Introduction

• “The presence of signs or symptoms of muscle weakness in the postoperative period after the intraoperative administration of a neuromuscular blocking drug.”

• Present with TOFR <0.9 rather than <0.7.

• TOFR <0.9 in PACU patients ranges from approximately 22% to 64%.

Case Information

• Surgical Procedure: Laparoscopic Tubal Ligation

• 36-year-old Female

• 70 kg and 163 cm

• ASA 2

Pre-operative Evaluation

• Medical history: hypothyroidism, depression, anxiety

• Past surgical history: cesarean section, knee arthroscopy

• N/A

• Medications: lorazepam, fluoxetine, zolpidem, levothyroxine

• No personal or family history of anesthetic complications

• Pre-op physical exam, VSS, and labs unremarkable

• Mallampati II; NPO 8 hrs

Anesthetic Course

• Drugs: midazolam 2 mg, diphenhydramine 12.5 mg, dexamethasone 4 mg, ondansetron 4 mg, fentanyl 250 mcg, lidocaine 40 mg, propofol 140 mg, rocuronium 40 mg, sevoflurane, glycopyrrolate 0.4 mg, neostigmine 2 mg, ketorolac 30 mg IV/IM,

• Technique: GETA

• Rationale: ETT and muscle relaxation required d/t insufflation of abdomen
Intraoperative Issues

- Muscle relaxant antagonized when TOF 2/4 with neostigmine 2 mg and glycopyrrolate 0.4 mg
- 4/4 with tetany after reversal, Vt >350 ml, ETCO2 WNL, regular respirations, SpO2 98%, expired Sevo 0.2%
- After extubation exaggerated respiratory effort and c/o SOB
- Additional neostigmine 1 mg and glycopyrrolate 0.2 mg given

PACU

- Normal respiratory pattern, patient relaxed and breathing “felt better”
- VSS

Monitoring Neuromuscular Blockade

- Neuromuscular blockade
  - 0 out of 4 twitches = 100%
  - 1 out of 4 twitches = 90-95%
  - 2 out of 4 twitches = 80-85%
  - 3 out of 4 twitches = 75-80%
  - 0-70% blocked even when 4/4 twitches are present
- TOFR: Current recommendations support adequate recovery when >/= 0.9.7
- Tetany: Reliable indicator of adequate recovery
  - BUT can occur when approximately 70% of receptors are occupied.21
- A TOF with no palpable fade at the adductor pollicis consistent with TOFR of 0.4.

Monitoring Neuromuscular Blockade

- Prospective, observational cohort study
- 150 patients received NMBDs with intraspinal qualitative monitoring
- Site monitored:
  - Adductor pollicis = 51 patients
  - Facial nerve = 99 patients
- RNMB present in the PACU
  - 11 out of 51 patients (22%) monitored at adductor pollicis
  - 51 out of 99 patients (52%) monitored at facial nerve
- Findings:
  - Patients monitored by facial nerve stimulation had a significantly higher incidence of RNMB than patients monitored by ulnar nerve.25

Monitoring Neuromuscular Blockade

- Qualitative clinical tests and results suggest normal function:
  - Sustained hand grasp, jaw clench, and inspiratory force > -40 cm H2O
    • approximately 50% of receptors occupied
  - VC > 20 ml/kg
    • approximately 70% of receptors occupied
  - VT > 5 ml/kg
    • approximately 80% of receptors occupied
  - 5-second unassisted head lift
    • Studies have shown, however, that a successful head lift was associated with a TOFR </= 0.5 in a majority of patients.9,10,12

Respiratory Complications of RNMB

- In 1955, Beecher and Todd use of NMBDs was associated with a 6-fold increased risk of mortality in the perioperative period.9,13
- A case-control prospective study compared 42 cases of CREs in the PACU with 42 control surgical patients matched for age, gender, and surgical procedure, but who did not develop a CRE.
- The mean TOFR:
  - Control group = 0.98
  - Case group (patients who manifested CREs) = 0.62
- No control patients had a TOFR <0.7
- 74.8% of the patients with CREs had a TOFR <0.7.9,10,21
Risk of Aspiration with RNMB

- Prospective, observational cohort study of 17 elderly participants

Method:
- Rocuronium was infused to 17 elderly fit volunteers to produce TOFR between 0.7 and 0.9 at the adductor pollicis.

