

The use of intraoperative transoesophageal echocardiography as a monitor for haemodynamic instability during pulmonary hydatid cyst excision

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Abstract

We present the case of a patient with bilateral, pulmonary hydatid cysts who presented for cystectomy and developed life-threatening, haemodynamic instability when turned into the lateral decubitus position. Intraoperative transoesophageal echocardiography allowed for rapid interpretation of the haemodynamic collapse and proved to be valuable in surgical and anaesthetic decision-making. Human immunodeficiency virus co-infection in patients with *Echinococcus* infection has been implicated in the development of a more severe and disseminated clinical course in hydatid disease.

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Introduction

Hydatid disease, or cystic echinococcosis, is a zoonotic disease of which humans are an accidental intermediate host. The causative parasite is the cestode, *E. granulosus* and requires a definitive and intermediate host to complete the life cycle (Figure 1). Jackals and dogs are the usual definitive host. Their intestines harbour the adult worms from which eggs are released into the environment through faecal material. The intermediate host, usually sheep, is infected by oral ingestion of the eggs and develop the larval stage of the parasite in the form of a cyst, which leads to the morbidity and mortality that is associated with cystic echinococcosis. The infection cannot be spread between intermediate hosts. Small-scale sheep farming linked with home-slaughtering practices and the feeding of raw offal to domestic dogs are known risk factors for the development of human hydatid disease.¹⁻⁴ There is a concern that co-infection with human immunodeficiency virus (HIV) may cause more severe and disseminated clinical courses of cystic echinococcosis that develop more rapidly and manifest earlier.¹⁻²

The right lobe of the liver is the most common site of cyst formation (60%), followed by the lungs (20%), kidneys (3%) and the brain (1%). There have been reports of cysts in rarer locations such as the heart, spine and eyes. The cyst consists of three layers: an outside layer derived from the host, an intermediate, laminated layer and an inner, germinal

layer that buds off brood capsules to form daughter cysts.⁴

Symptoms depend on the site of cyst formation and resemble those of a slow growing tumour. Chest pain and coughing are common presenting symptoms. Liver cysts may present as a dull ache and right hypochondria swelling, while pressure on the bile ducts may result in jaundice. The cyst may rupture into the abdominal cavity, pleural cavity or biliary tree. Cyst rupture into a bronchus can result in haemoptysis, bronchopleural fistula and anaphylaxis. Brain cysts may cause focal seizures or obstructive hydrocephalus. Renal involvement can produce lumbar pain and haematuria.

Confirmatory tests include indirect haemagglutination assay and enzyme immunoassay (EIA). Radiographs may show calcification of the outer cyst wall. Ultrasound, computed tomography (CT) and a magnetic resonance imaging scan are useful in detecting and defining the extent and condition of the cysts.^{3,4}

Treatment of choice is by surgical resection of an intact cyst. However, long courses of albendazole have also been effective. An alternative is fine-needle aspiration under ultrasound guidance and instillation of a protoscolicidal agent, together with albendazole treatment, to reduce the danger of subsequent renewed disease from spillage. Asymptomatic, chronic calcified cysts do not need to be treated.

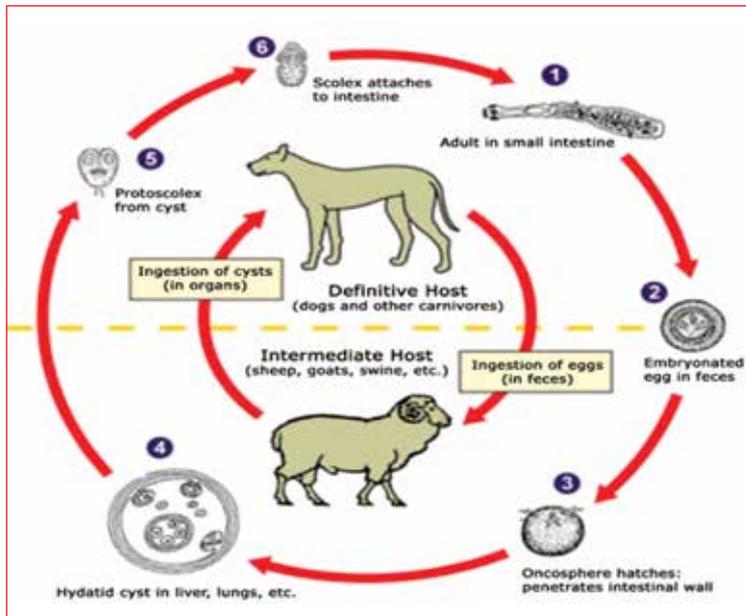


Figure 1: The life cycle of *Echinococcus granulosus*.⁵ Reproduced with permission from Wikipedia.

Case report

A 32-year-old woman with disseminated hydatid disease was referred to the thoracic surgery department of Groote Schuur Hospital, and scheduled for bilateral thoracotomy for cyst excision. She was HIV-positive, on antiretrovirals, and had a CD4 count of 225 cells/microlitre. She had already received a month of albendazole treatment. She complained of a dry cough and increasing difficulty with breathing and managing her daily living activities. On further questioning, she reported being short of breath when she lay flat and in the lateral position. There were no fainting episodes. The patient had no other noteworthy past medical or surgical history or allergies, and was a non-smoker.

