Head-Elevated Patient Positioning Decreases Complications of Emergent Tracheal Intubation in the Ward and Intensive Care Unit

- **Question:** Does elevating the head of the bed during endotracheal intubation reduce complications during an emergent intubation setting?
- **Bottom-line:** Raising the head of the bed (>30°) to maintain a horizontal line between sternal notch to external auditory meatus during intubation was associated with a reduction in airway related complications during emergent intubations.
- **Problem:** There is data (described elsewhere) that electively intubating patients while elevating the head of their bed is associated with reduction in complications in the operating room. This is due to better pulmonary dynamics, less hypoxemia, and better alignment of airway axis (less esophageal intubations and less aspiration). There is also evidence of these benefits while intubating obese patients.
- **What they did:** retrospective chart review of 528 patients who were emergently intubated outside of the OR setting. All intubations were initially attempted by direct laryngoscopy for any indication except cardiac arrest.
- **Primary endpoint:** was the occurrence of a composite of any intubation-related complication including a difficult intubation, esophageal intubation, pulmonary aspiration or hypoxemia. The authors found that when patients were intubated supine, at least one complication occurred in 76 of the 336 (23%) whereas complications only occurred in 18 of the 192 (9%) patients intubated with a back-up head-elevated position.
- **Strengths:** demonstrates what previous data has shown about positioning during intubation, patients who were deemed difficult were included
- **Weaknesses:** Retrospective, data was self-reported by the anesthesiologist, not an ED study by Emergency Medicine providers, perhaps difficult airways were excluded as DL wouldn’t have been included as a first-attempt in these patients.

Feasibility of upright patient positioning and intubation success rates at two academic emergency departments

- **Question:** Does elevation of the head of the bed improve intubation success in the Emergency Department?
- **Bottom-line:** This trial demonstrated a benefit for intubation when the head of the bed is upright as opposed to supine positioning. This study adds to the literature which has previously demonstrated a benefit with this positioning.
- **Problem:** Emergency endotracheal intubation is typically performed with the patient supine, however there is an associated increase in complications with this positioning (e.g., aspiration, hypoxemia, elevated ICP, and difficult intubation). Prior anesthesia studies have demonstrated a reduction in complications during intubations, including desaturations and esophageal intubations. There is a paucity of data for this technique of positioning in the Emergency Department.
- **What they did:** This was a prospective, observational study conducted at two academic sites. Prior to the study, faculty and residents were trained to intubate with the HOB elevated to 45 degrees. Once the study began, residents performed the procedure and were allowed to choose the angle for the HOB that they preferred; this angle was recorded. After the intubation a survey was conducted asking about the tools used, the changes to the angle of the HOB, adverse events, etc.
- **Primary outcome:** Successful intubation on the first attempt
- **Secondary endpoint:**
  - Cardiac arrest within 30 minutes of intubation
  - Overall success rate
  - Time required for intubation
  - Esophageal intubation
  - Reduction in oxygen saturation during intubation
  - Best view during the procedure
• Resident satisfaction with positioning
• Death in ED or within 5 days
• New PNA within 5 days of intubation

**What they found:** Data on 231 intubations were analyzed (over 58 different residents); 38 patients (16%) in the supine, 69 (29%) in inclined position, and 125 (54%) in the upright position. First pass success rates were significantly higher in upright (>45) as compared to supine (0-10) or included (11-44) group. In fact, for each 5 degrees of incline, odds for first pass success improved. This remained the case even when patients and operator characteristics were accounted for. There were significantly more post-intubation cardiac arrest in the supine group.

**Strengths:** Prospective, first of its kind, and multi-center.

**Weaknesses:** Selection bias, non-randomized, first pass success slightly lower than other studies raising questions of population bias.

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**Body mass index is associated with inappropriate tidal volumes in adults intubated in the ED**

• **Question:** Low tidal volumes (6-8cc/kg) are somewhat routine for mechanical ventilation, but what tidal volumes do obese patients receive when they are mechanically ventilated?
• **Bottom-line:** As a patient’s BMI increases there is an associated increase in the tidal volumes that a patient is prescribed.

