# *Emergency Airway Management: The Four Drugs That Matter*

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**Assistant Professor Emergency Medicine**
**Trauma Team Leader**
**Airway Nerd**

# *Disclosures, Confessions and General Warnings*

AIME

For Airway Success

EHS Nova Scotia Trauma Program

Emergency Health Services

ATLS™

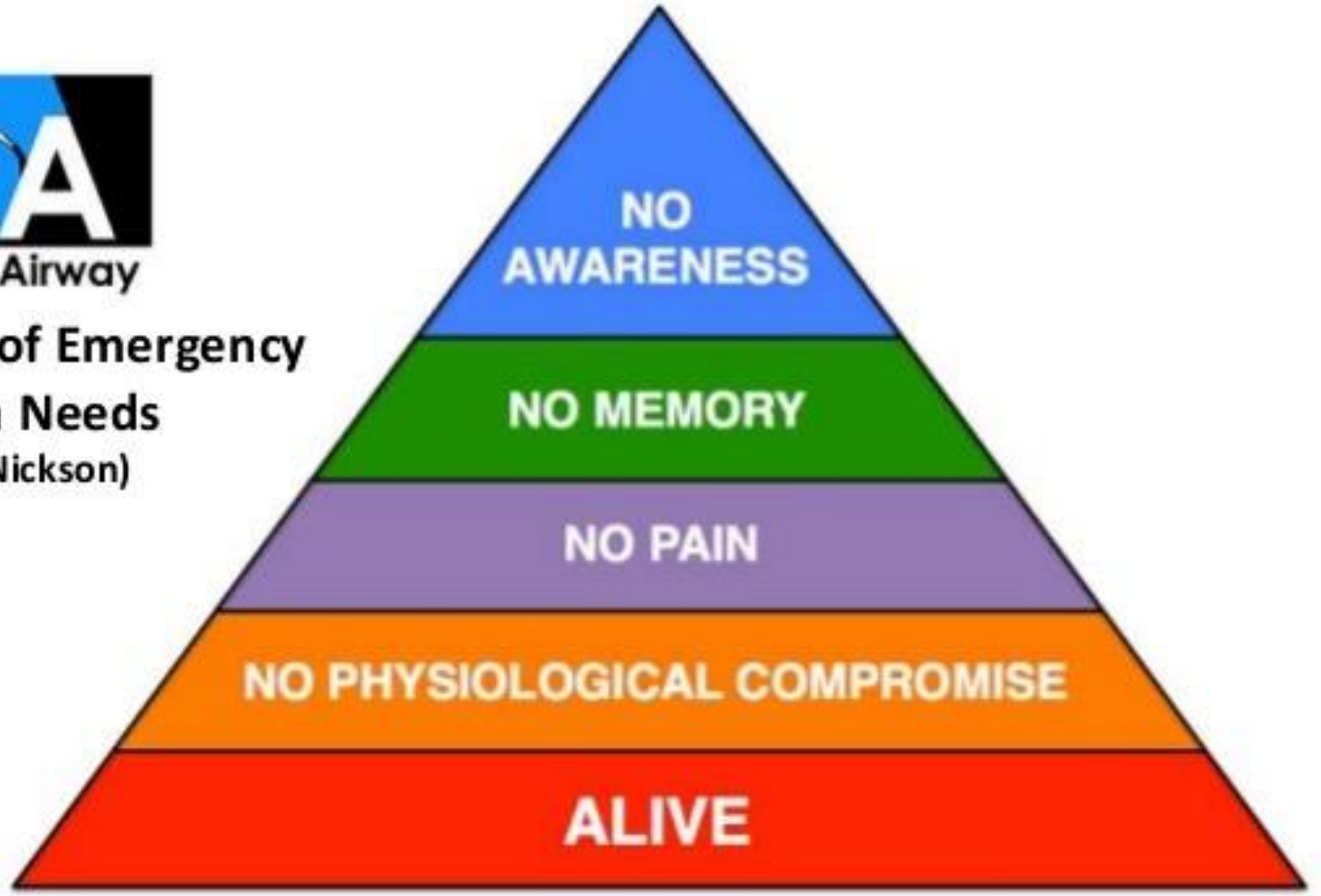
ADVANCED TRAUMA LIFE SUPPORT

# BELIEFS

Critically Ill Airway

# Hierarchy of Emergency Intubation Needs

(Weingart & Nickson)



Airway Management/RSI Priorities (In Order):

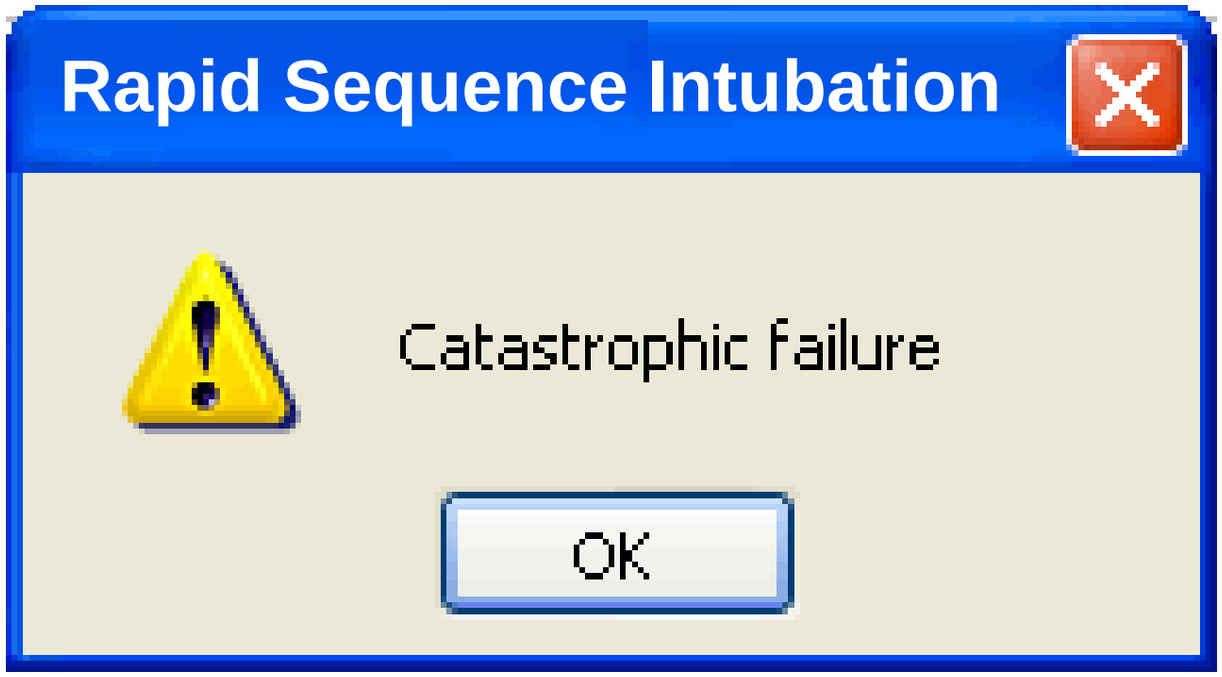
1. Save their life

2. Prevent complications (iatrogenic)

3. Improve patient’s experience (analgesia and amnesia)

Intubation in the critically ill Emergency Department patient is difficult until proven otherwise

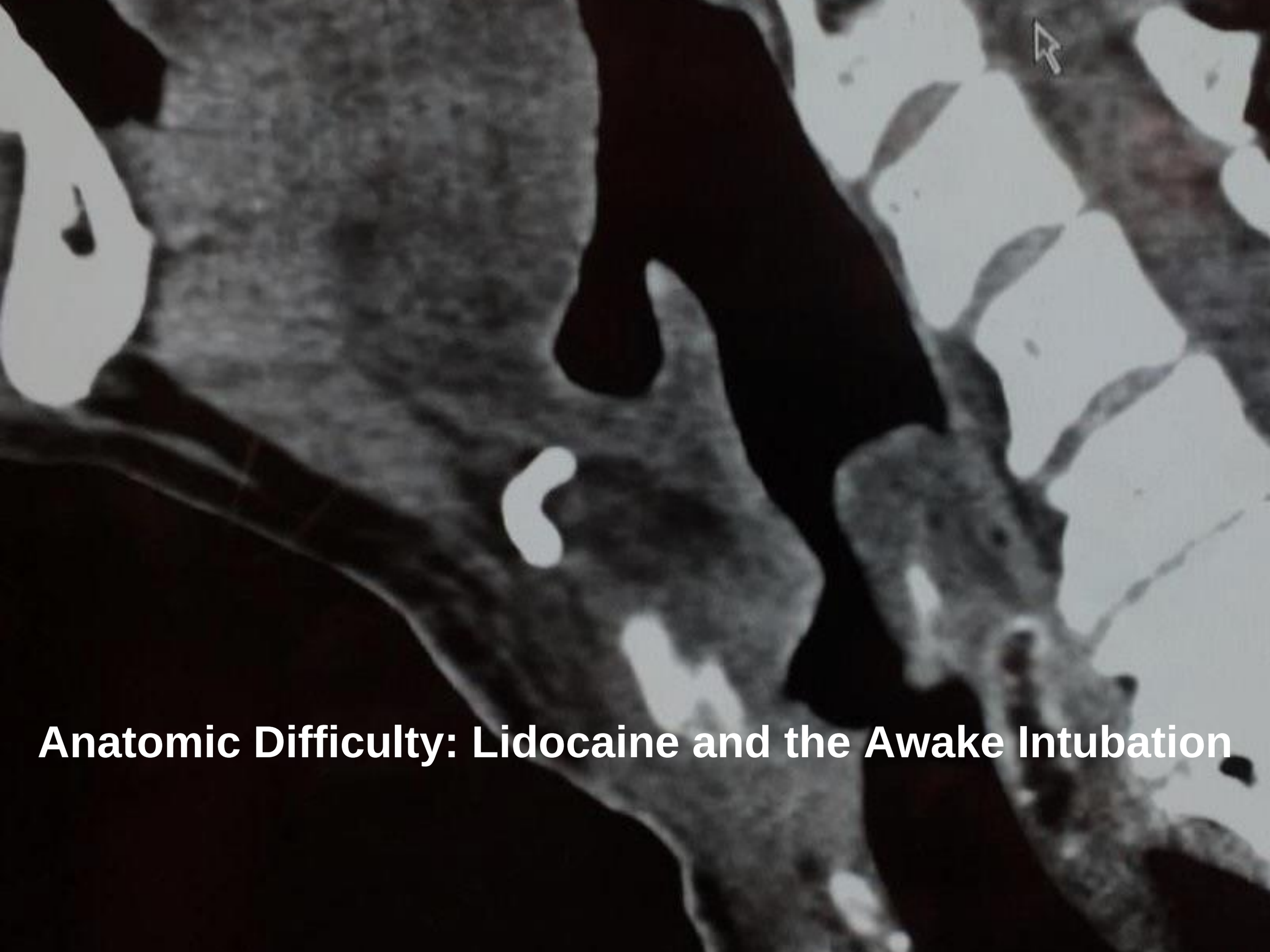
*Not recognizing and anticipating difficulty…*