On examination, her body mass index was 26 kg/m². She was afebrile and not cyanosed, but in moderate respiratory distress when lying at 30 degrees, with her head up. Her breathing rate was 28 breaths/minute, with a baseline oxygen saturation of 92% on room air. On chest auscultation, she experienced bilateral expiratory wheezes and dullness to percussion in both lung bases.

Cardiovascular examination was unremarkable, except for an apex beat that was difficult to palpate.

She had no signs of cardiac failure, with good volume pulses at a rate of 90 beats/minute. Abdominal examination revealed a 10-cm hepatomegaly below the right costal margin, with no ascites or splenomegaly.

Chest radiography showed bilateral, lower lobe hydatid cysts with displacement of mediastinal structures to the right. Both lungs were compressed cephalad displaced. The left cyst appeared intact, while the right had an air fluid level suspicious of previous rupture (Figure 2). A CT scan

confirmed these findings. The left lower lobe cyst measured 16 x 13 x 11 cm. The right measured 17 x 14 x 10 cm.

Pulmonary function tests showed a concave, mixed obstructive, restrictive pattern with no reversibility. Spirometry results showed a forced expiratory volume in one second (FEV₁) of 560 ml (19% of predicted), a forced vital capacity (FVC) of 1 180 ml (34% of predicted) and a FEV₁/FVC ratio of 47%.

Blood serology confirmed the diagnosis of cystic echinococcosis with a positive EIA ratio of 12. Other blood results showed haemoglobin 13.4 g/dl, platelets 222 x 10⁹/l, and normal coagulation, renal function and electrolytes.

Prior to induction of anaesthesia, intravenous access was obtained with a 16-g cannula. A left radial arterial line was inserted. A thoracic epidural was sited at the T7/T8 interspace, in the sitting position, tested with 3 ml of 2% lignocaine

and loaded with 5 ml of 0.25% bupivacaine. Cephazolin 2 g was given intravenously. After pre-oxygenation and an unremarkable induction of anaesthesia with 150 mg propofol and 50 mg rocuronium, the trachea was intubated using a 37-Fr (left) double-lumen tube. The tube position was confirmed with fibre-optic bronchoscopy. Anaesthesia was maintained with isoflurane, air and oxygen and volume-controlled mechanical ventilation.

A Philips transoesophageal echocardiography (TEE) probe (2-7m Omni[®]) was inserted prior to positioning the patient in the left lateral decubitus position for right posterolateral thoracotomy. This positional change promptly resulted

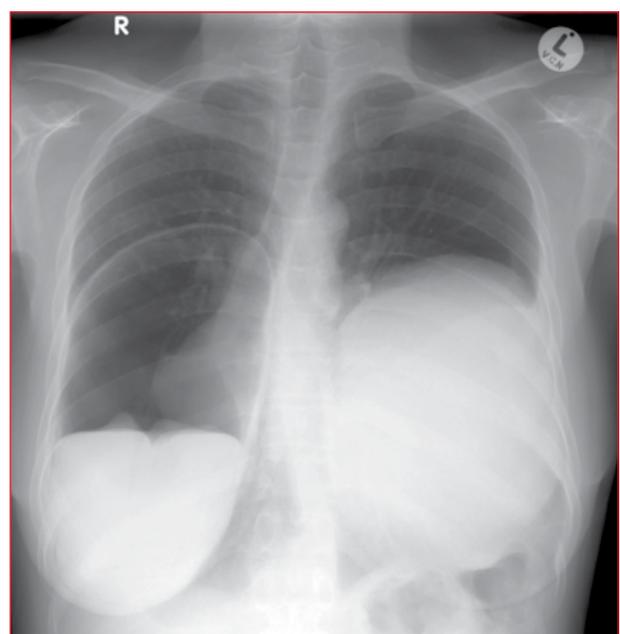


Figure 2: Posteroanterior chest radiograph



AV: aortic valve, RVOT: right ventricular outflow tract

Figure 3: Transoesophageal echocardiography: Mid-oesophageal, short-axis view of the aortic valve (during systole). Note the large fluid-filled cyst obstructing the right ventricular outflow tract



RVOT: right ventricular outflow tract

Figure 4: Transoesophageal echocardiography: Mid-oesophageal, short-axis view of the aortic valve. Note the now unobstructed right ventricular outflow tract

[The full-length video of figure 3 and 4 can be viewed on the South African Society of Anaesthesiologists (SASA)/Cardiac Anaesthesia Society of South Africa (CASSA) special interest group website: www.sasaweb.com]

in a hypotensive circulatory collapse. The blood pressure dropped to 53/37 (43) mmHg, with obstruction of the right ventricular outflow tract visualised on TEE (Figure 3). This was despite simultaneous administration of fluids and vasopressor boluses.

