Introduction & Statement of Problem

- The purpose of this project is to compare the differences between the video laryngoscope (VL) and the standard direct laryngoscope (DL) for intubation
  - There are many different types of VL, but for this presentation I will be using the GlideScope as an example because it is most common in this area
- Unexpected difficult airways occur and can result in standard laryngoscopy failure, difficulty securing the airway, and oxygen desaturation and/or hypoxia
- When used routinely, video laryngoscopy may result in a higher intubation success rate in both anticipated and unanticipated difficult airway situations

Purpose

- Poor glottic visualization is encountered in up to 8.5% of intubation attempts when using the DL
  - Multiple attempts can lead to decreased glottic exposure due to bleeding and edema
  - Multiple DL attempts can result in prolonged periods of ineffective ventilation, decreased oxygenation, and poor outcome
- Video laryngoscopy does not require direct line-of-sight visualization, external manipulation, or additional force
Significance

- Securing the patient airway, successful intubation, and patient safety are primary concerns for Certified Registered Nurse Anesthetists (CRNA).
- Endotracheal intubation is a time critical, important, life-saving medical procedure that involves competent anesthesia providers, practitioners, and proper airway management.
- Difficult and/or failed intubations are major contributors of morbidity and mortality in anesthesia.
- The use of VL results in improved intubation rates even in difficult airway patients.

Video laryngoscopy captures the anatomic image and results in fewer intubation attempts when used as a first-hand device.

- The period of time that a patient is not being ventilated, and subsequently risk of hypoxemia, is decreased because multiple attempts are generally not needed.
- VL may significantly improve morbidity and mortality related to failed intubations.

Airway Management

- VL in a variety of settings:
  - Difficult airways
  - First use intubations, replacing DL
  - Restricted oropharyngeal views
  - Morbidly obese patients
  - Traumatic airways
  - Patients requiring cervical spine immobilization
  - Awake intubations
  - Teaching the anatomy of the airway

Theoretical Framework

Several patient factors can make direct laryngoscopy difficult:

- Small mouth opening
- Limited neck movement
- Pathological conditions
- Protruding teeth
- Redundant tissue
- Short thyromental distance
- Previous radiation
- Overbite
- Low Mallampati score
Review of Literature

• In a comparison of the VL and the DL, 200 patients underwent general anesthesia and were randomly intubated using either device.
  
  • Using the Cormack and Lehane criteria, the VL produced a 10% increase in the glottic view for the anesthesia provider compared to the DL.
  
  • Additionally, the number of external maneuvers, such as neck extension or the BURP maneuver, was decreased by 40% with the use of the VL.
  
  • The time to tracheal intubation was significantly shorter with the VL at 40 seconds compared to the DL at 60 seconds.
  
  • Overall, in the 100 attempts for each device, the VL led to 99 successful intubations, whereas the DL was successful in 92 attempts.
  
  (Jungbauer et al., 2009)

Review of Literature

• In a review of over 2,000 cases where the VL was used for airway management:
  
  • Overall, the VL intubation success rate was 97%.
  
  • As a primary technique, success rates were 98%.
  
  • A 96% success rate was found in patients with predictors of a difficult airway.
  
  • After a failed DL, the VL success rate was 94%.
  
  (Aziz et al., 2011)

Review of Literature

• In patients with cervical spine injuries during tracheal intubation, 20 patients were compared using the DL for in-line stabilization and the GlideScope VL.
  
  • Fluoroscopic images of C-spine movement during intubation were acquired to determine segmental movement of each device.
  
  • C-spine displacement occurred most during glottic visualization using the DL.
  
  • Movement greater than 15 degrees occurred in 11% with the DL and 4% with the VL.
  
  • The glottic visualization grade with the VL showed either a Grade I or II view for all 20 patients.
  
  • Using the DL, 65% of the patients had a Grade II view and 35% had a Grade III view.
  
  • Some required laryngeal manipulation to obtain view.
  
  (Robitaille et al., 2008)

Review of Literature

• Video assisted instruction can also improve tracheal intubation for novices:
  
  • 37 novices with less than 6 prior intubation attempts were compared using the standard DL and the video-assisted VL.
  
  • 55% of novices were successful at tracheal intubation compared to 65% of novices using video-assisted display and instruction.
  
  • During the VL intubation, an instructor was able to view the video images and provide feedback to the novice to provide for successful tracheal intubation.
  
  • Esophageal intubation occurred in 17% with the DL and in only 3% with the VL.
  
  • Therefore, the improved rate of successful intubation and the decreased rate of esophageal intubations support the use of VL for novices.
  
