHg, heart rate 68 beats/min in sinus rhythm, respiratory rate 20 breaths/min, temperature 37.4 °C and oxygen saturation 98% on room air. The jugular venous pressure was not elevated at rest, heart sounds were normal without murmur or gallop, and the chest was clear on auscultation. The abdomen was distended but soft, with normal bowel sounds and no palpable flank mass. There was no peripheral edema and the extremities were warm.

Laboratory investigations demonstrated a normocytic anemia that improved with transfusion (hemoglobin 8.6 g/dL rising to 11.2 g/dL preoperatively), leukocytosis up to 11,630/μL, platelets 360,000/μL, hypokalemia (potassium 2.6–3.1 mmol/L, corrected preoperatively with oral potassium chloride), hypoalbuminemia (albumin 2.5–3.5 g/dL), preserved renal function (urea 17.1 mg/dL, creatinine 0.7 mg/dL), normal transaminases, procalcitonin 0.77 ng/mL and a progressively prolonged activated partial thromboplastin time (1.3× rising to 1.54–1.7× control) with a normal prothrombin time ratio (1.1×). Hepatitis B surface antigen and anti-hepatitis C antibody were non-reactive.

Whole-body 18F-FDG PET/CT demonstrated a lobulated hypermetabolic mass with malignant features measuring approximately 68.6 × 64.9 mm with central necrosis in the lower pole of the right kidney, consistent with RCC. The mass compressed the proximal right ureter, producing grade III right hydronephrosis, and displaced the inferior portion of the right renal

pelvis. A tumor thrombus was demonstrated within the inferior vena cava reaching the right atrium, with dilatation of the cava. No pulmonary, nodal or marrow metastases were identified. Bilateral hepatomegaly with an inhomogeneous, slightly enhancing non-metabolic lesion in the right and caudate lobes raised the possibility of a synchronous second primary or metastasis, and diffuse hypermetabolic wall thickening from the ascending colon to the rectum suggested colitis. Bilateral pleural effusions were present. Chest radiography one day before surgery showed no pulmonary nodules, a suspected left pleural effusion and a normal cardiac silhouette.

Transthoracic echocardiography showed a left ventricular ejection fraction of 63% with normal left and right ventricular systolic function, dilatation of the right atrium and inferior vena cava, mild tricuspid regurgitation, and a multilobulated mass consistent with tumor thrombus extending from the inferior vena cava into the right atrium, with a mobile tip that moved in and out of the right ventricle and partially obstructed tricuspid inflow. This finding — a mobile, intermittently obstructing intracardiac mass in a patient who remained ambulant and only mildly symptomatic — defined the principal anesthetic hazard.

The patient was classified as ASA physical status III. Internal medicine assessed both cardiac and respiratory operative tolerance as moderate-to-severe risk. The agreed anesthetic plan was general anesthesia with invasive arterial pressure monitoring, central venous access, intraoperative TEE and planned postoperative admission to the cardiac intensive care unit (CICU). A joint procedure was scheduled with the urology and cardiothoracic-vascular surgery teams: median sternotomy with evacuation of the intracardiac tumor thrombus using CPB, combined with laparotomy and right radical nephrectomy, with femoral venous cannulation and inferior vena cava repair anticipated. Blood products were reserved in advance (1,000 mL packed red cells, 4 units fresh frozen plasma, 2 units platelet concentrate), cefazolin prophylaxis was prescribed, and a six-hour preoperative fast and structured family counselling regarding the operative risk were undertaken.

Anesthetic conduct

Before induction, a single-shot spinal injection was performed in the sitting position with bupivacaine 0.25% 10 mg and preservative-free morphine 500 µg, more than 60 minutes before any systemic heparin was given and after confirming an atraumatic, non-bloody tap. The purpose was to provide prolonged postoperative analgesia for the laparotomy and sternotomy wounds, blunt the perioperative stress response and reduce the intraoperative opioid requirement, thereby facilitating early extubation.

