


Preoperative Evaluation and Considerations of the Pediatric Patient




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Prematurity

Preterm defined by birth before 37 weeks gestation

- Low birth weight (<2500 g)
- Very low birth weight (<1500 g)
- Extremely low birth weight (<1000 g)

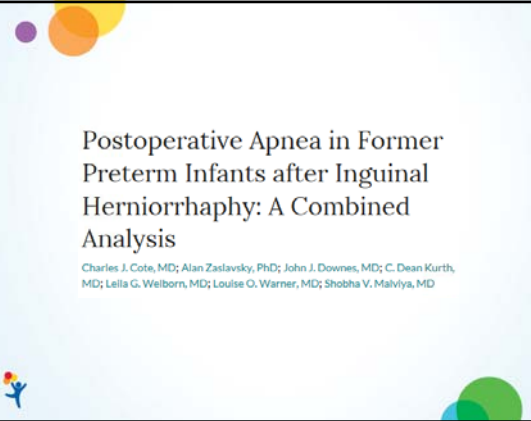


The ideal pediatric anesthetic strikes the perfect balance between psychological and clinical considerations and care.



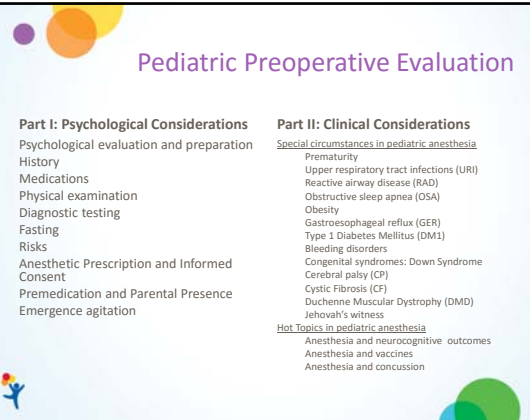
Postoperative Apnea in Former Preterm Infants after Inguinal Herniorrhaphy: A Combined Analysis

Charles J. Cote, MD; Alan Zaslavsky, PhD; John J. Downes, MD; C. Dean Kurth, MD; Lella G. Welborn, MD; Louise O. Warner, MD; Shobha V. Malviya, MD

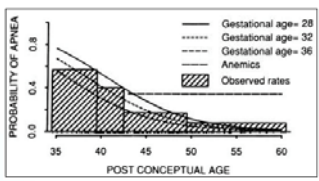


Pediatric Preoperative Evaluation

<p>Part I: Psychological Considerations</p> <p>Psychological evaluation and preparation History Medications Physical examination Diagnostic testing Fasting Risks Anesthetic Prescription and Informed Consent Premedication and Parental Presence Emergence agitation</p>	<p>Part II: Clinical Considerations</p> <p><u>Special circumstances in pediatric anesthesia</u></p> <p>Prematurity Upper respiratory tract infections (URI) Reactive airway disease (RAD) Obstructive sleep apnea (OSA) Obesity Gastroesophageal reflux (GER) Type 1 Diabetes Mellitus (DM1) Bleeding disorders Congenital syndromes: Down Syndrome Cerebral palsy (CP) Cystic Fibrosis (CF) Duchenne Muscular Dystrophy (DMD) Jehovah's witness <u>Hot Topics in pediatric anesthesia</u> Anesthesia and neurocognitive outcomes Anesthesia and vaccines Anesthesia and concussion</p>
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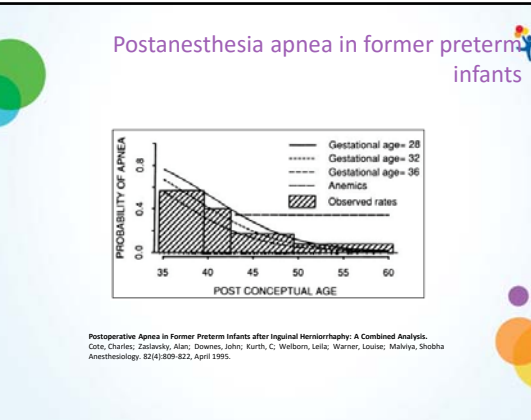


Postanesthesia apnea in former preterm infants



Legend:
 - Gestational age = 28
 - Gestational age = 32
 - Gestational age = 36
 - Anemias
 - Observed rates


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Anesthesiology, 82(4):908-922, April 1995.



