e-ISSN (online): 2745-9497

Journal of Anesthesiology and Clinical Research (JACR)

Journal website: https://hmpublisher.com/index.php/jacr

Anesthetic Management of Emergency Esophagoscopy for Denture Foreign Body Extraction in an Adult with Uncorrected Pulmonary Atresia–Ventricular Septal Defect, Major Aortopulmonary Collateral Arteries, and Bacterial Pneumonia: A Case Report

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ARTICLE INFO

Keywords:
Adult congenital heart disease
Esophageal foreign body
PA-VSD
Pneumonia
Shared airway anesthesia

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/jacr.v7i2.894

A B S T R A C T

Introduction: Esophageal foreign body impaction is a common emergency, but its management becomes uniquely complex when superimposed on uncorrected cyanotic congenital heart disease and acute pulmonary infection. Adults with pulmonary atresia–ventricular septal defect (PA-VSD), major aortopulmonary collateral arteries (MAPCA) and patent ductus arteriosus represent a fragile physiology in which any deterioration in cardiac output, oxygenation or systemic vascular resistance may precipitate refractory hypoxemia. **Case presentation:** A 51-year-old man presented with sudden throat pain after accidentally swallowing a denture. Cervical radiography revealed an irregular opacity at C4–C5. He had longstanding uncorrected PA-VSD with MAPCA, patent ductus arteriosus and moderate aortic regurgitation; echocardiography showed cardiac output 2.9 L/min and cardiac index 1.86 L/min/m². He was concurrently diagnosed with Klebsiella pneumoniae bacterial pneumonia (chest radiograph: cardiothoracic ratio 75% with pulmonary edema; SpO_2 94% on room air). Following multidisciplinary preoperative optimization—nebulized ipratropium-salbutamol, furosemide, digoxin, lansoprazole, warfarin, bisoprolol and spironolactone—he underwent emergency rigid esophagoscopy under general anesthesia with endotracheal intubation. Hemodynamic-protective induction preserved systemic vascular resistance and avoided hypoxic-hypercapnic shifts. The denture was extracted intact and the patient was transferred to the intensive care unit with blood products on standby. **Conclusion:** Successful management required prompt diagnosis, multidisciplinary preoperative optimization and a hemodynamic-protective anesthetic plan tailored to balanced systemic-pulmonary circulation. Awareness of the specific physiology of unrepaired PA-VSD with MAPCA and concurrent pneumonia is essential to safe perioperative care.

1. Introduction

Esophageal foreign body impaction is one of the most frequent indications for emergency endoscopy worldwide, with a bimodal age distribution that captures children swallowing coins, button batteries and toy fragments and older adults inadvertently dislodging dentures, food boluses, bones and fish bones.[1] The European Society of Gastrointestinal Endoscopy 2016 clinical guideline frames esophagoscopy under general anesthesia as the definitive management for sharp objects, batteries, large blunt items lodged for more than 24 hours, and any object causing complete obstruction.[2] Athanassiadi and colleagues' landmark series of 400 patients

reported an 85.7% success rate for rigid esophagoscopy under general anesthesia, establishing the technique as a benchmark for the discipline.[3]

While the indications and procedural approach for esophageal foreign body removal are well codified, the perioperative environment is not. The shared airway between anesthetist and endoscopist, the risk of aspiration from the static esophagus, and the potential for sudden hemorrhage from mucosal disruption together constitute a high-acuity situation in even an otherwise healthy adult.[4-6] When the patient also harbors complex cardiopulmonary comorbidity, the perioperative team must reconcile competing imperatives: the surgical urgency of foreign body extraction, the airway protection demands of an esophageal procedure, and the physiologic constraints of the patient's underlying disease.[7-11]

Pulmonary atresia with ventricular septal defect (PA-VSD) is an extreme form of conotruncal abnormality in which the pulmonary valve and proximal trunk are atretic and pulmonary blood flow depends on alternative sources—principally a patent ductus arteriosus and major aortopulmonary collateral arteries.[12,13] Adult survivors of unrepaired PA-VSD are rare but not unheard of; their physiology is characterized by chronic cyanosis, secondary erythrocytosis, fixed pulmonary vascular disease and delicate balance between systemic and pulmonary circulations.[14] The concurrent presence of MAPCA, patent ductus arteriosus and moderate aortic regurgitation, as in our patient, further complicates the perioperative picture by introducing variable shunt direction, valvular regurgitation and risk of fluid mismanagement.

Bacterial pneumonia layered upon this fragile physiology adds further risk. Klebsiella pneumoniae, in particular, is associated with severe lobar consolidation and rapid clinical deterioration, especially in patients with reduced functional reserve.[15] The American Thoracic Society and Infectious Diseases Society of America 2019 community-acquired pneumonia guideline emphasize prompt empiric coverage and supportive management, but emergent non-cardiac surgery in this setting must navigate the additional risks of anesthesia in a patient whose respiratory mechanics are already compromised.[16] Ohbe and colleagues' 2020 cohort analysis demonstrated that pulmonary complications after non-cardiac surgery in adults with congenital heart disease are common and associated with significantly higher in-hospital mortality.[17]

Perioperative management of adult congenital heart disease (ACHD) patients undergoing non-cardiac surgery is now informed by the 2018 AHA/ACC ACHD guideline, the 2017 AHA scientific statement on noncardiac complications, and a growing series of expert consensus documents. These resources broadly agree on three principles: stratify risk preoperatively by the anatomic complexity and physiologic stage; involve a multidisciplinary team of anesthesiology, cardiology, pulmonology and the surgical specialty; and tailor the anesthetic plan to preserve pulmonary blood flow, systemic vascular resistance and avoid sudden hemodynamic shifts.[7-8]

