PREOPERATIVE EVALUATION OF THE PEDIATRIC PATIENT

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THE OBJECTIVES

- Discuss Preoperative Evaluation of the Pediatric Surgical Patient
- Discuss the Complications of Anesthesia in children with Upper Respiratory Infections
- Discuss the Safety of anesthetic agents in the pediatric population

Is This Necessary?

- Helps streamline the day of surgery
- Helps eliminate the preventable causes for cancellation of surgery
- Helps to optimize medical management
- Helps familiarize child and parent to the hospital
- Reduce the percentage of cancellations and OR delays
- Enhance the utilization of OR time

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Preoperative Evaluation Objectives

- Obtaining a medical history
- Performing a physical examination
- Review of systems
- Family history
- NPO status
- Appropriate laboratory tests

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Preoperative Evaluation
Maternal Health and Children

Maternal Health	Implications to Children
Diabetes Mellitus	Neonatal hypoglycemia, macrosomia, respiratory distress, cardiac anomalies, vertebral anomalies
Pre eclampsia	IUGR, preterm delivery, high incidence of meconium at birth
Alcohol Abuse	Mental retardation, congenital heart disease, cleft palate, skeletal anomalies

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Preoperative Evaluation
An Outline

- Birth History:- Full term or pre term baby
- Determine post conceptual age
- History of previous hospitalizations and surgical procedures
- Concurrent medical illnesses
- History of recent upper respiratory infection
- Allergies

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Birth History
The Former Preterm Infant
Problems

- Pulmonary:- lung immaturity, bronchopulmonary dysplasia, elevated pulmonary vascular resistance
- Airway:- tracheomalacia, subglottic stenosis
- Multiple medications
- Apnea and bradycardia

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Postoperative Apnea and Bradycardia

Factors affecting include:-

- Prematurity
- Post conceptual age less than 60 weeks
- Anemia
- History of Apnea and bradycardia, on home apnea and bradycardia monitor

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Preoperative evaluation Physical Examination

Here, importance is given to the evaluation of:-

- Airway
- Dentition
- Heart murmurs
- Neurological status and deficits

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Preoperative evaluation Physical Examination

Here, importance is given to the evaluation of:-

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- Heart murmurs
- Neurological status and deficits

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Preoperative evaluation Miscellaneous workups

- Laboratory studies
- Radiographs
- CT scans/MRI
- Cardiac/pulmonary/hematology consults where necessary

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Preoperative Evaluation
Family History

Aspects of Family History with increased anesthetic risks include

- Unusual reactions to surgery or anesthesia
- Malignant Hyperthermia
- Sickle cell disease
- Thalassemia
- Atypical Pseudo cholinesterase
- Neuromuscular disorders

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Preoperative Evaluation
NPO Guidelines

Clear liquids	2 hours
Breast milk	4 hours
Infant formula	6 hours
Nonhuman Milk	6 hours
Solids	8 hours

“My Child Has A Running Nose” URIs and Anesthesia

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Upper Respiratory Infections

URIs affect the apparatus of the upper airways

Frequently occurring URIs include:

- The Common Cold
- Pharyngitis
- Laryngitis
- Croup
- Epiglottitis
- Sinusitis

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“My Child Has A Running Nose” URIs and Anesthesia

URI	Causative Agents
Common Cold	Rhino, Corona , RSV, Para influenza, Influenza , Adenoviruses
Pharyngitis	Viral:- “cold Virus”, Coxsackie, Herpes simples, E-B virus. Bacterial:- Streptococcus
Laryngitis	Viral:-Influenza, Para influenza, Rhino, Adeno, RSV Bacterial:-Streptococcus Fungal:-Candida Albicans

"My Child Has A Running Nose" URIs and Anesthesia

URI	Causative Agents
Croup	Para influenza viruses type1,2,3;, Influenza and RSV
Epiglottitis	H. Influenza type B
Sinusitis	S.pneumonia, H influenza, S.aureus, S.pyogenes, fungal infections

Symptoms and signs of URI

- Rhinorrhea, nasal congestion
- Cough with or without expectoration
- Sneezing
- Malaise and decreased activity
- Sore Throat
- Head ache
- Fever

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URIs and Anesthesia

- One URI can progress to another type
- Signs and symptoms are similar
- Difficult to distinguish these infections from one another
- Most children develop 6-10 “colds” a year
- Less frequent after age 6

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URIs and Anesthesia

Differential diagnosis of URI:-

- Vasomotor rhinitis
- Allergic rhinitis

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Risk factors for Perioperative Complications

- Copious secretions
- ETT in children <3yrs
- History of prematurity
- Nasal congestion
- Parental smoking
- History of Reactive airway disease
- Surgery involving the airway
- Productive Sputum

Tait et al, Anesthesiology, V 95, No 2, Aug 2000.

