Introduction & Statement of Problem

- Since the 1990's, the use of herbal medicines has increased dramatically with the number of people using these supplements growing at a rate of approximately 20% each year (Messina, 2006).
- It is estimated that 22-60% of adult surgical patients use some form of herbal medicine.
- Use of these medicines are not disclosed to medical providers up to 70% of the time (Gray & West, 2012).
- Some of the risks associated with herbal supplements include hypertension, prolonged bleeding and the potential for drug-herb interactions.

Purpose

- Examine some of the commonly used herbs that have the most potential for interactions and complications during the perioperative period.
- Review the surgical and anesthetic implications involved.
- Disseminate the information to CRNAs and SRNAs, increasing their knowledge regarding herbal medicines and how they can affect anesthesia.

Significance

- The use of herbal medicines is increasing significantly in the United States.
- Lack of regulation by the FDA, uneducated consumers and CRNAs, and failure to inform healthcare providers and anesthesia providers leads to possible risks perioperatively.
- Approximately 11% of surgical patients who use herbal supplements have had complications during surgery (Messina, 2006).
- A study by Temple, Fagerl and Saewyc (2005) found the mean knowledge score of adverse interactions of herbal supplements by CRNAs was 21% and only 17% of CRNAs indicated confidence in their familiarity with herbal-supplement anesthesia interactions.

Research Questions

- What effect do herbal medicines have on anesthesia and perioperative care?
- What are some of the most commonly used herbal medicines that would impact anesthesia and what are the risks involved?
Framework

- Orem’s Self-Care Deficit Theory
  - Describes how people care for themselves and encourages people to take good care of themselves and their families.
  - A person’s knowledge of potential health problems is needed for promoting self-care behaviors.
  - By taking herbal supplements, people are performing self-care.
    - People believe by using herbal supplements, they are enhancing their health.

Overview of Methods

- Electronic literature reviews were performed utilizing Cochrane Reviews and the Harley French Library.
- Harley French Online Library was used to access search engines including PubMed and CINAHL.
  - Once articles were identified as pertinent, similar articles were reviewed for pertinence.

Problems with the Research

- Herbal medicines are not regulated by the FDA therefore, research studies and clinical trials are not required.
  - Due to this lack of regulation the quality, potency, and active ingredients are not regulated which can lead to varying results and risks.
  - There is also no standardized dosing.
- It was difficult to find good quality research studies.

Results: Echinacea

- Used for illnesses such as colds and respiratory infections.
- All the studies in my research indicate that echinacea does have immunostimulation properties.
- Anesthesia concern: that the immunostimulatory effects may antagonize immunosuppressants.
  - There are currently no studies that address this specifically.

Results: Ephedra

- Acts as a sympathomimetic and is used for weight loss and energy.
  - Ephedrine is the predominant component.
- Studies found that even with small doses, ephedrine will increase HR, BP, and CNS effects.
- Anesthesia concerns: hypertension and tachycardia that may result could lead to myocardial ischemia or stroke.
  - Long-term use could potentially result in tachyphylaxis from depletion of endogenous catecholamine stores, therefore making indirect-acting sympathomimetics (ephedrine) less effective intraoperatively.
  - No current studies

Results: Gingko Biloba

- Used for cognitive disorders, PVD, and energy.
  - Primary studies found that ginkgolides provided antagonistic action of platelet-activating factor (PAF), thereby affecting plt function.
  - These studies used large doses and were often performed ex vivo.
- Current clinical trials have found no significant alteration in the PAF function, bleeding time, or coagulation parameters.
  - However, there have been case reports of intracranial bleeding, a spontaneous hymphema, and postop bleeding from a lap chole.
  - Anesthesia concern: potential increased risk for bleeding.
Results: Garlic

- Used for infection, HTN, hyperlipidemia, and atherosclerosis.
- Results are conflicting:
  - For the most part the older studies found that garlic does inhibit plt function and the newer studies had more conflicting results.
  - When smaller doses were used, the results indicated that garlic did not inhibit plt function.
- Anesthesia concern: potential increased risk for bleeding.

Results: Ginseng

- Used as a stimulant, immunomodulator, mood elevator, and to lower postprandial blood sugar.
- Primary studies claim that ginseng decreases plasma glucose levels and decreases insulin resistance.
  - Mostly animal and in vitro studies.
- Several current studies found that ginseng may have some affect on acute plasma glucose levels but no changes were found to the Hba1c, therefore the long-term affects remain questionable.
  - The results of one study showed no significant effect on Hba1c, fasting plasma insulin levels or finger-prick blood glucose levels.
- Anesthesia concern: risk of hypoglycemia perioperatively.