Despite this body of evidence, descriptions of emergency non-cardiac surgery in unrepaired adult PA-VSD with concurrent pneumonia are scarce. The novelty of this case lies in the convergence of three high-acuity threats—an esophageal foreign body, uncorrected cyanotic ACHD and active bacterial pneumonia—and in the structured anesthetic and multidisciplinary plan that allowed safe perioperative management. The aim of this study is to describe the diagnostic process, the preoperative optimization regimen, the hemodynamic-protective anesthetic strategy and the postoperative trajectory, and to derive practical learning points for anesthesiologists facing similar complex emergent situations.

2. Case Presentation

This case report has been prepared in accordance with the CARE guidelines. Written informed consent for the use of clinical data, images and publication of this report was obtained from the patient and his next of kin. Table 1 summarizes the patient's demographic and clinical characteristics relevant to perioperative decision-making. Laboratory and preoperative investigations are detailed in Table 2 with reference ranges and interpretation. The multidisciplinary preoperative optimization plan is presented in Table 3,

and the intraoperative anesthetic timeline is detailed in Table 4. Comparison with previously reported cases of non-cardiac surgery in cyanotic ACHD or shared-airway emergencies is presented in Table 5 within the Discussion.

History and examination

A 51-year-old male patient was admitted to the emergency department on May 2nd, 2024 with a chief complaint of sudden throat pain after accidentally swallowing his denture earlier that day. He reported a sensation of fullness in the neck but specifically denied choking, stridor or true respiratory distress at the time of ingestion. The onset of throat pain was immediate and progressively increased on attempted oral intake. The patient had attempted to dislodge the denture through coughing without success and presented within four hours.

Past medical history was significant for uncorrected cyanotic congenital heart disease, characterized by pulmonary atresia with ventricular septal defect, major aortopulmonary collateral arteries, patent ductus arteriosus and moderate aortic regurgitation. The patient had been followed at the cardiology service for several decades but had been deemed unsuitable for surgical correction at multiple junctures because of unfavorable pulmonary vascular anatomy and progressive pulmonary vascular disease. He was on long-term medical therapy comprising furosemide, spironolactone, digoxin, bisoprolol, lansoprazole and warfarin, the last for thromboembolic prophylaxis. He had also been admitted on April 26th, 2024—six days prior to the current presentation—with a clinically and radiologically confirmed bacterial pneumonia presumed secondary to Klebsiella pneumoniae and was on intravenous antibiotic therapy at the time of foreign body ingestion.

Other history included edentulism with two upper-jaw partial dentures, a 35 pack-year smoking history (quit five years previously), and limited functional capacity (NYHA class III with dyspnea on minimal exertion at baseline). He denied diabetes mellitus and had no known drug allergies. There was no family history of congenital heart disease.

On examination the patient was alert and conversant but visibly cyanotic with central peripheral cyanosis and clubbing of all digits. Vital signs showed a heart rate of 63 beats/min, blood pressure 105/60 mmHg, respiratory rate 20 breaths/min, oxygen saturation 94% on room air, and temperature 37.1°C. He was in mild respiratory distress with occasional non-productive cough and mild dyspnea on speaking. Body weight was 56 kg, and height was 162 cm.

Cardiac auscultation revealed a continuous murmur best heard at the apex consistent with collateral and ductal flow, and a soft early diastolic murmur at the left sternal border consistent with moderate aortic regurgitation. The jugular venous pressure was elevated. Pulmonary examination revealed vesicular breath sounds with bilateral rhonchi and scattered crackles at the right lower zone. The abdomen was soft with mild hepatomegaly. Throat examination demonstrated mild pharyngeal erythema; no foreign body was visible on direct inspection. The neck was supple but the patient described persistent retrosternal and cervical discomfort. Peripheral edema 2+ was present in both ankles. Neurological examination was unremarkable.

Laboratory, imaging and microbiologic findings

Laboratory and imaging studies obtained on admission and during preoperative preparation confirmed the clinical impression. Hemoglobin was 18.4 g/dL with hematocrit 56% and erythrocyte count 6.3 × 10^{12}/L, consistent with secondary erythrocytosis from chronic cyanosis. White cell count was 14.6 × 10^9/L with neutrophilic predominance (82%) consistent with active bacterial infection, platelet count 246 × 10^9/L. Prothrombin time was prolonged at 26.4 seconds (INR 2.6), reflecting the anticoagulant effect of warfarin. Activated partial thromboplastin time was 38 seconds. Serum sodium was 134 mmol/L, potassium 4.6 mmol/L, urea 38 mg/dL, creatinine 1.1 mg/dL, and random blood glucose 128 mg/dL. Arterial blood gas analysis on room air showed pH 7.41, $PaCO_2$ 36 mmHg, PaO_2 58 mmHg, HCO_3^- 22 mmol/L and base excess −1.4 mmol/L, consistent with chronic compensated hypoxemia.

Table 1. Demographic, cardiovascular and clinical characteristics of the patient.