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URI and Pulmonary Function

Pulmonary Function following URI:-

- Reduced FEV1
- Decreased mucociliary clearance
- Increased airway reactivity
- Increased closing volumes
- Compromised diffusion capacity
- Increased intrapulmonary shunting and worsening ventilation perfusion mismatch

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Causes for airway hyper-reactivity

- Respiratory epithelial cell damage
- Activation of the sub epithelial receptors
- Release of Mast cells, substance P
- Bronchial smooth muscle stimulation

URI:-Perioperative adverse events

- Laryngospasm
- Airway obstruction
- Croup
- Hypoxemia
- Bronchospasm
- Stridor
- Breath holding

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Laryngospasm and URI

Schreiner, Anesthesiology vol. 85(3), Sept. ‘96

- Laryngospasm is 2 times more common
- More likely to be in the younger age group
- More likely to be scheduled for airway surgery
- Anesthesia supervised by a less experienced anesthesiologist

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Cardiac surgery and URI
Malviya et al (Anesthesiology 98, March '03)

Intraoperatively:-

- Increased airway complications

Postoperatively an increased incidence of :-

- Respiratory complications
- Bacterial infections
- Atelectasis
- Extended stay in the ICU

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My Child has a LITTLE cough Should surgery be cancelled?

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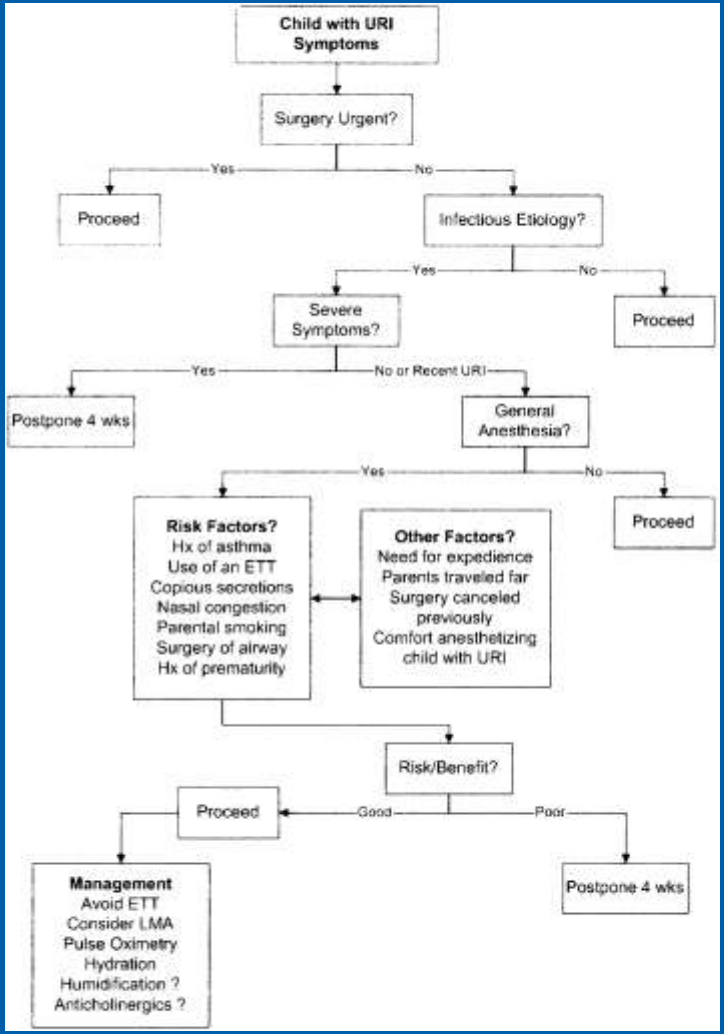
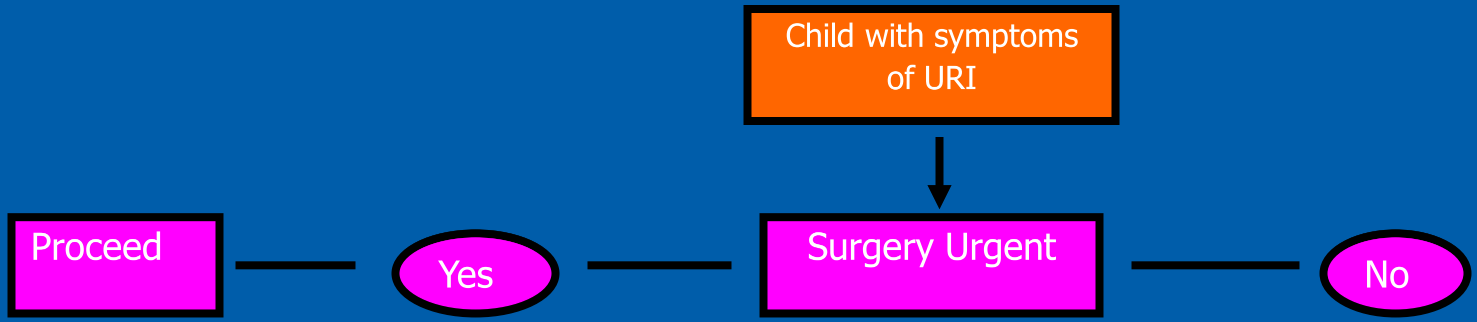
Figure 1. Suggested algorithm for the assessment and anesthetic management of the child with an upper respiratory infection.

