

## ORAL ABSTRACTS\*

### Introduction

The 18th Annual Trauma and Critical Care Symposium, TraumaCare 2005, was held in May in Paris in conjunction with Urgences 2005, the annual meeting of SAMU de France, one of Europe's most distinguished national EMS associations. The ITACCS portion of the 3-day agenda comprised 23 lectures by faculty members from Argentina, France, Germany, Israel, Japan, the United Kingdom, and the United States. The following abstracts of those lectures were submitted for publication in *TraumaCare*.

### Rapid-Sequence Induction Techniques

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#### Evaluation and Physical Examination

**Anesthesia Team.** Airway management in trauma patients for urgent or emergency anesthesia carries significant risk of morbidity and mortality. Recognition of a difficult airway requires a complete and thorough assessment prior to the induction of anesthesia.

Proper management of the airway should be performed by an emergency team of two or three people. It requires at least one assistant to stabilize the head and neck in patients with a not-ruled-out trauma of the cervical spine, and another to apply cricoid pressure and perform other tasks such as administration of anesthesia induction drugs.

**Recognition of a Difficult Airway.** In managing a patient with a full stomach in elective situations, predicting the ease or difficulty is of paramount importance in determining the approach, rapid sequence induction with Sellick maneuver. In cases of anticipated difficulty, one can choose from various options available, including fiberoptic intubation under topical anesthesia, light wand, Bullard laryngoscope, or Bonfils.

#### Risk of Aspiration

All trauma victims must be considered to have a full stomach and to be at high risk for vomiting, regurgitation, and aspiration. Because emergencies are unplanned, these patients may have eaten or drunk immediately before the event. A delay or even arrest of gastric emptying is caused by the trauma itself, anxiety, pain, or alcohol and drug consumption.

**Techniques to Prevent Aspiration.** A full stomach is a background condition in acute trauma. The urgency of securing the airway most often does not permit adequate time for pharmacologic measures to reduce gastric volume and acidity. To minimize and prevent an acid aspiration syndrome (aspiration pneumonitis, or Mendelson syndrome) in hospitalized patients at risk for acid aspiration, intravenous administration of H<sub>2</sub>-receptor blockers (cimetidine [200 mg] or ranitidine [50 mg]) 30 to 60 minutes prior to induction reduces the rate of accumulation and increases the pH of subsequent secretions. Administration of antacids such as sodium citrate (15–30 mL orally) shortly before induction will increase the pH of existing gastric fluid without producing an excessive increase in volume.

**Cricoid Pressure.** Cricoid pressure should be administered by trained personnel using the Sellick maneuver to apply sufficient force to prevent regurgitation (approximately 44 newtons [kg/meter/sec/sec in adults]). Overzealous assistants need to be reminded that the goal of the Sellick maneuver is to prevent regurgitation, not to distort the larynx or cervical spine.

Cricoid pressure (Sellick maneuver) must always be applied after the patient loses consciousness. By placing the thumb and index finger on the cricoid cartilage and exerting pressure in an anteroposterior direction, the esophagus is occluded. Proponents of the "bimanual technique" have the assistant place one hand behind the patient's neck, flexing it into the "sniffing" position, while applying conventional cricoid pressure with the other hand.

Cricoid pressure is maintained until proper placement of the endotracheal tube is confirmed (by visualizing the tube passing through the glottis, the endotracheal tube cuff has been inflated, auscultating breath sounds, and capnography). Prematurely releasing the cricoid pressure prior to confirming the correct placement of the tracheal tube is a common error and

places the patient at huge risk of aspiration if accidental esophageal intubation has occurred.

Cricoid pressure must be released immediately should active vomiting occur; otherwise, there is danger of esophageal rupture. Finally, the importance of using a properly functioning suction apparatus cannot be overemphasized.

Manipulations for cricoid pressure may lead to sudden airway obstruction. For example, cricoid pressure during rapid-sequence induction in a patient with injury to this cartilage may completely occlude the trachea.

**Rapid-Sequence Anesthesia Induction.** The "rapid-sequence induction" technique remains one of the cornerstones of preventing aspiration of gastric contents. This approach to the patient undergoing general endotracheal anesthesia is based on the belief that the shorter the interval from loss of protective airway reflexes to confirmed placement of a cuffed endotracheal tube, the lower the incidence of aspiration. Also, the risk of further gastric distention is reduced by not ventilating by positive-pressure techniques until the patient is intubated properly.

**Classic Rapid-Sequence Induction.** The "classic rapid-sequence" or so-called crash induction technique with muscle paralysis and oral tracheal intubation is preferred by many anesthesiologists in trauma situations when adequate preoxygenation of the patient is feasible. Mask ventilation is avoided because of a theoretic risk of air being forced into the stomach and inducing regurgitation.

Placing the patient in a 40-degree head-up position may be preferable because gravity will minimize the risk of passive regurgitation of gastric contents. The patient may breathe 100% oxygen for 3 to 5 minutes, at normal tidal volumes, to denitrogenate the functional residual capacity of the lungs. If time is limited, almost the same degree of preoxygenation can be accomplished with three to five vital capacity breaths of 100% oxygen. An induction dose of intravenous anesthetic drugs is then given rapidly, followed immediately by an appropriate dose of a rapid-acting muscle relaxant, i.e., succinylcholine or rocuronium. After the patient loses consciousness, cricoid pressure (the Sellick maneuver) is applied and maintained until the trachea is intubated and the cuff inflated.