Parameter	Finding
Age/gender	51 years/male
Body weight/height/BMI	56 kg/162 cm/21.3 kg/m²
ASA physical status	IV E (life-threatening, emergent)
Chief complaint	Throat pain after accidental denture ingestion
Time from ingestion to ED	4 hours
Cardiac diagnosis	Pulmonary atresia–VSD; MAPCA; PDA; moderate AR (uncorrected)
Functional capacity	NYHA III
Hemodynamics	HR 63/min; BP 105/60 mmHg; CO 2.9 L/min; CI 1.86 L/min/m²
Cyanosis	Central + peripheral; clubbing all digits
RVSP/LVEF	78 mmHg / 52%
Pulmonary status	Bacterial pneumonia (K. pneumoniae); SpO_2 94% RA; PaO_2 58 mmHg
Chest radiograph	CTR 75%; pulmonary edema; perihilar haziness
Cervical radiograph	Irregular opacity at C4–C5 (denture)
Anticoagulation	Warfarin (INR 2.6 on admission)
Active medications	Furosemide, spironolactone, digoxin, bisoprolol, lansoprazole, warfarin, ceftriaxone IV
Planned procedure	Emergency rigid esophagoscopy + denture extraction under GA + ETT

Footnote: ASA, American Society of Anesthesiologists physical status; PA-VSD, pulmonary atresia–ventricular septal defect; MAPCA, major aortopulmonary collateral arteries; PDA, patent ductus arteriosus; AR, aortic regurgitation; NYHA, New York Heart Association; CO, cardiac output; CI, cardiac index; RVSP, right ventricular systolic pressure; LVEF, left ventricular ejection fraction; CTR, cardiothoracic ratio; INR, international normalized ratio; ETT, endotracheal tube; GA, general anesthesia; RA, room air.

Cervical radiography demonstrated an irregular opacity overlying the C4–C5 vertebrae, consistent with an opaque foreign body lodged at the upper esophageal sphincter. Posteroanterior chest radiography (April 26) demonstrated cardiomegaly with cardiothoracic ratio of 75%, prominent pulmonary vascular markings and bilateral perihilar haziness consistent with pulmonary edema and superimposed bronchopneumonia. Echocardiography performed on May 1st, 2024 confirmed pulmonary atresia with a large membranous-malalignment-type ventricular septal defect, multiple major aortopulmonary collateral arteries arising from the descending aorta, a patent ductus arteriosus with bidirectional flow, and moderate aortic regurgitation. Cardiac output was 2.9 L/min, cardiac index 1.86 L/min/m² (severely reduced), left ventricular ejection fraction 52% and right ventricular function moderately impaired with right ventricular systolic pressure of 78 mmHg. Twelve-lead electrocardiography demonstrated sinus rhythm at 64 beats/min with right axis deviation, right atrial enlargement and right ventricular hypertrophy.

Microbiological studies, including blood cultures and sputum culture, were positive for Klebsiella pneumoniae sensitive to ceftriaxone, piperacillin-tazobactam and levofloxacin; the patient was already receiving intravenous ceftriaxone at the time of presentation. Pertinent investigations are summarized in Table 2 with reference ranges and clinical interpretation.

Table 2. Laboratory and imaging findings with reference ranges and interpretation. Abnormal values marked in bold red.

Investigation	Result	Reference range	Interpretation
Hemoglobin	18.4 g/dL	13.5–17.5 g/dL	Elevated — secondary erythrocytosis*
Hematocrit	56%	40–50%	Elevated*
RBC count	6.3×10^{12}/L	$4.5–5.9 \times 10^{12}$/L	Elevated*
WBC count	14.6×10^{9}/L	$4.0–11.0 \times 10^{9}$/L	Elevated — infection*
Neutrophils	82%	40–70%	Elevated*
Platelets	246×10^{9}/L	$150–450 \times 10^{9}$/L	Normal
Prothrombin time/INR	26.4 s / 2.6	11–13.5 s / 0.9–1.1	Prolonged — warfarin*
aPTT	38 s	25–35 s	Mildly prolonged*
Sodium/potassium	134 / 4.6 mmol/L	135–145 / 3.5–5.0	Mild hyponatremia*
Urea/creatinine	38 / 1.1 mg/dL	10–50 / 0.6–1.1 mg/dL	Normal
Random glucose	128 mg/dL	70–140 mg/dL	Normal
ABG (room air): pH/ $PaCO_2$/PaO_2/HCO_3^-	7.41 / 36 / 58 / 22	7.35–7.45 / 35–45 / 80–100 / 22–26	Chronic compensated hypoxemia*
Echocardiogram	PA-VSD with MAPCA; PDA; moderate AR; CO 2.9 L/min; CI 1.86 L/min/m²; RVSP 78 mmHg; LVEF 52%	Normal CI 2.5–4.0 L/min/m²	Severely impaired*
Cervical X-ray	Irregular opacity at C4–C5	—	Foreign body confirmed
Chest X-ray	CTR 75%; bilateral perihilar haziness	CTR < 50%	Cardiomegaly + pulmonary edema*
Microbiology	K. pneumoniae (sensitive ceftriaxone, piperacillin-tazobactam, levofloxacin)	—	Pathogen confirmed

Footnote symbols: * Abnormal value relative to reference range. ABG, arterial blood gas; RBC, red blood cell; WBC, white blood cell; aPTT, activated partial thromboplastin time; CTR, cardiothoracic ratio.

