



- * Pass the test.
- * Learn core EM concepts.
- * Get it done... quick!

LLSA 2014 Exam Guide - Clay Smith, MD LLSAexam.com

1st Edition

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Digitally Distributed in the United States of America

First Edition: April 2016

Table of Contents

<i>Article 1 - Patient Perceptions of Computed Tomographic Imaging and Their Understanding of Radiation Risk and Exposure</i>	<i>4</i>
<i>Article 2 - Drowning</i>	<i>6</i>
<i>Article 3 - Care of the Adult Patient after Sexual Assault</i>	<i>9</i>
<i>Article 4 - Post Cardiac Arrest Syndrome - A Review of Therapeutic Strategies</i>	<i>12</i>
<i>Article 5 - Clinical Policy: Critical Issues in the Evaluation of Adult Patients Presenting to the Emergency Department With Acute Blunt Abdominal Trauma</i>	<i>15</i>
<i>Article 6 - Does This Patient Have a Severe Upper Gastrointestinal Bleed?</i>	<i>18</i>
<i>Article 7 - Preoxygenation and Prevention of Desaturation During Emergency Airway Management</i>	<i>21</i>
<i>Article 8 - Sensitivity of computed tomography performed within six hours of onset of headache for diagnosis of subarachnoid haemorrhage: prospective cohort study.</i>	<i>26</i>
<i>Article 9 - Identifying Nontechnical Skills Associated With Safety in the Emergency Department</i>	<i>28</i>
<i>Article 10 - Diagnosis and Management of Sports-Related Concussion</i>	<i>30</i>
<i>Article 11 - Neonatal Resuscitation</i>	<i>32</i>
<i>Article 12 - Torsion of the Testicle.</i>	<i>35</i>

Article 1 - Patient Perceptions of Computed Tomographic Imaging and Their Understanding of Radiation Risk and Exposure

Bauman BM et al. Patient Perceptions of Computed Tomographic Imaging and Their Understanding of Radiation Risk and Exposure. *Ann Emerg Med.* 2011;58:1-7.

Questions 1 and 23 on the LLSA 2014 Test

Patients don't understand how much radiation CT delivers. A conservative estimate is that CT abdomen/pelvis delivers the equivalent of 100-250 CXRs.

Most patients are not aware that CT increases risk for cancer.

Patients do not reliably recall the number of prior CT scans.

We have to start limiting radiation exposure as much as possible. It's OUR responsibility.

Key Points

- "Previous literature estimates the radiation dose for an abdomen-pelvis CT to be equivalent to 100 to 250 2-view chest series. For the purpose of this investigation, we used the conservative estimate of 1 abdomen-pelvis CT = 100 2-view chest radiographs."
- "With respect to radiation risk, our sample had low median agreement with the Hiroshima statement [About 2 to 3 abdominal CTs give the same radiation exposure that survivors of the Hiroshima nuclear bombing received] and moderate median agreement with the cancer risk statement [Receiving 2 to 3 abdominal CTs over a person's lifetime can increase the chance of cancer]."

Study Question

Do patients feel more comfortable with a workup that includes CT? And do patients understand the amount of radiation and risk imparted by CT?

Study Design

Cross-sectional

Synopsis

- Adult patients with abdominal pain in an urban ED were surveyed as to their confidence in an evaluation in which the doctor performed only an H&P, H&P plus labs, H&P plus ultrasound, or H&P plus CT.

- They were also asked about their understanding of CT radiation dose and risk.
- They found patients had the most confidence in an evaluation that included CT.
- But they also found that most patients (75%) underestimated the dose of radiation delivered by CT and also did not have a good understanding of the risk.
- Patients also had poor recollection of how many prior CT scans they had undergone in the past.
- Physicians did a poor job at limiting radiation exposure, as the mean number of scans in patients with prior CT was 5.3!

Take Home Points

Patients feel more confident in an ED evaluation that includes advanced imaging, but they do

not understand the amount of radiation CT imparts nor do they comprehend the risk.

Limitations

It was single center, urban, with most patients not having obtained a college degree, which may have skewed the results.

Review of Key Points

- “Previous literature estimates the radiation dose for an abdomen-pelvis CT to be equivalent to 100 to 250 2-view chest series. For the purpose of this investigation, we used the conservative estimate of 1 abdomen-pelvis CT = 100 2-view chest radiographs.”
- “With respect to radiation risk, our sample had low median agreement with the Hiroshima

statement [About 2 to 3 abdominal CTs give the same radiation exposure that survivors of the Hiroshima nuclear bombing received] and moderate median agreement with the cancer risk statement [Receiving 2 to 3 abdominal CTs over a person’s lifetime can increase the chance of cancer].

Article 2 - Drowning

Szpilman D et al. Drowning. N Engl J Med 2012;366:2102-10.

Questions 2 and 13 on the LLSA 2014 Test

Pulmonary auscultation is important in rescued patients. Responsive patients without rales, even if coughing, may be immediately released from the scene or ED.

Infiltrates on CXR do not mandate antibiotic treatment after a drowning event. Patients may be monitored for fever or leukocytosis off antibiotics.

Pneumonia after aspiration of pool water is especially rare.

Key Points

- Patients rescued who are responding normally, have coughing or no coughing, and have clear lungs, without rales, may be safely discharged from the scene or ED. Survival is 100% even if cough is present after near drowning. VERY IMPORTANT - See Figure 1.
- “Aspiration of swimming-pool water rarely results in pneumonia.”
- “In a series of hospitalized cases, only 12% of persons rescued from drowning had pneumonia and needed treatment with antibiotic agents. Prophylactically administered antibiotics tend to select more resistant and aggressive organisms.”

Review

Introduction

- Drowning causes 500,000 deaths per year worldwide.
- Four patients are treated in the ED for non-fatal drowning for every person who dies.

Definition

- WHO definition: “Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid.”
- There are only two types: fatal and non-fatal.
- The terms “dry drowning,” “near drowning,” and “delayed onset respiratory distress” are to be avoided according to this review.



Pathophysiology

- A person may hold their breath for around a minute, but the impulse to breathe becomes too great. Some aspiration occurs, triggering cough and possibly laryngospasm.
- Hypoxia ensues, followed by worsening aspiration, loss of consciousness, bradycardia, PEA, and eventually asystole.

Water Rescue

- Lifeguards make a big difference, with only 0.5% needing CPR, compared to bystander rescue, with CPR rates of up to 30%.
- Rescue is safest if the rescuer can stay out of the water and help the victim.
- In-water resuscitation (ventilation only) increases

favorable outcome threefold, but is extremely difficult and requires a highly trained rescuer.

- Concomitant c-spine injury is very rare (0.5%), especially in the absence of diving, water-skiing, surfing, or operation of water craft.
- In the water, keep patients vertical to avoid aspiration of more water or emesis.