Results:
- Dysfunction of the pharynx was witnessed at a TOFR of 0.7 and 0.8, but not at 0.9
- Resting UES tone was significantly decreased even at a TOFR of 0.9

Respiratory Complications of RNMB

- Observational study of 415 patients, RNMB with rocuronium

Method:
- Patients were separated into two groups, elderly and young
  - Elderly group: 184 patients ages ≥ 65
  - Young group: 231 patients ages 19 – 57
- Neuromuscular monitoring not used intraop and recovery was spontaneous
- Neuromuscular block was clinically completely recovered in 4 patients
- Mean duration of anesthesia was 118 ± 32.1 minutes
- First 10 mins in the PACU, presence of RNMB was assessed by acceleromyography and TOF

Respiratory Complications of RNMB

- Prospective randomized cohort study of 150 patients
- Reduction in postoperative PFT in patients with RNMB

Method: Intermediate-acting NMBDs used
- All patients received neostigmine 0.05 mg/kg and glycopyrrolate 0.01mg/kg at end of case
- Patients were extubated on the basis of clinical judgment

Results:
- 57% of patients had RNMB on arrival to PACU
  - 21% reduction in FVC and 19% reduction in PEF in immediate postop period compared with pts who had completely recovered from neuromuscular blockade

Adverse Effects of RNMB

- Prospective, observer-blinded, observational study of 248 patients
- RNMB is independently associated with increased PACU LOS

Method:
- Intermediate-acting NMBDs used; RNMB was present if the TOFR < 0.9.

Results:
- The PACU length of stay was significantly longer in patients with RNMB (323 minutes), compared with patients with adequate recovery from neuromuscular blockade (243 minutes).
- The PACU discharge readiness time longer in patients with RNMB (224 minutes), compared with patients with adequate recovery from neuromuscular blockade (149 minutes).

Rocuronium was infused to 17 elderly fit volunteers to produce TOFR between 0.7 and 0.9 at the adductor pollicis.

The incidence of pharyngeal dysfunction during partial paralysis
- ≤ 28% at a TOFR of 0.6
- ≤ 17% at a TOFR of 0.7
- ≤ 20% at a TOFR of 0.8
- ≤ 13% TOFR of 0.9 or more

Majority of misdirected swallows resulted in penetration of liquid contrast bolus to the larynx. 80% reaching the level of the vocal cords.

10/16/14
Spontaneous Recovery of Neuromuscular Blockade

- The anesthetic concomitantly used with NMBDs affects DOA
  - Recovery of the TOF ratio to 0.8 when rocuronium was administered with sevoflurane, isoflurane, and propofol occurred in 103, 69, and 62 minutes, respectively.\(^{11,12}\)
  - Level of the inhaled volatile anesthetic present affects reversal
  - TIVA does not enhance effects of NMBDs\(^{2,11}\)

References


References Continued


Cerebral Oxygenation Monitoring of Patients in the Sitting Position

Lisa Krapp, SRNA

Thank You
Are There Any Questions?
Introduction

• The central nervous system remains the least monitored system in anesthesia despite the fact that anesthetic drugs directly interfere with brain activity
• Providers continue to rely on indirect parameters to measure brain oxygenation such as blood pressure and SpO2
• The sitting position, otherwise known as the beach chair position, is a commonly used position for patients undergoing shoulder surgery

Introduction Cont’d

• This position can put the patient at risk for hypotension, cerebral hypoperfusion, cranial nerve injury, visual loss, and cerebral infarction
• Prolonged hypotension may affect the cerebral oxygen supply and could result in cerebral ischemia as well as cardiac complications
• Perioperative stroke is particularly morbid, with a mortality of 60%, compared with 15–46% for stroke in general
• Near-infrared spectroscopy (NIRS) allows continuous, real time, non-invasive bedside monitoring of regional cerebral oxygen saturation (rSO2) through the scalp and the skull

Case Information

• Right shoulder arthroscopy
• 65 years old
• 65 kg
• Female
• ASA 2

Pre-operative Evaluation

• PMH included osteoarthritis, hypertension and hyperlipidemia
• PSH included right total knee arthroplasty and hysterectomy
• Pre-op VS: BP 138/72, HR 80, SpO2 98%
• Pertinent labs were within normal range, no other tests ordered
• Mallampati II

Anesthetic Course

• Midazolam, Fentanyl, Lidocaine, Propofol, Rocuronium, Phenytoin, Ephedrine, Cefazolin, Lactated Ringers
• General Endotracheal Anesthesia
• Secure Airway, Surgeon preference, Surgical position

Intraoperative Issues

• Hypotension after induction
  – Treated with intravenous fluids and vaspressors
• Repeated/continued hypotension after position change
  – Treated aggressively with vaspressors
    • Ephedrine and Phenytoin
• Resolved – patient responsive to treatment
• Short lived, no other hemodynamic issues
### PACU
- Patient emerged from anesthesia without difficulty
- Patient responsive and able to follow commands
- Neurologic checks all within normal limits

### Discussion
- The sitting, or beach chair, position is beneficial to the surgeon with regards to anatomy and reduced nerve strain
- Beneficial to anesthetist in regards to ventilation
- Higher risk for air embolism, hypotension, nerve injury