Multidisciplinary preoperative optimization

Multidisciplinary preoperative discussion involved anesthesiology, cardiology, pulmonology, otolaryngology and intensive care. The clinical team agreed that emergency esophagoscopy under general anesthesia with endotracheal intubation was the safest definitive intervention. Local or topical anesthesia alone was deemed inadequate for the foreign body extraction maneuvers required and would not protect the airway against regurgitation or hemorrhage. Conscious sedation was excluded because of the patient's precarious cardiopulmonary reserve and the high risk of hypoxia-induced shunt augmentation. Preoperative optimization concentrated on (i) treatment of pneumonia with continued intravenous ceftriaxone, nebulized ipratropium-salbutamol (Combivent) and chest physiotherapy; (ii) gentle diuresis with furosemide for pulmonary edema while preserving systemic vascular pressures; (iii) reduction of warfarin anticoagulation through fresh frozen plasma 10 mL/kg and intravenous vitamin K 5 mg, with target INR <1.5 prior to the procedure; (iv) rate control with bisoprolol; and (v) infective endocarditis prophylaxis with a single dose of intravenous ceftriaxone 30 minutes before the procedure given the underlying valvular and shunt anatomy.

The anesthetic team prepared a hemodynamic-protective induction with etomidate, opioid (fentanyl titration), and a nondepolarizing muscle relaxant. Vasopressors—phenylephrine bolus and infusion, with norepinephrine on standby—were drawn up to manage any fall in systemic vascular resistance. Crystalloid fluids were limited and packed red cells crossmatched (two units) and platelets were prepared on standby. Intraoperative monitoring planned included five-lead electrocardiography, invasive arterial blood pressure, central venous pressure, pulse oximetry, capnography, urine output, temperature and intermittent arterial blood gases. Postoperative disposition was the intensive care unit. The plan is summarized in Table 3.

Table 3. Multidisciplinary preoperative optimization plan and rationale.

Domain	Optimization measure	Rationale
Respiratory	Continued IV ceftriaxone; nebulized ipratropium-salbutamol; chest physiotherapy	Treat pneumonia, reduce airway reactivity, and mobilize secretions
Cardiac — preload	Furosemide titrated to euvolemia; bisoprolol continued	Address pulmonary edema while preserving SVR
Cardiac — anticoagulation	FFP 10 mL/kg + IV vitamin K 5 mg; target INR < 1.5	Reduce bleeding risk during esophagoscopy
Cardiac — endocarditis prophylaxis	IV ceftriaxone 30 min preprocedure	AHA-recommended prophylaxis (high-risk anatomy)
Hematology preparation	PRC × 2 units cross-matched; platelets on standby	Anticipate intraoperative bleeding
Anesthesia plan	Modified RSI; etomidate 0.2 mg/kg + fentanyl 1.5 mcg/kg + rocuronium 0.9 mg/kg; cricoid pressure	Hemodynamic-protective induction; aspiration prophylaxis
Monitoring	5-lead ECG; invasive arterial line; CVP; SpO_2; $ETCO_2$; UOP; temperature; serial ABG	Continuous tracking of fragile physiology
Vasopressor strategy	Phenylephrine bolus 50–100 mcg + infusion 0.3–0.5 mcg/kg/min; norepinephrine on standby	Preserve SVR; avoid right-to-left shunt augmentation
Ventilation	TV 6 mL/kg IBW; PEEP 5 cm H_2O; FiO_2 0.6; $ETCO_2$ 35–40 mmHg; Pplat < 25 cm H_2O	Lung protection; normocapnia; preserve PVR
Disposition	Cardiac ICU postoperatively	Structured weaning, ongoing antibiotic & diuretic, anticoagulation re-titration

Footnote: SVR, systemic vascular resistance; PVR, pulmonary vascular resistance; PRC, packed red cells; FFP, fresh frozen plasma; RSI, rapid sequence induction; ABG, arterial blood gas; UOP, urine output; IBW, ideal body weight; PEEP, positive end-expiratory pressure; ICU, intensive care unit.

Anesthetic procedure and esophagoscopy

On arrival in the operating theatre the patient was placed supine with the head slightly elevated and gentle reverse Trendelenburg positioning to optimize functional residual capacity and minimize abdominal pressure on the diaphragm. After preoxygenation with 100% oxygen for five minutes at high tidal volumes, modified rapid sequence induction was performed with intravenous fentanyl 1.5 mcg/kg, etomidate 0.2 mg/kg titrated to loss of consciousness, followed by rocuronium 0.9 mg/kg. Cricoid pressure was applied during induction to mitigate aspiration risk despite the known foreign body. A direct laryngoscopy with a Macintosh size 3 blade revealed a Cormack–Lehane grade I view; an 8.0-mm cuffed endotracheal tube was placed atraumatically with first-attempt success. Cuff pressure was maintained at 25 cm H_2O. Capnography confirmed correct placement and the tube was secured at 23 cm at the lip.

Anesthesia maintenance comprised sevoflurane 1.0–1.5 minimum alveolar concentration in an oxygen-air mixture (FiO_2 0.6) titrated to maintain blood pressure within ±20% of baseline. Mechanical ventilation was set at tidal volume 6 mL/kg ideal body weight, respiratory rate adjusted to maintain end-tidal CO_2 between 35 and 40 mmHg, positive end-expiratory pressure 5 cm H_2O and inspiratory plateau pressure kept below 25 cm H_2O. After successful induction, an arterial line was placed in the right radial artery and a central venous catheter in the right internal jugular vein under ultrasound guidance for invasive monitoring and vasopressor administration.

