

Risk

- Men approximately equal to women.
- *Echinococcus granulosus* causes cystic echinococcosis (hydatid disease) in people exposed to feces of dogs and other canids in endemic areas of nearly every continent.
- *E. multilocularis* causes alveolar echinococcosis in people exposed to feces of infected foxes living in colder regions of the northern hemisphere. Cases of alveolar echinococcosis continue to expand over the past 2 decades, despite increased awareness of the disease.
- *E. vogeli* and *E. oligarthrus* cause polycystic echinococcosis in people exposed to feces of infected dogs and wild carnivores in rural Central and South America.

Perioperative Risks

- Hydatid cyst rupture leads to anaphylaxis and spread of encapsulated organisms, which implant in exposed tissues (e.g., peritoneal cavity), later causing disseminated hydatidosis (bowel obstruction, cachexia, death)
- Failure to resect all echinococcal tissue due to microscopic or extensive disease extension
- Hemorrhage (if cyst attached to liver or major blood vessel)
- Systemic reactions to toxic agents instilled into cyst cavity; air embolism if cyst attached to a vein or hydrogen peroxide instilled into cyst cavity
- Postop jaundice, cholangitis, bacterial superinfection, vascular compression, and hepatic failure

Overview and Etiology

- Parasitic disease caused by organism classified as flatworm (adult stage). Parasite cycles through four

different stages (adult tapeworm, egg, oncosphere, metacestode) each adapted to maximize survival in the two host organisms:

- Definitive host: Carnivore; intestines contain adult flatworms releasing eggs into feces.
- Intermediate host: Herbivore/omnivore (sheep, small rodents, man); ingests minute amount of feces of definitive host; eggs hatch in stomach and release oncospheres (first larval stage), which penetrate gut blood vessels and distribute to potentially any organ, especially liver and lung. Develop into slowly expanding fluid-filled cysts (metacestodes). Inner (germinal) layer of metacestode buds off tiny encapsulated protoscolices (Gk: juvenile heads) which accumulate to form hydatid sand.
- A definitive host eats infected organs of intermediate host; protoscolices are released into intestinal lumen; these evaginate; anterior parts attach to intestinal epithelium and become adult tapeworms.
- Adult *E. granulosus* (2–11 mm) inhabits small intestine of canid (dog, wolf, coyote, dingo, jackal); eggs distribute to grass eaten by sheep, goats, camels, yaks, cattle, pigs, horses, marsupials; man becomes infected via hand-to-mouth contact with fecally contaminated object. Cysts of volume up to 1000 mL form within intermediate host (or man—sometimes called dead end host), physically compromising organ function.
- Adult *E. multilocularis* (1–5 mm) inhabits small intestine of fox (occasionally dog, bush dog, rarely cat); intermediate host usually a rodent. Cysts become multiple and invade target organs.
- *E. vogeli* and *E. oligarthrus* rarely cause human disease (if present of polycystic type).

Usual Treatment

- *Echinococcus granulosus*:
 - Medical: Cyst instillation with nonspecific histotoxic solution (hypertonic NaCl, alcohol, silver nitrate, povidone-iodine, formaldehyde, hydrogen peroxide, chlorhexidine) in sequence of PAIR. Not appropriate if multiple cysts, cyst architecture subdivided into daughter cysts, or cysts balloon out via narrow passages to form satellite cysts. Increasing in popularity; complications include biliocutaneous fistula and bacterial superinfection of residual cyst cavity. Technique variants include percutaneous evacuation (sometimes using cutting-aspiration device), cyst catheterization/continuous irrigation.
 - Laparoscopic: Cystotomy, toxin irrigation, partial cystectomy (± use of aspirator-grinder); 77.16% of hydatid cyst surgeries are laparoscopic, regardless of location; cysts near major vascular structures require open technique.
 - Open: Complete resection for concealed, extensive, or invasive disease; attempt to avoid spilling contents; histotoxic solutions often used in conjunction.
- *Echinococcus multilocularis*:
 - Exhibits cancer-like growth behavior. Specific immunologic tests in combination with high-performance imaging techniques promise substantial improvements in early diagnosis of alveolar echinococcosis, which is essential for curative treatment, staging, and follow-up. Radical open surgical resection if possible; liver transplantation considered if disease confined to liver. Prevent recurrence by treating infected family companion animals with oral anthelmintic and praziquantel.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
GENERAL		Pt from endemic area, fever, itching, family Hx	Fever (if high, possible superinfection)	US, CT, or MRI imaging of any part of body
GI	Liver mass (70%), biliary obstruction, Budd-Chiari	Abdominal pain dyspepsia, vomiting fatigue; previous surgery for same disease	Jaundice; signs of cirrhosis	Abdominal US, CT, or MRI; PT/ INR
RESP	Lung mass (20%) bronchial obstruction, pulm Htn	Chest pain, cough, SOB, hemoptysis	Fever (superinfection)	CXR; thoracic ultrasound, CT, or MRI; sputum microscopy for protoscolices
RENAL	Ureteral obstruction			Abdominal ultrasound, CT, MRI
HEME	Eosinophilia, antibodies	Duration of albendazole therapy (marrow toxicity)		CBC, eosinophil count; plt count; antibody-based tests (e.g., ELISA), newer DNA-based tests: problems with cross-reactivity, false negativity
CV	Obstruction, anaphylaxis			ECHO
GYN	Incidental occurrence	Last menstrual period	Signs of pregnancy	Blood or urine pregnancy test
CNS	Cyst (1.5%)	Seizure	Localizing neurologic findings, gait abnormality, hydrocephalus	Head CT, MRI