### Discussion Cont’d
- In normal physiologic state, the SNS is activated when in the seated position causing increased SVR and HR alterations to maintain CO and MAP
- Under anesthesia, the ANS response is blunted by the vasodilating effects of the anesthetic medications
- Stroke volume and CO can be decreased by up to 20% in the anesthetized state
- CPP decreases by approximately 15% simply by reaching sitting position and could further decrease due to vasodilation and impairment of venous return when anesthetized

### Discussion Cont’d
- Studies have shown significant decreases in MAP when changing to sitting position initially and after staying in said position
- Decreases from 36-42% when utilizing the sitting position are possible
- Autoregulation is defined as the body’s ability to maintain MAP despite changes in the blood pressure
  - Functionally adequate with MAP values 50-150
  - The lower limit of autoregulation is patient dependent and is approximately 25% less than resting value
- Carotid artery MAP can be as much as 20 mmHg lower than traditionally measured brachial artery MAP

### Discussion Cont’d
- When in the sitting position, hypotension must be avoided and cerebral oxygenation should be monitored
- There are monitors to evaluate cerebral hemodynamics (ICP, CPP, CBF, EEG, SEPs, MEPs), however, they demonstrate electrical activity NOT oxygenation status
- Near-infrared spectroscopy (NIRS) monitors cerebral oxygenation utilizing the same premise of a pulse oximeter
- The two displayed numerical percentages are representative of the regional cerebral oxygen saturation (rSO2) for each hemisphere in real time

### Discussion Cont’d
- Important to obtain baseline and maintain values within 20% of baseline for each patient
- Used most commonly in cardiovascular, neurological, and carotid endarterectomy surgeries
  - Starting to gain popularity and expand into trauma, major abdominal, and elderly populations
- NIRS has been shown to demonstrate continuous and accurately recognize cerebral desaturations in order to intervene appropriately
Conclusion

• Hypotension episodes treated with IV fluids and vasopressors
• According to literature, not aggressive enough with maintaining pressures within 20% of baseline
• More studies need to be done to prove the validity and appropriate place the NIRS (cerebral oximeter) has in the OR
• Shows tremendous potential to aid in reducing neurological risks associated with certain surgical procedures and positioning

References


Introduction

• Types of Leukemia:
  – Acute vs. Chronic
  – Lymphoid vs. Myeloid

• Leukemia occurs in 1 out of 100,000 pregnancies

Acute Promyelocytic Leukemia

• Form of Acute Myelogenous Leukemia
  • Annual incidence is between 600-800 cases
  • Typically affects patients in early adulthood
  • One of the most curable forms of acute leukemia

Anesthetic Management & Considerations of the Parturient with Leukemia

Lindsey Nelson, SRNA

Thank You
Are There Any Questions?
APL Signs & Symptoms

- Decreased Hgb and Platelets; Increased WBC
  - Fatigue, generalized malaise
- Associated with hemorrhage
  - DIC
- Overproduction and clumping of specific promyelocytic blasts in bone marrow
  - Causes life-threatening coagulopathies

Case Information

- Cesarean Section
- 20 year old female
- 34 weeks gestation
- G2P1
- 83 kg
- ASA 3

Pre-operative Evaluation

- Past Medical Hx: uterine anomaly, acute-onset APL
- Surgical Hx: LEEP, cone biopsy, D&C, and C-section in 2012
- Pre-op VS: 101/56, 90, 22, 95% RA, 36.9C
- Labs: Hgb 10.6, Hct 31.8, WBC 74.9, Platelets 116,000, PT 12.1, INR 1.2, Fibrinogen 170
- Mallampati 2, full neck ROM, intact native teeth, TM distance > 3 finger breadths

Anesthetic Course

- Induction
  - Standard RSI IV Induction with cricoid pressure
  - General Anesthetic due to patients disruption in coagulation
  - Regional Anesthesia contraindicated in this patient
- Maintenance
  - Sevoflurane (approximately 1.6-1.9% end-tidal)
  - Fentanyl, Dilaudid given once baby delivered
- Emergence
  - NDMB reversed with Glycopyrrolate and Neostigmine
  - Zofran and Decadron given for PONV prophylaxis
Intraoperative Issues

**Blood Products**
- 3 units RBC
- 2 units Platelets
- 2 units FFP
- 3.7 liters of crystalloid

**Medications**
- 40 units Pitocin IV
- Methergine 0.2 mg IM

Total blood loss of 2 liters

PACU

- Extubated immediately in the OR
- 2 L NC
- VSS
- Denied pain

Discussion

- APL
  - Treatment:
    - Control bleeding diathesis 3,4
    - ATRA + Anthracycline agent (chemotherapy) 3,4
- Pregnancy considerations:
  - Trimester recommendations for safe chemotherapy administration

Cardiac Considerations

- Cardiac 15
  - Cardiac toxicity has been shown with anthracycline agents (daunorubicin)
  - Dysrhythmias, SVT, heart blocks, and VTach
  - Cardiac depressant effect from anesthesia
  - EF < 45%- associated with anthracycline toxicity