The endoscopist performed rigid esophagoscopy through the side of the mouth contralateral to the endotracheal tube, with shared airway communication

maintained between teams. The denture was visualized lodged at the level of C4–C5, just distal to the upper esophageal sphincter, producing partial luminal obstruction with surrounding mucosal erythema and edema. The endoscopic view of the impacted denture is shown in Figure 1. After hydrodissection with normal saline, the denture was grasped with an endoscopic forceps and gently extracted intact. The extracted prosthesis is shown in Figure 2. Mucosal examination after extraction revealed superficial erosions but no transmural injury. Total endoscopic time was 22 minutes.

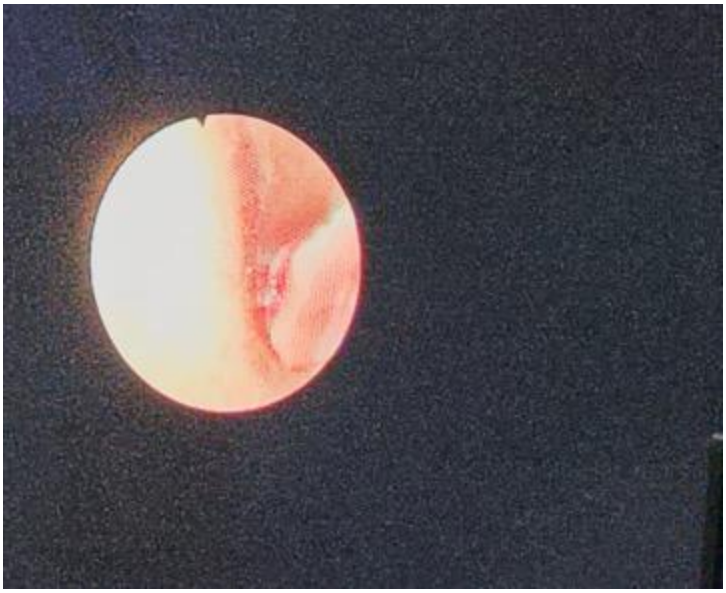

Figure 1. Intraoperative endoscopic view of the impacted denture lodged just distal to the upper esophageal sphincter at the level of C4–C5, with surrounding mucosal erythema and edema.

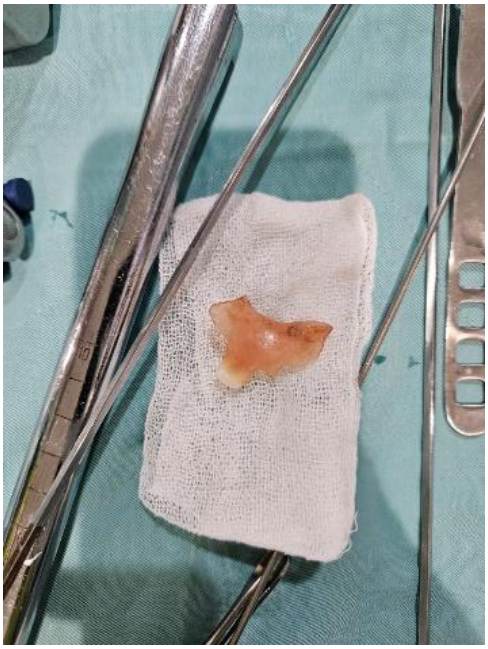

Figure 2. The denture after en-bloc extraction by rigid esophagoscopy, displayed on a sterile gauze beside the endoscopic instruments.

Table 4. Intraoperative anesthetic and procedural timeline (timestamps relative to OR arrival).

Time (min from arrival)	Event	Detail
0	Operating theatre arrival	ASA monitoring; arterial and central venous access placed
+10	Preoxygenation	100% O_2 × 5 min, high tidal volumes
+15	Induction	Fentanyl 1.5 mcg/kg → etomidate 0.2 mg/kg → rocuronium 0.9 mg/kg; cricoid pressure
+18	Direct laryngoscopy & intubation	Macintosh 3; Cormack–Lehane I; 8.0-mm cuffed ETT, single attempt
+20	Maintenance & ventilation set	Sevoflurane 1.0–1.5 MAC; FiO_2 0.6; TV 6 mL/kg; PEEP 5; $ETCO_2$ 35–40
+22 to +44	Rigid esophagoscopy & extraction	Denture removed intact; mucosal erosions but no perforation
+30 (intra-op)	Phenylephrine bolus 100 mcg	Brief MAP fall to 58 mmHg corrected
+45 to +60	Hemodynamic stabilization	Phenylephrine infusion 0.3–0.5 mcg/kg/min; MAP 65–78 mmHg
+62	Procedure complete	Bleeding 50 mL; no arrhythmia; SpO_2 88–94%
+65	Reversal	Sugammadex 4 mg/kg; remained intubated for ICU transport
+75	Cardiac ICU admission	Volume-control ventilation; sedation continued; ABG within target

Footnote: OR, operating room; ASA, American Society of Anesthesiologists; ETT, endotracheal tube; MAC, minimum alveolar concentration; TV, tidal volume; PEEP, positive end-expiratory pressure; MAP, mean arterial pressure; ICU, intensive care unit.

