frontiers | Frontiers in Anesthesiology

TYPE Case Report
PUBLISHED 30 January 2025
DOI 10.3389/fanes.2025.1490270

OPEN ACCESS

EDITED BY
Thomas Schricker,
McGill University, Canada

REVIEWED BY
Ahmed G. Elkhouly,
Tanta University, Egypt
Kathryn Glas,
University of Arizona, United States

*CORRESPONDENCE
Kathryn M. Jan
✉ kathryn.jan@utsouthwestern.edu

†These authors have contributed equally to this work and share first authorship

‡These authors have contributed equally to this work and share senior authorship

RECEIVED 02 September 2024
ACCEPTED 17 January 2025
PUBLISHED 30 January 2025

CITATION
Jan KM, Dao AQ, Joshi R, Cheruku S, Dellaria S and Karamchandani K (2025) Immediate postoperative cardiac tamponade following robotic lung resection surgery: a case report. Front. Anesthesiol. 4:1490270. doi: 10.3389/fanes.2025.1490270

Immediate postoperative cardiac tamponade following robotic lung resection surgery: a case report

Kathryn M. Jan*†, Anthony Q. Dao†, Ravi Joshi‡, Sreekanth Cheruku‡, Suzanne Dellaria‡ and Kunal Karamchandani‡

Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX, United States

Cardiac tamponade is a life-threatening emergency requiring immediate diagnosis and treatment to prevent mortality. Development of cardiac tamponade following non-cardiac surgery is rare, and diagnosis may often be overlooked due to low suspicion. Point-of-care ultrasound (POCUS) is an important tool in the perioperative physician's armamentarium. We describe the development of cardiac tamponade following an initially uneventful robotic lung resection surgery and its prompt detection using POCUS. This case highlights the importance of utilizing bedside POCUS during medical emergencies in the immediate postoperative period. We also make an argument for perioperative care management by POCUS-trained physicians.

KEYWORDS

case report, cardiac tamponade, point-of-care ultrasound, cardiac anesthesiology, postoperative management

Introduction

Cardiac tamponade is a life-threatening emergency associated with impaired cardiac filling, marked right heart flow restriction, and eventually, depressed cardiac output (1, 2). Clinical manifestations include hemodynamic instability with tachycardia and refractory hypotension. Untreated, external pressurization from tamponade leads to equalization of cardiac chamber pressures, and if not urgently addressed, it can lead to organ failure, cardiac arrest, and death. We report the case of a 73-year-old man who developed cardiac tamponade in the post-anesthesia care unit (PACU) following an initially uncomplicated robotic lung resection. Prompt diagnosis using point-of-care ultrasound (POCUS) helped institute emergent lifesaving interventions, underscoring the importance of integrating POCUS into managing medical emergencies during the postoperative period.

The patient has since deceased, and his next of kin has provided written consent as well as written Health Insurance Portability and Accountability Act authorization to publish this case report.

Abbreviations
PACU, post-anesthesia care unit; POCUS, point-of-care-ultrasound; IV, intravenous; MAP, mean arterial pressure; ABP, arterial blood pressure.

Case description

A 73-year-old male weighing 85 kg (body mass index of 24 kg/m^2) with medical history significant for hypertension on metoprolol, non-insulin dependent diabetes on metformin, and a 180 pack-year smoking history was scheduled for a robotic-assisted thoracoscopic right upper lobectomy and mediastinal lymph node dissection for lung adenocarcinoma. His electrocardiogram demonstrated normal sinus rhythm, and his preoperative transthoracic echocardiogram revealed normal biventricular function with mild inferior and distal anterior hypokinesis without significant valvular dysfunction. His preoperative labs were unremarkable. Chest imaging revealed a small right upper pulmonary nodule. He could easily achieve >4 metabolic equivalent tasks.