**Modified Rapid-Sequence Induction.** The modified rapid-sequence technique has been used increasingly during recent years. An injured, semiconscious, or uncooperative patient may resist preoxygenation and application of cricoid pressure before induction of anesthesia. The modified rapid-sequence induction technique should be performed in uncooperative patients, in patients in shock or with pulmonary contusion and ventilation-perfusion mismatch, and in any patient in whom preoxygenation and denitrogenation are difficult or impossible.

In this special setting, induction agents and neuromuscular relaxants can be given intravenously, followed by unconsciousness and then the application of cricoid pressure. After onset of apnea from the anesthetic drugs, the patient should be ventilated gently with 100% oxygen until muscle relaxation is adequate. Inflation pressures below 18 cm H<sub>2</sub>O and maintenance of cricoid pressure while mask ventilating are essential to minimize the risk of passive regurgitation and consecutive aspiration of gastric contents.

Modified rapid-sequence induction is a reasonable modification of the rapid-sequence induction technique for special patient groups for the following reasons:

- The use of pulse oximetry and capnography has revealed that a significant percentage of trauma patients treated with the classic rapid-sequence induction approach have unacceptably low oxygenation during the induction procedure and

- Properly applied cricoid pressure is very effective in preventing both gastric distention and passive regurgitation during mask ventilation.
- With higher doses of rocuronium (or even vecuronium), the time until onset of satisfactory conditions for intubation is only  $30 \pm 15$  seconds longer than with succinylcholine (1.5 mg/kg). Further, the additional time needed to reverse anesthesia is not usually a consideration in multitrauma patients, who require extensive diagnostic and therapeutic procedures.
- If the clinician is unable to visualize laryngeal structures or intubate, the allegedly “short” duration of standard doses (1.5 mg/kg) of succinylcholine (i.e., maybe up to 10 minutes in normal patients) is more than enough to result in profound hypoxia or dangerous hypercarbia unless preoxygenation is augmented with positive-pressure ventilation using a high fraction of inspired oxygen (FiO<sub>2</sub>) mixture.
- Avoidance of succinylcholine eliminates the possibility of transient increased intragastric, intraocular, and intracranial pressure and increased masseter muscle tone. These can occur despite use of a “blocking dose” of a nondepolarizing muscle relaxant. Furthermore, in selected patients (e.g., those with burns, facial lacerations, long-bone fractures, long-standing spinal cord injury), risks of other unwanted side effects could be consistently avoided. It is questionable whether succinylcholine will be used at all after optimized short-acting steroidal analogs of vecuronium become available.

**Failed Rapid-Sequence Induction.** Rapid-sequence induction is used increasingly by emergency physicians in the emergency department and in the prehospital setting (e.g., in Europe). A feared complication of the technique is the inability to intubate and subsequently ventilate the patient. Current drills based on anesthetic practice may be unsuitable for use in the emergency department or in the field.

The probability of a full stomach precludes the use of a laryngeal mask airway, or any other device that does not protect the trachea, as a definitive airway in trauma patients. The laryngeal mask airway may, however, be used for a brief period as a bridge to reestablish airway patency or to facilitate intubation aided by a flexible fiberoptic laryngoscope, especially in infants and children. Flexible fiberoptic-guided orotracheal intubation can be achieved rapidly and successfully during rapid sequence induction. Other options include the new EasyTube or the Combitude.

**Other Airway Options.** Oral or nasal awake tracheal intubation performed under topical anesthesia in the hospital setting can be best attempted with a flexible fiberoptic bronchoscope or special laryngoscopes (e.g., Bonfils, Bullard, Wu-Scope). Success may be limited because of the lack of proper patient preparation, the presence of secretions and blood that blur the field, and the practical realities of having the necessary equipment immediately available to handle the emergency trauma patient.

Adequate topical anesthesia of the lower airway, which greatly facilitates successful flexible fiberoptic intubation, is not contraindicated in patients with full stomachs. Rather, caution must be taken when administering heavy sedation, as it potentially creates conditions that could result in aspiration from reflux. Awake tracheal intubation should be attempted with caution if there is evidence of a brain injury or if the patient has penetrating eye or neck injuries.

## Loco Regional Anesthesia for Peripheral Injuries in an Accident and Emergency Department: Setting for a Nonanesthetist Practitioner

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In 2002, French national recommendations were written for the performance of local and loco regional anesthesia (LRA) by nonanesthetist practitioners in an emergency department.<sup>1</sup> These recommendations concern patients admitted to emergency and accident departments for management of peripheral injuries requiring anesthesia. With these guidelines describing the use of several LRA techniques and different local anesthetics (LAs), pain management can be improved while LA toxicity risks are reduced. These aseptic techniques are easy to learn and perform, but good anatomic and pharmacologic knowledge are mandatory, as well as training with an anesthetist in an operating room.

