Introduction & Statement of Problem

- In today’s ever changing sociopolitical world, along with the influences of multimedia healthcare, the importance of patient safety has become a national issue.
- Facilities often have policies or guidelines regarding what they recommend and enforce in terms of distractions in the OR, but are they evidence based and clinically significant?
- With changes in technology and ever changing societal trends these distractions must be addressed to find out what is clinically acceptable practice.

Purpose

- The purpose of this independent project is to identify common distractions and study their effects on vigilance.
- The focus of the project will be on smartphone/computer use, reading, and music during the maintenance phase of anesthesia.

Significance

- Anesthesia professionals have prided themselves in being leaders and advocates in patient safety for decades.
  - Support and reimbursement are often based on patient safety and outcomes.
  - Seeing a change from a reactive to a proactive culture of safety.
- The AANA emphasizes not only the significance of vigilance and safety within nurse anesthesia care, but the legal and ethical obligations to act accordingly as set forth by their Scope and Standards for Nurse Anesthesia Practice and the Code of Ethics for the Certified Registered Nurse Anesthetist.
  - The fifth standard of the CRNAs scope and standards outlines monitoring responsibilities with the AANA stating that, “continuous clinical observation and vigilance are the basis of safe anesthesia care”.
- With technological advances the maintenance phase of anesthesia is progressively becoming more automated. In these automated environments vigilance is a crucial component where the anesthesia provider serves as a fail-safe to monitor for problems and intervene when necessary (Warm, Parasuraman, & Matthews, 2008).
  - “The fact that most accidents occur during the maintenance phase of anesthesia—rather than during induction or emergence—implies a failure of vigilance” (Morgan, Mikhail, & Murray, 2006, p.962).
  - “Up to 70% of errors in medicine are linked to human factors and systems safety issues” (Rall, Gessel & Staiender, 2011, p. 260).
  - In a study of 1089 critical incidents it was found that only four percent of critical incidents were a cause of equipment failure, meaning many of the incidents were related to human error (St. Jacques & Rothman, 2011).
Research Question

• Does the use of electronic devices, reading in the operating room, and listening to music within the operating theatre during the maintenance phase of anesthesia negatively impact anesthesia provider vigilance and ultimately patient outcomes?

Framework

• Jean Watson’s Theory of Transpersonal Human Caring was the theoretical framework used to demonstrate the critical aspect of provider vigilance.

  • In order to form a caring relationship with patients, the healthcare provider must be consciously engaged to maintain the intention and commitment of providing a healing and safe environment (Watson Caring Science Institute, 2012; Bailey, 2009).

Overview of Methods

• An inclusive search was conducted utilizing the Cochrane Collaboration, PubMed, CINAHL, and Scopus databases, a search of all articles relevant to the project were sought after.

  • Although meta-analysis and randomized control trials would be ideal they are not widely available.

  • Therefore, search limits addressing this clinical question were very unrestricted.

Review of the Literature

• Vigilance

  – “The state of readiness to detect and respond to stimulus changes that are barely detectible, or which occur infrequently or at irregular intervals” (Ballard, 1996, p. 844).

Review of the Literature

• Vigilance Cont’d

  – The maintenance of vigilant tasks is now known to be resource demanding with a considerable amount of workload and stress (Warm, Parasuraman, & Matthews, 2008).

  – There is a negative correlation between the length of time a vigilant task needs to be sustained and the efficacy at which vigilance is maintained (Paget, Lambert, & Srihar’s, 1981).

  – The psychology of decision making is also gaining more attention as researchers continue to show that errors often resulted from cognitive lapses influenced by individuals’ subconscious thoughts and feelings.

  • Unfortunately, the tangibility of cognition is low at best making them challenging to define, identify, study, and also prevent (Stiegler, Neelankavil, Canales, & Dhillon, 2012).

Review of the Literature

• Vigilance continued:

  – Under certain circumstances the addition of a secondary task can improve vigilance during extended periods of low stimulation.

    • The effect that an additional task may have is dependent upon the personality traits of the individual, the workload of the primary task, and nature of the secondary task (Jorm & O’Sullivan, 2012).

    • Extraverts vs. introverts

      • Extraverts (high sensation seekers) require more stimuli and complex sensations to maintain cognition and are less capable of performing at satisfactory levels during monotonous tasks.

      • Introverts (low sensation seekers) require fewer stimuli and are more likely to perform well with monotonous tasks (Larue, Rakotonialy, and Pettitt, 2010).
Review of the Literature

• Vigilance continued:
  – It has also been noted that "boredom may be minimized by altering the sequence of tasks or by adding new tasks to a monotonous job" (Weinger, 1999, p. 549).
  – Although boredom can certainly be unpleasant, the literature is also void of any research that provides strong evidence showing patient harm as a result of boredom (with proper rest).

• Smartphone/Computer
  – There has been no research regarding the impact of smartphone and computer use on nurse anesthesia vigilance.
  – However, the human attention span is without a doubt limited and interruptions and unnecessary noise and other causes of arousal do negatively impact human functioning and vigilance (Jorm & O’Sullivan, 2012).