The patient underwent general endotracheal anesthesia with a left-sided 41 French double lumen tube confirmed by fiberoptic visualization, and anesthesia was induced using intravenous (IV) propofol and rocuronium. A post-induction radial arterial line and a 16-gauge IV catheter were placed, and anesthesia was maintained using sevoflurane in an oxygen and air (50:50) mixture. Intraoperatively, the patient received 5,000 units of subcutaneous heparin shortly following induction of anesthesia for venous thromboembolism prophylaxis per institutional protocol. The surgery itself was uncomplicated and uneventful, and the patient tolerated one lung ventilation well with stable oxygenation and lung mechanics. A phenylephrine infusion at 0.1 mcg/kg/min was maintained following induction to keep mean arterial pressures (MAPs) >65 mmHg. At the end of the procedure, the surgical team performed a multilevel intercostal nerve block with 20 ml of liposomal bupivacaine under direct endoscopic visualization. Estimated blood loss during the surgery was 100 ml, and the patient received 3.2 L of crystalloid throughout the duration of the 4-h case. Though volume resuscitation was relatively generous for the duration of this procedure, hemodynamics remained stable intraoperatively.

At the end of the surgery, the phenylephrine drip was discontinued, and the patient's trachea was extubated after the patient met all extubation criteria. He was then taken to the PACU, where initial postoperative vitals were stable with a heart rate of 84 beats/min, invasive arterial blood pressure (ABP) of 103/74 mmHg, and a temperature of 36.2 °C. The patient was drowsy but arousable and was able to respond normally to verbal stimuli. Soon after, his ABP decreased to 74/50 mmHg, and his heart rate increased to 120–130 beats/min. The patient endorsed mild chest pain during this time. He was empirically treated with a 2-L IV bolus of crystalloid as well as two doses of 20% intravenous fat emulsion for possible hypovolemia and suspected local anesthetic systemic toxicity, solely based on recent timing of liposomal bupivacaine injection (<30 min) and relative ease of treatment to rule-out local anesthetic systemic toxicity. Due to his refractory hypotension, femoral central venous access was obtained, and infusions of norepinephrine (up to.4 mcg/kg/min), vasopressin (up to.04 units/min), and epinephrine (up to.06 mcg/kg/min) were initiated sequentially and titrated to target MAP >65 mmHg. Despite the escalating doses of vasopressors, the ABP precipitously dropped to 53/44 mmHg. Electrocardiogram revealed sinus tachycardia with electrical alternans, and chest radiography demonstrated a right chest tube with mild pulmonary atelectasis but did not show any cardiac silhouette enlargement. Bedside POCUS was performed and revealed a 1 cm pericardial effusion with right atrial diastolic collapse (Supplementary Video 1), prompting preparation for emergent intervention.

On return to the operating room for pericardial window creation, IV midazolam and ketamine were administered, and spontaneous ventilation was maintained. The surgical team created a 5 cm subxiphoid longitudinal incision to drain the patient's pericardium after subcutaneous infiltration of local anesthetic, and 100 ml of blood was surgically drained with immediate hemodynamic improvement resulting in decreased requirements of vasoactive infusions. Given the profound acidosis (pH 7.19) that had developed in the interim, general anesthesia was induced, and the patient's trachea was intubated. Transesophageal echocardiography was performed showing preserved biventricular function following effusion evacuation (Supplementary Video 2), and pharmacological support could be decreased. The bleeding source was never discovered, but the patient's pericardium remained hemostatic following drainage. After the procedure, he was admitted to the intensive care unit and quickly weaned off all vasoactive support. The patient's trachea was extubated the next day, and he followed an expected post-lobectomy recovery course with hospital discharge on postoperative day 7. Approximately a year after discharge, the patient passed due to events unrelated to this complication.