  (Howard-Quinones et al., 2008)
Clinical Pearls for Successful VL

- Step 1: Look in the mouth to introduce the GlideScope handle midline
- Step 2: Look at video screen to obtain glottic view
  - Top 1/3 of the video screen
- Step 3: Use a 60 degree stylet reinforced ETT
- Step 4: Insert the ETT sideways in a horizontal plane through the mouth
- Step 5: Look at the screen to intubate the trachea

Results

- The ASA difficult airway algorithm guides anesthesia practitioners in the management of expected and unexpected difficult airways, and the VL has proven to reduce time to intubation and improve intubation success.
- The video-assisted display can offer the opportunity to improve teaching of airway management
- The need to align the optical axis in the pharynx and mouth to visualize the larynx is not necessary with the VL
- The success rate of intubation is increased and fewer maneuvers are needed to optimize the view for intubation

Conclusion

- Video laryngoscopy may have a significant impact on anesthesia practice and patient safety if used as a first line intubation device rather than as a rescue device following failed intubation from DL
- Multiple attempts at intubation could be avoided if VL was used as the initial device for both the expected or unexpected difficult airway

Conclusion

- The data and literature has demonstrated a high success rate with the VL in both rescue-failed direct laryngoscopy and in primary airway management
- Finally, difficult airways and tracheal intubation can lead to airway trauma or even a life-threatening situation
  - The VL has assisted in these instances and intubations have become safer and more efficient for the patients
References


References


Thank You
Any Questions?

LIPID EMULSION THERAPY FOR LOCAL ANESTHETIC TOXICITY

Jenna Klabunde, SRNA

Introduction & Statement of Problem

- Regional anesthesia is a popular method of anesthesia in today’s surgical world.
- Local anesthetic systemic toxicity, or LAST, is a potentially fatal complication in which local anesthetic enters the bloodstream and causes central nervous system and cardiac toxicities
  - Symptoms can include circumoral numbness, tongue paresthesia, dizziness, tinnitus, blurred vision, restlessness, agitation, nervousness, paranoia, slurred speech, drowsiness, unconsciousness, depressed myocardial automaticity, contractility, and conduction, bradycardia, heart block, hypotension, and cardiac arrest
- Incidence of LAST is approximately 0.01%

Purpose

- Lipid emulsion (LE) therapy is a treatment modality used specifically for LAST and has been gaining popularity over recent years.
- The focus of this study is the effectiveness of LE therapy for LAST.
- LE therapy is closely examined as a treatment for LAST, the possible mechanisms of action of LE therapy, and current recommendations for the administration of LE therapy.
Significance

- This study is providing a compilation of evidence-based research studies, case reports, expert opinions, and literature reviews concerning LE therapy as a treatment of LAST.
- Since LAST is such a rare occurrence, many healthcare personnel are untrained and unknowledgeable in the treatment of this condition. If research can facilitate the implementation of protocols including LE therapy for LAST, then healthcare personnel will have specific guidelines to follow in order to improve patient morbidity and mortality.
- The work put into this study will hopefully aid in this implementation process.

Research Questions

- Do current research and case reports prove and confirm that LE therapy is an effective treatment of LAST?
- What are the benefits of LE therapy?
- How and when should LE therapy be utilized?
- What is the mechanism of action of LE therapy?

Framework

- Roy’s Adaptation Model created by Sister Callista Roy.
- The major concepts include adaptation, person, environment, health and nursing.
  - How a patient is able to adapt and cope with stressors to their health and a constantly changing environment
- The nursing process associated with Roy’s Adaptation Model is a problem solving approach for gathering data, identifying the needs of the human adaptation system, selecting and implementing approaches for nursing care, and evaluation of the outcome of the care provided.

Overview of Methods

- Research was conducted through the Harley French Library website at the University of North Dakota
  - PubMed, CINAHL, Cochrane Library Database, Clinicaltrials.gov, SCOPUS
- Evidence-based research articles, case reports, expert opinions, and systematic reviews were obtained from well-respected, credible research journals from around the world.
Review of the Literature

- Several Randomized Controlled Trials (RCT) of animal studies have proved that LE therapy can completely reverse the effects of LAST.
  - Reverses severe vasodilation
  - Reverses cardiac conduction abnormalities
  - Improves BP, HR, CO
  - Reverses cardiovascular depression
  - Binds and extracts local anesthetic from blood
  - Control groups: (no LE therapy) subjects died or did not improve
  (Chen et al., 2010), (Ok et al., 2011), (Candela et al., 2010), (Stehr et al., 2007), (G. L. Weinberg et al., 1998)

Review of the Literature

- Numerous case reports of real life human experiences demonstrate that LE therapy is the only treatment option that works even after all other traditional treatment modalities have failed.
  - Numerous complete recoveries, return to normal baseline functioning
  - VS dramatically and instantly improve, seizures resolve, cardiac abnormalities resolve
  - Results within minutes, even after traditional resuscitation fails
  - Local anesthetic levels in blood dramatically decrease
  (Espinet & Emmerton, 2009), (Ludot, Tharin, Belouadah, Mazoit, & Malinovsky, 2008)

Results

- The effects of LAST are devastating and can quickly lead to mortality.
- It has been proven time and again through research studies and real-life case reports that LE therapy is an effective treatment modality for LAST.
- Traditional resuscitation measures do not treat LAST effectively, and morbidity and mortality remain significantly higher without utilizing LE therapy.
- This therapy has caused people to have complete recoveries and return to their baseline functioning when it appeared that they would not even live at all.
  (Ludot, Tharin, Belouadah, Mazoit, & Malinovsky, 2008)

Treatment of LAST

- Get Help!
- Airway management
- Seizure suppression
- BLS, ACLS (avoid local anesthetics)
- Lipid Emulsion Therapy
  (ASRA, 2012)
Treatment of LAST, ctd.