Large-bore peripheral venous access was secured and a radial arterial catheter was inserted under local anesthesia before induction so that beat-to-beat pressure was available throughout. Anesthesia was then induced slowly and in titrated increments with midazolam 0.03 mg/kg, propofol 1 mg/kg, sufentanil 2 µg/kg and rocuronium 1.2 mg/kg. Doses were deliberately reduced and given over several minutes, with vasopressor support immediately available, on the principle that in a patient with a fixed, mobile obstruction at the tricuspid valve, both a fall in systemic vascular resistance and a fall in preload are poorly tolerated. Anesthesia was maintained with sevoflurane in an air-oxygen mixture, a continuous intravenous morphine infusion and intermittent rocuronium boluses. Neuromuscular blockade was maintained deep throughout to avoid any patient movement or straining during cardiac manipulation.

A central venous catheter was inserted in the right internal jugular vein under ultrasound guidance. The guidewire and catheter tip were deliberately kept high in the superior vena cava and their position confirmed on TEE, so that no wire or catheter tip approached the right atrium where it could fragment or dislodge the mobile thrombus. A multiplane TEE probe was inserted after induction. The initial examination confirmed the extension of the tumor thrombus from the inferior vena cava into the right atrium, characterized its mobile, multilobulated and fragile-appearing tip, excluded a patent foramen ovale, and established baseline biventricular function. TEE was thereafter maintained as a continuous monitor throughout the abdominal phase rather than being used only intermittently.

Hemodynamic goals during the abdominal phase were to maintain sinus rhythm and heart rate, preserve systemic vascular resistance and coronary perfusion pressure, avoid abrupt increases in intra-abdominal pressure or caval compression, and maintain adequate but not excessive right-sided filling. Normothermia, normocapnia and normokalemia were maintained, and transfusion was guided by ongoing losses and serial blood gases.

Intraoperative crisis and rescue

Anesthesia was induced at 07:45. Throughout the abdominal phase the patient remained stable, with a mean arterial pressure of 67–95 mmHg, heart rate 82–98 beats/min, central venous pressure 5–10 mmHg and nasopharyngeal temperature 34.6–34.8 °C. At 10:30, during mobilization of the right kidney and the retrohepatic inferior vena cava, the mean arterial pressure fell to 64 mmHg, and by 10:45 the patient had deteriorated abruptly to 63/35 mmHg with a mean of 43 mmHg. Critically, the central venous pressure did not fall — it remained at 9 mmHg — and the heart rate was unchanged at 87 beats/min, a combination that argued against hemorrhage or hypovolemia and pointed instead to an acute obstruction to right ventricular filling. TEE was interrogated immediately and demonstrated collapse of the tumor thrombus into the right atrium with obstruction of right ventricular inflow, distinguishing this within seconds from the competing diagnoses of hemorrhage, surgical caval compression and pulmonary thromboembolism.

The pre-agreed contingency plan was activated without delay. The cardiothoracic team performed an emergency median sternotomy, full heparinization was given, and CPB was established using aortic and right atrial cannulation shortly after 11:00. The patient was cooled to a nasopharyngeal nadir of 31.5 °C at 11:30; deep hypothermic circulatory arrest was not required. Intraoperative TEE performed on bypass at 11:47, with the heart arrested and the nasopharyngeal temperature 32.4 °C, confirmed the position of the thrombus before excision. The tumor thrombus was extracted under direct vision, and TEE re-examination confirmed clearance of the right atrium and inferior vena cava with no residual fragments, although these images were not archived. Rewarming was begun at approximately 11:45 and the temperature had returned to 36.6 °C by 12:15, at which point pulsatile arterial flow was restored (92/51 mmHg) and the patient was weaned from CPB with dopamine 10 µg/kg/min. Heparin was reversed with protamine to an activated clotting time of 160 seconds, hemostasis was secured, and coagulation was supported with fresh frozen plasma and platelets in accordance with the clinical field and laboratory results. Once cardiovascular stability had been re-established, the urology team completed the radical nephrectomy.