Results: Ginseng cont.

- Ginsenosides are inhibitors of cyclooxygenase and thromboxane A2 synthase, both of which are important enzymes for platelet function.
- Results were conflicting:
  - Some found plt function was not affected.
  - Others found plt aggregation was inhibited and there were prolonged aPTTs and PTs.
- These tended to be animal studies
- Anesthesia concern: increased risk of bleeding.

Results: St. John’s Wort

- Used for depression and anxiety.
- Induces the cytochrome P450 system.
  - Causes medications metabolized by the cyt P450 system to be metabolized at a greater rate.
  - One study found that high doses of SJW required a 65% increase in the dose of cyclosporine (immunosuppressant given to pts receiving a transplant).
- Another study found that the clearance of midazolam was significantly increased after SJW administration.
- Anesthesia concern: be aware of possible drug interactions with SJW.
  - Immunosuppressants, some antineoplastic drugs, benzodiazepines, alfentanil, lidocaine, digoxin, and warfarin.

Conclusions

- Overall, not a lot of concrete evidence regarding these herbal medicines discussed.
- Ask your patients if they are on any herbal supplements.
- Be aware of the possible risks with herbal supplements.
- G’s increased risk for bleeding so ask about concomitant use of ASA, NSAIDS, and anti-coagulants.
- The American Society of Anesthesiologists (ASA) recommends that all herbal medicines be stopped 2 weeks prior to surgery as a general guideline.

References

References


References

Use of Total Intravenous Anesthesia to Reduce Post-Operative Nausea Vomiting in Women Undergoing Laparoscopic Gynecological Procedures

Myles Brandt, SRNA

Introduction

- Postoperative Nausea and Vomiting (PONV) is experienced by roughly 20-30% of surgical patients. (Apfel, et. al. 2012).
- Rates of PONV in young female patients undergoing gynecological laparoscopic procedures can be as high as 70%. (Lambert & Lambert 2009).

Statement of Problem

- Patients at high risk for PONV may be placed at increased risk with the use of inhalational anesthetics.

Purpose

- The purpose of this project is to examine current literature to determine if the use of a propofol based anesthetic is effective at reducing the rates of PONV in the selected patient population.

Significance

- PONV is a significant reason for delayed discharge from the PACU.
- Many patients rank PONV as a concern of receiving anesthetics.
- The delayed discharge from the PACU has the potential to generate considerable costs in the form of increased nursing care, more medications, etc.
- Many organizations are looking for ways to cut costs in the form of faster discharges and decreased time in the PACU.

Significance

- Delaying discharge can be especially problematic for patients undergoing same day surgical procedures.
- In addition, ineffective treatment of PONV in patients undergoing same day procedures can lead to unplanned, costly admissions.
- Other complications include wound dehiscence and potential for aspiration.
Research Questions

• Is the use of a propofol based anesthetic effective at decreasing the overall incidence of PONV?

• Does using a TIVA technique decrease the overall incidence of PONV in a high risk patient population?

Framework

• A physiologic framework was selected for this project.
• The physiology of PONV is complex with multiple triggers.
• Multiple neurotransmitters including serotonin, dopamine, histamine and acetylcholine being the most important.

Overview of Methods

• A literature search was conducted utilizing the CINAHL and PubMed databases through the Harley French Library at the University of North Dakota.

• The following keywords were used in the search: PONV, TIVA, Propofol, Laparoscopic and Gynecological.

Population Selection

• Is your patient high risk for PONV?
• Risk factors:
  – Female sex
  – History of PONV or motion sickness
  – Non-smoker
  – Surgery type
  – Duration of surgery
  – Anesthetic technique
  – Anesthetic drugs

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Number of risk factors</th>
<th>PONV incidence</th>
<th>Prophylaxis strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female gender</td>
<td>1</td>
<td>20%</td>
<td>None</td>
</tr>
<tr>
<td>Nonsmoker</td>
<td>2</td>
<td>20%</td>
<td>Avoid motion agents if possible + 6 mg dexamethasone + 2 mg prochlorperazine (e.g. scopolamine patch)</td>
</tr>
<tr>
<td>History of PONV or motion sickness</td>
<td>3</td>
<td>62%</td>
<td>Avoid motion agents if possible + 6 mg dexamethasone + another prophylactic anticholinergic (e.g. scopolamine patch)</td>
</tr>
<tr>
<td>Use of opioids &gt;100 mcg fentanyl or equivalent</td>
<td>4</td>
<td>79%</td>
<td>Avoid motion agents if possible + 6 mg dexamethasone + 1 mg 5-HT3 Receptor Antagonist + another prophylactic anticholinergic (e.g. scopolamine patch)</td>
</tr>
</tbody>
</table>