• **Problem:** Mechanically ventilated patients should receive their tidal volume at 6-8cc/kg of ideal body weight. Ideal body weight is determined by a person’s gender and height. It has been observed, however, that there is a low adherence to ventilation dosing using ideal body weight and more attention to actual body weight; this error has the potential to ventilate patients at a potentially harmful tidal volume.
• **What they did:** This was a retrospective chart review of Emergency Department patients who were mechanically ventilated. Data was obtained from the patient’s chart and the ideal body weight was calculated based on patient data as well as a patient’s body mass index (BMI). Tidal volumes used during mechanical ventilation were also obtained from the patient’s chart.
• **What they found:** A total of 517 charts were reviewed with 46% being female and 62% of the cohort was either overweight or obese. 22% of patients were found to have inappropriate tidal volumes, receiving approximately 10mL/kg. After analysis it was found that the odds of inappropriate tidal volume was associated with being overweight or obese and higher BMI increased the odds of a patient receiving inappropriate tidal volumes.
• **Strengths:** Chart reviews contain objective data free from study bias and the data in this study are relatively easy to obtains.
• **Weaknesses:** Retrospective and single center study.

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**Platelet transfusion versus standard care after acute stroke due to spontaneous cerebral haemorrhage associated with antiplatelet therapy (PATCH): a randomised, open-label, phase 3 trial**

• **Question:** Do platelet transfusions improve outcomes in patients who are on anti-platelet agents and present with an intracranial hemorrhage (ICH)?
• **Bottom line:** Patients who received platelets had worse outcomes at 3 months compared to patients who did not receive platelets suggesting that we should avoid platelets in this population of patients. The recommendation has even made it into the Neuro Critical Care and SCCM guidelines
• **Problem:** We’ve been taught to throw the kitchen sink at patients when they present with an ICH, which includes giving platelets if they are on anti-platelet agents. The problem is that a blood product transfusion is not a benign intervention and may be associated with harm (e.g., TRALI, pro-thrombotic cytokines, suppress new platelet formation, etc). This was the first trial to evaluate this question.
• **What they did:** 190 patients who were on aspirin, clopidogrel or dipyridamole (for at least 7 days prior to presentation) plus and non-traumatic ICH, were prospective randomized to receive usual care (n=93) or usual care plus a platelet transfusion (n=97). Patients were included if they presented within 6 hours
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... of symptoms onset or within 90 minutes of positive imaging. They excluded subdural and epidurals, prior aneurysms, planned surgical evacuation known use of VK antagonists, history of coagulopathy

• **Primary outcome:** significantly increased odds of death or dependence at 3 months in the platelet group (this was assessed using a modified rankin scale of 3-6). This was true when analyzed amongst the pre-specified subgroups as well.

• **Secondary outcomes:**
  - More patients with higher modified rankin scores at 3 months in the platelet group
  - No change in ICH growth at 24 hours
  - More adverse events in platelet group, although not statistically significant

• **Strengths:** Randomized control trial, no patients lost to followup, the assessors of primary outcome were blinded, baseline characteristics balanced between groups

• **Weaknesses:** Protocol violations in both groups, non-blinding of clinicians at the bedside, small numbers recruited, more patients were taking aspirin than non-aspirins, some patients are responders to platelet transfusions and perhaps we haven’t identified that subgroup yet.

**Intensive Blood-Pressure Lowering in Patients with Acute Cerebral Hemorrhage**

• **Question:** Does rapid lowering of systolic blood pressure (SBP) improve outcomes in patients with an acute spontaneous ICH?

• **Bottom line:** This trial does not support a strategy of early and aggressive lowering of SBP in patients with an acute ICH. Perhaps a higher perfusion pressure is better for patients similar for ischemic CVA

• **Problem:** Lowering the SBP in patients with acute non-traumatic ICH is often done, but the evidence for this practice is limited. A large trial from 2013 ([INTERACT-2](#)) demonstrated benefit of lowering SBP, but there was criticism that the primary anti-hypertensive medications were not uniform and some of the statistical analyses. The ATACH-2 trial used nicardipine as the first line agent to answer this question.

• **What they did:** Randomized 2,839 patients at multiple sites (patients in the intensive-treatment arm and 1,436 in standard treatment arm). Included GCS >4, ICH < 60ml³, within 3-4.5 hours of symptom onset. Exclusion (there’s lots, check out the article) coagulopathy, use of warfarin, candidate for surgery, or intraventricular hemorrhage
  - Intervention group (n=1,403): target SBP 110-139 mmHg for seven days
  - Control group (1,436): target SBP <140-179
  - Nicardipine was first line agent (max dose 15mg/hr), labetlol was used as a second line agent if necessary.