Intraoperative course

Intraoperative hemodynamics were challenging but maintained within acceptable parameters. Mean arterial pressure ranged from 60 to 78 mmHg with phenylephrine bolus support (50–100 mcg) used twice during induction and esophagoscopy, and a phenylephrine infusion at 0.3–0.5 mcg/kg/min during the procedure. Heart rate ranged from 56 to 72 beats/min. Pulse oximetry remained between 88% and 94%, consistent with the patient's baseline cyanotic state and reflecting balanced physiology under anesthesia. End-tidal CO_2 was maintained at 36–40 mmHg with adjusted minute ventilation. Two intra-operative arterial blood gases were obtained at 30 and 60 minutes, demonstrating PaO_2 62 and 65 mmHg respectively, with normal acid-base status. Estimated intraoperative blood loss was 50 mL (predominantly mucosal oozing). No arrhythmias, hypotensive episodes requiring rescue beyond the infusion, or oxygen desaturations below baseline were encountered. The intraoperative timeline is summarized in Table 4.

Postoperative course and follow-up

At the conclusion of the procedure neuromuscular blockade was reversed with sugammadex 4 mg/kg. The patient remained intubated and was transferred directly to the cardiac intensive care unit on volume-control ventilation with FiO_2 0.5, PEEP 5 cm H_2O and

sedation with continuous fentanyl 50 mcg/h. Initial post-procedural laboratory studies confirmed stable hemoglobin (17.8 g/dL), platelet count (236 × 10^9/L) and INR 1.4. Arterial blood gas at one hour after admission showed pH 7.39, $PaCO_2$ 38 mmHg, PaO_2 102 mmHg on FiO_2 0.5, with HCO_3^- 22 mmol/L. Continuous antibiotic therapy was maintained.

Extubation was achieved on the morning of postoperative day one after weaning sedation. The patient was transitioned to high-flow nasal cannula oxygen at 30 L/min with FiO_2 0.4 and subsequently to standard low-flow nasal cannula. Diuretic therapy was continued and warfarin was resumed once hemostasis at the esophageal site was confirmed by repeat endoscopic inspection on postoperative day three. The patient remained in the intensive care unit for five days for ongoing pneumonia treatment and gradual diuresis, before transfer to the cardiology ward for two further days. He was discharged on postoperative day eight on his preadmission cardiac regimen, oral antibiotics for pneumonia and scheduled outpatient cardiology follow-up. Follow-up at four weeks demonstrated complete resolution of the pneumonia, return to baseline functional capacity and no recurrent foreign body events. The denture had been definitively retired and replaced by a more securely fixed prosthesis.

3. Discussion

This case illustrates how three high-acuity clinical threats—an esophageal foreign body, uncorrected cyanotic congenital heart disease with markedly reduced cardiac output, and active bacterial pneumonia—were navigated through structured multidisciplinary preoperative optimization, a hemodynamic-protective anesthetic plan, and disciplined intra- and postoperative monitoring. The principal lesson is that none of these threats could be addressed in isolation: the safety of the procedure depended on integrating each into a coherent management strategy.

Esophageal foreign body impaction is itself a well-defined clinical entity. Fung and colleagues' comprehensive review describes the anatomical sites of predilection (upper esophageal sphincter, aortic arch level and lower esophageal sphincter), the spectrum of objects encountered in adults (food boluses, bones, denture fragments) and children (coins, batteries, small toys), and the spectrum of presentations from asymptomatic to airway-threatening.[1] The 2016 ESGE clinical guideline[2] emphasizes that foreign bodies that fail to pass spontaneously, are sharp, are large blunt objects lodged for more than 24 hours, or are batteries demand prompt endoscopic intervention. Athanassiadi and colleagues' retrospective series of 400 cases[3] established rigid esophagoscopy under general anesthesia as the dominant treatment modality with an 85.7% success rate, which remains the contemporary benchmark.[18-22]

In our patient, the irregular opacity at C4–C5 and the corresponding history of denture ingestion mandated emergency removal. The denture was lodged near the cricopharyngeus, a region with limited compliance in which prolonged impaction risks pressure necrosis, perforation and secondary mediastinitis. Bustamante and colleagues' case report and the Çetin and Kocaöz series describe similar patterns of cervical esophageal impaction and reinforce the urgency of prompt intervention.[5] Boronat-Lopez and colleagues' case series specifically on dental prosthesis impaction notes that delays beyond 48 hours significantly increase complication rates.[23]

The complexity of management was driven by the underlying cardiac physiology. Pulmonary atresia with ventricular septal defect represents a severe form of conotruncal abnormality in which the right ventricle ejects entirely through the VSD into the systemic circulation, with pulmonary blood flow dependent on alternative sources—chiefly major aortopulmonary collateral arteries arising from the descending aorta and a persistent ductus arteriosus.[12] Adult survivors are uncommon, and uncorrected cases like ours are increasingly rare in modern high-income contexts but persist in resource-limited environments. Soquet and colleagues' contemporary review describes the spectrum of anatomic variants and the modern surgical and medical management options, but for patients no longer surgical candidates the challenge is one of careful longitudinal medical optimization.[14]

The patient's echocardiographic profile—cardiac output of 2.9 L/min, cardiac index of 1.86 L/min/m^2,

right ventricular systolic pressure of 78 mmHg and moderate aortic regurgitation—indicates severely reduced biventricular reserve. Such physiology is highly intolerant of tachycardia, which reduces diastolic filling time; bradycardia, which decreases output further; and acute reductions in systemic vascular resistance, which increase right-to-left shunt and worsen cyanosis. The 2018 AHA/ACC ACHD guideline[7] and the 2017 AHA scientific statement on noncardiac complications[8] articulate the principles for perioperative care: preserve loading conditions, avoid sudden shifts in afterload or preload, and manage pulmonary vascular resistance through controlled oxygenation and ventilation.

