Saturday, October 15, 2016
7:30 - 14:00
Breakfast & Lunch Provided**

The Ballantyne Hotel
10000 Ballantyne Commons Parkway
Charlotte, NC 28227

Providence Anesthesiology Associates
2016 Annual Update

7:30-8:00
Registration / Breakfast

8:00-8:05
Welcome and Announcements
Rick Griggs, MD
Chief, Clinical Practice Committee - PAA

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Session 1: Case Discussions
Moderator: Jay Duggins, MD
Chairman, Anesthesiology - SPR

8:05-8:25 - Colon Cancer in a Patient with a Recent DES
Freeman Jackson, MD
Anesthesiologist, PAA

8:25-8:45 - My Patient with a Humerus Fracture Has Severe COPD and OSA
Karen Slocum, MD
Anesthesiologist, PAA

8:45-9:05 - OK, I'll Have a Spinal, but I Don't Want to Know ANYTHING! - Sedation Strategies for Regional Anesthesia
Dan Briggs, MD
Section Chief, COH

9:05-9:15 - Discussion

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Session 2: Pain Management
Moderator: Christopher Gunn, MD
VP, Clinical Operations - PAA

9:15-9:35 - Improving the Safety of Postop Pain Management
Cheryl Sarnow-Marlow, RN, RN-BC
Regional Pain Management Coordinator, GCM

9:35-9:55 - Perioperative Lidocaine and Ketamine Infusions
Rick Griggs, MD

9:55-10:15 - Alternative Pain Procedures - Coolief for Knee Pain and Blocks for Headaches
Farrukh Sair, MD
Anesthesiologist, PAA

10:15-10:25 - Discussion

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10:25-10:50 - Morning Break

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Session 3: Keynote Speaker
Moderator: Rick Griggs, MD

10:50-11:35 - Sugammadex - How a New Class of Medication May Transform Anesthesia Care
Laura Clark, MD
Professor; Director, Acute Pain and Regional Anesthesia
Director, Resident Program
Department of Anesthesiology & Perioperative Medicine
University of Louisville

11:35-11:50 - Discussion

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11:50-12:35 - Lunch Break and Discussion

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Session 4: Clinical Updates
Moderator: Paul Vadnais, MD
Past President and Retired PAA Anesthesiologist

12:35-12:55 - Update on Guidelines for Adult and Pediatric Resuscitation
Julie Wright, CRNA
Chief Anesthetist, NHPMC

12:55-13:15 - Interventional Neurosurgery - Anesthetic Perspectives
John Sandoval, MD
Section Chief, PMC

13:15-13:35 - Intraoperative Vent Management in 2016
Kristin Washburn, MD
Anesthesiologist, PAA

13:35-13:45 - Discussion

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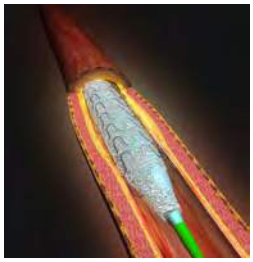
13:45-14:00
Final Remarks - *Jim Benonis, MD*
President, PAA

Colon Cancer in a Patient with Recent Drug Eluting Stents



Freeman Jackson MD

Case Presentation

65 year old female

proximal LAD and ostial OM1 DES 3 months prior

recent diagnosis of colon cancer

Balancing act:

optimization of myocardium and coronary endothelium versus progression of cancer and compromised oncological prognosis

Balancing Act

Elective versus emergent

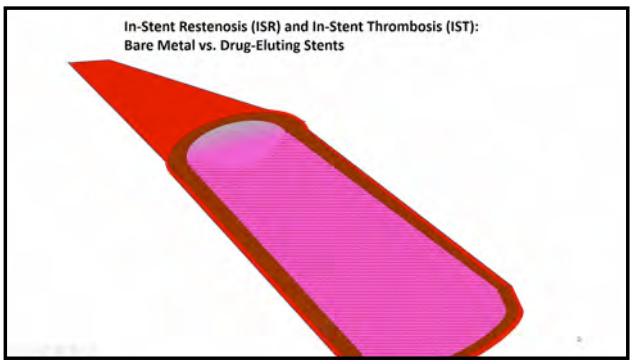
Type of surgery (risk of bleeding)

Patient comorbidities (bleeding ulcer)

Nature of previous PCI (angioplasty, BMS, DES)

Patient presentation prior to PCI (ACS vs. SIHD)

	CLASS I *Benefit >>> Risk* Procedure/Treatment **SHOULD** be performed/ administered	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment **MAY BE CONSIDERED**	CLASS III *No Benefit* or CLASS III *Harm* COR III: No benefit — Procedure/Test Not Helpful — Treatment No Proven Benefit COR III: Harm — Excess Cost w/o Benefit or Harmful — Harmful to Patients
LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Sufficient evidence from multiple randomized trials or meta-analyses
LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is useful/effective ■ Evidence from single randomized trial or nonrandomized studies	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Evidence from single randomized trial or nonrandomized studies
LEVEL C Very limited populations evaluated* Only consensus opinion of experts; case studies, or standard of care	■ Recommendation that procedure or treatment is useful/effective ■ Only expert opinion, case studies, or standard of care	■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard of care



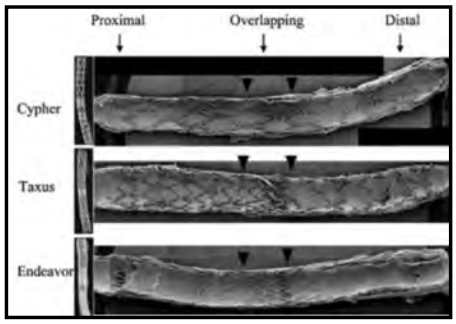
Second Generation DES:

Promus: everolimus eluting platinum chromium strut (0.0032”-0.0034”)

Endeavor: zotarolimus eluting cobalt strut (0.0035”-0.0036”)

Weaker inflammatory response and quicker re-endothelialization

optical coherence tomography (OCT)



Overriding Principals of Newer Recommendations

2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Prior recommendations for duration of DAPT for patients treated with DES were based on data from “first-generation” DES, which are not used in current clinical practice. Compared with first-generation stents, newer- generation stents have an improved safety profile and lower risk of stent thrombosis

Intensification of antiplatelet therapy, with the addition of a P2Y12 inhibitor to aspirin monotherapy, and prolongation of DAPT, necessitate a fundamental tradeoff between decreasing ischemic risk and increasing bleeding risk. Decisions regarding treatment with and duration of DAPT require thoughtful assessment of benefit/risk ratios, integration of study data, and **patient** preference

Generally, shorter-duration DAPT can be considered for patients at lower ischemic risk and/or higher bleeding risk, whereas longer-duration DAPT may be considered for patients at higher ischemic risk with lower bleeding risk

Increased Ischemic Risk/Risk of Stent Thrombosis (may favor longer-duration DAPT)
Increased ischemic risk
Advanced age
ACS presentation
Multiple prior MIs
Extensive CAD
Diabetes mellitus
CKD
Increased risk of stent thrombosis
ACS presentation
Diabetes mellitus
Left ventricular ejection fraction <40%
First-generation drug-eluting stent
Stent undersizing
Stent underdeployment
Small stent diameter
Greater stent length
Bifurcation stents
In-stent restenosis

Increased Bleeding Risk (may favor shorter-duration DAPT)
History of prior bleeding
Oral anticoagulant therapy
Female sex
Advanced age
Low body weight
CKD
Diabetes mellitus
Anemia
Chronic steroid or NSAID therapy

Updated recommendations for duration of DAPT are now similar for patients with NSTE-ACS and STEMI, as both are part of the spectrum of acute coronary syndrome

In most clinical settings 6–12 months of DAPT is recommended

prolonged DAPT beyond this initial 6- to 12-month period may be beneficial

Variable	Points
Age ≥75 y	-2
Age 65 to <75 y	-1
Age <65 y	0
Current cigarette smoker	1
Diabetes mellitus	1
MI at presentation	1
Prior PCI or prior MI	1
Stent diameter <3 mm	1
Paclitaxel-eluting stent	1
CHF or LVEF <30%	2
Saphenous vein graft PCI	2

A score of ≥2 is associated with a favorable benefit/risk ratio for prolonged DAPT while a score of <2 is associated with an unfavorable benefit/risk ratio. Adapted with permission from Yeh et al. (61).

CHF indicates congestive heart failure; DAPT, dual antiplatelet therapy; LVEF, left ventricular ejection fraction; MI, myocardial infarction; and PCI, percutaneous coronary intervention.

Be cautious not to extrapolate these variables to the inverse. In other words, these data have not been studied as predictors for safety in shortening DAPT

Lower daily doses of aspirin, including aspirin in patients treated with DAPT, are associated with lower bleeding complications and comparable ischemic protection than are higher doses of aspirin. The recommended daily dose of aspirin in patients treated with DAPT is 81 mg (range 75 mg to 100 mg)

In studies of prolonged DAPT after DES implantation or after MI, duration of therapy was limited to several years thus, in patients for whom the benefit/risk ratio seemingly favors prolonged therapy, the true optimal duration of therapy is unknown

Aspirin therapy should almost always be continued indefinitely in patients with CAD

Timi telet
medi rgery

I | B-NR

Elective noncardiac surgery should optimally be delayed 6 months after drug-eluting stent (DES) implantation

IIa | C-EO

In patients in whom noncardiac surgery is required, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy is useful

III: Harm | B-R

Elective noncardiac surgery should not be performed within 14 days of balloon angioplasty in patients in whom aspirin will need to be discontinued perioperatively

Elective noncardiac surgery should be delayed 14 days after balloon angioplasty and 30 days after BMS implantation

In patients undergoing urgent noncardiac surgery during the first 4 to 6 weeks after BMS or DES implantation, DAPT should be continued unless the relative risk of bleeding is greater than the risk of stent thrombosis

In patients who have received coronary stents and must undergo surgical procedures that mandate the discontinuation of P2Y12 platelet receptor–inhibitor therapy, aspirin should be continued if possible and the P2Y12 platelet receptor–inhibitor be restarted as soon after surgery as possible

Management of the perioperative antiplatelet therapy should be determined by a consensus of the surgeon, anesthesiologist, cardiologist

and the patient, who should weigh the relative risk of bleeding with that of stent thrombosis

In patients undergoing nonemergency/ nonurgent noncardiac surgery who have not had previous coronary stenting, it may be reasonable to continue aspirin when the risk of potential increased cardiac events is outweighed by the risk of increased bleeding

Initiation or continuation of aspirin is not beneficial in patients undergoing elective noncardiac noncarotid surgery who have not had previous coronary stenting unless the risk of ischemic events outweighs the risk of surgical bleeding

In patients with SIHD treated with DAPT after BMS implantation, P2Y12 inhibitor therapy should be given for a minimum of 1 month

In patients with SIHD treated with DAPT after DES implantation, P2Y12 inhibitor therapy should be given for at least 6 months

In patients with SIHD treated with DAPT after DES implantation who develop a high risk of bleeding (e.g., treatment with oral anticoagulant therapy), are at high risk of severe bleeding complication (e.g., major intracranial surgery), or develop significant overt bleeding, discontinuation of P2Y12 inhibitor therapy after 3 months may be reasonable

In patients with SIHD treated with DAPT after BMS or DES implantation who have tolerated DAPT without a bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), continuation of DAPT for longer than 1 month in patients treated with BMS or longer than 6 months in patients treated with DES may be reasonable

In patients treated with DAPT, a daily aspirin dose of 81 mg (range 75 mg to 100 mg) is recommended

In patients with ACS (NSTE-ACS or STEMI) treated with DAPT after BMS or DES implantation, P2Y12 inhibitor therapy should be given for at least 12 months

IIb | A SR

In patients with ACS (NSTE-ACS or STEMI) treated with coronary stent implantation who have tolerated DAPT without a bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), continuation of DAPT for longer than 12 months may be reasonable

IIb | C-LD

In patients with ACS treated with DAPT after DES implantation who develop a high risk of bleeding (e.g., treatment with oral anticoagulant therapy), are at high risk of severe bleeding complication (e.g., major intracranial surgery), or develop significant overt bleeding, discontinuation of P2Y12 inhibitor therapy after 6 months may be reasonable

IIb | A SR

In patients with ACS treated with medical therapy alone (without revascularization or fibrinolytic therapy) who have tolerated DAPT without bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), continuation of DAPT for longer than 12 months may be reasonable

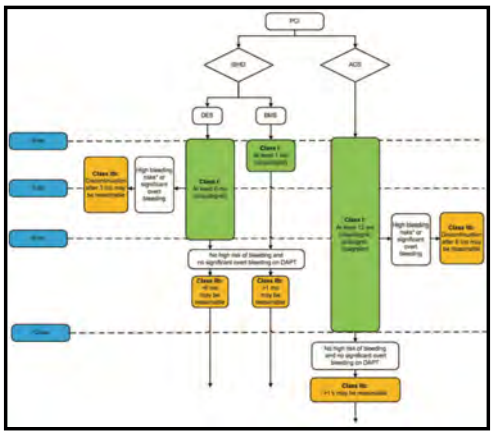
IIa | C-EO

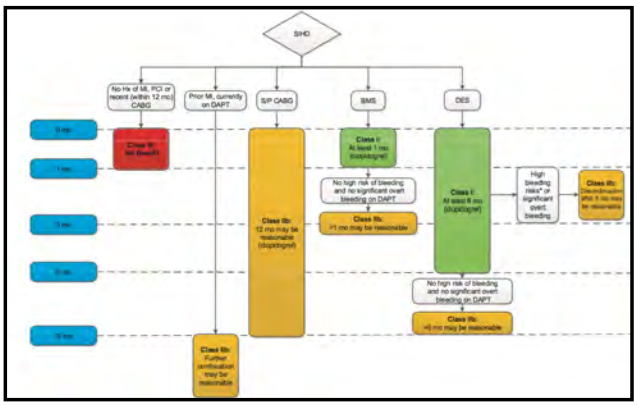
Elective noncardiac surgery after DES implantation in patients for whom P2Y12 inhibitor therapy will need to be discontinued may be considered after 3 months if the risk of further delay of surgery is greater than the expected risks of stent thrombosis

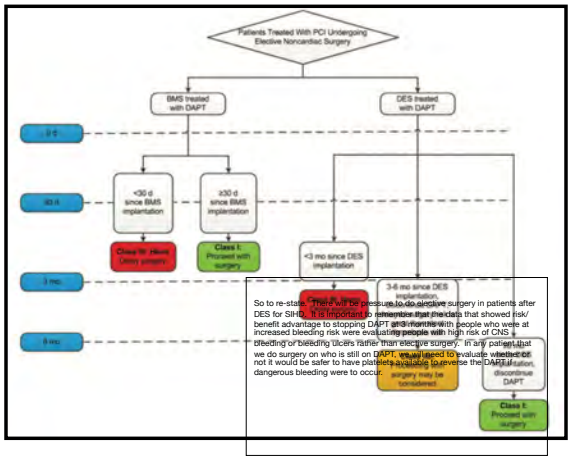
The 5 trials primarily enrolled low-risk (non-ACS) patients, with only a small proportion having had a recent MI. The main endpoints of these noninferiority trials were composite ischemic events (or net composite events) and stent thrombosis.

IIb | A SR

In patients with SIHD being treated with DAPT for an MI that occurred 1 to 3 years earlier who have tolerated DAPT without a bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), further continuation of DAPT may be reasonable







So to re-state: There will be pressure to do elective surgery in patients after DES for SIHD. It is important to remember that the data that showed risk/benefit advantage to stopping DAPT and 3 months with people who were at increased bleeding risk were evaluating people with high risk of CNS bleeding or bleeding issues rather than elective surgery. In any patient that we do surgery on who is still on DAPT, we will need to evaluate whether or not it would be safer to have platelets available to reverse the DAPT if dangerous bleeding were to occur.

Novant Policy

6 weeks from the time of BMS placment
365 Days form the time of DES placement
All patients should see cardiologist pre-op for “start/stop” recommendations of clopidogrel/prasugrel/ticagrelor and aspirin
Except from neurosurgical and urological surgeries, patients should stay on aspirin preoperatively
81mg of aspirin is protective and poses minimal risk
Warfarin, Lovenox, and Heparin are not protective in cardiac stent patients
Patients with cardiac stents on clopidrogrel, prasurgrel, or ticagrelor may not have surgery at Midtown, Southpark, Huntersville, Monroe, and Ballantyne. Exceptions are people for cataracts who continue aspirin preoperatively

ACC/AHA Focused Update | September 2016
2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery DiseaseA Report of the American College of Cardiology/ American Heart Association Task Force on Clinical Practice Guidelines

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2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery
A Report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines

Hawn MT, Graham LA, Richman JS, et al

Risk of major adverse cardiac events following noncardiac surgery in patients with coronary stents.
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Nuttall GA, Brown MJ, Stombaugh JW, et al

Time and cardiac risk of surgery after bare-metal stent percutaneous coronary intervention. Anesthesiology. 2008;109:588–95.

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My Patient with a Humerus Fracture Has Severe COPD and OSA

Karen Slocum, MD
Providence Anesthesiology Associates
2016 Annual Update

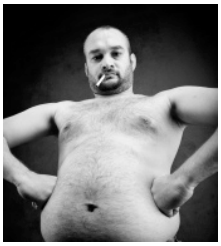
Objectives:

- Discuss how COPD and OSA affect our anesthetic plan.

-Discuss different types of anesthesia for humerus fracture

-Discuss how various anesthetics can affect the physiology of respiration

How do COPD and OSA affect my anesthetic plan?



-COPD and OSA both pose risks of increased perioperative pulmonary and cardiac complications.

A metaanalysis showed that the presence of OSA increased the odds of postoperative cardiac events including myocardial infarction, cardiac arrest and arrhythmias (OR 2.1), respiratory failure (OR2.4), desaturation (OR 2.3), ICU transfers (OR 2.8), and reintubations (OR2.1).

How to evaluate the severity of COPD/OSA

Questions to ask:

-Does patient get short of breath walking up a flight of stairs?
-What is baseline pulse ox, and is patient on home O2?
-When did they last smoke? This morning?
-Does patient use inhalers? Did they use them today?
-When was last COPD exacerbation?
-Does patient use CPAP/BiPAP? Settings?
-Stop-Bang score?

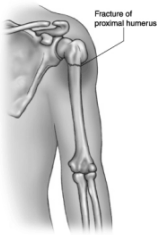
Perioperative considerations for patients with COPD/OSA

-Should you premedicate?
-Potential difficult airway (with OSA, obesity)
-Opioid related respiratory depression
-Excessive sedation with MAC (hypoventilation, hypoxia, hypercarbia)
- Post extubation airway obstruction

Options for anesthesia—Regional vs General

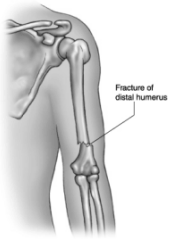
Anesthesia for humerus fracture: proximal, mid, distal?

- The location of the fracture is important to determine if a general anesthetic is necessary, or if operation can be done with regional anesthesia only.
- If proximal or mid humerus fracture, interscalene block should be used with general anesthesia. Consider length of surgery, coverage of nerve block, surgical instruments near face/head, positioning, affects of sedation on comorbidities.



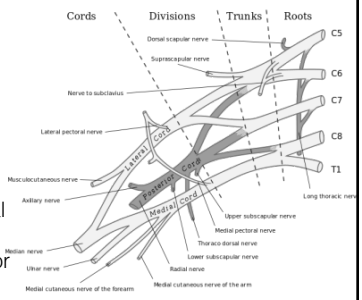
Distal Humerus Fracture

- If distal humerus fracture, supra or infraclavicular brachial plexus block should provide adequate coverage



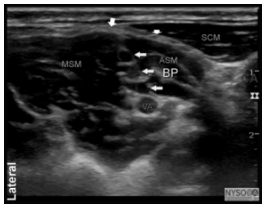
Options for regional anesthesia

- Interscalene, Supraclavicular, Infraclavicular, Suprascapular, Axillary nerve blocks
- Brachial Plexus: C5-T1 nerve roots (T2/Intercostobrachial is supplemented to cover medial/posterior portion of upper arm)



Interscalene Nerve Block

- Interscalene nerve block—most often used for shoulder surgery and proximal humerus fractures (C5-C7). Will cover the lateral 2/3 of the clavicle. Spares C8/T1 (ulnar distribution)—100% incidence of ipsilateral phrenic nerve block.



Phrenic nerve lies on ventral surface of anterior scalene muscle

Why does a phrenic nerve block matter?

- Phrenic nerve block can decrease forced vital capacity (FVC) by 21-34% and forced expiratory volume in 1 second (FEV1) by 17-37%. Intercostal muscles have to compensate to maintain normal minute ventilation in response to PaCO2.
- If FVC decreases below closing capacity, patient may have a reduced ability to cough and clear secretions.

Can we decrease risk of phrenic nerve paralysis?

- **Lower LA volumes**—Successful Interscalene blocks have been done with 5ml or less of LA, with pain scores and Morphine consumption no greater than in those patients receiving higher volumes. A study by Riazi et al demonstrated PNP to be reduced to 45% with 5ml 0.5% Ropivacaine compared to 100% with 20ml.

- Using low volumes does not guarantee that phrenic nerve paralysis (PNP) is avoided, but rates are generally decreased.
- However, in one case report, a respiratory compromised patient experienced respiratory collapse requiring intubation with 3ml of 2% Mepivacaine.