Prematurity

- Risk of apnea after anesthesia (central and obstructive)
- Anemia increases risk
- CHCO guidelines for admission
 - Former premature infants born prior to 37 weeks gestational age who are less than 56 weeks PCA
 - Full term infants (gestational age > 37 weeks) less than 44 weeks PCA

URI

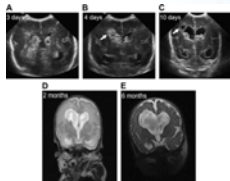


- Postpone acute purulent URI, fever, change in behavior/mental status, signs of lower respiratory tract involvement
- Evaluate risk of acute nonpurulent URI or URI within the last month
- Predictors of adverse perioperative events
 - Airway management
 - Nasal congestion
 - Copious secretions
 - Snoring
 - Passive smoke
 - Induction agent
 - Former premature infants
 - Reactive airway disease
- Risk takes four to six weeks (or more) to return to baseline

Prematurity

Neurologic Complications

- Periventricular white matter susceptible to injury
- IVH can be early or late in onset (50% D1, 90% by D4)
- Long-term neurologic and developmental disabilities are common



RAD

- Incidence of children with RAD is increasing rapidly in North America
- Continue bronchodilators including (especially) on the morning of surgery
- ETT and light anesthesia may trigger bronchospasm
 - Propofol
 - Ketamine
 - Lidocaine
 - Opioids
 - Volatile agents
 - B-agonists



Prematurity

Pulmonary Complications


- BPD
 - Form of chronic lung disease associated with prolonged mechanical ventilation and oxygen toxicity
- Infants with BPD may suffer from hypoxemia, hypercarbia, abnormal airway growth, tracheomalacia, bronchomalacia, subglottic stenosis, increased PVR, CHF
- Pulmonary function abnormalities may persist into school-aged years

Anesthesiology 2006, 64:1425-31

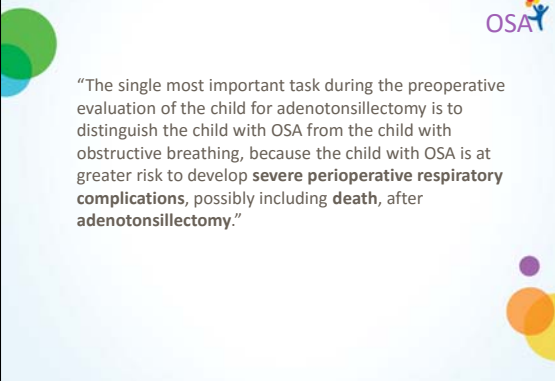
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Recurrent Hypoxemia in Children Is Associated with Increased Analgesic Sensitivity to Opiates

Karen A. Brown, M.D.,¹ Andrei Luliano, B.A.,¹ Indrani Lakshman, M.D.,¹ Immanueli Rawl Moss, M.D., Ph.D.²


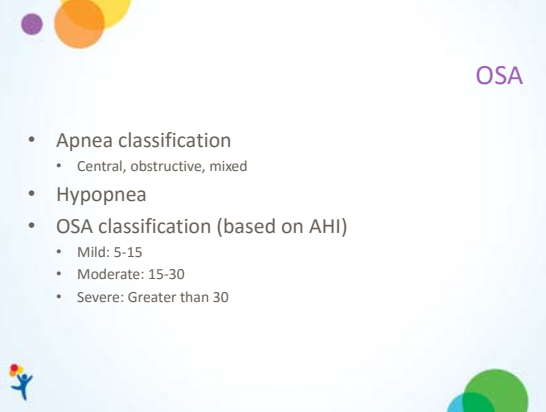
OSA 

“The single most important task during the preoperative evaluation of the child for adenotonsillectomy is to distinguish the child with OSA from the child with obstructive breathing, because the child with OSA is at greater risk to develop **severe perioperative respiratory complications**, possibly including **death**, after **adenotonsillectomy.**”