# The Four Drugs That Matter

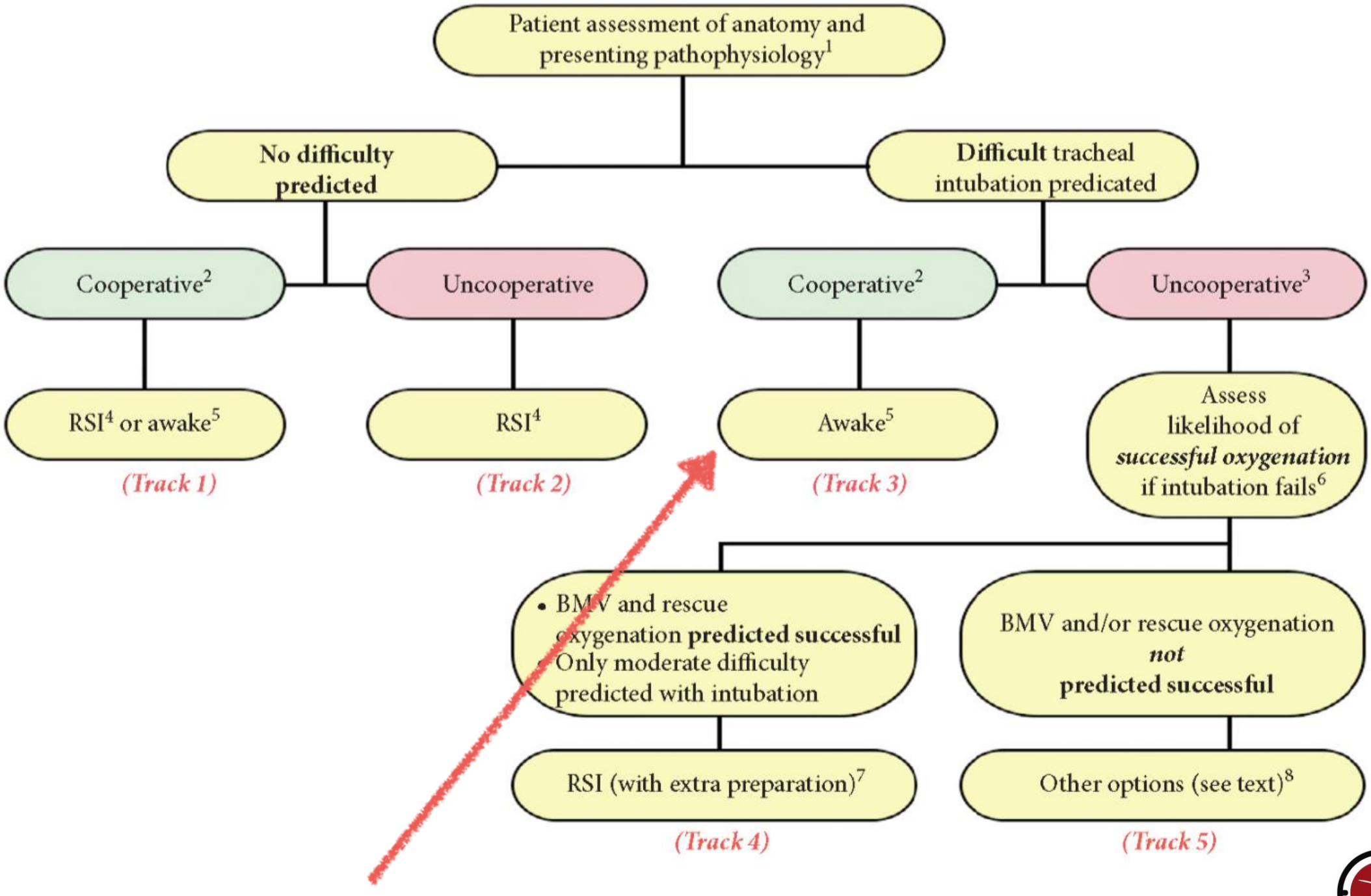

*Anatomic Difficulty*
*Agitated/Behaviourly Difficult*
*Physiologically Difficult*
*Unanticipated Difficulty*

***Lidocaine***
***Ketamine***
***Norepinephrine***
***Roccuronium***



# Anatomic Difficulty: Lidocaine and the Awake Intubation

# Algorithm 1
# Approach to Tracheal Intubation.




*'this looks bad but I have some time…'*

AIME
For Airway Success

Can J Anesth/J Can Anesth (2015) 62:736–744
DOI 10.1007/s12630-015-0387-y

REPORTS OF ORIGINAL INVESTIGATIONS

# The incidence, success rate, and complications of awake tracheal intubation in 1,554 patients over 12 years: an historical cohort study

# Incidence, taux de réussite et complications de l'intubation trachéale chez 1554 patients éveillés sur une période de 12 ans: une étude de cohorte historique

**J. Adam Law, MD · Ian R. Morris, MD · Paul A. Brousseau, BEd · Sylvia de la Ronde, MSc · Andrew D. Milne, MD**

1554 patients awake intubation in
operating room setting
success rate 98%
very low complication rates

# *It does take some time…*

Anesthesiology, V 125 • No 1
July 2016

## A Retrospective Study of Success, Failure, and Time Needed to Perform Awake Intubation

Thomas T. Joseph, M.D., Ph.D., Jonathan S. Gal, M.D., Samuel DeMaria, Jr., M.D., Hung-Mo Lin, Ph.D., Adam I. Levine, M.D., Jaime B. Hyman, M.D.

1085 awake intubations in the operating room

average total time to intubation 24 minutes

*Anecdotally in our ED = ~15min*


F 4
E 1
A 1
R 1

# *Lidocaine Toxicity*

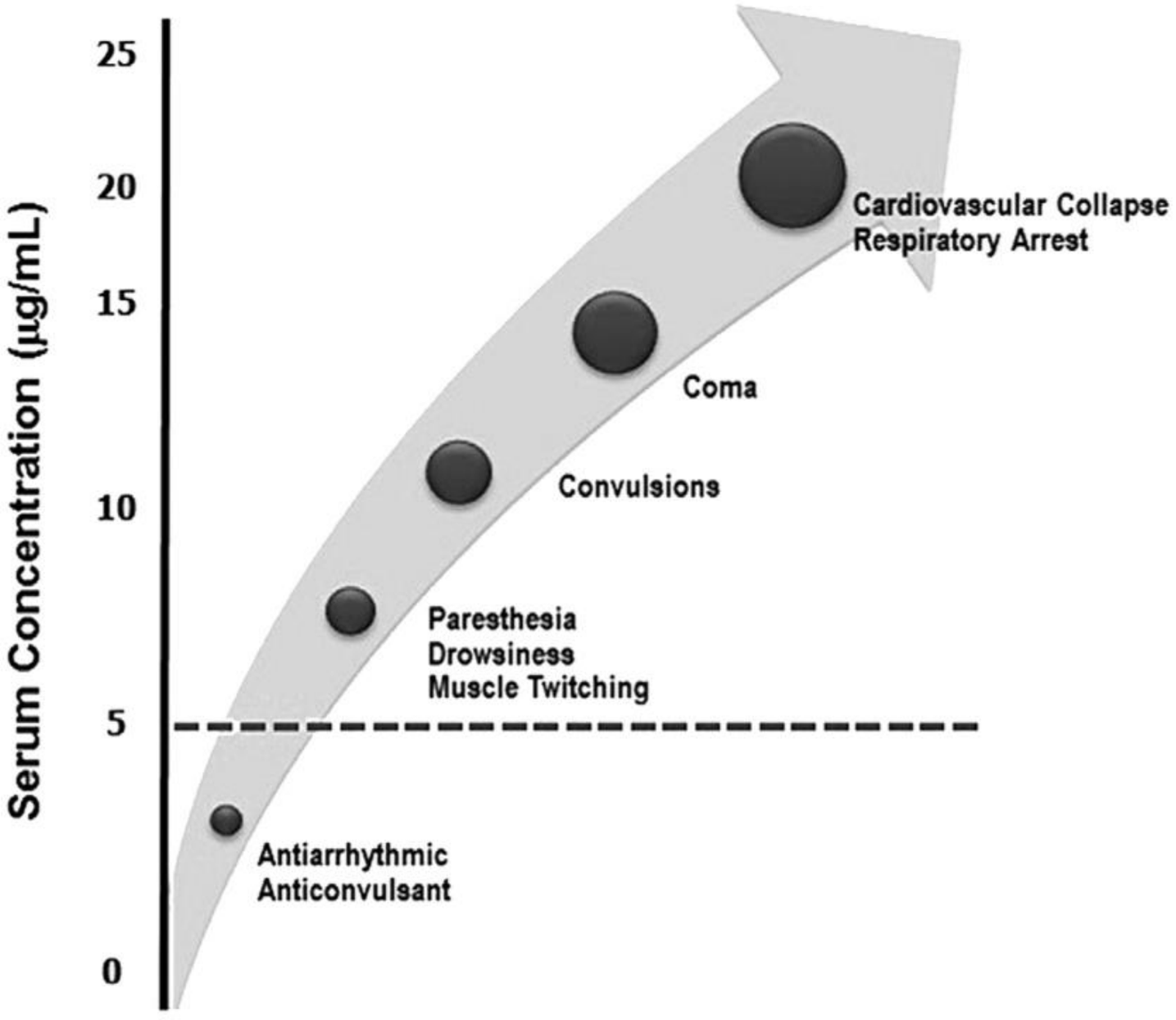



**Fig. 11.** The types of complications that can occur when local anesthetics are administered in toxic concentrations. In the case of lidocaine, toxicity may occur at blood concentrations exceeding 5 µg/mL. (*From* Becker DE, Reed KL. Local anesthetics: review of pharmacological considerations. Anesth Prog 2012;59(2):90–101; with permission).

AMERICAN JOURNAL OF OTOLARYNGOLOGY–HEAD AND NECK MEDICINE AND SURGERY 35 (2014) 62–65

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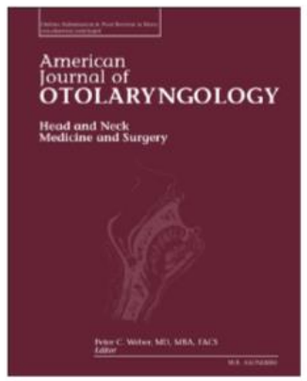



# Neurologic toxicity of lidocaine during awake intubation in a patient with tongue base abscess. Case report☆

*Davide Giordano, MD*[a,*], *Alessandro Panini, MD*[b], *Carmine Pernice, MD*[a], *Maria Gabriella Raso, MD*[c], *Verter Barbieri, MD*[a]

planned. The patient received an anesthetic premedication with midazolam 4 mg IM immediately before surgery. Then, local anesthesia of the nasal fossae, hypopharynx, and larynx was achieved with lidocaine 10 mg/ml, 1% solution (three gargles with about 5–6 ml in total). The estimated total dose of lidocaine was about 200 mg. Twenty minutes after starting this procedure, the patient had psychomotor agitation, rapidly progressing to generalized tonic–clonic seizures and loss of consciousness. Repeated IV bolus doses of midazolam (4 mg total) were administered in order to control seizures and ventilation was assisted by bag–valve–mask ventilation. The

***Looking for guidence…***

*Thorax* 2013;**68**:i1–i44.

**BTS guidelines**

# British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults

I A Du Rand,[1] J Blaikley,[2] R Booton,[3] N Chaudhuri,[4] V Gupta,[2] S Khalid,[5] S Mandal,[6] J Martin,[4] J Mills,[7] N Navani,[8] N M Rahman,[9] J M Wrightson,[9] M Munavvar,[7] on behalf of the British Thoracic Society Bronchoscopy Guideline Group

2001 Guidelines: 8mg/kg

2013 Guidelines: ‘the lowest dose sufficient to facilitate…’

CHEST / 117 / 4 / APRIL, 2000

# Serum Lidocaine Concentrations in Asthmatics Undergoing Research Bronchoscopy*

*Esther L. Langmack, MD; Richard J. Martin, MD, FCCP; Juno Pak, BS; and Monica Kraft, MD, FCCP*

51 asthmatic patients undergoing bronchoscopy

**Table 2—*Amount of Lidocaine Administered**

| Procedure | Lidocaine, mg | Lidocaine, mg/kg |
|---|---|---|
| 4% lidocaine (before bronchoscopy) | 434 ± 97 | 5.9 ± 1.8 |
| 1% lidocaine (during bronchoscopy) | 165 ± 69 | 2.2 ± 0.8 |
| Total | 600 ± 122 | 8.2 ± 2.0 |
| Range | 320–880 | 4.3–14.3 |

*Values given as mean ± SD.

*J Bronchol* • Volume 15, Number 1, January 2008

ORIGINAL INVESTIGATION

# Safety of High Dose Lidocaine in Flexible Bronchoscopy

*William C. Frey, MD, Ethan E. Emmons, MD, and Michael J. Morris, MD*

154 patients undergoing bronchoscopy in pulmonology clinic

Total lidocaine dose, mean serum lidocaine levels, and mean blood MetHb levels for the overall group are shown in Table 1. The mean lidocaine dose was 1.17 ± 0.20 g (range, 0.80 to 1.60 g). When adjusted for body weight, the mean lidocaine dose was 15.4 ± 4.5 mg/kg (range, 7.1 to 32.5 mg/kg). The mean length of time until blood was drawn for lidocaine and MetHb levels was 51.1 ± 11.8 minutes (range, 23 to 135 min). Mean serum lidocaine levels were 1.55 ± 0.67 µg/mL with peak level of 5.1 µg/mL. Only 1 patient had a serum lidocaine level

