Forensics of Anesthesia
What Went Wrong?

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Disclaimer; Chronic Cough

Important Notice
Every attempt has been made to use generic names when possible, at times brand names are used.
I do use the vernacular and most commonly used name
Mentioning a company does not imply endorsement

Disclosure;
I tutor at-risk Nurse Anesthesia Residents for school, SEE, and NCE but have NO financial relationship with the big six review companies.

I am NOT an item writer!
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Forensics

Scientific tests or techniques used in connection with the detection of a medical error.

A Few Vital Principles In Our Investigation

Occam’s Razor says that when presented with competing hypotheses that make the same predictions, one should select the solution with the fewest assumptions.
Some People Act Without Thinking

Still Don't Know The FORCE Required To Go Through The Caps

Take It For Granted

We all Practice to that one PATIENT?
Clinically Relevant

Medical Error
The Third Leading Cause of Death in the US

Mistakes!
How Many Die From Medical Mistakes in U.S. Hospitals?

Deaths Per Year!
1999, the Institute of Medicine published the famous “To Err Is Human” report, which dropped a bombshell on the medical community by reporting that up to 98,000 people a year die because of mistakes in hospitals

(2014) A study in the current issue of the Journal of Patient Safety that says the numbers may be much higher — between 210,000 and 440,000 patients

Crime Scene

RES IPSA LOQUITUR
Why is the patient having a panic attack?

It was just a MAC case …. “crazy patient” or was it something I did?

What IV solution to you choose?

Panic attacks… oh boy?

“Lactate infusions commonly induce feeling of anxiety, and few cases of panic attack have been reported” Package insert

Do you write on your IV or put tape on it?

ISMP also cautions against writing an expiration date directly on the bag, because volatile chemicals from the ink may leach into the solution. http://www.ismp.org/library침속

Can Permanent Marker Leach into IV Infusion Bags?

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30 Million Prescription Mistakes per year (100,000 Deaths)

4% Stocking Errors…. What is in your top drawer?
I Would Never Do That!
I Would Never Do THAT
MommiFied.com

“Often stepping back you see more, don’t you?”
- David Hockney

Crazy!
Beef Anaphylaxis?

2009

Alpha-Gal
3% of food allergies

Delayed Anaphylaxis to Alpha-gal

Triggered by an IgE antibody to a sugar (not a protein) Galactose alpha 1-3 galactose ("alpha gal") found in meat (beef, pork, lamb, venison, bison but not poultry or fish)

Cardiovascular symptoms (arrhythmia, blood pressure fall, syncope, shock) – Death

Reported in several hundred people across US (Virginia highest)
Gelatin Based Products

Examples of intravenous medications in which those inactive ingredients are found include insulin, heparin, hydromorphone, haloperidol, recombinant human coagulation factor VII, and albumin.

Some medications that the patient may receive preoperatively are acetaminophen, aspirin, naproxen, lisinopril, hydrocodone/acetaminophen, oxycodone, clonidine, methadone solution, celecoxib, pregabalin, gabapentin, lidocaine patch, gelatin containing vaccines.

Surgical products such as porcine-derived heart valves, gelatin-based hemostatic agents, surgical powder, thrombin, cat-gut suture and biologic mesh are capable of triggering anaphylaxis as well.

WOW!

Alpha-gal Syndrome

Bird Egg Syndrome
(Alpha-Livetin, Chicken Serum Albumin)

Chicken Allergy
(can’t eat shrimp or poultry) OR most fish

Effects Females more

Alpha-Livetin
Bird Egg Syndrome
Gabapentin
Omeprazole
atorvastatin
Labetalol
Meloxicam
Chlorthalidone
Aspirin
Corn Allergy Thoughts

Antibiotics are grown in corn medium
Hand sanitizer, ethanol from corn
Powdered surgical gloves, cornstarch
LR fermented in corn sugar
Tongue depressors
Anesthesia Circuits should be rinsed before use
Local anesthetics preserved corn-based
ETT rinse before use
Avoid rubber instruments
Avoid dissolvable sutures
Face Mask should be rinsed before use


25-Year-Old Patient, Male, OPEN Appy, ASA 1, 175 lbs., NPO 10 hours. Allergy to Eggs (Hives)-- LMA

Propofol 200 mg mixed with 60 mg lidocaine

He requires a second dose of 200 mg Propofol mixed with 60 mg lidocaine

And then........