• Reading
  – Along with all distractions, this is greatly dependent upon individual psychological and physiologic factors.
  – For some, reading may increase vigilance, especially when feeling fatigued; while causing others to be even less vigilant (Slagle & Weinger, 2009).
  – "Adding tasks to a monotonous job can decrease boredom, and dividing attention among several tasks (time-sharing) will improve monitoring performance in some circumstances" (Slagle & Weinger, 2009, p. 280).

• Music
  – Again due to varying physiological and psychological factors among people, music affects people differently.
  – Excessive noise and distractions can have negative physiologic and psychological effects on health care providers, including decreased mental efficacy and short-term memory (Broom, Capek, Carachi, Akeroyd, & Hilditch, 2011).
  – Continuous noise can improve, decrease, or have no effect on vigilance decrement (Ballard 1996).
  – However, according to Ballard (1996), during low demand tasks performance can be enhanced by music or voice.
  – Researchers have indicated that the choice or nature of a secondary task is probably less critical than how the secondary task is combined with the primary task (Jorm & O’Sullivan, 2012).

Results

• To date, the literature is void of any research that justifies blanket prohibition of these potential distractions in the OR.

• Multitasking is inherent to anesthesia provider’s daily activities, but there are limits and implications associated with it.

• Experienced anesthesia providers have an enhanced situational awareness due to the fact that the task of providing anesthesia is almost second nature to them. (Jorm & O’Sullivan, 2012).

Conclusions

• Although many activities have become ubiquitous they may have sociopolitical and medicolegal implications.
  – Technological advances have improved patient safety, but have a tendency to allure attention away from patient care.
  – Without evidence to back up recommendations for practice it is suggested to refrain from making recommendations regarding “distractions” during the maintenance phase of anesthesia until further research is conducted.
  – For now, anesthesia providers must be educated to have insight about the significance of these activities related to patient safety.
  – “The vigilant qualified anesthesia care provider remains the most important guarantor of quality care in the operating room suite” (Rothman et al., 2011, p.29).
IDENTIFYING TRANSFUSION-RELATED ACUTE LUNG INJURY IN THE ANESTHETIZED PATIENT

Michael Branby, SRNA

Introduction & Statement of Problem

• Non-hemolytic transfusion reactions (NHTR’s) are the most common transfusion reactions and include transfusion-related acute lung injury (TRALI), allergic reactions, febrile reactions, hypotension, bacterial sepsis, transfusion-associated circulatory overload (TACO), and metabolic complications. (Hirayama, 2010).

• TRALI is often misdiagnosed and often confused with transfusion-associated circulatory overload (TACO). The misdiagnoses of TRALI often delays and/or completely leads to incorrect treatment of TRALI which could compromise patients respiratory and cardiovascular systems and overall health. It is important for anesthesia providers to be aware of the signs and symptoms of TRALI as well as the treatment to optimize patient overall well-being.

Purpose

• The purpose of this project is to identify and understand why transfusion related acute lung injury (TRALI) is under-recognized and why it is often mistaken for transfusion-associated circulatory overload (TACO).

• With respect to TRALI and TACO, this project discusses:
  – Pathophysiology
  – Clinical Presentation
  – Evidence Based Actions if TRALI is suspected

Significance

• TRALI has been associated with a variety of blood products: whole blood, pRBC’s, FFP, cryoprecipitate, platelet concentrates, apheresis platelets, bone marrow, and IV IMG.

• Highest association with products with > 50 mL plasma

• Incidence of 1:5000 per unit of blood component

• Reported mortality rate of TRALI is 5-10%

Research Questions

• How is transfusion related acute lung injury (TRALI) different from transfusion associated circulatory overload (TACO)?

• How can transfusion related acute lung injury (TRALI) be differentiated from transfusion associated circulatory overload (TACO)?

Overview of Methods

• A comprehensive review of literature was conducted with the assistance of search engines such as Google Scholar, PubMed and CINAHL.

• Key words that were used to conduct this search were transfusion-related acute lung injury, TRALI, transfusion-associated circulatory overload, TACO, blood transfusion complications, blood transfusion reactions, and anesthesia.
Theoretical Framework

- Physiological Theory Used for Framework
- Two Physiological Mechanisms Identified:
  - Immune (antibody)-mediated mechanism
  - Non-immune "two-hit" mechanism
- Immune-Mediated Mechanism
  - Antibodies activated against HLA’s found on leukocytes.
  - Results in activation of granulocytes, adhere to pulmonary endothelium, resulting in permeability and pulmonary edema.
  - HLA antibodies thought to develop in woman as a response to pregnancy and people that have received previous blood transfusion.
- Non-Immune "Two-Hit" Mechanism
  - The "first-hit" or initial stressor: severe infection, surgery, trauma, or massive transfusion.
  - The "second-hit" activates neutrophils to release oxidases and proteases, damaging endothelium, leading to capillary leak and ALI.
  - The proposed cause of second hit is transfusion of biological modifiers such as leukocyte antibodies, lipid priming molecules, cytokines, or endotoxins.