Pulmonary Considerations

- Pulmonary 15
  - Pulmonary toxicity has been shown with bleomycin
  - Pulmonary infections are also common with immunocompromised patients
- Pulmonary Considerations:
  - Judicious use of PEEP to enhance oxygenation is essential 15
  - Fluid balance 15,16
  - Corticosteroid preoperatively 15,16
    - Improves vital capacity and diffusion capacity
    - Intraop monitoring of ABG 15

Renal Considerations

- Renal 15
  - Nephrotoxicity can occur from chemotherapy agents
    - Cisplatinum
  - Proper hydration and diuresis (necessary balance) 15,16
  - Drugs cleared from kidneys should be decreased if issues suspected 15,16
    - Pancuronium and NSAIDs
  - Inhaled agents of choice 15,16
    - Isoflurane or Desflurane
Hepatic Considerations

- Hepatic
  - Hepatic dysfunctions are commonly reversible side effects of chemotherapy
  - Monitor LFT's
  - Many chemotherapies induce CP450
    - Accelerates enzyme synthesis
    - Decreased pharmacologic action
- Frequent LFT monitoring required
- Isoflurane is considered the favored inhalational agent
- Vec/Roc used with caution and closely monitored with nerve stimulator

Immune Considerations

- Immune
  - Bone marrow depressant
  - Causes dysfunction in some or all of the blood components
  - Can have detrimental effects in coagulation

Immune Modulation in Anesthesia

- Surgical stressors affect immune function for up to several days after surgery
  - Immune-suppressed patients may have an exaggerated response
  - Puts patients at risk for postop infection, tumor growth, mets of cancer
  - Neuraxial anesthesia/analgesia associated with overall preservation of immune function
  - Opioids in GA helps restore autonomic stabilization during periop course

Regional vs. General Anesthesia

- Regional
  - Risk of infection around or within spinal canal
  - Chemo can cause peripheral neuropathies
  - Contraindicated in many cancer patients
  - Contraindicated in patients with bleeding diatheses
- General
  - Risk for failed airway
  - Cuffed ET
  - 1 out of 250 intubations
  - Risk for awareness
  - BIS
  - GA exaggerates stress response to surgery
  - May exacerbate postop immunosuppression
  - GA correlated with higher blood loss

Conclusion

- Summary
  - Timing of the diagnosis of leukemia with the gestation greatly impacts the morbidity and mortality of the parturient as well as the unborn child
- Take-Home Message
  - Treatment goals are aimed at restoring maternal health and decreasing fetal mortality
  - Chemotherapy poses many physiological changes in the parturient in addition to the normal physiological changes that occur
  - Vigilance is key

References

Thank You
Are There Any Questions?

Introduction

- This scholarly presentation will focus on anesthesia management of the pregnant patient undergoing non-obstetric surgery.
- Challenges CRNA to adapt anesthetic technique due to the physiologic adaptations associated with pregnancy.
- The safety of non-obstetric surgery and anesthesia has been well established without ill effects on mother or fetus.
Case Information

- 28 year old, Caucasian Female, ASA 3E
- 5’7” 61 kg, 28 weeks gestation
- Past Medical History – Drug abuse and a current ½ ppd smoker
- Presented to the emergency room (ER) with 10/10 pain and the sudden onset of a headache for the past 2 days.
- Alert and oriented, with nausea and photophobia
- CT scan findings - Cerebral aneurysm in the left anterior communicating artery with a small subarachnoid hemorrhage.
- Plan - Coiling of the cerebral aneurysm in Interventional Radiology under general anesthesia

Pre-operative Evaluation

- Preoperative Vital Signs
  - BP 121/73mmHg, HR 62bpm NSR, RR 16bpm, 100% So2 on RA
- Airway Evaluation - Mallampati I
- Standard monitors applied
- Pre-oxygenation with 7L/min O2 by face mask for 5 minutes
- Rapid sequence induction of GA with a 6.5mm ET T with continuous cricoid pressure until bilateral breath sounds auscultated.
- Left radial arterial line and 2nd large bore intravenous catheter placed

Anesthetic Course

- Drugs utilized
  - Induction - fentanyl 100mcg, rocuronium 5mg, propofol 130mg, succinylcholine 100mg
  - Maintenance - Sevoflurane 2% with 1L/min O2 and 1L/min Air. Rocuronium prn to maintain neuromuscular blockade and fentanyl prn for analgesia
  - Emergence - Glycopyrolate 0.4mg, Neostigmine 3mg, Ondansetron 4mg

Intraoperative

- Left uterine displacement (LUD) utilized throughout procedure.
- Fetal heart tones monitored and managed by labor and delivery staff.
- Orogastric tube placed for aspiration precautions.
- Neosynephrine drip utilized to maintain perfusion to the uterus and fetus under general anesthesia.