• **Primary outcome:** No significant difference in the proportion of patients with death or major disability (modified rankin score of 4-6). The trial was stopped early for futility

• **Secondary outcomes:** no difference in hematoma expansion but higher incidence of serious adverse events within 3 months in the intervention group when adjusted.

• **Strengths:** Multi-centered and measured clinically relevant patient outcomes

• **Weaknesses:** More than half of patients from Asia (population bias), recruitment criteria changed during enrollment, and all ICH grouped together as one.

• **Please note that despite this trial (and others), both the European and US guidelines still recommend a BP < 140mmHg within 6 hours of presentation, so talk to your local consultants for consensus.**

**Effect of Conservative vs Conventional Oxygen Therapy on Mortality Among Patients in an Intensive Care Unit: The Oxygen-ICU Randomized Clinical Trial.**

• **Question:** Is there a mortality difference associated with the level of oxygen that critically ill patients receiving?

• **Bottom-line:** For patients in an ICU for more than 72 hours a conservative strategy of administering oxygen resulted in a lower mortality than conventional administration.
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• **Problem:** Critically ill patients often receive elevated levels of \( fio2 \) post-intubation to maintain a oxygen saturation of 98-100%. There is evidence, however, that higher levels of \( fio2 \) can cause problems within the microcirculation, increase free radial production, and negatively affect organ dysfunction. This study sought to demonstrate that this harm was not only theoretical but could also affect mortality.

• **What they did:** This was a prospective randomized controlled trial that was non-blinded in ICU patients. Patients were randomized to the control group (244 patients) who had a target of 97-100% and \( PaO2 \) was allowed to reach 150mmHg vs. the intervention group (236 patients) where the lowest possible \( fio2 \) was used to maintaining a saturation of 94-98% or an \( PaO2 \) of 70-100mmHg using the lowest possible \( fio2 \). Patients were well balanced in characteristics and there were a variety of critically ill patients included in the study.

• **What they found:** The primary outcome was ICU mortality which was found to be significantly lower in the intervention group (11.6 vs. 20.2%). As far as secondary outcomes, there was significantly less shock, liver failure, bacteremia in the conservative group. A post-hoc analysis showed significantly less mortality and less time on the ventilator in the conservative group.

• **Strengths:** This was a prospective, randomized control trial and it was well designed.

• **Weaknesses:** Non-blinded, single-center, excluded COPD and ARDS patients, and stopped early because of difficulty recruiting (there was a severe earthquake that shut down the hospital for a period of time).

**Association Between Tracheal Intubation During Adult In-Hospital Cardiac Arrest and Survival Airway in arrest**

• **Question:** Does tracheal intubation during in-hospital cardiac arrest negatively affect patient outcomes?

• **Bottom-line:** Patients who were endotracheally intubated during in-hospital cardiac arrest had worse outcomes (survival, ROSC, and neurologic outcome) for every minute (up to 15 minute) as compared to patients who were not intubated.

• **Problem:** Securing the airway during cardiac arrest is a well-accepted part of resuscitation. Although it is increasingly appreciated that focus on chest compressions is vitally important, the role of a definitive airway is less understood. A previous study demonstrated that outcomes were work with tracheal intubation for out-of hospital cardiac arrest. This study sought to investigate this question for in patient cardiac arrests.

• **What they did:** This was a retrospective cohort-matched review of a prospectively collected multi-center patient database in the US. Adult patients were included if CPR was initiated and they did not already have an endotracheal tube. Unsuccessful intubations were not registered in the dataset. Time to intubation was recorded as the time (in whole minutes) from loss of pulse to intubation.

• **Primary outcome:** Survival to hospital discharge.

• **Secondary endpoint:** ROSC (for at least 20 minutes) and favorable neurological outcome by a CPC score of 1-2.

• **Secondary analysis:** There were a number of predefined subgroup analyses: 1) initial rhythm as shockable vs. non-shockable 2) timing of the cohort matching in minute intervals 3) illness category 4) the presence of preceding respiratory insufficiency, and 5) location of the event.