(Silberman, 1997) (Triulzi, 2006)

Review of Literature

- TRALI, or transfusion-related acute lung injury is defined as new acute lung injury (ALI) that develops within six hours from the start of a transfusion of any blood component.
- Patients develop respiratory distress, hypoxemia, rales on auscultation, and diffuse bilateral infiltrates on chest x-ray with no signs of circulatory overload.
- TACO has been recognized for decades, however, there is no universally agreed upon definition of what constitutes TACO.
- It has been observed that during or within several hours following transfusion, patients develop respiratory distress.

Li et al., (2011) studied 901 ICU patients:
- 51 Patients (6%) developed TACO following transfusion.
- TACO cases received:
  - Greater number transfused units
  - Larger volume plasma
  - More positive fluid balance
  - Faster rate of transfusion
  - Documented left ventricular dysfunction
  - Received FFP for reversal of anticoagulation

Factors that help distinguish TACO from TRALI include:
- Patients fluid balance
- Cardiac function
- Pulmonary edema fluid
- Leukocyte antibody testing
- Elevated pulmonary artery occlusive pressure (PAOP)
  - > 18 mmHg suggestive of TACO

Factors that help distinguish TACO from TRALI include:
- Elevated BNP and proBNP levels are used to detect presence of CHF
- Li et al., (2009) did a prospective cohort study of 115 critical care patients with development of pulmonary edema during or after transfusion in suspected TRALI and TACO cases.
  - Elevated levels of BNP and proBNP were higher in patients developing TACO than TRALI
  - Large overlap in values between the two groups
  - Not specific to identify TACO
Implications

- American Association of Blood Banks Protocols:
  - Donors implicated in TRALI case are tested for presence of HLA class I & 2 antibodies
  - Multiparous females are tested for HLA class I & 2 antibodies
  - The use of fresher blood products to reduce the amount of biological modifiers
  - Removal of plasma from stored platelets and replacement with platelet additive solutions.

References

Introduction & Statement of Problem

• Postsurgical pain is prevalent, and is estimated to be experienced by 80 percent of postsurgical patients.
• Postoperative pain is associated with both physiological and psychological effects decreasing the patients overall wellbeing.
• If pain is not adequately controlled, the postsurgical patient cannot quickly resume normal activity, leading to increased length of stay or possible readmission to the hospital.

Healthcare Reform

With the passage of the Patient Protection and Affordable Care Act:

• Centers for Medicare & Medicaid Services (CMS) will base reimbursement on the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey of patient satisfaction.
• This act makes patients more proactive in evaluating providers and their experiences can now affect healthcare institutions financial bottom line.

Significance

• One of the most important measures of a successful outcome in patient care is effective pain management.
• Pain is so important, that it is one of the eight key topics tracked by CMS’ HCAHPS survey of patient satisfaction.
• Narcotics are often used for pain management but can have inherent risks that can lead to complications that harm the patient and further increase the cost of care.
• The fact that relatively small amounts of narcotics can increase the risk of adverse events, length of stay and associated costs are well documented in the literature.

Purpose

To determine if preemptive ketamine could be a worthwhile addition to the anesthesia providers pain prevention strategy.
Ketamine

- Ketamine was first approved for human use in 1970.
- Became commonly used as a battlefield anesthetic and called the "buddy drug" because soldiers could administer it to each other.
- Ketamine produces a dissociative anesthesia and possesses profound analgesic properties and also produces hypnosis and amnesia.
- Although ketamine has been used for nearly four decades, it has gone somewhat out of favor, mostly due to its psychomimetic effects in higher doses (Cohen, 2011).
- Because ketamine has been in use for so many years it is a low-cost drug.

Ketamine

- Ketamine is an N-methyl-D-aspartate (NMDA) receptor antagonist, which blocks the spinal processing of nociceptive inputs and prevents the central sensitization of nociceptors (Ryu, 2011).
- Functionally it dissociates the thalamus from the limbic cortex.

**BENEFITS**
- Minimally effects ventilations
- Bronchodilator (asthma)
- Analgesia
- Sedation

**SIDE EFFECTS (↑ doses)**
- Hallucinations
- Photophobia
- Psychomotor excitation
- Nystagmus
- Psychotic symptoms
- Increased ICP
- Increased salivation
- ↑ BP ↑ HR ↑ CO

Preemptive analgesia

- The concept of preemptive analgesia suggests that the best postoperative pain management begins preoperatively (Morgan, 2009).
- Preemptive analgesic administration involves the introduction of analgesic medications before the onset of noxious stimuli, with the goal of preventing sensitization of the nervous system which could amplify pain.
- Surgery offers a favorable venue for preemptive analgesia because the timing of noxious stimuli is known.