Initial Land Resuscitation

- ABC is more applicable than CAB for drowning victims.
- Ventilation is primary in drowning victims, so chest compression-only CPR is not best in such patients.
- Regurgitation is very common.
- Avoid abdominal thrusts to “force out water.” It doesn’t

work and increases regurgitation.

Prehospital

- This includes the usual advanced life support with particular attention to maintaining oxygenation.
- Well trained personnel in airway management may need to intubate if inadequate oxygenation on high-flow mask.

ED Care

- For starters, <6% of patients rescued by a lifeguard need to go to the ED.
- The review goes over the standard stuff we do every day in sick patients: ABCs, imaging, initial resuscitation, etc.
- Most patients with Grade 2 (scattered rales on

auscultation) through Grade 6 drowning (pulseless, submerged < 1 hour) will be admitted (See Figure 1 in article).

- However, Grade 2 (scattered rales only) may be observed 6-8 hours with oxygen as needed and discharged home if improved.

ICU Care

- Most are treated similar to ARDS patients, but they usually improve more quickly.
- Antibiotics are not routinely or prophylactically given, despite infiltrates on CXR. Aspiration pneumonia is rare, 12%, even in contaminated water, and is even less likely if drowning occurred in pool water.

Prevention

- Don't breathe underwater.
 - Most are common sense. Don't drink and swim. Teach children to swim. Use life jackets. Obey warnings. Avoid rip currents.
 - "It is estimated that more than 85% of cases of drowning can be prevented by supervision, swimming instruction, technology, regulation, and public education."
- "Aspiration of swimming-pool water rarely results in pneumonia."
 - "In a series of hospitalized cases, only 12% of persons rescued from drowning had pneumonia and needed treatment with antibiotic agents. Prophylactically administered antibiotics tend to select more resistant and aggressive organisms."

Review of Key Points

- Patients rescued who are responding normally, have coughing or no coughing, and have clear lungs, without rales, may be safely discharged from the scene or ED. Survival is 100% even if cough is present after near drowning. VERY IMPORTANT - See Figure 1.

Article 3 - Care of the Adult Patient after Sexual Assault

Linden JA. Care of the Adult Patient after Sexual Assault. N Engl J Med 2011;365:834-41.

Questions 3 and 19 on the LLSA 2014 Test

The incidence of HIV transmission after sexual contact with an HIV positive person is unknown.

Risk of transmission of HIV increases with anal vs vaginal penetration, genital trauma or open ulcers, and higher viral load in the assailant.

HIV prophylaxis greatly reduces risk but requires strict adherence and completion of treatment.

Key Points:

- “The exact incidence of HIV transmission after isolated sexual contact with an HIV-positive person is unknown...”
- “[Sexual Abuse Nurse Examiner (SANE)] programs have been associated with improved compliance with medical treatment guidelines, increased quality of evidence collection, and an increased likelihood that charges are filed and successfully prosecuted, as compared with routine care.”

Review

Clinical Problem

- Definition: “Sexual assault is a broad term that includes rape, unwanted genital touching, and

even forced viewing of or involvement in pornography.”

- Less than half of rape cases are successfully prosecuted.

Strategies and Evidence

- General
 - Rape workup is time sensitive and must occur within 72-120 hours, depending on the jurisdiction.
 - It is best done at centers with a team of providers, such as emergency medicine, a sexual assault nurse examiner (SANE), and a social worker or rape counselor.
 - Some locales use a sexual assault response team (SART), with representatives from health care, forensics, the local rape crisis center,

law enforcement, and the prosecutor's office.

- SANE and SART increase the likelihood that rape cases will be successfully prosecuted, ensure proper evidence collection, and treatment of the patient.
- Evaluation for traumatic injuries
 - $\frac{2}{3}$ have other bodily trauma, even more commonly than genital injuries.
 - Anogenital injuries are not always seen, which does not rule out sexual assault.
 - Colposcopy and toluidine blue staining increases the chance of identifying injuries.
- Forensic History and Evidence Collection
 - Treatment of injuries and evidence collection should occur together, with

treatment taking precedence.

- Evidence collection and photography should follow SANE protocols.
- After medical clearance, the patient may be consented for formal evidence collection. This is a laborious, detailed, and time-consuming undertaking. It is beyond what an emergency physician can reasonably do during a busy shift, as it could take hours to complete. We refer to another local hospital where the patient can undergo forensic exam.
- Don't forget appropriate tox screening.
- Prevention of STI
 - There is a large table of STI treatment worthy of

attention. I won't reproduce it here, as you should consult the most current recommendations when this situation arises.

- Pregnancy Prevention
 - Risk of pregnancy is 5% after rape.
 - Levonorgestrel 1.5mg is recommended. This largely prevents ovulation but may prevent implantation, per the package insert. Some providers have an ethical objection to Plan B since it could prevent implantation. ACOG would not define this as abortion. Some providers do, however. An open discussion with the patient is the best course if there is a conflict for the provider. The medication is now available over the counter.
- Crisis Intervention

- “There is no normal reaction to rape.” Do not blame or judge the patient, the victim.
- Short and long term emotional ramifications are common in victims of sexual assault.
- Follow Up
 - Patients need medical and psychological follow up.
 - Check if your area has mandatory reporting of rape.
- The best form of psychotherapy following sexual assault is not known.

Review of Key Points:

Areas of Uncertainty

- The risk of HIV transmission during sexual assault is unknown.
- Risk of transmission of HIV increases with anal vs vaginal penetration, genital trauma or open ulcers, and higher viral load in the assailant.
- HIV prophylaxis greatly reduces risk but requires strict adherence and completion of treatment.
- “The exact incidence of HIV transmission after isolated sexual contact with an HIV-positive person is unknown...”
- “[Sexual Abuse Nurse Examiner (SANE)] programs have been associated with improved compliance with medical treatment guidelines, increased quality of evidence collection, and an increased likelihood that charges are filed and successfully prosecuted, as compared with routine care.”

Article 4 - Post Cardiac Arrest Syndrome - A Review of Therapeutic Strategies

Stub D et al. Post Cardiac Arrest Syndrome - A Review of Therapeutic Strategies. *Circulation*. 2011;123:1428-1435.

Questions 4 and 16 on the LLSA 2014 Test

Avoiding post-arrest hyperoxia improves mortality.

Although recently, the role of therapeutic hypothermia (TH) has come into question (as opposed to maintaining normothermia and avoiding hyperthermia), as of the writing of this article, TH was considered to be standard.

Key Points:

- “In a multicenter cohort study of 6326 patients admitted to intensive care after OHCA, arterial hyperoxia (PaO₂ 300 mm Hg) was independently associated with increased in-hospital mortality compared with patients with normoxia or hypoxia.”
- “Two randomized, controlled trials have clearly confirmed the benefit of therapeutic hypothermia (TH) after cardiac arrest. Both studies investigated mild TH in comatose adult patients after OHCA secondary to VF.”