Lower Local Anesthetic Concentration

- **Lower LA concentrations**—Using a more dilute LA concentration decreases the incidence of phrenic nerve paralysis after ISB.
- In a study by Al-Kaisy et al, patients received ISB with either 10ml 0.5% Bupivacaine or 10ml 0.25% Bupivacaine. Only 1/6 in the 0.25% group showed PNP, while 4/5 patients in the 0.5% group showed PNP. Sensory anesthesia in C5/6 dermatomes was comparable.

Lower Level (C7)

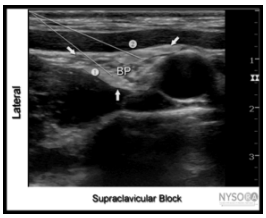
- **Performing nerve block at lower level (C7)**—Performing the block at the C7 level increases the distance between the brachial plexus and phrenic nerve which can decrease the incidence of PNP.

No nerve block

- **No nerve block**—If you rely on opiates, you will have a dose dependent ventilatory depression. Borgeat et al compared ventilatory function in patients receiving either continuous ISC or IV morphine PCA after shoulder arthroscopy.
- No statistical difference between the 2 groups for all pulmonary function parameters studied, which were equally diminished in both groups.
- Patients receiving Morphine PCA had higher pain scores and more post-operative nausea/vomiting.

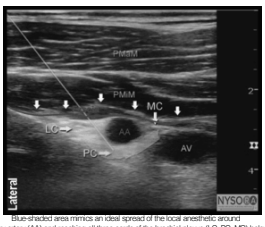
Other options for regional anesthesia (distal humerus)

- **Supraclavicular brachial plexus block—** Anesthetizes upper limb below shoulder—covers all nerve trunks/divisions. Still necessary to supplement T2/Intercostobrachial.
- Phrenic nerve paralysis—approximately 50%



Other options for regional anesthesia (distal humerus)

- **Infraclavicular brachial plexus block—** Anesthetizes upper limb below shoulder—covers lateral/posterior/medial cords. Again, necessary to supplement T2.
- Phrenic nerve paralysis—approximately 25%



Blue-shaded area mimics an ideal spread of the local anesthetic around axillary artery (AA) and reaching all three cords of the brachial plexus (LC, PC, MC) below the fascia (red line) of the pectoralis minor muscle. PMmM, pectoralis major muscle; PMM, pectoralis minor muscle.

Suprascapular and Axillary nerve blocks

- The acromioclavicular joint is largely supplied by the suprascapular nerve, which also provides some innervation to the capsule and the glenohumeral joint.
- Suprascapular nerve block can be a useful local analgesic supplement where interscalene block is either not technically possible or contraindicated. The technique only blocks a proportion of the afferent input from the shoulder joint and is therefore substantially inferior to the interscalene block.
- The inferior aspect of the capsule and glenohumeral joint are supplied by the axillary nerve.

My Plan:

For this patient with a humerus fracture and severe OSA and COPD, I would perform a single shot Interscalene block for postoperative pain with low volume (10ml), low concentration (0.25%) Ropivacaine. and do a general anesthetic with endotracheal tube for surgery.

My goals for the anesthetic are:
1) Minimize narcotics.
2) Use Multimodal analgesia (acetaminophen, +/- pregabalin, clonidine, ketamine, NSAIDS if not contraindicated).
3) Continuous pulse ox/telemetry postoperatively.
4) Have CPAP available.

Thank you!

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Sedation Strategies for Regional Anesthesia

Daniel R. Briggs, MD
Providence Anesthesiology Associates
Section Chief of Anesthesiology
Novant Health Charlotte Orthopedic Hospital

Sedation Scores used in Clinical Practice and Research Studies

ASA continuum of sedation[11]	Modified Observer's Assessment of Alertness/Sedation Scale[12]	Modified Ramsay Sedation Scale[13]
Minimal sedation/anxiolysis: a drug-induced state during which patients respond normally to verbal commands	5—Responds readily to name spoken in normal tone	1—Awake and alert, minimal or no cognitive impairment
Moderate sedation/analgesia ("Conscious sedation"): a drug-induced depression of consciousness during which patients respond purposefully* to verbal commands, either alone or accompanied by light tactile stimulation	4—Lethargic response to name spoken in normal tone 3—Responds after name called loudly or repeatedly or both 2—Responds only after mild prodding or mild shaking	2—Awake but tranquil, purposeful responses to verbal commands at a conversational level 3—Appears asleep, purposeful response to verbal commands at a conversational level 4—Appears asleep, purposeful responses to commands but at a louder than conversational level, requiring light glabellar tap, or both
Deep sedation/analgesia—purposeful* response after repeated or painful stimulation	1—Responds only to painful stimulation	5—Asleep, sluggish purposeful responses only to loud verbal commands, strong glabellar tap, or both 6—Asleep, sluggish purposeful responses only to painful stimuli
General anaesthesia—a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation	0—No response to painful stimulation	7—Asleep, reflex withdrawal to painful stimuli only 8—Unresponsive to external stimuli, including pain
Note: *Reflex withdrawal from a painful stimulus is NOT considered a purposeful response.	Note: MOASS is the responsiveness component of the Observer's Assessment of Alertness/Sedation Scale[12]	Original Ramsay Sedation Scale is a 6-item scale developed to assess ICU sedation[13]

CG Sheahan, DM Matthews. BJA; 113 (S2): ii37-ii47 (2014)

What about MAC?
Monitored Anesthesia Care

http://www.chewboom.com/2016/01/28/the-big-mac-has-siblings-and-you-can-get-them-at-mcdonalds-saudi-arabia/

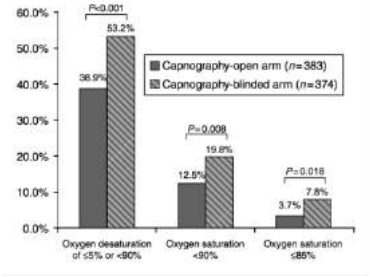
Monitoring the Sedated Patient

Oxygenation:	SpO2, FIO2
Circulation:	Continuous ECG, BP, HR
Body Temperature:	Temp Probe
Ventilation:	ETCO2

'*During regional anesthesia with no sedation or local anesthesia (with no sedation), the adequacy of ventilation shall be evaluated by continual observation of qualitative vital signs. During moderate or deep sedation the adequacy of ventilation shall be evaluated by continual observation of qualitative clinical signs and monitoring the presence of exhaled CO2 unless precluded/invalidated by the nature of patient, procedure, or equipment*'

Standards for Basic Anesthetic Monitoring, ASA Standards and Practice Parameters Committee, Oct 2010

Capnography Results in Less Hypoxemia



CG Sheahan, DM Matthews. BJA; 113 (S2): ii37-ii47 (2014)

Monitoring the Sedated Patient

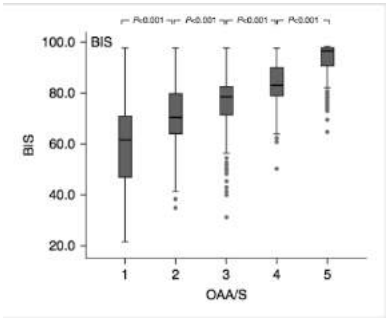
Level of Consciousness:

'For both moderate and deep sedation, patients' level of consciousness…should be assessed and recorded…At a minimum, this should be : (1) before the beginning of procedure; (2) after administration of sedative-analgesic agents; (3) at regular intervals during the procedure; (4) during initial recovery; and (5) just before discharge.'

Standards for Basic Anesthetic Monitoring, ASA Standards and Practice Parameters Committee, Oct 2010

Practice Guidelines for Sedation and Analgesia by Non-Anesthesiologist, Anesthesiology 2002; 96:1004-17.

The Relationship between BIS and MOASS Score



CG Sheahan, DM Matthews. BJA; 113 (S2): ii37-ii47 (2014)

Epically Inadequate

The Ideal Sedative Agent

- Rapid Onset: Time to Peak Effect (TPE)
- High Clearance/Ease of Recovery
- Easy Titration
- Easily Measured Concentration
- Maintains Cardiovascular Stability
- Minimal Respiratory Depression
- Powerful Amnesic
- Intrinsic Analgesic
- Available antidote
- Absence of other unwanted side effects
- Inexpensive

Midazolam

Mechanism: GABA mediated

Time to Peak Effect: Variable by dose, 1.5-5 minutes[1]

Amnesia may last up to 6 hours

CV/Resp Depression

Favorable Side Effect Profile

Reversible with Flumazenil

[1]Http://www.drugs.com accessed 5 October 2016

Propofol

Mechanism: GABA mediated

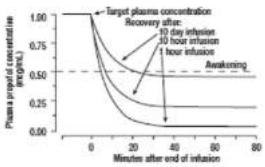
Time to Peak Effect: 78-113 seconds[1]

Predictable Recovery[2]

Notable CV/Resp Depression

Discomfort with infusion[3]

Favorable Side Effect Profile



[1]Garoud, F. et al. European J of Anaesthesiology; 2006 (23 supp 37): 187
[2]Package Insert: Access DailyMed, US Library of Medicine 5 October 2016
[3]Fisher, MJM. Et al. JBC; 2010: 285(45), 34781-92.

Comparison of Midazolam and Propofol for BIS-Guided Sedation During Regional Anaesthesia

Indian J Anaesth. 2009 Dec; 53(6):662-666.

	Midazolam	Propofol
No. Patients	50	48
Loading Dose	0.5 mg/kg/hr	100 mcg/kg/min
Time to Effect	11 min	6 min
Time to Recovery	18.6 min	10.1 min
Hypotension ΔMAP>20%	16	27
Maintenance dose	0.12 mg/kg/hr	36.6 mcg/kg/min
Awareness	20%	16.7%
Nausea	16%	8.3%
Restlessness	8.8%	14.2%

Alpha 2 Agonists: Dexmetomidine

Mechanism: selective α2-agonist

Usual Dose: 1 μg/kg x 10 min; 0.2 μg/kg/hr

Onset: 5 min TTPE: 15 min

CV: bradycardia

Minimal Respiratory Depression

Intrinsic Analgesia

Cooperative Sedation/Natural Sleep

Kaur M, Singh P M. Current role of dexmedetomidine in clinical anesthesia and intensive care. Anesth Essays Res 2011;5:128-33

Opioids

Mechanism: μ opioid receptor

TTPE: 1 min (r), 1.4 min (a), 3-5 (f,s)

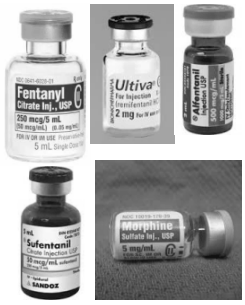
CV: bradycardia

Significant Respiratory Depression

Intrinsic Analgesia

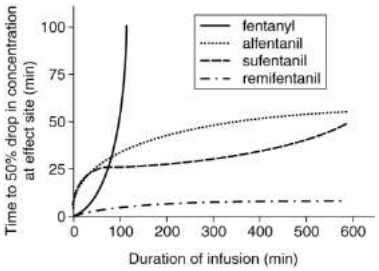
Chest Wall Rigidity

Reversible with Narcan



Ingrande, J et al. BJA. 2010; 105 (supp 1): i16-23.

Context-Sensitive Half-Times



The pharmacokinetics of the new short-acting opioid remifentanil (GI87084B) in healthy adult male volunteers. Anesthesiology 1993, 79:881–892

Ketamine

Mechanism: NMDA receptor (? Other)

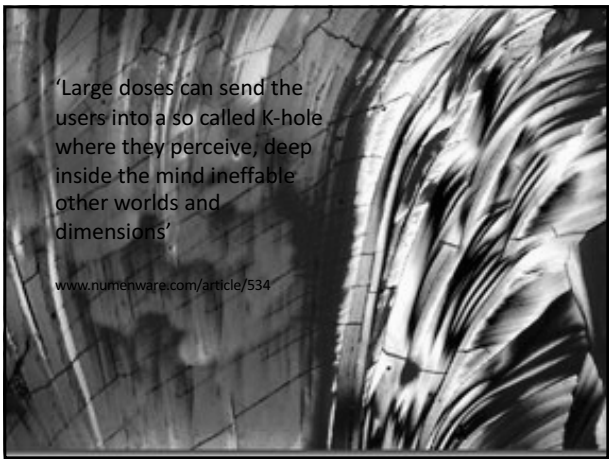
TTPE: 1 min

CV: activation (increased HR and BP)

Minimal Respiratory Depression

Intrinsic Analgesia

https://www.drugs.com/pro/ketamine-injection.html



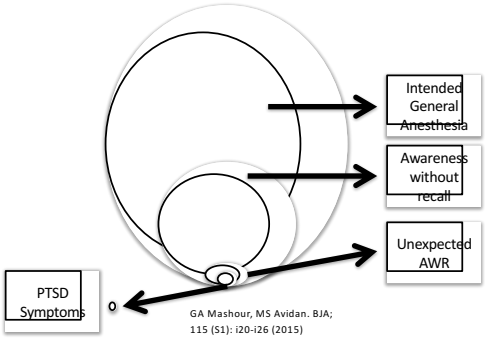
Ketofol: The Ideal Sedative Combination?

http://www.60secondem.com/archives/239

Lee, KC, et al. Ketofol for Monitored Anesthesia Care in a shoulder arthroscopy and labral repair: a case report. J of Pain Research 2016; 9:417-420

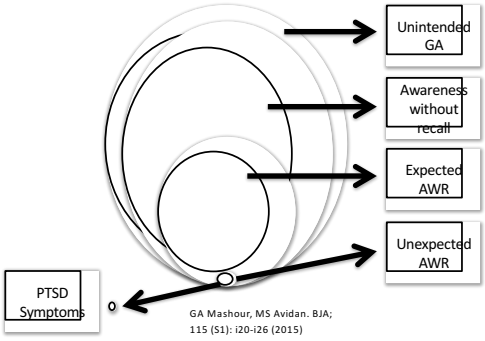
Rapeport DA,e t al. The use of "ketofol" infusioin in conjunction with regional anesthesia. Anaesh Intensive Care 2009; 37:121-123.

Awareness During General Anesthesia



GA Mashour, MS Avidan. BJA; 115 (S1): i20-i26 (2015)

Awareness During Regional Anesthesia with Sedation



GA Mashour, MS Avidan. BJA; 115 (S1): i20-i26 (2015)

From: Horace Wells' "Humbug Affair" Occurred at Massachusetts General Hospital? Humbug!

Anesthesiology. 2013;119(5):1009-1010

Image: Adapted from Figuier L. Les Merveilles de la Science ou Description Populaire des Inventions Modernes. Paris, Furne, Jouvet et Cie, 1868, p. 645.

Consequences of Awareness During Sedation

British Journal of Anaesthesia 110 (3): 381-7 (2013)
Advance Access publication 15 November 2012 · doi:10.1093/bja/aes386

BJA

CLINICAL PRACTICE

Psychological impact of unexpected explicit recall of events occurring during surgery performed under sedation, regional anaesthesia, and general anaesthesia: data from the Anesthesia Awareness Registry

C. D. Kent[1], G. A. Mashour[2], N. A. Metzger[1], K. L. Posner[1] and K. B. Domino[1]*
[1] Department of Anesthesiology and Pain Medicine, University of Washington School of Medicine, Box 356540, 1959 NE Pacific Street, Seattle, WA 98195-6540, USA
[2] Department of Anesthesiology and Neurosurgery, University of Michigan, Ann Arbor, MI, USA

257 pts in registry → 181 pts after 1990 → 83 with OR data → 27 had RA/sedation

Consequences of Awareness During Sedation

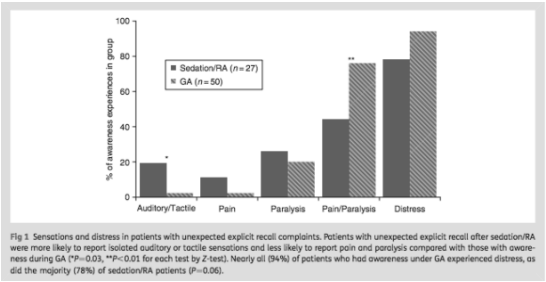


Fig 1 Sensations and distress in patients with unexpected explicit recall complaints. Patients with unexpected explicit recall after sedation/RA were more likely to report isolated auditory or tactile sensations and less likely to report pain and paralysis compared with those with awareness during GA (*P=0.03, **P<0.01 for each test by Z-test). Nearly all (94%) of patients who had awareness under GA experienced distress, as did the majority (78%) of sedation/RA patients (P=0.06).

CD Kent, et al. BJA; 110 (3): 381-7 (2013).

Consequences of Awareness During Sedation

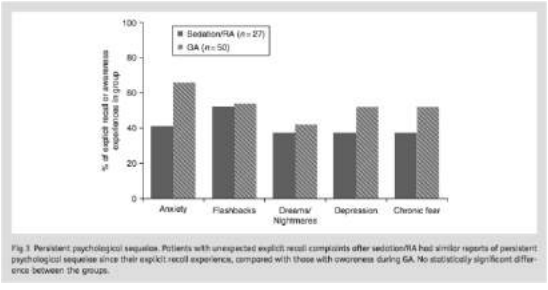


Fig 3 Persistent psychological sequelae. Patients with unexpected explicit recall complaints after sedation/RA had similar reports of persistent psychological sequelae since their explicit recall experience, compared with those with awareness during GA. No statistically significant difference between the groups.

CD Kent, et al. BJA; 110 (3): 381-7 (2013).

Anesthesia Patient Safety Foundation
Section Editor: Sorin J. Brull
BRIEF REPORT

Sedation Depth During Spinal Anesthesia and Survival in Elderly Patients Undergoing Hip Fracture Repair

Charles H. Brown IV, MD MHS,* Andrew S. Azman, MS,† Allan Gottschalk, MD, PhD,* Simon C. Mears, MD, PhD,* and Frederick E. Sieber, MD*

Low intraoperative Bispectral Index (BIS) values may be associated with increased mortality. In a previously reported trial to prevent delirium, we randomized patients undergoing hip fracture repair under spinal anesthesia to light (BIS >80) or deep (BIS approximately 50) sedation. We analyzed survival of patients in the original trial. Among all patients, mortality was equivalent across sedation groups. However, among patients with serious comorbidities (Charlson score >4), 1-year mortality was reduced in the light (22.2%) vs deep (43.6%) sedation group (hazard ratio [HR], 0.43; 95% confidence interval, 0.19–0.97; P = 0.04) during spinal anesthesia. Similarly, among patients with Charlson score >6, 1-year mortality was reduced in the light (28.6%) vs deep (52.6%) sedation group (HR 0.33; 95% confidence interval, 0.12–0.94; P = 0.04) during spinal anesthesia. Further research on reduced mortality after light sedation during spinal anesthesia is needed. (Anesth Analg 2014;118:977–80)

Sedation Depth During Spinal Anesthesia and Survival in Elderly Patients Undergoing Hip Fracture Repair

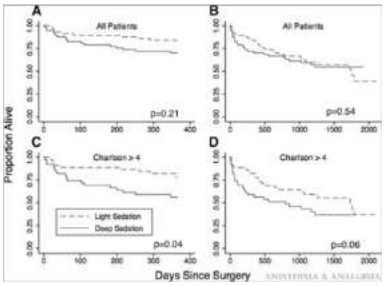


Figure 1. Kaplan-Meier survival curves (1-year and overall) for all patients and for patients with Charlson score >4. Survival of all patients (A) and patients with Charlson score >4 (C) at 1 year. Survival of all patients (B) and patients with Charlson score >4 (D) in overall follow-up. (P values for 1-year mortality are given by adjusted Cox proportional hazards models, and P values for overall mortality are given by adjusted parametric models).

Brown, Charles H. IV; Azman, Andrew S.; Gottschalk, Allan; Mears, Simon C.; Sieber, Frederick E.
Anesthesia & Analgesia. 118(5):977-980, May 2014.

Bolus vs. Continuous Infusion

TCI: Target-Controlled Infusion

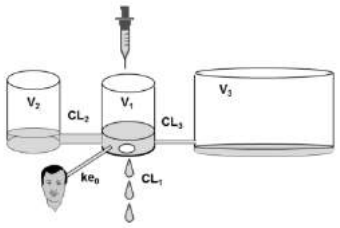
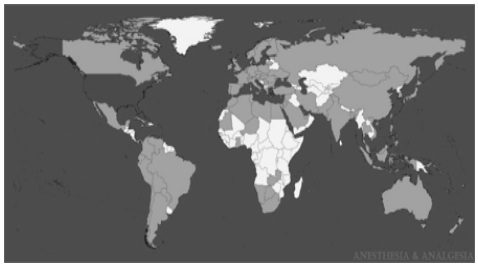


Figure 1. **Three-compartment pharmacokinetic model.** $CL_1 = k_{10} * V_1$; $CL_2 = k_{12} * V_1$; $CL_3 = k_{13} * V_1$; $V_2 = CL_2/k_{21}$; $V_3 = CL_3/k_{31}$. CL: clearance; k: micro-constant; V: distribution volume.

Billard V. Pharmacl kinetic-pharmacodynamic relationshipe of anesthetic drugs: from modeling to clinical use. F1000Research. 2015;4:F1000 Faculty Rev-1289.

TCI: Target-Controlled Infusion



AR Absalom, et al. Target-Controlled Infusion: A Mature Technology.
Anesth Analg. 2016; 122(1): 70-78.