### Techniques for Loco Regional Anesthesia

Anesthetized Area	Injection Site	Volume of LA	Epinephrine	Neuro-stimulation
<b>Face</b>				
Upper eyelid + half forehead up to cranial suture	Supraorbital + supratrocheal foramen	2 mL	No	No
Inferior eyelid, cheek and upper lip	Infraorbital foramen	2–4 mL	No	No
Inferior lip and chin	Mental foramen	2–3 mL	No	No
<b>Hand</b>				
Palmar face of thumb; second and third fingers and half of the fifth	4 cm above wrist crease, between flexor carpi radialis and palmaris	4 mL	Yes	Flexion I, II, III fingers
Fifth and lateral half of the fourth finger	4 cm above wrist crease, lateral to flexor carpi ulnaris tendon	4 mL		
Dorsal face of thumb, II and lateral half of III (except last phalanx)	Between extensor pollicis longus and brevis or Subcutaneous infiltration dorsal face of the wrist	3 mL	Yes	Paresthesias I, II, III
<b>Thigh</b>				
Anterior surface, femoral fracture	Ilio-fascial block, 3 cm below and 2/3 medial, 1/3 lateral on the inguinal ligament	20 mL	Yes	No
<b>Foot</b>				
First interdigital space	Lateral to extensor hallucis longus and anterior tibial artery	4 mL	No	No
Dorsal face of the foot except first interdigital space, fifth toe and lateral part of the foot	Anterior subcutaneous infiltration between the malleolus	4–6 mL	No	No
Fifth toe and lateral part of the foot	Subcutaneous infiltration 4 cm above external malleolus	5 mL	No	No
Plantar face of the foot	Between Achilles tendon and internal malleolus	6 mL	No	Flexion foot or toes

In all cases, the patient must be supine in a clean and calm room, relaxed, with a peripheral intravenous line and classic monitoring (noninvasive blood pressure, heart rate, and oxygen saturation). Resuscitation devices must be present mandatory in the room. The patient's comfort is improved by providing clear and detailed explanations of the technique. All patients are conscious and awake when the block is induced. During the procedure and for 30 minutes thereafter, patients are monitored by the practitioner (or a nurse) to detect early side effects (cardiac or neurologic LA toxicity). The LA is injected slowly with intermittent aspiration tests to detect inadvertent intravascular injection. Moreover, a painful injection is stopped and the needle is slightly moved to avert intraneural injection. In narrow anatomic spaces such as the carpal tunnel, LA volume is reduced to prevent nerve compression.

Concerning the LA solution, 1.5% to 2% lidocaine is used most commonly, more or less associated with epinephrine. Ropivacaine, a long-lasting LA, can be an alternative when long-duration analgesia is required.

The main contraindications to LRA are the patient's refusal or agitation, cutaneous infection at the puncture site, porphyria, and LA allergy (rare). Epinephrine must be avoided in patients with coronary disease or terminal vascularization (e.g., digits, nose).

The face blocks are easy to learn and to perform. With approximately 15 mL of LA, the whole face can be anesthetized and there are no wound border distortions. However, practitioners must keep in mind that epinephrine is contraindicated for face blocks (terminal vascularization) and LA must be injected outside the foramina to avoid definitive nerve injuries (LA compression).

Several peripheral techniques are useful for upper and lower limb anesthesia and analgesia. At the wrist, complete anesthesia can be obtained with no more than 15 mL of LA. Easy to perform, these techniques imply neurostimulator use, except for the radial nerve.

The fascia iliac block is the most popular block for analgesia in an emergency context. Analgesia of the anterior part of the thigh and the knee is obtained without using nerve stimulator. It is strongly recommended for analgesia in patients with femoral shaft fracture. At the ankle, foot anesthesia is also easy to achieve but is often painful, limiting its use.

Various techniques are listed in the table on page 165.

### Conclusion

Several LRA techniques can be performed by nonanesthetist practitioners in an emergency setting. Compared with direct local anesthesia of the wound, they allow a good and large analgesia, reducing LA volumes, then reducing toxicity risks. Moreover, quality of suture is improved because wound borders are not distorted. To avoid peripheral or systemic side effects, LA characteristics and the details of each technique (anatomy, landmarks) must be very well understood, and induction with an anesthetist in an operating room is strongly recommended.

### Reference

1. Pratique des anesthésies locales et locorégionales par des médecins non spécialisés en anesthésie-réanimation, dans le cadre des urgences. Experts conference of Société Française d'Anesthésie Réanimation (SAFR) – SAMU de France – Société Francophone de Médecine d'Urgence (SFMU), 2002. Available at <http://www.sfar.org>.

## New Techniques in Trauma Airway Management

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Complications related to airway management in the prehospital setting are frequent and, because of the importance and vulnerability of the ventilatory system, can be life-threatening within a very short time. Therefore, airway management is perhaps the most vital component in the early treatment of any patient in critical condition.

Identifying the difficult airway, managing the failed airway, and performing a cricothyrotomy are no different in the prehospital arena than they are in hospital. Thus, the "thinking" and "doing" in the prehospital environment are identical to that which occurs in an emergency department or operating room. However, the environment of care is much different in the prehospital arena and often presents unique features. Alternate and innovative methods must at times be employed in these unique situations.

Airway management involves more than just proficiency with tracheal intubation techniques. With an ever-increasing number of devices and techniques available, the method chosen will be that which best matches the needs of the patient, depending on the availability of equipment, the level of training and expertise, and the patient's specific injury or disease.

Generally, bag-and-mask ventilation is employed to ensure immediate oxygenation, though supraglottic devices may be used in specific situations.

The EasyTube (EzT) was developed for in-hospital and prehospital use in all patients with anticipated or unanticipated airway difficulties. It is a disposable device that combines the essential features of an endotracheal tube with those of a supraglottic airway.