Emergence

- Extubated fully awake after suctioning of oropharynx and protective reflexes returned.
- Transferred directly to the Intensive Care Unit (ICU) on oxygen per nasal cannula at 4L/min.
- No headache noted, vital signs stable.
- Discharged home.
- Baby delivered at 38 weeks with no complications.

Discussion

- Pregnancy is associated with physiological and pharmacological changes
  - Pose potential harm to mother and fetus when under general anesthesia
  - Due to mechanical effects of an enlarging uterus, increased metabolic demands of the fetus, and low resistance placental circulation.
  - Present challenges to anesthesia professionals to provide superior care to the mother while maintaining fetal well-being and minimizing the risk of preterm labor or fetal demise.
Discussion

**PREOPERATIVE**

- Swelling of the oropharyngeal tissues and a decreased caliber of the glottic opening\(^{13}\)
  - Thorough airway examination crucial
- Mallampati scores in pregnancy increase by 38%\(^{14}\)
  - Difficulty ventilating and intubating the unconscious pregnant patient\(^{16}\)
  - Failed intubation-leading cause of maternal death caused by anesthesia\(^{16}\)

**PREOPERATIVE CONT’D**

- Aortocaval compression-24 weeks\(^8\)
  - Gravid uterus compresses the vena cava
    - Decreased cardiac preload, reduced cardiac output and maternal hypotension\(^{4}\)
    - Fetal hypoxemia and asphyxia\(^{1,4}\)
  - Increased incidence of reflux esophagitis after 16 weeks and a decrease in esophageal sphincter tone affects 50-80% of pregnant patients\(^{10,13,15}\)
    - RSI with cricoid pressure

**INDUCTION**

- Maximize oxygen tension within the FRC of the lungs\(^{11}\)
- FRC decreases due to decreased expiratory reserve and residual volume\(^{3,4,8}\)
  - Increased risk of hypoxemia and rapid desaturation when apneic
- Maternal oxygen requirements increase during pregnancy
  - Acceleration of the mother’s metabolic rate and an increase in fetal needs\(^{10}\)
  - Minute ventilation increases by 50%
    - Increase in tidal volume and maintenance of mother’s pre-pregnancy respiratory rate\(^{3,15}\)

**INDUCTION CONT’D**

- Pregnancy produces a state of lower anesthetic requirement\(^3,15\)
- Minimum alveolar concentrations (MAC) decrease by about 30% by 8 weeks\(^3,15\)
- Light general anesthesia and it’s associated catecholamine surge may lead to impaired uteroplacental perfusion\(^4\)
  - Increasing the risk of fetal hypoxemia

**MAINTENANCE**

- Positive pressure ventilation should be used meticulously and EtCO2 levels maintained within limits normally seen in pregnancy\(^4,15\)
  - Maternal hypercarbia limits the gradient for CO2 diffusion from fetal to maternal blood and can lead to fetal acidosis, increasing the risk of fetal loss\(^4\)

**FETAL CONSIDERATIONS**

- Safety is related to teratogenicity of pharmacologic agents, avoidance of fetal asphyxia, and avoidance of preterm labor and delivery\(^1\)
- Monitor closely for signs of distress
  - Hypotension, anesthetic drugs, central neuraxial blockade, or aortocaval compression post major risk to fetus\(^4,17\)
- FHR monitoring-detects early compromise
- Preoperative plan in place
  - Fetal distress unresponsive to conservative measures
Discussion

EMERGENCE

- Awake extubation in the left lateral position
- Lower esophageal sphincter tone is decreased in pregnancy as a result of the displacement of the stomach upward and muscle relaxation caused by progesterone.\(^{15}\)
- Orogenic suctioning prior to extubation
- Risk of aspiration is present until protective reflexes are present

POSTOPERATIVE

- Hypercoagulable state\(^{10}\)
  - Increased release of factors VII, VIII, IX, and fibrinogen.\(^ {15} \)
  - Increase in platelet turnover, clotting and fibrinolysis\(^ {10} \)
  - 5 times greater risk of thromboembolic complications such as venous thrombosis or pulmonary embolism by postoperative venous stasis.\(^ {15} \)
- Tocometry
  - Postoperative analgesia may mask awareness of mild early contractions and delay tocology.\(^ {15} \)
  - Adequate analgesia should be maintained as pain has shown to increase the risk of premature labor.

Conclusion

- Comprehensive preoperative evaluations, meticulous attention to maternal and fetal physiology perioperatively, and ongoing care during the postoperative period are essential.
- Close communication throughout the multidisciplinary team, including the CRNA, is vital to provide preservation of maternal and fetal well being during non-obstetric surgery.