PCS: Patient-Controlled Sedation

Rev Bras Anestesiol. 2013;63(5):410-414

REVISTA BRASILEIRA DE ANESTESIOLOGIA

ELSEVIER

SCIENTIFIC ARTICLE

Patient-Controlled Sedation in Orthopedic Surgery Under Regional Anesthesia: A New Approach in Procedural Sedation

Abdulselam Ekin[a], Ferah Donmez*[,b], Vildan Taspinar[b], Bayazit Dikmen[b]

[a]Department of Anesthesiology, Special Genesis Hospital, Diyarbakir, Turkey
[b]Department of Anesthesiology, Ankara Numune Education and Research Hospital, Ankara, Turkey

Received on March 22, 2012; accepted on July 16, 2012

The evidence on…

Improving the safety of post-operative pain management

Cheryl Sarna-Marlow RN, RN-BC
Regional pain management coordinator
Novant Health Greater Charlotte Market

Conflict of interest disclosure

- I hereby certify that, to the best of my knowledge, there is no conflict of interest on the subject I am presenting.

Objective

- Review the evidence around current pain management strategies.
- Discuss the evidence around opioid safety.

Original Article

American Society for Pain Management Nursing Guidelines on Monitoring for Opioid-Induced Sedation and Respiratory Depression

2012

Practice Guidelines for Acute Pain Management in the Perioperative Setting

An Updated Report by the American Society of Anesthesiologists Task Force on Acute Pain Management

apsf NEWSLETTER

"No Patient Shall Be Harmed By Opioid-Induced Respiratory Depression"

Whose weighing in

Chronic Pain — United States, 2016

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Medicare & Medicaid Services
7500 Security Boulevard, Mail Stop C2-21-16
Baltimore, Maryland 21244-1850

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES

Center for Clinical Standards and Quality/Survey & Certification Group

Revisions to Condition of Participation Standards
Ref: S&C: 14-15-Hospital

DATE: March 14, 2014

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Medicare & Medicaid Services
7500 Security Boulevard, Mail Stop S2-26-12
Baltimore, MD 21244-1850

CMS

CMCS Informational Bulletin

DATE: February 2, 2016

FROM: Vikki Wachino
Director
Center for Medicaid and CHIP Services

SUBJECT: Best Practices for Addressing Prescription Opioid Overdose, Misuse and Addiction

Who's being blamed?

July 07, 2016 | Print | Email

Record Incentive Programs. We also are proposing to remove the HCAHPS Pain

Joint Commission Statement on Pain Management

April 18, 2016

Statement on pain management from David W. Baker, MD, MPH, FACP, Executive Vice President, Healthcare Quality Evaluation, The Joint Commission:

In the environment of today's prescription opioid epidemic, everyone is looking for someone to blame. Often, The Joint Commission's pain standards take that blame. We are encouraging our critics to look at our exact standards, along with the historical context of our standards, to fully understand what our accredited organizations are required to do with regard to pain.

The Joint Commission first established standards for pain assessment and treatment in 2001 in response to the national outcry about the widespread problem of undertreatment of pain. The Joint Commission's current standards require that organizations establish policies regarding pain assessment and treatment and conduct educational efforts to ensure compliance. The standards DO NOT require the use of drugs to manage a patient's pain, and when a drug is appropriate, the standards do not specify which drug should be prescribed.

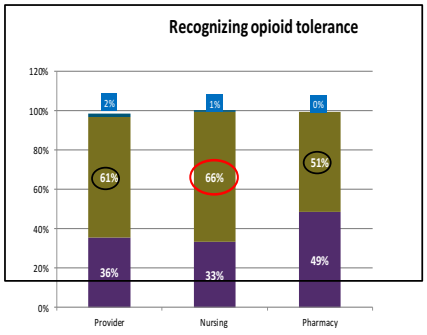
The Joint Commission
Sentinel Event Alert

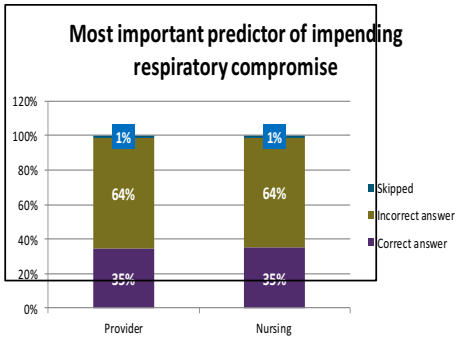
A complimentary publication of The Joint Commission — Issue 49, August 8, 2012

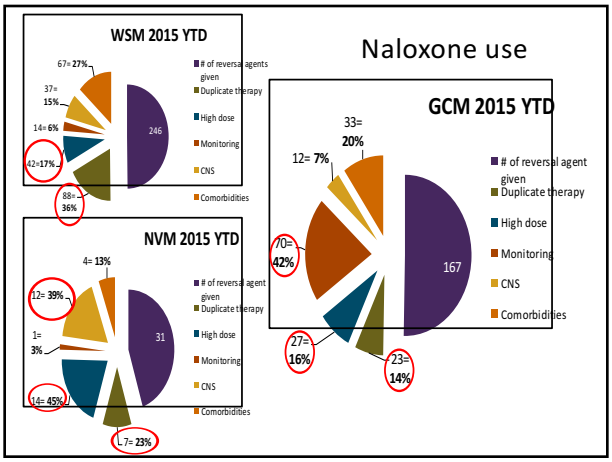
Safe use of opioids in hospitals

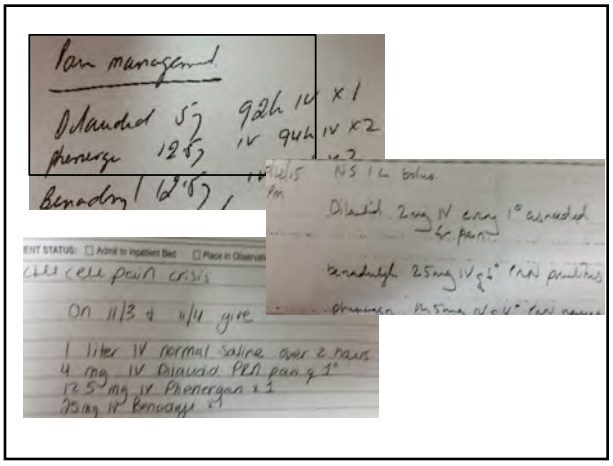
- **Education and Training:**
  - Review with clinicians prescribing pain medications to incorporate alternative therapies
    - Non-pharmacological therapies
    - Multi-modal approach
  - Evaluate staff knowledge of opioid therapy and safety
  - Patient education on side effects, storage, safety, disposal and risk for misuse/abuse.

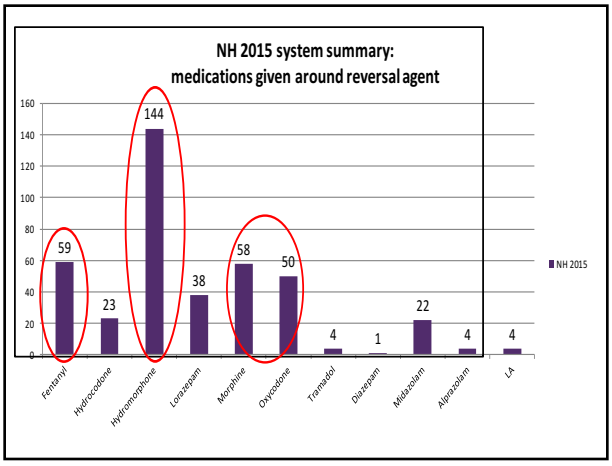
2015 Opioid Safety Survey











Barriers in safe pain management

- **Nurses**
  - Lack of understanding of professional accountability as it relates to "ordered" analgesics and their administration. *(overmedicating/patient satisfaction)*
    - Intensity as the only indicator.
  - Pain assessment: "Worse pain imaginable" versus "Worse pain experienced" and the context of the experience.
  - Synergy of analgesics and use of CNS altering medications.
  - Understanding of multimodal approach.
- **Providers**
  - Training and knowledge about pain management pharmacotherapy.
  - Lack of understanding/liability around opioid prescribing.
  - Use of preferred order sets.
- **Institutional**
  - Policy and practice.
  - Oversite around pain management approaches.

American Pain Society
RESEARCH
EDUCATION
TREATMENT
ADVOCACY

Guidelines on the Management of Postoperative Pain

Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council

The Journal of Pain, Vol 17, No 2 (February), 2016: pp 131-157
Available online at www.jpain.org and www.sciencedirect.com

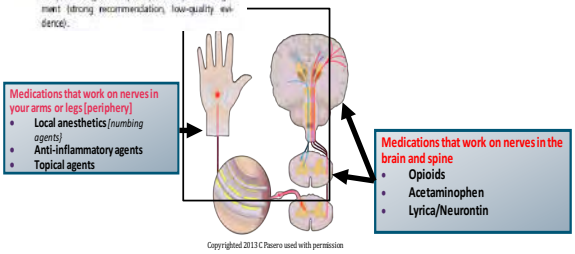
Recommendations

Preoperative Education and Perioperative Pain Management Planning

Recommendation 1

- The panel recommends that clinicians provide patient and family-centered, individually tailored education to the patient (and/or responsible caregiver), including information on treatment options for management of postoperative pain, and document the plan and goals for postoperative pain management (strong recommendation, low-quality evidence).

"Opioid medications will be used immediately after surgery and will be tapering off by 6 to 8-weeks."



Recommendation 2

- The panel recommends that the parents (or other adult caregiven) of children who undergo surgery receive instruction in developmentally-appropriate methods for assessing pain as well as counseling on appropriate administration of analgesics and modalities (strong recommendation, low-quality evidence).

Recommendation 3

- The panel recommends that clinicians conduct a preoperative evaluation including assessment of medical and psychiatric comorbidities, concomitant medications, history of chronic pain, substance abuse, and previous postoperative treatment regimens and responses, to guide the perioperative pain management plan (strong recommendation, low-quality evidence).

Recommendation 4

- The panel recommends that clinicians adjust the pain management plan on the basis of adequacy of pain relief and presence of adverse events (strong recommendation, low-quality evidence).

Methods of Assessment

Recommendation 5

- The panel recommends that clinicians use a validated pain assessment tool to track responses to postoperative pain treatments and adjust treatment plans accordingly (strong recommendation, low-quality evidence).

Multi-modal approach

General Principles Regarding the Use of Multimodal Therapies

Recommendation 6

- The panel recommends that clinicians offer multimodal analgesia, or the use of a variety of analgesic medications and techniques combined with nonpharmacological interventions, for the treatment of postoperative pain in children and adults (strong recommendation, high-quality evidence).

Multimodal analgesia, defined as the use of a variety of analgesic medication and techniques that target different mechanisms of action in the peripheral and/or central nervous system (which might also be combined with nonpharmacological interventions) might have additive or synergistic effects and more effective pain relief compared with single-modality interventions. For

Use of Systemic Pharmacological Therapies

Recommendation 10

- The panel recommends oral over intravenous (i.v.) administration of opioids for postoperative analgesia in patients who can use the oral route (strong recommendation, moderate quality evidence).

Most evidence suggests that i.v. administration of opioids is not superior for postoperative analgesia compared with oral administration.[245,268] Therefore, oral administration of opioids is generally preferred for management of postoperative pain in patients who can use the oral route. Postoperative pain is often continuous initially and often requires round-the-clock dosing during the first 24 hours. Long-acting oral opioids are generally not recommended or labeled for use in the immediate postoperative period[269] because of the need to titrate doses and the lack of evidence showing superiority over short-acting oral opioids, with the possible exception of patients who receive long-acting opioids before surgery.

Preoperative administration of opioids is not recommended as an intervention to decrease postoperative pain and/or opioid consumption, because studies show no clear benefit from this practice.[213] Clinicians should counsel patients to continue regularly prescribed opioids during the preoperative period unless there is a plan to taper or discontinue opioids.

Recommendation 14

- The panel recommends that clinicians provide appropriate monitoring of sedation, respiratory status, and other adverse events in patients who receive systemic opioids for postoperative analgesia (strong recommendation, low-quality evidence).

Recommendation 15

- The panel recommends that clinicians provide adults and children with acetaminophen and/or nonsteroidal anti-inflammatory drugs (NSAIDs) as part of multimodal analgesia for management of postoperative pain in patients without contraindications (strong recommendation, high-quality evidence).

Recommendation 16

- The panel recommends that clinicians consider giving a preoperative dose of oral celecoxib in adult patients without contraindications (strong recommendation, moderate-quality evidence).

Recommendation 17

- The panel recommends that clinicians consider use of gabapentin or pregabalin as a component of multimodal analgesia (strong recommendation, moderate-quality evidence).

Recommendation 18

- The panel recommends that clinicians consider i.v. ketamine as a component of multimodal analgesia in adults (weak recommendation, moderate-quality evidence).

I.v. ketamine has been evaluated as a part of multimodal analgesia. In adults and children, studies found i.v. ketamine infusions were associated with decreased postoperative pain medication use compared with placebo, and in some studies with decreased postoperative pain scores.[i,23,28,75,172,213] I.v. ketamine was also associated with decreased risk of persistent postsurgical pain.[180] In the trials, ketamine was administered preoperatively, intraoperatively, and/or postoperatively, at widely varying doses (ranging from boluses of .15–2 mg/kg before incision and at closure, with or without infusions ranging from .12 mg/kg/h [2 μg/kg/min] to 2 mg/kg/h). There was insufficient evidence to determine the optimal method for dosing ketamine, but the panel suggests using a preoperative bolus of .5 mg/kg followed by an infusion at 10 μg/kg/min intraoperatively, with or without a postoperative infusion at a lower dosage.[161] Ketamine was associated with increased risk of hallucinations and nightmares. Clinicians who administer ketamine should be familiar with its use and adverse effects, and the panel suggests that ketamine be reserved for major surgeries. Some situations in which ketamine might be particularly useful include management of highly opioid-tolerant patients[183] and patients who have difficulty tolerating opioids.

Recommendation 19

- The panel recommends that clinicians consider i.v. lidocaine infusions in adults who undergo open and laparoscopic abdominal surgery who do not have contraindications (weak recommendation, moderate-quality evidence).

Use of Local and/or Topical Pharmacological Therapies

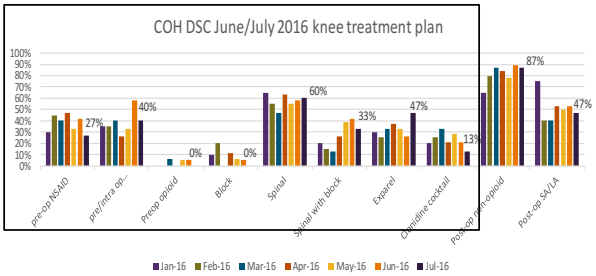
Recommendation 20

- The panel recommends that clinicians consider surgical site-specific local anesthetic infiltration for surgical procedures with evidence indicating efficacy (weak recommendation, moderate-quality evidence).

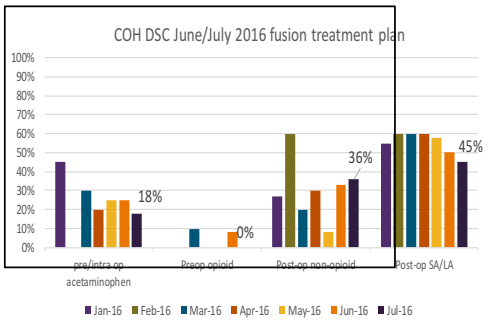
Use of Peripheral Regional Anesthesia

Recommendation 23

- The panel recommends that clinicians consider surgical site-specific peripheral regional anesthetic techniques in adults and children for procedures with evidence indicating efficacy (strong recommendation, high-quality evidence).



July: 25% of surgeries audited
27% CPNB
20% anticonvulsant given
33% A&C
7% C/ 47%A



July: 24% of surgeries audited
18% anticonvulsant given
36% A

Opportunities to improve pain management & safety

- Patient education
- Use of multi-modal approach
- Serial assessment and monitoring

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THANK YOU

Perioperative Ketamine and Lidocaine Infusions

Rick Griggs, MD

Pain Management in 2016

Minimize opioids
Multimodal techniques

Severe pain
- Delays discharge
- Poor patient satisfaction
- Increased morbidity
- Hyperalgesia - "Persistent Postoperative Pain"
  - Incidence up to 40% - moderate to severe

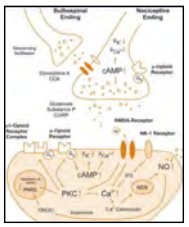
Opioids

Traditionally the mainstay of therapy
Pain not always relieved by opioids
Development of tolerance
Adverse effects of opioids
- PONV
- Constipation
- Sedation
- Opioid-Induced Hyperalgesia

Opioid-Induced Hyperalgesia

Nociceptive (pain) sensitization caused by exposure to opioids
- Exposure to opioids causes paradoxical increased sensitivity to painful stimuli
- Same underlying pain or different location

Mechanisms
- Neuroplastic changes in peripheral and CNS
- Sensitization of pronociceptive pathways
- Central glutaminergic system
- Central excitatory NMDA receptor activation
  - When inhibited (ketamine), prevent development of tolerance and OIH



OIH in 1870

Allbutt: "At such times I have certainly felt it a great responsibility to say that pain, which I know is an evil, is less injurious than morphia, which may be an evil."

"Does morphia tend to encourage the very pain it pretends to relieve?"

"…in the cases in question, I have much reason to suspect that a reliance upon hypodermic morphia only ended in that curious state of perpetuated pain."

Sir Clifford Allbutt

Opioid-Induced Hyperalgesia

Differential Modulation of Remifentanil-induced Analgesia and Postinfusion Hyperalgesia by S-Ketamine and Clonidine in Humans

Wolfgang Koppert, M.D.,* Reinhard Sittl, M.D.,† Karin Scheuber, M.D.,‡ Monika Alsheimer, M.D.,† Martin Schmelz, M.D.,§ Jürgen Schüttler, M.D.‖

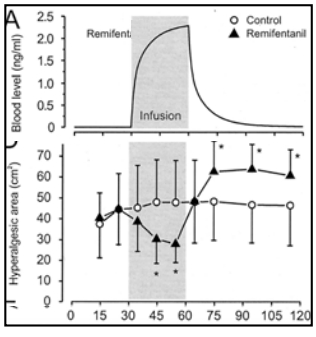
Anesthesiology 2003; 99:152-9

13 healthy volunteers, randomized, double-blind, placebo-controlled

Transcutaneous electrical stimulation, high current density

Induced acute pain

Stable areas of mechanical hyperalgesia to punctate stimuli
- Before, during, after 30 min drug infusions remifentanil and ketamine



Multimodal Analgesia

Opioids
NSAIDs
Acetaminophen
Local Anesthetics
- Blocks, Infiltration, IV

Ketamine
Dexamethasone
Gabapentin

ENHANCED RECOVERY AFTER SURGERY

ERAS is a multimodal perioperative care pathway designed to achieve early recovery for patients undergoing major surgery.

"The immediate challenge to improving the quality of surgical care is not discovering new knowledge, but rather how to integrate what we already know into practice."

Where do we begin?!?

American Pain Society

Guidelines on the Management of Postoperative Pain

Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council

The Journal of Pain, Vol 17, No 2 (February), 2016: pp 131-157

APS - 23 member expert panel
- Input from ASA (American Society of Anesthesiologists)
- Approved by ASRA (American Society of Regional Anesthesia and Pain Medicine)

Evidence through December 2015

American Pain Society

Guidelines on the Management of Postoperative Pain

Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council

The Journal of Pain, Vol 17, No 2 (February), 2016: pp 131-157

Recommendation 18

- The panel recommends that clinicians consider i.v. ketamine as a component of multimodal analgesia in adults (weak recommendation, moderate-quality evidence).

Consider bolus (0.5mg/kg) followed by intraoperative infusion (0.6mg/kg/hr)
Reserved for major surgeries
Highly opioid-tolerant patients
Patients who poorly tolerate opioids

Recommendation 19

- The panel recommends that clinicians consider i.v. lidocaine infusions in adults who undergo open and laparoscopic abdominal surgery who do not have contraindications (weak recommendation, moderate-quality evidence).