- The proper administration of LE therapy is as follows:
  - Bolus of 20% lipid at a dose of 1.5ml/kilogram
  - Followed by an infusion of 0.25ml/kilogram/minute for twenty minutes or until a stable heart rhythm is restored and then continued for at least ten minutes
  - Additional bolus may be administered if adequate circulation is not restored, bolus may be repeated up to two times at five minute intervals or until a stable rhythm is restored.
  - Other possibilities include increasing the infusion to 0.5ml/kilogram/minute for ten minutes
  - Upper limit for dosing is 10ml/kilogram for thirty minutes in cases where adequate circulation is not being restored
  - Recommend the initiation of LE therapy as early as possible in the resuscitation process, ideal to utilize this therapy before cardiac arrest occurs.

[ASRA, 2012]

Results

- Unknown mechanism of action LE therapy
- Most commonly accepted theory is the "lipid sink" phenomenon.
  - The emulsified fat droplets that form the lipid compartment take up lipophilic substances such as local anesthetics into a "lipid sink" forming a concentration gradient between the tissue and the blood. This causes the local anesthetic to move away from the heart and brain.
- Other proposed but vaguely researched mechanisms of action exist

[Saez et al., 2007], [Rothschild et al., 2010], [Toledo, 2011]

References

References


References

Introduction & Statement of Problem

- Preeclampsia= Abnormal proteinuria & hypertension (previously definition contained non-dependent edema).
- Systemic inflammation and severe hypertension significantly influences both maternal and fetal mortality and morbidity risks.
- Treatment is supportive and delivery of the fetus and placenta is the only curative measure.
- The problems encountered while administering general anesthesia include difficult airways, ventilation issues, unstable hemodynamics, fluid administration challenges, and altered pharmacodynamics.

Purpose

- The purpose of this project is to discuss implications of preeclampsia on the safe practice of general anesthesia.
- Focused on:
  - fluid management through invasive monitoring
  - airway concerns
  - blood pressure control
  - pharmacological considerations
Significance

- Hypertensive disorders occur in 5-8% of all pregnancies in the United States; 70% of these disorders presenting in nulliparous women (Turner, 2010).
- Risk factors: previous diagnosis, obesity, multiple gestation, extremes of age, kidney disease, diabetes.
- Maternal risks: mortality equal 0.2%, serious morbidity equals 5% (Ghulmiyyah & Sibai, 2012).
- Neonatal risks: higher rates of perinatal mortality, preterm birth and low birth weight (NICE).
- 5-fold increase in mortality for infants born to women with preeclampsia; much of the mortality is contributed to iatrogenic prematurity (Gan and Roberts, 2002).

Areas of Clinical Importance

- How to guide fluid administration? Invasive monitoring necessary: CVP vs. PCWP.
- What are the specific airway concerns for this population?
- Optimal antihypertensive agent for treatment? What agents can be used to blunt hypertensive responses to intubation?
- Any other pharmacological concerns? Interactions with magnesium sulfate and pseudocholinesterase changes.

Framework

- Physiologic theoretical framework used.
- Etiology still unknown.
- Two stage model adopted:
  - Stage 1: Asymptomatic, occurring between 12-20 weeks gestation when trophoblasts invade placental beds. Too shallow resulting in inadequate vessel remodeling leading to decreased perfusion.
  - Connection from Stage 1 into Stage 2: Unknown, likely vasoactive substances are released.
  - Stage 2: Development into a maternal systemic disorder. Widespread vascular endothelium dysfunction resulting in cerebral edema, increased LFTs, decreased platelets, kidney dysfunction, & pulmonary edema.

Overview of Methods

- Literature review obtained from searches of Cochrane Library, Pubmed, CINAHL and International Journal of Obstetric Anesthesia.
- Prominent key words: Preeclampsia, Pregnancy-induced hypertension, HELLP syndrome, Obstetric anesthesia, general anesthesia.
- Nearly all of research published between 1995-2012.
Results: Fluid Management

- Preeclampsia decreases intravascular volume up to 30-40% (Mandal & Surapaneni, 2004; Ramanathan & Bennett, 2003).
- Leaky capillaries and decreased oncotic pressures easily result in non-dependent edema and high risk for flash pulmonary edema.
- Some advocate fluid boluses when CVP < 4 mm Hg and urine output < 100 ml/4 hours (Robson, 1999). If ≥ 4 mm Hg, fluid can increase CVP to >10 mmHg and induce pulmonary edema (Pearson, 1999).
- CVP versus PCWP monitoring, inconsistencies found, recommend only PCWP (Boite et al. 2000).

Results: Airway Concerns

- Increased airway edema and thrombocytopenia, airway assessments can change drastically in as little as 4-6 hours (Mokriski et al., 1988).
- Case studies exhibit nasal intubations necessary. Choices of vasoconstrictor: 3% lidocaine combined with 0.125% phenylephrine in a normal saline solution (Mokriski et al. 1988) and a mixture of 1 ml of 1% phenylephrine with 4% lidocaine 10 ml (Arendt et al. 2000).
- Preparation most important
- A rapid and extreme adrenergic response can be caused by laryngoscopy and intubation.