References


10/16/14
Anesthetic Implications for a Patient with Gitelman’s Syndrome

Jamie L. Greicar, SRNA

Introduction

• Gitelman’s syndrome
  – First described in 1966 (Dr. Hillel Gitelman)
  • AKA Gitelman’s variant of Barter’s syndrome
  – Autosomal recessive kidney disorder characterized by hypokalemic metabolic alkalosis (Farmer et al., 2012)
  • Hypocalciuria
  • Hypomagnesemia
  • Low to Normal Blood Pressures
  – Estimated 1 in 40,000 people worldwide (Farmer et al., 2012)
  – Typically diagnosed in adolescence and early childhood

Gitelman’s Syndrome: Pathophysiology

• Distal Convoluted Tubule Defects
  – Thiazide sensitive Na-Cl cotransporter responsible for reabsorption of Na-Cl across basolateral membrane of intraluminal cells. (Simon et al., 1996)
  – Salt wasting = hypovolemia and metabolic alkalosis
  – A variety of nonconservative amino acid substitutions and splice site mutations on chromosome 16q13 of the NCCT gene. (Simon et al., 1996)
    • >140 mutations of the NCCT gene

Pathophysiology: DCT

Case Information

• 37 year-old Female
• Admitted through ER
  – Acute right sided abdominal pain, N&V
• Laparoscopic cholecystectomy.
  – Following acute cholecystitis with cholelithiasis.
  • 62.7 kg - 160 cm tall
  – BMI 24.4
• ASA: 2
Pre-operative Evaluation

- **Medical Hx:** Gitelman’s Syndrome with hypokalemia, Depression, hypothyroid, GERD (well-controlled)
- **Surgical Hx:** functional endoscopic sinus surgery (FESS) under general anesthesia.
- **Medications:** Amiloride, Citalopram, Klor-Con, Omeprazole PRN, and levothyroxine.
- **Pre-op Vitals:** BP 97/60, HR 72, RR 16, Temp 97.7 °F, and Sats 97% on room air.
- **Airway Evaluation:** Mallampati II classification, thyromental distance > three fingerbreadths, mouth opening > three fingerbreadths, and full neck range of motion.

Pre-Operative Evaluation Cont...

- **Labs:**
  - Hgb 12.7 g/dl
  - Hct 38.6%
  - Platelets 235
  - Sodium 138 mEq/l
  - Potassium 2.9 mEq/l
  - Chloride 93 mEq/l
  - magnesium 1.6 mEq/l
  - pregnancy screen negative
- **Electrocardiogram:**
  - normal sinus rhythm
  - HR 78
  - PR interval of 0.17
  - QRS interval of 0.09
  - QT interval of 0.48
  - regular ST

Anesthetic Course

- **GETA:**
  - Midazolam 2mg
  - Preoxygenated 8L via Facemask
  - Fentanyl 100 mcg
  - Rocuronium 5 mg
  - Lidocaine 50 mg
  - Propofol 150 mg
  - + Mask Ventilation
  - Rocuronium 35 mg
  - 7.5 ETT
    - ETT through cords, BIS, ECOG
    - Sevoflurane
  - + Additional Medications:
    - Acetaminophen 1000 mg
    - Dexamethasone 10mg
    - Ondansetron 4 mg
    - Phenylephrine 200 mcg
    - Fentanyl 150 mcg
    - Rocuronium 50 mg
    - Glycopyrrolate 0.4 mg
    - Neostigmine 3 mg.
- **Results:**
  - SBP maintained > 100 mm Hg throughout
- **Continuous EKG analysis:** No changes from baseline noted.

Intraoperative Issues

- **Hypotension**
  - Phenylephrine 100 mcg bolus
  - Lactated Ringers 1500 ml
- **Results**
  - SBP maintained > 100 mm Hg throughout
- **Continuous EKG analysis:** No changes from baseline noted.

PACU

- **Emergence and transfer to PACU Uneventful**
- **Vital Signs:** BP 121/78, HR 84, RR 16, Temp 37.0, Sats 98% on 3L nasal cannula
- **No complaints of pain**
- **Post-op ECG ordered**
- **Post op labs ordered (BMP)**

Gitelman’s Discussion (Cardiac)

- **Electrolyte abnormalities can cause prolongation of the QT interval**
  - increasing the risk for developing ventricular arrhythmias, which could advance to syncope and sudden cardiac death (Bettinelli et al., 2002)
Gitelman’s Discussion (Cardiac)

- **Study**: 21 patients with Gitelman’s syndrome assessed using continuous 24 hour ambulatory ECG, echocardiography, and treadmill exercise testing. (Foglia et al., 2004)
  - Results were consistent with Gitelman’s syndrome causing an increased QT interval when compared to a normal QT interval of less than 0.4 seconds.
  - In greater than 50% of the participants QT interval was 0.45-0.51 seconds.
- Potassium, magnesium, and bicarbonate levels did not correlate with the prolonged QT interval in these patients.
  - Important to monitor ECG closely, rather than rely on laboratory testing alone.

Gitelman’s Discussion (Cardiac)

- **QT Prolongation**
  - Chronic/acute diarrhea
  - Dehydration
  - Nutritional deficiencies
  - ETOH abuse.