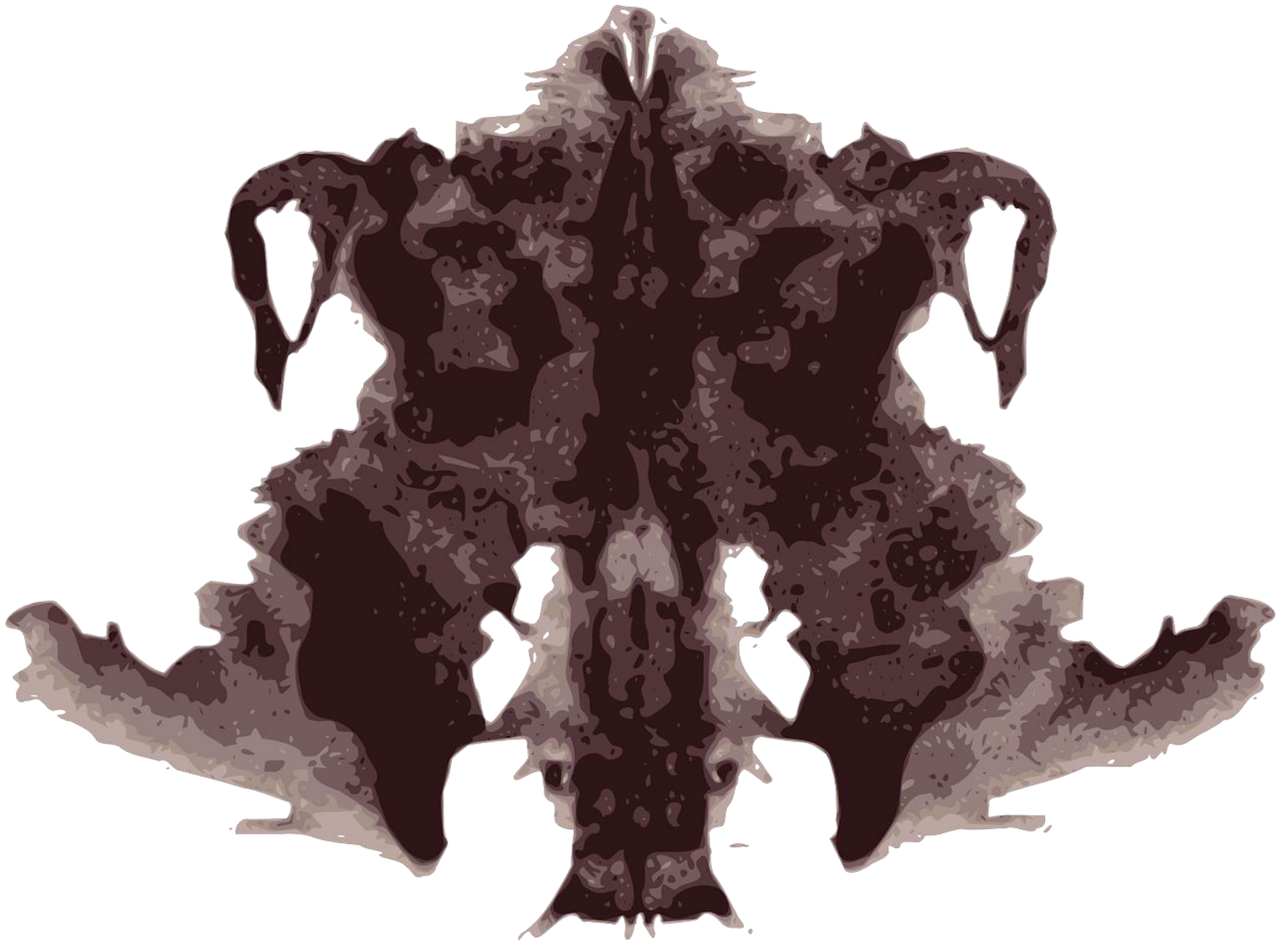
**TABLE 4.** Lidocaine Levels After FB

| Study | Year | N | Mean Age (y) | Lidocaine Dose | Mean Peak Level (µg/mL) | Peak Time (min) | Max Level (µg/mL) |
|---|---|---|---|---|---|---|---|
| Patterson et al[15] | 1975 | 21 | NR | 280 mg | 1.9 | 26 | 18.2 |
| Karvonen et al[16] | 1976 | 15 | NR | 400 mg | 1.07 | 10 | 2.86 |
| Boye and Bredesen[17] | 1979 | 9 | 63 | NR | 2.7 | NR | 4.4 |
| Le Lorier et al[18] | 1979 | 12 | NR | 600 mg | NR | 60 | 3.79 |
| Korttila et al[19] | 1981 | 20 | 53 | 439 mg | 0.53 | 15 | 2.54 |
| | | 20 | 53 | 462 mg | 0.89 | 5 | 1.17 |
| Efthimiou et al[20] | 1982 | 41 | NR | 9.3 mg/kg | 2.9 | 45 | 5.0 |
| Jones et al[21] | 1982 | 19 | NR | 294 mg | 1.54 | 60 | 3.34 |
| Gomez et al[22] | 1983 | 29 | NR | 290 mg | 1.21 | 45 | NR |
| McBurney et al[23] | 1984 | 10 | 63 | 1.8 mg | 0.66 | 38 | 0.87 |
| | | 10 | 63 | 200 mg | 1.54 | 55 | 4.03 |
| Smith et al[11] | 1985 | 9 | 63.8 | 335 mg | 2.7 | 30 | NR |
| | | 9 | 64 | 315 mg | 1.58 | 30 | NR |
| Sutherland et al[9] | 1985 | 11 | NR | 513 mg | 2.3 | NR | NR |
| | | 21 | NR | 370 mg | 2 | NR | NR |
| Ameer et al[6] | 1989 | 14 | 66.6 | 27.1 mg/kg | 2.4 | 45 | 3.5 |
| | | 5 | 41.6 | 19.0 mg/kg | 3.04 | 45 | 4.75 |
| Berger et al[24] | 1989 | 8 | 62 | 2086 mg | 2.7 | 30 | 5.5 |
| Amitai et al[25] | 1990 | 15 | 2.5 | 5.7 mg/kg | 2.5 | NR | NR |
| Gjonaj et al[7] | 1997 | 10 | 4.67 | 5.08 mg/kg | 0.59 | 20 | 1.13 |
| | | 10 | 2.19 | 10.13 mg/kg | 1.17 | 20 | 2.27 |
| Milman et al[13] | 1998 | 16 | 63 | 5.2 mg/kg | NR | 20 | NR |
| Langmack et al[4] | 2000 | 48 | 33.5 | 8.2 mg/kg | 1.29 | 60 | 3.2 |
| Loukides et al[26] | 2000 | 12 | NR | 622 mg | 2.14 | 25 | 2.25 |
| Mainland et al[27] | 2001 | 33 | 60 | 5.77 mg/kg | 2.78 | NR | 6.28 |
| Sucena et al[8] | 2004 | 30 | NR | 11.6 mg/kg | 3.3 | 30 | NR |
| Total | | 457 | 47.4 ± 23.7 | 488 ± 463 mg, 9.7 ± 5.0 mg/kg | 1.89 ± 0.84 | 33 ± 16 | 4.2 ± 3.8 |
| Current study | 2007 | 154 | 64.3 ± 13.7 | 1170 ± 200 mg, 15.4 ± 4.5 mg/kg | 1.55 ± 0.67 | 51 ± 12 | 5.1 |

Data for totals are reported as mean ± SD.

**Literature is markedly hetergenious**

**Five studies doses 9-19mg/kg w/o complications**



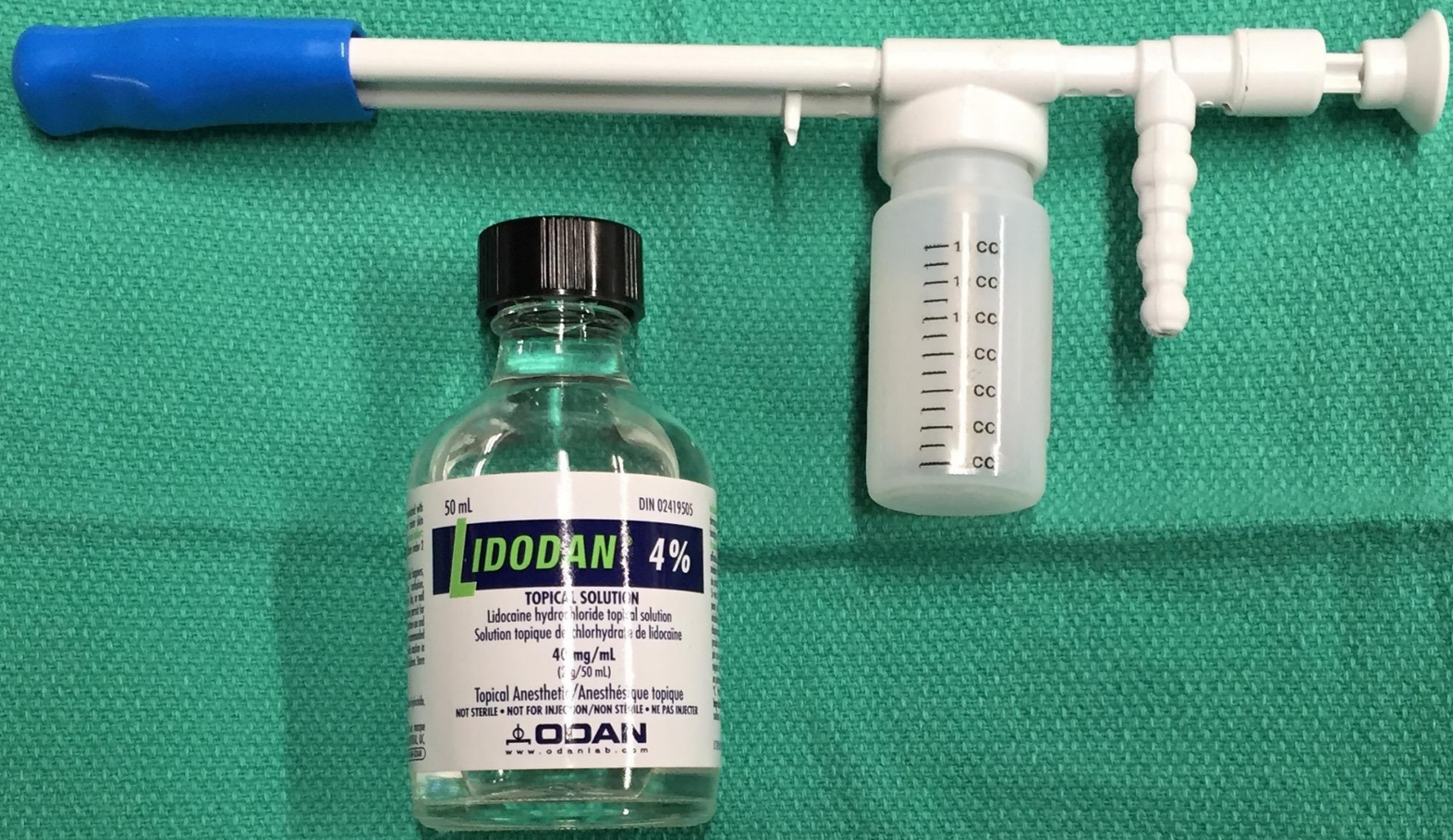
*“So how do I use this on my next shift?”*

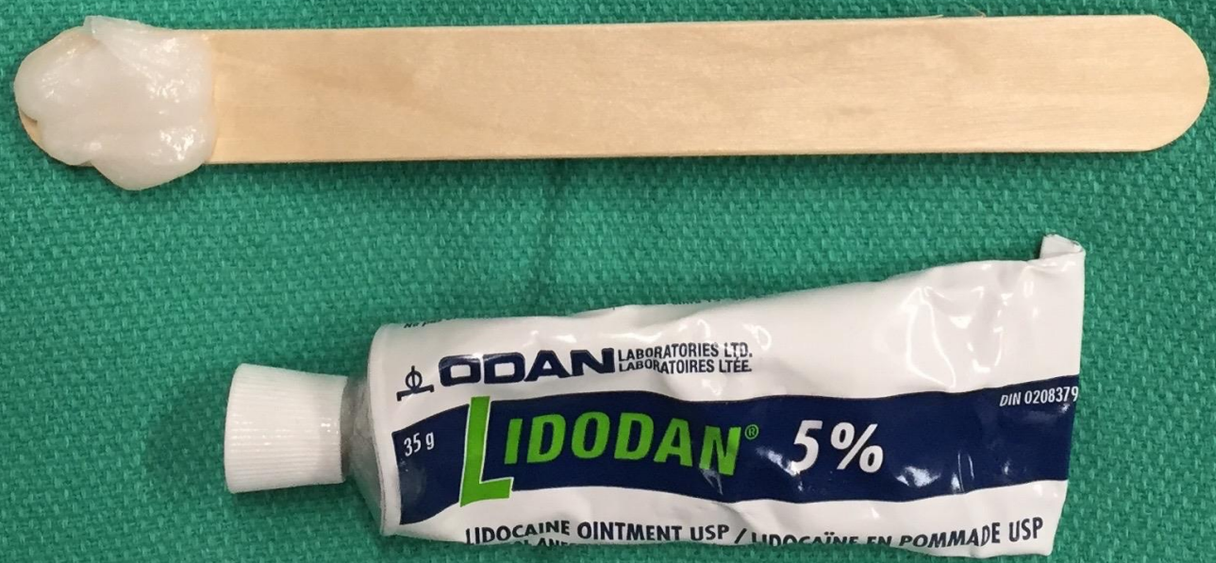
Maximum dose of 5-8mg/kg is likely quite safe

Closely monitor patients for signs of toxicity

Have a protocol for management of toxicity

***An example from my practice…***


1 cc
1 cc
1 cc
cc
cc
cc
cc
50 mL
DIN 02419505
LIDODAN 4%
TOPICAL SOLUTION
Lidocaine hydrochloride topical solution
Solution topique de chlorhydrate de lidocaine
40 mg/mL
(2 g/50 mL)
Topical Anesthetic / Anesthésique topique
NOT STERILE • NOT FOR INJECTION/NON STERILE • NE PAS INJECTER
ODAN
www.odanlab.com