Results: Antihypertensives

- Preeclampsia causes a state of generalized vasoconstriction, higher total vascular resistance, and low CO (Melchorre & Thilaganathan, 2011) (Tihtonen et. al, 2006).
- Management must balanced maternal risk of cerebral hemorrhage with fetal risks if uterine perfusion pressure is decreased.
- Prevent laryngoscopy response: Esmolol 1mg/kg plus lidocaine 1.5mg/kg approx. 2.5 mins prior to intubation (Bansal & Pawar, 2002), remifentanil 0.5 mcg/kg 2 mins prior to intubation (Park et al., 2011).
- Hydrazaline and labetalol can be used safely (Vigli-De Gracia et al., 2005), however, a meta-analysis found hydralazine to have increased hypotension & tachycardia and don’t recommend for 1st line treatment (Magee et al., 2003).

Results: Pharmacologic Concerns

- Magnesium sulfate increases duration of muscle blockers.
- BIS numbers and consumption of midazolam, fentanyl, and atracurium were decreased with magnesium sulfate on board (Lee & Kwon, 2009).
- 60% of the HELLP syndrome group had reduced pseudocholinesterase activity compared to the preeclamptic group with 33.3% and the normal group with only 6.6%. Serum levels of liver enzymes did correlate with pseudocholinesterase activity, but not with platelet count or gestational week (Lurie et al. in 2007).
Other interesting points

- Research during induction, but not during maintenance or emergence phases
- Some worry many, especially new, providers are reliant on regional and are inexperienced with pregnant airways
- As always, careful evaluation and determination of risks and benefits is important. Overall, preparation and familiarity with medications and monitoring devices should guide decisions

References

References


Thank You

Are There Any Questions?

**DEXMEDETOMIDINE FOR NON-INVASIVE PEDIATRIC PROCEDURAL SEDATION**

Jennifer Schumann, SRNA

Introduction

- **Dexmedetomidine –FDA approved for adult use**
  - 1999 for sedation of intubated adults in the ICU
  - 2008 for adult surgical/procedural sedation in non-intubated patients outside the ICU
- **Major advantages**
  - Sedative, sympatholytic, and analgesic effects
  - Minimal respiratory depression
  - Less relaxation of upper airway structures
  - No psychotropic side effects
Introduction

• Respiratory compromise is a top concern for pediatric sedation (4)
  – Pediatric Research Consortium - incidence of stridor, laryngoepiglottitis, wheezing or apnea
  – 33,000 sedation encounters - occurred 1:400
  – 49,836 propofol sedations - occurred 1:65
• Increasing off-label use of Dexmedetomidine in pediatrics
  – Over 200 published studies (3)
• Shown promise in non-invasive procedural sedation (1, 2, 3)

Research Question

• Does dexmedetomidine offer a safe, efficacious, and reasonable alternative to the current standards of non-invasive, pediatric procedural sedation?

Purpose

• Review of the Literature
  – Pharmacology
  – Safety and efficacy profile
  – Applicability of use
• Create sample protocol
  – Current anesthesia and sedation guidelines
  – Review of the literature on dexmedetomidine

Significance

• Up to 40% of anesthesia services are provided outside the OR (1)
• Up to half of sedation services in large pediatric hospitals occur in radiology department (2)
• 8-9% increase per year in the number of children receiving anesthesia care for CT/MRI (3)
**Theoretical Framework**

- **Physiology of CNS control on upper airway structures** (1), (2)
  - Inhibition of CNS innervation leads to relaxation of upper airway musculature; narrows airway diameter
- **Pediatric airway anatomy** (2)
  - Increased risk for upper airway obstruction and collapse
- **Dexmedetomidine’s sedation mechanism of action**
  - Mimics natural stage II non-REM sleep, maintains natural respiratory drive, and patency of the airway (4), (5), (6)

1- (Mahmoud et al., 2009); 2- (Nagelhout & Plaus, 2010); 3- (Mahmoud et al., 2010); 4- (Tobias, 2007); 5- (Mason & Lerman, 2011); 6- (Mahmoud et al., 2010)

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**Findings: Pharmacology**

- **MOA** (1), (2)
  - Alpha 2 agonist (1600:1)
- **Bioavailability** (4)
  - Intramuscular - 104%
  - Transmucosal - 65-82%
  - Orogastric - 16%
- **Distribution/Elimination** (3)
  - Redistribution: life ~ 7 min
  - Elimination: life ~ 2 hr
  - Primarily liver metabolism

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**Findings: Cardiovascular Effects**

- **Depressed SA and AV node function** (11)
- **Biphasic hemodynamic effects** (1)
  - Increased SVR/BP \(\Rightarrow\) reflexive bradycardia \(\Rightarrow\) HR/BP below baseline
- **Two most common side effects** (2-10)
  - Bradycardia (5-20% incidence)
  - Hypotension (7-33% incidence)
  - More common with prolonged fasting
- **Hypertension 3-5%** (6, 10, 12, 13)
  - Younger age, repeat boluses, glycopyrrolate treatment