Review

Introduction

- Out-of-hospital cardiac arrest (OHCA) kills >325,000 people a year in the US.

- Survival to discharge is only 7.6%.

Regional Systems of Care

- Such patients are extraordinarily complex.
- Care of patients in cardiac arrest centers of excellence improves mortality outcome.
- Longer transport time to such specialized facilities does not appear to negatively impact outcome.

Initial Management

- Oxygenation and Ventilation
 - 100% oxygen is used immediately after arrest. By all means, avoid hypoxia, but it can be too much of a good thing.
- Hyperoxia for an extended period post-arrest increases mortality.

- As soon as possible, decrease levels of oxygen to maintain SpO₂ 94-96%.
- Hypocarbica causes cerebral vasoconstriction and should be avoided.
- Circulatory Support
 - Usually fluid and vasopressors are adequate.
 - Early echo to assess myocardial dysfunction is helpful.
 - An intra-aortic balloon pump in patients not responsive to fluid and vasopressors may be beneficial.
 - Some patients may require ECMO or may need a left ventricular assist device (LVAD).
- Therapeutic Hypothermia
 - TH as a form of neuroprotection has a strong evidence base and is recommended in this review.

That is important to know for the LLSA Test.

- However, recent studies show that hypothermia may not be most important. Rather normothermia and strict avoidance of hyperthermia may be what produces benefit.
- Other forms of neuroprotection
 - Preventing seizures is important.
 - Thiopentone, magnesium, and calcium channel blockade have not been shown to be helpful neuroprotective agents.

Management of Acute Coronary Syndrome in the OHCA Patient

- PCI is beneficial in patients with post-arrest STEMI on ECG.
- However, benefit in post-arrest NSTEMI is less clear.

- “The largest series in coronary intervention and OHCA has found that primary PCI was an independent predictor of survival regardless of initial ECG findings.” Oddly, though many of our cardiologists were authors of one of the sentinel papers, they are still reluctant to take patients who do not have obvious post-arrest STEMI.
- PCI + TH (or 36°C) may have a synergistic effect on survival.

Prognostication

- Clinical Exam
 - TH may delay performance of a reliable exam for up to 72 hours.
 - In the TH era, “a retrospective review of 36 patients, the authors found that the absence of motor responses better than extensor posturing on day 3

may not be reliable, whereas absent papillary and corneal reflexes at day 3 remained accurate at predicting hopeless prognosis in the hypothermia setting.”

- Neurophysiologic tests
 - Somatosensory evoked potentials and EEG may be used but are not ideal predictors of which patients will have meaningful recovery.
- Biomarkers are not routinely used to prognosticate.

Review of Key Points:

- “In a multicenter cohort study of 6326 patients admitted to intensive care after OHCA, arterial hyperoxia (PaO₂ 300 mm Hg) was independently associated with increased in-hospital mortality compared

with patients with normoxia or hypoxia.”

- “Two randomized, controlled trials have clearly confirmed the benefit of therapeutic hypothermia (TH) after cardiac

arrest. Both studies investigated mild TH in comatose adult patients after OHCA secondary to VF.”

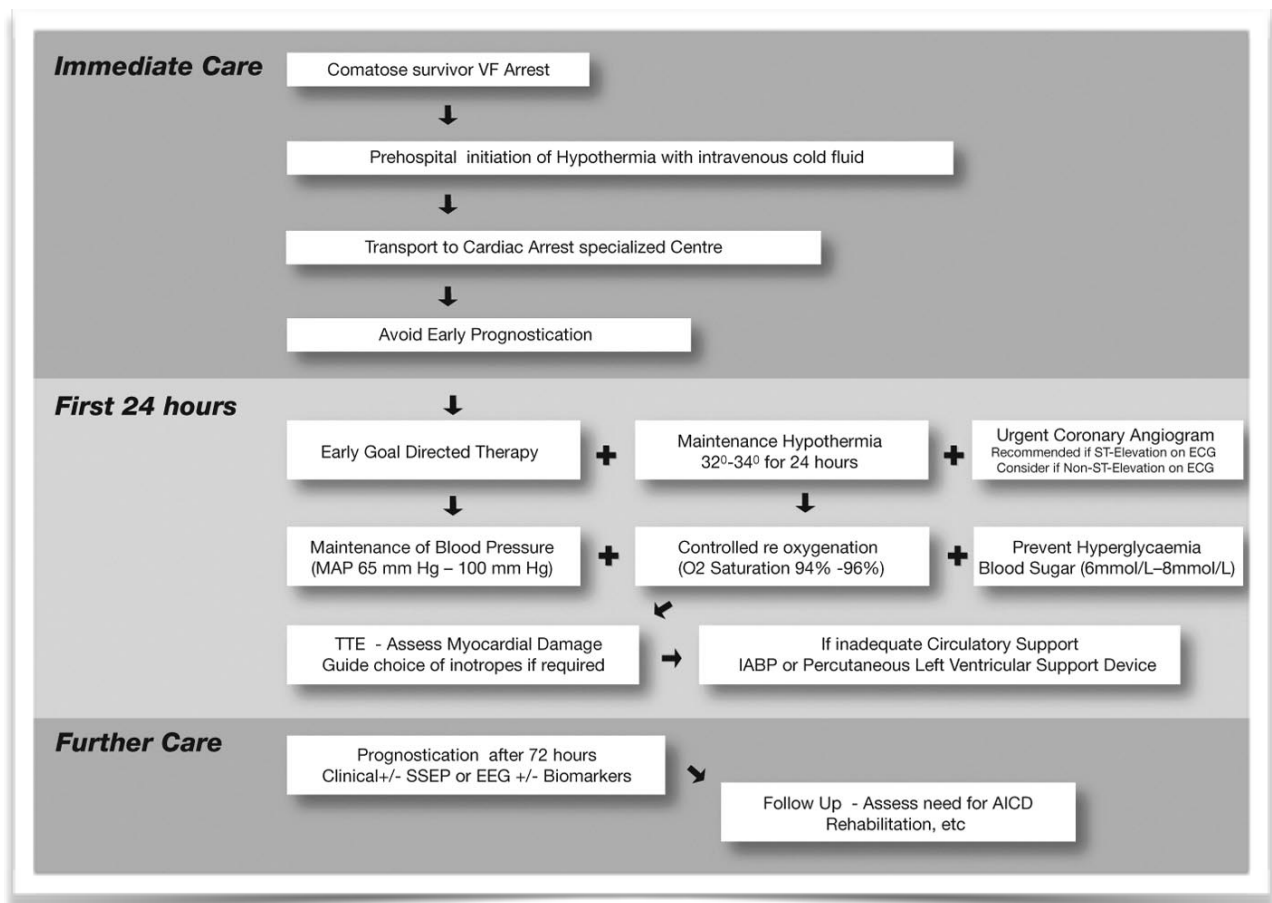


Figure from the article cited above.