Consider bolus (1.5mg/kg) followed by intraoperative infusion (2mg/kg/hr)
Suggested for open or laparoscopic abdominal surgeries

Ketamine

Ketamine

N-methyl-D-aspartate (NMDA) receptor antagonist
Described in 1965; FDA approved 1970
Modulates central sensory processing of pain
Potent anti-hyperalgesic agent
- Counteract opioid-induced hyperalgesia

Prevent development of opioid tolerance
Other uses
- Treatment of depression, complex regional pain syndrome (CRPS), cancer pain, alcohol addition, heroin addition, asthma exacerbations

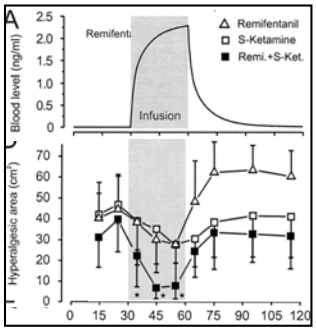
Opioid-Induced Hyperalgesia

Differential Modulation of Remifentanil-Induced Analgesia and Postinfusion Hyperalgesia by S-Ketamine and Clonidine in Humans

Wolfgang Koppert, M.D.,* Reinhard Sittl, M.D.,† Karin Scheuber, M.D.,‡ Monika Alsheimer, M.D.,† Martin Schmelz, M.D.,§ Jürgen Schüttler, M.D.‖

Anesthesiology 2003; 99:152–9

- 13 healthy volunteers, randomized, double-blind, placebo-controlled
- Transcutaneous electrical stimulation, high current density
- Induced acute pain
- Stable areas of mechanical hyperalgesia to punctate stimuli
  - Before, during, after 30 min drug infusions remifentanil and ketamine



Adverse Effects

- Usually transient in nature
- Decreased incidence and severity with prophylactic midazolam
- Physical symptoms
  - dose-dependent
  - lightheadedness, headache, nausea, diplopia, drowsiness, dizziness, nightmares

Ketamine and Acute Pain Management

Intraoperative Ketamine Reduces Perioperative Opiate Consumption in Opiate-dependent Patients with Chronic Back Pain Undergoing Back Surgery

Randy W. Loftus, M.D.,* Mark P. Yeager, M.D.,† Jeffrey A. Clark, M.D.,* Jeremiah R. Brown, M.S., Ph.D.,‡ William A. Abdu, M.S., M.D.,§ Dilip K. Sengupta, M.D., Ph.D.,‖ Michael L. Beach, M.D., Ph.D.†

Anesthesiology 2010; 113:639 - 46

- Randomized, prospective, double-blinded, placebo-controlled
- Opiate-dependent patients for Major Lumbar Spine Surgery
- n=52 - ketamine 0.5mg/kg IV at induction
  - 0.6mg/kg/hr gtt until wound closure
- n=50 - saline placebo
- Patients followed for 48 hrs and at 6 weeks

Intraoperative Ketamine Reduces Perioperative Opiate Consumption in Opiate-dependent Patients with Chronic Back Pain Undergoing Back Surgery

Randy W. Loftus, M.D.,* Mark P. Yeager, M.D.,† Jeffrey A. Clark, M.D.,* Jeremiah R. Brown, M.S., Ph.D.,‡ William A. Abdu, M.S., M.D.,§ Dilip K. Sengupta, M.D., Ph.D.,‖ Michael L. Beach, M.D., Ph.D.†

Anesthesiology 2010; 113:639 - 46

	Placebo	Ketamine	*P* Value
24 hr ME, total mg/24 hr	202 (176)	142 (82)	0.032
48 hr ME, total mg/48 hr	309 (341)	195 (111)	0.029
48 hr ME Adjusted, mg*	323 (347)	203 (109)	0.045
PACU VAS, cm	5.6 (3.0)	4.1 (3.1)	0.033
6-wk ME, mg/hr intravenous morphine	2.8 (6.9)	0.8 (1.1)	0.041
6-wk VAS, cm	4.2 (2.4)	3.1 (2.4)	0.026

	Placebo	Ketamine	*P* Value	RR (95% CI)
48 hr				
Nausea	22.5	26.9	0.603	1.20 (0.60, 2.38)
Vomiting	12.2	15.4	0.648	1.26 (0.47, 3.36)
Hallucinations	2.0	1.9	0.737	0.94 (0.06, 14.65)
Urinary Retention	2.0	7.7	0.200	3.77 (0.44, 32.56)
6 wk				
Nausea	17.0	11.8	0.458	0.69 (0.26, 1.84)
Vomiting	8.5	9.8	0.552	1.15 (0.33, 4.04)
Hallucinations	23.4	11.8	0.126	0.50 (0.20, 1.25)
Constipation	57.5	45.1	0.222	0.79 (0.53, 1.16)

CI = confidence interval; RR = risk ratio.

Lidocaine Infusions

Lidocaine Infusions - Dosing for "10 stone patients"

VOL. 9, No. 2 ANÆSTHESIA *April, 1954*

SUCCINYLDICHOLINE AND LIGNOCAINE BY CONTINUOUS INTRAVENOUS DRIP

Report of 1000 administrations

By

S. G. de CLIVE-LOWE, M.B., CH.B., F.F.A.R.C.S., D.A.
CONSULTANT ANÆSTHETIST, GUILDFORD GROUP OF HOSPITALS

P. W. SPENCER GRAY, M.B., B.S., D.A.
CONSULTANT ANÆSTHETIST, CHASE FARM HOSPITAL

AND

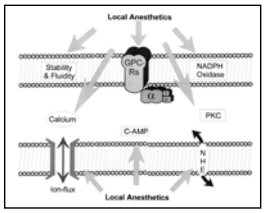
J. NORTH, M.R.C.S., L.R.C.P., D.A.
CONSULTANT ANÆSTHETIST, GUILDFORD GROUP OF HOSPITALS

Postop analgesia for 10 hours
Low incidence of PONV

Lidocaine

Analgesic
Anti-hyperalgesic
Anti-nociceptive
Anti-inflammatory
- Inhibition of NMDA receptors and leukocyte priming
- Stimulates secretion of antinflammatory IL-1 receptor antagonist

Na+ Channel Blockade
- Multiple other sites of action
  - G protein-coupled receptors
  - NMDA receptors



Treatment of Postoperative Paralytic Ileus by Intravenous Lidocaine Infusion

Gunnar Rimbäck, MD, Jean Cassuto, MD, PhD, and Per-Olof Tollesson, MD

ANESTH ANALG 1990;70:414–9

Open Cholecystectomy, Double blind
Lidocaine 3mg/min x 24 hrs vs saline control

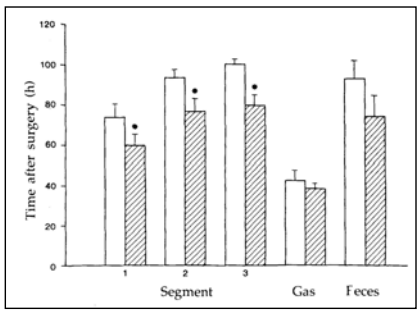


Figure 1. Time taken for the radiopaque markers in the cecum/ascending colon (segment 0) to reach other segments of the colon and the time for the first postoperative passage of gas and feces in patients receiving IV infusion of lidocaine (*shaded bars*) or isotonic saline infusion (*open bars*). Segment 1 (transverse colon); segment 2 (descending colon); segment 3 (rectosigmoid colon). *P < 0.05 vs control. Data are expressed as mean ± SEM.

Meta-analysis of intravenous lidocaine and postoperative recovery after abdominal surgery

E. Marret[1], M. Rolin[2], M. Beaussier[2] and F. Bonnet[1]

Departments of Anaesthesiology and Intensive Care, [1]Tenon University Hospital, Assistance Publique–Hôpitaux de Paris (AP-HP), Unité Inserm National de la Santé et de la Recherche Médicale U707, and [2]St Antoine University Hospital, AP-HP, University Pierre et Marie Curie, Paris, France

British Journal of Surgery 2008; 95: 1331–1338

8 Trials (320 patients) - Randomized, Double-blind, Abdominal surgery
- Open surgery (6/8 trials), Laparoscopy (2/8 trials)
- Open colorectal (2 studies)
- Laparoscopic colorectal (1 study)

7 Trials:
- Bolus IV lidocaine (100mg or 1.5-2 mg/kg) prior to incision
- Continuous infusion (1.5-2mg/kg/hr or 2-3 mg/min)
  - stopped at end of surgery to 24 hrs postop

1 Trial:
- Lidocaine infusion started 30 minutes before skin incision

Meta-analysis of intravenous lidocaine and postoperative recovery after abdominal surgery

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British Journal of Surgery 2008; 95: 1331–1338

IV lidocaine: Findings
- 25% reduction in volatile anesthetics
- 7/8 Trials: 30-50% reduction in postop opioids
- Decreased DURATION OF ILEUS - WMD -8.4 hrs (95% CI -13.24 - -3.47)
  - Colonic resection - WMD -12.0 hrs
- HOSPITAL LOS - WMD -0.84d (95% CI -1.38 - -0.31)
- POSTOP PAIN at 24hrs - WMD -5.93 (95%CI -9.63- -2.23 on VAS 0-100)
- NAUSEA AND VOMITING 52% control vs 32% lidocaine (OR 0.39, 95%CI 0.20-0.76)
  - NNT = 5

NNT - PONV

IV lidocaine	5
Zofran	7
Decadron	6
Scopolamine Patch	6
Reglan 10mg IV	30
Droperidol	5

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British Journal of Surgery 2008; 95: 1331–1338

IV lidocaine: Safety (320 patients)

One study - 1 patient developed an arrhythmia

Another study - 3 patients developed intraoperative bradycardia, but remained stable

Lidocaine Infusion - Effects on Ileus

Autonomic nervous system dysfunction
- Decreased sympathetic tone
- Tonic inhibition in mesenteric plexus - contractile stimulation
- Smooth muscle direct effect

Inflammatory response
- Anti-inflammatory (blunted postop increase in proinflammatory cytokines and complement

Anesthetics and opioids
- Reduced opioid consumption
- Inhibition of ectopic impulse discharge at nerve injury sites
- Suppressed secondary hyperalgesia by peripheral mechanisms

Gastrointestinal hormone disruption

Lidocaine - Spine Surgery

Effect of Perioperative Intravenous Lidocaine Administration on Pain, Opioid Consumption, and Quality of Life after Complex Spine Surgery

Ehab Farag, M.D., F.R.C.A.,* Michael Ghobrial, M.D., † Daniel I. Sessler, M.D., ‡ Jarrod E. Dalton, Ph.D., § Jinbo Liu, M.D., ‖ Joel H. Lee, B.A., # Sherif Zaky, M.D.,** Edward Benzel, M.D., †† William Bingaman, M.D., ‡‡ Andrea Kurz, M.D.§§

Anesthesiology 2013; 119:932-40

Complex spine surgery, n= 116, randomized, blinded

IV lidocaine 2mg/kg/hr (max 200mg/hr) vs placebo
- Induction of GA to PACU discharge (or max 8 hr)

Pain scores, Morphine equivalents, Quality of Life Scores 1 and 3 months

Effect of Perioperative Intravenous Lidocaine Administration on Pain, Opioid Consumption, and Quality of Life after Complex Spine Surgery

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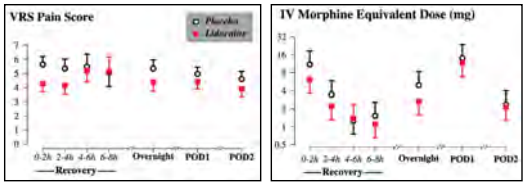
Anesthesiology 2013; 119:932-40

Lidocaine superior to placebo:
- Mean pain scores (p<0.001; 4.4 vs 5.3)
- Significantly non-inferior on mean morphine equivalents (P=0.011; 55mg vs 74 mg)
- Slightly fewer 30-day complications (95% CI 0.84-1.00, P=0.049)
- Greater SF-12 Physical Composite Scores at 1 month (38 vs 33; P=0.002) and 3 months (39 vs 34; P=0.04)



IV Lidocaine Infusions *vs* Epidurals

A Clinical Comparison of Intravenous and Epidural Local Anesthetic for Major Abdominal Surgery

Abdullah S. Terkawi, MD, Siny Tsang, PhD,† Ali Kazemi, MD,* Steve Morton, BSN, RN,* Roy Luo, MD,* Daniel T. Sanders, MD,* Lindsay A. Regali, MD,* Heather Columbano, MD,* Nicole Y. Kurtzeborn, MD,* and Marcel E. Durieux, MD, PhD**

Regional Anesthesia and Pain Medicine • Volume 41, Number 1, January-February 2016

Retrospective review at Univ of VA (Oct 2013 - Oct 2014)

Major Abdominal Surgery
- Perioperative IV Lidocaine infusion (108 pts)
  - OR: 2-3mg/min; PACU: 0.5-1mg/min; Postop ≤1mg/min
- Epidural analgesia (108 pts)
  - 0.125% Bupiv + hydromorphone

Similar pain scores

IV lidocaine - higher opioid consumption
- Less hypotension
- Less PONV
- Less pruritis
- Less urinary retention
- Earlier foley catheter removal
- Earlier GI function

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Regional Anesthesia and Pain Medicine • Volume 41, Number 1, January-February 2016

Lidocaine Superiority

TABLE 4. Summary of the Secondary Outcomes

Character/Incidence	Lidocaine Group	Epidural Group	*P*
Hypotension*			
POD 1	4 (107), 3.7%	28 (107), 26.1%	<0.0001
POD 2	2 (99), 2%	13 (104), 12.5%	0.013
POD 3	0 (60), 0%	7 (93), 7.5%	0.045
POD 4	0 (35), 0%	1 (71), 1.4%	1
Postoperative nausea and vomiting (PONV)*			
POD 1	14 (107), 13%	27 (107), 25.2%	0.090
POD 2	12 (99), 12.1%	28 (103), 27.1%	0.042
POD 3	8 (60), 13.3%	19 (91), 20.8%	0.435
POD 4	4 (35), 11.4%	20 (70), 28.5%	0.141
Pruritus*			
POD 1	3 (106), 2.8%	38 (103), 27.1%	<0.0001
POD 2	1 (99), 1%	40 (103), 38.8%	<0.0001
POD 3	1 (61), 1.6%	32 (92), 34.7%	<0.0001
POD 4	2 (35), 5.7%	26 (70), 37.1%	0.004
Urine retention*			
POD 1	3 (107), 2.8%	7 (54), 12.9%	0.035
POD 2	3 (99), 3%	9 (64), 14%	0.029
POD 3	3 (61), 4.9%	5 (68), 7.3%	0.723
POD 4	1 (36), 2.7%	2 (55), 3.6%	1
Patient pain management satisfaction (yes)*			
POD 1	79 (107), 73.8%	77 (102), 75.4%	1
POD 2	72 (99), 72.7%	82 (102), 80.3%	0.718
POD 3	40 (58), 68.9%	84 (91), 92.3%	0.309
POD 4	25 (34), 73.5%	67 (70), 95.7%	0.493
Time for first ambulation,†‡ h	40 (22, 55)	44 (26, 70)	0.252
Time for urinary catheter removal,†‡ h	26 (20, 58)	50 (37, 96)	<0.0001
Time for first return of bowel function,†‡ h	61 (41, 85)	84 (53, 107)	0.019
Duration of hospital stay,†‡ h	120 (75, 168)	144 (102, 193)	0.081

Lidocaine in Ambulatory Surgery

Systemic Lidocaine Fails to Improve Postoperative Pain, But Reduces Time to Discharge Readiness in Patients Undergoing Laparoscopic Sterilization in Day-Case Surgery
A Double-Blind, Randomized, Placebo-Controlled Trial

Geertrui Barbara Erika Devoogdt, MD,* An Teunkens, MD,* Kristien Vermeulen, MD,* Lieve Al Imimi, MD,* Marc Van de Velde, MD, PhD,*† and Steffen Rex, MD, PhD*†

Regional Anesthesia and Pain Medicine • Volume 41, Number 3, May-June 2016

Prospective, Randomized, Double-blind, n=80
Lap tubal ligation
Lidocaine infusion intraop into PACU x 30 min vs Placebo
No difference in Pain, Opioid Use
More nausea in lidocaine group (7 vs 1), but low severity (NRS 3/10)
Hospital discharge faster in lidocaine group

	All (n = 79)	Lidocaine (n = 39)	Placebo (n = 40)	Median Difference (95% Confidence Interval)	P
Duration of surgery, min	55 (36–101)	57 (42–101)	54 (36–91)	−3 (−7.0 to 2.0)	0.3
Time to be fit for discharge, min	204 (96–420)	177 (96–408)	221 (121–420)	44 (6.0 to 64.0)	0.02
Cumulative opioid consumption (M° equivalents), mg	15 (8–44)	15 (10–44)	14 (8–35)	−1.5 (−2.5 to 0.0)	0.8
Duration of lidocaine infusion, min	75 (60–118)	77 (63–108)	74 (60–103)	−3.5 (−6.0 to 2.0)	0.2

Lidocaine Infusions

Analgesic in patients have major abdominal and spine surgery
- Reduced PONV, ileus, LOS in abdominal surgery
- 25% reduction in opioid requirements

Not proven beneficial in THA, GYN surgery, Cardiac surgery, Tonsillectomy

Half-life - 1.5 hours
- Modulatory action on inflammatory response
- Lidocaine metabolites have analgesic effects by inhibiting glycine transporter 1
  - Shown in animal model of chronic pain to reduce pain and improve cognitive function

Lidocaine Infusions

Avoids side-effects and complications of epidurals
Option when epidural or TAP blocks are contra-indicated

Target Plasma Concentrations for Systemic Effects:
- Low micromolar range are required (0.5-5.0 µg/mL)
  - 2-4 mg/min gtt after 150 min - 1-3 µg/mL
  - 15 min after 2 mg/kg IV bolus - peak 1.5-1.9 µg/mL
- Adverse Effects - >10 µg/mL
- (Lidoderm patch - Cmax 0.13 µg/mL)

Proposed regimen
- Bolus 100mg IV
- 2 mg/min infusion continued into PACU for up to 8 hours
- Discontinued at time of PACU discharge

Ketamine + Lidocaine?

ANESTHESIOLOGY NEWS
Pain Medicine
OCTOBER 5, 2016

Opioid-Free Anesthesia With Ketamine Plus Lidocaine Less Effective Than Fentanyl, and With More Nausea and Delirium

Santiago, Chile
Abstract at IARS 2016 Annual Meeting
ASA I-II; Hip arthroscopies, opioid-naive
- Propofol, rocuronium, desflurane GAs
- Fentanyl 2mcg/kg - *versus* - Ketamine 0.5mg/kg + Infusion 0.5mg/kg(/hr?) + Lidocaine 1mg/kg (+ infusion?)

Study stopped at 53 of planned 100 patients
- Due to higher rates of delirium (19% vs 4%) and PONV (46% vs 32%)
  - Neither measure reached clinical significance

Opioid-Free Anesthesia With Ketamine Plus Lidocaine Less Effective Than Fentanyl, and With More Nausea and Delirium

Patient selection - Hip arthroscopy in opioid-naive??
- Lidocaine - major abdominal or spine
- Ketamine - opioid dependent patients; major surgery
- PONV & Delirium - No Statistical Significance!

Peter Goldstein, MD - NY Presbyterian
- "There are very specific criteria to define delirium, but these data seem to be absent."
- "If the study was not designed to test for delirium up front, then what was the basis for stopping the trial, especially when outcomes did not reach clinical significance?"
- PODCAST Study - ketamine being studied to actually DECREASE postop delirium
  - "The doses are a bit different, but if there's evidence that suggests ketamine may have a benefit in this setting, what does that mean here?"

Proposed Anti-Hyperalgesic Pathway

Ketamine

- Major Surgery and/or Opioid-tolerant patients
- 0.5mg/kg bolus
- Infusion (or hourly doses) 0.5mg/kg/hr

IV Lidocaine

- Abdominal (or Major Spine?) Surgery without other local anesthetic techniques/blocks
- 100mg IV at induction
- Infusion 2mg/kg/hr until PACU discharge up to 8 hours

Recommendation 18

- The panel recommends that clinicians consider i.v. ketamine as a component of multimodal analgesia in adults (weak recommendation, moderate-quality evidence).

Recommendation 19

- The panel recommends that clinicians consider i.v. lidocaine infusions in adults who undergo open and laparoscopic abdominal surgery who do not have contraindications (weak recommendation, moderate-quality evidence).

Thank You!

Minimally Invasive Procedures for Knee Pain & Headaches

Farrukh I. Sair, M.D.
Interventional Spine Associates of the Carolinas
isacarolina.com

Farrukh I. Sair, M.D.