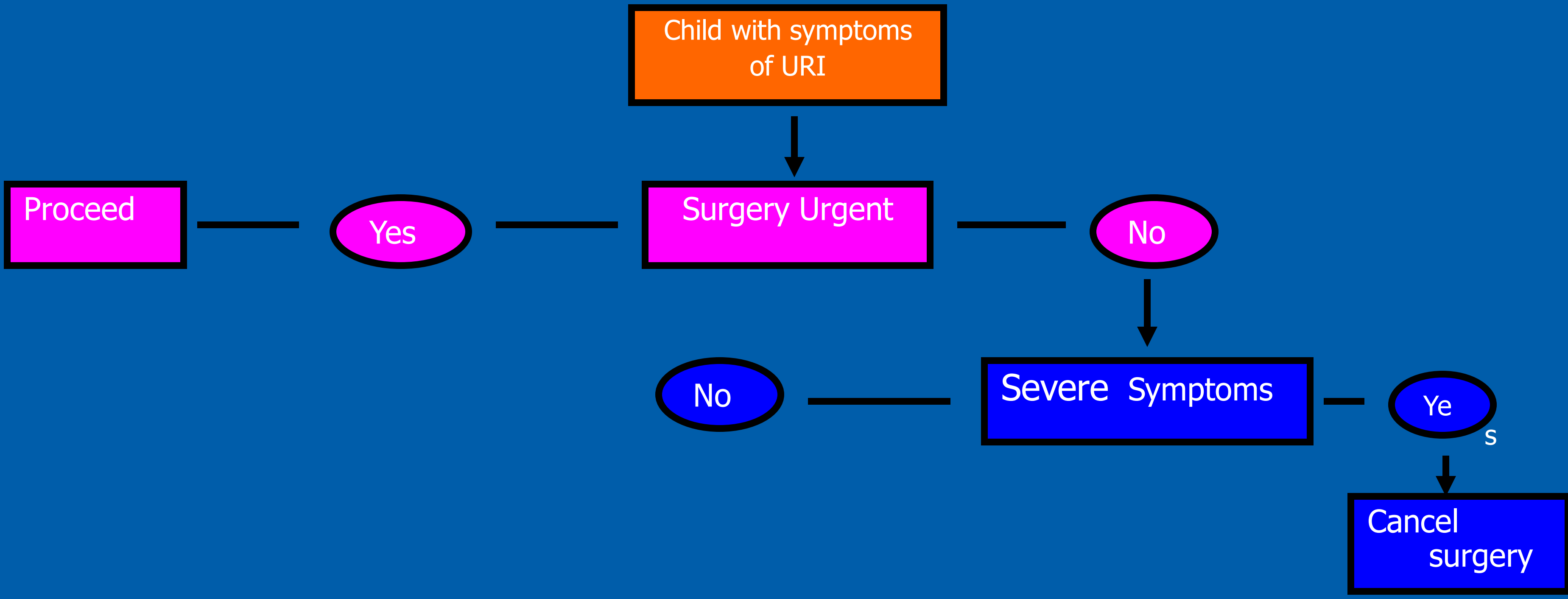


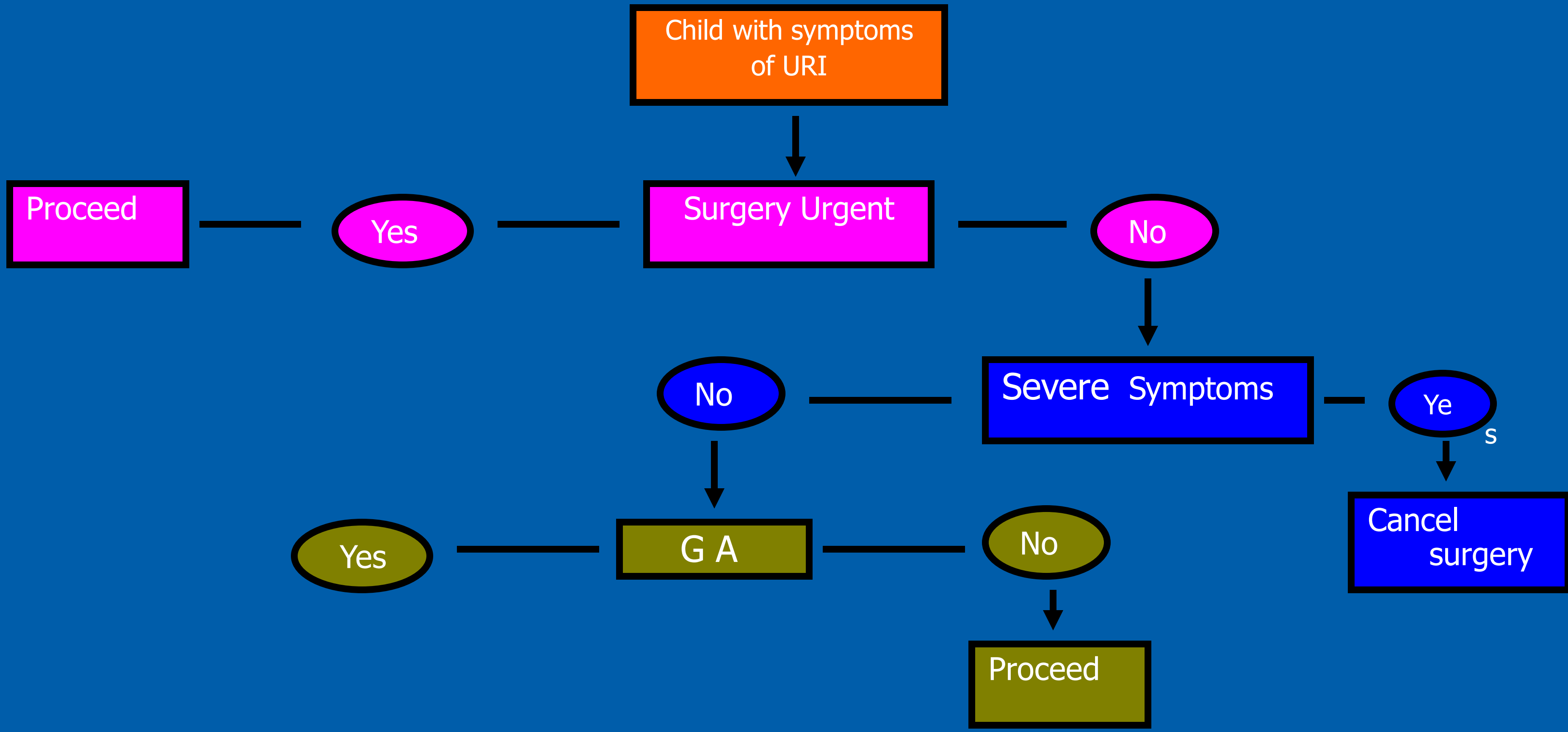
Tait A R , Malviya S Anesth Analg 2005;100:59-65