Saturation drops to 84%, tachycardia, hypotension, cyanosis,
You send stat ABG;
Decrease in PCO2, Decrease in PO2, Increase in pH

Patient arrests and CPR and ACLS Started........ What happened?

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He requires a second dose of 200 mg Propofol mixed with 60 mg lidocaine

And then........

Allergy to Eggs (Hives)-- LMA

Propofol 200 mg mixed with 60 mg Lidocaine

Distractor

Real Clue

Saturation drops to 84%, tachycardia, hypotension, cyanosis,
Decrease in PCO2, Decrease in PO2, Increase in pH
Remember Propofol Points!

Lilley et al. showed that adding lidocaine to propofol emulsion increased the lipid droplet size and caused an oil droplet to form. High risk of PE

Eriksson et al. found that mixing 20 mg of Lidocaine with 200 mg of Propofol increased the dose of Propofol required.

The incidence of coring was 29% with blunt plastic needles as opposed to only 4% with acutely beveled sharp needles.

The incidence of coring and fragmentation may occur with rubber cap and blunt needles.

The incidence of coring with blunt versus sharp needles.

Near-Emboliadion of a Rubber Core from a Propofol Vial

Rubber Core of Injectable Medication Vial Stopper: An Evaluation of Coronal Factors

PONV Plan

45-year-old Female, non-smoker with motion sickness having a GYN procedure with opioids

Propofol: Bolus of 1 mg/kg followed by an infusion at 20 mcg/kg/min
Decadron in small doses (20 mg as needed)

Decadron 0.15 mg/kg cover PONV and reduce postoperative pain and opioid demand. IDE Oliera 2011)

Best Combination is 4 mg Zofran prior to induction; 0.15 mg/kg Decadron either hours prior to or right after going to sleep and Haldol 0.5-2.0 mg IV (Haldol takes 60 min to fully work.)
Dexamethasone Sodium Phosphate

The pharmacological mechanism explaining this phenomenon remains poorly understood, but could be related to the phosphate ester of the corticosteroid since perineal irritation has been described with hydrocortisone-21-phosphate sodium and prednisolone phosphate.

The first article for Internal Journal of Environmental Research found burns from MRI as early as 2007 and 2009.

Based on the limited information available, inserting an epidural or spinal needle through a tattoo could cause long-term problems such as arachnoiditis or neuropathy secondary to an inflammatory reaction, but we don’t know.

Tattoos

Professional inks may be made from iron oxides

MRI Burn? What could be missed?

Based on the early research found burns from MRI as early as 2007 and 2009.

Lumbar Epidural Catheter Placement in the Presence of Low Back Tattoos: A Review of the Safety Concerns

First article for Internal Journal of Environmental Research found burns from MRI as early as 2007 and 2009.
Electricity....oh boy!!

Valleylab.com

If EXPAREL and other non-bupivacaine local anesthetics, including lidocaine, are administered at the same site, there may be an immediate release of bupivacaine from EXPAREL. [https://www.exparel.com/hcp/dosing-and-preparation]

DO NOT dilute Exparel with water for injection or other hypotonic agents, as it will result in disruption of the liposomal particles.

Bupivacaine HCl administered together with Exparel may impact the pharmacokinetics and physicochemical properties of liposomal, and the effect is concentration dependent. Therefore, bupivacaine HCl and Exparel may be administered simultaneously in the same syringe, and bupivacaine HCl may be injected immediately before Exparel as long as the ratio of the milligram dose of bupivacaine HCl solution to Exparel does not exceed 1:2. [https://www.drugs.com/pro/exparel.html]

Etomidate-Lipuro 2mg/cc

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Sugammadex

- 70kg man
  - 2mg/kg dose: 140mg, one 2mL vial = $84.93
  - 4mg/kg dose: 280mg, one 5mL vial = $155.55
  - 16mg/kg dose: 1120mg, two 5mL vials and one 2mL vial = $396.03

Caveats:
- Neostigmine 5 mg and Robinol 1.0 mg = $300 - $400
- Uncontracted prices from distributor
- Patient cost usually approximately 3x this cost


Neostigmine, Expensive?