The EzT is available in two sizes for adults and children. The tip of the 41 (28) Fr. EzT has an inner diameter of 7.5 (5.0) mm. Even when the tube tip is positioned in the esophagus, the trachea is still accessible through the second lumen.

The EzT was designed primarily for airway management and for controlled ventilation in emergency patients with potentially difficult airways, as in cases of cardiopulmonary resuscitation, trauma to the facial skeleton, or emergency caesarean section. The EzT can also be used during general anaesthesia induction, where the additional oropharyngeal cuff can help to ensure optimum protection against aspiration from the upper airways.

Though standard laryngoscope blades are the norm, modifications of such blades (e.g., Henderson, McCoy) and flexible or rigid fiberoptic intubation techniques (e.g., Bonfils) offer alternatives to the expert, even in the prehospital environment. Rigid intubation fibrescopes such as the Bonfils or the Bullard improve the view of the larynx, especially in patients with difficult anatomy. These devices also permit tracheal intubation with less head and cervical spine movement than is often generated by direct laryngoscopy. Success with these devices, however, requires considerable experience, as in intubation techniques using flexible fibrescopes.

Needle or surgical cricothyrotomy is rarely required, but they remain crucial techniques in the event that other techniques fail.

## Venous Thrombosis Prophylaxis

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### Learning Objectives

- Definitions of thromboembolic events
- Risk factors and their stratification
- Screening techniques and indications
- Prophylactic measures including risks and benefits

Trauma is an independent high-risk factor for developing venous thrombosis. Proximal venous thrombosis may lead to pulmonary embolism, from which the risk of death is up to 5%. Because of this potential mortality rate, it is standard practice to use prophylaxis for trauma patients, especially because advancing age, obesity, immobility, surgery, requirement for acute intensive care, and longer term chronic care are also independent risk factors. However, standard practice is based more on tradition than good quality research evidence.

Both the American College of Chest Physicians (ACCP) and the Eastern Association of Surgeons for Trauma (EAST) have produced reviews of the evidence and recommendations. Because the evidence base is weak, their conclusions differ in some respects. Both the ACCP and EAST consider patients with spinal cord injury and neurologic deficit to be at greatest risk. ACCP, but not EAST, also considers patients with combined pelvic and lower

limb fractures to be at high risk. EAST notes that although advanced age and increasing injury severity are risk factors, these are continuous variables and it is impossible to know at what point the risk becomes significant. Similarly, there is debate about whether screening should be prophylactic or diagnostic. Patients entered into trials may need different screening from those in the clinical setting. Both ACCP and EAST tend to favor venography and Doppler ultrasound.

Thromboembolic pathophysiology requires the triad of venous stasis, injury to intimal vessels, and a hypercoagulable state. Prophylactic interventions are concentrated on mechanical devices to reduce stasis and anticoagulant drugs.

Mechanical prophylaxis includes graduated compression stockings, intermittent pneumatic compression devices, and venous foot pumps. They increase flow but do not increase bleeding. Evaluation has been inadequate, and compliance with their use is often poor. ACCP is cautious about recommending these devices and notes that their main role may be for patients with uncontrolled bleeding of any type and for patients at risk of intracranial hemorrhage. EAST is enthusiastic about venous foot pumps.

Both ACCP and EAST favor low-molecular-weight heparin (LMWH) over low-dose unfractionated heparin. LMWH is thought to be more effective and easier to use because of simplified dosing and reduced monitoring requirements.

Aspirin and platelet inhibitors are not recommended.

Direct thrombin inhibitors such as fondaparinux are long-acting and do not require dose adjustment or laboratory monitoring. They may be advised in the future but have not been tested in trauma patients.

Inferior vena cava filters are not recommended for prophylaxis but may be indicated for patients with recurrent or major pulmonary embolism and patients with or without proximal vein thrombosis or other risk factors, who cannot be anticoagulated.

It is important to note that prophylaxis does not always prevent thrombotic events. This may be because of delayed treatment, poor compliance, or lack of efficacy. EAST makes useful suggestions for future research.

#### Suggested Reading

Geerts WS, Pineo GF, Heit JA, et al. Prevention of venous thromboembolism. *Chest* 2004;126:338S–400S.

Rogers FB, Cipolle MD, Velmahos G, et al. Practice Management Guidelines for the Management of Venous Thromboembolism in Trauma Patients. Available at [www.east.com](http://www.east.com). Accessed in March 2005.

## “One Injury/Two Patients” —Trauma in Pregnancy

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#### Learning Objectives

At the end of this presentation, each participant will be able to

1. Recognize anatomic and physiologic changes associated with pregnancy.
2. Discuss special considerations in the management of penetrating and blunt abdominal trauma in pregnancy.
3. Describe the steps in resuscitation the trauma patient who happens to be pregnant.

#### Physiologic Changes in Pregnancy

Cardiac output increases during the first 10 weeks of pregnancy (up to 1.0 to 1.5 L/min) and is maintained at that level throughout pregnancy. Heart rate increases as well (physiologic tachycardia reaches a maximum of 15 to 20 beats above baseline in the third trimester). In a normal pregnancy, the systolic and diastolic blood pressures both fall by 10 to 15 mm Hg. Blood

volume expands to a maximum of 45% at term, but the red blood cell mass does not increase to the same degree, causing a “dilutional anemia.”