ODAN LABORATORIES LTD.
LABORATOIRES LTÉE.
35 g
LIDODAN® 5%
DIN 02083795
LIDOCAINE OINTMENT USP / LIDOCAÏNE EN POMMADE USP

5% = 50mg/cc

1-2cc

50-100mg


4% = 40mg/cc

8-10cc

320-400mg



Press plunger on inhalation

8L/min


**10% = 10mg/cc**

**12mg/spray**

**Very difficult to reach structures beyond the posterior pharynx**

320-400mg

50-100mg

500mg

hieved not necessarily with a large dose of lidocaine but rather th

***Precision > Dose***

*(Dr. G. Kovacs, with permission)*

# take-home points

Awake intubations with Lidocaine are a safe and effective practice in the Emergency Department

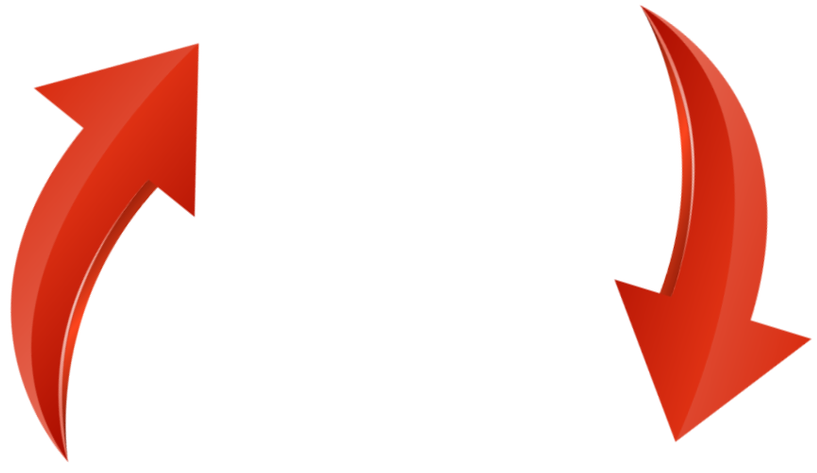
Practise and improved technique may result is lower does of lidocaine being required

Rare complication of Lidocaine toxicity
- vs -
Real complication of a failed airway?

# Behavioural Difficulty and Agitation: Ketamine and Facilitated Pre-Oxygenation

equently agitated; sometimes preventing effective resuscitation, i

Agitated



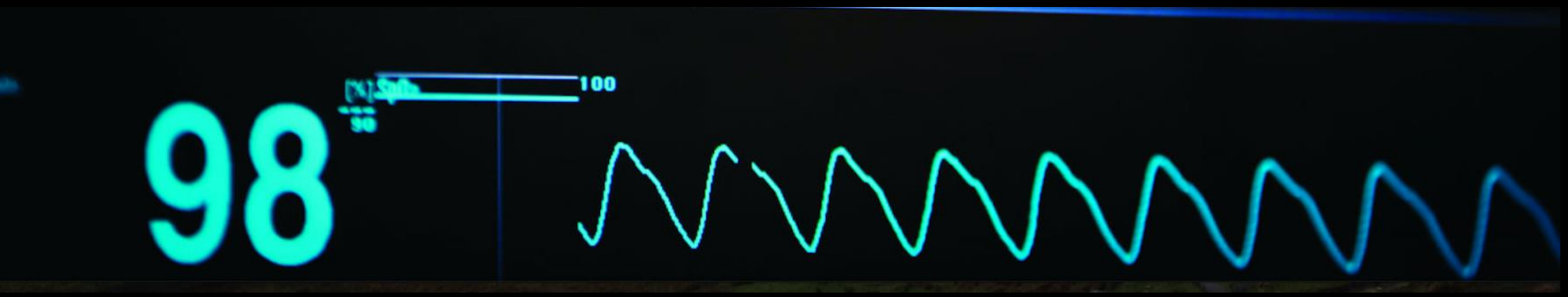
Hypoxemic

Tendancy to skip pre-oxygneation or move forward with pre-oxygenation incomplete

To just ‘put them down, get the tube and move on’

$$\text{Safe Apneic Time} = \frac{\text{Volume Oxygen Reserve}}{\text{Rate of Oxygen Consumption}}$$

Typically we pre-oxygenate to an O2 Sat 100%

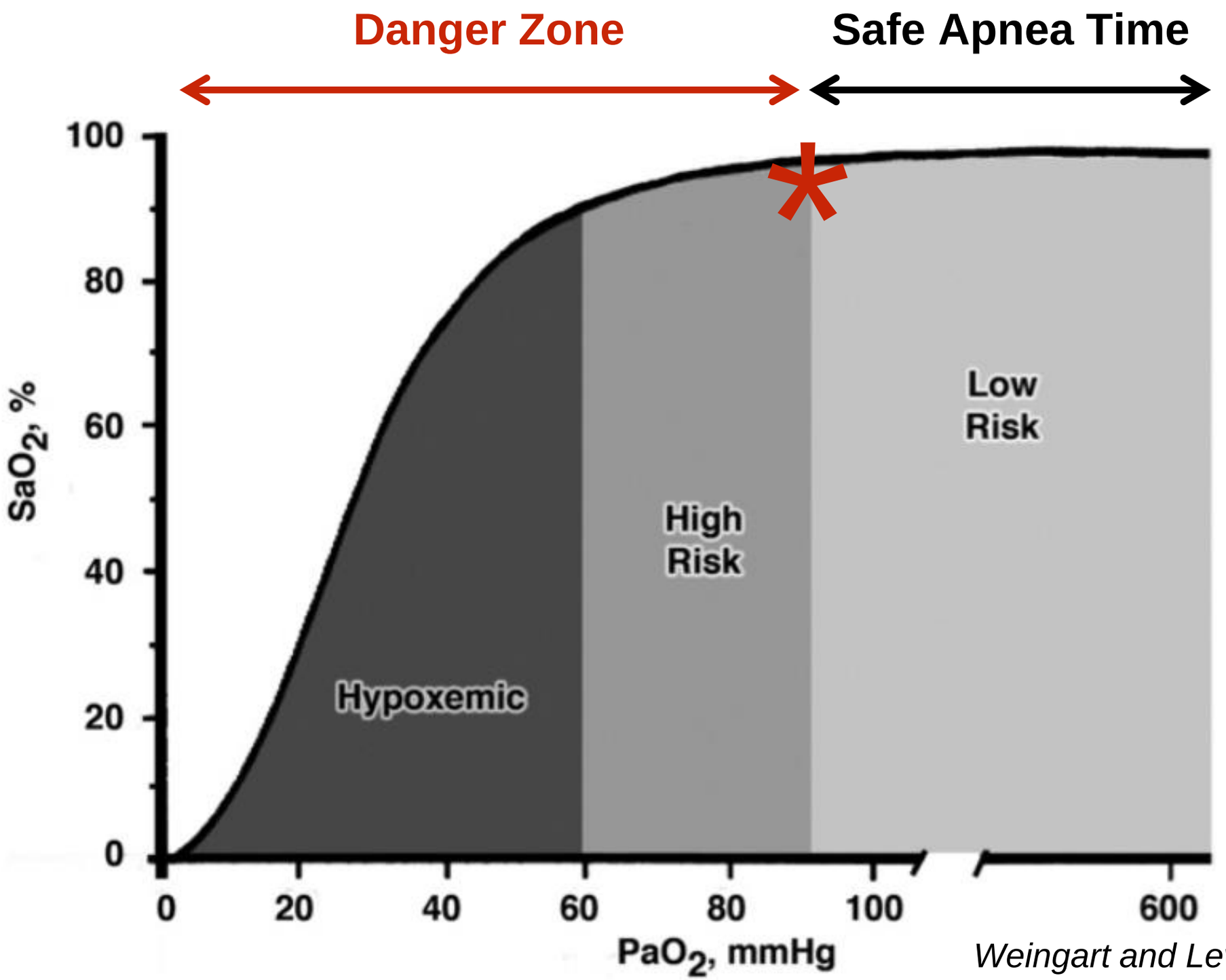



*O2 Saturation really just tells us the percentage of hemoglobin currently bound to oxygen*

Oxygen Saturation ≠ Safe Apnea Time

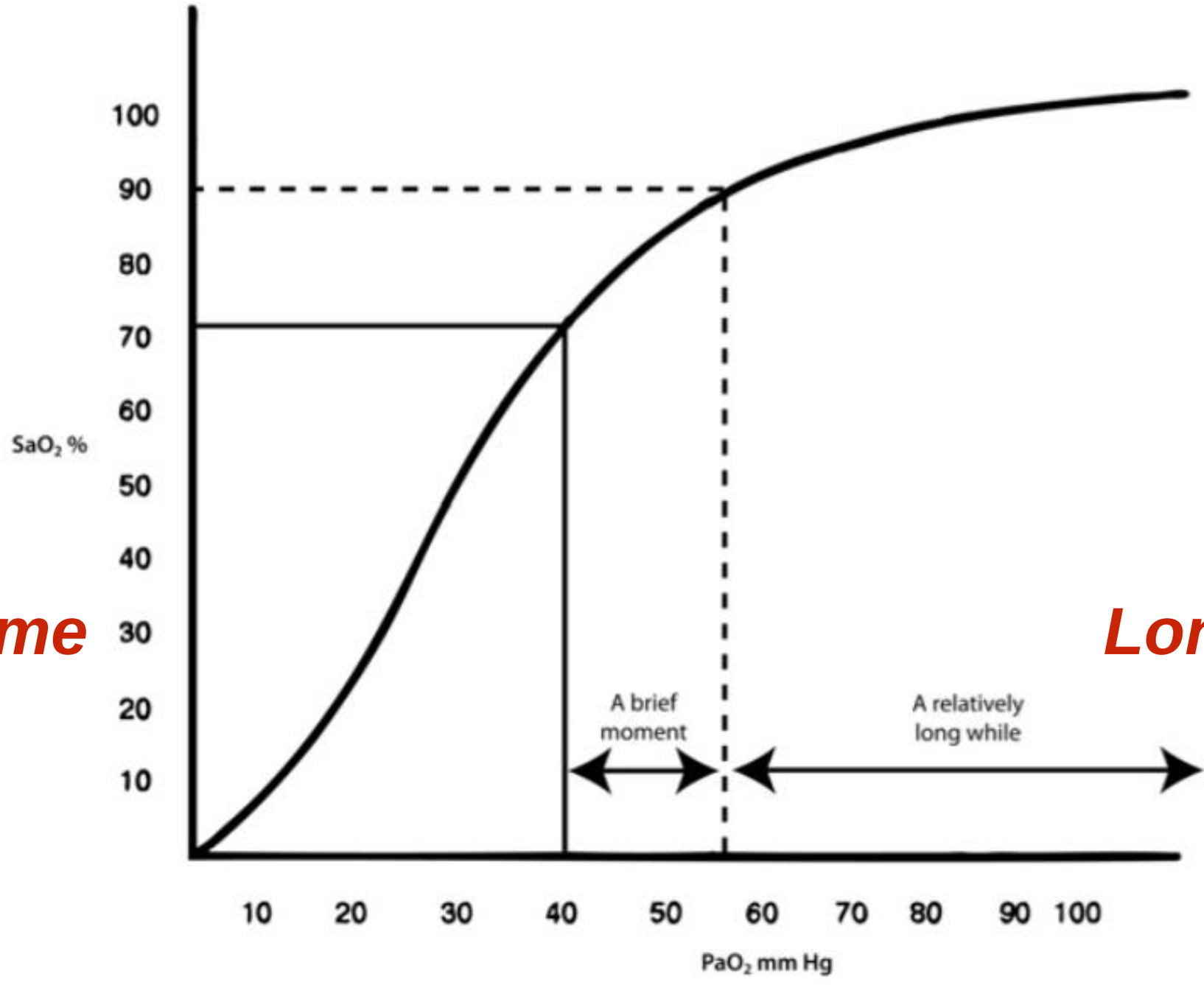
Oxygen Saturation tells us when we are in trouble but shouldn’t necessarily reassure us that we’re fine