• **What they found:** There were 108,078 patients in the study from 668 hospitals. 70% of the study population was intubated during the arrest, and of those 95% were intubated in the first 15 minutes. The median time to intubation was 5 minutes. In total, 22% survival to hospital discharge and those patients who were intubated in the first 15 minutes had a significantly lower rate of survival than those who were not intubated (primary outcome), 17% vs 33% respectively. 0.57-0.59; \( P < .001 \). With respect to the secondary outcome of ROSC, the proportion of patients who were intubated in the first 15 minutes was significantly lower than those that were not (59% vs. 69%). With respect to the other secondary outcome, good functional neurologic outcome, the proportion of patients with a good functional outcome was significantly lower in patients intubated within the first 15 minutes as compared with those who were not intubated. For the subgroup analysis there was a significantly less survival if patients were intubated with an initially shockable rhythm as compared to a non-shockable rhythm.
**Strengths:** This was a large, prospectively collected registry of patient data from multiple US hospitals. This was the first study to evaluate the effect of intubation on this population of patients.

**Weaknesses:** Retrospective review from a database so there is the potential for reporting bias. Data on compression quality, the level of clinical expertise during the code, evidence of CPR cessation during intubation, the rate of ventilation post-intubation, and the number of unsuccessful intubation attempts was not recorded. Ventilation rate was not reported and this is intimately tied in with ETCO2; it would have been better to include this data into the analysis.

**Commentary:** This study raises an interesting question and is potentially practice changing. There are many postulated reasons for the negative outcomes associated with tracheal intubation: 1) Are there interruptions in chest compressions during the procedure? 2) Does it promote hyperventilation (increased intra-thoracic pressure) and hyperoxia. 3) Does it delay other more important interventions (e.g., defibrillation or arterial line), 4) Does it lead to hypoxia when it is not successful? and, 5) Are there unrecognized esophageal intubations further leading to worse outcomes?

Video laryngoscopy vs. direct laryngoscopy: Which should be chosen for endotracheal intubation during cardiopulmonary resuscitation?

**Question:** Is there a difference in the success of endotracheal intubation during CPR by experienced intubators using either video or direct laryngoscopy?

**Bottom-line:** This trial did not find a difference in the rate of success, the time needed to intubate, or complications. However, VL was better with respect to intubating patients without interrupting CPR and outcomes in cardiac arrest are related to the number and duration of pauses in chest compressions. Therefore, this study suggests that VL is a better tool for intubations during CPR and may improve survival.

**Problem:** Airway management is necessary during CPR, but there are many possible complications while intubating a patient during chest compressions (e.g., esophageal intubation, interruptions of chest compression, etc.). Video laryngoscopy could potentially get around these problems as has been suggested in simulation trials but critics cite its expense and it could be prone to mechanical failure or lens contamination (e.g., blood or vomit) that can obscure the view.

**What they did:** This was a prospective and randomized control study conducted in the Emergency Department enrolling all adult patients with out of hospital or in-hospital cardiac arrest during the study period. An experienced intubator was defined as someone who has previously attained >50 successful intubations. Patients with C-collars were excluded.

**Primary outcome:** The intubation success rate during CPR.

**Secondary endpoint:** The number of successful intubation attempts, the total time to intubate, complications of intubations (esophageal intubations and dental injuries), number of interruptions of chest compressions, and serious no flow in which there were interruptions of chest compressions for more than 10 seconds.

**Study results:** There were 140 intubations included for analysis, 69 with DL and 71 with VL; there were no significant differences in the baseline data in the study group.

- There were no significant difference in the success rate, number of attempts, time to complete intubation or esophageal intubations or dental injury.
- There was a significant difference with respect to interruptions to chest compression in the DL vs. VL group as well as more serious no-flow periods in DL vs. VL (25% of intubations)

**Strengths:** Prospective and randomized trial. Evaluated important end-points with respect to CPR (i.e., pauses in chest compression)

**Weaknesses:** Factors during CPR such as pulse check or defibrillation could not be standardized across patients or groups. This was also a small, single center study.

Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest

**Question:** Is point-of-care ultrasound (POCUS) helpful for patients who present in cardiac arrest with non-shockable rhythms (i.e. PEA or asystole)?
• **Bottom-line:** The detection of cardiac activity on POCUS is associated with and improvement in survival and also allows the rapid identification of a reversible cause in PEA / asystolic arrest. Ultrasound may also be used as a means to terminate ACLS when there is no cardiac activity.