Key References: Gottstein B, Stojkovic M, Vuitton DA, et al.: Threat of alveolar echinococcosis to public health—a challenge for Europe, *Trends Parasitol* 31(9):407–412, 2015; Tuxun T, Zhang JH, Zhao JM, et al.: World review of laparoscopic treatment of liver cystic echinococcosis—914 patients, *Int J Infect Dis* 24:43–50, 2014.

Perioperative Implications

Preoperative Preparation

- Review all imaging studies.
- Ensure entire surgical team aware of nature of disease.
- If liver disease, OR table capable of intraop cholangiography; if cirrhosis, normalize coagulation status (vitamin K, FFP); ensure intraop availability of PRBC (possibly FFP, plts, cryoprecipitate).
- Know anatomic extent of disease, proposed surgical approach (position, laparoscopy/incision); know backup plan if disease more extensive than thought.

- Pt to take oral benzimidazole anthelmintic (albendazole) 1 wk preop, 3 mo postop.

Monitoring

- Based on planned/potential procedure.
- Consider urinary catheter; if possibly extensive, consider invasive hemodynamic monitoring (art line, cent line), serial hct/coag/abg, precordial Doppler or TEE to diagnose embolism (air, CO₂, cyst contents), serial Na⁺ if hypertonic NaCl used.
- Observe for SQ emphysema if laparoscopic approach.

Airway

- Tracheal intubation for laparoscopic or open procedure; double-lumen tube to protect nondiseased lung if pulm echinococcosis

Induction

- Rx choice based on general health status and concurrent diseases

Maintenance

- Large-bore venous access and fluid warmer(s) if hemorrhage risk.
- Consider gastric tube (whether laparoscopic or open).
- Immobile operative field essential, especially during portions of procedure where cyst spillage could occur.
- Have on-hand in case of anaphylactic or hemorrhagic shock: Epinephrine, vasopressin, other inotrope/vasopressor, CaCl₂, and NaHCO₃, adequate crystalloid/colloid/blood products.

- If gas embolism suspected, aspirate central line; if none, consider subcostal insertion of spinal needle attached to large aspirating syringe directly into RV.

Extubation

- Base on usual criteria, extent of operative procedure, pt's age and physical condition, and concurrent disease

Postoperative Period

- Base pain control plan on nature and extent of resection; regional anesthesia an option if coagulation status permits.

- Base monitoring on extent of resection, blood loss, and preop health status.
- Watch for pneumothorax, subphrenic abscess, pneumonia, bronchobiliary fistula, jaundice, hepatic failure, and septicemia.

Anticipated Problems/Concerns

- If the pt is being treated in a nonendemic area, surgical team may be unfamiliar with disease; antelmintic medications may require special order well in advance of procedure.

- Consider *Echinococcus* in any pt from endemic area presenting for surgical excision of cyst; search for others using US imaging; consider ID consult and serologic testing.
- Cysts may eventually involute and degenerate, hence the conservative nature of treatment in nonemergent cysts.
- Arrange ultrasound imaging in family/neighbors/farm animals capable of being intermediate hosts.
- Examine stool of companion canids for eggs and segments.

Eclampsia

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Risk

- Incidence varies from 0.01–0.1% of pregnancies in developed countries.
- Occurs in 1–3% of pts with preeclampsia.
- Risk factors include age <20 y old, nulliparity, anemia, diabetes, and preexisting heart disease.