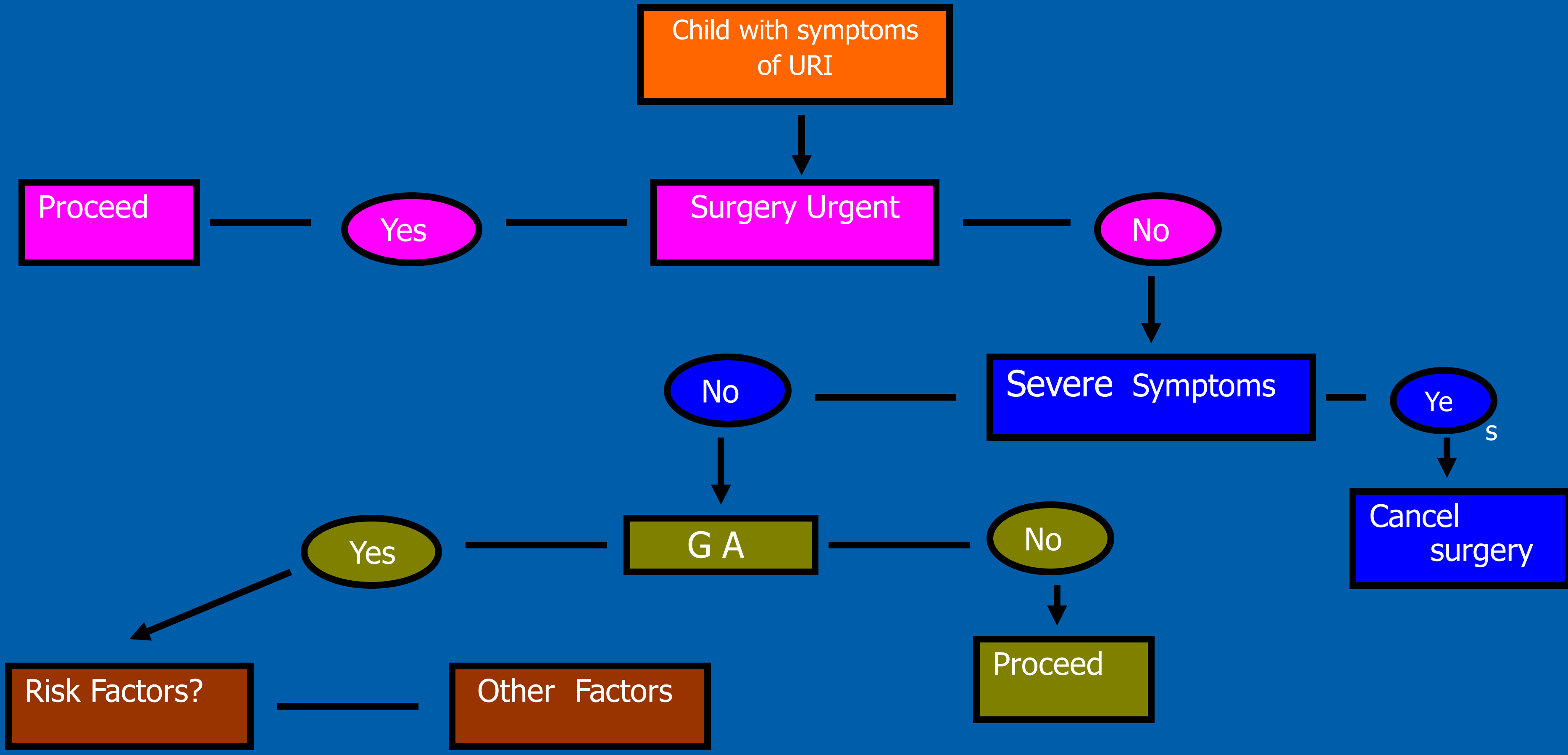
ANESTHESIA & ANALGESIA

Child with symptoms of URI

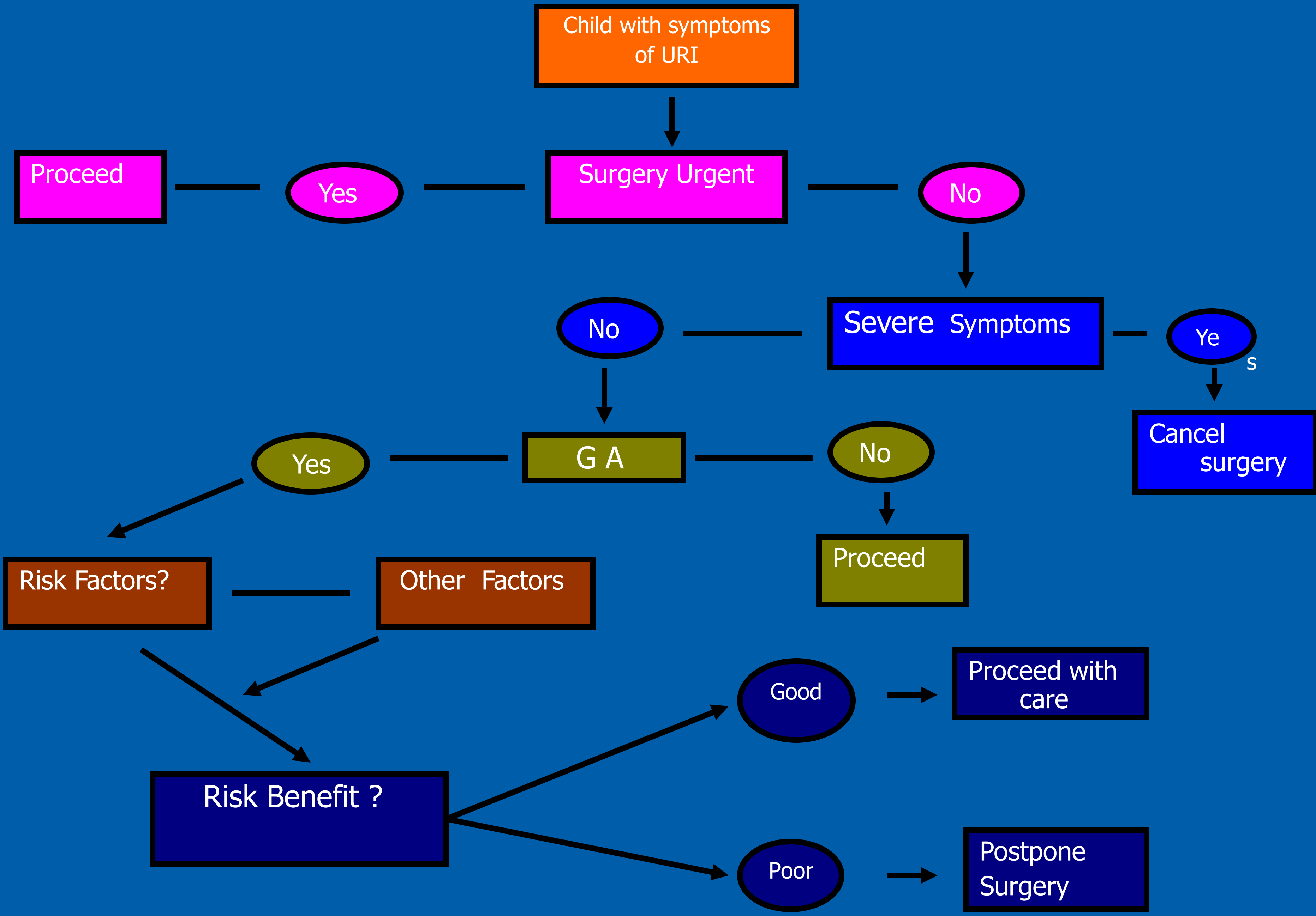

Child with symptoms of URI
Proceed
Yes
Surgery Urgent
No


Child with symptoms of URI
Proceed
Yes
Surgery Urgent
No
No
Severe Symptoms
Ye
s
Cancel surgery


Child with symptoms of URI
Surgery Urgent
Yes
Proceed
No
Severe Symptoms
Yes
Cancel surgery
No
G A
Yes
No
Proceed



Child with symptoms of URI