Maxwell and colleagues' analysis of perioperative outcomes in adults with congenital heart disease[9] documented an in-hospital mortality of approximately 1% for non-cardiac surgery overall, but with marked elevation in patients with cyanotic disease, single-ventricle physiology or pulmonary hypertension. Cannesson and colleagues' anesthesia-focused review[10] reinforces the need for an integrated anesthesiology-cardiology team and the importance of preoperative optimization, intraoperative invasive monitoring and structured postoperative care.

Concurrent pneumonia introduced an additional layer of risk. Klebsiella pneumoniae is a common cause of severe community-acquired or healthcare-associated pneumonia, frequently producing dense lobar consolidation, pleural effusion and rapid clinical deterioration in compromised hosts.[15] The ATS/IDSA guidelines emphasize prompt empiric coverage with a third-generation cephalosporin or beta-lactam-beta-lactamase inhibitor combination, with adjustment based on local microbiology and patient risk factors.[16] Our patient was already on intravenous ceftriaxone at the time of presentation, with susceptibility subsequently confirmed.

Perioperative pulmonary management focused on optimizing pulmonary mechanics and gas exchange. Nebulized ipratropium-salbutamol was used to address airway reactivity, gentle diuresis with furosemide to address pulmonary edema (as evidenced by cardiothoracic ratio of 75% and bilateral perihilar haziness), and chest physiotherapy to mobilize secretions. Ohbe and colleagues' 2020 cohort[17] documented that pulmonary complications are the most common adverse perioperative events in ACHD non-cardiac surgery and are associated with prolonged intensive care unit stay and increased mortality. The recognition of this risk justified the multimodal pulmonary preparation our patient received.

The anesthetic plan was crafted to honour several constraints simultaneously. First, the shared airway between anesthetist and endoscopist imposed the choice of endotracheal intubation rather than supraglottic airway, both to protect against aspiration of saliva, gastric contents and any blood from procedure-related mucosal injury, and to allow positive-pressure ventilation while the rigid esophagoscope occupied the oropharynx. Second, the patient's cyanotic physiology demanded an induction agent that preserved systemic vascular resistance; etomidate was selected because it reliably maintains afterload, while propofol was avoided because of its tendency to drop systemic vascular resistance and to depress myocardial contractility. Third, a non-depolarizing relaxant (rocuronium) was preferred over succinylcholine to avoid the brief sympathetic and vagal effects of depolarizing relaxants in this fragile patient.

Intraoperative ventilation strategy reflected a balance between the need to maintain adequate gas exchange and the need to avoid increases in pulmonary vascular resistance. Lung-protective tidal volumes (6 mL/kg ideal body weight) and modest PEEP (5 cm H_2O) were used; FiO_2 was kept at 0.6 to maximize PaO_2 in a chronically cyanotic patient without inducing hyperoxia. Normocapnia was the explicit goal—hypercapnia and acidosis would worsen pulmonary vascular resistance and right-to-left shunt, while hypocapnia from hyperventilation would impair cerebral perfusion in a patient with secondary erythrocytosis at increased thrombotic risk.[21-24] Diller and colleagues' 2024 review of ACHD non-cardiac anesthesia provides a useful synthesis of these ventilatory principles and supports our approach.[6]

Hemodynamic management leveraged invasive arterial monitoring and central venous access. Phenylephrine bolus and infusion were used to preserve systemic vascular resistance during induction and esophagoscopy; norepinephrine was prepared as a

second-line agent. Crystalloid administration was deliberately conservative because of the patient's underlying biventricular dysfunction and pulmonary edema risk. Heggie and Karski's practical synthesis of the anesthesiologist's role in adult congenital heart disease non-cardiac surgery[21] underscores the importance of these principles.

Anticoagulation management was a particular challenge. The patient's INR of 2.6 on warfarin precluded immediate intervention. Reversal with fresh frozen plasma 10 mL/kg and intravenous vitamin K 5 mg achieved the target INR of 1.4 within four hours, balancing the urgency of foreign body extraction against the thromboembolic risk inherent in his underlying anatomy. Prothrombin complex concentrate was considered but not available at our institution. Blood products including two units of packed red cells and platelets were crossmatched and held on standby. The relatively limited intraoperative blood loss (50 mL) was fortunate; had significant hemorrhage occurred during foreign body extraction, the team was prepared with on-call cardiothoracic surgery support.

Our outcome compares favorably with the limited published experience in shared-airway emergency surgery in cyanotic ACHD, summarized in Table 5. Ko and colleagues described emergency non-cardiac surgery in an adult with Eisenmenger syndrome, emphasizing the same principles of afterload preservation, normocapnia and gradual recovery.[20] Bustamante and colleagues' case of cervical esophageal foreign body[5] managed without cardiac comorbidity provides a benchmark for the endoscopic component but does not address the cardiopulmonary challenges. Yip and colleagues' focused review on anesthesia for esophageal foreign body removal[19] highlights shared-airway management and aspiration prevention but again assumes a relatively healthy host. The absence of published reports specifically on emergent esophageal foreign body extraction in unrepaired adult PA-VSD with concurrent pneumonia underscores the contribution of the present case.