- Medical Director, Interventional Spine Associates of the Carolinas
- Department Chair, Pain Medicine, Novant Presbyterian Medical Center

ISA

- A division of Providence Anesthesiology Associates
- Injection and interventional options for both spine and non-spine pain

ISA Clinic

- Midtown Medical Plaza
- 8th floor
- 1918 Randolph Road, Charlotte, NC

Knee Pain

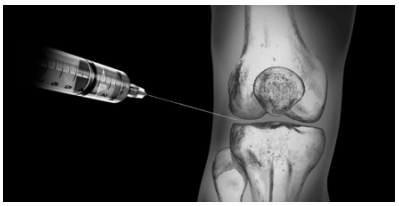
Knee Pain: treatment options

- NSAIDS and medications
- Physical Therapy
- Weight Loss
- Knee bracing
- Injections
- Surgery

Knee Pain: Injections

- Steroid Injections
- Hyaluronic Acid
- Platelet-rich Plasma
- Stem cells

Synvisc (hyaluronic acid)

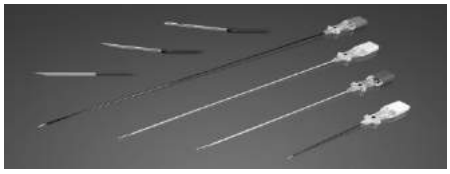


Failed conservative treatment

- 29% of patients over the age of 65 with chronic knee and hip pain are not candidates for surgery
- Contraindications to surgery: age, BMI, comorbidities, implant allergies, patient refusal

Cooled Radiofrequency Treatment

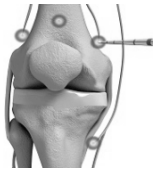
- Minimally invasive procedure
- Ablation of sensory nerves around the knee



Cooled Radiofrequency Treatment

- Cannot have surgery
- Don't want surgery
- Still in pain even after surgery

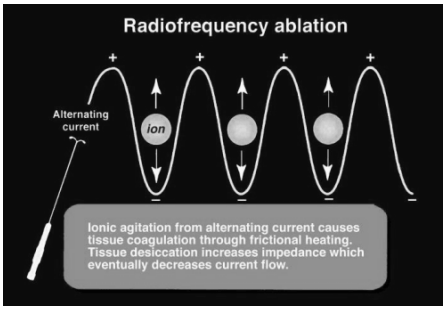
Cooled Radiofrequency Ablation



- Osteoarthritis
- Degenerative Joint Disease
- Post-knee Replacement Pain

Radiofrequency Ablation

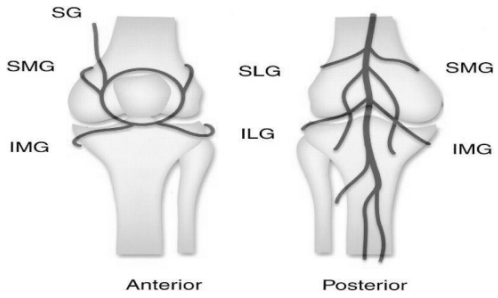
Radiofrequency ablation



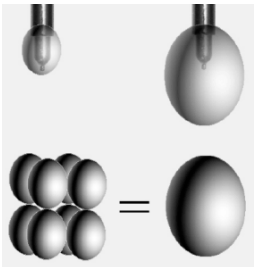
Radiofrequency ablation

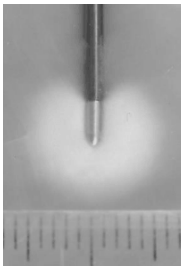
- Electrode with exposed tip is placed close to a nerve
- Electrical current concentrates around the tip, moves from tip into tissue and heats and coagulates the target nerve
- Cell death at greater than 60 degrees Celsius

Genicular Nerves of the Knee

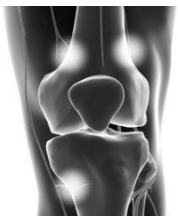


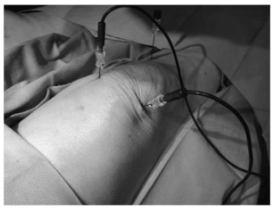
Standard vs Cooled RF Lesion





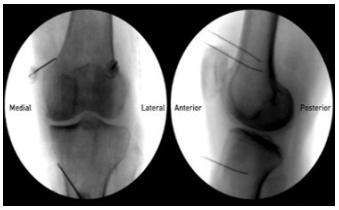
Cooled Knee RFA



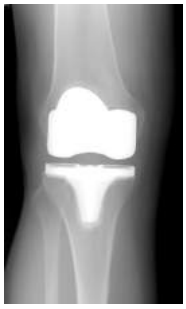


Cooling

Cooled Knee RFA



Cooled RFA



- Internally Cooled Radiofrequency Ablation
- Burn at 80 degrees Celsius

Cooled Radiofrequency: Results

- Up to two years of pain relief following procedure
- Double blind RCT results (study size 35pts):
  - RF group: 59% improvement at 12 wks
  - Control group: 0 % improvement at 12 wks

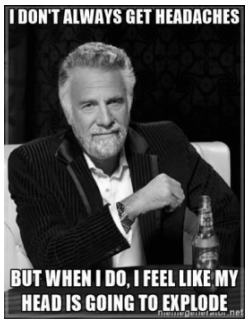
Cooled Knee Radiofrequency

- Outpatient procedure, 30-40 minutes
- Performed under fluoroscopy
- IV sedation with midazolam and fentanyl

Contraindications and Complications

- Contraindications: infection, blood thinners, pregnancy
- Complications: infection, hematoma, motor nerve damage, neuritis

Headaches



Headaches

- Tension headaches
- Migraine headaches
- Cluster headaches
- TMJ
- Cervicogenic and Occipital Headaches

Headache Treatments

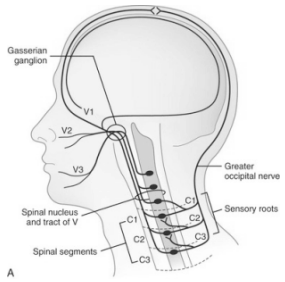
- Medications
- Physical therapy
- Chiropractic Treatments
- Complementary Therapies
- Botox

Interventional Headache Procedures

- Cervical Facet Radiofrequency Ablation
- Occipital Nerve Blocks
- Sphenopalatine Ganglion Blocks
- Stellate Ganglion Blocks

Cervicogenic Headache

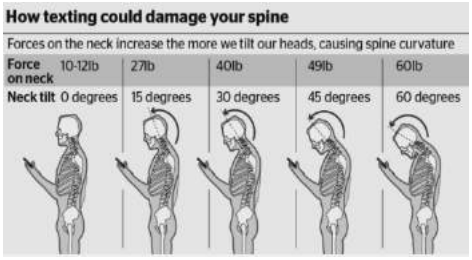
Trigeminocervical Pathway



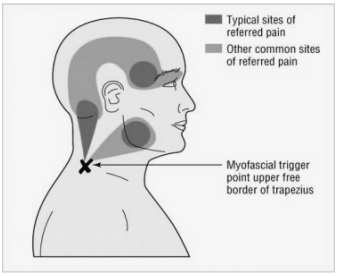
Cervicogenic Headaches: Causes

- Whiplash and trauma
- Poor posture
- Repetitive neck motion
- Degeneration of the cervical spine
- Prior cervical fusion or surgery
- Malignancy

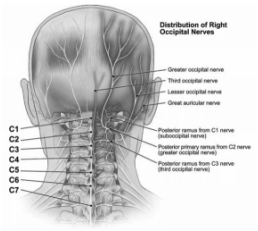
Text Neck Syndrome



Cervicogenic Headache Pattern

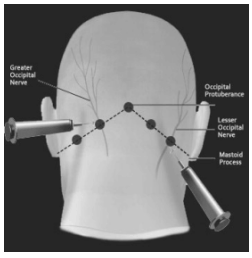


Occipital Neuralgia

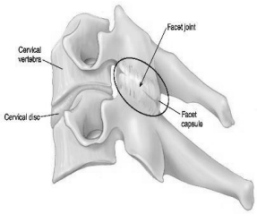


- Pain in the upper neck and back of the head
- Entrapment of occipital nerves
- May also arise from cervical facet joints

Occipital Nerve Block



Cervical Facet Joint

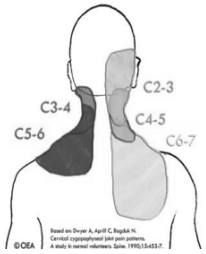


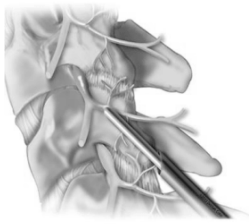
- Facet joints exist between vertebra
- Medial branch nerves located near facet joints

Cervical Facet RFA Indications

- Chronic neck pain and/or headaches
- Imaging (plain films, MRI, CT) consistent with degenerative/arthritic changes
- No nerve compression of the cervical nerve roots

Cervical Facet Radiofrequency





Cervical RFA: results

- Conflicting results with regards to efficacy of cervical facet radiofrequency ablation versus occipital nerve blockade.
- Cervical RFA procedure may benefit patients who have failed conservative measures including occipital nerve blocks.

SUGAMADEX- LET'S JUST RELAX EVERYBODY

Laura Clark MD
Professor of Anesthesiology and Perioperative Medicine
Director of Acute Pain and Regional Anesthesia
Residency Program Director
University of Louisville
Louisville, Ky

THE HOLY GRAIL

THE HOLY GRAIL

Success in life is the result of good judgment. Good judgment is usually the result of experience. Experience is usually the result of bad judgment.

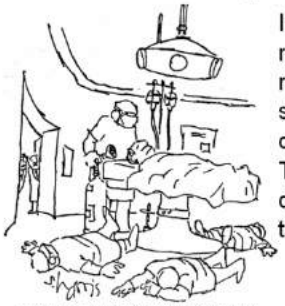
Anthony Robbins

Hazards of Light Anesthesia

"I said I was sorry!"

On the other hand, anesthesia that is too light has its own hazards – mainly for the surgeons.

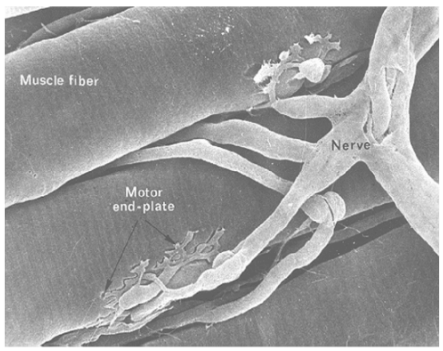
Hazards of Deep Anesthesia



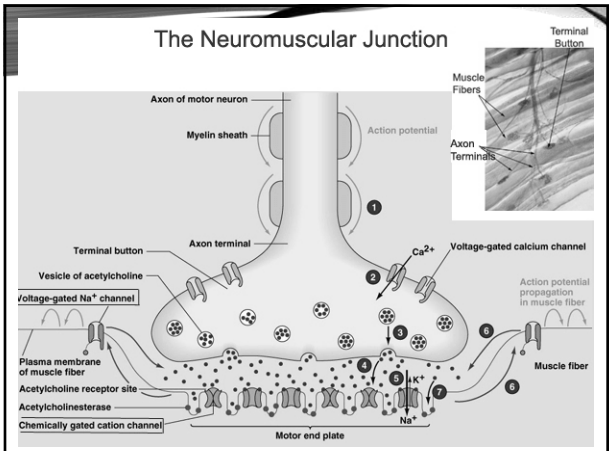
"He's truly an anesthesiologist's anesthesiologist."

In order to achieve muscle relaxation and abolition of reflexes sufficient for deep surgery, dangerous levels of anesthesia are required. This often led to patient death on the operating table.

Mechanism of Action – the Neuromuscular Junction



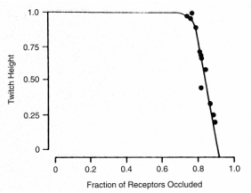
The Neuromuscular Junction



MARGIN OF SAFETY

Wide margin of safety of neuromuscular transmission

- 70% receptor occupancy before twitch depression



THE CASE FOR TWITCH MONITORING

- Current professional guidance in the UK is simply that a neuromuscular monitor be available when NMBAs are used
- This advice should be revisited.
- A case can now be made for monitoring every patient, especially those at high risk of problems from residual blockade.
- Monitoring should start after induction of anaesthesia to establish a baseline.
- Additionally, quantitative monitors offer a further dimension of understanding and should be used more widely.

Association of Anaesthetists of Great Britain and Ireland, Recommendations for standards of monitoring during anaesthesia and recovery, 4th ehttp://www.aagbi.org/publications/guidelines/docs/standardsofmonitoring07.pdf

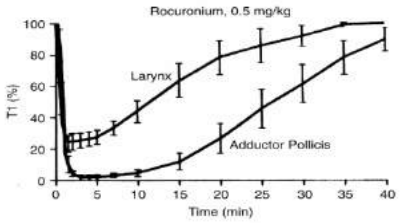
Intraoperative Monitoring

- Peripheral nerve stimulator
  - Train of four with no fade: 70-75% receptors occupied
  - Tetany at 50 Hz for 5 seconds: 70% occupied
- Other test
  - Sustained head lift: 50% occupied
  - Hand squeeze: 50% occupied
  - Sustained bite: 50% occupied

MONITORING THE BLOCK

- Monitoring NMB at the wrist, can *overestimate* the amount of block
- it is not uncommon for a patient with NMB monitored at the wrist to have more abdominal muscle tone than the twitch monitor suggests
- Monitoring NMB on the face can *underestimate* the amount of block
- If the patient has only 1 twitch on the face, it is very unlikely that there is any appreciably abdominal muscle tone

ROCURONIUM: LARYNX V. THUMB

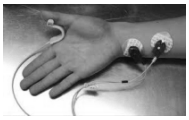


Muscles of the larynx, diaph, + eye are more resistant to effects of non-depolarizers v. thumb

Meistelman: CJA 1992;39:665-9

ACCELEROMYOGRAPHIC MONITORING OF NEUROMUSCULAR BLOCK OVER THE ORBICULARIS ORIS MUSCLE IN ANESTHETIZED PATIENTS RECEIVING VECURONIUM

- Time to onset of block in the orbicularis oris group was significantly shorter
- Times to return of the first, second, third, or fourth (T1, T2, T3, or T4) response of train-of four (TOF), and recovery of T1/control were comparable
- Depth of neuromuscular block
- can be assessed acceleromyographically over the orbicularis oris muscle.



Saitoh Y, Oshima T, Nakata Y.
J Clin Anesth. 2010 Aug;22(5):318-23.

HOW OFTEN IS A TWITCH MONITOR USED?

- 19·4% of European and 9·4% of US respondents did not routinely use a neuromuscular monitor
- Substantial variation in the use of reversal agents and in the appreciation of the poor value of clinical tests for predicting adequate recovery of neuromuscular function

B Debaene, B Plaud, MP Dilly and F Donati, Residual paralysis in the PACU after a single intubating dose of nondepolarizing muscle relaxant with an intermediate duration of action, *Anesthesiology* 98 (2003), pp. 1042–1048.

M Naguib, AF Kopman, CA Lien, JM Hunter, A Lopez and SJ Brull, A survey of current management of neuromuscular blockade in the United States and Europe, *Anesth Analg* 111 (2010), pp. 110–119

ASSESSING POSTOPERATIVE NEUROMUSCULAR FUNCTION

CLINICAL ASSESSMENT

- ✶Sustained 5-second head lift
- ✶Ability to appose incisors (clench teeth)
- ✶Negative inspiratory force > – 40 cm H_2O
- ✶Ability to open eyes wide for 5 seconds
- ✶Hand-grip strength
- ✶Sustained arm/leg lift
- ✶Quality of speaking voice
- ✶Tongue protrusion

Kopman AF, et al. *Anesthesiology*, 1997:86;765

PROBLEMS WITH NEOSTIGMINE/GLYCOPYRROLATE COMBINATIONS

- Can be ineffective
- Can have cardiac tachycardia or bradycardia
- Combination of two agents
  - Is the the right dose for this patient
  - Ever give them separately?

Residual Neuromuscular Blockade in PACU

- Murphy GS 2004
  - 69 non-elderly adults with GA with either rocuronium (duration 35-75 min) or pancuronium (duration 60-120 min)
    - Pancuronium patients had more episodes of severe and mild hypoxia in PACU
    - More pancuronium patients had TOF < 0.7
- Residual neuromuscular blockade is more frequent with neuromuscular blockers of longer duration

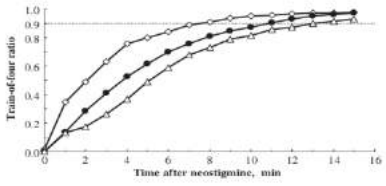
RESIDUAL NEUROMUSCULAR BLOCKADE IN PACU

- Murphy 2008
  - 7459 patients with GA during 1 year
  - 0.8% had respiratory event in the first 15 min in PACU
    - 59% severe hypoxemia –Sat <90%
    - 34% upper airway obstruction
    - 20% mild hypoxemia-Sat 90-93%
  - 42 cases when compared to controls
    - 73% with residual block –TOF ration< 0.7
- Residual neuromuscular blockade increases incidence of respiratory complications in PACU

EFFECTS OF RESIDUAL NEUROMUSCULAR BLOCKADE

- Demonstrated in awake volunteers
  - Upper airway obstruction at TOF of 0.8
  - Pharyngeal obstruction with TOF< 0.9
  - 30% decrease in response to hypoxia at TOF <0.7
- Even in patients with acceptable reversal by subjective and objective standards there can still be effects of neuromuscular blockade

TIME FOR REVERSAL

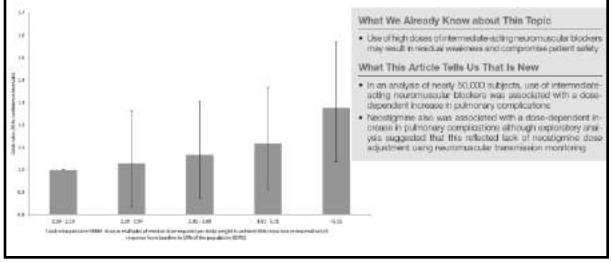


The increase of a train-of-four ratio after reversal of a 90% NMB induced by atracurium with neostigmine 50 $\mu g \cdot kg^{-1}$ in patients <1 year old (open diamonds), 2–10 years old (black circles) and ≥11 years old (open triangles). Data are redrawn with kind permission of the publisher from Kirkegaard-Hansen *et al.* (87).

Dose-dependent Association between Intermediate-acting Neuromuscular-blocking Agents and Postoperative Respiratory Complications

Duncan J. McLean, M.B.Ch.B., Daniel Diaz-Gil, Cand.Med., Hassan N. Farhan, M.B.B.S., Karim S. Ladha, M.D., Tobias Kurth, M.D., Sc.D., Matthias Eikermann, M.D., Ph.D.

Residual paralysis has been reported to occur in 20 to 45% of cases in which NMBAs are used- Maybauer, Anaesthesia 2007 Anes June 2016



ASSOCIATION BETWEEN NMBA DOSE AND RISK OF POSTOPERATIVE RESPIRATORY COMPLICATIONS

60ug/kg TOF 2 or greater No Neostigmine

Table 4. Exploratory Analysis: Association between NMBA Dose and Risk of Postoperative Respiratory Complications

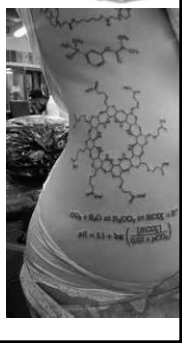
	Appropriate Reversal (n = 13,799)		Inappropriate Reversal (n = 34,700)	
NMBA Dose (Multiples ED95)	Postoperative Respiratory Complications, n (%)	Effect Size	Postoperative Respiratory Complications, n (%)	Effect Size
0.09–2.19	55 (0.39%)	n/a	150 (0.43%)	Not applicable
2.20–2.94	62 (0.45%)	1.04 (0.69–1.56)	194 (0.56%)	1.03 (0.81–1.31)
2.95–3.80	83 (0.60%)	1.16 (0.77–1.73)	227 (0.65%)	1.06 (0.84–1.34)
3.81–5.15	87 (0.63%)	0.95 (0.62–1.44)	310 (0.89%)	1.20 (0.95–1.52)
>5.15	126 (0.91%)	0.98 (0.63–1.52)	518 (1.49%)	1.41 (1.11–1.79)

High-dose neostigmine (>60 µg/kg) results in longer time to discharge from PACU and longer postoperative hospital length of stay

ED95--median dose required per body weight to achieve 95% reduction in maximal twitch response from baseline in 50% of the population

SUGAMMADEX-THE DOUGHNUT

- Sugammadex, is a novel "doughnut-shaped" modified γ-cyclodextrin
- irreversibly binding molecules of rocuronium in the plasma into its "hole" to form a biologically inert complex
- Unbound drug then diffuses rapidly away from the neuromuscular junction, allowing the patient's own acetylcholine to act to restore muscle activity
- Avoidance of muscarinic side-effects The effects of sugammadex seem to be similar
- No difference under propofol and sevoflurane anesthesia

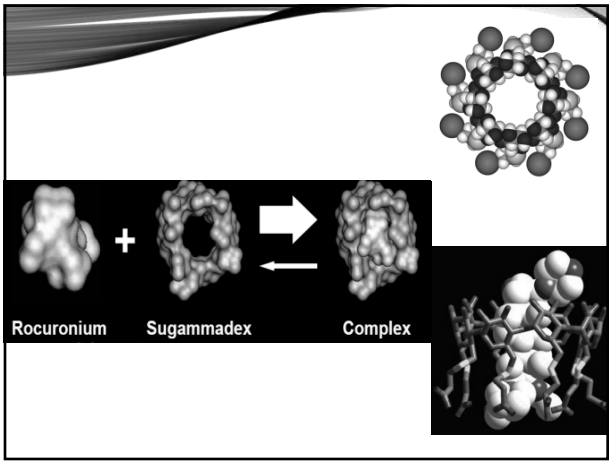


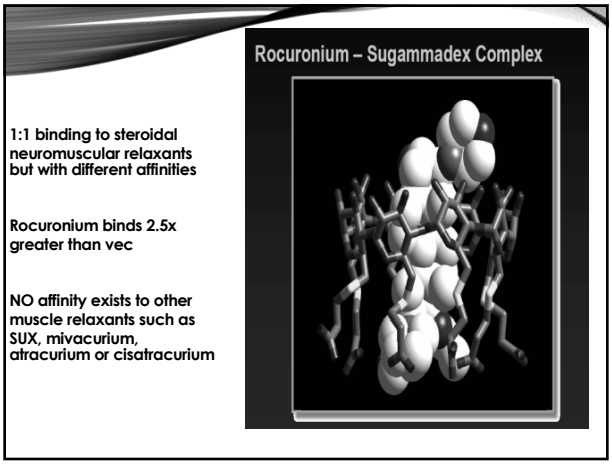
Sugammadex: A Review of its Use in Anaesthetic Practice

Yang, Lily P.H.; Keam, Susan J.