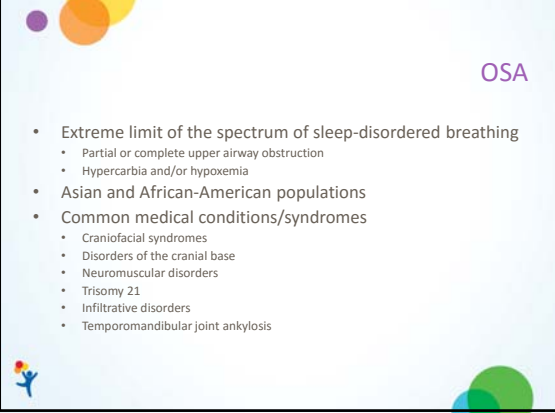
OSA


- Apnea classification
 - Central, obstructive, mixed
- Hypopnea
- OSA classification (based on AHI)
 - Mild: 5-15
 - Moderate: 15-30
 - Severe: Greater than 30

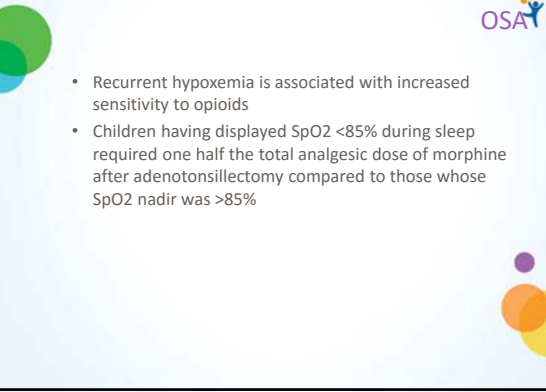
OSA


- Extreme limit of the spectrum of sleep-disordered breathing
 - Partial or complete upper airway obstruction
 - Hypercarbia and/or hypoxemia
- Asian and African-American populations
- Common medical conditions/syndromes
 - Craniofacial syndromes
 - Disorders of the cranial base
 - Neuromuscular disorders
 - Trisomy 21
 - Infiltrative disorders
 - Temporomandibular joint ankylosis

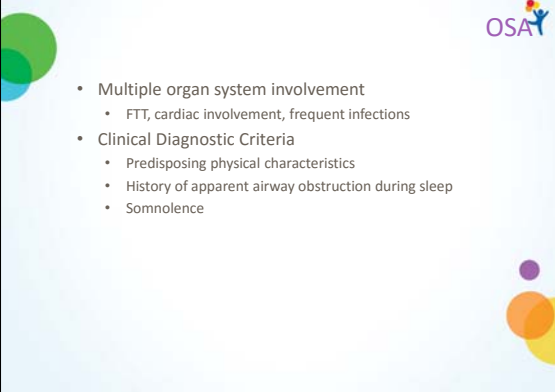
OSA 

- Recurrent hypoxemia is associated with increased sensitivity to opioids
- Children having displayed SpO2 <85% during sleep required one half the total analgesic dose of morphine after adenotonsillectomy compared to those whose SpO2 nadir was >85%



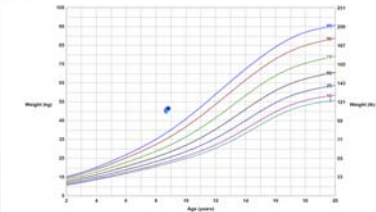

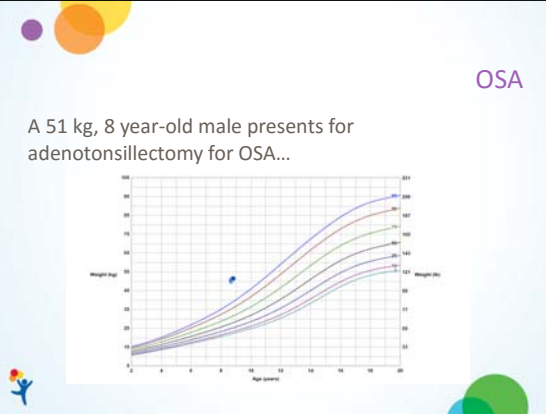
OSA 

- Multiple organ system involvement
 - FTT, cardiac involvement, frequent infections
- Clinical Diagnostic Criteria
 - Predisposing physical characteristics
 - History of apparent airway obstruction during sleep
 - Somnolence



OSA

A 51 kg, 8 year-old male presents for adenotonsillectomy for OSA...