Rescue strategy: Anticholinergic not used for prophylaxis, e.g., 0.5 mg IV atropine

Table 1: Assessments/Recommendations for prevention and management of PONV

(Adapted from Apfel 2002/11)

Apfel, 2002

Patient Factors

<table>
<thead>
<tr>
<th>Surgical Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Gender</td>
</tr>
<tr>
<td>History of PONV or Motion Sickness</td>
</tr>
<tr>
<td>Nonsmoker</td>
</tr>
<tr>
<td>Postoperative Opd Use</td>
</tr>
</tbody>
</table>

Mild to Moderate Risk

- 20% - 40%
- 1.5 Factors Present
- Any 1 of the Following: Dexamethasone, Scopolamine, 5-HT3 Receptor Antagonist, Droperidol

Moderate to High Risk

- 40% - 80%
- 3.4 Factors Present
- Dexamethasone Plus Scopolamine, Droperidol Plus Scopolamine, Antagonist

Very High Risk

- >80%
- 4 Factors Present
- Combination Anticholinergic Plus Total Intravenous Anesthetic With Propofol

Apfel, 2002
Results

- White, et. al (2007):
  - Compared two anesthetic groups undergoing day-case gynecological surgery. One with a propofol based technique and one with a sevoflurane based technique utilizing dolasetron.
  - Results showed that the rates of PONV were similar in both groups. However, rates of post-discharge nausea and vomiting were higher in the propofol based group.
  - Increased rates of PDNV in the propofol based group associated with propofol’s short term anti-emetic effects.

- Park & Cho (2011):
  - Two groups of patients undergoing gynecological laparoscopic surgery greater than one hour duration were compared. One group received a propofol based technique and the other group received a sevoflurane technique with palonosetron.
  - Results showed no significant differences in rates of PONV. PONV was decreased only in the early post-operative period.
  - Authors did state that the use of a propofol based technique is just as powerful as a single anti-emetic agent.

- Shinn, et. al. (2011):
  - Two groups of patients undergoing laparoscopic gynecological surgery. One group maintained with propofol, one group maintained with sevoflurane.
  - Results showed patients in the propofol group had significantly lower rates of PONV in the first hour postoperatively. Rates of PONV following the first hour showed no significant difference.
  - Authors also pointed out the short duration of propofol’s anti-emetic effects.

- Hofer, et. al. (2003):
  - Compared two groups of patients to compare and assess patient well-being following inhalational and intravenous anesthesia. One group maintained with propofol, one group maintained with sevoflurane.
  - Results of this study demonstrate that for gynecological procedures, the rates of PONV in the propofol group were significantly reduced 90 minutes post-operatively compared to inhalational techniques.
  - Results also show that a TIVA technique is effective for decreasing PONV in patients undergoing gynecological procedures.

- Eriksson & Korttila (1996):
  - Compared three groups of patients undergoing outpatient gynecologic laparoscopic procedures. Two groups received desflurane for maintenance both with and without ondansetron, one group received propofol for maintenance.
  - Results favor the use of propofol for day case gynecological day case procedures. Patients in the propofol based group showed the lowest rates of PONV.

- Jokela, et. al. (2000):
  - Compared three different groups undergoing breast surgery. Sevoflurane both with and without ondansetron was compared to propofol for maintenance of anesthesia.
  - Results of this study showed that the rates of PONV in the propofol group were similar to the rates in the sevoflurane-ondansetron group.
  - Beyond two hours postoperatively, rates of PONV in the propofol group became greater than the rates in the sevoflurane-ondansetron group.
  - Study also points out that the anti-emetic effects of propofol are short lived and does not cover the post-discharge period.
Results

• Habib, et. al. (2004):
  - Study compares a variety of strategies to prevent PONV. One such strategy is the use of a TIVA technique.
  - Results of this study show that the use of a TIVA technique with no other anti-emetics is every bit as effective as the use of an inhalational agent and two anti-emetics.
  - This study also suggest the use of a TIVA technique with the use of longer acting anti-emetics is an effective way to treat high risk patients to provide coverage into the post-discharge period.