The Theory

- Ketamine works differently than more traditional analgesics such as narcotics in that rather than binding to opioid receptors, ketamine antagonizes NMDA receptors which have an important role in processing pain (E. Silva, R. Sakata, J. Garcia, R. Salomao, A. Issy, 2012).
- NMDA receptors are activated by glutamate after the dorsal horn is bombarded with pain for an extended period of time.
- The goal of preemptive ketamine analgesia is to prevent NMDA receptor activation in the dorsal horn which then prevents central sensitization and wind up which may lead to a both an immediate and chronic pain state (Barash, 2009).

Research Questions

- Does preemptive ketamine administration decrease the adult surgical patients pain after surgery?
- Can the undesirable side effects of ketamine be diminished by administering a low dose while still reducing postoperative pain?
- Does preemptive ketamine administration have a narcotic sparing effect in the postoperative period?

Framework

- A physiological framework of NMDA receptors and the anesthetic qualities of ketamine was used as the theoretical basis of this project.

[Diagram of NMDA Receptor with binding sites]
Overview of Methods

- A comprehensive review of literature was conducted using databases such as PubMed, CINAHL (Cumulative Index to Nursing and Allied Health), Cochrane, DynaMed and MedlinePlus, as well as multiple search engines on the Internet.

- Types of studies found with related material included qualitative and quantitative reviews, as well as randomized, prospective, and double blinded clinical trials.

Results

- Overall 15 studies were examined for the project.
- Both short term (up to 12 hours) and long term (up to 30 months) pain relief was evaluated.
- 8 of the studies were conducted on low dose intravenous preemptive ketamine administration.
  - All doses were 0.15-0.75 mg/kg.
  - 7 of the studies were conducted on epidural preemptive ketamine administration.
  - Doses administered by epidural were 20 mg to 100 mg.

What About Ketamine’s Side Effects?

- Patients who received a dose of 0.5 mg/kg or lower intravenously had no psychotic episodes, while in the one study where 0.75 mg/kg was administered a small percentage of patients did experience them.

  None of the patients who received ketamine via epidural experienced ketamine’s psychic side effects.

In Conclusion

- Ketamine is a valuable asset to the concept of multimodal anesthesia and reduction of postoperative pain.
- Better pain relief can lead to faster rehabilitation and increase patient satisfaction.
- When given intravenously, preemptive low dose ketamine appears to reduce pain, both postoperatively and chronically, has limited side effects, and reduces postoperative narcotic consumption.
- Short term pain relief is seen in some studies with epidural administration, however it doesn’t seem, so far in studies, to have any effect on chronic pain issues.
- Although ketamine is an old drug its many uses and benefits continue to be discovered.

References

DEXMЕDΕΤΟΜΙΔΙΝΕ AS AN ADJUNCT TO GENERAL ANESTHESIA IN THE ADULT OBESE SURGICAL POPULATION

Bryan Phelps, SRNA

Introduction & Statement of Problem

- Opioid sparing techniques may be useful in avoiding respiratory complications; however inadequate pain control may lead to hypoxemia, hypercarbia and atelectasis.
- Postoperative respiratory problems remain the most frequently reported complication with potentially serious adverse effects.
- Alpha-adrnergic agonists like Dexamethomidine (dex) have emerged as possible solution; reliably providing sedation, analgesia and anxiolysis while maintaining a predictable hemodynamic response without causing respiratory depression.

Purpose

- The purpose of this independent project was to:
  - Identify and put to scale the impact of obesity in the perioperative setting.
  - Identify the common physiologic derangements associated with obesity.
  - Explore the anesthetic considerations for the obese surgical patient.
  - Evaluate the effectiveness of dex when used as an adjunct to anesthesia in this patient population.
Significance

• The rapid rise in obesity combined with the establishment of bariatric surgery for an effective treatment of morbid obesity has lead to obese persons presenting for surgery with ever increasing frequency.

• Comorbidities associated with obesity that have a direct impact on the anesthetic management include: respiratory derangements, cardiovascular dysfunction, endocrine problems, gastrointestinal dysfunction and impaired physical mobility.

Significance

• For each increase in BMI of 5 kg/m$^2$ above a baseline of 22.5-25 kg/m$^2$, there is a 30% increase in all cause mortality; 40% in CV mortality, 60-120% increase in diabetic, renal and hepatic mortality, 10% increase in neoplastic mortality, and 20% increase in respiratory and all other mortality.

• Obese patients are presenting more frequently for surgery and anesthesia at an increased risk; the identification of an anesthetic agent or regimen that can significantly improve outcomes in this population would be of great benefit to the practice of anesthesia.

Research Questions

• What is the impact of obesity in the adult surgical population?
• How are we currently managing these patients?
• What are the unique anesthetic considerations encountered in this patient population?
• Is dex a safe and effective alternative to traditional anesthetic regimens?
• Can dex improve outcomes in the obese adult surgical population?