# Risk Stratifying O2 Saturations



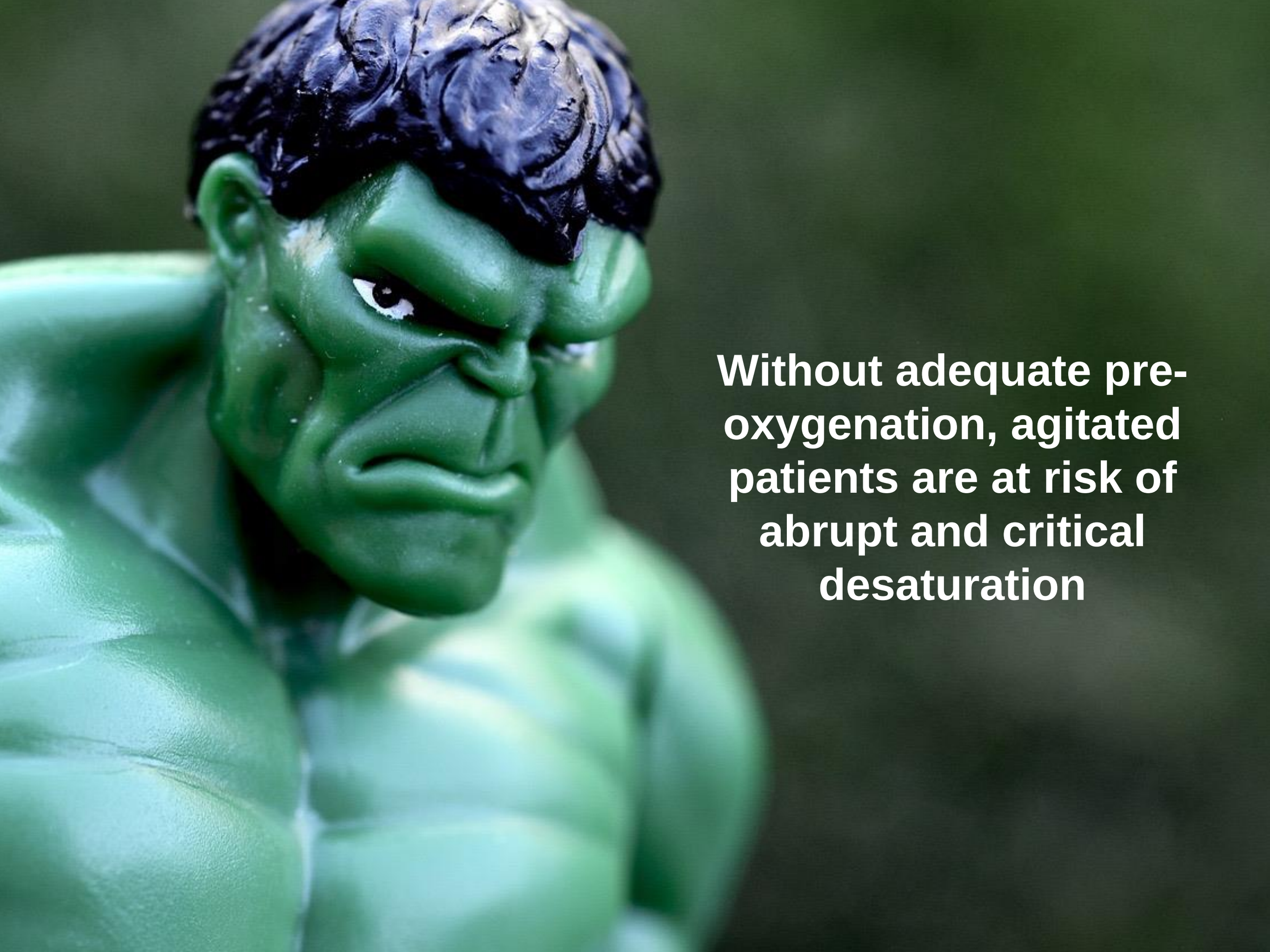

*Weingart and Levitan, 2012*

90%




*Short Time* *Long Time*

**Figure 2. Oxyhemoglobin dissociation curve. The shape of the curve demonstrates that at 90% saturation, the patient is at risk of critically low oxygen levels (< 40 mm Hg $PaO_2$) if even a brief period of time elapses without reoxygenation. Patients will take a much longer time to desaturate from 100% to 90% than to go from 90% to 70%.**


Without adequate pre-oxygenation, agitated patients are at risk of abrupt and critical desaturation

Increasingly we recognize that pre-oxygenation is a procedure and like many procedures in Emergency Medicine it may require appropriate sedation

Delayed Sequence Intubation (DSI)

Facilitated Oxygenation

Annals *of* Emergency Medicine
Volume 65, NO. 4 : April 2015

AIRWAY/ORIGINAL RESEARCH

# Delayed Sequence Intubation: A Prospective Observational Study

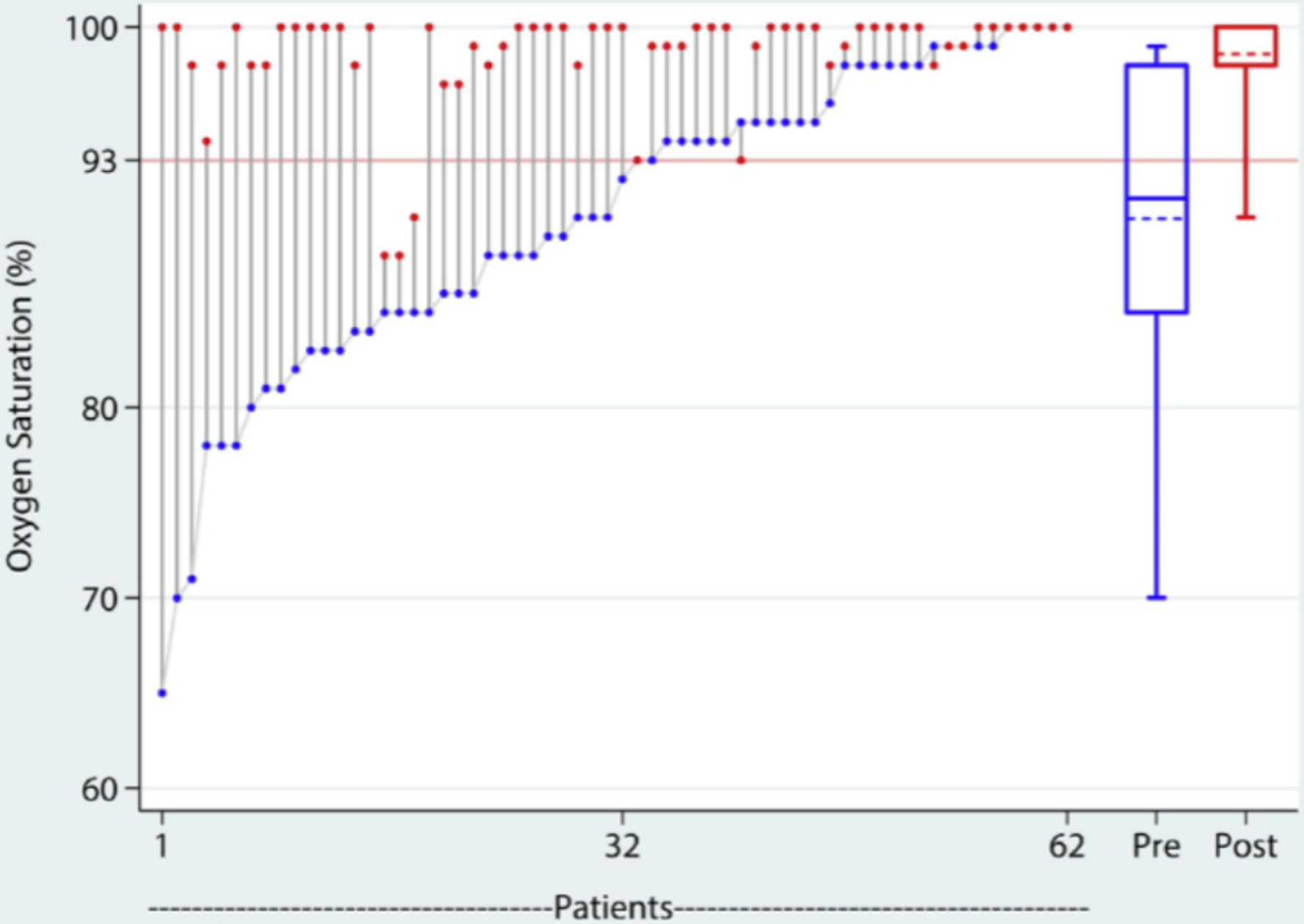
Scott D. Weingart, MD*; N. Seth Trueger, MD, MPH; Nelson Wong, MD; Joseph Scofi, MD; Neil Singh, MD; Soren S. Rudolph, MD

*Corresponding Author. E-mail: scottweingart@gmail.com, Twitter: @emcrit.

62 Emergency Department patients, hypoxemic
and unable to pre-oxygenate adequately due to agitation

Ketamine 1mg/kg initially with 0.5mg/kg
as required to achieve dissassociation

3 minutes of pre-oxgyenation prior to RSI




***After Ketamine***

***Before Ketamine***

Mean improvement in O2 Sats 89% to 98%

No complications. No post-disassociation apnea.

i got enough ketamine to floor a horse mate, how much you want?

***IV: 0.5 - 1.5mg/kg (using 10mg/cc preparation)***
***IM: 4mg/kg (using 50mg/cc preparation)***

Annals *of* Emergency Medicine
Volume 67, NO. 1 : January 2016

# Delayed Sequence Intubation: Danger in Delaying Definitive Airway?

be adopted in difficult situations by less capable hands. As such, this article deflects attention from the primary purpose of rapid sequence intubation, which is to decisively control the airway with well-defined pharmacologic (including ketamine) and bag-valve-mask ventilation techniques followed by decisive intubation.[2] Preoxygenation with a tight-fitting mask, such as found with a bag-valve-mask apparatus or an anesthesia circuit, is reliable.[3,4] The implementation of delayed sequence intubation adds the associated risk of delays in definitive intubation compared with using a simple bag-valve-mask setup.

*Richard Skupski, MD*
*Department of Anesthesiology*
*Memorial Hospital of South Bend*
*South Bend, IN*

Annals *of* Emergency Medicine
Volume 69, NO. 1 : January 2017

AIRWAY/CASE REPORT

# Apnea After Low-Dose Ketamine Sedation During Attempted Delayed Sequence Intubation

Brian E. Driver, MD*; Robert F. Reardon, MD

*Corresponding Author. E-mail: briandriver@gmail.com, Twitter: @brian_driver.

This case highlights the fact that sedation with ketamine for preoxygenation is not without risk, even in low doses. Clinicians should remain at the bedside until intubation is complete while monitoring vigilantly for respiratory depression or arrest. All necessary airway equipment should be available and ready; paralytic agents should likewise be prepared before administration of ketamine. Sedation remains a valuable technique to enable optimal preoxygenation in agitated patients. Clinicians should not perform this technique lightly and should be prepared to secure the patient's airway immediately.

***What if my patient has a head injury?***

***Do I need to worry about raised ICP?***

Annals *of* Emergency Medicine
Volume 65, NO. 1 : January 2015

PAIN MANAGEMENT AND SEDATION/SYSTEMATIC REVIEW–META-ANALYSIS

# The Effect of Ketamine on Intracranial and Cerebral Perfusion Pressure and Health Outcomes: A Systematic Review

Lindsay Cohen, MD; Valerie Athaide, MD, FRCP(C); Maeve E. Wickham, MSc; Mary M. Doyle-Waters, MA, MLIS; Nicholas G. W. Rose, MD, FRCP(C); Corinne M. Hohl, MD, FRCP(C)*

*Corresponding Author. E-mail: chohl@mail.ubc.ca.