**Article 5 - Clinical Policy:
Critical Issues in the
Evaluation of Adult Patients
Presenting to the Emergency
Department With Acute Blunt
Abdominal Trauma**

**Diercks DB et al. Clinical Policy:
Critical Issues in the Evaluation
of Adult Patients Presenting to
the Emergency Department With
Acute Blunt Abdominal Trauma.
Ann Emerg Med 2011;57:387-404.**

**Question 5 and 17 on the
LLSA 2014 Test**

FAST (ultrasound) is an effective way to determine which hemodynamically unstable patients will need emergent operative management.

Stable patients with abdominal trauma and normal CT may be safely discharged.

Key Points:

- “In hemodynamically unstable patients (systolic blood pressure \leq 90 mm Hg) with blunt abdominal trauma, bedside ultrasound, when available, should be the initial diagnostic modality performed to identify the need for emergent laparotomy.”
- “Clinically stable patients with isolated blunt abdominal trauma can be safely discharged after a negative result for abdominal CT with IV contrast (with or without oral contrast).”

Review

This is an evidence-based clinical policy from ACEP.

In a hemodynamically unstable patient with blunt abdominal trauma is bedside ultrasound the diagnostic modality of choice?

- FAST exam is the imaging modality of choice for hemodynamically unstable patients to predict need for laparotomy. Level B recommendation
- Comments - Gone are the days of DPL. Good luck getting your trauma surgeon to take a patient to the OR without CT. However, per the review and for the test, go with the Level B recommendation above.

Does oral contrast improve the diagnostic performance of CT in blunt abdominal trauma?

- Level B - “Oral contrast is not required in the diagnostic

imaging for evaluation of blunt abdominal trauma.*”

- “*All of the studies reviewed included the use of intravenous (IV) contrast.”
- Comments - We never use oral contrast in trauma patients.

In a clinically stable patient with isolated blunt abdominal trauma, is it safe to discharge the patient after a negative abdominal CT scan result?

- Level B - “Clinically stable patients with isolated blunt abdominal trauma can be safely discharged after a negative result for abdominal CT with IV contrast (with or without oral contrast).”
- Level C - “Further observation, close follow-up, and/or imaging may be warranted in select patients based on clinical judgment.”

- Comments - Patients with severe tenderness, especially bike handlebar injury or seatbelt sign warrant admission for serial exams.

In patients with isolated blunt abdominal trauma, are there clinical predictors that allow the clinician to identify patients at low risk for adverse outcome who do not need an abdominal CT?

- Level C - “Patients with isolated abdominal trauma, for whom occult abdominal injury is being considered, are at low risk for adverse outcome and may not need abdominal CT scanning if the following are absent: abdominal tenderness, hypotension, altered mental status (Glasgow Coma Scale score 14), costal margin tenderness, abnormal chest

radiograph, hematocrit 30% and hematuria.*”

- “*Hematuria is defined variably in different studies, with the lowest threshold being greater than or equal to 25 RBCs/high-power field (HPF).”
- Comments - It is hard not to image a patient who comes in with blunt abdominal trauma, and it is the rare patient who meets all of the above criteria.
- I am less inclined to CT kids, and my imaging threshold is higher. The PECARN group has done [important study](#) in this area.

Review of Key Points:

- “In hemodynamically unstable patients (systolic blood pressure \leq 90 mm Hg) with blunt abdominal trauma,



bedside ultrasound, when available, should be the initial diagnostic modality performed to identify the need for emergent laparotomy.”

- “Clinically stable patients with isolated blunt abdominal trauma can be safely discharged after a negative result for abdominal CT with IV contrast (with or without oral contrast).”

Article 6 - Does This Patient Have a Severe Upper Gastrointestinal Bleed?

Srygley FD et al. Does This Patient Have a Severe Upper Gastrointestinal Bleed? JAMA. 2012;307(10):1072-1079.

Question 6 on the LLSA 2014 Test

BUN:Creatinine ratio > 30 predicts UGIB, with positive LR 7.5.

Melena matters - history of or finding of melena on exam are powerful in discriminating UGIB from LGIB.

Key Points:

- “An increased serum urea nitrogen:creatinine ratio suggests a UGIB...with a summary LR of 7.5 (95% CI, 2.8-12.0).”
- “Increasing severity of anemia increases the likelihood of UGIB. Patients with severe anemia (hematocrit \leq 20%) are more likely to have a UGIB (LR, 2.6; 95% CI, 1.4-4.6), but those with no anemia are less likely to have a UGIB.”
- Note, the LR for degree of anemia is much lower than BUN:Creatinine ratio.

Study Question

- What are the the, “historical features, symptoms, signs, bedside maneuvers, and basic laboratory test results that distinguish acute upper GIB

(UGIB) from acute lower GIB (LGIB)”?

- What is the best way to, “risk stratify those patients with a UGIB least likely to have severe bleeding that necessitates an urgent intervention”?

Study Design

Meta-analysis

Synopsis

- This was a structured literature search and meta-analysis to answer the study questions.
- The following variables increase the likelihood of UGIB:
 - history of melena (LR range, 5.1- 5.9)
 - melenic stool on examination (LR, 25; 95% CI, 4-174)
 - a nasogastric lavage with blood or coffee grounds (LR, 9.6; 95% CI, 4.0-23.0)

- NOTE: A *negative* NG aspirate is of no diagnostic value, only a positive aspirate matters. NG aspirate has low sensitivity, high specificity.
- serum urea nitrogen:creatinine ratio of more than 30 (summary LR, 7.5; 95% CI, 2.8-12.0)
- NSAID use did not predict UGIB.
- Clots in stool (LR, 0.05; 95% CI, 0.01-0.38) decreases the likelihood of UGIB.
- Predictors of *severe* UGIB needing urgent intervention included:
 - nasogastric lavage with red blood (summary LR, 3.1; 95% CI, 1.2-14.0)
 - tachycardia (LR, 4.9; 95% CI, 3.2- 7.6)
 - hemoglobin level of less than 8 g/dL (LR range, 4.5-6.2)
- The only variable that decreased the likelihood that a

UGIB requires urgent intervention was a Blatchford score of 0 (summary LR, 0.02; 95% CI, 0-0.05).

Take Home Points

- Clinical variables can predict UGIB vs. LGIB.
- Clinical variables can, but are not as strongly predictive of severe UGIB.
- The **Blatchford Score** is a powerful predictor of stability and of patients who may be safely managed as outpatients.
- The rectal exam matters. I had a surly Internal Medicine resident recently try to tell me that doing a rectal exam was unnecessary in the workup of UGIB. Wrong... positive LR = 25 makes it a very important discriminator.
- A simple lab value, like the lowly BUN:creatinine ratio >30, is a powerful diagnostic test to determine UGIB vs. LGIB.