• **Problem:** Survival from cardiac arrest is extremely low and is lowest for the subset of PEA / asystolic arrest (i.e., when compared to shockable rhythms). A major problem with the PEA / asystole algorithm is that the differential is broad (e.g., tension PTX, massive PE, etc.) and there is no way to “blindly” treat all the possible causes. This is where ultrasound has been proposed to be helpful, but data for ultrasound during cardiac arrest is limited. That was one of the major reasons for this trial

• **What they did:** Prospective, multi-center trial of 793 patients who presented with non-traumatic out of hospital cardiac arrest (or in ED arrest) with a non-shockable rhythm. POCUS was performed at the beginning and the end of ACLS. Patients were excluded if resuscitation was stopped after the initial ultrasound, the resuscitation was less than 5 minutes, or ACLS was terminated because of a DNR. The subxiphoid or parasternal views were used to look for any movement of the myocardium or valvular movement.

• **Primary endpoint:** Overall survival to hospital admission (14%)

• **Secondary endpoint:** Return of spontaneous circulation (26%) and survival to hospital discharge (1.6%)

• **Study results:**
  - 33% had cardiac activity on initial ultrasound
    - 54% of patients with PEA actually had cardiac activity on initial ultrasound
    - Survival to hospital admission (29%), ROSC (51%), and survival to discharge (4%)
    - Cardiac activity with ultrasound associated with increased odd of survival to admission and discharge
  - 67% had no cardiac activity on initial ultrasound
    - Survival to hospital admission (7%), ROSC (14%), and survival to discharge (0.6%)
    - Absence of cardiac activity on ultrasound associated with non-survival
  - Ultrasound identified potentially reversible causes of arrest
    - Pericardial effusion in 34 patients and was associated with increased survival to discharge versus other causes.
    - Pulmonary embolism in 15 patients who received thrombolytics; 7% survived

• **Strengths:** This was the first study to show ultrasound was beneficial in cardiac arrest and it was a multi-center trial that was protocol driven.

• **Weaknesses:** The end-point of neurologic survival would be more meaningful and this was an unblinded trial.

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

• **Bottom-line:** This is the first major update to the definition of sepsis for more than 20 years. The authors sought to clarify some of the confusion in previous definitions and terms.

• **What they did:**
  - Sepsis is now re-defined as “a life-threatening organ dysfunction caused by a dys-regulated host response in response to a presumed or confirmed infection”, but how do you assess organ dysfunction?
  - To identify organ dysfunction, the SOFA (Sequential Organ Failure Assessment) score should be used and a score of 2 or more is considered positive; this requires a lot of lab testing and is not so simple, so a faster test is qSOFA
  - qSOFA (or quick SOFA) can rapidly identify patients with suspected infection who are likely to have a prolonged ICU stay or hospital mortality. Remember H.A.T. (Hypotension / SBP <100mmHg, Altered mental status (GCS <or equal to 13), and Tachypnea / RR 22 or more / min). A score of 2 or 3 is predictive of a mortality of ≥40%.
  - There is no longer a definition of **severe sepsis** in sepsis 3.0
  - Septic shock is a subset of sepsis where underlying circulatory and cellular metabolic abnormalities are profound enough to substantially increase mortality above the rate of septic patients
Septic shock is defined as sepsis with hypotension (MAP<65) after adequate fluid resuscitation; shock requires vasopressors and a lactate >2 mmol/L (note: “adequate” fluid is not precisely defined).

Please note that SIRS is **gone**. The authors felt that SIRS only signifies the presence of an infection and not necessarily life-threatening plus SIRS missed 1 in 8 patients who actually had organ dysfunction despite being SIRS negative. But part of the definition of Sepsis 3.0 is infection, which is what SIRS helps define.

**Strengths:** Updated definitions that are simpler to use and translate into stratifying sicker patients to more aggressive care

**Weaknesses:** Much of data was retrospective and validated in the ICU and not in the ED. No clinicians from Emergency Medicine were on the panel defining these definitions.

**Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016**

Here are the highlights:

- **New definition and criteria**
  - Used the Sepsis 3.0 definitions (i.e., only sepsis and septic shock)
  - Did not weigh in on SIRS, SOFA, qSOFA, etc.