Tidal volume increases by approximately 40% and residual volume decreases by approximately 25%. The respiratory rate changes little, but there is reduced alveolar and arterial PCO<sub>2</sub>, averaging 30 torr.

There is decreased gastric motility and decreased gastric emptying time. Because of the cephalad displacement of the intraabdominal contents, signs of peritoneal irritation are less reliable and rebound tenderness and rigidity are often diminished, delayed, or absent.

The renal pelvis and ureters become dilated, and the bladder is displaced superiorly and anteriorly. The bladder becomes an abdominal organ around the 12th week of gestation.

The uterus increases in size from a 7-cm, 70-g organ to a 36-cm, 1,000-g organ at term. Blood flow to the uterus increases from 60 to 600 mL/min at term.

#### Penetrating Abdominal Trauma

The risks of uterine and fetal injuries increase proportionately with the duration of pregnancy uterine size. Uterine involvement is extremely common in the third trimester. Clinical presentation depends on concomitant intraperitoneal injuries, the extent of blood loss, fetal pathologic conditions, and injuries to other organ systems. The uterus offers some protection to other intraperitoneal organs. A bullet striking the uterus expends a significant portion of its energy in the muscular wall.

#### Blunt Abdominal Trauma

Motor vehicle crashes are the most common cause of blunt trauma in pregnancy. Eighty percent of falls occur after 32 weeks' gestational age. When the mechanism of injury is obscure, domestic violence should be considered. Retroperitoneal hemorrhage is common with pelvic fractures. The retroperitoneum has a volume capacity of at least 4 liters, and hypovolemic shock is a frequently associated occurrence. Pelvic fracture does not preclude an attempt at vaginal delivery.

Second only to maternal death, abruptio placentae is the most common cause of fetal death. Abruptio placentae occurs when the placenta prematurely separates from the uterine wall. The common presenting signs and symptoms in order of frequency are vaginal bleeding, abdominal pain, uterine irritability, titanic uterine contractions, and fetal death.

Fetal and maternal circulations are normally separate during pregnancy. The most unfavorable consequence of fetal-maternal hemorrhage (FMH) is isoimmunization, which is the development of maternal antibodies against the Rho(D) antigen on the surface of the Rh-positive fetal cells. These maternal IgG antibodies can cross the placenta and may cause fetal red blood cell hemolysis in the current or future pregnancies. The standard dose of Rhogam (300 mcg) will protect against FMH  $\leq 30$  mL of whole blood. In the face of a larger bleed, this standard dose may not be adequate to protect the woman against Rh isoimmunization.

The use of continuous fetal monitoring has been shown in prospective studies to reliably predict fetal outcome. If immediate adverse events such as abruptio placentae, ruptured membranes, or fetal death do not occur, then pregnancy outcome appears to be good.

#### Management of the Pregnant Trauma Patient

When dealing with a trauma patient who happens to be pregnant, an obstetrician should be involved early. Because fetal survival depends wholly on maternal integrity, maternal stabilization is of primary importance.

The steps in the initial examination of a seriously injured victim should be no different from those for a nonpregnant trauma victim, with the following exceptions: In positioning the injured gravida of more than 20 weeks' gestational age, the left lateral tilt position is preferred because the uterus lies directly over the inferior vena cava and subsequently decreases venous return. The physiologic hypervolemia of pregnancy often allows 30% to 35% blood loss before the usual signs of hypovolemia develop, so aggressive fluid replacement, 50% above nonpregnant needs, is necessary.

Maternal vitals signs and fetal heart tones must be obtained at frequent intervals. Maternal and fetal resuscitation are best accomplished by restoring the mother's circulating blood volume.

Tetanus prophylaxis is also important for injured pregnant women, since tetanus is readily preventable.

**Suggested Reading**

Hansen WF, Hansen AR. Problems in pregnancy. In Tintinalli JE, Ruiz E, Krome RL, eds. *Emergency Medicine: A Comprehensive Study Guide*. New York: McGraw-Hill, 1996.

Pearlman MD. Blunt abdominal trauma during pregnancy. In Tintinalli JE, Ruiz E, Krome RL, eds. *Emergency Medicine: A Comprehensive Study Guide*. New York: McGraw-Hill, 1996.

## “He Takes a Little White Heart Pill in the Morning” Select Drug Effects on Shock in the Trauma Patient

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**Learning Objectives**

1. To discuss the alcohol withdrawal syndrome and its clinical presentation.
2. To understand the pharmacologic profile of certain drugs that may mask the clinical presentation of shock.
3. To discuss the effect of certain herbs on bleeding and coagulation.

Many prescribed medications, over-the-counter drugs, social drugs, drugs of abuse, and “herbal medicinals” may camouflage the clinical presentation of the shock syndrome in the trauma patient. Therefore, a detailed history of prescribed medications, over-the-counter drugs, and social drug use activity must be sought if the “typical” presentation of shock is not consistent with the injury pattern or clinical appearance of the patient. A working knowledge of the pharmacokinetics and pharmacodynamics of commonly prescribed medications and over-the-counter medications and other drugs on various organ systems will aid the clinician in the overall assessment and management of the trauma patient.