- 'Removes' steroidal neuromuscular blocking agents from the neuromuscular junction
  - rather than by increasing the amount of acetylcholine competing with the neuromuscular blocking agent at the nicotinic receptor
- Cyclodextrins have been safely employed in the food, cosmetic and pharmaceutical industries since the 1970s

Drugs: Volume 69(7), 7 May 2009, pp 919-942





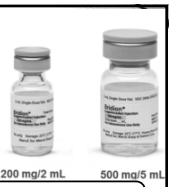
UNIQUE CHARACTERISTICS

- Metabolism
- Interaction with steroid hormones and chemotherapeutic agent
- Physical incompatibility

PRACTICAL POINTS

- Overdose or renal dialysis pts - high flux filter reduced sugammadex plasma concentrations up to 70%
- Ondansetron ,Verapamil ,Ranitidine– will precipitate, be sure to flush line
- NO NEED for glycopyrolate
- Toremifene-oral selective estrogen receptor modulator which helps oppose the actions of estrogen, chemo for breast CA,
  - Only within the same 24 hour period
  - Can displace rocuronium
- Sugammadex may Sequester Hormonal Contraceptives
  - = one missed daily dose of oral contraceptive steroids

DOSING- BASED ON TWITCHES
ON ACTUAL WEIGHT



Moderate 2mg/kg
- The second twitch after TOF

Deep 4mg/kg
- 1-2 PTC
- No TOF

Fully blocked 16mg/kg
- Immediate reversal
- No PTC

Recovery of TOF Ratio to 0.9*
Trial 19.4.301

Neuromuscular Blocking Agent	Sugammadex 2.0 mg/kg	Neostigmine 50 mcg/kg
Rocuronium		
n	48	48
Median (minutes)	1.4*	17.6
Range	0.9-5.4	3.7-106.9
Vecuronium		
n	48	45
Median (minutes)	2.1*	18.9
Range	1.2-64.2	2.9-76.2

* P<0.0001 versus neostigmine

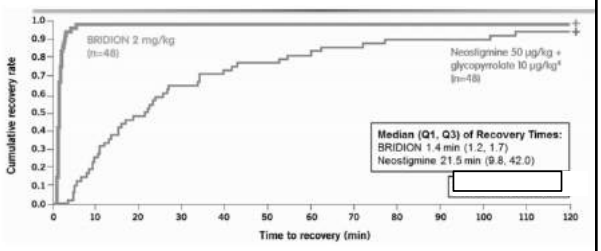
SUGAMMADEX COMPARISON WITH NEOSTIGMINE

- Cochrane review-18 clinical trials of 1,321 patients
- more effective
- effectively reversed all all levels of NMB, including profound block
- overall incidence of adverse events was less than 1%

Abrishami A, Ho J, Wong J, Yin L, Chung F. Sugammadex, a selective reversal medication for preventing postoperative residual neuromuscular blockade. Cochrane Database Syst Rev. 2009(4):CD007362

RECOVERY FROM ROC

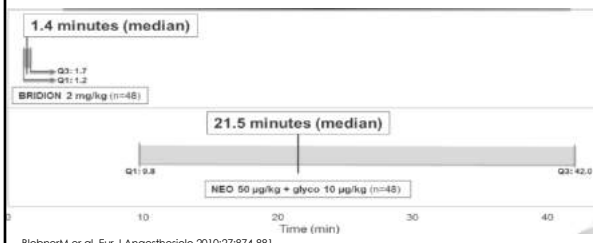
Shallow block



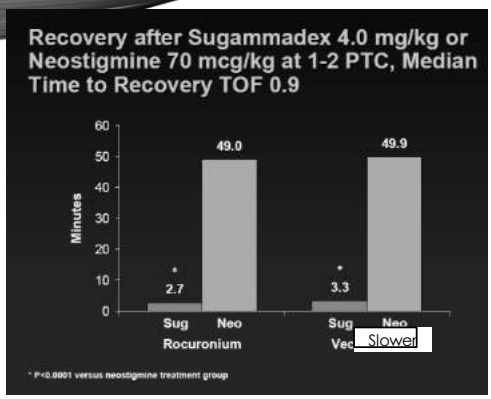
BlobnerM er al. Reversal of rocuronium-induced neuromuscular blockade with sugammadex compared with neostigmine during sevoflurane anaesthesia: results of a randomized controlled trial. Eur J Anaesthesiolo 2010:27:874-881

RECOVERY FROM ROCURONIUM MODERATE BLOCK

- Reappearance of T2

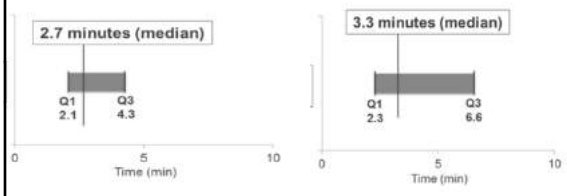


BlobnerM er al. Eur J Anaesthesiolo 2010:27:874-881



REVERSAL OF DEEP BLOCK

Roc Vec



Jones R etal Anesthesiology 2008:109;816-824

SIDE EFFECTS AND PRECAUTIONS

- Anaphylaxis (0.3% in one study of 299 (1person) and Hypersensitivity
- Bradycardia
- Not recommended for severe renal failure
  - Mild to moderate is ok
  - Can be removed by dialysis
- No change in dosing for hepatic

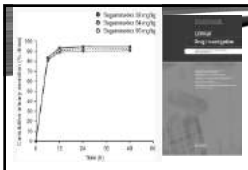
Re-administration of rocuronium or vecuronium after reversal (up to 4 mg/kg BRIDION)	
Minimum waiting time	NMBA and dose to be administered
5 minutes	1.2 mg/kg rocuronium
4 hours	0.6 mg/kg rocuronium or 0.1 mg/kg vecuronium

MOST COMMON ADVERSE REACTIONS

Most common adverse reactions reported in ≥10% of patients at a 2, 4, or 16 mg/kg BRIDION® (sugammadex) dose with rates higher than the placebo rate

Adverse Reaction	Sugammadex 2 mg/kg (N=895) n (%)	Sugammadex 4 mg/kg (N=1921) n (%)	Sugammadex 16 mg/kg (N=98) n (%)	Placebo (N=544) n (%)
Vomiting*	98 (11)	236 (12)	15 (15)	57 (10)
Pain*	434 (48)	993 (52)	35 (36)	207 (38)
Nausea*	208 (23)	503 (26)	23 (23)	127 (23)
Hypotension*	33 (4)	102 (5)	13 (13)	20 (4)
Headache	61 (7)	99 (5)	10 (10)	42 (8)

Package Insert Bridion



Safety, Tolerability and Pharmacokinetics of Sugammadex Using Single High Doses (Up to 96 mg/kg) in Healthy Adult Subjects

A Randomized, Double-Blind, Crossover, Placebo-Controlled, Single-Centre Study

- Up to 96 mg/kg was well tolerated in 12 of the 13 subjects
- sugammadex dose was excreted unchanged in urine within 48 hours
- no serious adverse events
- most common adverse event was dysgeusia-(foul , salty, rancid, or metallic taste persists)
- All were mild and short lived
- 1 withdrawn with sx of hypersensitivity

AE	Placebo (n=12)	Sugammadex 32 mg/kg (n=13)	Sugammadex 64 mg/kg (n=12)	Sugammadex 96 mg/kg (n=12)
Dysgeusia	0	2 (15.4)	1 (8.3)	8 (66.7)
Headache	1 (8.3)	0	1 (8.3)	2 (16.7)
Fatigue	0	0	1 (8.3)	2 (16.7)
Nausea	0	1 (7.7)	0	2 (16.7)
Dizziness	0	0	2 (16.7)	0
Dizziness (postural)	0	0	1 (8.3)	1 (8.3)
Abdominal pain	0	0	1 (8.3)	1 (8.3)
Pharyngolaryngeal pain	0	0	0	2 (16.7)
Micturition urgency	1 (8.3)	0	0	1 (8.3)
Any AE	3 (25.0)	5 (38.5)	5 (41.7)	9 (75.0)
Discontinuation due to AE	0	1 (7.7)	0	0

DON'T TRY TO GET BY "ON THE CHEAP"

- under-dosing may cause reappearance of NMB after apparent successful recovery
- 0.5-1mg instead of the on label dosing for 30 patients
- may be sufficient to form initally complexes in the central compartment
- However---insufficient to sustain roc redistribution from peripheral to central compartments

Incomplete reversal in 3
Recurarization after initial successful reversal in 4

Fuchs-Binder T. EurJ Anaesth2010;

CASE REPORT Open Access

Three suspected cases of sugammadex-induced anaphylactic shock

Intraoperative anaphylaxis 1: 3500 to 1:13 000 cases

13-year-old boy who underwent laparoscopic appendectomy,

a 75-year-old woman who underwent left knee arthroplasty

a 34-year-old man who underwent left pansinectomy for sinobronchitis

- Symptoms occurred in all 3 on the way to the PACU or in PACU
- experienced a decrease in blood pressure along with mucocutaneous erythema
- reintubation after extubation was required in 1 due to difficulty in manual ventilation
- All patients recovered with anti-allergic therapy.
- On later investigation, all three patients had a positive skin reaction to sugammadex.

Takazawa T at al. BMC Anesthesiology 2014; 14: 92.f

3 CASES OF SUSPECTED SUGAMMADEX-INDUCED HYPERSENSITIVITY REACTIONS

- Hypersensitivity to sugammadex may not have cardio-vascular or respiratory symptoms might be missed during anesthesia
- Can have increased Pulmonary Peak Pressure
- Case 1-Three minutes after reversal, the patient developed facial erythema and blepharoedema, but there was no hypotension, tachycardia, or bronchospasm
  - Rx-Vistaril improved in 9 min
- Case 2-Three minutes after , the patient developed hypotension (systolic arterial pressure <50 mm Hg), tachycardia (>110 beats min−1), and generalized erythema.
  - The oxygen saturation decreased from 99% to 83%
  - The peak airway pressure increased from 24 mm Hg to 33 mm Hg within 5 min of sugammadex RX- intubated epi, neo overnight in ICU
- Case 3-89-yr-old, 45 kg female underwent elective cataract surgery under general
  - Four minutes after extubation, she developed
  - a wheezing, decreased sat from 99 to 91%, HR increased to 110 beats
  - intense erythema over her left arm
  - RX- methylprednisolone 250 mg, aminophylline 250 mg, and two puffs of procaterol
  - Improved in 30 min.

SUGAMMADEX FOR TREATMENT OF ROC ANAPHYLAXIS

- During an anaphylactic reaction to rocuronium, there was a poor response to standard treatment.
- Sugammadex, given 19 min after roc, was associated with haemodynamic improvement.
- The exact role of sugammadex here is not clear, but worthy of investigation.

McDonnell NJ at al. Brit J Anaesth 2011; 106/2: 199-201

DOES NOT REQUIRE SPECIAL CONSIDERATIONS FOR PATIENT MORBIDITY OR AGE

- Geriatric
- Pulmonary disease
- Cardiac disease
- Mild to Moderate renal impairment

DIFFERENCE IN THE TIME FOR ELDERLY

Median time from start of 4 mg/kg of BRIDION to a TOF ratio of 0.9

Patient Population	Median Time (min)
18 to 64 years (n=359)	**2.0**
≥65 years (n=63)	**2.5**

DIFFERENCES IN MUSCLE SENSITIVITY

- Deep neuromuscular blockade reportedly improves the surgical conditions of retroperitoneal laparoscopic procedures such as prostatectomy, nephrectomy, and hysterectomy
- Fernando showed that diaphragmatic movement is possible even with deep neuromuscular blockade
- No response to TOF stimulation at the adductor pollicis muscle, movement of the diaphragm or abdominal muscles is possible
- Much more movement is possible with moderate neuromuscular blockade, which is maintained with a TOF count of 1 or 2

Fernando PU, Viby-Mogensen J, Bonsu AK et al (1987) Relationship between posttetanic count and response to carinal stimulation during vecuronium-induced neuromuscular blockade.Acta Anaesthesiol Scand 31:593–596
Dubois PE, Putz L, Jamart J et al (2014) Deep neuromuscular block improves surgical conditions during laparoscopic hysterectomy: a randomised controlled trial. Eur J Anaesthesiol 31:430–436
Martini CH, Boon M, Bevers RF et al (2014) Evaluation of surgical conditions during laparoscopic surgery in patients with moderate vs deep neuromuscular block. Br J Anaesth 112:498–505

The use of sugammadex for bariatric surgery: analysis of recovery time from neuromuscular blockade and possible economic impact

- Sugamadex
  - Shorter time to TOF of >.9
  - Shorter time to a Aldrete score of 10
  - Higher cost , 2.8% of surgery
    - Neostigmine 0,06%
  - Total time saved was 19.4 hours which could be used to perform extra laparoscopic sleeve gastyrectomies

	SUG (50 patients)	NEO (49 patients)
Rocuronium (mg)	73.3 (1.9)	72.2 (2.5)
Cisatracurium (mg)	–	15.6 (0.9)
Sugammadex (mg)	258.8 (58.4)	–
Neostigmine (mg)	–	6.4 (0.9)
Mean time to obtain an Aldrete score of 10 (minutes)	16 (1.8)*	21.8 (2.8)
Time to achieve a TOF ratio of 0.9 (minutes)	1.4 (0.4)*	26.4 (5.9)
Duration of laparoscopic sleeve gastrectomy (minutes)	86.4 (5)	87.8 (4)

E DeRobertis et al ClinicoEconomics and Outcomes Research June 2016

Randomized Clinical Trial of Moderate Versus Deep Neuromuscular Block for Low-Pressure Pneumoperitoneum During Laparoscopic Cholecystectomy

Beneficial effects of deep blockade with lower pressure required

- 64 patients
- Benefits of lower pressure
  - reduce the incidence and severity of postoperative shoulder tip pain and postoperative pain
  - provide more stable intraoperative hemodynamics
  - provide better pulmonary function quality of life in the immediate postoperative period
- The proportion of patients with a surgical condition score of 1 or 2 (excellent or good)
  - 34.4 % in the moderate group –low pressure
  - 68.8 % in the deep group (P = 0.006)
- Deep neuromuscular blockade allowed
  - lower rate of conversion to standard pressure
  - higher surgeon satisfaction with the surgical conditions than was moderate blockade in patients undergoing low-pressure pneumoperitoneum laparoscopic cholecystectomy
  - intraoperative movement was 21.9 % in the moderate group and only 3.1 % in the deep group
  - Shorter operating time

Koo, B., Oh, A., Seo, K. et

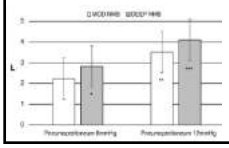
Journal of Clinical Anesthesia
Volume 34, November 2016, Pages 197–203

Increase in Work Space?

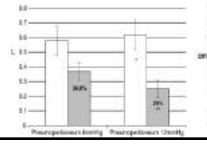
Effect of depth of neuromuscular blockade on the abdominal space during pneumoperitoneum establishment in laparoscopic surgery ☆ ☆☆

- Prospective, randomized, crossover clinical trial
- Compared moderate vs deep blockade for pre-set intraabdominal pressures of 8 and 12 mmHg
- evaluated the volume of CO2 introduced
  - and the skin-sacral promontory distance at pneumoperitoneum establishment

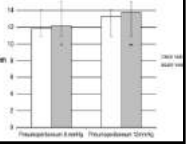
Intraabdominal volume of CO2



% of increase in intraabdominal volume



Distance Difference



Comparison of Sugammadex versus Neostigmine Costs and Respiratory Complications in Patients with Obstructive Sleep Apnoea

- 74 patients
- Time to 0.9 was shorter in the Sugammadex group
  - 2 min vs 8 min
- OR time
  - 72 min vs 97 min
- PACU stay
  - Shorter
- Neostigmine group
  - 3 patients were reintubated
  - 8 (21.6%) unplanned ICU admissions, 1 in the S group
- Reversal cost was higher in the S group but complication treatment cost and total cost were lower

ol Reanim. 2015 Dec; 43(6): 387–395.

Minerva Anestesiol. 2016 Oct

THE EFFECT OF ROUTINE AVAILABILITY OF SUGAMMADEX ON POSTOPERATIVE RESPIRATORY COMPLICATIONS: A HISTORICAL COHORT STUDY

- Unrestricted access
- 1257 surgeries, ENT, General Surgery
- Incidence of postoperative in hospital respiratory diagnoses and airway complications in PACU
  - pattern of muscle relaxant use and the relative costs
- Significant reduction
  - in the rate of a postoperative in-hospital respiratory diagnosis(p=0.01)
  - in hospital respiratory diagnoses(p=0.04)
  - decrease in the need for manual airway support in the recovery room (3.2% vs 1.1%, p=0.02)
  - decrease in patients being transferred intubated to ICU (5.5% vs 1.3%, p<0.001).

Royal North Shore Hospital, St. Leonards, Sydney, Australia

Acta Anaesthesiologica Scandinavica

AN INTERNATIONAL JOURNAL OF ANAESTHESIOLOGY AND INTENSIVE CARE, PAIN AND EMERGENCY MEDICINE

Effects of sugammadex vs. pyridostigmine–glycopyrrolate on post-operative nausea and vomiting: propensity score matching

September 2016

- 7179 patients
- Sugammadex group on day 0 had a nausea score and a emesis score
  Less that their matched cohort

Group Sugammadex used fewer rescue antiemetics on day 0 and had a higher complete response on day 0

Conclusion:

	Group R (n = 408)	Group S (n = 115)	STD (%)	Diff (95% CI)	P-value
Nausea NRS	0.33 ± 0.74	0.17 ± 0.42	23.43	0.17 (0.03–0.31)	0.002 *†
CR	221 (54.2)	77 (67.0)	−23.62	0.13 (0.03–0.23)	0.014 *
Number of vomiting	0.10 ± 0.32	0.04 ± 0.21	20.04	0.06 (0.01–0.11)	0.036 *†
Rescue antiemetic	160 (39.2)	33 (28.7)	26.79	0.11 (0.01–0.21)	0.039 *

Sugammadex might be more beneficial for PONV compared to pyridostigmine–glycopyrrolate mixture for patients who have received opioid-based IV-PCA.

Journal of Clinical Anesthesia

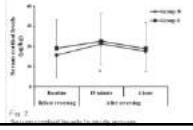
Volume 34, November 2016, Pages 62–67

ELSEVIER

Original Contribution

The effect of sugammadex on steroid hormones: A randomized clinical study

- Sugammadex dose of 4 mg/kg showed no adverse effects on progesterone and cortisol levels
- is not associated with adverse effects on steroid hormones progesterone and cortisol
- it may lead to a temporary increase in aldosterone and testosterone
- the effect sugammadex on steroidal hormones could probably considered to be insignificant



Canadian Journal of Anesthesia

Journal canadien d'anesthésie

Sugammadex as rescue therapy for residual neuromuscular blockade in the intensive care unit

- Sept 2016 –Q/I study of incidence

Postoperative residual paralysis after fast-track cardiac surgery

50 patients studied

-- 24 (48%) had received an NMB during the last hour of surgery

-- 33 (66%) had evidence of residual paralysis during the immediate postoperative period

Off label use at this point

PEDIATRIC PATIENTS

Off label use in this country

- Outside of US Age 2-17
- 2mg/kg recommended for routine reversal of roc-induced block at reappearance of T2
- Su 100mg/ml may be diluted to 10mg/ml to increase accuracy in dosing

Infants

- not recommended until further data become available.

SUGAMMADEX IN PEDIATRICS

Sugammadex for reversal of rocuronium-induced neuromuscular blockade in pediatric patients: A systematic review and meta-analysis.

- Six randomized controlled trials comparing 253 pediatric patients (age range, 2-18 years)
  - Mean time to reach 0.9 TOF was 7 min vs 17 min
  - Significantly faster to extubation by 6 minutes
- suggest that sugammadex is fast and effective in reversing rocuronium-induced NMB in pediatric patients
- no evidence of a higher incidence of adverse events
- much more data regarding the safety of sugammadex in pediatric patients may be still required

Recent Published Reports

J Clin Anesth. 2016 Sep;33:315-8. doi: 10.1016/j.jclinane.2016.04.033. Epub 2016 May 18.

Reversal of profound neuromuscular blockade with sugammadex in an infant after bronchial foreign body removal.

J Clin Anesth. 2016 Sep;33:314-9. doi: 10.1016/j.jclinane.2016.01.015. Epub 2016 Apr 6.

Recovery of laryngeal nerve function with sugammadex after rocuronium-induced profound neuromuscular block.

mean time to recovery of the TOF ratio to 0.9 was 118 ± 80 seconds

J Clin Anesth. 2016 Sep;33:1-4. doi: 10.1016/j.jclinane.2015.12.023. Epub 2016 Apr 6.

The use of sugammadex in a pregnant patient with Wolff-Parkinson-White syndrome.