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**Process**

- **Literature review through UND’s online library**
  - **Data Bases**: Pubmed, Cochrane library, MD Consult First Consult, CINHAL, and SCOPUS
  - **Search Terms**: conscious sedation, deep sedation, pediatrics, and dexmedetomidine
- **Example dexmedetomidine protocol created**
  - Current ASA & AANA guidelines
  - Findings from literature review
- **Findings and Recommendations shared with North Dakota nurse anesthesia community**
Findings: Respiratory Effects

- **Dexmedetomidine vs. Propofol**
  - 1/3 requirement for artificial airways or airway manipulation in children with OSA (1)
- **Increasing doses of dexmedetomidine on airway**
  - No clinical signs of obstruction
  - Minimal changes to upper airway measurements during MRI imaging in healthy pediatric patients
    - (5%- low dose and 10% - high dose dexmedetomidine) (2)

1- (Mahmoud et al., 2009); 2- (Mahmoud et al., 2010)

Findings: CT/MRI Sedation

- **“Low-Dose Dexmedetomidine”** Standard FDA approved adult doses have shown inconsistent results
  - Propofol had shorter onset, recovery, and discharge times
  - Desaturation and decreased RR in propofol group (2)
  - Midazolam had shorter onset, more rescue sedation, lower quality images, but similar hemodynamic changes (1)
  - Dexmedetomidine 0.5-1.5 mcg/kg bolus and 1 mcg/kg/hr for MRI over 75% required rescue sedation resulting in 90 min. discharge times (3)
  - Midazolam-Dex combo vs. propofol similar findings to 2006 study (4)

1- (Koroglu et al., 2005); 2- (Koroglu et al., 2006); 3- (Heard, Joshi, & Johnson, 2007); 4- (Heard et al., 2008)

Findings: CT/MRI Sedation

- **“High-Dose Dexmedetomidine”**
  - Children’s Hospital Boston using Dexmedetomidine Protocol since 2005 (1,2,4,5)
  - CT: 2 mcg/kg bolus followed by 1 mcg/kg/hr infusion shown good efficacy
  - MRI: 3 mcg/kg bolus followed by 2 mcg/kg/hr infusion shown good efficacy
  - 2 mcg/kg bolus and 1 mcg/kg/hr infusion for MRI required 36% re-dosing and 29% rescue sedation (3)
  - Incidence of hemodynamic effects comparable

1- (Mason et al., 2006); 2- (Mason et al., 2008); 3- Saddippa, Riggins, Kariyanna, Calkins, & Rotta, 2011); 4- (Mason, Prescilla, Fontaine, & Zurakowski, 2011); 5- (Mason, Fontaine, Robinson, & Zurakowski, 2012)

Findings: Dexmedetomidine – Ketamine Combination

- **Attenuation of hemodynamic side effects** (1, 3)
- **Attenuation of psychodynamic effects** (3)
- **Sedation for more stimulating procedures** (2)
  - Lithotripsy
Findings: Cost

- **Dexmedetomidine**
  - $55 per 200 mcg vial (1,2)
  - (100 mcg/mL in 2 mL)
- **Midazolam**
  - $5 per 5 mg vial (2)
- **Propofol**
  - $10 for 200 mg vial (1,2)

Cost of sedation (1)
- Dexmedetomidine $15.40
- Propofol $14.50
  - (Based on volume for a 20 kg patient over 1 hr)

1- (Hear, Joshi, & Johnson, 2007); 2- (Heard et al., 2008)

Findings: Additional Perioperative Indications

- Pre-anesthesia sedation
- Treatment of cyclic vomiting syndrome
- Prevention of emergence delirium
- Anti-emetic effects
- Treatment for post-op shivering
- Less interference during EEG monitoring
- Treating withdrawal from opiates and benzodiazepines

(Tobias, 2007); (Phan, & Nahata, 2008); (Mason, & Lerman, 2011); (Cravero, 2009); (Yuen, 2010)

Conclusion

- Dexmedetomidine has increasing clinical support for pediatric use
  - Good results seen with consistent use of a protocol
- Several factors are preventing mainstream use and FDA approval
  - Inconsistent focus in research studies
  - Lack of a standardized pediatric dose
  - Incidence of bradycardia and hypotension seen with increasing doses
References


Thank You
Are There Any Questions?

Introduction

Patients with genetic disorders, with or without multiple congenital anomalies, present unique challenges to the health care provider responsible for administering sedation and anesthesia during surgical procedures. It is important health care providers recognize the risk factors and potential complications before sedation or anesthesia (Butler, Hayes, Hathaway, and Begleiter, 2000, p. 837).
Introduction

- Down syndrome is the most common chromosomal disorder, occurring in 1 in every 600-800 live births.
- The inherent traits and characteristics of this disorder increase the frequency of which this patient requires surgical intervention necessitating the administration of general anesthesia.

Purpose

- The purpose of this independent project is to identify the increased risks that pediatric Down syndrome patients encounter during general anesthesia and to provide a comprehensive review of current recommendations to prevent anesthesia-related complications.
- Knowledge of these considerations as well as current evidence-based recommendations will assist the anesthesia provider in reducing potential anesthesia-related complications.