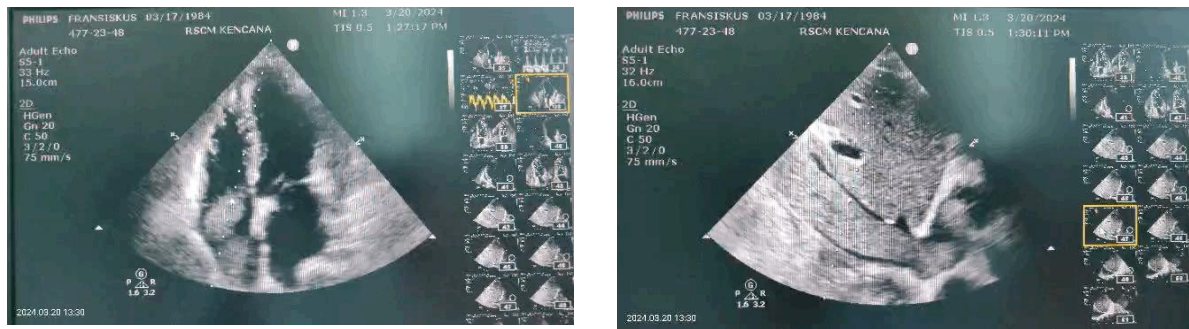


Figure 1. Preoperative transthoracic echocardiography (Philips S5-1, 20 March 2024)

(A) Apical four-chamber view showing a multilobulated echogenic mass consistent with tumor thrombus within the dilated right atrium. (B) Subcostal view demonstrating the thrombus within the dilated inferior vena cava as it courses towards the cavo-atrial junction. (C) Modified subcostal view of the right heart showing the mobile tip of the thrombus at the tricuspid orifice. LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle; IVC = inferior vena cava.

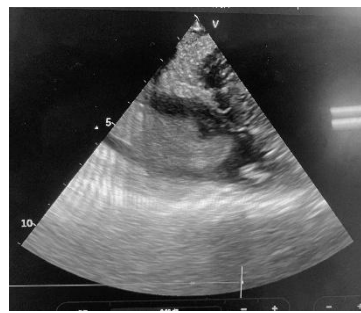


Figure 2. Intraoperative transesophageal echocardiography (GE Vingmed, 6Tc-RS probe) recorded at 11:47 on cardiopulmonary bypass with the heart arrested and a nasopharyngeal temperature of 32.4 °C, immediately before excision of the tumor thrombus. [Authors to specify the imaging plane and to add an arrow indicating the thrombus, with labelling of the cardiac chambers.]

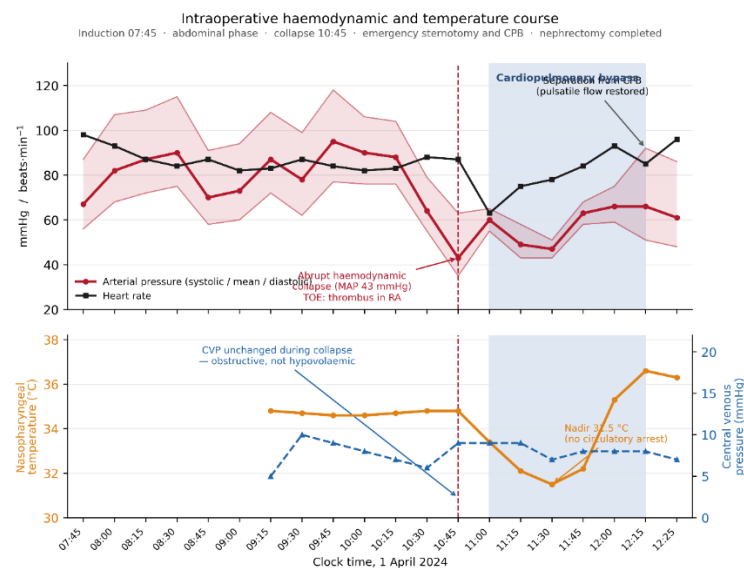


Figure 3. Intraoperative haemodynamic and temperature course reconstructed from the anaesthetic monitor trend (15-minute epochs, 1 April 2024)

Upper panel: invasive arterial pressure (systolic, mean and diastolic) and heart rate. Lower panel: nasopharyngeal temperature and central venous pressure. The dashed vertical line marks the abrupt collapse at 10:45; the shaded band indicates the period of cardiopulmonary bypass. Note that the central venous pressure remained unchanged at 9 mmHg while the mean arterial pressure fell to 43 mmHg, and that the temperature nadir was 31.5 °C without circulatory arrest.