There are more than 35 million Americans who are 65 years of age or older. There is a high incidence of diabetes mellitus and cardiovascular disease in the elderly, and many in this patient population are dependent on prescribed drugs for maintenance of health. The elderly are more at risk for an adverse drug reaction (ADR) affecting the presentation of shock. Even though many drug side effects are rare, they must be considered when there is little or no response to attempts at resuscitation.

Alcohol is the most frequently used and abused toxicant in the United States. High levels of alcohol seem to accentuate some of the manifestations of shock in some injured patients. Hypotension resulting from total peripheral resistance with reflex tachycardia is a problem with alcohol consumption. Alcohol is a central nervous system depressant that may affect Glasgow Coma Scale evaluation. Respiratory depression may occur in unhabituated individuals at blood concentrations of 400 to 500 mg/dL. Alcohol abstinence can invoke a withdrawal syndrome. Major withdrawal, if unrecognized and untreated, can cause death from circulatory collapse.

Tricyclic antidepressants (TCAs) are associated with more drug-related deaths than any other class of prescription medication. TCAs may cause sedation or coma. The agitation caused by these drugs may mimic hypoxia. The hypotension may accentuate the hypotension due to hypovolemia.

The most common cause of drug-induced priapism is Trazadone. Therapeutic ranges have been occasionally documented to cause arrhythmias including, but not limited to, bradycardia.

Lithium may cause a false sense of security in evaluating resuscitation response resulting from one of its most common side effects, polyuria.

Cardiac drugs such as captopril and diltiazem hydrochloride may

cause profound hypotension. Diltiazem may cause either tachycardia or bradycardia as well.

Aspirin and many of the nonsteroidal anti-inflammatory drugs (NSAIDs) may prolong bleeding time from their effect on platelet aggregation.

Opioids cause respiratory depression with resultant hypoxia as well as mental status depression. Stimulants such as cocaine and amphetamines cause tachycardia and hypertension and may cause a frank psychosis. Profound hypoglycemia may be seen with phencyclidine (PCP), which may result in decreased mental status or combative behavior.

Many of the medications prescribed for asthma, such as adrenergics, sympathomimetics, and smooth-muscle relaxants may cause tachycardia.

*Tanacetum parthenium*, or Fever Few, is an herb used for migraine headaches and has antiplatelet activity that may affect bleeding time. *Ginkgo biloba*, or Maidenhair, has been used for centuries by the Chinese and is made into a tea to treat asthma, bronchitis, dementia, and peripheral vascular disease. It has been implicated in significant bleeding events.

**Suggested Reading**

Baldrigen EB, Bessen HA. Phencyclidine. *Emerg Med Clin North Am* 1990;8:513.

Berk WA, Henderson WV. Alcohols. In Tintinalli JE, Ruiz E, Krome RL, eds. *Emergency Medicine: A Comprehensive Study Guide*. New York: McGraw-Hill, 1996.

Herbal supplements and surgery: what you need to know. Available at [www.mayoclinic.com/invoke.cfm](http://www.mayoclinic.com/invoke.cfm).

## ACLS Update: From Guidelines 2000 to Consensus 2005

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**Learning Objective:** To understand the Guidelines 2000 and their problems, which new evidence may cause to be revised.

Publication of Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care<sup>1</sup> had an enormous impact on the practice of clinical education and resuscitation worldwide. More than 400 topics of resuscitation issues were closely reviewed and discussed at the January and March meetings of the International Liaison Committee on Resuscitation, and will be published as Consensus on Science and Treatment Recommendations 2005 in the December issues of *Circulation*, *Resuscitation*, and *Pediatrics*.

The importance of uninterrupted chest compression was reemphasized. In a witnessed cardiac arrest, chest compression should be started as soon as possible even without rescue breathing in adults, and uninterrupted chest compression is the most important factor in successful restoration of spontaneous circulation and maintaining cerebral circulation. Airway and rescue breathing should not be ignored in the pediatric age group.

Two studies on quality of cardiopulmonary resuscitation during out-of-hospital and in-hospital cardiac arrest by professionals revealed less than adequate chest compressions.<sup>2,3</sup> The present ventilation-compression ratio of 2:15 may be revised with higher compression rate. Three successive shocks of defibrillation with increasing energy level, which have been recommended since 1986 Guidelines of American Heart Association, were reassessed. With new technology defibrillators employing biphasic electrical wave, the success rate of the first shock was reported to be 84% to 100%, and interrupted chest compression during the three stacks of defibrillation may be deleterious.

Deployment of AEDs and PAD (public access defibrillation) is improving the success rate of resuscitation significantly. However, one study reported that the first responders using AED voice prompts provided cardiopulmonary resuscitation less than half the time that the AED is connected to the patient, since the voice prompts require long “hands-off” time for rhythm analysis and defibrillation.<sup>4</sup> The algorithm for AED use,

which presently employs three stacks of shocks, may be revised. The hyperventilation during resuscitation was condemned, from the standpoint of its deleterious effect caused by elevated intrathoracic pressure, decreased cerebral circulation, and other ill effect on restoration of spontaneous circulation. The term "signs of circulation" first introduced by Guidelines 2000 was discussed and dismissed as misleading. Laypersons are inclined to take agonal ineffective respiration-like movements, gasping, or seizure as positive signs of circulation. Education of laypersons is to be stressed. Recommendation of therapeutic moderate hypothermia of 32°C to 34°C for 12 to 24 hours in prolonged comatose patients after restoration of spontaneous circulation was reconfirmed.<sup>5</sup>