Significance

- Up to half of all children with Down syndrome (DS) are born with congenital heart disease, with between 40-50% requiring surgery to repair or correct a cardiac anomaly (Tonge, 2011, p. 609).
- Between 25-30% of children with DS are born with endocardial cushion defects (ECD), abnormal developments of the lower atrial and upper ventricular septum, which in comparison represents only 4% of all congenital heart disease (Kriss, 1999, p. 442).
- Increased risk of other congenital heart defects: Ventral septal defects (27%), patent ductus arteriosus (12%), tetralogy of Fallot (TOF) (8%), and defects to the atrioventricular canal (AV canal), tricuspid and mitral valves (Kobel, Creighton, & Steward, 1982, p. 596).
- Children with DS also present with greater frequency for treatment of routine pediatric ENT problems with increased incidences of ear infections, chronic rhinorrhea, and sinusitis. Stenosis of the ear canal is present in up to 50% of newborns with DS (Shrott, 2006, p. 132).

- Patients with Down syndrome are at an increased risk of possessing critical airway differences, which may result in difficult airway management including a short neck, small chin, large tongue, prominent dentition or deformities to the palate, maxilla or mandible contribute to difficult airway management and to increased incidences of upper airway obstruction and obstructive sleep apnea syndromes (Goldstein, et al., 1998, p. 171).
- The entire airway of the patient with Down syndrome is intrinsically irritable. Any airway manipulation places a patient with DS at an increased risk for developing postoperative respiratory complications such as postoperative stridor and apnea (Morgan, Mikhail, & Murray, 2006, p. 938).
- Further, the congenital laxity of the atlantooccipital ligaments increases the risk of dislocation with neck extension during laryngoscopy necessitating extreme care with positioning during intubation (Buller, Hayes, Hathaway, & Begleiter, 2000, p. 842).
- An often-overlooked consideration is the existence of abnormalities of the immune system which these children possess, predisposing them to respiratory infections. Respiratory tract infections are the most important cause of mortality in Down syndrome patients of all ages (Bloemers et al., 2010, p. 799).
Research Questions

- During general anesthesia what are the unique risks encountered by the pediatric patient with Down syndrome?
- Are there any interventions, supported by current evidence based practice recommendations, that can modify or reduce anesthesia related complications for the pediatric patient with Down syndrome?

Overview of Methods

- A comprehensive review of the literature, using the medical databases PubMed, CINAHL, AccessMedicine, Cochrane, DynaMed & MedlinePlus, was performed to examine the existing body of knowledge concerning general anesthesia and the pediatric patient with Down syndrome.
- Key words searched included, but were not limited to, Down syndrome, Trisomy 21, pediatric, children, general anesthesia, complications, airway management, risk factors, atlantooccipital instability, bradycardia, laryngoscopy, endotracheal and tracheal intubation and all of their variants.
- The pathophysiology of the condition, Down syndrome was used as the theoretical framework for this project.

Results

- Pediatric patients with Down syndrome present with specific considerations for the safe provision of general anesthesia.
- Three key areas of special consideration for general anesthesia in the pediatric Down syndrome patient emerged: the physical differences in the airway, the risk of craniooccipital instability, and the increased occurrence of bradycardia with inhalation induction.

Airway

- DS patients have smaller than expected airways, not only with the presence of subglottic stenosis, but an overall decreased tracheal lumen size.
- This decreased lumen size was confirmed by radiographic measurements (Aboussouan, O'Donovan, Douglas Moodle, Gragg, & Stoller, 1993), by measurement of air leak around the endotracheal tube and by measurements via magnetic resonance imaging (MRI) (Shortt, 2006).
- Further, it was determined that the presence of a significantly narrowed trachea was unrelated to height, weight, or the presence of congenital heart disease (Aboussouan, O'Donovan, Douglas Moodle, Gragg, & Stoller, 1993).
- Santamaria, DiPaola, Mattrica, & Fodale attributed this overall decrease in airway lumen size to the elevated risk of intraoperative hypoxemia, intra and postoperative death (2007).
Airway recommendations

- Current, evidence-based practice recommends the use of smaller than expected tracheal tubes for intubation to compensate for the presence of smaller airway lumens and increased incidence of subglottic stenosis and to minimize risk of airway trauma.
- Aboussouan et al. attributes the use of smaller endotracheal tubes to the reduction of post-operative ventilatory dysfunction (1993).
- While previous studies, Kobel, Creighton, & Steward, 2008 and Aboussouan et al., 1993 all recommend the consideration of smaller endotracheal tubes, they do not provide specifications.
- Shott provides clear recommendations stating initial intubation should be performed with an endotracheal tube at least two sizes smaller than predicted by age to avoid potential trauma to the airway (2000). Proper size should, as always, be confirmed by presence of air leak (Shott, 2000).