No evidence to support concerns re Ketamine and ICP

Some evidence to suggest that it may lower ICP, strong anti-epileptic, and has analgesic properties

# take-home points

Patients don’t die from a lack of plastic in the trachea

Pre-oxygenation is vital component of resuscitation

Sometimes it requires procedural sedation

Ketamine is the ideal agent

# Physiologic Difficulty: Norepinephrine and Post Intubation Hypotension

Western Journal *of* Emergency Medicine
Volume XVI, NO. 7 : December 2015

REVIEW ARTICLE

# The Physiologically Difficult Airway

**Jarrod M. Mosier, MD***†
**Raj Joshi, MD***†
**Cameron Hypes, MD***†
**Garrett Pacheco, MD***
**Terence Valenzuela, MD***
**John C. Sakles, MD***

*University of Arizona, Department of Emergency Medicine, Tucson, Arizona
†University of Arizona, Department of Medicine, Division of Pulmonary, Critical Care, Allergy and Sleep, Tucson, Arizona

*'…the physiologically difficult airway is one in which physiologic derangements place the patient at higher risk of cardiovascular collapse with intubation and the transition to mechanical ventilation.'*

Journal of Critical Care (2012) **27**, 417.e9–417.e13

# The frequency and significance of postintubation hypotension during emergency airway management☆

**Alan C. Heffner MD [a, b], Douglas Swords BA, MS III [b], Jeffrey A. Kline MD [b], Alan E. Jones MD [b, c,*]**

[a]*Division of Critical Care Medicine, Department of Internal Medicine, Carolinas Medical Center, Charlotte, NC, USA*
[b]*Department of Emergency Medicine, Carolinas Medical Center, Charlotte, NC, USA*
[c]*Department of Emergency Medicine, University of Mississippi Medical Center, Jackson, MS, USA*

Retrospective cohort study of 336
Emergency Department intubations (98% were RSI)

Incidence 23%

Increased mortality by 12%

*CJEM* 2012;14(2):74-82

ORIGINAL RESEARCH • RECHERCHE ORIGINALE

*EM Advances*

# Evaluation of the incidence, risk factors, and impact on patient outcomes of postintubation hemodynamic instability

Robert S. Green, BSc, MD*[†‡]; Janet Edwards, BSc, MD[§]; Elham Sabri, MSc[‡‖]; Dean Fergusson, MHA, PhD[‡‖]

PIHI SBP<90, MAP <65, decrease >20%
within 30 min of intubation

Incidence of 44%

Preintubation hemodynamic instability
a major predictor (OR 2.52)

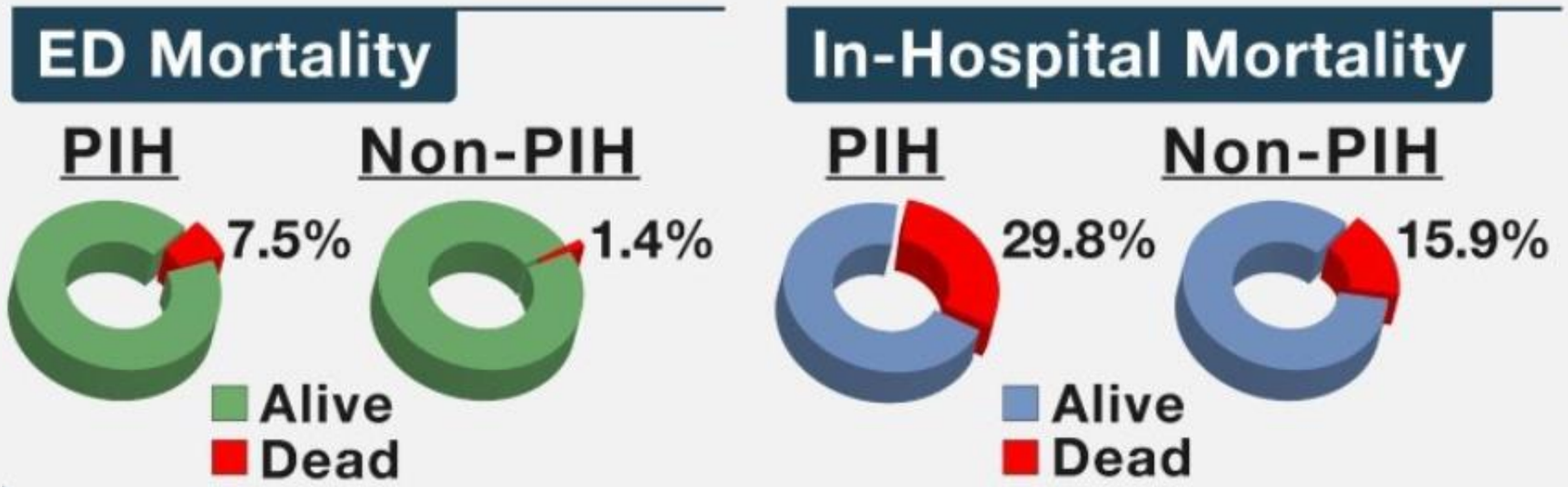
**Green *et al*, 2017**
**Journal of Trauma and Acute Care Surgery**

# *Increased mortality in trauma patients who develop postintubation hypotension*

Retrospective Review of Trauma Nova Scotia database 2000-2015

**477** Intubated Trauma Patients

Prevalence of PIH = **36.3%**



Journal of Critical Care (2012) **27**, 417.e9–417.e13

# Predictors of the complication of postintubation hypotension during emergency airway management☆

**Alan C. Heffner MD[a,b,*], Douglas S. Swords BA, MS IV[b], Marcy L. Nussbaum MS[c], Jeffrey A. Kline MD[b], Alan E. Jones MD[b,d]**

[a]*Division of Critical Care Medicine, Department of Internal Medicine, Charlotte, NC*
[b]*Department of Emergency Medicine, Carolinas Medical Center, Charlotte, NC*
[c]*Dickson Institute for Health Studies, Carolinas HealthCare System, Charlotte, NC*
[d]*Department of Emergency Medicine, University of Mississippi Medical Center, Jackson, MS*

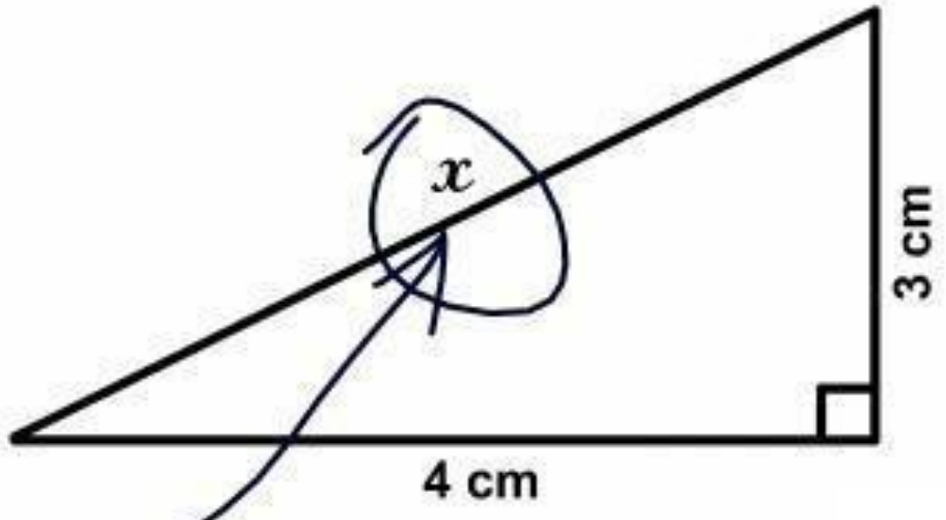
Regression analysis of the original study to identify variables that predicted PIHI.

‘pre-intubation hemodynamic instability’

shock index >0.8

$$\text{Shock Index} = \frac{\text{Heart Rate}}{\text{Systolic BP}} = > 0.8$$

**3. Find x.**




Here it is

Don’t like doing math in a resuscitation?

Call it a Shock Index = 1 i.e. ‘is the HR higher then the SBP?’

If so this is a patient at risk of PIHI

*(So we should do something about that)*

***Peri-Intubation Resuscitation***

Blood/Massive Transfusion
Resuscitative Procedures (chest and pelvis)
Crystalloid
Vasopressors


# *What pressor should I be using?*

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 4, 2010 VOL. 362 NO. 9

## Comparison of Dopamine and Norepinephrine in the Treatment of Shock

Daniel De Backer, M.D., Ph.D., Patrick Biston, M.D., Jacques Devriendt, M.D., Christian Madl, M.D., Didier Chochrad, M.D., Cesar Aldecoa, M.D., Alexandre Brasseur, M.D., Pierre Defrance, M.D., Philippe Gottignies, M.D., and Jean-Louis Vincent, M.D., Ph.D., for the SOAP II Investigators*

***Resuscitation NOT Rescue***

# What if I don't have a central line?

Journal of Critical Care 30 (2015) 653.e9–653.e17

Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: www.jccjournal.org

## A systematic review of extravasation and local tissue injury from administration of vasopressors through peripheral intravenous catheters and central venous catheters☆,☆☆

Osama M. Loubani, MD, FRCPC [a,*], Robert S. Green, MD, FRCPC [a,b]

[a] Departments of Critical Care Medicine and Emergency Medicine, Dalhousie University, Room 377, Bethune Building, 1276 South Park St, Halifax, Nova Scotia B3H 2Y9, Canada
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"In emergency situations, short-term administration (<2hrs) of vasopressor infusions via proximal peripheral IVs is unlikely to cause local tissue injury."

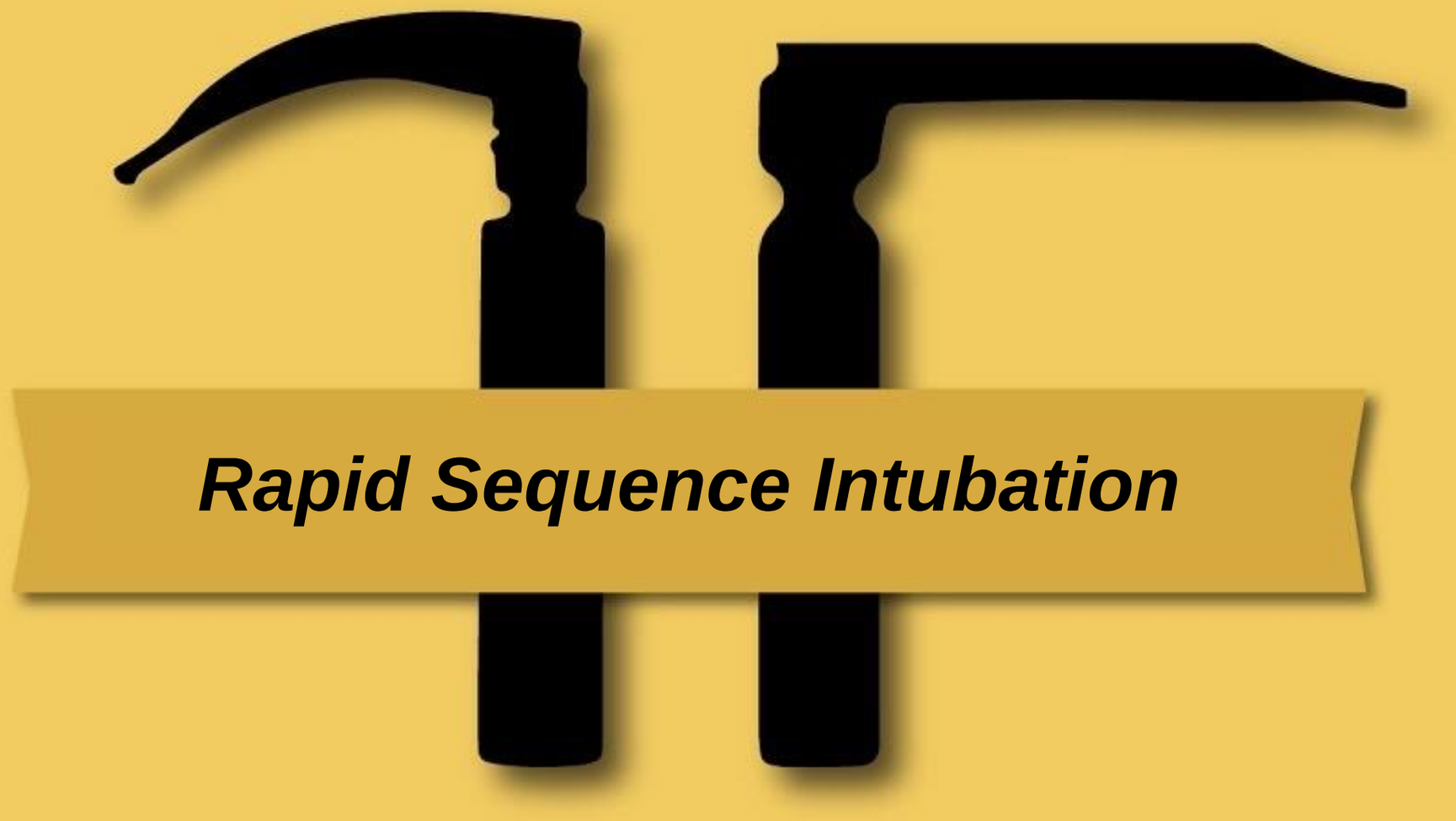
# take-home points

Peri-intubation hypotension occurs frequently

Likely associated with increased mortality

Predictive based on pre-intubation hemodynamics

Hemodynamic resuscitation and Pre-oxygenation are equal components of Pre-Intubation Resuscitation



# *Rapid Sequence Intubation*

## Unanticipated Difficulty: Roccuronium

# Airway Management by US and Canadian Emergency Medicine Residents: A Multicenter Analysis of More Than 6,000 Endotracheal Intubation Attempts

**Mark J. Sagarin, MD**
**Erik D. Barton, MD**
**Yi-Mei Chng, MD**
**Ron M. Walls, MD**
**on behalf of the National Emergency Airway Registry (NEAR) Investigators**

From the University of New Mexico Health Sciences Center, Albuquerque, NM (Sagarin); University of Utah, Salt Lake City, UT (Barton); Harvard Affiliated Emergency Medicine Residency, Boston, MA (Walls); Brigham & Women's Hospital, Boston, MA (Chng, Walls); and Harvard Medical School, Boston, MA (Chng, Walls).