Conclusions

• The use of a propofol based technique is highly effective for reducing the incidence of PONV in high risk patients.
• The anti-emetic effects of propofol are as effective as an anti-emetic agent.
• The anti-emetic effects of propofol are effective for approximately 1-2 hours post-operatively, requiring longer lasting agents.
• Current recommendations for high risk patients is to utilize a TIVA technique with longer acting anti-emetic agents.
• Further research is required for this demographic group.

References


Thank You Are There Any Questions?
Neurodevelopmental Outcomes in Pediatric Patients Undergoing General Anesthesia

Chelsea Boekelheide, SRNA

Introduction & Statement of Problem

• 4 million American children undergo general anesthesia per year.
• Growing concern: link between anesthesia and neurocognitive delay.
• Is there a real causal relationship, and what can we do about it?

Purpose

• Identify the effects of general anesthesia on the developing brain.
• Identify crucial periods of neurocognitive development that are significantly affected by anesthesia.
• Investigate practical alternatives to general anesthesia in pediatrics.
• Provide recommendations for clinical practice.

Definitions

• Pediatric population: birth to 36 months of age.
• Neurodevelopment: the time between the third trimester of pregnancy to the first 36 months of postnatal life, during which the critical period of cerebral plasticity and peak synaptogenesis occurs (when the brain is most vulnerable to insult).
  – Vutskits et al., 2012

Significance

• Developmental delays are being diagnosed more and more frequently.
  – ADHD, autism, learning disorders
• ADHD: increased over 25% in the last 10 years (CDC, 2011).
• Autism: increased 289.5% over past 12 years (Plizska, 2007).
• Unspecified developmental delay: increased by 17.1% (Plizska, 2007)

Significance

• No effect on life expectancy
• Effects continue into adulthood
• Multi-factorial etiologies
  – One theory: general anesthesia
Significance

• General anesthesia in the pediatric population is reserved for completely necessary surgeries.

Research Questions

• Does general anesthesia in patients younger than 3 years significantly increase the risk of diagnosis of behavioral or developmental delay?
• What alternatives are available to decrease the risk on the developing brain?

Framework

• Physiologic framework
  – Physiologic biological mechanisms of the developing brain
  – Effects of NMDA-antagonists and GABA-agonists on neurodevelopment
  – Exposure to anesthetic agents in critical periods of neurodevelopment

Overview of Methods

• Comprehensive review of literature using research databases from UND’s Harley E. French Library of Health Sciences
  – PubMed, CINAHL, Google Scholar
• Search terms:
  – Pediatric anesthesia, neurotoxicity, developmental disorder OR behavioral disorder AND general anesthesia
• Jamie Sperle, CRNA, DNP, consulted as faculty advisor

Results

• Does general anesthesia in patients younger than 3 years significantly increase the risk of diagnosis of behavioral or developmental delay?
  – Preclinical data: Mammalian studies have tested NMDA-antagonists and GABA-agonists, and have found unanimously that neuroapoptosis occurs at an accelerated rate during periods of peak synaptogenesis (Slikker et al., 2007; Fredriksson, Ponten, Gordh, & Eriksson, 2007; Jevtovic, Hartman, & Izumi, 2003).

Results Cont’d

• Clinical studies:
  – Wilder et al. (2009): Retrospective cohort study—found multiple, but not single, exposures to general anesthesia resulted in an increased incidence of learning disability.
  – DiMaggio et al. (2009): Exposure was defined as general anesthesia during an inguinal hernia repair; found 3.5-fold increase in incidence of behavioral or developmental disorder.
  – Sprung et al. (2012): ADHD incidence increased almost 2.5-fold with multiple, but not single, exposures to general anesthesia.
Results Cont’d

- Alternatives to general anesthesia
  - Xenon: rarely-used NMDA antagonist
    - Ma et al. (2007) and Cattano et al. (2008)
    - Significant protection against isoflurane injury.
    - Limitations to use: exceedingly scarce, very expensive, MAC of 70%.

Recommendations

- Continued research into alternatives to general anesthesia.
- Care conferencing with parents/families so that they can make informed decisions.
- Continued exceptional, evidence-based care for all of our patients.

References

References


Introduction

• Intravenous lidocaine is an old strategy gaining new interest (Gordon and Schroeder, 2008).