Framework

• A physiologic framework based on dex’s unique pharmacologic profile and mechanism of action was used to guide this study.
  – Dex is a lipophilic imidazole derivative that is a highly selective $\alpha_2$-adrenergic receptor agonist.
  – $\alpha_2$ receptors are found throughout the body; the sedative and analgesic effects of dex result from its actions on the $\alpha_2$-adrenergic receptors located in the locus coeruleus in the brain and receptors in the spinal cord.
  – Dex’s action in locus coeruleus modulates the release of norepinephrine preventing activation of the CNS allowing the patient to fall into a sedated state where the sleep pattern appears to be like natural sleep.
  – Dex stimulates $\alpha_2$-adrenergic receptors in the spinal cord inhibiting nociceptive neurons stimulated by peripheral A and C fibers.

Overview of Methods

• Literature Search
  – Databases Used:
    - PubMed
    - Cumulative Index to Nursing and Allied Health (CINAHL)
    - Cochrane Database of Systematic Reviews (CDSR)
  – Keywords Used (Not All Inclusive):
    - Dexmedetomidine
    - Obesity
    - Anesthesia considerations in obesity
    - Physiopharmacology
    - Epidemiology
    - $\alpha_2$-adrenergic agonists
  – The literature selected for review included clinical studies, case reviews, large retrospective studies, and systematic reviews.
  – The review was limited to the obese surgical population, dex as an adjunct to anesthesia, and the English language; no limit was placed on date as the intervention of interest is relatively new.

Results

• Obesity Overview:
  – Obesity has increased nationally from 14.5% in 1980 to 22.2% in 1994 to over 35% in 2012.
  – Cardiovascular effects:
    - Hypertension, increased blood volume, impaired ventricular function, atherosclerosis, atrial fibrillation, ischemic heart disease.
  – Pulmonary effects:
    - Restrictive ventilatory defect, decreased FRC, increased closing capacity, obesity hypoventilation syndrome, Pickwickian syndrome and OSA.
  – Gastrointestinal, Hepatic and Endocrine Effects:
    - Increased intra-abdominal pressure, delayed gastric emptying, hiatal hernia, GERD, increased gastric residual volume, NASH, increased glucose tolerance and insulin resistance, hyperinsulinemia and diabetes.
Results

Anesthetic Considerations

• Preoperative Evaluation:
  - Focus on issues unique to the obese patient, especially cardiorespiratory status and airway.
  - Primary goal is identification and optimization of comorbid conditions such as hypertension, CAD, diabetes, pulmonary hypertension, and OSA.

• Premedication:
  - Should address anxiolysis, analgesia, and prophylaxis (aspiration and DVT)

• Positioning:
  - Increased neural injuries and pressure sores.

• Monitoring:
  - Inaccurate blood pressure r/t cuff fit; BMI > 55 kg/m^2 and CV disease is an indication for arterial pressure monitoring.

Airway:

• Increased neck circumference > 43 cm indication of problematic intubation
• Fat deposition in suboccipital and nuchal area make “sniffing” position difficult to achieve
• “Ramped” back-up position superior for facilitating endotracheal intubation, known or highly suspected difficult airway is an indication for awake FOI
• Excellent pre-oxygenation necessary r/t increased atelectasis and rapid desaturation especially when supine.

Maintenance:

• No one superior regimen to date; desflurane may be volatile agent of choice.
• N2O generally contraindicated; increased O2 consumption and CO2 production in obesity.
• Lipophilic drugs dosed on IBW; drugs with weak to moderate lipophilicity dosed on lean body mass.
• Increased renal clearance of drugs secondary to increased renal blood flow and GFR.

Emergence:

• Sequestration of lipid-soluble anesthetic drugs can delay recovery from anesthesia and contribute to inadequate respiration and alveolitis.
• “Awake” extubation generally indicated to ensure adequate recovery from anesthesia and ability to protect airway.
• Extubating in the head-up position can decrease work of breathing increase FRC and optimize oxygen delivery.
• Increased risk of CV events with HTN and tachycardia.

Postoperative considerations:

• Increased incidence of atelectasis and hypoxemia.
• Those receiving CPAP preoperatively should receive it immediately postoperatively.
• Increased sensitivity to respiratory depressant effects of opioids.
• Increased incidence of postoperative pain.

Dexmedetomidine as an Adjunct to Anesthesia

• Field et al. (2006) examined fentanyl vs dex during desflurane anesthesia; significant reduction in required desflurane concentration, postoperative pain scores, and postoperative morphine use.
• Arain et al. (2004) compared dex and morphine as adjuncts to general anesthesia; pt’s receiving dex received 66% less morphine postoperatively to achieve equivalent analgesia.
• Bakhamels et al (2007) compared dex vs placebo during fentanyl/propofol anesthesia; significantly reduced intraoperative propofol and fentanyl use, reduced postop morphine use, shorter times to spontaneous respiration and extubation, reduced perioperative heart rate and blood pressure.

• Hofer et al. (2005) substituted intraoperative narcotics with dex during inhaled anesthesia; stable hemodynamic course, rapid emergence, adequate analgesia, 68 % reduction in postoperative morphine use.
• Ramsay (2006) examined dex vs placebo during general anesthesia using desflurane and morphine; decreased perioperative heart rate and blood pressure, decreased postoperative morphine use, no required airway interventions postop with dex compared to placebo = 100% required chin lift, 62% NPA, 100% had at least one episode of hypoxia (O2 sat < 90%), and 23% required reintubation.