OSA

Diagnosis:

1. Severe Obstructive Sleep Apnea, OAH1 23.8 events/hour and increased in the REM sleep to 56.6 events/hour.
2. Significant Hypoxemia with O2 saturations <90% for 4.5% of total sleep time.


The Sleep Technologist Summary Report:

The RPSGT reported that Jayden was cooperative for the study set-up. Overall sleep appeared to be good. There was increased work of breathing noted, with the following characteristics: retractions, gasping, paradoxical breathing in NREM and paradoxical breathing in REM. In addition, the following were noted: moderate snoring, greater than 50% of sleep time snoring frequency, mouth breathing, noisy breathing, frequent obstructive sleep apnea, occasional mixed apnea and frequent central sleep apnea or periodic breathing and occasional obstructive hypopneas were observed.

At home, Jayden is not on oxygen. During the study, Jayden was started on oxygen with the final concentration 1/4 LPM. The oxygen saturation nadir was 59%.

GER

- 40% of newborns regurgitate in the first few days of life
- The lower esophageal sphincter pressure takes 3-6 weeks to increase to adult levels
- Symptoms may be GI and/or pulmonary
 - Esophagitis, persistent vomiting, failure to thrive
 - Aspiration (pneumonia), bronchospasm/RAD
 - Apnea and bradycardia in preterm infants



Nissen fundoplication may be performed for children with GER who fail medical management

Obesity

- In 2011, the incidence ranged from 8%-11%
- Increasing in developed and developing countries
- Anesthesia-relevant coexisting diseases
 - Hypertension
 - Dyslipidemia
 - Type 2 diabetes mellitus
 - Nonalcoholic fatty liver disease
 - OSA
 - Asthma
 - Psychosocial issues



Type 1 Diabetes Mellitus

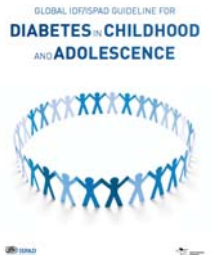
- Absolute deficiency of insulin secretion
- Most cases are primarily due to T-cell mediated pancreatic islet beta cell destruction
- Metabolic disorder characterized by chronic hyperglycemia and disturbances of carbohydrate, protein, and fat catabolism
- Hormonal responses to surgery result in hyperglycemia and potentially ketoacidosis

Obesity

- Fasting guidelines are unchanged
- Premedication dosed on ideal body weight
- Avoid intramuscular medications
- Standard monitoring and IV placement can be difficult
- Higher incidence of anesthesia-related complications
 - Upper airway obstruction
 - Difficult mask ventilation
 - Difficult laryngoscopy
 - Desaturation during induction and emergence

Type 1 Diabetes Mellitus

- Evaluation and planning are best conducted in advance with the help of an endocrinologist
- ISPAD guidelines are an excellent reference
 - First case of the day
 - Avoid hypo- and hyperglycemia, fluid and electrolyte imbalance, and ketosis
 - Management depends on procedure, duration, and patient's usual regimen
 - IV access, glucose infusion, and frequent blood glucose monitoring is essential
 - Even fasting Type 1 diabetic patients need insulin



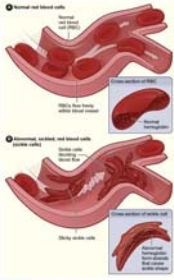
(<http://ispad.site-ym.com>)

Von Willebrand Disease



- Autosomal dominant (disorder occurs equally in both sexes)
- Nosebleeds, bleeding from gums, prolonged bleeding from lacerations, increased bleeding during surgery
- Prolonged bleeding time due to defect in platelet-binding protein (platelet count and PT are normal)
- Treat with von Willebrand factor (FFP or cryoprecipitate)


Sickle Cell Disease



- Autosomal recessive
- 8% of the African American population are heterozygotes (trait)
 - Does not affect anesthetic management or perioperative outcome
- 0.16% are homozygotes
 - Increased risk of ACS, MI, sickle cell crises
- Perioperative preparation
 - PFT
 - Hemoglobin electrophoresis
 - Hb or Hematocrit
 - Partial exchange transfusion to decrease HbS to <40% or transfusion to Hb 10 in cases of severe anemia or history of CVA or ACS