**Study objective:** We determine success rates of endotracheal i
departments (EDs) by North American emergency medicine resi

**Methods:** During 58 months, physicians performing intubations a
nations completed a data form that was entered into the National E
Included were all patients undergoing endotracheal intubation in th
age, sex, weight, indication for intubation, technique of airway ma
medications used to facilitate intubation, level of training and spe
attempts, success or failure, and adverse events. We queried this
data to analyze intubations done by US and Canadian emergency

**Results:** Enrollment was incomplete (eg, 85% at the main study
include all consecutive patients. Emergency medicine residents p
confidence interval [CI] 76% to 78%) of all initial intubation attempt
first intubator was successful in 90% (5,193/5,757; 95% CI 89%
(4,775/5,757; 95% CI 82% to 84%) on the first attempt. Success
follows: postgraduate year 1 = 72% (498/692; 95% CI 68% to 75%
2,544; 95% CI 80% to 83%), postgraduate year 3 = 88% (1,963/
postgraduate year 4+ = 82% (233/283; 95% CI 77% to 87%), and
95% CI 87% to 91%). Success rates by the first intubator were as
(553/692; 95% CI 77% to 83%), postgraduate year 2 = 89% (2,2
postgraduate year 3 = 94% (2,105/2,238; 95% CI 93% to 95%), p
95% CI 89% to 96%), and attending physician = 98% (755/772;
intubation technique was used in 78% (4,513/5,768; 95% CI 77%
in 85% (3,843/4,513; 95% CI 84% to 86%) success on the first at
90% to 92%) success by the first intubator. The overall rate of cric
intubations was 0.9% (50/5,757; 95% CI 0.6% to 1.1%). When an
95% CI 37% to 44%) of rescue attempts were performed by emer
emergency medicine residents, success on the first rescue attem
84%), and success by the first rescue intubator was 88% (328/3

**Conclusion:** Success of initial intubation attempts increased ov
large multicenter study demonstrates the success of airway ma
residents in North America. Using rapid-sequence intubation pre
residents achieved high levels of success. [Ann Emerg Med. 20

0196-0644/$-see front matter

doi:10.1016/j.annemergmed.2005.01.009





# Airway Management in the Emergency Department: A One-Year Study of 610 Tracheal Intubations

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*Received for publication January 24, 1997. Revisions received July 28, 1997, September 15, 1997, and September 30, 1997. Accepted for publication October 13, 1997.*

*Presented in part at the Society for Academic Emergency Medicine Scientific Assembly, Washington, DC, May 1997.*



**See editorial, p 398.**

Study objective: To describe the methods, success rates, and immediate complications of tracheal intubations performed in the emergency department of an urban teaching hospital.

Methods: This was an observational, consecutive series undertaken in an urban university hospital with an emergency medicine residency training program and an annual ED census of 60,000 patients. The study population included all patients for whom intubation was attempted in the ED during a 1-year period (July 1, 1995 through June 30, 1996). At the time of each intubation, the intubator filled out an intubation data collection form. If an intubation was performed in the ED but no form was filled out, the data were obtained from the medical record.

Results: A total of 610 patients required airway control in the ED; 569 (93%) were intubated by emergency medicine residents or attending physicians. Rapid-sequence intubation (RSI) was used in 515 (84%). A total of 603 patients (98.9%) were successfully intubated; 7 patients could not be intubated and underwent cricothyrotomy. In 33 patients, inadvertent placement into the esophagus occurred; all such situations were rapidly recognized and corrected. Eight (24%) of the 33 esophageal intubations resulted in a reported immediate complication. Overall, 49 patients (8.0%; 95% confidence interval [CI], 6% to 11%) experienced a total of 57 immediate complications (9.3%; 95% CI, 7% to 12%). Three patients sustained a cardiac arrest after intubation; two of these patients had agonal rhythms before intubation, and one probably had a succinylcholine-induced hyperkalemic cardiac arrest.

Conclusion: At this institution, the majority of ED intubations were performed by emergency physicians and RSI was the most common method used. Emergency physicians intubated critically ill and [illegible] ED patients with a very low associated [illegible] rate and few complications.





EDUCATION AND PRACTICE

# Rapid-sequence Intubation at an Emergency Medicine Residency: Success Rate and Adverse Events during a Two-year Period

VIVEK S. TAYAL, MD, RUSSELL W. RIGGS, MD, JOHN A. MARX, MD, CHRISTIAN A. TOMASZEWSKI, MD, ROBERT E. SCHNEIDER, MD

tions for intubation among RSI patients were as follows: mechanical ventilation 57.4%, airway protection 41.3%, and cardiac arrest 1.3%. Distribution of intubations by level of EM training was PGY1, 5%; PGY2, 52%; PGY3, 40%; and attendings, 3%. Intubations were successfully completed within two attempts in 97% of the patients. Major immediate adverse events were encountered in six patients (1.4%) (hypotention = 2, hypoxemia = 1, dysrhythmia = 3). There was no death attributable to RSI. The rate of intubations requiring two or fewer attempts and without major immediate adverse events was 96%. Three patients required cricothyrotomy. **Conclusion:** In the setting of an EM residency at a tertiary care ED, RSI can be performed successfully with few major immediate adverse events. **Key words:** intubation; emergency; RSI; residency; adverse events; success rate. ACADEMIC EMERGENCY MEDICINE 1999; 6:31–37

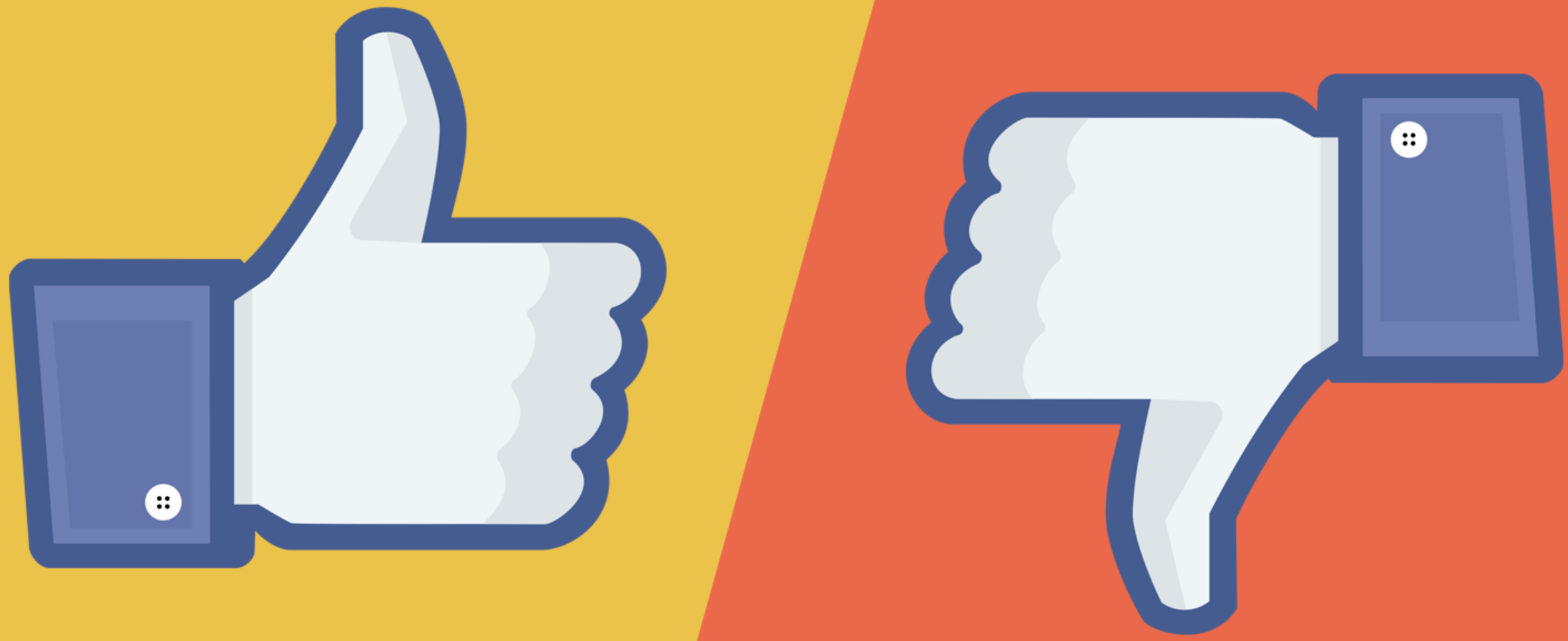
Rapid-sequence intubation has been used successfully by emergency physicians (EPs) at tertiary Level 1 trauma and community hospital EDs.[1,8–11] However, experience using RSI in a residency training center has been reported infrequently to date. We evaluated the rate of success and adverse events, including major immediate and other adverse events, associated with RSI in our setting of an emergency medicine (EM) training program at a tertiary care center and Level 1 trauma center.

## METHODS

***Study Design.*** This was an observational study of RSI at an urban ED/Level 1 trauma center.

***Study Setting and Population.*** Carolinas Medical Center (CMC) is a regional tertiary care hospital with an active Level 1 trauma center and ED (100,000 annual visits). There are 22 board-certified EM faculty and 30 EM residents (PGY1–3). Airway management in the department is typically performed by EM residents and supervised by EM

***arly supported by the literature for Emergency Department a***



***Roccuronium  vs  Succinylcholine***

***Doesn't Succinycholine work faster, create better conditions and wear off sooner…***

***This is why you're the sidekick!***

Cochrane Library

Cochrane Database of Systematic Reviews

# Rocuronium versus succinylcholine for rapid sequence induction intubation (Review)

Tran DTT, Newton EK, Mount VAH, Lee JS, Wells GA, Perry JJ

## Main results

The previous update (2008) had identified 53 potential studies and included 37 combined for meta-analysis. In this latest update we identified a further 13 studies and included 11, summarizing the results of 50 trials including 4151 participants. Overall, succinylcholine was superior to rocuronium for achieving excellent intubating conditions: RR 0.86 (95% confidence interval (CI) 0.81 to 0.92; n = 4151) and clinically acceptable intubation conditions (RR 0.97, 95% CI 0.95 to 0.99; n = 3992, 48 trials). A high incidence of detection bias amongst the trials coupled with significant heterogeneity provides moderate-quality evidence for these conclusions, which are unchanged from the previous update. Succinylcholine was more likely to produce excellent intubating conditions when using thiopental as the induction agent: RR 0.81 (95% CI: 0.73 to 0.88; n = 2302, 28 trials). In the previous update, we had concluded that propofol was the superior induction agent with succinylcholine. There were no reported incidences of severe adverse outcomes. We found no statistical difference in intubation conditions when succinylcholine was compared to 1.2 mg/kg rocuronium; however, succinylcholine was clinically superior as it has a shorter duration of action.

# Intubating Conditions: Goldberg Scale

**Table 1. Intubating conditions**

| Score | Ease of laryngoscopy | Vocal cords | Intubation response |
|---|---|---|---|
| **1. Excellent** | Good | Open | None |
| **2. Good** | Fair | Open | Diaphragmatic movement |
| **3. Poor** | Difficult | Movement | Moderate coughing |
| **4. Impossible** | Poor | Closed | Severe coughing or bucking |

***Paralysis is a binary response…***

## Subgroup analysis for the primary outcome of excellent intubation conditions: comparing the dose of rocuronium

The subgroup using a dose of rocuronium of 0.6 to 0.7 mg/kg had a RR favouring succinylcholine for excellent conditions (RR 0.80, 95% CI 0.72 to 0.88; participants = 2808; studies = 39; $I^2$ statistic = 77%). The NNTH for this subgroup is six (95% CI 7 to 5). There was significant heterogeneity between the trials. There were no statistical differences for excellent or acceptable intubation conditions in the group that received 0.9 to 1.0 mg/kg of rocuronium or the group that received 1.2 mg/kg of rocuronium. (Analysis 2.1)

Tran DTT, Newton EK, Mount VAH, Lee JS, Wells GA, Perry JJ.
Rocuronium versus succinylcholine for rapid sequence induction intubation.
*Cochrane Database of Systematic Reviews* 2015, Issue 10. Art. No.: CD002788.

**In the Emergency Department ‘intubating conditions’ isn’t really a part of our terminology…**

***First Pass Success Rates***

***Peri-Intubation Complications***

***Clinically more meaningful for our patients***

ACAD EMERG MED • January 2011, Vol. 18, No. 1

# Comparison of Succinylcholine and Rocuronium for First-attempt Intubation Success in the Emergency Department

Asad E. Patanwala, PharmD, Sara A. Stahle, PharmD, John C. Sakles, MD, and Brian L. Erstad, PharmD

Retrospective Analysis of Quality Control Database

327 Emergency Department RSI
Succinylcholine vs Rocuronium (1.2mg/kg)

All patients were successfully intubated, with none requiring a surgical airway. First-attempt intubation success was similar between the succinylcholine and rocuronium groups (72.6% vs. 72.9%, p = 1.00). The median number of intubation attempts was also similar between the succinylcholine and rocuronium groups (1,

Cochrane Library
Cochrane Database of Systematic Reviews

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**Main results**

The previous update (2008) had identified 53 potential studies and included 37 combined for meta-analysis. In this latest update we identified a further 13 studies and included 11, summarizing the results of 50 trials including 4151 participants. Overall, succinylcholine was superior to rocuronium for achieving excellent intubating conditions: RR 0.86 (95% confidence interval (CI) 0.81 to 0.92; n = 4151) and clinically acceptable intubation conditions (RR 0.97, 95% CI 0.95 to 0.99; n = 3992, 48 trials). A high incidence of detection bias amongst the trials coupled with significant heterogeneity provides moderate-quality evidence for these conclusions, which are unchanged from the previous update. Succinylcholine was more likely to produce excellent intubating conditions when using thiopental as the induction agent: RR 0.81 (95% CI: 0.73 to 0.88; n = 2302, 28 trials). In the previous update, we had concluded that propofol was the superior induction agent with succinylcholine. There were no reported incidences of severe adverse outcomes. We found no statistical difference in intubation conditions when succinylcholine was compared to 1.2 mg/kg rocuronium; however, succinylcholine was clinically superior as it has a shorter duration of action.