- 70 kg man – Cost to Patient
  - 70mcg/kg neostigmine = 4.9mg = $42.34
    ($208.82 to patient)
  - 10mcg/kg glycopyrrolate = 0.7mg = $19.55
    ($122.12 to patient)

Caveat – Approximate prices prorated for amount used from premixed syringes available from pharmacy.

Flamel merged with Avadel Pharmaceuticals in 2017.
Cost Comparisons


In response to the FDA’s requests, four additional studies were conducted examining the impact of sugammadex on coagulation. These investigations demonstrated a slight increase in PT and aPTT that occurred within minutes of administration but resolved within an hour.

In addition, in a large study of patients undergoing hip or knee replacement surgery, no increase in bleeding or transfusion requirements was observed in patients randomized to receive sugammadex.

Source: Full Prescribing Information, Bridion® (Sugammadex). 2015, Merck Sharpe and Dohme Corp.

PTT and PT

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74

73

76

75

78

Question?

The patient presents with hypertension, tachycardia, agitation, and restlessness.

Patient history reveals current treatment with fluoxetine (Prozac), and they also report taking “some alternative medicines for depression.”

What syndrome does this patient exhibit and which herbal medicine has potentiated the syndrome?
The patient with hypertension, tachycardia, agitation and restlessness has a serotonin-like syndrome. St. John’s wort, often used as a “natural remedy” for depression can produce or potentiate the serotonin-like syndrome.

St John’s Wort

The recommendation as with all herbals and supplements is to stop this drug at least two weeks prior surgery...

If they are using it for mild depression, they may need to stop it sooner so they can do a taper.

Interacts directly with: anticoagulants, oral contraceptives, NSAIDS, antidepressants, anti-seizure medications, and transplant and HIV medications.

LMA Cysto 45-year-old Female on Cymbalta

Surgeon asks for you to give Methylene Blue

1. Agitation or restlessness
2. Confusion
3. Rapid heart rate and high blood pressure
4. Dilated pupils
5. Loss of muscle coordination or twitching muscles
6. Muscle rigidity
7. Heavy sweating
8. Shakes
9. Headache
10. Shivering
11. Goose bumps

Serotonin Syndrome

Cyproheptadine: (5HT2) Sometimes used to block serotonin production in the body. It has demonstrated effectiveness in reducing the severity of symptoms associated with serotonin syndrome

Initial dose of 12 mg, then 2 mg every two hours until response is seen

Cyproheptadine HCl Tablets, USP

Swelling In the Face Urticaria

Angiotensin-converting enzyme (ACE) inhibitors, such as enalapril, lisinopril, perindopril and ramipril, which are used to treat high blood pressure.

Ibuprofen and other types of NSAID painkillers

Angiotensin 2 receptor blockers (ARBs), such as andesartan, irbesartan, losartan, valsartan and Olmesartan

Crucially, bradykinin-mediated angioedema does not respond to the same treatment as histamine-mediated angioedema.

Ace Inhibitor Angioedema

Icatibant (FIRAZYR) is a minimal peptide which blocks bradykinin-receptors

Icatibant 30 mg subcutaneously for ACE inhibitor-induced angioedema.

Icatibant shortened the time to complete the resolution of edema. Unfortunately, the cost of this therapy is $11,000 US.

FFP Can Help Angioedema

FFP contains many proteins, including a protein called C1-inhibitor (C1-INH), which is produced in insufficient amounts in people with non-allergic angioedema.

C1-INH blocks two other proteins, plasma kallikrein, and coagulation factor 12, from producing a different substance called bradykinin.

Hereditary Angioedema, YES Induced – Well Maybe

Tranexamic acid is used in prophylactic management of hereditary angioedema;

However, evidence for TXA in angiotensin-converting enzyme (ACE) inhibitor-induced angioedema. (ACEI-AE) is limited. The

Crucially, bradykinin-mediated angioedema does not respond to the same treatment as histamine-mediated angioedema.
Your Called to PACU

Restlessness, confusion, hallucinations, suppression of sweating and leading to flushing heat intolerance and hyperthermia.