Hemophilia

- 1/10,000 males (defective gene carried on X chromosome)
- Bleeding during the neonatal period suggests the diagnosis (factor VII does not cross placenta)
- Hallmark of the disease is hemarthrosis




Congenital Syndromes


Online Mendelian Inheritance in Man (OMIM)



Pierre Robin Sequence



Crouzon Syndrome




Treacher Collins Syndrome

Hemophilia

- Factor VIII should be measured during the preoperative period
- Prolonged PTT but normal platelet count, bleeding time, and PT
- Preoperative factor VIII and/or DDAVP may be required (consult pediatric hematologist)
- Intramuscular medication administration should be avoided

Down Syndrome

- Most common chromosome disorder in live born infants (1/700 births)
- Higher risk of anesthesia-related complications
- Cervical spine instability (up to 15%)
 - AAP previously recommended obtaining one set of lateral C-spine x-rays between 3 and 5 years of age
 - Newest AAP guidelines no longer recommend routine C-spine x-rays for asymptomatic children
 - Relying on symptomatology to identify patients at risk for instability is problematic (it is estimated only 1-2% will actually show significant symptoms)
 - The probability of injury is low but the consequence of an adverse event could be severe
 - All patients should be considered at increased risk for instability

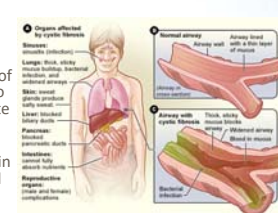


Down Syndrome

- Upper airway obstruction
 - Macroglossia, narrow nasopharynx, hypertrophic lymphatic tissue, tracheal and subglottic stenosis, airway malacia, hypotonia
 - OSA is common
- Thyroid problems
- Congenital heart disease (40-50%)
 - AVSD most common
 - Bradycardia with sevoflurane
- Pulmonary hypertension
- Leukemia
- Obesity

Cystic Fibrosis

- Autosomal recessive disorder
- 1/2,000 white births
- Mutation on long arm of chromosome 7 leads to disruption of electrolyte transport in epithelial cells
- Lung disease is the main cause of morbidity and mortality
- Malnutrition, diabetes, and hepatic dysfunction are common



The diagram illustrates the organs affected by cystic fibrosis: sinuses, lungs, skin, pancreas, and sweat glands. It also shows two airway cross-sections: a normal airway with a thin layer of mucus and an airway with cystic fibrosis where the mucus is thick and sticky, blocking the airway.

<http://www.nhlbi.nih.gov>


Cerebral Palsy

- Nonprogressive, but often changing, motor impairment syndromes secondary to lesions or anomalies in the brain that occur during early stages of development
- Leading cause of motor disability in childhood (2/1,000)
- Classified according to deficit and distribution
- Three broad categories:
 - Spastic (70%)
 - Dyskinetic (10%)
 - Ataxic (10%)
- Distribution may involve:
 - Single limb (monoparesis)
 - Both limbs on one side (hemiparesis)
 - Both lower limbs (diparesis)
 - Three limbs (triparesis)
 - All four limbs (quadriparesis)

Cystic Fibrosis

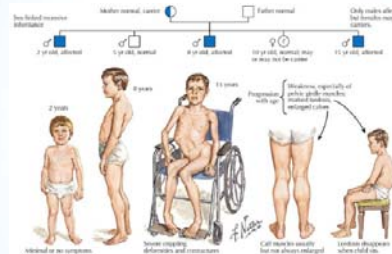
- Children frequently present for anesthesia for ENT procedures and bronchoscopy/pulmonary lavage
- Pulmonary disease is the predominant pre-anesthesia concern
 - Fitness/exercise tolerance (best predictor of survival)
 - Quality/quantity of secretions
 - Recent/chronic infections
 - Use and effectiveness of bronchodilators
 - Number of hospitalizations
- Children are often anxious

Cerebral Palsy



- Systemic disorders affect respiratory, GI, GU, orthopedic systems
- Disorders include cognitive impairment, sensory loss, seizures, and communication and behavioral disturbances
- Post-op pain and spasticity are common and often undertreated
- Communication disorders and sensory deficits may mask near-normal or normal intellect

Duchenne Muscular Dystrophy (DMD)



The diagram shows the progression of DMD: at 2 years, the child is walking; at 4 years, they are running; at 8 years, they are using a wheelchair; at 11 years, they are in a wheelchair with significant muscle wasting; at 15 years, they are in a wheelchair with severe muscle wasting and respiratory issues.