Limitations

- In several studies, the definite source of bleeding was unknown.
- Also, some of these clinical variables have few studies from which to pool the evidence.
- Variables requiring NG tube are fine, but placing an NG tube is one of the most uncomfortable procedures we do in the ED.

Review of Key Points:

- “An increased serum urea nitrogen:creatinine ratio suggests a UGIB...with a summary LR of 7.5 (95% CI, 2.8-12.0).”
- “Increasing severity of anemia increases the likelihood of UGIB. Patients with severe anemia (hematocrit \leq 20%) are more likely to have a UGIB



(LR, 2.6; 95% CI, 1.4-4.6), but those with no anemia are less likely to have a UGIB.”

- Note, the LR for degree of anemia is much lower than BUN:Creatinine ratio.

Article 7 - Preoxygenation and Prevention of Desaturation During Emergency Airway Management

Weingart SD et al.
Preoxygenation and Prevention of Desaturation During Emergency Airway Management.
Ann Emerg Med 2012;59:165-175.

Questions 7, 11, and 18 on the LLSA 2014 Test

Head up vs supine position prolongs the time to desaturation during apnea.

Use non-invasive positive pressure ventilation if a standard non-rebreather mask at 30-60 L/min does not improve SpO₂ beyond 93-95%.

Most patients may be adequately pre-oxygenated with a non-rebreather mask. Turn the valve up past 15 L/min; most will deliver 30-60 L/min, though the regulator only reads a max of 15 L/min.

Key Points:

- “Supine positioning is not ideal to achieve optimal preoxygenation... Patients should receive preoxygenation in a head-elevated position whenever possible.” Multiple studies are cited that confirm head up vs. supine position increases the duration of apnea time before desaturation.
- “Recommendation: CPAP masks, noninvasive positive pressure ventilation, or PEEP valves on a bag-valve-mask device should be considered for preoxygenation and ventilation during the onset phase of muscle relaxation in patients who cannot achieve saturations greater than 93% to 95% with high FiO₂.”
- “Recommendation: Standard reservoir facemasks with the

flow rate of oxygen set as high as possible [30-60L/min] are the recommended source of high FiO₂ for preoxygenation in the ED.”

Review

Introduction

- Desaturation increases risk for cardiac arrhythmia and death during intubation.
- Patients with preexisting illness desaturate more quickly, often within seconds.
- Planning and pre-oxygenation may prevent this.

WHAT IS THE RATIONALE FOR PROVIDING PREOXYGENATION BEFORE TRACHEAL INTUBATION?

- It extends the duration of safe apnea before the SpO₂ decreases below 88-90%
- This is the steep part of the oxyhemoglobin dissociation curve, below which hemoglobin oxygen saturation precipitously declines.
- Rapid sequence induction (RSI) gives sedation and paralytics in succession and provides no ventilation during the apneic phase to avoid gastric distention and lower aspiration risk. Making this unavoidable period of apnea as safe as possible is the goal, and adequate pre-oxygenation is key.

WHAT IS THE BEST SOURCE OF HIGH FIO₂ FOR PREOXYGENATION?

- A normal non-rebreather mask in the ED is adequate, but turn up the oxygen flow rate. The valve may register a max of 15L/min but will actually deliver much more. 15 L/min is not enough.
- “Standardly available nonrebreather masks can deliver FiO₂ greater than or equal to 90% by increasing the flow rate to 30 to 60 L/minute. Such flow rates may be achievable on most flow regulators in EDs by continuing to open the valve, though there will be no calibrated markings beyond 15 L/minute.”

FOR WHAT PERIOD OF TIME SHOULD THE PATIENT RECEIVE PREOXYGENATION?

- 3 minutes of normal breathing at 90% FiO₂ is usually enough.
- “Recommendation: Patients with an adequate respiratory drive should receive preoxygenation for 3 minutes or take 8 breaths, with maximal inhalation and exhalation.”

CAN INCREASING MEAN AIRWAY PRESSURE AUGMENT PREOXYGENATION?

- Yes it can but is usually indicated only in patients who cannot improve SpO₂ over 93-95% with usual pre-oxygenation above.
- “The benefits of noninvasive positive-pressure ventilation for preoxygenation in the ED should primarily be observed in



patients who cannot achieve acceptable saturations with high FiO₂ alone.”

IN WHAT POSITION SHOULD THE PATIENT RECEIVE PREOXYGENATION?

- Sitting up slightly or reverse Trendelenberg position vs supine position reduces posterior dependent atelectasis and prolongs the apneic period before desaturation occurs.
- “Patients should receive preoxygenation in a head-elevated position whenever possible.”

HOW LONG WILL IT TAKE FOR THE PATIENT TO DESATURATE AFTER PREOXYGENATION?

- This is highly unpredictable. In patient with normal lungs and

no comorbid illness, desaturation occurs after 1 minute on room air and about 8 minutes on 100% oxygen.

- The problem is, most patients in the ED who require RSI have abnormal lung function or critical illness with increased oxygen consumption. Many have reduced cardiac output, volume depletion, shunting, or anemia, all of which reduce oxygen delivery.
- “Recommendation: Given the unique variables involved in each ED tracheal intubation, it is impossible to predict the exact duration of safe apnea in a patient.”

CAN APNEIC OXYGENATION EXTEND THE DURATION OF SAFE APNEA?

- Yes it can. We have started using this on all our ED intubations. The recent FELLOW trial calls this into question but there are several issues with this trial that may have blunted the effect of ap-ox in this study.
- “Recommendation: Apneic oxygenation can extend the duration of safe apnea when used after the administration of sedatives and muscle relaxants. A nasal cannula set at 15 L/minute is the most readily available and effective means of providing apneic oxygenation during ED tracheal intubations.”

WHEN AND HOW SHOULD WE PROVIDE MANUAL VENTILATIONS DURING THE APNEIC PERIOD?

- This answer is that it depends on the patient's starting point from a pulmonary standpoint.
- "Recommendation: The risk/benefit of active ventilation during the onset phase of muscle relaxants must be carefully assessed in each patient. In patients at low risk for desaturation (95% saturation), manual ventilation is not necessary. In patients at higher risk (91% to 95% saturation), a risk-benefit assessment should include an estimation of desaturation risk and the presence of pulmonary pathology. In hypoxemic patients, low-pressure, low-volume, low-rate ventilations will be required."

WHAT POSITIONING AND MANEUVERS SHOULD THE PATIENT RECEIVE DURING THE APNEIC PERIOD?