• Lidocaine was the first amide type local anesthetic utilized when its discoverers colleague injected it in himself in 1943.

• Lidocaine's history has since well-established its highly effective analgesia and quality of recovery following some but not all surgeries.
Purpose

The purpose of this independent project was to explore the efficacy in utilizing intravenous lidocaine as an adjunct in perioperative pain management for adult patients.

Significance

- Intravenous lidocaine is suitable in many surgical procedures.*
- Ample current research findings are associated with reductions in physiological, somatic, autonomic, and behavioral responses (Baral, Bhattarai, Rahman, Regmi, and Singh, 2010).

Research Questions

- When implemented in the perioperative analgesia plan, how does the utilization of intravenous lidocaine outcomes compare to those not treated with lidocaine in terms of:
  - Time to return of bowel and bladder function?
  - Time to resumption of oral intake?
  - Time to participation in post-operative exercises?
  - Incidences of post-operative nausea and vomiting?
  - Opioid requirements?
  - Time to discharge from hospital?

Framework

- For this independent project, I chose to use Kolcaba’s Theory of Comfort to evaluate nurse anesthesia care and desirable outcomes.
- Anesthesia professionals relieve physical pain through the administration of many different pharmacological agents.

Framework (continued)

- Applicable to this independent project is anesthesia professionals relief of physical pain and behavioral changes to follow that moves them towards a holistic state of well being.
Overview of Methods

• A comprehensive review of the literature was performed using the PubMed and CINAHL databases as well as Google Scholar.

• Search terms included, but were not limited to lidocaine, infusion, intravascular, intravenous, intraoperative, postoperative, perioperative, surgery, analgesia, comfort, and pain.

• Limitations to English language, less than five years old, and peer reviewed were set in deeper CINAHL, PubMed, and Google Scholar searches.

• The Johns Hopkins Research Evidence Appraisal Tool and Stetler’s Evidence of Hierarchy were utilized to rank the strength of the articles.

Results

• The literature review demonstrated statistically significant outcomes for lidocaine groups when compared to the control groups.

• The following slides summarize the interpretation of the data.

Results (continued)

• A statistically significant reduction by 11.8% time in hours to first flatus was observed in those receiving lidocaine.

Results (continued)

• Review of the literature revealed statistically significant reductions by 10.4% time in hours to the first passage of feces in the lidocaine groups.

Results (continued)

• Statistically significant. Nausea and vomiting (a critical patient comfort and sense of well being marker) incidences were reduced by 13.7% in those treated with lidocaine.
Results (continued)

• Patients whom received lidocaine infusions as a component of their anesthetic plan experienced less opioid consumption.*

Results (continued)

• Patients treated with intravenous lidocaine resumed oral intake and discontinuation of intravenous fluids earlier.*

Results (continued)

• The implementation of lidocaine on functional walking capacity yielded a statistically significant decrease in number of feet lost preoperatively to postoperatively.

Results (continued)

• Patients treated with lidocaine were discharged from the hospital on average one day earlier (Fitzgerald et al., 2012 and Cote et al., 2011).

Results (continued)

• The literature supports beneficial outcomes to multimodal analgesia in contrast to the deleterious effects when opioids are used solely.*

• In the pursuit of multimodal analgesic techniques the joint commission has since labeled pain as “the fifth vital sign.”

Results (continued)

• Recent evidence by Derry et al., 2012 and the American Society of Anesthesiologists (ASA) both send a strong message that there is room for improvement.*

• In contrast to less emphasis being placed on traditional measures**, patient reports of well-being and administrative markers*** are taking precedence.
Results (continued)

- Dosing
  - Many of the individual pieces of literature's authors agreed that more research was needed to make recommendations about dosing for continuous lidocaine infusions.*
  - A wide array of dosing ranges were employed in the trials observed for this project.**
  - Contraindications:
    - Cardiac arrhythmias, history of seizures, allergy.

References (continued)

- Cote et al., (2011) found there to be no significant difference between control and lidocaine groups with respect for neurological and cardiovascular events.*
- In planning utilization of intravenous lidocaine in the perioperative setting anesthesia professionals should consider the proposed procedure, contraindications, and benefits for its application.

References (continued)

- Cardiac arrhythmias, history of seizures, allergy.
- Contraindications:
  - Cardiac arrhythmias, history of seizures, allergy.
  - In planning utilization of intravenous lidocaine in the perioperative setting anesthesia professionals should consider the proposed procedure, contraindications, and benefits for its application.