Several practical implications emerge from this synthesis. First, early recognition of the convergence of multiple high-acuity threats is essential; the absence of any one of them might have allowed a less intensive approach, but their simultaneous presence demanded the full multidisciplinary apparatus. Second, preoperative optimization—even within the constrained time window of an emergent procedure—materially shifted the risk profile. A four-hour delay to allow INR reversal, antibiotic optimization and gentle diuresis was time well spent. Third, the choice of induction agents and ventilation strategy must be deliberate and explicit; off-the-shelf approaches that work for healthy patients can be catastrophic in cyanotic ACHD. Fourth, intensive care admission with structured weaning, continued antibiotic and diuretic therapy, and resumption of anticoagulation according to surgical bleeding tolerance is the appropriate disposition.[25]

There are limitations to the generalizability of this case. The favorable outcome reflects in part the availability of a cardiac intensive care unit, invasive monitoring expertise, a multidisciplinary team and immediate access to blood products. In resource-limited settings, some of these elements may not be available; the principles remain valid but the specific tactics must be adapted. The patient was hemodynamically compensated at baseline despite his profound anatomic abnormality; patients in acute decompensation may not tolerate even meticulous anesthetic care. The denture extraction was uncomplicated; perforation, hemorrhage or aspiration during extraction would have necessitated additional measures—including possible thoracotomy—that were prepared but not required. Despite these limitations, the structured framework illustrated here provides a transferable template: stratify risk early, optimize what can be optimized within the surgical time window, choose anesthetic agents and ventilation parameters specific to the patient's physiology, monitor invasively and continuously, and disposition the patient to an appropriate level of postoperative care. Each element of this template scales with available resources.

Table 5. Comparison of the present case with previously reported cases of esophageal foreign body extraction or non-cardiac surgery in cyanotic adult congenital heart disease.

Author/Year	Patient profile	Procedure/Anesthetic plan	Key challenge	Outcome
Athanassiadi, 2002[3]	Adult series (n=400) of EFB	Rigid esophagoscopy under GA	Endoscopic technique benchmark	85.7% success; rare perforation
Bustamante, 2021[5]	48-year-old male; cervical EFB (food)	Failed endoscopy → surgery	Late presentation	Resolved after open surgery
Çetin & Kocaöz, 2023[11]	Pediatric EFB with awake central apnea	Esophagoscopy under GA	Atypical presentation	Successful
Yip et al, 2022[19]	Focused review — EFB anesthesia	Shared-airway GA	Aspiration & shared-airway management	Framework only
Ko et al, 2014[20]	Adult Eisenmenger syndrome; non-cardiac surgery	Etomidate-based GA; phenylephrine	Cyanotic ACHD physiology	Successful
Maxwell et al, 2013[9]	ACHD adults non-cardiac surgery (n=10,756)	Mixed	Outcome data	Mortality elevated in cyanotic ACHD
Present case (2026)	51-year-old male; uncorrected PA-VSD + MAPCA + PDA + AR + K. pneumoniae pneumonia; emergent EFB	Multidisciplinary optimization; modified RSI; etomidate-fentanyl-rocuronium; phenylephrine; lung-protective ventilation; ICU disposition	Triple convergence: emergent shared-airway + cyanotic ACHD + active pneumonia	Successful denture extraction; uncomplicated recovery; discharged POD 8

Footnote: EFB, esophageal foreign body; GA, general anesthesia; ACHD, adult congenital heart disease; PA-VSD, pulmonary atresia–ventricular septal defect; MAPCA, major aortopulmonary collateral arteries; PDA, patent ductus arteriosus; AR, aortic regurgitation; RSI, rapid sequence induction.

Several learning points crystallize. The convergence of an emergent surgical issue, cyanotic congenital heart disease and acute infection requires multidisciplinary management with explicit role assignment and clear decision points. Hemodynamic-protective anesthesia in cyanotic ACHD requires preservation of systemic vascular resistance, normocapnia, controlled oxygenation, conservative fluid administration and vigilance for arrhythmia. Anticoagulation reversal must be planned within the available surgical time window and balanced against thromboembolic risk in the underlying anatomy. Postoperative intensive care with structured ventilatory weaning, continued antibiotic therapy, gradual diuresis and considered resumption of anticoagulation is essential.

4. Conclusion

Emergency esophagoscopic extraction of an impacted denture in a 51-year-old man with uncorrected pulmonary atresia–ventricular septal defect, major aortopulmonary collateral arteries, patent ductus arteriosus, moderate aortic regurgitation and concurrent Klebsiella pneumoniae bacterial pneumonia was managed safely through structured multidisciplinary preoperative optimization, hemodynamic-protective general anesthesia with endotracheal intubation, lung-protective ventilation, invasive hemodynamic monitoring, and disciplined postoperative intensive care. The convergence of an emergent shared-airway procedure, fragile cyanotic physiology and active infection demanded the full multidisciplinary apparatus of anesthesiology, cardiology, pulmonology, otolaryngology and intensive care, with each element contributing to the favorable outcome. The structured framework described here—risk stratification, focused preoperative optimization, physiology-specific anesthetic choices, lung-protective ventilation that preserves pulmonary vascular tone,

and intensive care disposition—provides a transferable template for anesthesiologists facing similar complex emergent presentations in adult congenital heart disease patients. Continued case-level documentation and registry data are essential to consolidate evidence in this rare but high-stakes clinical scenario, particularly as adult survivors of complex unrepaired congenital heart disease increasingly present to non-specialist environments worldwide. The principal anesthetic message is that fragile physiology rewards deliberate, physiology-specific planning at every step of the perioperative trajectory.

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