In WPW Neostigmine used as a reversal agent in general anesthesia can trigger such fatal arrhythmias

BJA

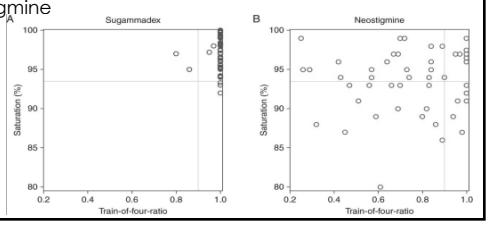
Improved postoperative oxygenation after antagonism of moderate neuromuscular block with sugammadex *versus* neostigmine after extubation in 'blinded' conditions

- Multicentre, double-blind, randomized controlled 2mg/kg vs neostigmine 2.5mg
  - propofol, sufentanil, and rocuronium
  - the level of NMB was kept at one to two twitches in the TOF
- After antagonism, the attending anaesthetist was blinded to the TOF monitor, and extubation was based on clinical grounds (head lift, hand grip, open eyes, tongue protrusion, etc.)
- 8 patients required one additional neostigmine dose of 1 mg
- 3 others received a "rescue" dose of sugammadex after their initial neostigmine dose
- None of the patients who initially received sugammadex required additional treatment

HIGHER % OF PATIENTS HAD O2 SATURATION >94%

- 70% of neostigmine patients TOF was < 0.9
- 4% (2) of sugammadex patients were <0.9
- 90% of the patients were in the upper right quadrant of the graph (TOF ratio of >0.9 combined with lowest saturation ≥94%) vs 16% of patients treated with neostigmine

No adverse events because supplement oxygen was given

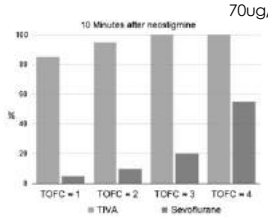


Curr Anesthesiol Rep. 2016

Qualitative Neuromuscular Monitoring: How to Optimize the Use of a Peripheral Nerve Stimulator to Reduce the Risk of Residual Neuromuscular Blockade

- Due to Limitations of the PNS
- PNS should be applied properly and early
- All overdosing of neuromuscular blocking drugs should be avoided
- the intraoperative neuromuscular blockade should be maintained only as deep as necessary
- The adductor pollicis is the gold standard site and must be used for the pre-reversal assessment
  - the next best site for is the great toe twitch with stimulation of the posterior tibial nerve
- Spontaneous recovery should be maximized
- Neostigmine should be administered after a TOF count of 4 has been confirmed at the adductor pollicis
- Extubation should not occur within 10 min

% with 0.9 after 10 min
70ug/kg



Curr Anesthesiol Rep. 2016; 6: 164–169.

PADOVA HOSPITAL APPROVED INDICATIONS

Preventative

- **Elderly, morbid obesity, neurologic impairment**
- **Respiratory, cardiac, kidney and liver disease**
- **Difficult airway management**
- **Contraindications to neostigmine or atropine**

Rescue

- **"Emergency use": Rapid reversal of high dose ROC-induced NMB in cannot ventilate/cannot intubate (CVCI)**
- **Curative use: any post-op recurization-related adverse respiratory events after reversal with Neostigmine**

RESULTS: PREVENTATIVE GROUP

Table 1 Data for "preventive" use of sugammadex in high-risk patients and comparison with a control group

	Treated group[a] (128 patients)	Control group[b] (128 patients)	P-value
Sex (male/female), n (%)	60 (46.8)/68 (53.2)	57 (44.5)/71 (55.5)	0.8
Age, years, mean ± SD	64±15	62±14	0.58
Weight, kg, mean ± SD	88±25	84±22	0.18
Height, cm, mean ± SD	174±8	172±9	0.14
Reversal in patients with difficult airways, n (%)[c]	8 (6.2)	4 (3.1)	0.37
Elderly subjects (≥75 yr), n (%)	27 (21)	27 (21)	1.0
Morbid obesity (BMI >35), n (%)	36 (28.1)	36 (28.1)	1.0
Respiratory disease, n (%)[d]	10 (7.8)	15 (11.7)	0.4
Cardiac disease, n (%)[e]	14 (10.9)	19 (14.8)	0.45
Kidney disease, n (%)[f]	22 (17.1)	16 (12.5)	0.38
Cirrhosis, n (%)	4 (3.1)	7 (5.4)	0.54
Neuromuscular disease, n (%)[g]	3 (2.3)	4 (3.1)	1.0
Contraindications to neostigmine/atropine, n (%)	4 (3.1)	0 (0)	0.12
Duration of surgery, min, mean ± SD	153±92	162±111	0.45
Duration of anesthesia, min, mean ± SD	174±98	192±121	0.17
Inhalational anesthesia/TIVA, n (%)[h]	102 (79.6)/26 (20.4)	96 (75)/32 (25)	0.45
Intraoperative analgesia (remifentanil/fentanyl), n (%)	91 (71.1)/37 (28.9)	84 (65.6)/44 (34.4)	0.42
Degree of NMB at extubation, n (%)[i]			
Acceptable, n (%)	128 (100)	71 (55.5)	<0.001
Mild to moderate, n (%)	0 (0)	41 (32)	<0.001
Severe, n (%)	0 (0)	16 (12.5)	<0.001
PR length of stay, min, mean ± SD	56±29	103±52	<0.001

MOST FREQUENT POST OPERATIVE RESIDUAL CURARIZATION (PORC)

- Difficult weaning from mechanical ventilation (60.4%)
- Postextubation severe hypoxemia (19.8%)
- Inability to breathe deeply (9.4%)
- Upper airway obstruction (5.2%)
- Signs of respiratory distress (3.1%)
- Respiratory failure requiring mask ventilation (2%)

Ten PORC-related unplanned ICU admissions were registered in 2011–2012

- one in the 2013–2014

SOURCES OF COST SAVINGS

1. Drug Utilization / Cost
2. Operating Room Resource Utilization / Time to Discharge to Surgical Ward
3. Reduced ICU admissions

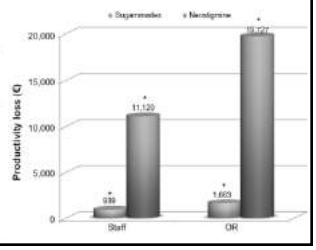
ECONOMIC BENEFITS OF USING SUGAMMADEX AS FIRST-CHOICE REVERSAL DRUG

- Speeding the complete recovery from NMB and the discharge to surgical ward—Total Gain of 20,000+ €
  1. **OR Time** – gain of 18,064 €
     6.6 Euro per minute (including staff time)
  2. **PACU Time-** gain of 2,105 €
  3. **ICU time** – (cost of 1345 per day)-10 events
     economic gain of decreased admissions estimated at 13,548

MONETARY COST OF TIME FOR REVERSAL- OR EFFICIENCY

Comparison of Productivity with New Reversal Strategy

	Reversal time (min)	Cases (n)	Overall time (min)	Staff costs (€)	OR costs (€)
Sugammadex					
Moderate NMB	1.7[a]	93	158	588	1043
Deep NMB	2.7[a]	35	94	350	620
Total		128	252	938	1,663
Neostigmine					
Moderate NMB	13.7[a]	93	1,274	4,740	8,408
Deep NMB	49[a]	35	1,715	6,380	11,319
Total		128	2,989	11,120	19,727



INCIDENCE OF PORC

- 2 studies estimate rates ranging from 26% to 64%
- Residual effects of NMBAs are associated with an increased risk of AREs
- Murphy and others - estimated overall incidence of AREs (1.9-6.9%)
  - Post extubation AREs >0.8%
  - Rose reported 1.3%
- Postoperative AREs are associated with
  - increased postoperative morbidity and mortality
  - prolonged postanesthesia care unit (PACU) stay
  - unanticipated admissions to the ICU

Esteves S, Martins M, Barros F, et al. Incidence of postoperative residual neuromuscular blockade in the postanaesthesia care unit: an observational multicentre study in Portugal. Eur J Anaesthesiol. 2013;30(5):243–249.
Hayes AH, Mirakhur RK, Breslin DS, Reid JE, McCourt KC. Postoperative residual block after intermediate-acting neuromuscular blocking drugs. Anaesthesia. 2001;56(4):312–
Murphy GS, Szokol JW, Marymont JH, Greenberg SB, Avram MJ, Vender JS. Residual neuromuscular blockade and critical respiratory events in the postanesthesia care unit. Anesthesia and Analgesia. 2008;107(1):130–137.
Rose DK, Cohen MM, Wigglesworth DF, DeBoer DP. Critical respiratory events in the postanesthesia care unit. Patient, surgical, and anesthetic factors. Anesthesiology. 1994;81(2):410–418.

AVOIDING PORC HAS ADVANTAGES

- Sugammadex was demonstrated to increase safety in patients receiving a rocuronium-induced NMB
  - avoiding PORC if given as the first-reversal drug in high-risk patients
- Prompt treatment of PORC-related AREs occurring after administration of standard reversal drugs
- Despite its cost, sugammadex showed resource savings to the hospital by
  - Speeding the recovery from NMB in the OR
  - Potentially produce resource savings by reducing the rate of PORC
  - Reducing time spent in the RR, and rate of unplanned ICU admissions.

THE INTANGIBLES--DO THE BENEFITS OUTWEIGH THE COST ?

- Sugammadex provides a rapid, safe, and complete recovery to 0.9
  - Implications for a strong patient verses a weaker one that may not even out for 50 minutes or more
- As rescue therapy after neostigmine reversal quickly resolved PORC-related AREs
  - Clinical and economic implications
- Prolonged time to extubation at the end of general anesthesia delays OR exit and slows OR workflow
- Residual weakness increases significantly the risk of delayed OR exit and PACU discharge

CASE REPORTS ABOUND

- Rocuronium-sugammadex for electroconvulsive therapy management in neuroleptic malignant syndrome: A case report. Rev Esp Anestesiol Reanim. 2016 Jul 14.
- Rapid Return of Spontaneous Respiration after General Anesthesia with Sugammadex in a Patient with Myasthenia Gravis Turk J Anaesthesiol Reanim. 2016
- Use of sugammadex in parotid surgery: a case report. J Med Case Rep. 2016
- A case of anaphylaxis apparently induced by sugammadex and rocuronium in successive surgeries. J Clin Anesth. 2016 Aug;32:30-2.

MYASTHENIA GRAVIS

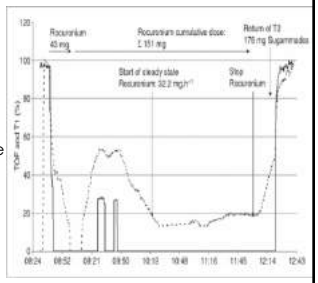
- Problems can occur with Cholinesterase Inhibitors
  - Inhibitors...may be ineffective on those with chronic therapy
- Can induce a cholinergic crisis, which can be clinically indistinguishable from a myasthenia crisis
- May require 60% reduction in dose of muscle relaxants
- Twitch recovery can be very individual dependent
- Can take 30 min longer to return to a twitch height to return to 25% of control

Buzello W et al. Vecuronium for muscle relaxation in patients with myasthenia gravis. Anesthesiology 1986; 64: 507-9.

The use of sugammadex in a patient with myasthenia gravis

C. Unterbuchner, H. Fink, M. Blobner

- Large variability in sensitivity to depolarizing and non-depolarizing neuromuscular blocking drugs
- Continuous infusion of rocuronium
- On arrival in the post-anesthesia care unit his muscle function was clinically unimpaired.
- He was able to drink 20 ml water without complication



Unterbuchner C at al. Anaesthesia 2010; 65: 302-305.

Successful Use of Sugammadex in a Myasthenic Patient Case Report

Silvia Kangassu Rios, Daiana Gomes, Marcos Lopes De Miranda, Carlos Frederico La Cava, Carlos Darcy Bersot

Department of Anesthesia. Hospital Federal da Lagoa. Rio de Janeiro. Brazil.

- Used sugammadex immediately after intubation– not for reversal at the end of the case
- Reversed with recovery ,150 minutes of surgery, the TOF remained above 90%.
- surgery required no relaxation, had an epidural
- can pre-vent complications such as postoperative respiratory failure.
- no occur-ence of postoperative residual curarization.

Open Journal of Anesthesiology, 2013, 3, 48-50

REVERSAL OF C-SECTION

- Rocuronium my be prolonged in pregnant women
- Report of 7 cases
- 7 patients had a significant degree of neuromuscular block
- In all patients, sugammadex provided rapid and sufficient reversal to TOF >0.9 within 2 min
- No signs of recurarization or neuromuscular weakness were observed in any patient.

Pühringer FK at al. Brit J Anaesth Aug 24, 2010.1

Non-IgE-Dependent Hypersensitivity to Rocuronium Reversed by Sugammadex: Report of Three Cases and Hypothesis on the Underlying Mechanism

Spoerri D.[a] · D'Incau S.[b] · Roux-Lombard P.[c] · Harr T.[a] · Czarnetzki C.[d]

- Report of 3 cases
- Presumed pseudoallergic reactions to rocuronium with a rapid response to sugammadex
  - sugammadex might act via the inhibition of non-IgE mediated MRGPRX2 (Mas-related G-protein-coupled receptor member X2)-triggered mast cell degranulation induced by rocuronium
- 36-year-old atopic female underwent abdominal surgery during which fentanyl, lidocaine, propofol, suxamethonium and ceftriaxone followed by repeated injections of rocuronium were given
- At the end of the procedure she presented a generalized urticarial rash associated with bronchoconstriction and hypoxemia
- Treated with antihistamines, methylprednisolone and nebulized adrenaline,
- However, her condition improved rapidly only after treatment with 400 mg i.v. of sugammadex

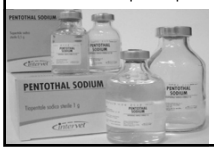
TWO CENTS

- Propofol was introduced almost 20 years ago forever changed anesthesia practice
- Nothing since then, however, has had the same effect.
- Unquestionably, the introduction of sugammadex is an important breakthrough, and one that is likely to change the face of clinical neuromuscular pharmacology.
- its future clinical use should decrease the incidence of postoperative muscle weakness
  - facilitate the use of rocuronium for rapid sequence induction of anesthesia
- the residual postoperative muscle weakness caused by this class of drugs is likely to continue unless if the current regimen of practice continues to be the norm.

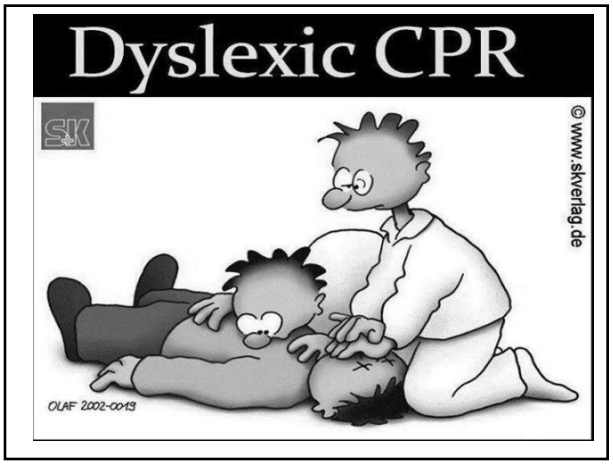
Naguib, MohamedAnes Analg Volume 104(3), March 2007, pp 575-581,

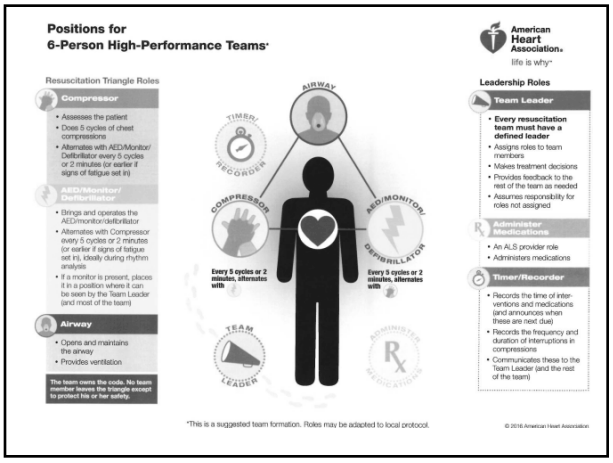
DO WE HAVE A CHANGE IN THE PRACTICE OF ANESTHESIA???

- Minimize or eliminate neostigmine ??
- Minimize or eliminate succinylcholine??
- Impact on residual paralysis in the PACU ???
- Increase operative conditions???
- Decrease excessive hypnosis and use of drugs and agents in a way they were not intending to be used???
- Increase perioperative safety???



QUESTIONS?





2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

	New	Old	Rationale
BLS Changes			
Assessment sequence	Healthcare providers (HCPs) must call for nearby help upon finding the victim unresponsive, but it would be practical for an HCP to continue to assess the breathing and pulse simultaneously before fully activating the emergency response system (or calling for backup). These recommendations allow flexibility for activation of the emergency response system to better match the HCP's clinical setting. Trained rescuers are encouraged to simultaneously perform some steps (ie, checking for breathing and pulse at the same time), in an effort to reduce the time to	The HCP should check for response while looking at the patient to determine if breathing is absent or not normal.	The intent of the recommendation change is to minimize delay and to encourage fast, efficient, simultaneous assessment and response rather than a slow, methodical, step-by-step approach.

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

	New	Old	Rationale
BLS Changes			
	reduce the time to first chest compression. Integrated teams of highly trained rescuers may use a choreographed approach that accomplishes multiple steps and assessments simultaneously rather than the sequential manner used by individual rescuers (eg, one rescuer activates the emergency response system while another begins chest compressions, a third either provides ventilation or retrieves the bag-mask device for rescue breaths, and a fourth retrieves and sets up a defibrillator).		

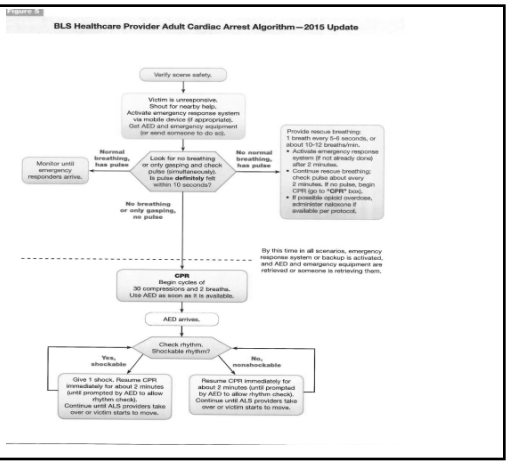
2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

	New	Old	Rationale
BLS Changes			
Compression Rate	In adult victims of cardiac arrest, it is reasonable for rescuers to perform chest compressions at a rate of 100 to 120/min.	It is reasonable for lay rescuers and HCPs to perform chest compressions at a rate of at least 100/min.	The minimum recommended compression rate remains 100/min. The upper limit rate of 120/min has been added because 1 large registry series suggested that as the compression rate increases to more than 120/min, compression depth decreases in a dose-dependent manner. For example, the proportion of compressions of inadequate depth was about 35% for a compression rate of 100 to 119/min but increased to inadequate depth in 50% of compressions when the compression rate was 120 to 139/min and to inadequate depth in 70% of compressions when the compression rate was more than 140/min.

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

	New	Old	Rationale
BLS Changes			
Chest Compression Depth	Perform chest compressions to a depth of at least 2 inches/5 cm for an average adult. Avoid excessive chest compression depths of more than 2.4 inches/6 cm when a feedback device is available	The adult sternum should be depressed at least 2 inches (5 cm).	A compression depth of approximately 5 cm is associated with greater likelihood of favorable outcomes compared with shallower compressions. While there is less evidence about whether there is an upper threshold beyond which compressions may be too deep, a recent very small study suggests potential injuries (none life-threatening) from excessive chest compression depth (greater than 2.4 inches/6 cm). It is important for rescuers to know that chest compression depth is more often too shallow than too deep



2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

	New	Old	Rationale
ACLS Changes			
Advanced airway ventilation rate	It may be reasonable for the provider to deliver 1 breath every 6 seconds (10 breaths per minute) while continuous chest compressions are being performed (ie, during CPR with an advanced airway).	When an advanced airway (ie, endotracheal tube, Combitube, or laryngeal mask airway) is in place during 2-person CPR, give 1 breath every 6 to 8 seconds without attempting to synchronize breaths between compressions (this will result in delivery of 8 to 10 breaths per minute).	This simple single rate—rather than a range of breaths per minute—should be easier to learn, remember, and perform

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

	New	Old	Rationale
ACLS Changes			
Targeted temperature Management	All comatose (ie, lacking meaningful response to verbal commands) adult patients with return of spontaneous circulation (ROSC) after cardiac arrest should have targeted temperature management (TTM), with a target temperature between 32°C and 36°C selected and achieved, and then maintained constantly for at least 24 hours.	Comatose (ie, lacking meaningful response to verbal commands) adult patients with ROSC after out-of hospital ventricular fibrillation cardiac arrest should be cooled to 32°C to 34°C for 12 to 24 hours. Induced hypothermia also may be considered for comatose adult patients with ROSC after IHCA of any initial rhythm or after OHCA with an initial rhythm of pulseless electrical activity or asystole.	Initial studies of TTM examined cooling to temperatures between 32°C and 34°C compared with no well-defined TTM and found improvement in neurologic outcome for those in whom hypothermia was induced. A recent high-quality study compared temperature management at 36°C and at 33°C and found outcomes to be similar for both. Taken together, the initial studies suggest that TTM is beneficial, so the recommendation remains to select a single target temperature and perform TTM. Given that 33°C is no better than 36°C, clinicians can select from a wider range of target temperatures. The selected temperature may be determined by clinician preference or clinical factors.

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

	New	Old	Rationale
ACLS Changes			
Out-of-hospital cooling	The routine prehospital cooling of patients with rapid infusion of cold intravenous (IV) fluids after ROSC is not recommended	Comatose (ie, lacking meaningful response to verbal commands) adult patients with ROSC after out-ofhospital ventricular fibrillation cardiac arrest should be cooled to 32°C to 34°C for 12 to 24 hours. Induced hypothermia also may be considered for comatose adult patients with ROSC after IHCA of any initial rhythm or after OHCA with an initial rhythm of ulseless electrical activity or asystole.	Before 2010, cooling patients in the prehospital setting had not been extensively evaluated. It had been assumed that earlier initiation of cooling might provide added benefits and also that prehospital initiation might facilitate and encourage continued in-hospital cooling. Recently published high-quality studies demonstrated no benefit to prehospital cooling and also identified potential complications when using cold IV fluids for prehospital cooling.