References (continued)

Anesthetic Considerations for Phantom Limb Pain

Robert Kari, SRNA

References (continued)


Thank You Are There Any Questions?

Introduction & Statement of Problem

- Phantom limb pain (PLP) is the perception of pain in a region of the body that is no longer present.
- Most common following limb amputation but has been described in other areas of the body including the eyes, breast, genitals, bowel and bladder.
- Concept was first introduced in mid 16th century by a French military surgeon.
- Silas Weir Mitchell, a famous civil war surgeon, provided an early and accurate description and coined the term “phantom pain.”
Epidemiology and Statistics

- Studies indicate a wide variation in prevalence, symptoms and development suggesting complex interactions between physiological mechanisms.
- Estimated 1.7 million amputees in the United States.
- Demographic changes and higher rates of vascular disease, secondary to diabetes, may double this number by the year 2050.
- Some studies suggest PLP is rare but recent epidemiological studies indicate prevalence rates between 50% - 80%.

Purpose

- Educate anesthesia providers on possible mechanisms for the development of PLP.
- Investigate current recommendations supported by the literature for the prevention and treatment of PLP in terms of preemptive analgesia and anesthesia.

Significance

- Anesthesia providers are on the forefront of pain management.
  - Epidemiological studies and prevalence rates indicate that PLP is a common problem following amputation.
  - Is often underreported: Study of 2700 veteran amputees showed 69% were reluctant to talk to providers.

Research Questions

- What are the physiological mechanisms that contribute to the development of PLP?
- Is preemptive analgesia and anesthesia effective in preventing the development or lessening the severity of PLP?

Framework

- Physiological Framework
  - Pain is individual in nature, what may be a mild nuisance to one person may be debilitating to another.
  - Complex physical and emotional factors.
  - PLP is a type of neurogenic pain that is typically chronic in nature.
  - Abnormal processing or dysfunction of the nervous system.
  - Neuropathic pain is difficult to diagnose and treat.

Overview of Methods

- Comprehensive literature review
  - Keywords: phantom limb pain, anesthesia, analgesia, epidural, perineural, neuropathic, and neurogenic.
Results

- Multiple theories for the development of PLP.
- No one specific pain theory can accurately describe PLP.

PLP Peripheral Theory

- PLP originates at the nerves around the injury.
- Amputation causes neurogenic inflammation leading to a release of inflammatory mediators (bradykinin, histamine, arachadonic acid metabolites).
- Peripheral nociceptors become up-regulated.
- Neuromas form-hyperalgesia, allodynia.
- Non-nociceptive peripheral Aβ nerve fibers carry pain impulses into dorsal root.
- All these factors lead to peripheral sensitization.

PLP Spinal Cord Theory

- Changes in spinal cord contribute to development of PLP.
- Inhibitory GABA can be destroyed by massive ectopic discharge caused by neural damage.
- GABA neurons can actually change from inhibitory to excitable.
- Down regulation of opioid receptors.
- Increased glutamate activity leading to increased excitatory NMDA receptor activity.
- Substance P released from Aβ nerve fibers, non-noxious stimulus can cause pain.
- All factors lead to central sensitization.

PLP Central Theory

- Supraspinal areas: brainstem, thalamus and cortex.
- Theories revolve around reorganization of somatosensory cortex (remapping) and neurosignatures (pain memories).
- Melzack proposed neuromatrix theory: neurosignature or memory of each body part in the brain.
- Reorganization suggests that removal of a body part causes other areas of the brain to take over impulses from the missing body part.

Preemptive Epidural Anesthesia

- 6 main studies that investigated different epidural approaches:
  - Nikolajsen, Ilkjaer, Christensen, Kroner and Jensen (1997): epidural with bupivacaine and morphine.

Preemptive Epidural Anesthesia

- Mixed results from studies
  - Not surprising considering complexity of PLP.
  - Data suffered from lack of randomization and blinding, high attrition rates and limited sample sizes.
  - Some researchers suggested promising results, but no strong statistical data to support preemptive epidural anesthesia.
Preemptive Perineural Anesthesia

- 4 main studies investigating perineural anesthesia:
  - Pinzur, Garla, Pluth and Vrbos (1996): same as above with larger sample and better control.

Preemptive Perineural Anesthesia

- Mixed results for these studies as well
  - Small sample sizes, lack of blinding, high attrition.
  - Researchers concluded that perineural anesthesia is effective in some cases but lacks statistical significance.
  - Borghi study: 84% of participants that were able to complete study had no PLP at one year followup.