Discussion

This case highlights the importance of considering cardiac tamponade as a cause of postoperative hemodynamic instability in patients undergoing non-cardiac surgery, recognizing the signs of cardiac tamponade early, and utilizing POCUS as an efficient, noninvasive tool to evaluate medical emergencies in the perioperative period. Our patient underwent an initially uneventful robotic-assisted thoracoscopic lung surgery and emergence from anesthesia. However, he rapidly decompensated in the PACU. Hypotension, though slightly delayed in this patient, is not uncommon in the postoperative period, and includes a long list of differentials including residual anesthesia, hypovolemia, opioid-induced vasodilation, etc., but the refractory and precipitous decrease in ABP is not common and often indicates a more sinister etiology. In our case, local anesthetic systemic toxicity was suspected considering the temporal relationship with liposomal bupivacaine administration and no specific reasons to suspect a cardiac etiology. It was only after bedside POCUS that the true etiology was discovered, and appropriate treatment could be initiated. A more expeditious POCUS examination could have more quickly elucidated the diagnosis of tamponade and limited delay of treatment.

Cardiac tamponade is a rare occurrence after non-cardiac thoracic surgery (3). Therefore, the diagnostic suspicion may remain low in patients with hemodynamic instability in the postoperative period. Our case highlights the importance of performing due diligence in evaluating postoperative hemodynamic instability, including the use of POCUS. Cardiac tamponade in our patient may have gone unrecognized if there was not a readily available ultrasound machine with phased-array probe and qualified personnel trained in bedside POCUS. POCUS provides innumerable benefits with little risk given its non-invasive nature; however, its implementation, or lack thereof, has widely varied across multiple institutions (4). Implementing standardized training for POCUS is feasible, and having dedicated POCUS-trained staff in the PACU has shown positive impacts on patient outcomes. In a prospective observational study conducted in two major academic center PACUs, staffing the recovery area with POCUS-trained faculty anesthesiologists led to a reduction in the PACU length of stay as well as a reduction in number of suspected diagnoses (4). POCUS examinations should be routinely completed to assess acute hypotension and hypoxia as it provides high diagnostic utility in a relatively quick and non-invasive manner. The role of bedside POCUS during medical emergencies on nursing floors and during the peri-resuscitative period as well as its integration into out-of-operating room emergency airway management has been explored and may positively impact patient outcomes (5–7). Further studies are needed to assess the cost-benefit analysis and the impact of staffing PACU with POCUS-trained anesthesiologists on patient outcomes before routine implementation.

Cardiac tamponade remains one of the most significant diagnoses to investigate via cardiac sonography. Typically, effusions are classified as small, moderate, or large based on sizes of <9 mm, 10–19 mm, and >20 mm, respectively. Right atrial collapse is 100% sensitive for tamponade while left atrial collapse is notably very specific (8). Though a 1 cm effusion appears to be a small amount of fluid, rapid accumulation of fluid can lead to dramatic hemodynamic instability. The cause of the pericardial effusion with ensuing tamponade following this patient's initial surgery remains unclear. He had received subcutaneous heparin shortly after induction, but this is unlikely to have contributed to any clinically significant bleeding, let alone tamponade. There are case reports of iatrogenic vascular injury, spontaneous coronary artery rupture, as well as retraction injury to an aberrant right bronchial artery resulting in cardiac tamponade; however, these do not appear to be the case in this patient (1, 3, 9, 10). As the surgery was right-sided and the patient was in the left lateral decubitus position, robot arm retraction is less likely a source as well. No source of bleeding was identified during pericardial window creation, and hemostasis was established quickly after initial drainage, thus ruling out coagulopathy as a contributing factor. However, the patient did have medical risk factors for developing pericardial effusion such as malignancy, hypertension, and diabetes which can result in long-term inflammatory stimulation and remodeling of vasculature, but it is unclear if these medical comorbidities would have led to this acute event without evidence of pre-existing pericardial effusion on preoperative workup (1, 9, 10).

Cardiac tamponade must be treated in a timely manner or else it is fatal. Pericardiocentesis and pericardial windows are both valid treatment options (2). However, it is important to recognize that pericardiocentesis has a higher risk of inadequately draining an effusion and recurrence, especially when the cause is unclear. Given that our institution had cardiothoracic surgeons readily available, we were able to complete a pericardial window in an efficient manner, which would be a more definitive treatment. Pericardial drainage is recommended to be completed under local anesthesia or mild sedation as induction of anesthesia as any reduction in the sympathetic stimulation or changes in pulmonary pressures can further exacerbate hemodynamic instability. If it were not for the readily available operating room staff and equipment, bedside drainage would be recommended.