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

	New	Old	Rationale
Pharmacology Changes			
Vasopressors for resuscitation: Vasopressin	It may be reasonable to administer epinephrine as soon as feasible after the onset of cardiac arrest due to an initial nonshockable rhythm	Epinephrine should be given for pulseless cardiac arrest	A very large observational study of cardiac arrest with nonshockable rhythm compared epinephrine given at 1 to 3 minutes with epinephrine given at 3 later time intervals (4 to 6, 7 to 9, and greater than 9 minutes). The study found an association between early administration of epinephrine and increased ROSC, survival to hospital discharge, and neurologically intact survival.

Adult Cardiac Arrest Algorithm—2015 Update

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

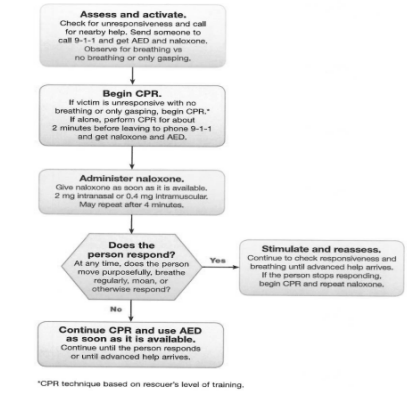
	New	Old	Rationale
Opioid overdose education and naloxone training and Distribution	It is reasonable to provide opioid overdose response education, either alone or coupled with naloxone distribution and training, to persons at risk for opioid overdose (or those living with or in frequent contact with such persons).		

2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

	New	Old	Rationale
	Cardiac Arrest Changes		
Cardiac arrest in patients with known or suspected opioid overdose	Patients with no definite pulse may be in cardiac arrest or may have an undetected weak or slow pulse. These patients should be managed as cardiac arrest patients. Standard resuscitative measures should take priority over naloxone administration, with a focus on high-quality CPR (compressions plus ventilation). It may be reasonable to administer intramuscular (IM) or intranasal (IN) naloxone based on the possibility that the patient is in respiratory arrest, not in cardiac arrest. Responders should not delay access to more-advanced medical services while awaiting the patient's response to naloxone or other interventions.		Naloxone administration has not previously been recommended for first aid providers, non-HCPs, or BLS providers. However, naloxone administration devices intended for use by lay rescuers are now approved and available for use in the United States, and the successful implementation of lay rescuer naloxone programs has been highlighted by the Centers for Disease Control. While it is not expected that naloxone is beneficial in cardiac arrest, whether or not the cause is opioid overdose, it is recognized that it may be difficult to distinguish cardiac arrest from severe respiratory depression in victims of opioid overdose.

Opioid-Associated Life-Threatening Emergency (Adult) Algorithm—New 2015



2015 Training Materials
ACLS Provider Manual and ACLS EP Manual Comparison Chart

American Heart Association. GUIDELINES 2015 CPR & ECC

	New	Old	Rationale
Cardiac arrest in pregnancy: provision of CPR	Priorities for the pregnant woman in cardiac arrest are provision of high-quality CPR and relief of aortocaval compression. If the fundus height is at or above the level of the umbilicus, MANUAL left uterine displacement can be beneficial in relieving aortocaval compression during chest compressions.	To relieve aortocaval compression during chest compressions and optimize the quality of CPR, it is reasonable to perform manual left uterine displacement in the supine position first. If this technique is unsuccessful and an appropriate wedge is readily available, then providers may consider placing the patient in a left lateral tilt of 27° to 30°, using a firm wedge to support the pelvis and thorax.	

longlives

Interventional Neuroradiology Review and PMC Update

PAA Annual Update
October 15, 2016

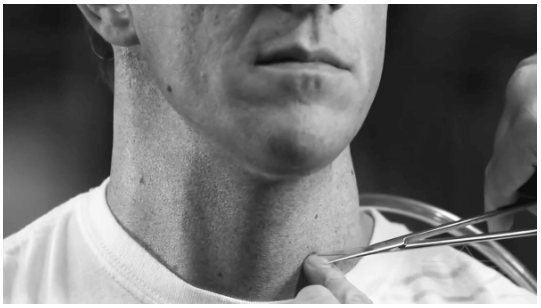
About me

- Staff Anesthesiologist PAA 2007
- Section Chief PMC, since late 2012

- Nothing to Disclose

Intervention Neuroradiology History

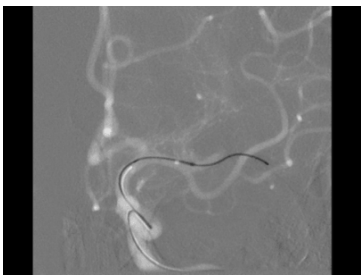
- 1927: First cerebral angiogram
  - Dr. Egas Moniz-
    - Portuguese neurologist
    - Nobel Prize in 1949
- 1953: Seldinger technique
  - Dr. Sven-Ivar Seldinger



Interventional History

- 1980's: largely experimental
- Late 80's - 90's:
  - Digital subtraction angiography
  - Roadmap fluoroscopic imaging
- 1990's-2000's
  - Development microcatheters

Roadmap Flouroscopic Imaging



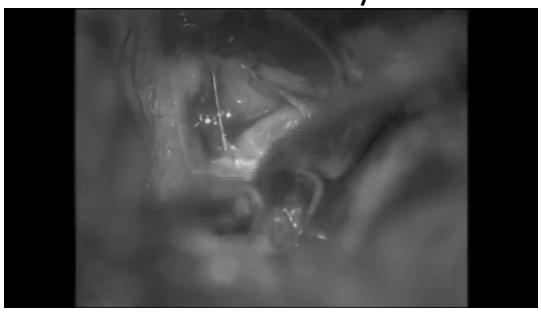
Multidiciplinary

- In 1992, The American Society of Interventional and Therapeutic Neuroradiology
- Transition of neuroradiologist from consultants to active clinicians
- Neurosurgeons have taken a more active role in diagnostic techniques and minimally invasive techniques

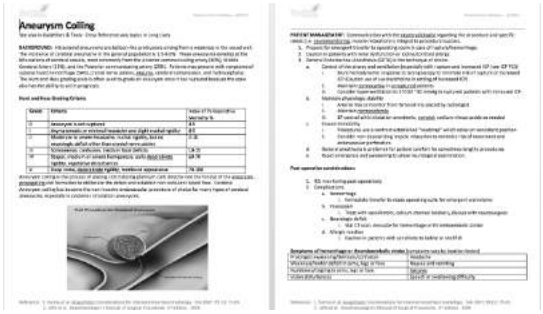
Treatable Conditions & Procedures

- Aneurysm Coiling
- Arteriovenous Malformation
- Stroke (tPA, clot retrieval)
- Stent, Stent graft
- Angioplasty
- Angiography

Cerebral Aneurysm



Anesthetic Considerations



Anesthesia for aneurysm coiling

- GETA, technique of choice
  - Control airway and ventilation
  - Maintain physiologic stability
  - Ensure immobility
  - Rapid awakening
  - Prepare for possible emergent transfer to OR

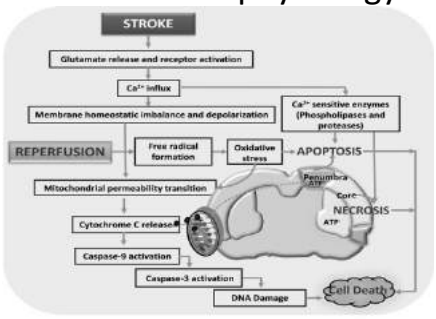
Acute Ischemic Stroke

- 2nd leading cause of death worldwide
- Leading cause of long term disability
- 87% of all strokes are ischemic
  - Decrease perfusion of brain tissue
    - Embolus
    - Thrombus
    - Stenosis
- Treatment Goal → RESTORE PERFUSION!

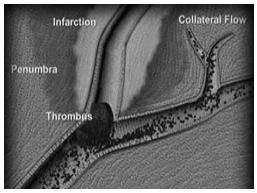
Acute Stroke Treatment

- Restore Perfusion!
- Recombinant tissue plasminogen activator
  - "clot buster"
  - Given within 4.5 hrs of onset of stroke symptoms
- Endovascular therapy
  - Standard of care for large vessel occlusion
  - Endovascular thrombolysis, tPA
  - Endovascular clot retrieval devices

Stroke Pathophysiology



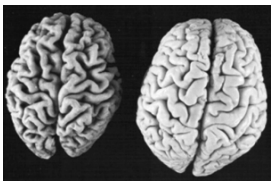
The Ischemic Penumbra



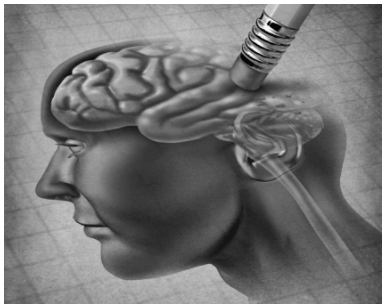
- Collateral flow creates a region of tissue that is mild to moderately ischemic and "at risk"
- Blood flow must be restored promptly to save the tissue in the penumbra.

The Sensitive Brain

- Average stroke loses 1.9 million neurons per min
- Compared to normal aging: the ischemic brain loses 3.6 yrs/hr
- Approx 9000 neurons die each day. Can increase to almost 300,000 with toxins..



Take care of your neurons..



Anesthesia for Acute Ischemic Stroke

- Conscious Sedation
  - Pros
    - Allows for intraprocedure neuro evaluation
    - Smooth, patient driven hemodynamics
    - Potentially faster time to canalization
  - Cons
    - Unprotected Airway
    - Potential for patient movement
    - Patient pain and discomfort

Anesthesia for Acute Ischemic Stroke

- General Anesthesia
  - Pros
    - Patient immobility
    - Airway protection, controlled ventilation
    - Patient comfort and pain control
  - Cons
    - Hemodynamic changes, induction/intubation
    - Aspiration potential, full stomach
    - Possible delayed canalization
    - Unable to evaluate neuro status
    - Anesthetic disruption of autoregulation

What would you choose?

First Do No Harm

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Impact of General Anesthesia on Safety and Outcomes in the Endovascular Arm of Interventional Management of Stroke (IMS) III Trial.

Abou-Chebl A[1], Yeatts SD[2], Yan B[3], Cockroft K[4], Goyal M[5], Jovin T[6], Khatri P[7], Meyers P[8], Spilker J[9], Suga R[2], Wahlenberg KE[2], Tomsick T[2], Broderick J[2], Hill MD[3].

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Schönenberger S[1], Möhlenbruch M[2], Pfaff J[2], Mundiyanapurath S[1], Kieser M[3], Bendszus M[2], Hacke W[1], Bösel J[1].

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Conscious sedation versus general anesthesia during endovascular acute ischemic stroke treatment: a systematic review and meta-analysis.

Bilotta F[1], Murad MH[2], Rabinstein AA[3], Cioni R[4], Lanzino G[4], Kallmes DF[4].

Cerebrovasc Dis. 2014;38(4):252-7. doi: 10.1159/000365216. Epub 2014 Nov 13.

Intra-arterial therapy for acute ischemic stroke under general anesthesia versus monitored anesthesia care.

John S[1], Thebo U, Gomes J, Saggur M, Feng E, Xu J, Wisco D, Uchino K, Hussain MS.

General vs. Sedation

- Several Retrospective / Observational studies
  - GA associated with worse outcome
  - Increase morbidity and mortality
    - More likely to be deceased at discharge, 3mo, 6mo
    - Increased morbidity (worse neurologic outcome)
      - Stroke progression
      - Modified Rankin score
    - Trend held when previously intubated pts excluded
    - Trend also shown when corrected for:
      - Initial stroke severity score
      - Average BP during the procedure

How can this be??

- GA more often selected for ”sicker” patients?
- GA selected when stroke severity is higher?
- Does involving the Anes team delay therapy?
- Is the BP changes during GA detrimental?
- Is the increase in PaO2 detrimental?
  - Reperfusion injury worse?
- MORE STUDIES ARE NEEDED

Help is on the way?

Int J Stroke. 2016 Jul 12. pii: 1747493016656103. [Epub ahead of print]

Anesthetic strategy during endovascular therapy: General anesthesia or conscious sedation? (GOLIATH - General or Local Anesthesia in Intra Arterial Therapy) A single-center randomized trial.

Simonsen CZ[1], Sørensen LH[2], Juul N[3], Johnsen SP[4], Yoo AJ[5], Andersen G[6], Rasmussen M[3].

- Investigator-initiated, single center, randomized study
- Metrics
  - Infarct growth at 48-72 h (by MRI)
  - 90 day modified Rankin Scale score
  - Time parameters
  - Blood pressure variables
  - Use of vasopressors
  - Complications
  - Success of revascularization
  - Radiation dose
  - Amount of contrast media

Novant Press Release

Novant Health adds roughly 30 neurosciences experts and providers

Written by Kelly Gooch | September 20, 2016 | Print | Email

Novant Health Expands Neurosciences Service Line; Adds New Providers

System adds 20 new healthcare providers in Charlotte; eight new healthcare providers in Winston-Salem with more to come.

Novant Health Expands Neurosciences Service Line; Adds New Providers

Posted: Sep 22, 2016 7:36 AM EDT

Novant Neurosciences

» Dr. Eric Eskioglu

NOVANT HEALTH
Making healthcare remarkable

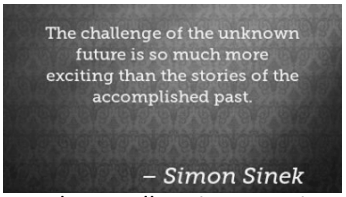
- Novant has made a significant investment in advancing the Neurosciences
- Novant Forsyth: Advanced Comprehensive Stroke Center
- Novant PMC Charlotte: Primary Stroke Center
  - Goal to become Advanced Comprehesive Stroke Center
  - Establishing team of Interventional Neurosurgeons, Neurointensivists, Neurologists, Advance Practice Nurses

New Providers

Greater Charlotte

- Dr. Joshua Billingsley, neurosurgeon at Novant Health Neurosurgery Specialists
- Dr. Ziad Hage, neurosurgeon at Novant Health Neurosurgery Specialists
- Dr. Jenny Ching, neurosurgeon at Novant Health Neurosurgery Specialists
- Dr. Laurie McWilliams, neuro-intensivist and neurology ICU medical director at Novant Health Presbyterian Medical Center
- Dr. Kevin Meier, neuro-intensivist at Novant Health Presbyterian Medical Center
- Dr. Quaiser Tapper, neuro-hospitalist at Novant Health Presbyterian Medical Center
- Dr. Jason Edgecombe, neuro-hospitalist at Novant Health Presbyterian Medical Center
- Dr. Ali Turk, neuro-hospitalist at Novant Health Presbyterian Medical Center
- Dr. C. Edward Robles, neurologist and physical medicine/rehabilitation specialist at Novant Health Northlake Neurology
- Dr. James Sattiraju, outpatient neurologist and movement disorder specialist/Parkinson's disease at Novant Health Neurology Specialists
- Dr. Matthew "Max" Conraro, outpatient neurologist and multiple sclerosis specialist at Novant Health Neurology Specialists
- Dr. Deepika Shengula, outpatient neurologist at Novant Health Neurosurgery Specialists
- Dr. Elshita Arhebamen, outpatient neurologist at Novant Health Neurology Specialists
- Ana Messler, PhD, neuro-psychologist, Novant Health Neurology Specialists
- Lynne Campbell, lead neurology ICU advanced nurse practitioner at Novant Health Presbyterian Medical Center
- Erica Ayerimon, neurology ICU advanced nurse practitioner at Novant Health Presbyterian Medical Center
- Natalie Hall, neurology ICU advanced nurse practitioner Stroke Bridge Clinic at Novant Health Presbyterian Medical Center
- Katherine McClure, neurosurgery advanced practice clinician at Novant Health Neurosurgery Specialists
- Sharon Walter, physician assistant at Novant Health Neurology Specialists

Future Direction

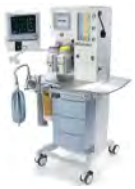


- Adding to the excellent interventional neuroradiologist team
- Novant positioned well to provide the best care for a variety of neurological disorders

Thank You!!

Ventilation

Kristin Washburn



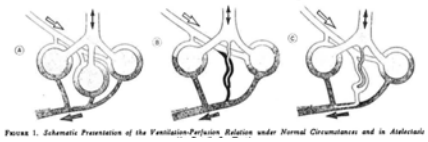
Goals of talk

historical approach to ventilation
changes in ventilation strategy in the ICU
- lung protective ventilation
- ARDS

mechanical ventilation in the OR
overview of ventilator modes
post operative care of CABG patients at Novant

Historical approach to ventilation

progressive decrease in compliance during ventilation causes atelectasis/shunt and therefore higher pressures/ volumes are needed to open collapsed airspaces



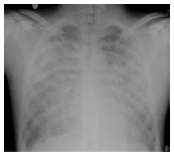
Historical approach to ventilation

1963 a study by Bendixen et al. found that ventilation with tidal volumes >10cc/kg improved oxygenation and prevented atelectasis
Tidal volumes >10cc/kg became the gold standard

Acute Respiratory Distress Syndrome

Definition
- acute onset of respiratory failure
- bilateral infiltrates on chest xray (non cardiogenic pulmonary edema)
- hypoxemia PaO2/FiO2 ratio <= 200mmHg

mortality rate 40-50%



Intensive Care Unit- ARDS

1998- origin of lung protective ventilation strategy in patients with ARDS
- low tidal volumes 6cc/kg as compared with 12cc/kg in conventional group
- use of PEEP to avoid alveolar collapse
- minimize shear stress in lung tissue during inspiration
- study was stopped early due to significant improvement in survival at 28 days 38% versus 71% and ventilator weaning 66% versus 29% (no difference in overall survival)

Evolution of the vent management in ARDS

2000 large multi center randomized trial of 861 patients was discontinued due to 22% reduction in mortality in lung protective ventilation

- conventional ventilation 12cc/kg - keeping plateau pressure <50 cm H2O
- lung protective ventilation 6cc/kg- keeping plateau pressure <30 cm H2O

anatomy and physiology of ventilator induced lung injury

Lung structure composed of elastin fibers and collagen tissue

- elastin fibers are easily distended and stretched by more than 100% but collagen is much more rigid
- collagen maximally unfolded at total lung capacity, distention beyond that point results in barotrauma or strain

tidal volume of 10cc/kg with a very low end expiratory lung volume can cause an 140% increase in strain, decreasing to 6cc/kg reduces strain to 84% in diseased lung

anatomy and physiology of ventilator induced lung injury

when lung units collapse at end expiration there is more stress associated with reopening them at the next inspiration because the surface bearing the force is diminished (stress=force/area) causing atelectrauma or shear stress

anatomy and physiology of ventilator induced lung injury

stress/strain results in biochemical activation of intracellular pathways occurs causing an inflammatory reaction to unphysiological stress/strain- extracellular matrix may undergo remodeling, cytokines released, white cells recruited

Clinical relevance in application of lung protective ventilation strategies in the OR

low tidal volume
PEEP
Lung recruitment maneuvers

Postoperative pulmonary complications

Postoperative pulmonary complications: respiratory failure, lung injury, pneumonia, prolonged or unplanned mechanical ventilation or intubation, hypoxemia, atelectasis, bronchospasm, pleural effusions, pneumothorax, ventilatory depression, and aspiration pneumonitis. within 5-7 days of surgery
5% of patients will develop a PPC following surgery and one in 5 patients who develop a PPC will die within 30 days of surgery

Low tidal volume

meta analysis published in july 2015 in Anesthesiology showed that protective ventilation with tidal volumes <8cc/kg were associated with less postoperative pulmonary complication (postoperative lung injury, pulmonary infection, or barotrauma) as compared with conventional ventilation >8cc/kg, RR 0.64 (0.46-0.88)

High peep vs low peep

PEEP minimizes cyclical alveolar collapse and corresponding sheer injury
Closing capacity is around 7cm H2O in a healthy adult with normal BMI therefore it has been suggested that this may be the optimal level of PEEP to prevent atelectasis there has not been support for lung protection with high peep values (only benefit has been in ARDS patients) because it does not reduce incidence of PPC and is associated with increased pressor requirement (decrease in preload)

Lung recruitment maneuvers

application of increase in airway pressure in the 40-50cm H2O range reduces atelectasis and improves lung compliance for a short period of time, PEEP may be needed to prevent re accumulation of atelectasis

Vent mode

Volume control
- mandatory
- no patient synchrony, risk of pressure injury

Pressure control
PRVC
SIMV
PS

CVRU vent weaning

Difficulty weaning post op routine CABG patients from the vent. Patient's were either agitated or over sedated and not breathing requiring prolonged ventilation.
ventilation mode: PRVC with transition to PS for a breathing trial prior to extubation
sedation: propofol with prn pain medications
Dr Shook and I identified patient in the OR who would be good candidates for a rapid wean of the vent. Straight forward CABG patients with limited co morbidities.

CVRU vent weaning

CABG Vent Times	Q115	Q215	Q315	Q415	Q116	Q216	STS
% Prolonged Ventilation (ventilated greater than/=24h post-op measured from OR exit, includes any reintubations) Goal < 8%	**11.1**	**11.1**	**7.7**	**4.4**	**6.3**	**5.3**	8.0
n/d	5/45	5/45	4/52	2/45	2/32	3/57	
% Extubatated </=6h (extubated in </= to 6 hours post-op, measured from OR exit) Goal > 51.2%	**42.2**	**42.2**	**42.3**	**33.3**	**53.1**	**64.9**	51.2
n/d	19/45	19/45	22/52	12/45	17/32	37/57	

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Thank you

Questions?