Preemptive IV Ketamine

- 2 studies:
  - No statistical difference between study and control.

Conclusion

- Complex nature of PLP
  - Peripheral, spinal cord and supraspinal
- Anesthetic and analgesic techniques discussed are quality methods for relieving acute stump pain and phantom pain in the immediate postoperative period.
- Literature does not support preemptive anesthesia and analgesia for the prevention of chronic PLP.
- More research is needed for definitive treatment recommendations.
  - New pain research involving genetics and epi-genetics: i.e., peripheral and centrally expressed CACNG2 gene may be responsible for the development of neuropathic pain .

References


References


References


References


References


Thank You
Are There Any Questions?

Introduction

- Over 27 million patients have surgery/year.
- 8 million have CAD or risk factors for CAD.
- 1 million have perioperative cardiac ischemia.
- Advanced hemodynamic monitoring is needed to limit morbidity and complications. (Fleisher & Eagle, 2001) (Eman, 2011)
- Cardiac output monitoring can help guide medical interventions.

Less Invasive Alternatives

- Esophageal Doppler monitors (EDMs)
- Pulse contour analysis technology (PCAs)
- Others

Introduction

- Using conventional Data alone (BP & HR) can lead to subclinical hypovolemia.
  - Impaired tissue perfusion and $\downarrow$ O$_2$ delivery
  - $\uparrow$ morbidity and $\uparrow$ complications
    (Phan, Ismail, Heriot & Ho, 2008)

- Pulmonary Artery Catheters (PACs) used traditionally- up to 24% complication rate.
  (Boyd, Thomas, Gold & Boyd, 1983)
Statement of Problem

• BP & HR can be normal while microcirculation and tissue oxygenation markedly decreased (compensation).
  (Schober, Loer, & Schwarte, 2009)

• Low CO often caused by hypovolemia (fasting, anesthetic induced vasodilation, surgical blood loss, etc.)
   tissue perfusion leads to ↑CO2, ↑lactic acid
    – Leads to ↑ morbidity and mortality
  (Gan et al., 2002)

Purpose

• “Gold Standard” for CO is thermodilution via a PAC.
  (Funk, Moretti, & Gan, 2009)
  – Disadvantages: ↑cost (equipment and time), ↑health risks (arrhythmias, pulmonary infarct/embolus, infection, & pulmonary artery rupture).
  (Domino et al., 2004)

• EDM a safe, quick, and less invasive.
  – Assess preload, afterload, contractility, and more

• PAC alternative to EDM but accuracy concern.
  (Meng et al., 2011) (Monnet et al., 2012) (Suehiro et al., 2013)

Significance

• ↑ age = ↑prevalence of CV disease

• 50% of Americans 65+ will have surgery.
  – Equates to 20 million seniors (Ersan, 2011)

• PAC has relative high morbidity.
  – Complication rate 5-10% (Harvey et al., 2005) (Binanay et al., 2005)
  – Must weigh risks and benefits

Research Questions

• How does EDM compare to PAC in terms of accuracy, effectiveness on outcomes, ease of placement/use, and cost?

• How does EDM compare to PCA (i.e. FloTrac) in accuracy of CO in relation to the “gold standard” PAC?

Significance

• EDMs can be used to optimize perfusion.
  – NO significant complications reported
  – Reported to improve outcomes
  – Reported to reduce length of stay
  – First introduced in 1970s
  – Used in 1,750 hospitals in 30+ countries
  – 200+ clinical publications validating EDM
  (Keen, 2009)

Framework

• A physiologic framework was utilized.

• Key concepts
  – Cardiac Output: preload, afterload, cardiac contractility, heart rate, Frank-Starling relationship, stroke volume.
  – Hypovolemia: compensation, shock
## Overview of Methods

- Online literature search of PubMed, The Cochrane Library, and CINAHL.
- Terms: “esophageal Doppler” and “cardiac output” = 127 articles
  - Narrowed by adding “anesthesia” = 28 articles and “critically ill” = 21 articles
- Additional articles acquired by links to similar articles on PubMed.

## Results

### Accuracy of EDMs
- Su et al. (2002): Primary CABG
  - “good agreement” for CO with thermodilution PAC.
- Dark & Singer (2004): meta-analysis of RCTs
  - “high validity” for monitoring changes in CO compared to thermodilution PAC.
- Bein et al. (2004): CABG (EF<50%)
  - “clinically acceptable agreement” for continuous CO comparing EDM, PAC, and PCA with femoral artery catheter.