Craniocevical instability

- Craniocevical instability describes atlantoaxial or atlantooccipital instability, and while instability at the atlantoaxial level of C1-C2, occurs more commonly, than excessive movement at the occiput and C1, the terms are often used interchangeably.
- A anterior atlantodental interval (AADI), greater than 4-5 mm is a positive indication for atlantoaxial instability and demonstrates a failure of the first cervical vertebrae, C1 to properly adhere to C2, which allows C1 and the base of the skull to dislocate anteriorly (Hata & Todd, 2005 p. 681).
- By most current estimate, it appears that 15-20% of patients with Down syndrome have ligamentous laxity of the atlantoaxial joint, predisposing them to C1-C2 subluxation and spinal cord injury (Meitzner & Skurnowicz, 2005, p. 103).
- While the majority of the population with AAI is asymptomatic, signs and symptoms for the anesthesiologist to be aware of may include a positive Babinski sign, hyperactive deep tendon reflexes, ankle clonus, muscle weakness, increased muscle tone, neck pain, and an abnormal or difficult gait when walking (p. 104).
- Additionally, laxity of ligaments in other areas of the body, particularly the joints of the finger, thumb, elbow, and knee positively correlate with the presence of AAI and should be evaluated in the preoperative interview.

Recommendations

- The most common screening test used to detect AAI is a simple x-ray with lateral flexion, extension, and odontoid views.
- Although cervical spine radiography is used most often as a screening, there is some support for use of magnetic resonance imaging to determine neural canal width, researchers have determined MRI to be a better predictor of spinal cord compression over x-ray films (1993).
- American Academy of Pediatrics currently recommends lateral cervical radiographs screening for all patients with Down syndrome sometime between the ages of 3 and 5 years (Hata & Todd, 2005, p. 482).
- Proper positioning when performing laryngoscopy during endotracheal intubation, as well as care in rotating the head laterally (as during a myringotomy), is of critical importance, as the neck must be maintained in a neutral position to avoid cervical spine damage (Melzner & Skurnowicz, 2005).
- Especially in patients with suspected or documented AAI, recommendations for the use of a soft cervical collar during the intraoperative and immediately postoperative periods to avoid cervical spine damage have been suggested.

Bradycardia

- Pediatric patients with Down syndrome exhibit significant hemodynamic changes following the inhalation induction of general anesthesia, at a rate significantly higher than the general pediatric population.
- Liao et al. (2000) documented heart rate abnormalities in Down syndrome fetuses as early as 10-14 weeks gestation, displaying abnormally high heart rates, above the 95th percentile, or abnormally low heart rates, below the 2.5th percentile, as assessed by ultrasound Doppler and real time 2-mode imaging (p. 610).
- In a multivariate analysis, Down syndrome as an independent factor, was found to be associated with bradycardia (Borland, Colligan, & Brandon, 2004).
- Additionally, post induction bradycardia is more common in children with Down syndrome both with, and without, a history of co-existing congenital heart disease (Kraemer et al., 2010).
Bradycardia recommendations

- Bradycardia was resolved with reduction of inhalation agent concentration, airway manipulation, and pharmacological treatment.
- While not necessarily an intervention, the increased incidence of bradycardia with inhalation induction of the pediatric patient with Down syndrome should be kept in the forefront of the mind of the anesthesiology provider.
- While current research does not recommend for pretreatment with atropine for this patient population in its entirety, the development of bradycardia should be considered to be an expected development during inhalation induction.

References


Conclusion

- Remember that these patients have overall smaller tracheal and airway lumen sizes, use smaller endotracheal tubes, at least 2 sizes smaller than expected for age, confirm size with air leak test.
- Keep in mind the existence of immune system abnormalities and intrinsic airway irritability when considering the patient’s airway.
- Consider the presence of AAI, especially if the patient has no previous cervical spine radiographic evaluation and/or if they display excessive laxity of other joints such as the finger, thumb, elbow, and knee.
- Be aware of AAI when extending the patients head for direct laryngoscopy or turning laterally for surgical procedures (i.e. myringotomy).
- Bradycardia with inhalation induction should be anticipated and appropriate pharmacological treatment should be prepared and available.
ANESTHETIC CONSIDERATIONS FOR THE CHILD WITH CEREBRAL PALSY

Elizabeth McBride, SRNA

Introduction & Statement of Problem

- Cerebral palsy is a non-progressive neuromuscular disorder affecting thousands of children each year.
- Children with cerebral palsy often require anesthesia and surgical care for a variety of procedures.
- Due to co-morbidities, these children are at high risk for anesthetic complications.

References

Purpose

- An increased understanding of the pathophysiology of cerebral palsy (CP), as well as potential anesthetic implications and complications, will help the CRNA to deliver safe patient care and improve patient outcomes.

Significance

- Despite advances in medicine and prenatal care the prevalence remains constant at about 1-2.5 per 1000 live births. 57.
- Children with cerebral palsy often require surgery and anesthetic care for a variety of reasons. 57
  - Dental, gastroesophageal reflux, feeding tubes, tracheostomies, spinal surgery, and neurosurgical procedures to control spasticity (highly selective dorsal rhizotomy) 57

Research Questions

- What is the etiology and pathophysiology of cerebral palsy?
- How does cerebral palsy affect our anesthetic plan of care?