- Airway patency is key to successful apnea oxygenation. If the oxygen stays in the pharynx, it isn't doing much good.
- "Recommendation: Patients should be positioned to maximize upper airway patency before and during the apnea period, using ear-to-sternal notch positioning. Nasal airways may be needed to create a patent upper airway. Once the apnea period begins, the posterior pharyngeal structures should be kept from collapsing backwards by using a jaw thrust. Cricoid pressure may negatively affect apneic oxygenation, but studies examining this question in the setting of modern emergency

airway management do not exist to our knowledge."

DOES THE CHOICE OF PARALYTIC AGENT AFFECT PREOXYGENATION?

- Fasciculations from succinylcholine increase oxygen consumption, which make a small but potentially significant difference.
- "Recommendation: In patients at high risk of desaturation, rocuronium may provide a longer duration of safe apnea than succinylcholine."

RISK STRATIFICATION AND CONCLUSIONS

- Table 2 depicts this best.
- The best pre-oxygenation strategy depends on the starting SpO₂.

Review of Key Points:

- “Supine positioning is not ideal to achieve optimal preoxygenation... Patients should receive preoxygenation in a head-elevated position whenever possible.” Multiple studies are cited that confirm head up vs. supine position increases the duration of apnea time before desaturation.
- “Recommendation: CPAP masks, noninvasive positive pressure ventilation, or PEEP valves on a bag-valve-mask device should be considered for preoxygenation and ventilation during the onset phase of muscle relaxation in patients who cannot achieve saturations greater than 93% to 95% with high FiO₂.”
- “Recommendation: Standard reservoir facemasks with the flow rate of oxygen set as high as possible [30-60L/min] are the recommended source of high FiO₂ for preoxygenation in the ED.”

Table 2. Risk categorization of patients during preoxygenation.*

Risk Category, Based on Pulse Oximetry While Receiving High-Flow Oxygen	Preoxygenation Period (3 Minutes)	Onset of Muscle Relaxation (≈60 Seconds)	Apneic Period During Tracheal Intubation (Variable Duration, Depending on Airway Difficulty; Ideally <30 Seconds)
Low risk, SpO ₂ 96%–100%	Nonrebreather mask with maximal oxygen flow rate	Nonrebreather mask and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min
High risk, SpO ₂ 91%–95%	Nonrebreather mask or CPAP or bag-valve-mask device with PEEP	Nonrebreather mask, CPAP, or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min
Hypoxemic, SpO ₂ 90% or less	CPAP or bag-valve-mask device with PEEP	CPAP or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min

*Risk categories are based on patient's initial response to high-flow oxygen through a tightly fitting nonrebreather mask. Patients who are already hypoxemic exhibit shunt physiology and are prone to rapid desaturation during the peri-intubation. Patients with saturations of 91% to 95% have values close to the precipice of the steep portion of the oxyhemoglobin dissociation curve and should be considered high risk. Patients with saturations greater than or equal to 96% are at low risk for peri-intubation desaturation. Patients in all risk categories should receive preoxygenation in a head-elevated position (or reverse-Trendelenburg if there is a risk of spine injury).

Article 8 - Sensitivity of computed tomography performed within six hours of onset of headache for diagnosis of subarachnoid haemorrhage: prospective cohort study.

Perry JJ et al. Sensitivity of computed tomography performed within six hours of onset of headache for diagnosis of subarachnoid haemorrhage (SAH): prospective cohort study. BMJ 2011;343:d4277 doi: 10.1136/bmj.d4277.

Question 8 on the LLSA 2014 Test

Patients presenting with acute, severe headache (HA) should be given high priority, and CT should be ordered as rapidly as possible to optimize SAH detection.

Key Points:

- "...Given the deterioration of the sensitivity of computed tomography over hours, we believe that urgent evaluation and imaging of emergency patients presenting with acute headache should be prioritised in keeping with a 'brain attack' paradigm. Likewise, it is important that patients undergo imaging quickly after arrival to allow for a larger proportion of patients to be imaged within the six hour window."

Study Question

What is the sensitivity of modern generation CT scanners for SAH, especially within 6 hours of HA onset?

Study Design

Prospective cohort

Synopsis

- Patients presenting with severe HA, maximal intensity within one hour of onset and who underwent CT head were included.
- SAH was defined by - "subarachnoid blood on computed tomography, xanthochromia in cerebrospinal fluid, or any red blood cells in final tube of cerebrospinal fluid collected with positive results on cerebral angiography."
- Of the > 3000 patients, overall sensitivity was 92.9%.
- But in patients who underwent CT within 6 hours of HA onset, sensitivity was 100%.

- Authors concluded that in the era of modern CT scanners, with images read by a qualified radiologist, CT within 6 hours was definitive and obviated the need for further workup, i.e. lumbar puncture.

Limitations

- Patients with larger bleeds may have had worse symptoms, perceived greater severity, more rapid triage, and better early detection, which could have confounded the results.
- However, authors noted that, “The only slightly higher prevalence of subarachnoid haemorrhage (12%) in the group seen in less than six hours suggests any such bias was in fact minor...”

Take Home Points

- Patients presenting with severe HA and concern for SAH should have high triage priority and CT imaging as rapidly as possible.
- CT with a modern generation scanner, read by a qualified radiologist within 6 hours of HA onset can be considered a definitive rule out for SAH and obviate the need for further testing, such as LP.

Review of Key Points:

- “...Given the deterioration of the sensitivity of computed tomography over hours, we believe that urgent evaluation and imaging of emergency patients presenting with acute headache should be prioritised in keeping with a ‘brain attack’

paradigm. Likewise, it is important that patients undergo imaging quickly after arrival to allow for a larger proportion of patients to be imaged within the six hour window.”

Article 9 - Identifying Nontechnical Skills Associated With Safety in the Emergency Department

**Wolf SJ et al. Identifying
Nontechnical Skills Associated
With Safety in the Emergency
Department: A Scoping Review of
the Literature. Ann Emerg Med.
2012;59:386-394.**

Questions 9 and 20 on the LLSA 2014 Test

Communication failure may occur
when there is a power differential.

Repeating back the communication
you received (closed-loop
communication) to confirm or clarify
is smart and enhances patient
safety.

Key Points:

- "...Barriers to effective communication included (1) hierarchy, in which nurses and junior physicians were reluctant to question senior colleagues; (2) noise in the department; and (3) the absence of somewhere to speak in private."
- "[Closed-loop communication], in which the message is repeated to ensure correct transmission, could potentially reduce errors caused by 'slips' (errors in the performance of skill-based behaviors that occur when our attention is diverted)."

Study Question

What does the literature say about the non-technical skills associated with safety in the ED?