Surgery Urgent
Yes
Proceed
No
Severe Symptoms
Ye s
Cancel surgery
No
G A
Yes
No
Proceed
Risk Factors?
Other Factors


Child with symptoms of URI
Surgery Urgent
Yes
Proceed
No
Severe Symptoms
Yes
Cancel surgery
No
G A
Yes
No
Proceed
Risk Factors?
Other Factors
Risk Benefit ?
Good
Proceed with care
Poor
Postpone Surgery

In Conclusion--- Upper respiratory infection and anesthesia

What seems like a little cough to me may not mean the same to my colleagues. And, when this cough is associated with other signs of infection like fever, sputum which is greenish-yellow, wheezes, lethargy, ------ it most definitely is not a Little Cough.

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Is it safe for my baby to have anesthesia ?

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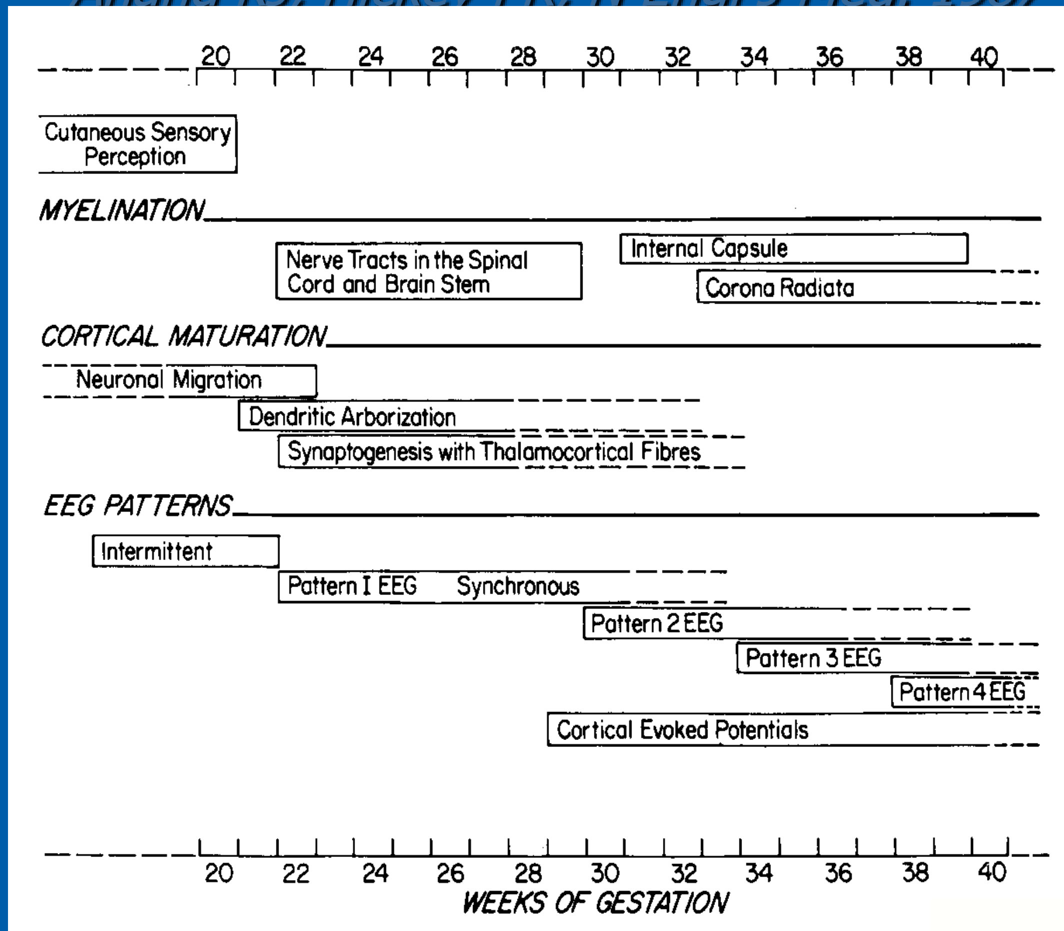
Pain And Its Effects In The Human Neonate And Fetus