Postoperative course

The patient was transferred sedated and intubated to the CICU. He remained hemodynamically stable, inotropic support was weaned, and he was extubated on the first postoperative day. Analgesia in the first 24 hours was satisfactory and systemic opioid requirements were low. He was transferred to the general ward on the second postoperative day. There was no clinical evidence of postoperative cognitive dysfunction, stroke, spinal hematoma or new neurological deficit, and no acute kidney injury requiring renal replacement therapy. He was discharged home on the fifth postoperative day and referred for oncological follow-up.

This case is instructive less because CPB was used than because it was not planned to be used at that moment. The patient had been consented and prepared for a combined procedure in which cardiac support was anticipated, but the thrombus embolized into the right atrium during the abdominal phase, before the chest had been opened. What converted a potentially fatal event into a survivable one was the combination of a monitor capable of making the diagnosis instantaneously, a team already assembled in the room, and an agreed plan for what to do.

Preoperative evaluation and risk stratification

Level IV thrombus is uncommon and its clinical presentation is characteristically disproportionate to its anatomical severity. Our patient walked around the ward while carrying a mobile intracardiac mass that intermittently obstructed his tricuspid valve; his only cardiovascular symptom was exertional dyspnea, which is easily attributed to anemia. Preoperative echocardiography is therefore mandatory in any RCC with radiological caval involvement, and the report should specifically address thrombus level, mobility, adherence and the presence of inflow obstruction rather than simply noting its presence.^{7,8}

Several features of this patient compounded the risk. Anemia and hypoalbuminemia reflected both the tumor burden and a chronic inflammatory state and reduced physiological reserve for a procedure with a predictably large transfusion requirement; the median blood loss in published level III–IV series is of the order of 2,500 mL.³ Hypokalemia in a patient about to be exposed to catecholamines, cardioplegia and reperfusion was corrected preoperatively. The isolated prolongation of the activated partial thromboplastin time, progressing from 1.3× to 1.54–1.7× control with a normal prothrombin time, deserved particular attention in a patient scheduled for both neuraxial puncture and full heparinization; it was attributed to the chronic inflammatory and consumptive state associated with an extensive tumor thrombus, and hemostasis was normal clinically. Bilateral pleural effusion and the possibility of a synchronous hepatic primary further supported the internal medicine assessment of moderate-to-severe cardiac and respiratory operative risk.

Rationale and safety of the neuraxial component

The use of a spinal injection in a patient who may require full heparinization for CPB is the most debatable element of this anesthetic and merits explicit justification. The rationale was analgesic and physiological: a laparotomy combined with a sternotomy is among the most painful combinations of incisions in surgery, and intrathecal morphine produces reliable analgesia for approximately 24 hours, reduces postoperative systemic opioid consumption and attenuates the perioperative stress response, all of which favor early extubation (Bhat et al., 2021; “Intrathecal Morphine for Cardiac Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials,” 2024). In this patient, extubation on the first postoperative day and a five-day hospital stay after a combined cardiac and oncological procedure are consistent with that objective.

The principal hazard is spinal hematoma. Two considerations mitigate it. First, the single-shot intrathecal technique with a small-gauge needle carries a substantially lower risk than an indwelling epidural catheter, which is why the intrathecal route is generally preferred when systemic anticoagulation is anticipated (“Intrathecal Morphine for Cardiac Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials,” 2024; Putra et al., 2025). Second, the American Society of Regional Anesthesia and Pain Medicine does not regard CPB as an absolute contraindication to neuraxial technique, but advises that heparinization be delayed at least 60 minutes after neuraxial instrumentation and that surgery be postponed for 24 hours after a traumatic or bloody tap (Horlocker et al., 2018; “Neuraxial Anesthesia and Timing of Heparin Administration in Patients Undergoing Surgery for Congenital Heart Disease Using Cardiopulmonary Bypass,” 2012). Both conditions were satisfied here: the block was atraumatic and heparin was not administered until well beyond that interval. Retrospective series of more than 700 patients receiving neuraxial blockade before full heparinization for CPB have reported no symptomatic hematomas, and randomized data in cardiac surgery similarly report none, although no study is powered to establish safety definitively (Bhat et al., 2021; “Neuraxial Anesthesia and Timing of Heparin Administration in Patients Undergoing Surgery for Congenital Heart Disease Using Cardiopulmonary Bypass,” 2012).