- X-linked recessive
- Characteristic clinical features include muscle weakness, contractures, sluggish deep tendon reflexes, and involvement of cardiac and respiratory musculature

Duchenne Muscular Dystrophy (DMD)

- Rhabdomyolysis, hyperkalemia, and cardiac arrest in the setting of inhalational agents and/or succinylcholine
 - Rhabdomyolysis may mimic malignant hyperthermia (MH) but DMD and MH are independent disease processes
 - The risk of MH is NOT higher in patients with DMD than it is in the general population

Neurodevelopmental outcome and anaesthesia

Neurodevelopmental outcome at 2 years of age after general anaesthesia and awake-regional anaesthesia in infancy (GAS): an international multicentre, randomised controlled trial

Andrew Davidson, Nicola Diama, Jürgen C. de Graaf, Daniela E. Withington, Liam Dorris, Graham Bell, Ruby Storgatt, David C. Bellinger, Faber Schreier, Sarah J. Arney, Polyesia Hardy, Rodney W. Hunt, Michael Sakagi, Galen Corbett, Penelope Hartmann, Mo Salah, Neil S. Martin, Britta S. von Ungem Steinhilber, Bruno Guido Lucarelli, Neal Wilson, Anne Lynn, Jess J. Thomas, David Palanc, Oliver Bagshaw, Peter Samak, Anthony R. Abouk, Geoff Frawley, Charles Berde, Garret D. O'Rourke, Joshi Marmor, Mary Beth McCann, for the GAS consortium

The child of a Jehovah's Witness

- Belief that the "life force" resides in the blood requires them to refuse transfused blood
- While adults may refuse a life-saving transfusion, a child may not
- Anesthesia team must define a plan with the family in the event that a transfusion is required
- No child of a Jehovah's Witness parent should die due to lack of transfused blood without the physician seeking a court order

Neurodevelopmental outcome and anaesthesia


- Data suggest that general anesthetics affect brain development
- Mixed evidence that young children exposed to anaesthesia can have an increased risk of poor neurodevelopmental outcome
- Secondary outcome of neurodevelopmental outcome at 2 years of age in the General Anesthesia compared to Spinal anaesthesia (GAS) trial
- No evidence that just less than 1 h of sevoflurane anaesthesia in infancy increases the risk of adverse neurodevelopmental outcome at 2 years of age compared with awake-regional anaesthesia**

Vaccines and anaesthesia

- No direct evidence of any major interaction
- Possible that immunosuppressive effect of anaesthesia and surgery may decrease efficacy
- Diagnostic difficulty may arise with post-op fever or malaise
- Recommend postponing elective surgery for 1 week after inactive vaccination and 3 weeks after live attenuated vaccination

Concussion and anaesthesia

- Very little data available
- Mutch and colleagues reported abnormalities in mean regional CBF and cerebrovascular responsiveness to CO₂ in adolescents with postconcussion syndrome
- Unclear clinical and anesthetic significance

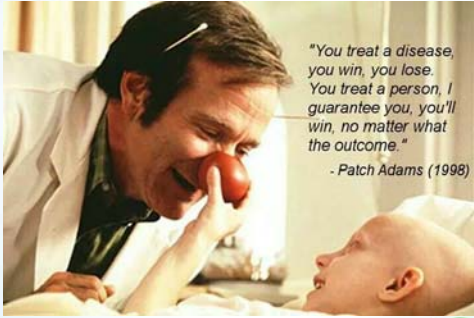


In Summary

- Children are not small adults
- The effects of events in the fetal and neonatal period can persist for years
- Pediatric patients often present with different comorbidities and anesthetic considerations than adults
- Children require different psychological and medical preoperative evaluation and preparation than adults for an optimal perioperative experience

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*"You treat a disease,
 you win, you lose
 You treat a person, I
 guarantee you, you'll
 win, no matter what
 the outcome."
 - Patch Adams (1998)*



questions