Perioperative Risks

- Eclampsia is a factor in approximately 10% of all maternal deaths in developed countries.
- Maternal complications include adult respiratory distress syndrome, acute renal failure, cardiopulmonary arrest, and CVA.
- Fetal complications include respiratory distress syndrome, small for gestational age, preterm birth, and intrauterine growth restriction.

Worry About

- Risk of pulm aspiration and hypoxemia with seizure
- Fetal bradycardia may occur during or following seizure

- 90% of women with eclampsia have manifestations of severe preeclampsia (Htn, proteinuria, renal insufficiency, pulmonary edema, coagulopathy)

Overview

- New onset of generalized, tonic-clonic seizures, and/or unexplained coma during the peripartum period in a woman without a preexisting neurologic disorder.
- Eclamptic seizures can occur during the antepartum (60%), intrapartum (20%), or postpartum (20%) period.
- Onset of eclampsia is generally preceded by signs of severe preeclampsia but approximately 10% occur without Htn.

Etiology

- Precise etiology is unknown, but two models have been proposed based on the central role of Htn in the majority of eclampsia cases.
 - Forced dilation theory: Htn exceeds the upper limit of cerebral autoregulation leading to

hyperperfusion, endothelial dysfunction, and interstitial edema.

- Vasospasm theory: Htn causes overactivation of cerebral autoregulation leading to vasoconstriction, hypoperfusion, localized ischemia, and cerebral edema.

Usual Treatment

- Establish patent airway and maintain maternal oxygenation.
- Maintain left uterine displacement.
- Seizure treatment/prophylaxis: Magnesium sulfate (4–6 g bolus over 20 min followed by 1–2 g/h infusion ± 2 g bolus over 10 min for recurrent seizure).
- Antihypertensive treatment for SBP ≥160 mm Hg and/or DBP ≥110 mm Hg: Labetalol (10–20 mg IV) and/or hydralazine (5–10 mg IV).
- Expedient delivery via induction/augmentation of labor (preferred) or cesarean delivery (if persistent maternal or fetal distress).

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Htn Reduced intravascular volume LV dysfunction (rare)	Dyspnea, peripheral edema	Htn, peripheral edema, decreased CVP	ECHO if suspect LV dysfunction
RESP	Airway edema Pulm edema	Snoring, stridor dyspnea, orthopnea	Tachypnea, dyspnea, hypoxemia, rales	CXR ABG
RENAL	Proteinuria Renal failure Decreased RBF Decreased GFR	Rapid weight gain, decreased urine output	Nondependent edema	24-h urine protein, BUN, Cr, uric acid
HEME	Thrombocytopenia Microangiopathic hemolysis DIC	Mucosal bleeding, easy bruising	Petechiae, bleeding from puncture sites	Hgb, Hct, plt, fibrinogen, and FSP
NEURO	Seizure Coma	Headache, visual disturbances	Hyperexcitability, hyperreflexia	CT/MRI if focal deficits or prolonged coma
FETUS	Fetal distress IUGR Oligohydramnios			Fetal heart monitor Fetal ultrasound

Key References: Leffert LR: What's new in obstetric anesthesia? Focus on preeclampsia, *Int J Obstet Anesth* 24(3):264–271, 2015; Parthasarathy S, Kumar VR, Sriprya R, et al.: Anesthetic management of a patient presenting with eclampsia, *Anesth Essays Res* 7(3):307–312, 2013.

Perioperative Implications

Monitoring

- Standard maternal monitors including noninvasive BP, pulse oximetry, and UO.
- Indications for invasive BP monitoring: (1) BP poorly controlled; (2) frequent blood sampling; or (3) infusion of potent vasodilators (nitroprusside or nitroglycerin).

- Indications for invasive central venous monitoring: (1) infusion of potent vasoactive agents; (2) pulmonary edema; and (3) cardiomyopathy.
- Electronic fetal heart monitoring.

Regional Anesthesia for Labor and Delivery

- Benefits of an early epidural: (1) high-quality analgesia (attenuates hypertensive response to pain); (2) improvement in uteroplacental circulation; and

- (3) avoidance of general anesthesia if emergency cesarean delivery indicated.

- Assessment of coagulation status, as outlined previously, should be checked prior to both placement and removal of epidural cath.

- Avoid IV fluid boluses prior to neuraxial anesthesia because of the increased risk of pulm edema.