We would nevertheless emphasize that this decision should be individualized rather than adopted as a routine. In a patient with a baseline aPTT of $1.54\times$ control, the balance is genuinely arguable. Contemporary alternatives — bilateral erector spinae plane or parasternal blocks combined with a multimodal systemic regimen — provide much of the analgesic benefit without any neuraxial risk and may be preferable where coagulation is abnormal or where the timing of heparinization cannot be guaranteed.

Induction and hemodynamic goals

A mobile thrombus that intermittently occludes the tricuspid orifice creates a physiology closely analogous to that of a ball-valve tumor or a large right atrial myxoma. Cardiac output becomes preload-dependent and position-dependent, and the circulation tolerates neither the vasodilatation of a brisk induction nor the reduction in venous return caused by high intrathoracic pressure. Our induction sequence — a small dose of midazolam, a reduced dose of propofol, a generous opioid dose to blunt the sympathetic response to laryngoscopy, and a rapid-onset dose of rocuronium — reflects the standard cardiac anesthetic principle of maintaining afterload and preload while eliminating the stress response, and is consistent with

the approaches reported in comparable cases (Bektaş et al., 2018; Chen et al., 2024; Hsu & Wu, 2022).

An underappreciated hazard is iatrogenic embolization from the anesthesiologist rather than the surgeon. Guidewires, catheter tips and pulmonary artery catheters advanced into a right atrium containing friable tumor can fragment it. For this reason a pulmonary artery catheter is generally avoided in level IV disease, and central venous cannulation should be performed under ultrasound guidance with the wire and catheter tip kept high in the superior vena cava and confirmed on TEE — as was done in this case.

Transesophageal echocardiography as the decisive monitor

TEE is widely considered imperative in level IV thrombus and in any case in which CPB may be required.⁷ Performed after induction, it restages the thrombus, which not infrequently differs from the preoperative computed tomography or transthoracic study, and it characterizes mobility and adherence — properties that directly alter surgical technique. Intraoperatively it guides clamp placement, monitors for migration during manipulation, assesses volume status and ventricular function, and confirms complete clearance and the absence of residual fragments at the end of the procedure (“Perioperative Anesthetic Management for Renal Cell Carcinoma with Vena Caval Thrombus Extending into the Right Atrium: Case Series,” 2017).

Its most important contribution in this case, however, was diagnostic. When a patient undergoing IVC thrombectomy becomes acutely hypotensive, the differential includes hemorrhage, surgical compression or clamping of the cava, tumor embolization to the pulmonary artery, thrombus prolapse across the tricuspid valve, and air embolism — conditions whose treatments diverge sharply and which cannot be distinguished by arterial pressure alone. Two bedside findings narrowed the differential before the probe was even interrogated: the central venous pressure remained at 9 mmHg while the mean arterial pressure halved, and the heart rate did not rise. Hemorrhage and hypovolemia produce the opposite pattern — a falling filling pressure with compensatory tachycardia — so a preserved or rising CVP in the face of profound hypotension should direct attention immediately to an obstructive cause. A sudden fall in end-tidal carbon dioxide accompanying hypotension is a similarly valuable early clue to embolic obstruction and should trigger immediate echocardiographic interrogation. In this patient TEE identified thrombus collapse into the right atrium within seconds and directed the team straight to sternotomy rather than to fluid resuscitation or a search for surgical bleeding. Where TEE is performed continuously rather than intermittently, this diagnostic latency is measured in seconds; where it is not available, it may be measured in minutes that the patient does not have.