Anand KJ, Hickey PR, N Engl J Med, 1987



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Randomised Trial Of Fentanyl Anaesthesia In Preterm Babies Undergoing Surgery

Anand, Sippell and Aynsley-Green Lancet 1987

- Premature neonates for ligation of PDA
- Randomized
  - Nitrous oxide and curare with fentanyl (10 µg/kg)
  - Nitrous oxide and curare
- No fentanyl group
  - Metabolic acidosis
  - Hyperglycemia
  - Post operative
    - Ventilator requirements
    - Bradycardia
    - Intraventricular hemorrhages
    - hypotension

What We Think That We Know Now

- Based on Anand's early work, Infants have a profound physiological response to surgical trauma
- This response has an impact on outcome
- Poor outcomes can be reduced by the judicious use of anesthetics
- Bottom line: Infants have pain

Commonly used Anesthetic Agents

Table 1. Receptor Activity of Commonly Used Anesthetic Agents[a]

Anesthetic agent	NMDA antagonist	GABA-mimetic	μ-Opioid agonist
Volatile anesthetics			
Halothane	−/0	+++	0
Isoflurane	−/0	+++	0
Desflurane	−/0	+++	0
Enflurane	−/0	+++	0
Sevoflurane	−/0	+++	0
Injectable anesthetics			
Propofol	0	+++	0
Barbiturates	0	+++	0
Etomidate	0	+++	0
Benzodiazepines	0	+++	0
Ketamine	−−−	−/0	0
Medical gases			
Nitrous oxide	−−−	+++	0
Opioid analgesics			
Morphine	−/0	0	+++
Methadone	−−−	0	+++
Meperidine	−/0	0	+++
Fentanyl	−/0	0	+++
Other sedative hypnotics			
Chloral hydrate	−−−	+++	0
Trichloroethanol	−−−	+++	0
Ethanol	−−−	+++	0

Key: (−−−), strong antagonism within the clinically relevant range based on available *in vitro* data; (+++), strong potentiation within the clinically relevant range based on available *in vitro* data; (−/0), little antagonism within the clinically relevant range based on available *in vitro* data; (+/0), little potentiation within the clinically relevant range based on available *in vitro* data; (0), no compelling data to support activity at this site within the clinically relevant range.

NMDA = *N*-methyl-D-aspartate; GABA = γ-aminobutyric acid.

[a] Receptor activity as noted in the table does not imply mechanism of action; rather it indicates potential to neurological injury. The table was adapted, in large part, from re[illegible] and Harrison (9) and by Dilger (10); for more detail, please refer these review articles.