Gitelman’s Discussion (Cardiac)

- **QT Prolongation**
  - Antiarrhythmics
  - Antihistamines
  - Macrolides
  - Antifungals
  - Psychotropics
  - Beta-2 adrenergic agonists
  - Cisapride.

Gitelman’s Discussion (Vascular Tone)

Normotension - Hypotension despite consistent activation of RAAS.
  - The vasoconstriction and cardiovascular remodeling effects of angiotensin II were blunted in patients with Gitelman’s syndrome. (Calo, 2006)
  - The abnormalities in vascular tone pathways were identical in both hypertensive patients and those with Gitelman’s
  - Researchers studying to find if this is due to receptor sensitization.
  - Decreased responsiveness to vasoconstrictors through altered cellular signaling transduction systems coupled with the upregulation of the nitric oxide synthetase system. (Sorier et al., 2007)

Gitelman’s Discussion (Renal)

- **Study**: Managing a pre-operative Gitelman’s syndrome patient with potassium supplements and saline infusions (1.5 Liters/3 times per week) in order to overcome the chronic hypovolemia and hypokalemia. (Bonfante et al., 2001)
- Increasing fluid administration in Gitelman’s Patients.
  - Urinary Catheter Insertion

Gitelman’s Discussion (Renal)

- Hypokalemia and hypomagnesemia predisposed the patients to calcium pyrophosphate deposition (CCPD) in the articular tissues. (Cruz et al., 2001)
  - Early onset of symptoms (<50 years old)
  - Progressive joint neuropathy and weakness
- **Study**: 84% of the Gitelman’s syndrome patients reported having some degree of cramping; 42% reporting frequent cramping. (Cruz et al, 2001)
  - Muscle weakness reported by 70% of the patients

Gitelman’s Discussion (Musculoskeletal)

- Hypokalemia and hypomagnesemia predisposed to the patients to calcium pyrophosphate deposition (CCPD) in the articular tissues. (Cruz et al., 2001)
  - Early onset of symptoms (<50 years old)
  - Progressive joint neuropathy and weakness
- **Study**: 84% of the Gitelman’s syndrome patients reported having some degree of cramping; 42% reporting frequent cramping. (Cruz et al, 2001)
  - Muscle weakness reported by 70% of the patients
**Gitelman’s Discussion (Supplementation)**

- **Study:** After consultation with a nephrologist, researchers reported not giving electrolyte supplementation to a Gitelman’s syndrome patient with hypokalemia and hypomagnesemia. *(Shanbhag and Howell, 2010)*
  - Asymptomatic
  - Normal sinus rhythm on ECG.

**References**


**CRNA: Take Home Message**

- ECG Monitoring
- Electrolyte Analysis
- Pre-Op Assessment
  - Musculoskeletal
  - Fluid Status
- Fluid Management

**Thank You Are There Any Questions?**

**Independent Project/Case Report**

**Continuous Noninvasive Hemodynamic Monitoring**

Corey Knox, SRNA

**Introduction**

- Patients who are at risk for hemodynamic instability can benefit from the hemodynamic optimization provided by noninvasive hemodynamic monitoring. 20
- Delayed treatment of hemodynamic instability during surgery leads to increased patient morbidity, hospital length of stay, and healthcare costs. 1
- Average cost of treating one surgical complication is $18,000. 38
- The Nexfin allows for continuous monitoring of multiple hemodynamic parameters including ABP, CO/CI & SVV.
- This device is not intended to replace invasive monitoring methods but rather to enhance the monitoring of the other surgeries as indicated. 7
Case Information

- Surgical Procedure: Right total shoulder arthroplasty
- Age: 76
- Weight: 67 kg
- Gender: Female
- ASA: III
- Past Medical Hx: Aortic stenosis (AS) & IDDM

Pre-operative Evaluation

- Pre-op VS: BP = 166/66, HR = 64, RR = 16, SpO2 = 96% RA, Temp = 36.4 °C
- Pertinent labs: H/H = 12/36, AIC = 6.4, Glucose = 132
- EKG: NSR
- Airway evaluation: Mallampati II, 3-3-2 rule appropriate, full neck ROM
- Chemistry unremarkable

Anesthetic Course: Technique

- Preoperative
  - ISB with Ropivacaine 0.5% 30 ml
  - Metoclopramide 10 mg IV, non-particulate antacid 30 ml
- Induction
  - RSI: O2, fentanyl 100 mcg, lidocaine 40 mg, rocuronium 5 mg, propofol 70 mg, succinylcholine 100 mg, ondansetron 4 mg
  - GETA, beach chair, Nexfin monitoring
- Maintenance
  - 2% sevoflurane in a mixture of O2 at 1.5 L & air 1 L/min
  - Phenylephrine infusion at 50 mcg/min
- Emergence: Awake

Intraoperative Issues

- Hemodynamic instability
  - Stroke Volume Variation (SVV) 16%
    - Treatment with fluid challenges until SVV < 13%
  - Hypotension
    - Treatment with phenylephrine infusion
    - Cardiac Index low 2.1 L/min/m2
      - After perioperative hemodynamic optimization was achieved with adequate fluid load and vasopressor support, CI was increased & maintained between 2.8 and 3.4 L/min/m2.