### Results cont.
- Chatti et al. (2009): EDM vs. FloTrac
  - Clinically unacceptable percentage error of SV in PCA (1st & 2nd gen. FloTrac) compared to EDM.
  - Led to development of current 3rd gen.
- Meng et al. (2011): EDM vs. FloTrac (3rd gen.)
  - Percentage error - $\Delta$MAP/$\Delta$CO in response to intervention (phenylephrine 23%, ephedrine 69%, and increased preload 96%).
  - FloTrac affected with acute vasomotor change.
    - Accurate with increased preload,
    - Less accurate with ephedrine,
    - Poor with Neo (showed $\uparrow$CO with FloTrac)

### Results cont.
- Monnet et al. (2012): CI data- FloTrac vs. PAC
  - Volume expansion and norepinephrine administration
  - FloTrac not reliable trending CI with Levo use
    - (higher the SVR = $\uparrow$bias between FloTrac and PAC)
- Suehiro et al. (2013): FloTrac vs. PAC in CABG
  - CO and trend CO with $\uparrow$SVR using phenylephrine
  - Clinically acceptable for normal SVR only

### Effectiveness on outcomes
- Gan et al. (2002): goal-directed fluid therapy administration using EDM.
  - No significant change in HR or MAP between control group and protocol group.
  - Significant increase in SV, CO, and FTc (flow time corrected).
  - Significant Results: shorter LOS, quicker toleration of oral solids, fewer incidences of PONV.
- Noblett et al. (2006): Colorectal resection
  - Fluid bolus given solely on EDM assessment.
  - Significant for intervention group:
    - $\uparrow$ time to fitness for discharge
    - $\uparrow$ time to “actual discharge”
    - Earlier diet tolerance
    - Intermediate or major complications
    - PONV
    - $\uparrow$ admissions to critical care unit.
  - No sig diff in total volume given.
  - Intervention group received fluid earlier in surgery.
Results cont.

– Phan et al. (2008): meta-analysis of 58 RTCs
  • EDM to optimize intravascular volume (or SV).
  • EDM guided Results: ↑ intraoperative fluid,
    ↓ hospital LOS, ↓ time to resume full oral diet,
    ↓ postop morbidity or complications.

– Figus et al. (2011): free perforator flap
  • EDM vs. CVP and arterial catheter.
  • EDM results: ↑ return to OR, ↓ postop complications,
    ↑ flap survival, 1.9 days less LOS.

Results cont.

– Abbas & Hill (2008): systematic review, 5 RCTs,
  • EDM use during major abdominal surgery.
  • EDM significant: ↑ LOS, ↓ complications, ↑ ICU
    admits, more rapid return of gut function.
  • NO Sig Diffs: volume of crystalloid used, mean urine
    output, MAP after surgery, or CVP.

– Wang et al. (2008): Shock resuscitation in burns
  • Trending of hemodynamic parameters useful,
    not absolute values of preload and CO.

Use

• Proficiency of placement in < 13 attempts

• Both conscious and anesthetized patients

• Oral or nasal (like gastric tube)

• Depth of probe at T5-6
  – Esophagus and descending aorta parallel

  (Schober et al. 2009)

Cost

• Direct cost:
  – Variable in USA due to purchasing power etc.
    • CMS reimbursement declared on May 22, 2007
      (Phurrough et al., 2007)
  – In UK (Deltex medical, CardioQ EDM)
    • Probe- $93 for 6-hr probe to $188 for 10-day probe
    • Monitor (5 year lifetime)- $12,457
      – $8.75/patient if 500 patients/monitor/year

  (NHS-CEP, 2008)

Cost Cont’d

• Indirect cost savings:
  • Length of stay
    • In UK, estimated at reduced LOS of 1.82 days with
      EDM use
      – Per patient savings of:
        $4,863 for ICU
        $2,228 for step down unit
        $878 for floor bed
  • Morbidities
  • Time/training for insertion

Summary

• CO monitoring essential for indication of tissue
  perfusion in critical cases.

• EDM is safer, easier to place and use, as
  accurate, and possibly cheaper than Swan-
  Ganz.

• FloTrac is inaccurate with vasopressors.

• Use of EDM with goal-directed fluid therapy
  results in decreased M & M.