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Blockade of NMDA Receptors and Apoptotic Neurodegeneration in the Developing Brain

Chrysanthy Ikonomidou, Friederike Bosch, Michael Miksa, Petra Bittigau, Jessica Vöckler, Krikor Dikranian, Tanya I. Tenkova, Vanya Stefovska, Lechoslaw Turski, John W. Olney*

- *Programmed cell death occurs during normal development*
- *Blockade of NMDA glutamate receptors produce widespread apoptotic neurodegeneration in developing rat brain*
- *Suggested that glutamate acting at NMDA receptors controls neuronal survival*
- *Question: Does this have relevance to human neurodevelopmental disorders?*

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Early Exposure to Common Anesthetic Agents Causes Widespread Neurodegeneration in the Developing Rat Brain and Persistent Learning Deficits

Jevtovic-Todorovic et al, J Neurosci, 2003

- Triple cocktail (P7 rat pups)
  - Midazolam
  - Isoflurane
  - Nitrous oxide
- Histological changes
  - neurodegeneration
- Functional changes
  - Memory impairments
  - Learning impairments

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Anesthesiology 2005; 102:866-8

Of Mice and Men: Should We Extrapolate Rodent Experimental Data to the Care of Human Neonates?

Sulpicio G. Soriano, M.D.,* Kanwaljeet J. S. Anand, M.B.B.S., D.Phil., Cynthia R. Rovnaghi, M.S., Paul R. Hickey, M.D.
* Children's Hospital Boston and Harvard Medical School, Boston,

Human Babies are not Large Rat Pups!!

Problems with Rodent Experimental Paradigm

- Duration of exposure to drugs

7 rat days ≅ 27 human months

6 hour ≅ 1 month

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Human Babies are not Large Rat Pups!!

Problems with Rodent Experimental Paradigm

- Duration of exposure to drugs
- Lack of precise physiological monitoring

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Physiological Monitoring

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Human Babies are not Large Rat Pups!!

Problems with Rodent Experimental Paradigm

- Duration of exposure to drugs
- Lack of precise physiological monitoring
  - End-organ perfusion
  - Varying anesthetic depth
    - MAC values
    - Target-controlled infusions

Human Babies are not Large Rat Pups!!

Problems with Rodent Experimental Paradigm

- Duration of exposure to drugs
- Lack of precise physiological monitoring
- Interspecies variation

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Human Babies are not Large Rat Pups!!

Problems with Rodent Experimental Paradigm

- Duration of exposure to drugs
- Lack of precise physiological monitoring
- Interspecies variation
  - Dose-response
  - Drug metabolism
  - Peak susceptibility

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■ 2008 ANESTHESIOLOGY/FAER SESSION: ANESTHESIA AND THE DEVELOPING BRAIN: IMPLICATIONS FOR OBSTETRICS AND PEDIATRICS

Anesthesiology 2009; 110:796–804

Early Exposure to Anesthesia and Learning Disabilities in a Population-based Birth Cohort

Robert T. Wilder, M.D., Ph.D., Randall P. Flick, M.D., M.P.H.,† Juraj Sprung, M.D., Ph.D.,‡ Slavica K. Katusic, M.D.,§ William J. Barbaresi, M.D.,‖ Christopher Mickelson, M.D.,# Stephen J. Gleich, M.D.,** Darrell R. Schroeder, M.S.,†† Amy L. Weaver, M.S.,†† David O. Warner, M.D.‡*

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Early exposure to Anesthesia and Learning Disabilities

- Population based birth cohort study
- Children born between 01/1976 - 2/1982
- Risk factor was exposure to general anesthesia <4yrs of age (total of 593)
- Tested for learning disabilities
- Higher incidence of LD

    1. in those exposed to 2 or more anesthetics
    2. in those receiving anesthesia >120mins.

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Initiatives by the Pediatric Anesthesia Community

- Neonatal Drug Development Initiative Workshops
- Society for Pediatric Anesthesia
  - Awareness-educational programs
  - Registry and complications database
- American Society of Anesthesiology
  - Increased awareness
  - Funding investigators
- Multi-center Randomized Control Trial

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GAS Study

- Multi-national, multi-center collaborative group
  - Andrew Davidson, Melbourne, Australia
  - Mary Ellen McCann, Boston, USA
  - Neil Morton, Glasgow, Scotland
- Randomized controlled equivalence trial
  - Inguinal hernia in infants
  - Spinal (bupivacaine) versus general (sevoflurane) anesthesia
  - Neurodevelopmental assessments at 2 and 5 years

Timeline	2007	2008	2009	2010	2011	2012	2013	2014
Recruit	x	x	x					
Yr 2 assessment			x	x	x			
Yr 5 assessment						x	x	x

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Is it safe for my baby to have anesthesia?

For now:

- Drug induced apoptosis is a valid concern
- Much needed area of research
- Does it affect just preterms or neonates or are adults vulnerable too?
- Is the plasticity of human brain able to overcome these insults
- Until we have more convincing data on this subject it is prudent that we continue with our current level of care

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Is it safe for my baby to have anesthesia ?

Remember:

1.Majority have been animal studies

2. Questionable intraop monitoring

3. Limited data in primates

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