Evidence of various resuscitation drugs was discussed, but most of the reports were found to be powerless, except for amiodarone and vasopressin. Amiodarone replaced lidocaine by Guidelines 2000 as the first-line drug for ventricular arrhythmia, but it is not used as frequently as it was during amiodarone study period. A randomized controlled study revealed vasopressin as effective as epinephrine in restoring spontaneous circulation after ventricular fibrillation, asystole, or pulseless electrical activity. The combination of both drugs does not appear to be harmful, and even appears to be beneficial in asystole.<sup>6</sup>

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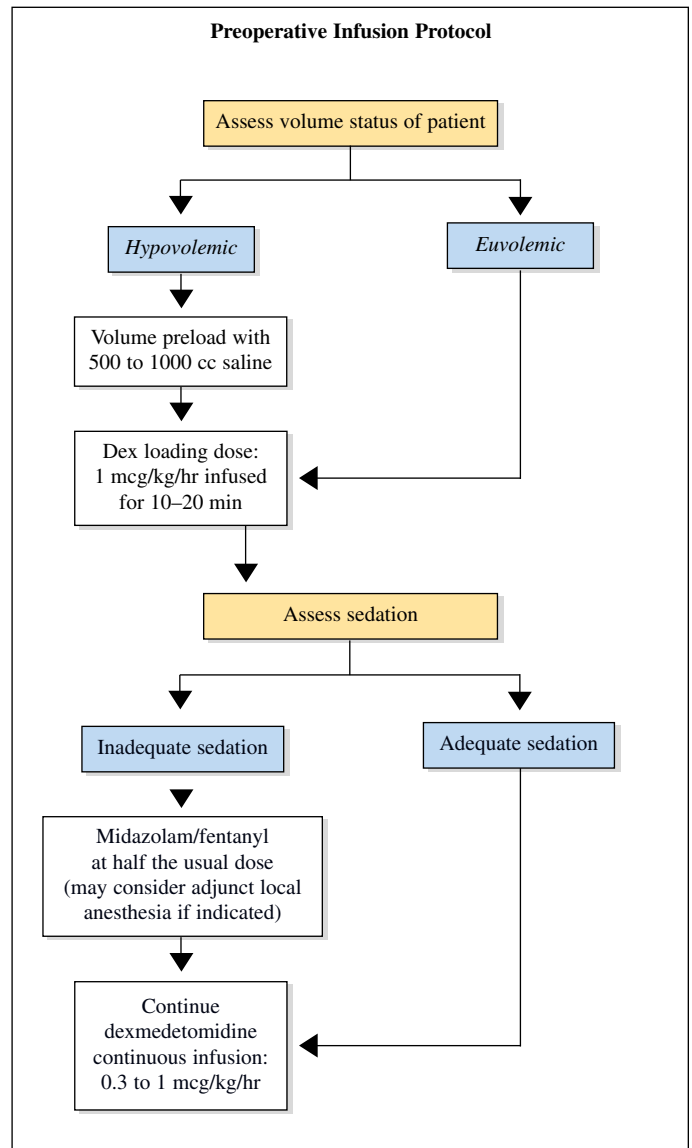
## Alpha Agonists: Novel Techniques for Sedation in the Critically Injured

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Dexmedetomidine is currently the only FDA-approved IV alpha<sub>2</sub> agonist. This drug has an alpha<sub>2</sub>:alpha<sub>1</sub> selectivity of 1,620:1, compared with clonidine at 200:1. The effect is therefore primarily sedation. Alpha<sub>2</sub> agonists provide sedation/hypnosis, anxiolysis, analgesia, sympatholysis (BP/HR, NE), cardioprotection, shivering reduction, and neuroprotective effects with no effect on ICP. Additionally, alpha<sub>2</sub> agonists uniquely offer no respiratory depression. Alpha<sub>2</sub> agonists are particularly useful in perioperative sedation in trauma care. Such sedation may be utilized for the safety of an intubated patient with traumatic brain injury or considered in the setting of awake intubations.

A suggested method for sedation is presented in the following algorithm:



## Cutting Edge Management of Brain Injury

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**Learning Objectives**

- To revise current knowledge concerning protection, preservation, and resuscitation of the injured brain.
- To reinterpret this knowledge in a manner that may improve the management of brain injury.

Despite extensive research, there are no recent developments that improve outcome after injury. Given the crude outcome measures used, it may be that we are missing subtle improvements in neurocognitive outcome. It may also be that we can better use existing knowledge to improve our management of brain injury.

The CRASH trial of methylprednisolone given early after injury was stopped early because mortality was increased by 3%. This result is not as

surprising as has been suggested because methylprednisolone causes hyperglycemia. Hyperglycemia correlates even more strongly with poor outcome than does hypotension.

Global oxygen delivery in the trauma treatment is most likely to fall to critical levels if cardiac output is reduced by blood loss. Review of numerous studies strongly confirms that poor tissue perfusion is a significant event leading to poor outcome. Thus, we should aim to maintain cerebral perfusion pressure. This can be achieved by increasing mean arterial pressure or reducing intracranial pressure. Usually nonsurgical interventions are preferred but there comes a time when medical management may cause complications that themselves compromise outcome.