The patient was promptly repositioned supine with resolution of haemodynamic compromise. Oblique positioning with the left side up also produced compression on the right ventricular outflow tract, as seen on TEE. Surgery then proceeded with a left anterolateral thoracotomy in the supine position and excision of the left lower lobe cyst. One-lung ventilation in the supine position, with the large, right lower lobe cyst compressing the right lung resulted in hypoxaemia with oxygen saturations of \pm 83%, despite ventilation with 100%-inspired oxygen concentration.

Table II: Differential diagnosis for hypotension during thoracic anaesthesia^{6,7}

Pre-operative causes	
Massive Haemoptysis	Expectoration of >600 ml of blood/24 hours. Commonly due to erosion of bronchial arteries.
Intra-operative causes	
Respiratory	
<ul style="list-style-type: none"> Dynamic pulmonary hyperinflation Excessive IPPV at induction Extrinsic PEEP Pneumothorax in the ventilated closed chest 	These all lead to increased right ventricular afterload which results right ventricular dysfunction followed by reduction in left ventricular preload and reduced cardiac output.
Cardiovascular	
<ul style="list-style-type: none"> Vasodilation following induction of anaesthesia Sympathetic blockade secondary to thoracic epidural 	Exacerbated by relative hypovolaemia.
Anaphylaxis	Muscle relaxants, antibiotics, induction agents, latex.
<ul style="list-style-type: none"> Hypovolaemia from bleeding Cardiac manipulation by surgeon 	Good communication with surgeon essential.
Arrhythmias	Often due to direct mechanical irritation of the heart.
Venous air embolism	Suspect when surgery is near large non-collapsible veins, especially if patient is in the head-up position.
Spurious hypotension	Innominate artery compression with BP monitoring on right arm.
Post-operative causes	
Intra-thoracic haemorrhage	Observed by increased drain output.
Arrhythmias	Potentiated by severe illness, metabolic stress and acutely deranged physiology.
Cardiac herniation	Rare but potentially fatal complication of pneumonectomy when pericardium incomplete or breaks down. Often precipitated by turning patient onto operated side, coughing, positive pressure ventilation and excessive drain suction.
Pulmonary embolism (PE)	Massive PE causing acute <i>cor pulmonale</i> . Thoracic patients are an at risk group due to immobility, malignancy and hypercoagulability.

BP: blood pressure, IPPV: intermittent positive-pressure ventilation, PE: pulmonary embolism, PEEP: positive-end expiratory pressure

Anaphylaxis due to cyst rupture is well documented and should always be considered. For a differential diagnosis of perioperative hypotension in thoracic surgery, please see Table I.

After completion of the left anterolateral thoracotomy and excision of the left lower lobe hydatid cyst, the patient was repositioned into the left lateral position without haemodynamic compromise (Figure 4). Right posterolateral thoracotomy and right pulmonary hydatid cyst excision was completed uneventfully.

Intraoperatively, the epidural was loaded with a further 10 ml of 0.25% bupivacaine and 50 µg fentanyl. The trachea was reintubated with a single-lumen, 7.5-mm endotracheal tube. The sedated patient was transferred to the intensive care unit. She was ventilated overnight and extubated the following morning. Epidural analgesia was adequate, and she coped well following extubation. She was discharged to the ward after 48 hours and went home after 11 days.

Discussion

Perioperative TEE enables direct visualisation of the heart and its chambers, valves and major vessels. All aspects of cardiac function can be measured and monitored. The validity of TEE has become an established intraoperative monitoring device in cardiac anaesthesia and its use has been extended to include noncardiac surgery. Routine perioperative TEE in noncardiac surgery may be indicated in cardiovascular unstable patients or those with cardiac disease who are likely to require cardiovascular support.⁸⁻¹¹

The benefits of perioperative TEE need to be weighed against its risks. TEE is an invasive imaging method and carries a low incidence of complications, such as odynophagia, dental injury, upper-gastrointestinal haemorrhage and oesophageal perforation.

Any monitor is only useful if it provides information of sufficient quality and is interpreted correctly. Perioperative TEE remains a specialised form of monitoring which requires considerable training before sufficient expertise and consistency can be achieved. Enthusiasm among general anaesthetists and critical care physicians has led to the spread of the practice of echocardiography to these fields.

Conclusion

With the high prevalence of HIV in southern Africa, cystic echinococcosis is likely to continue to play an important role in patient morbidity and mortality. Cystic echinococcosis also poses a wide range of clinical presentations and unique surgical challenges. It is especially important to be

cognisant of the impact that large fluid-containing spaces can have on the cardiovascular system.

Intraoperative TEE monitoring can influence key surgical and anaesthetic management decisions.

In our case, it:

- Provided a rapid evaluation of the cause of cardiovascular collapse, associated with positional change.
- Influenced the surgical plan.
- Guided fluid and vasopressor management in a haemodynamically unstable patient.
- Played a key role in ensuring a good clinical outcome.

Intraoperative TEE is likely to play an increasing role in the future because of improved access to TEE equipment in theatres, general acceptance of its roles and usefulness, and broadening experience and expertise with its use.

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