• Tufanogullari et al. (2008) examined dex vs placebo during fentanyl/desflurane GA; 20% reduction in inhaled anesthetic, 40% reduction in postop fentanyl, decreased PONV, shorter recovery times.

In summary dex as an adjunct to GA has been shown to reduce required anesthetic concentrations, opioid requirements, improve postop pain, reduce postop narcotic use, provide a more hemodynamically stable operative course and improve outcome variables like PONV, airway events and PACU times.
Conclusion

- Obesity is associated with an increased risk of CV disease; numerous studies have shown dex can lead to improved control of perioperative blood pressures and heart rates potentially reducing adverse cardiovascular events.
- Obesity is associated with pulmonary changes that place this population at risk for the development of postoperative atelectasis and hypoxemia; dex’s ability to provide analgesia and sedation without respiratory depression allows the anesthetist to minimize or avoid the depressant effects of opioid analgesia potentially improving emergence and recovery from GA.
- Dex is well established in its’ ability to reduce intraoperative inhaled anesthetic concentrations; this may help to minimize the sequestration of lipid soluble anesthetic agents and avoid postoperative adverse airway events.

References

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References

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Thank You Are There Any Questions?
Introduction & Statement of Problem

- Neuraxial anesthetic techniques are frequently used in a variety of surgical and obstetric procedures.
- New technologies and anesthetic recommendations are continually evolving from ongoing research.
- Ultrasound use for lumbar puncture was first described in the literature in 1971. (Chin et al., 2011).

Purpose

- The purpose of this independent study is to identify risk factors and technical difficulties associated with lumbar neuraxial anesthesia.
- Anesthesia professionals must seek to improve the efficacy and success of these procedures, while reducing the incidence of complications. The focus of this review is to determine whether the use of ultrasound can aid in this goal.

Significance

- Neuraxial blocks can provide surgical anesthesia and analgesia for a number of procedures involving the chest, abdomen, perineum, and lower extremities.
- According to the CDC, 61% percent of parturients receive neuraxial anesthesia for vaginal deliveries (Osterman & Martin, 2011).

- Subarachnoid block or epidural anesthesia is the recommended method of anesthesia for uncomplicated cesarean section. (American Society of Anesthesiologists Task Force on Obstetric Anesthesia, 2007)
Research Questions

• What are the risk factors and technical difficulties associated lumbar neuraxial anesthesia?

• Can the use of ultrasound technology facilitate successful neuraxial block placement and decrease adverse events associated with neuraxial anesthesia?

Overview of Methods

• A physiological framework was chosen to frame the analysis of data for this project.

• A review of the literature was performed using CINAHL and PubMed databases.
  – Search terms used but not limited to: neuraxial, spinal, epidural, anesthesia, ultrasound and ultrasonography

Literature Review

• Risk of spinal cord trauma during neuraxial anesthesia
  – Case studies have been published that illustrate damage to the spinal cord following spinal anesthesia (Hamandi, Mottershead, Lewis, Ormerod, & Ferguson, 2002; Rajakulendran, Rahman, Venkat, 1998; Reynolds, 2001).
  – The spinal cord typically ends at the L1 vertebral level (Morgan, et al., 2006).
  – An examination of 504 MRI studies showed the level of the conus medullaris varied from T12-L3 (Saifuddin et al., 1998).

• Ultrasonography and Location of Intervertebral Level
  – Advantage over the traditional “blind” approach, which relies on palpation.
  – Broadbent et al. (2000) examined the ability to locate a specific lumbar interspace utilizing a traditional palpation technique in a study of 100 patients.
  – 51% of the time, the marked level was actually one space higher than the provider believed, 15% two spaces higher, 1% three spaces higher. In one instance (0.5%), the level was four spaces higher than the anesthesiologist believed.
  – Space identified correctly in only 29%.
  – Only 3% of the time, the space was lower than thought.

• Risk of spinal cord trauma during neuraxial anesthesia
  – Below the level of the conus, the lower spinal nerves form the cauda equina and are typically pushed away by a needle, rather than pierced (Morgan et al., 2006).
  – Tuffier’s line (the line connecting the superior iliac crests) is frequently used as a landmark for the palpation technique
  – Tuffier’s line can often vary one interspace higher or lower (Kim et al., 2003)
  – Low lying spinal cord + variation of Tuffier’s line = increased risk?

Literature Review

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  – Low lying spinal cord + variation of Tuffier’s line = increased risk?