The Journal of Emergency Medicine, Vol. 37, No. 2, pp. 183–188, 2009

# ROCURONIUM VS. SUCCINYLCHOLINE IN THE EMERGENCY DEPARTMENT: A CRITICAL APPRAISAL

William K. Mallon, MD,* Samuel M. Keim, MD, MS,† Jan M. Shoenberger, MD,* and Ron M. Walls, MD‡

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*"No statistical difference in intubating conditions was found when succinylcholine was compared to 1.2mg/kg rocuronium; however, succinylcholine was clinically superior as it has a shorter duration of action."*

# How do you value time?

“Succinylcholine has a faster onset”

“Succinylcholine wears off sooner”

Anesthesiology
79:913–918, 1993


# *Comparison of Rocuronium, Succinylcholine, and Vecuronium for Rapid-sequence Induction of Anesthesia in Adult Patients*

*Toni Magorian, M.D.,* K. B. Flannery,† Ronald D. Miller, M.D.‡*

**Table 4. Onset and Recovery Data**

| | Rocuronium 0.6 mg/kg | Rocuronium 0.9 mg/kg | Rocuronium 1.2 mg/kg | Vecuronium 0.1 mg/kg | Succinylcholine 1 mg/kg |
|---|---|---|---|---|---|
| Onset (s) | | | | | |
| n | 10 | 10 | 10 | 10 | 10 |
| Mean | 89 | 75 | 55 | 144 | 50 |
| SD | 33 | 28 | 14 | 39 | 17 |
| Range | 48–156 | 48–144 | 36–84 | 96–204 | 24–84 |
| Duration (min) | | | | | |
| n | 10 | 9 | 9 | 10 | 10 |
| Mean | 37 | 53 | 73 | 41 | 9 |
| SD | 15 | 21 | 32 | 19 | 2 |
| Range | 23–75 | 25–88 | 38–150 | 17–82 | 5–14 |
| Recovery index (min) | | | | | |
| n | 9 | 8 | 8 | 10 | 10 |
| Mean | 14 | 22 | 24 | 20 | 2 |
| SD | 8 | 14 | 11 | 18 | 1 |
| Range | 6–27 | 8–29 | 11–43 | 6–57 | 1–3 |

Variables: onset = the time interval between the completion of injection of NMB and time to maximal depression $T_1$; duration = the time interval between the completion of injection of NBM and time to maximal depression $T_1$ to 25% of control; recovery index = the time from $T_{25}$ to $T_{75}$% of recovery.

***Statistical significance vs Clinical significance?***

# Rocuronium Versus Succinylcholine: Cochrane Synopsis Reconsidered

*To the Editor:*

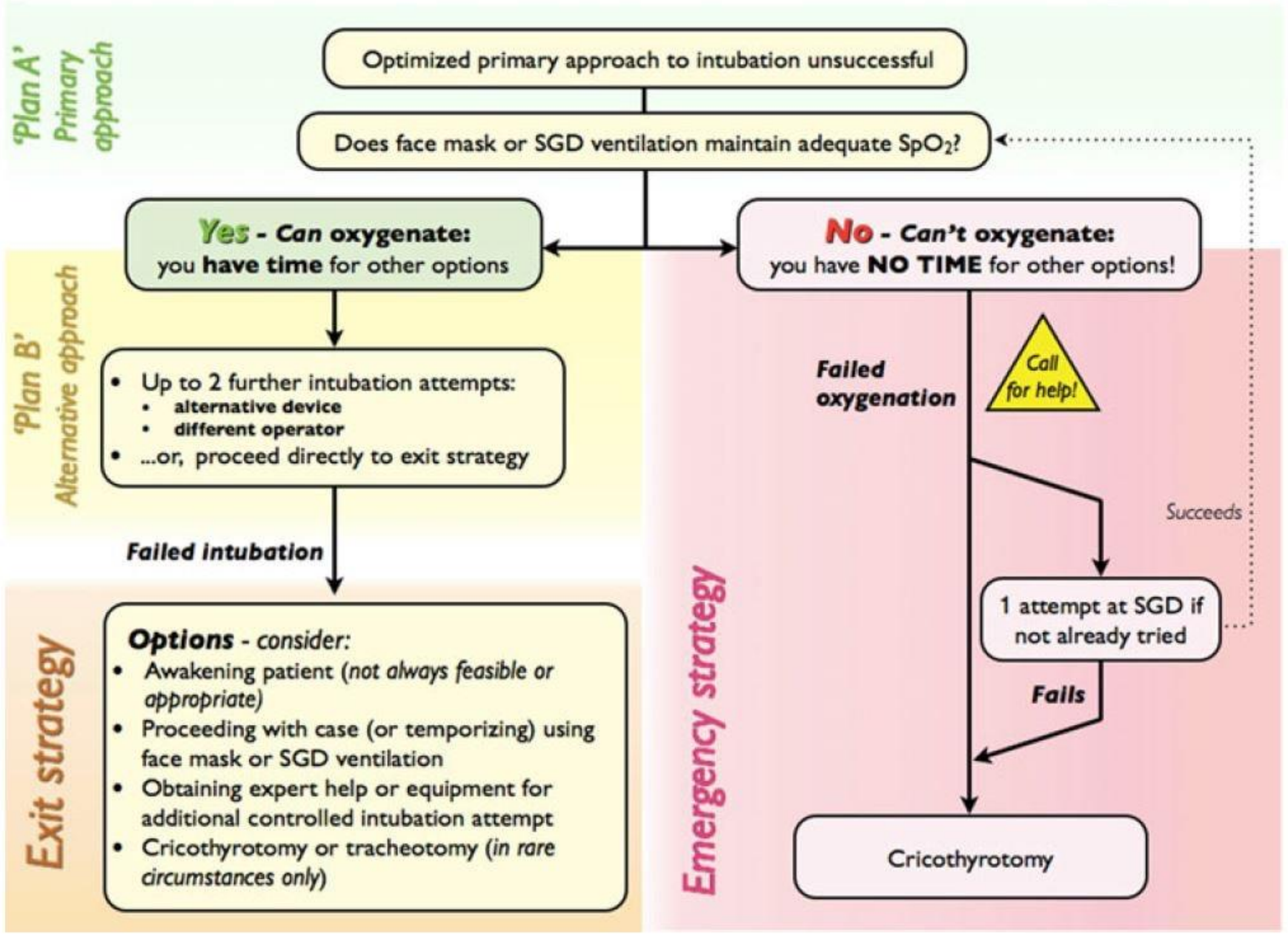
The longer duration of action of rocuronium is an advantage, not a disadvantage. Emergency clinicians who believe they are protected against a can't-intubate, can't-ventilate scenario by the short duration of succinylcholine are usually wrong[5] and make dangerous decisions as a result. When early attempts at laryngoscopy fail, further attempts are hindered by the return of the patient's airway reflexes; this already precarious situation is worsened if the patient puts his now-functioning muscles to use by vomiting.

*Reuben J. Strayer, MD*
*Department of Emergency Medicine*
*Mount Sinai School of Medicine*
*New York, NY*

***When the intubation is fast and smooth the choice of paralytic probably doesn't really matter.***

***When it really matters is when the intubation doesn't go well.***

# Difficult tracheal intubation encountered in an unconscious patient

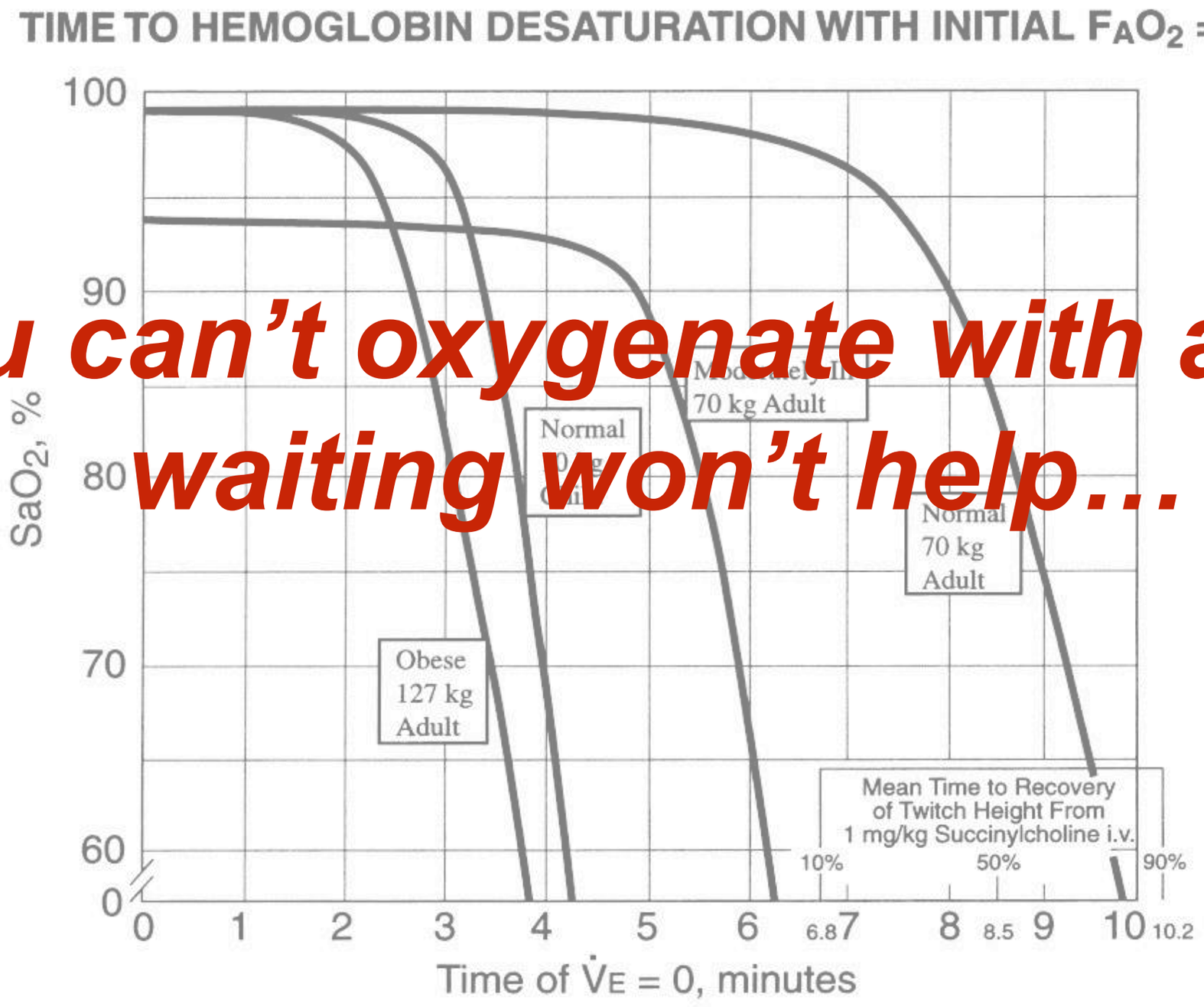



J. A. Law et al.
Can J Anesth/J Can Anesth (2013) 60:1119–1138

Anesthesiology 1997: (87) 979-82

# *Critical Hemoglobin Desaturation Will Occur before Return to an Unparalyzed State following 1mg/kg Intravenous Succinylcholine*

***Jonathan L. Benumof, Rachel Dagg, Reuben Benumof***




***If you can't oxygenate with a BMV, waiting won't help…***

*“Sux creates better intubating conditions”*

***(Not really and FPS is the same)***

*“Sux time of onset is faster”*

***(At 1.2mg/kg the difference is ~5 sec)***

*“Sux wears off faster”*

***(It does, and that might be a bad thing)***

# take-home points

The evidence does not support using Succinylcholine over Roccuronium in the Emergency Department

# Parting Thoughts

Anatomic Features that make RSI Dangerous? → Lidocaine

Can this patient cooperate with pre-oxygenation? → Ketamine

Hemodynamic Instability? (hypotension, SI >1) → Norepinephrine

RSI - potential for unanticipated difficulty? → Rocuronium

Airway Management/RSI Priorities (In Order):

1. Save their life

2. Prevent complications (iatrogenic)

3. Improve patient’s experience (analgesia and amnesia)

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