Symptoms include, fever, blurred vision, photophobia, tachycardia, restlessness

Exam Type Question

One of the most important side effects of anticholinergic therapy is central-cholinergic syndrome....

Symptoms include, fever, blurred vision, photophobia, tachycardia, restlessness

Central anticholinergic syndrome during recovery is essentially a diagnosis of exclusion and can be confirmed only after resolution of symptoms with physostigmine (0.03-0.04mg/kg)
2006 Case

17-year-old developed seizure activity and CV collapse after intentional ingestion.

Ingested: Bupropion (Antidepressant) and Lamotrigine (Anticonvulsant)

Unsuccessful resuscitation attempts for 70 minutes.

After 1 minute, an effective, sustained pulse was observed. The patient recovered with no major neurologic deficit.

Many Compounds Inhibit Na Channels

Ca channel blockers, Beta Blockers
\( \alpha \) agonists, Olanzapine
KHAT, Methamphetamine
Tricyclic antidepressants
Substance P antagonists
Many nerve toxins
Benadryl
Droperidol ?????

Innovar injection—a combination of droperidol and fentanyl.

The Power of an Antidote

Lipid Rescue

20% lipid solution
1.5 ml/kg over 1 minute;

Follow immediately by a infusion at rate of;
0.25ml/kg/min

www.lipidrescue.org

“But I Have Never Heard of That?”
Case Study

26-year-old female in labor presents for elective epidural

Second baby.. Hx of preterm Labor

On Fish Oil

Obstetrics Patient in Active Labor

No allergies, No other medical history
Second baby.. Hx of preterm Labor
Prenatal Vitamins, Fish Oil

You place the epidural, three pokes, test dose negative, you go home finally at 7 am.
Your called at 11 am to tell you mom is taken emergently to surgery.

Fish Oil- 3000mg Omega 3

To test the postulated preventive effects of dietary n-3 fatty acids on pre-term delivery, intrauterine growth retardation, and pregnancy induced hypertension

21-33% reduction in Preterm Labor

Herbals

Can have significant perioperative implications:
Cardiovascular instability (ginseng, ma huang)
Hypoglycemia (ginseng)
Immunosuppression (echinacea use for > 8 weeks)
Increased risk of bleeding (garlic, ginkgo, ginseng)
Prolongation of anesthesia (kava, St. John’s wort, valerian)

STOP 2 weeks before surgery

Is Nitrous Back?

The position of the American College of Nurse Midwives that women should have access to a variety of measures to assist them in coping with the challenges of labor. Among these should be nitrous oxide, which is commonly used in many other countries.

Inhaled Entonox (50:50 N2O/O2 mixture)
Side effects: dizziness, N/V, dysphoria, lack of cooperation
Appears to have no effect on hepatic, renal, cardiac or pulmonary function
Not Everything is it Appears? Labor Epidurals Going Away?

Blair et al. Patient-controlled analgesia for labor using remifentanil: a feasibility study?

Remifentanil PCA with a bolus dose in the range 0.25–0.5 µg kg⁻¹ and a lockout time of 2 min appears a safe and effective drug for use in labor in patient-controlled analgesia systems.

References


Versed

Anesthesia and Analgesia 2016; 122-656

Meta-Analysis of studies from 1974-2014

Drastically reduced PONV, especially with prep and small dose 30 minutes before extubation.


Conclusion, the results of this study indicated that for patients undergoing surgery, midazolam 2 mg given intravenously 30 minutes before the end of surgery was effective in decreasing the incidence of PONV without increasing recovery time and the level of sedation.
The drug, amisulpride, showed a statistically significant reduction in the occurrence of PONV, when used intraoperatively in combination with a standard anti-nausea treatment, in the 24 hours after surgery in high-risk patients.

D2/D3 antagonist antiemetic
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I do not do sale presentation or work for any drug company. I used the name of the pharmaceutical agent that is commonly accepted.