Study Design

Systematic review (called a "scoping review")

Synopsis

- Using a structured literature search, they found the following nontechnical skills linked to safety and performance in the ED: communicating, managing workload, anticipating, situational awareness, supervising and providing feedback, leadership, maintaining standards, using assertiveness, and decision-making.
- Nontechnical skills are "the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance."
- The authors ramblingly discuss the 9 nontechnical skills listed above.

- This article was painful.

Limitations

- There is no standardized terminology in the literature covering these subjects, so undoubtedly the search was incomplete.
- The quality of the included articles was very low; most were qualitative studies.

Take Home Points

- It is important to allow open communication whenever there is a power differential.
- Closed-loop communication is key. If they have to repeat back your order at Burger King to confirm “no onions”, surely we should repeat orders for paralytic agents to make sure the orderer and giver of drugs are on the same page.
- Interruptions are killers, and we have an abundance of that in

the ED. Strategies to minimize interruptions would be great. Good luck with that.

Review of Key Points:

- “...Barriers to effective communication included (1) hierarchy, in which nurses and junior physicians were reluctant to question senior colleagues; (2) noise in the department; and (3) the absence of somewhere to speak in private.”
- “[Closed-loop communication], in which the message is repeated to ensure correct transmission, could potentially reduce errors caused by ‘slips’ (errors in the performance of skill-based behaviors that occur when our attention is diverted).”

Article 10 - Diagnosis and Management of Sports-Related Concussion

Zafonte R. Diagnosis and Management of Sports-Related Concussion. JAMA. 2011;306(1):79-86.

Questions 10 and 24 on the LLSA 2014 Test

Neurologic dysfunction resolves spontaneously, by definition, in patients with concussion.

Return to play is stepwise and does not begin until the athlete is asymptomatic at rest.

Key Points:

- "...the consensus of experts suggests that after concussion,

an athlete should undergo physical and cognitive rest until asymptomatic. ...After symptoms fully resolve, an athlete may return to a trial of activity..."

- "Typically, concussion results in rapid-onset neurophysiologic and neurologic dysfunction that resolves in a spontaneous manner over a relatively short period."

Review

Definition and Pathophysiology

- Concussion involves functional rather than structural injury.
- It occurs as a result of shearing or stretching axons, usually from acceleration/deceleration mechanism.
- Neurotransmitters are released and ion channels and ion flux are affected. There is

combined increased glucose utilization and impaired blood flow.

- This explains the importance of physical and cognitive rest during recovery.

Epidemiology

- Sports related concussions are increasing in frequency.
- Skiing, horseback riding, and football are the top three sports resulting in concussion.

Evaluation after fall and LOC

- A structured assessment on scene, like SCAT2 is best.
- Any youth or adolescent athlete should never return to play on the day of the accident.

Management of first concussion

- Athletes need both physical and cognitive rest until no symptoms are present at rest.

- There is a supervised return to play with graded increased exertion, with 24 hours between steps. Athletes may only progress if asymptomatic at each stage.

Prognosis after first concussion

- Most are better in 7-10 days.
- Recovery may be significantly longer in some, especially younger patients.

Prognosis after second concussion

- The feared complication is second-impact syndrome. It is not well understood and is rare.
- “Second-impact syndrome is defined as a second concussion that occurs soon after the initial concussion, resulting in profound brain swelling and vascular dysregulation.”

- It has a 50% mortality rate and 100% morbidity.
- Patients with multiple concussions have slower recovery.
- Also in the news due to the NFL is “chronic traumatic encephalopathy/posttraumatic encephalopathy, which can cause cognitive, motor, and behavioral problems,” even dementia like problems.

Prevention

- Helmets reduce the incidence of concussion significantly.
- Rule changes in football have also reduced head injuries.

Review of Key Points:

- “...the consensus of experts suggests that after concussion, an athlete should undergo physical and cognitive rest until asymptomatic. ...After symptoms fully resolve, an

athlete may return to a trial of activity...”

- “Typically, concussion results in rapid-onset neurophysiologic and neurologic dysfunction that resolves in a spontaneous manner over a relatively short period.”

Article 11 - Neonatal Resuscitation

Bobrow BJ, Spaite DW, Berg RA, et al. Neonatal Resuscitation - 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122[suppl]:S909 –S919.

Question 12, 15, and 21 on the LLSA 2014 Test

Improvement in HR is the best indicator that resuscitative efforts are succeeding.

Vigorous babies with meconium stained fluid do not require any intervention.

When in doubt in real life or on the test, just bag the baby (give PPV).

Key Point:

- “The most sensitive indicator of a successful response to each step is an increase in heart rate.”
- “Elective and routine endotracheal intubation and direct suctioning of the trachea were initially recommended for all meconium-stained newborns until a randomized controlled trial demonstrated that there was no value in performing this procedure in babies who were vigorous at birth.”
- “If the infant remains apneic or gasping, or if the heart rate remains 100 per minute after administering the initial steps, start PPV.”

Review

Is resuscitation needed?

- A 1) term, 2) crying or breathing, 3) vigorous baby does not need any help. Just place skin-to-skin with the mother.
- If all of the above are not present, the baby may need:
 - A. Initial steps in stabilization (provide warmth, clear airway if necessary, dry, stimulate)
 - B. Ventilation
 - C. Chest compressions
 - D. Administration of epinephrine and/or volume expansion

Initial Steps

- Just remember: warm, dry, suction, stimulate. This works most of the time.
- Temperature control is key. Have a warmer, especially for premature infants.
- You don't have to suction every baby with clear amniotic fluid

unless obvious obstruction is present.

- There is no benefit to tracheal suctioning of vigorous babies with meconium stained amniotic fluid. Only suction the trachea if depressed at birth.
- Pulse oximeter values may hover in the 70-80% range in the first several minutes after birth, and that is normal. Values will approach normal by about 10 minutes.
- If apneic or gasping or HR <100, start positive pressure ventilation (PPV) if the initial steps have not helped. Focus on chest wall movement rather than pressures for the first few breaths. The lungs start out very stiff. Just move the chest.
- Chest compressions should be started if HR < 60 despite PPV. Use thumbs. 3:1 compression:ventilation ratio.
- Some babies need epinephrine 0.01 mg/kg if ventilation and compressions fail.