U/S and Location of Intervertebral Level

• 17 patients undergoing elective MRI. (Watson et al., 2001)
  – Ultrasound to locate the L3-4 interspace. Subsequent MRI studies showed that in 14 instances, the space was correctly marked. Four patients were found to be marked at a L2-3 level.
  – Advantages of ultrasound imaging over traditional palpation techniques for identification of lumbar intervertebral level (Furness, Reilly, & Kuchi, 2002)
  – 50 patients. Anesthesiologist marked what was believed to be the L2-3, L3-4, and L4-5.
  – Radiologist marked the spaces utilizing ultrasound guidance. Then, the spaces were correctly identified by X-ray.
  – Palpation technique: interspaces were correctly marked 29% of the time and were marked more than one spinal level off in 27% of the instances.
  – Interspaces correctly marked 71% of the time with ultrasound guidance and were not marked more than one interspace off from the actual level.
Literature Review

• Ultrasound and Epidural Placement
  – 40 parturients undergoing CSE; 20 had pre-procedure u/s (Grau et al., 2001)
    • Depth to epidural space identified in all 20 women. Both ligamentum flavum and
      the dura mater identified in 80% of cases
    • access to the epidural space on the first-attempt 75% of the time in the u/s
      group versus 20% in the control
  – 300 epidurals: 150 underwent pre-procedure u/s, 150 control (Grau et al., 2002)
    • US measured distance to ligamentum flavum found to correlate to the actual
      measured distance, using LOR (6.96 mm shallower)
    • Mean number of attempts = 1.3 for u/s group; 2.1 for control group

• Ultrasound and Epidural Placement
  – Improved success of trainees when utilizing pre-procedure u/s for epidurals. 10 residents. (Grau et al., 2003)
    • US group success rate = 88% for first 10 procedures; 94% within the next 50 procedures.
    • Control group success rate = 60% for first 10 procedures; 84% after the next 50 procedures
  – Study examined the benefit of pre-procedure u/s in decreasing the number of failed epidurals when placed by anesthesia
    residents (Vallejo et al., 2010)
    • 310 parturients included. Epidurals performed by 15 residents
    • Epidural failure rate = 1.6% for u/s group vs. 5.5% for control group
    • Insertion attempts significantly decreased for u/s group

<table>
<thead>
<tr>
<th>Ultrasound Group</th>
<th>Control Group</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of puncture sites</td>
<td>1.27 (0.51)</td>
<td>1.5 (0.7)</td>
</tr>
<tr>
<td>Number of catheter advancement attempts</td>
<td>1.1 (0.6)</td>
<td>1.3 (0.6)</td>
</tr>
<tr>
<td>Number of asymmetrical or patchy blocks</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Number of epidural failures</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Grau et al., 2001

• Ultrasound for Difficult Anatomy
  – 120 patients for spinal anesthesia: poorly palpable spinous
    processes and a BMI > 35kg/m², lumbar scoliosis, or the hx of
    lumbar spine surgery (Chin et al., 2011)
  – Pre-procedure scan performed. L2-3 to L4-5 spaces were
    identified; midline marked for insertion points
    • fewer puncture attempts
    • fewer catheter advancement attempts
    • US measured depth from skin to epidural space was 7.9mm shallower than
      the clinically measured depth

<table>
<thead>
<tr>
<th>Ultrasound Group</th>
<th>Landmark Group</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of needle insertion attempts</td>
<td>[1-2]</td>
<td>2 [1-4]</td>
</tr>
<tr>
<td>Number of needle passes advancement attempts</td>
<td>[1-10]</td>
<td>13 [15-21]</td>
</tr>
<tr>
<td>Total procedure time (minutes)</td>
<td>12.2 (6.0)</td>
<td>7.9 (7.7)</td>
</tr>
</tbody>
</table>

Chin et al., 2011
Literature Review

- Tuohy needle with U/S probe imbedded into the needle (Chiang et al., 2011).
- Examined epidural structures of porcine spines by inserting the epidural needle 3 x each into 5 pigs. Displayed an echo signal on an oscilloscope.
- Tracings utilized to identify the ligamentum flavum and the dura mater.
- Ligamentum flavum identified in 83.3%
- Dura mater identified in all insertions
- Could prove useful in preventing dural puncture; an advantage not found with traditional u/s methods.

Conclusion: Advantages of U/S

- Advantage in locating desired interspace
- Assist new providers in placement of neuraxial blockade
- Estimation of distance to epidural space
- Fewer needle insertions / redirections
- Especially useful in patients with “difficult” anatomy
- Improve patient care and enhance patient safety

Discussion:

- Future?
  - Cost of ultrasound technology
  - Learning curve with ultrasound technique
  - Increased procedure time with addition of U/S
    - Offset by fewer needle insertions / redirections?

References


Conclusion: Disadvantages

- Learning curve with ultrasound technique
- Increased procedure time with addition of U/S
  - Offset by fewer needle insertions / redirections?
- Cost of ultrasound technology

References


References

Introduction

- Many patients presenting for surgery today receive or have received glucocorticoids for treatment of a wide variety of diseases.

- These patients may be at risk for peri-operative shock due to secondary adrenal insufficiency if not properly bridged with supplemental glucocorticoid therapy.

Statement of Problem

- There is a wide variety of steroid preparations available today with many variations in pharmacologic profiles.

- There also is a wide variety of patients receiving these steroids.