PACU

- Awake emergence, airway was suctioned and Sevoflurane off.
- The endotracheal tube was removed and oxygen was applied via simple mask.
- The Nexfin monitor was discontinued and the patient was transported to the Post Anesthesia Care Unit.
- Vital signs remained stable and the patient was comfortable with no complaints of pain or nausea.
- A 24-hour follow up evaluation revealed patient’s recovery progressing with adequate analgesia and discharge pending.

Anesthetic Course cont’d

Anesthetic methods used in this case study were supported by evidence found in the review of literature.

- With the use of the ISB, high opioid-based anesthesia was not required.
- Etomidate & benzodiazepines for a cardiac safe induction with AS.
- Propofol was used & midazolam was not.
Discussion

• Overview
  – The use and accuracy of the Nexfin in the operating room was examined.
  – There have been multiple studies evaluating different aspects of the Nexfin’s capabilities.
  – Reports of accuracy and inaccuracies are examined followed by a systematic review of CNAP monitoring devices.
  – While this case report involves the Nexfin device, the benefits of the monitor could be realized with most CNAP devices.

Discussion Cont’d

Nexfin vs. Standard BP

• Voss et al. (2014)
  – 120 patients undergoing neurosurgical, oncological and vascular surgery.
  – Concluded that Nexfin was interchangeable

• Chen et al. (2012)
  – 25 subjects undergoing general anesthesia for abdominal and orthopedic operations.
  – Tighter blood pressure control was shown.

Discussion Cont’d

Nexfin vs. Arterial Line

• Martina et al. (2010) & (2012)
  – Feasibility research study
  – 18 and 53 patients during cardio-pulmonary bypass.
  – Results showed the Nexfin readings correlated with the A-line
• Geersing et al. (2011)
  – Feasibility research study
  – 24 adult patients during electroconvulsive therapy.
  – This monitoring method was found to be feasible during electroconvulsive therapy.

Discussion Cont’d

Nexfin vs. Pulmonary Artery Catheter (CO/CI)

• Broch et al. (2013)
  – Cohort prospective observational research study
  – 40 patients undergoing CABG surgery.
  – Conclusion: a significant correlation between the two values during and after the operation.
• Monnet et al. (2012)
  – 45 patients experiencing septic or hypovolemic shock
  – 500 mL of normal saline was infused over 30 minutes.
  – Conclusion: due to hypoperfusion to the finger, the noninvasive technique could not estimate changes made to the CI with any level of accuracy in this patient population.

Discussion Cont’d

Nexfin vs. A-line & PA Cath: finally some middle ground

• Fischer et al. (2012)
  – 50 consecutive cardiac surgical patients were included.
  – Conclusion: the Nexfin was a safe and accurate method for measuring beat-to-beat ABP. However, when performing continuous CI measurements, the device was not precise.
• Weiss et al. (2014)
  – 31 patients evaluated during the induction phase of GA
  – Conclusion: although the Nexfin can reliably & quickly detect changes in ABP, its accuracy was not sufficient to replace invasive ABP monitoring.

Discussion Cont’d

Systematic review & meta-analysis: CNAP vs. A-Line

• Kim et al. (2014)
  – 28 qualitative studies, 912 patients & 12 different devices.
  – Conclusion: the pooled bias would not satisfy the standards set forth by the Association for the Advancement of Medical Instrumentation.
• Limitations to consider
  – Pooled together 12 devices
  – Pulse pressure amplification phenomenon
  – CNAP devices were not measured against standard cuff pressures, which is the majority of the population where the devices would be utilized.
Discussion Cont’d

Summary of Evidence

• The evidence reviewed was derived from 23 separate research studies and one systematic review of literature.
• 2 studies were conducted in the US and the 21 were conducted in Europe.
• 54% reported the Nexfin as being accurate.
• 17% reported the Nexfin as not being accurate.
• 29% of the research studies concluded the Nexfin is accurate but also has limitations, including the systematic review of literature.

Conclusion Cont’d

• After reviewing the current literature, the feasibility and accuracy of the Nexfin use in the OR has yielded various results.
• The evidence reviewed consistently indicates that the Nexfin provides accurate ABP measurements, however the accuracy fades with CO/CI values when compared to invasive methods of measurement.
• The Nexfin has shown to be accurate to a degree and has some favorable clinical applications but is not interchangeable to invasive hemodynamic monitoring.
• Further clinical studies are needed to validate the applicability of perioperative use of the Nexfin.

References

References Cont’d