Decompressive craniectomy is a management option that is attracting renewed interest. Decompressive craniectomy undoubtedly reduces intracranial pressure and improves brain tissue oxygenation, but beneficial effects on outcome have not yet been demonstrated. To date, there is no consensus about optimal timing, although promising results have been described following early decompression. Following decompression and recovery, there is a need to cover the brain to provide long-term protection. This is achieved by replacing the bone flap or inserting a titanium plate. Both procedures carry the risk of significant infection and postoperative hemorrhage. In some cases, these complications may be fatal. Thus, there is a need to balance the early benefits of decompression against the potentially life-threatening complications of reversal.

#### Suggested Reading

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## Essentials of Pediatric Spinal Cord/Column Trauma Care

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Pediatric spinal trauma is infrequent, yet not rare. Five percent of all spinal column/cord injuries occur in those <16 years old. Significant anatomic and biomechanical differences in children explain the injury patterns. The 0 to 2-year-old children have a large head with respect to torso with tremendous mobility and elasticity as a result of underdevelopment of neck muscles, along with incompletely calcified, wedge-shaped vertebrae and shallow, horizontally oriented spine (facet) joints, increasing the likelihood of injuries at the skull and C1 level. Age-related maturation occurs in the 2- to 10-year group, including the head becoming smaller in proportion to the torso. The upper cervical spine usually matures by age 10, the lower cervical spine by age 14. Muscles and ligaments strengthen. Bones grow and reach a mature shape and size. Areas of cartilage and soft bone are replaced with normal calcified bone. By adulthood, C5-C6 gradually becomes the most common site of spinal injury.

Injury patterns in the 0 to 10-year-old group are related to hypermobility and skeletal immaturity and tend toward dislocations without fracture, with a higher rate of persistent instability compared with fracture dislocation injuries. This age tends to sustain soft tissue injuries, with “true fractures” being less common. Upper segments of the cervical spinal column are most often affected. Cervical sprain is the most common type of spinal injury. When serious dislocations occur, they are most commonly located in the upper cervical spine. Dislocations between the skull and C1 are extremely unstable and often fatal. Dislocations between C1-C2 (atlantoaxial joint) are less often fatal but often just as serious.

Thoracolumbar injuries tend to involve the junction between the thoracic and lumbar spine, where the relatively rigid T segments join more mobile L segments, and tend to involve the soft tissues and ligaments, along with cartilage or growth plate injuries. The most common cause is motor vehicle crash with frontal impact, particularly in children restrained by standard rear-seat lap belts. Clues to the injury include lap belt abrasions across the abdomen or lower thorax.

Adolescents (16–24 years) have the highest incidence of spinal injury. Fractures are seen more often than isolated soft tissue injuries. Combination fracture and dislocation injuries are seen more often.

While CS injuries are more evenly distributed through the entire neck, the most common level of injury is the C5/C6 level. TL spinal column injuries assume greater importance. Spinal cord injury without radiographic abnormality (SCIWORA) occurs in ~20% of all pediatric SC injuries, almost exclusively among younger children, with two thirds of cases in patients <8 years old. It is very uncommon in adolescents and rare among adults. CS and TS are injured with almost equal frequency. LS is rarely involved.

Children with SCIWORA have increased risk for recurrence, and recurrent injuries are typically more severe. Once SCIWORA is confirmed, external immobilization is usually necessary for at least 1 to 2 months. The SCIWORA mechanism is mismatched elasticity between spinal column and spinal cord. The immature spine has ligamentous flexibility and elasticity, and withstands elongation without evidence of deformity. Infant spine and cadaveric specimens evidence up to 5 cm of stretch without disruption; however, the spinal cord ruptures after only 0.5 cm of stretch.

Pediatric spinal cord injury is usually accompanied by a traumatic insult. Varying degrees of neurologic deficit may be present, from incomplete spinal cord injury with partial loss of function to complete spinal cord injuries with loss of all function below the level of injury. Lesions above C3-4 typically require intubation and mechanical ventilation due to loss of C3-5 diaphragm innervation. C5-6 lesions result in loss of innervation of parasternal intercostal muscles and also commonly result in the need for ventilatory support. Treatment of traumatic spinal cord injury begins as soon as possible with management of the ABCs and modern techniques of resuscitation and transport to prevent secondary injury. Complete spine immobilization is mandatory. High-dose methyl prednisolone is initiated, 30 mg/kg load followed by 5.4 mg/kg per hour infusion for 23 to 47 hours. Early concerns with spinal cord injury include spinal shock, dysrhythmias, pulmonary, and GI/GU. Spinal shock (neurogenic shock) is characterized by flaccid paralysis, hypothermia, ablated sympathetic tone, vasodilation, and hypotension. Initial treatment is with volume (>10 liters may be needed), supplemented as needed with vasopressors. Hypotension may be exacerbated by hemorrhage. Electrocardiogram changes similar to subendocardial myocardial infarction are possible with C5-6 transections. Dysrhythmias are common with T1-4 (cardiac accelerators) lesions or above. The higher the lesion, the more likely dysrhythmias, particularly bradydysrhythmias. Bradycardia, heart block, asystole, and cardiac arrest may be noted. Cardiac dysrhythmias play a significant role in morbidity and mortality, with instability most prominent in the first 30 days after injury. Treatment includes atropine or glycopyrrolate. Prophylactic isoproterenol, 0.01–0.015 mcg/kg per minute, may be useful. Pacing is rarely required.