Emergency conversion to cardiopulmonary bypass

Intraoperative tumor embolization occurs in approximately 1.8–5.4% of IVC thrombectomies and is associated with a mortality of up to 60%.^{5,6} CPB with embolectomy is regarded as the definitive management when it is available.⁵ Reported salvage in these circumstances depends almost entirely on the interval between recognition and the institution of extracorporeal support, and several published survivors — like ours — were rescued by immediate sternotomy and bypass after echocardiographic diagnosis (“Successful Treatment of Intraoperative Pulmonary Tumor Embolism from Renal Cell Carcinoma,” 1998; Trifoi et al., 2023).

This argues for a specific principle of preparation rather than reaction. When operating on a mobile level IV thrombus, the cardiac surgical team, perfusionist and primed circuit should not merely be theoretically available but physically present, with the sternum prepped into the field and the roles for an emergency conversion assigned before incision. In this case CPB was instituted through aortic and right atrial cannulation; peripheral femoral cannulation is an equally valid alternative and is often the faster route when the chest is not yet open, and both options should be considered in advance. Bypass was conducted with mild-to-moderate hypothermia to a nasopharyngeal nadir of 31.5 °C. Deep hypothermic circulatory arrest, which some centers employ for extensive or adherent level IV thrombus, was neither required nor used, and avoiding it is desirable in an abdominal field that is already open and bleeding, since the associated coagulopathy is considerable.

Heparinization in a patient with an open laparotomy and a partially resected kidney inevitably worsens surgical bleeding, and this tension is intrinsic to the emergency conversion. Management therefore requires anticipation: blood products immediately available in the room, a pre-agreed transfusion strategy, prompt and complete protamine reversal — confirmed here by an activated clotting time of 160 seconds — and correction of the dilutional and consumptive coagulopathy before the abdominal resection is resumed. Completing the nephrectomy only after cardiovascular stability had been restored, rather than attempting to continue during the crisis, was an important element of the sequencing.

Postoperative considerations

Recovery was rapid: extubation on day 1, ward transfer on day 2 and discharge on day 5, without cognitive dysfunction or neurological deficit. Several factors plausibly contributed — the relatively short bypass time, the avoidance of deep hypothermic circulatory arrest, maintenance of adequate perfusion pressure, and the quality of analgesia provided by the intrathecal morphine, which permitted early extubation without a large systemic opioid load.^{10,11} Neurological assessment after any procedure combining CPB with a preceding neuraxial block warrants particular attention, since both bypass-related cerebral injury and spinal hematoma must be actively excluded; motor and sensory function should be documented as soon as sedation is lightened.

Limitations

This is a single case, and the conclusions that can be drawn are correspondingly limited. Cerebral oximetry and objective neurocognitive testing were not performed, so the absence of postoperative cognitive dysfunction is a clinical rather than a measured observation. Post-thrombectomy transesophageal echocardiography was performed and confirmed complete clearance, but the images were not archived, so this finding is documented in the anesthetic record rather than illustrated here. Long-term oncological outcome and the histological confirmation of the suspected synchronous hepatic lesion lie beyond the scope of this report. Finally, the favorable outcome reflects the resources of a tertiary center with an in-house cardiothoracic surgical and perfusion service, and the strategy described is not directly transferable to settings where emergency CPB cannot be instituted within minutes; in such centers, referral before surgery is the appropriate course.

CONCLUSION

Renal cell carcinoma with a mobile Mayo level IV tumor thrombus places the anesthesiologist at the center of a high-risk procedure in which catastrophic tumor embolization or acute intracardiac obstruction may occur without warning and rapid diagnosis depends heavily on echocardiographic assessment. In this patient, carefully titrated anesthetic induction with preservation of preload and systemic vascular resistance, meticulous central venous cannulation that avoided instrumentation of the right atrium, appropriately timed intrathecal morphine administration before systemic heparinization, and, most importantly, continuous intraoperative transesophageal echocardiography (TEE) enabled immediate recognition of acute prolapse of the tumor thrombus into the right atrium and prompt management with emergency median sternotomy and cardiopulmonary bypass (CPB). The patient recovered without major complications and was discharged on postoperative day 5. The principal lesson from this case is the importance of preparation rather than improvisation: in patients with Mayo level IV disease, the cardiac surgical team, perfusion capability, and a clearly defined emergency conversion plan should be established before the abdominal phase of surgery begins.

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