Newborn Resuscitation

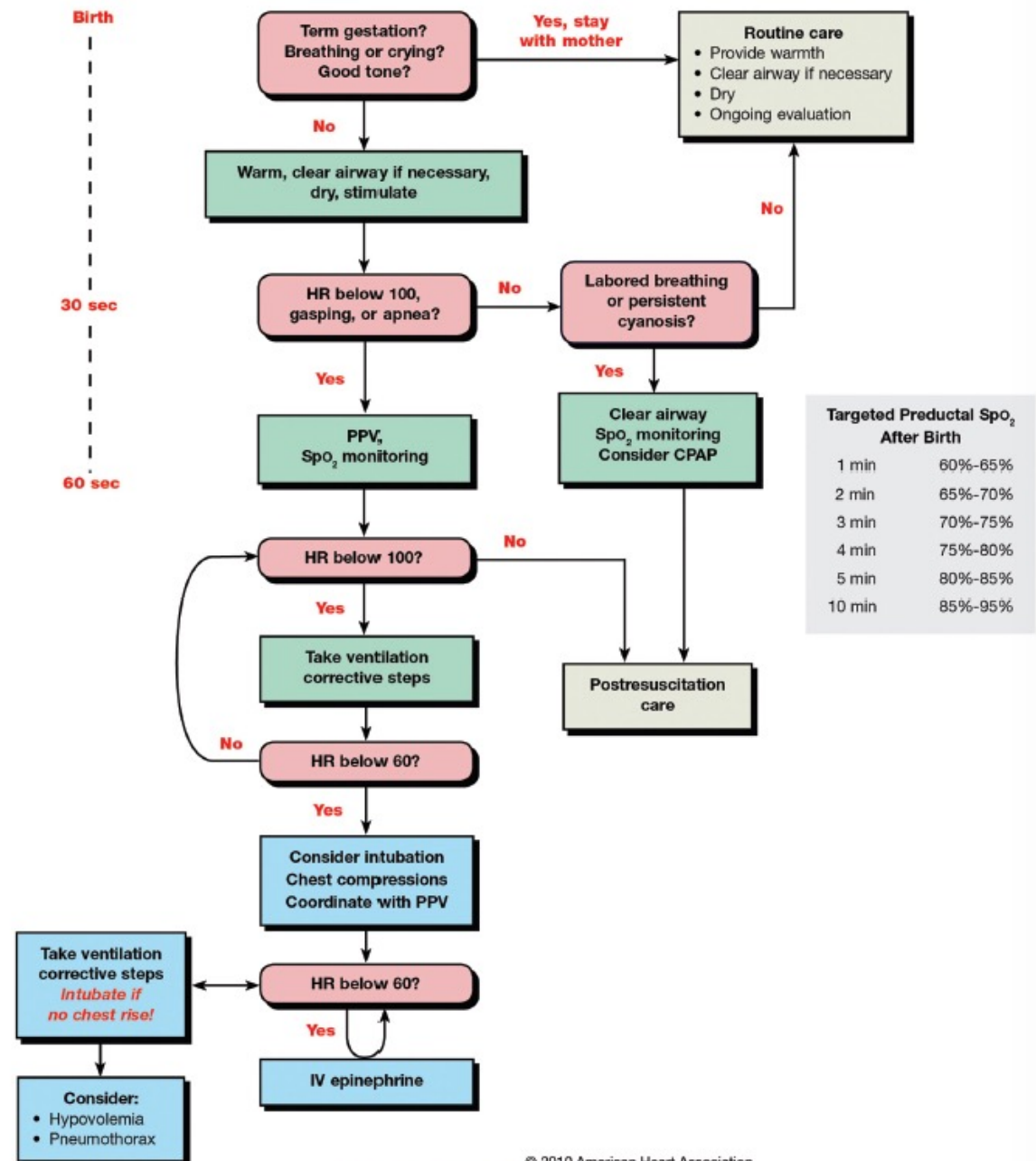


Figure. Newborn Resuscitation Algorithm.

Figure from citation above.

- Consider 10mL/kg NS if blood loss or ongoing poor perfusion.

Withholding or Stopping

- In babies born pre-viable (<23 weeks), with known congenital illness not compatible with life (e.g. anencephaly), it is acceptable to withhold resuscitation.
- If no HR after 10 minutes, consideration should be given to discontinuing resuscitation.

until a randomized controlled trial demonstrated that there was no value in performing this procedure in babies who were vigorous at birth.”

- “If the infant remains apneic or gasping, or if the heart rate remains 100 per minute after administering the initial steps, start PPV.”

Review of Key Points:

- “The most sensitive indicator of a successful response to each step is an increase in heart rate.”
- “Elective and routine endotracheal intubation and direct suctioning of the trachea were initially recommended for all meconium-stained newborns

Article 12 - Torsion of the Testicle.

Mellick LB. Torsion of the Testicle. *Pediatr Emer Care* 2012;28:80-86.

Question 14 and 22 on the LLSA 2014 Test

If the history and exam are concerning for TT, yet Doppler ultrasound is normal, remain suspicious that imaging is falsely negative and consult urology.

Color Doppler ultrasound is a good diagnostic tool. But even better is when the knot is seen in the spermatic cord.

Key Points:

- “If after diagnostic steps are accomplished and the

diagnosis remains unclear, a concurrent consultation with a urology colleague to share in the decision making should be accomplished. If based on the history and examination the potential risk of TT remains, surgical exploration may be appropriate despite apparently normal imaging studies.”

- “The most important finding on ultrasound seems to be the identification of the torsion knot in the spermatic cord.”

Review

Myth 1: Testicular Torsion Can Be Consistently Ruled Out by Physical Examination Alone

- Acute scrotal pain = testicular torsion (TT).
- Findings such as cremasteric reflex, redness, abnormal lie may or may not be present in cases of TT.

- Just because the exam is reassuring does not mean it can't be TT.

Myth 2: Testicular Torsion Can Be Differentiated From Other Causes of Scrotal Pathology by Its Pathognomonic History

- Rapid onset and severe pain may also be seen with other scrotal pathologies.
- Nausea and vomiting are also common with TT but may also be seen with epididymitis, etc.
- TT is not usually associated with dysuria but may be on occasion.
- In summary, the history may suggest an alternative diagnosis but is not predictive enough to exclude TT.

Myth 3: Testicular Torsions That Present After 6 Hours Are Not Salvageable and No Longer Need to Be Evaluated in a Timely Manner

- 6 hours is the usual time frame quoted for viability of the torsed testicle.
- But numerous case series have documented viability at even up to 48 hours, though with a significant decrement over time.

Myth 4: Color Doppler Ultrasound Is a Consistently Reliable Tool for Confirming the Diagnosis of Testicular Torsion

- Color Doppler ultrasound is far from perfect. Early on, decreased venous outflow predominates and arterial signals may still be seen.
- If the history and exam are concerning but ultrasound is normal, consult urology.

- If it is seen, a knot in the spermatic cord is the most important finding. It was visible in 96% of patients in one study, as opposed to abnormal color Doppler seen in only 76% of the same patients, all of whom were ultimately diagnosed with TT.

Review of Key Points:

- “If after diagnostic steps are accomplished and the diagnosis remains unclear, a concurrent consultation with a urology colleague to share in the decision making should be accomplished. If based on the history and examination the potential risk of TT remains, surgical exploration may be appropriate despite apparently normal imaging studies.”
- “The most important finding on ultrasound seems to be the

identification of the torsion knot in the spermatic cord.”