In conclusion, we present the case of a patient who developed delayed, but sudden and refractory hypotension impending on total cardiovascular collapse from cardiac tamponade that developed as a complication from a robotic-assisted lung surgery. This case highlights the need for heightened alertness for this condition, even in non-cardiac surgery, and diagnostic utility of POCUS in rapidly diagnosing this life-threatening medical emergency. Efforts should be made to investigate ways to integrate POCUS routinely into the perioperative arena.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

KJ: Writing – original draft, Writing – review & editing. AD: Writing – original draft, Writing – review & editing. RJ: Supervision, Writing – review & editing. SC: Data curation, Writing – review & editing. SD: Supervision, Writing – review & editing. KK: Supervision, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fanes.2025.1490270/full#supplementary-material

VIDEO 1
Video of transthoracic echocardiogram in the subxiphoid view demonstrating a 1 cm pericardial effusion.

VIDEO 2
Video of transesophageal echocardiogram revealing resolution of tamponade and normal biventricular function in the midesophageal four chamber view.

References

1. Chen W, Shen Y, Yuan Y, Zheng Q, Zhou Y. Acute cardiac tamponade following thoracoscopic lobectomy: a case report and literatures review. *J Cardiothorac Surg*. (2023) 18(1):279. doi: 10.1186/s13019-023-02374-3

2. Stashko E, Meer JM. *Cardiac Tamponade*. Treasure Island, FL: StatPearls (2024).

3. Chen X, Miao Q, Yu Y, Zhang F, Sun L, Meng Y, et al. Blunt trauma-induced pericardial tamponade after video-assisted thoracoscopic surgery. *Ann Thorac Surg*. (2019) 107(6):e381–e3. doi: 10.1016/j.athoracsur.2018.10.046

4. Ramsingh D, Singh S, Canales C, Guran E, Taylor Z, Antongiorgi Z, et al. The evaluation point-of-care ultrasound in the post-anesthesia unit-A multicenter prospective observational study. *J Clin Med*. (2021) 10(11):2389. doi: 10.3390/jcm10112389

5. Bughrara N, Herrick SL, Leimer E, Sirigaddi K, Roberts K, Pustavoitau A. Focused cardiac ultrasound and the periresuscitative period: a case series of resident-performed echocardiographic assessment using subcostal-only view in advanced life support. *A A Pract*. (2020) 14(10):e01278. doi: 10.1213/XAA.0000000000001278

6. Khorsand S, Chin J, Rice J, Bughrara N, Myatra SN, Karamchandani K. Role of point-of-care ultrasound in emergency airway management outside the operating room. *Anesth Analg*. (2023) 137(1):124–36. doi: 10.1213/ANE.0000000000006371

7. Zieleskiewicz L, Lopez A, Hraiech S, Baumstarck K, Pastene B, Di Bisceglie M, et al. Bedside POCUS during ward emergencies is associated with improved diagnosis and outcome: an observational, prospective, controlled study. *Crit Care*. (2021) 25(1):34. doi: 10.1186/s13054-021-03466-z

8. O'Connor CJ, Tuman KJ. The intraoperative management of patients with pericardial tamponade. *Anesthesiol Clin*. (2010) 28(1):87–96. doi: 10.1016/j.anclin.2010.01.011

9. Ozturk E, Tanidir IC, Saygi M, Ergul Y, Guzeltas A, Odemis E. Evaluation of non-surgical causes of cardiac tamponade in children at a cardiac surgery center. *Pediatr Int*. (2014) 56(1):13–8. doi: 10.1111/ped.12192

10. Pillai JB, Barnard S. Cardiac tamponade: a rare complication after pulmonary lobectomy. *Interact Cardiovasc Thorac Surg*. (2003) 2(4):657–9. doi: 10.1016/S1569-9293(03)00188-9