- **Early Goal Directed Therapy**
  - It's no longer recommended; it's not discouraged, but they don't recommend it like they did before
  - You don't need to use CVP to assess volume responsiveness and they recommend dynamic markers for fluid assessment

- **Fluid therapy**
  - Use at least 30cc/kg of fluids spaced over three hours
  - There was no mention of how to volume resuscitate patients if they have ESRD or heart failure….so that needs addressing
  - Crystalloids are still first-line therapy, but you could consider albumin if you are giving a lot of volume

- **Goal MAP**
  - Still aim for > 65

- **Lactate measurements**
  - Goal is to normalize lactate because a high lactate is a poor prognostic factor
  - Elevated lactate doesn't necessarily mean volume is needed, so look for volume responsiveness before fluid loading

- **Vasopressor / Inotropes therapy**
  - Norepinephrine is the first line agent and epinephrine should be added if you cannot achieve a MAP of 65. Vasopressin can be considered if you are on high-dose norepinephrine to decrease doses.
  - Dopamine falls even lower on the list; definitely don't use renal dose dopamine
  - Dobutamine regarded as first line inotrope

- **Steroids**
  - Recommend for patients who have increasing pressor requirement when another one will be added
  - Hydrocortisone 200mg / day is recommended.

- **Blood culture**
  - Best would be to obtain before antibiotics, but if not possible then give antibiotics and get your cultures when you can

- **Antimicrobials**
  - Go with broad spectrum antibiotics directed towards a source (if known)
  - Give within one hour of the diagnosis of sepsis
  - No need to double cover for pseudomonas or acinetobacter
  - Consider empiric anti-fungals if suspected (e.g., TPN, neutropenic, etc.)
  - Determine previous exposures with hospital admissions and/or recent IV antibiotics
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• probably best in general to switch class of drug from prior antibiotics; check prior cultures

  • **Blood transfusion**
    • Transfuse for a Hb < 7.0 unless active bleeding, cardiac ischemia or severe hypoxia
    • Goal Hb for NSTEMI or recent ischemia is unknown

  • **Vents**
    • Use ARDSnet
    • Keep her of the bed elevated to >30 degrees
    • Use a tidal volume of 6-8 cc/kg and keep plateau pressures <30cmH2O

  • **Miscellaneous**
    • Keep serum glucose < 180
    • Administer bicarbonate if pH is < 7.15

Predicting Fluid Responsiveness by Passive Leg Raising: A Systematic Review and Meta-Analysis of 23 Clinical Trials

• **Question:** Is the passive leg raise (PLR) a reliable measure of volume (or preload) responsiveness in critically ill patients?

• **Bottom-line:** PLR is a very reliable measure of preload assessment across a variety of patient populations. Interestingly, another meta-analysis was done in December 2016 that demonstrated very similar findings.

• **Problem:** Administering IV fluids is a cornerstone of management for patients in shock, however only 50% of patients who are critically ill will improve their cardiac output in response to fluids; unfortunately, it is not immediately obvious which patients these will be. Excess fluid administration has also been associated with patient harm, so we need an accurate and objective way to determine which critically ill patients should receive fluids and which should receive vasopressors / inotropes. PLR has previously been shown to be accurate in patients who are intubated as well as those who are spontaneously breathing. Not everyone should be included for a PLR: amputees, hip/leg surgery, head trauma, or those where it’s too painful to perform the procedure.

• **What they did:** This was a systematic review and meta-analysis of trials that evaluated the PLR on patients with circulatory dysfunction. Included in the analysis were 23 paper, consisting of 1,013 patients and 1,034 fluid challenges. One of four methods was used to assess the change in flow (i.e., cardiac output or stroke volume) to a PLR 1) ultrasound, 2) esophageal Doppler, 3) calibrated plus contour analysis, 4) bio-reactance. A positive PLR was an increase in SV/CO by at least 15%. The pooled sensitivity and specificity for PLR was 86% and 92%, respectively. The area under the receiver operating curve (AUROC) was 0.95. The techniques of measuring the flow did not demonstrate a difference in performance.

• **Strengths:** Good study method and used validated methods to assess changes in flow

• **Weaknesses:** Meta-analysis, variable cut-offs in the studies, potential publication bias, and there were no outcome variables measured in the studies evaluated.