- The current best evidence for steroid supplementation stems from clinical case reports and inferences drawn from these, and the best practice for steroid bridging can be at times unclear.
Purpose

• Purpose: Can dexamethasone be safely used to bridge patients presenting for surgery who have previously received long term steroid therapy

• Review of pharmacologic and pharmacodynamic properties of dexamethasone

Significance

• Patients on long term steroids may have increased risk from the comorbidities requiring them to take the steroids

• Developing a plan requires an estimate of the degree of stress associated with the surgery to determine how much replacement is necessary

• Higher degrees of physiologic surgical stress may require longer durations of coverage

• Dexamethasone has a 72 hour duration of action and is 25 times as potent as physiologic cortisol, making it a potentially attractive substitute

CORTICOSTEROID CONVERSION TABLE

<table>
<thead>
<tr>
<th>Glucocorticoid</th>
<th>Approximate equivalent dose (mg)</th>
<th>Half-life (hr)</th>
<th>Anti-inflammatory Potency</th>
<th>Mineralocorticoid Potency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisone</td>
<td>25</td>
<td>8 - 12</td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>20</td>
<td>8 - 12</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>4</td>
<td>18 - 36</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5</td>
<td>18 - 36</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Prednisone</td>
<td>5</td>
<td>18 - 36</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>63/3/15</td>
<td>18 - 36</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Dexamethasone 0.75

Data obtained from Holte & Kehlet (2001)

Significance

• Substituting dexamethasone may benefit practice by decreasing the amount of undesirable side effects associated with repeated dosing of steroids

• Also would be beneficial as its use would also provide long PONV coverage

History

• The need for perioperative steroid supplementation was first identified 59 years ago

• The first case report involved a patient who died while undergoing orthopedic surgery after withdrawal of steroids

• The autopsy report revealed complete adrenal cortical atrophy presumably from long term steroid therapy

• This began the initial clinical recognition of HPA axis suppression and the potential need for supplementation

Research Questions

• What dose of steroids or what duration of therapy may cause HPA axis suppression requiring intra-operative supplementation?

• How much supplemental steroid is sufficient coverage for surgery?

• Will the substitution of dexamethasone for the current standard reduce the need for re-dosing of glucocorticoids?

• What does current literature say regarding the actual efficacy of steroid supplementation?
Framework

A Physiological framework was created examining the physiology of the HPA axis as well as the pharmacokinetic and pharmacodynamic properties of dexamethasone.

Overview of Methods

- Comprehensive review of literature was performed through CINAHL, PubMed, Cochrane Collaboration, MEDLINE, and MeSH search engines using title, abstract, or keywords search
- Search terms included but were not limited to: dexamethasone, perioperative inflammation, corticosteroids, C-reactive protein, adrenal suppression, and glucocorticoids
- Date range of material from 1952-2012 for historical purposes

Results

- Many properties of dexamethasone have been identified, and the use of the drug is ever changing as new studies confirm increasing beneficial uses
- These uses include:
  - **Anti-inflammatory agent:** Decreased plasma levels of proinflammatory cytokines, c-reactive protein and tryptase levels after administration of a single dose (Moraru et al., 2005)
  - **Analgesic:** Dexamethasone was found to reduce pain and opioid consumption due to a decrease in local swelling and edema (Oliveira, Almeida, Benzon & McCarthy, 2011).

Overview of Methods

- Focus of the literature review was two-fold:
  - To review the current guidelines for patients with chronic disease receiving long-term steroids presenting for surgery
  - To review the current literature on dexamethasone regarding whether or not it can safely be used as a steroid bridge

Results

- Uses Continued:
  - **Nausea and Vomiting:** Although the mechanism is not fully understood many studies have shown dex is an excellent PONV adjunct.
  - **Convalescence:** Recreational activities and work were resumed earlier in the dex vs placebo group (Bisgaard et al., 2003).
Results

• However, the evidence supporting the use of dexamethasone as a bridge is inconclusive.

• Primary argument encountered for not using dexamethasone for a bridge relates to its lack of mineralocorticoid properties.

Results

• So what is the significance of mineralocorticoid activity?
  - Mineralocorticoids: Retention of sodium and potassium to aid in maintaining intravascular volume (Coursin & Wood, 2002).
  - Synthesis in adrenal zona glomerulosa; stimulated by the RAAS/hyperkalemia.
  - The primary endogenous mineralocorticoid is aldosterone.
  - It has been suggested that intact aldosterone secretion through the RAAS may obviate the need for a steroid preparation with mineralocorticoid activity...however no studies to date have tested this theory.

Results

• What is the current best evidence for steroid supplementation?
  - Primary problem: evidence from clinical case reports rather than higher levels of evidence.
  - Immunosuppressive doses of glucocorticoid vs stress doses, exhibited no signs of insufficiency (Friedman, Schiff, & Bromberg, 2005).
  - HPA axis function cannot be reliably estimated from the dose of glucocorticoid, the duration of therapy, or the basal plasma cortisol concentration (Schlaghecke et al., 2012).

References

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References