Framework

- Anatomy and physiology provided the conceptual framework.
- Complexities of cerebral palsy:
  - Communication deficits
  - Seizure Disorder (30%)
  - GERD
  - Recurrent aspiration
  - Scoliosis
  - Muscle weakness

* (Wongprasartsuk & Stevens, 2002)*
Framework

- Cerebral Palsy can be classified various ways.
  - Severity
  - Topographical Distribution
  - Motor Function
  - Gross Motor Function

  (Nolan, Chalkiadis, Low, Olesch, & Brown, 2000 37)

Framework: Swedish Classification System

- Spastic
  - Quadriplegia
  - Diplegia
  - Hemiplegia

- Dyskinetic
  - Dystonia: twisting position of the torso and extremities
  - Athetosis: slow, purposeless distal movements
  - Chorea: proximal quick, jerky movements

- Ataxic: Head tremor
- Mixed

  (Nolan, Chalkiadis, Low, Olesch, & Brown, 2000 37)

Framework: Etiology

- Prenatal causes include brain malformations, in utero stroke, maternal infection (including cytomegalovirus infection and other TORCH infections), and congenital anomalies 13
- As early as the 1950's, it was found that babies whose mothers were febrile were seven times more likely to suffer from cerebral palsy 36
- The exact cause of CP appears to be multifactorial 36

  (Dodge, 2008 13 & Nelson, 2008 36)

Methods

- A literature search provided the information gathered.
- Search engines such as CINAHL, PubMed, and MEDLINE were utilized.
- References of pertinent articles were reviewed and additional resources gathered.
**Literature Review: Prevention of Cerebral Palsy**

- MgSO4
  - Stabilize the neuronal cell membrane
  - Stabilize blood pressure/dilate cerebral arteries and decrease the pro-inflammatory cytokines and free radicals

  *(Wolf, Hegaard, Greisen, Huusom, & Hedegaard, 2012)*

**Literature Review: Communication**

- About half have normal cognition
- Ranges from non-verbal to verbal
- Parent/caretaker often necessary to facilitate communication
- Other communication methods
  - Facial expressions, computers

  *(Dodge, 2008)*

**Review of the Literature: Potential Respiratory Complications**

- Increased activity of and impaired cranial nerve function
  - Increased/augmented salivation
  - Pooling of secretions
- Bulbar muscle impairment influences ability to control mouth, tongue, and pharynx
- Decreased motor function
  - Weak cough
  - Reduced ability to clear secretions

  *(Holm-Knudsen & Rasmussen, 2006, & Theroux & Atkins, 2005)*

- Secretions drain into oral pharynx, irritate the vocal cords, and cause laryngospasm or pneumonia
- Reactive airway disease due to damaged pulmonary parenchyma
- Laryngomalacia
  - During inspiration there is a decrease in the tone of the supraglottic structures resulting in a collapse of soft tissue into the airway, decreasing the size of the airway and airflow, ultimately resulting in stridor

  *(Fitzgerald et al., 2009, Holm-Knudsen & Rasmussen, 2006, & Theroux & Atkins, 2005)*
Review of the Literature: Aspiration

- Abnormal esophageal motility, atypical lower esophageal sphincter function, spinal malformation
- Scoliosis may cause extrinsic restrictive lung disease leading to hypoxemia, pulmonary hypertension, decreased ability to cough and clear secretions

Review of the Literature: Aspiration & Laryngospasm

- Prevention of aspiration
  - RSI
  - Awake extubation
- Prevention of laryngospasm
  - Suction oropharynx
  - Propofol 0.5mg/kg
  - Positive pressure with extubation
  - No touch-techniques with extubation
    - Once patient was spontaneously breathing, anesthetic gas was turned off
    - No stimulation until patient opened his/her eyes
  - Tracheal extubation with eye opening

Review of the Literature: Treatment of Laryngospasm

- Treatment of laryngospasm
  - Positive pressure ventilation
  - Retroauricular digital pressure
  - Lidocaine 1-1.5 mg/kg
  - Propofol 0.8mg/kg
  - Succinylcholine (0.25-1mg/kg IV or 4-6 mg/kg IM)

Review of the Literature: Acetylcholine Receptors

- Up-regulation of acetylcholine receptors
  - Neuromuscular junctions never fully developed
  - Occur overtime due to disuse
  - Nonambulatory patient has structurally different neuromuscular junctions than the ambulatory cerebral palsy patient
  - Risk of hyperkalemia with succinylcholine
  - Resistance to vecuronium
Literature Review: Pharmacologic Considerations

- **Baclofen**
  - Increase sedative effects of other drugs
  - Withdrawal: fever, itching, & increased stiffness
  - Overdose: lethargy, seizures, & respiratory depression

- **Valproic acid**
  - Transient immune thrombocytopenia, red cell aplasia, acquired von Willebrand disease, and bone marrow failure
  - Preoperative coagulation tests

- **Botulinum toxin and Dantrolene**
  - Lethargy and generalized/respiratory weakness

(Aker & Anderson, 2007; Dodge, 2008; Wass et al, 2011)

Literature Review: Regional Anesthesia and Cerebral Palsy

- Regional anesthesia is a viable option for patients
  - Blocking the anterior obturator nerve with 5% phenol can reduce the adductor stiffness and improve range of motion for up to six months and longer

(Kwon & Kim, 2010; Mathuram, et al, 2010)

Conclusion

- Certified Registered Nurse Anesthetists (CRNA) provide anesthesia care to a variety of patients including those with cerebral palsy.
- Knowledge of the pathophysiology, anesthetic implications, and possible complications will allow CRNAs to individualize care and improve anesthetic outcomes for this population of patients.

References


References


Thank You
Are There Any Questions?