Capnography During Critical Illness

• Qualitative end-tidal capnography has a huge potential in critical care. In addition to providing information about ventilation, it can also be used to detect changes in cardiac output.

• It is well known that ET-CO₂ can be used during cardiac arrest and CPR
  • A value <10mmHg after 20 minutes associated with an increase mortality
  • Values that are decreasing during CPR may indicate fatigue in the person performing compressions, signaling the need for rotation. It may also indicate compressions that are not deep enough or too slow.
  • Increases in ETCO₂ signal ROSC without the need to interrupt chest compressions
ETCO₂ can also be used to help with predicting fluid responsiveness in mechanically ventilated patients. An increase by at least 5% following a passive leg raise predicts that a patient will be fluid responsive.

This article discusses this under appreciated measurement and there is a lot more discussed beyond the above….it is a must read!

Effect of Hydrocortisone on Development of Shock Among Patients With Severe Sepsis: The HYPRESS Randomized Clinical Trial

**Question:** Does hydrocortisone prevent the development of septic shock in patients with severe sepsis?

**Bottom-line:** This trial did not demonstrate a benefit of steroids to prevent the development of septic shock in patients with severe sepsis.

**Problem:** Sepsis is a dys-regulated host response to an infectious trigger and there has been debate for decades as to whether steroids could improve patients’ outcomes by altering that dys-regulated response. This trial was conducted to help answer this question.

**What they did:** This was a prospective, randomized, multi-center, double-blind placebo trial. Patients were included if there was evidence of infection plus evidence of SIRS, and evidence of organ dysfunction (e.g., AKI) for less than 48 hours. Patients were excluded if they were on a vasopressor (i.e., shock), regularly on steroids, have a condition requiring steroids, and a few more as detailed in the paper. Patients were not excluded if etomidate was used, but were excluded if steroids given within 72 hours prior to enrollment.

- Intervention group (n=190): received a bolus of 50mg, then 200mg/day for 5 days with a taper
- Control group (n=190): received placebo (i.e., a very small dose of mannitol)

**Primary outcome:** Occurrence of septic shock within 14 days or until discharge form the ICU; there was no significant difference found between the two groups.

**Secondary endpoint:** No significant difference between 1) time until development of shock 2) hospital mortality 3) duration of ICU and hospital stay, 4) duration of mechanical ventilation, 5) patient with renal replacement therapy, and 6) SOFA scores.

- There was significantly more hyperglycemia in the hydrocortisone group and less delirium in the hydrocortisone group as well; otherwise no differences in secondary infection, bleeding, muscle weakness, etc.

**Strengths:** Prospective, blinded administration, patients were similar between groups, and few lost to followup

**Weaknesses:** Low rate of septic shock expected based on prior studies so possibly a “healthier” septic cohort that normal. Etomidate was used, but was balanced between groups.

Hemodynamic Response After Rapid Sequence Induction With Ketamine in Out-of-Hospital Patients at Risk of Shock as Defined by the Shock Index

**Question:** Is ketamine a hemodynamically stable induction agent in patients who are have an elevated shock index (SI)?

**Bottom-line:** Ketamine is associated with hypotension in patients with an elevated shock index. Care must be taken when using this agent during rapid sequence intubation (RSI) especially when patients are critically ill.

**Problem:** Ketamine is typically thought of as a sympathomimetic drug that is hemodynamically stable during RSI and may even causes hypertension and tachycardia in some patients. Although it is one of the most stable induction agents there is prior evidence that it can lead to hypotension in sicker patients. The authors of this paper sought to see whether the shock index (HR/SBP) prior to intubation could predict whether a patient would become hypotensive with RSI
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- **What they did:** This was a prospective observational study in out of hospital intuitions in patients >15 years-old. Vitals were recorded at 3 minutes intervals before induction of RSI, then at 0-3 minutes, 3-6 minutes and 6-9 minutes post-induction. This allowed them to drive the SI at various intervals pre- and post-ketamine administration. Patients were divided into low SI (<0.9) or high SI (>0.9) based on their pre-induction vitals; 81 and 31 patients, respectively. A hypotensive response was defined when the pre-indication SBP was >90mmHg and then post-induction was <90. A hypertensive response was when SBP was >160 prior to induction and >160 post-induction.

- **What they found:** There were 112 patients in this study and characteristics were similar between the low SI and the high SI group. The authors found that the SBP was significantly greater for patients in the low SI as compared to the high SI group. Hypotension was seen in 9% of the population but 26% of the high SI and 2% of the low SI group. Hypertension was seen in 40% of the low SI group and in 13% of the high SI group. An increase in pulse rate was also seen for patients in the high SI as compared to the low SI group. The low SI group received a total of 2mg/kg, while the high SI group received about 1.7mg/kg.

- **Strengths:** First study to investigate the effects of Ketamine on pre-hospital induction, these results are in line with previous studies that reflected the same hemodynamic effects, and data collection methods appeared reasonable.

- **Weaknesses:** Observational trial without randomization, patients' weights were estimated and not actual, the groups were not of equal size.

Safety of the Peripheral Administration of Vasopressor Agents

- **Question:** Can vasopressors be given safely through a peripheral IV and if so, where is the best site for administration, what are the complication rates, and what size catheter should be used?

- **Bottom-line:** Using peripherally administered vasopressors is a relatively safe practice with a low-rate of complications.

- **Problem:** Shock is a common problem in the Emergency Department that often requires the use of vasopressors to restore normal perfusion to tissue beds. Every hour of hypotension is associated with an increase in mortality. The problem is that placing a central line to administer vasopressors is not always able to be done in an emergency department because it is both time consuming and associated with complications. If vasopressors could be given peripherally, these drugs could be started much sooner during the care of a hypotensive patient. However, the perceived risk of vasopressor extravasation has made this practice rare.

- **What they did:** This group performed a retrospective chart review of 202 patients at a single center who received vasopressor through a peripheral line. The use of peripheral vasopressors is not strictly protocolled at this institution and they claim this is a unique feature of their study as other studies used a nurse driven protocol to monitor the IV site and administer antidotes as needed. Eligible patents were adults who received a vasopressors via peripheral IV in an ICU. Patients were excluded if they had a central line in place and peripheral vasopressors were received for less than one hour. Data was collected on demographics, characteristics of the peripheral line, risk factors for extravasation, vasopressor infusion and concentration. If extravasation occurred then time to extravasation, location of extravasation, gauge of the IV, corrective measures to fix extravasation, and grade of severity was collected.

- **What they found:** The primary outcome was the incidence of extravasation events occurred in 8 patients (4% of study population); median time to extravasation was 21 hours. Secondary outcomes were type (norepinephrine 50%, phenylephrine 50%) dose (mean dose 0.08 mcg/kg/min), concentration (16mcg/mL was 54% but 16% had a concentration of 64 mcg/mL) and duration of peripheral vasopressor use (time till extravasation 21 hours). Other secondary outcomes were the location of extravasation (25% hand, 25% AC fossa, and 50% other) and the gauge of the catheters used (<20 25% and >20 75%). Of note 5 patients received two vasopressors simultaneously. 100% of patients with extravasation were managed conservatively (warm compresses and removal of the IV); 88% had vasopressors started again peripherally at a new site.
• **Strengths:** Somewhat consistent with prior studies on the safety of peripheral vasopressors and good patient sample size.

• **Weaknesses:** Retrospective chart review, reporting bias regarding extravasation events, and no control group. Meta-analysis, variable cut-offs in the studies, potential publication bias, and there were no outcome variables measured in the studies evaluated.

• This study further adds to the data that short-term peripheral vasopressors are safe:
  - A systematic review of extravasation and local tissue injury from administration of vasopressors through peripheral intravenous catheters and central venous catheters
    - This retrospective review found that most extravasation injuries occurred when the IV was distal to the antecubital or popliteal fossa or when infusions lasted for greater than 4 hours

• **Safety of Peripheral Intravenous Administration of Vasoactive Medication**
  - This was a single-arm prospective prospective study that found only 2% of extravasations in the 734 patients evaluated.
  - This group had a protocol of peripheral access for vasopressors
    - Vein > 4 mm with ultrasound and document catheter in vein with ultrasound
    - Only upper extremity used; no hand, wrist or AC fossa used
    - Only catheters <20 gauge used
    - Nursing protocol with site check every 2 hours and protocol for extravasation
    - Maximum duration of 72 hours for PIV use