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Trauma and Emergency Anesthesia Checklists

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Abstract

This study aimed at investigating the anesthesiologist critical role in stabilizing the patient and maintaining safe conditions during this dynamic period and frequently will find it necessary to shift management strategies as the case evolves. Ant to analyze the followed checklist upon the arrival of trauma patients and the using of the emergency anesthesia procedures. Besides the attempt to justify the use of medical checklists, and following up the checklists' protocols, especially in the field of emergency anesthesia procedures for trauma patients by analyzing the most used checklists worldwide, and demonstrates the importance of adherence to regulations in the checklists for trauma patients. The study concluded that trauma and emergency anesthesia checklist can improve communication in the care of critically ill patients requiring an anesthetic.

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1.1 Introduction

Trauma represents a major global health burden, with significant morbidity, mortality, and socioeconomic impact, the term trauma has Greek origins, meaning 'wound'. Injuries vary in aetiology, distribution, severity, and prognosis. Worldwide, millions are injured, disabled, or killed each year. Falls, burns, violence, and road traffic accidents are among the most significant causes stated by the World Health Organization (Fleming & Egeler, 2013).

Trauma is a leading cause of morbidity and mortality in all age groups, and is the leading cause of death in the young. All aspects of trauma care, from that provided at the scene, through transport, resuscitation, surgery, intensive care, and rehabilitation, must be coordinated if the patient is to have the greatest chance for full recovery.

Trauma is among the leading causes of morbidity and mortality worldwide. In fact, it is the leading cause of death in the Arab world for individuals between the ages of 1 and 50 years, accounting for a staggering 47% of deaths in this group. Trauma patients presenting to the operating room (OR) for emergency treatment generally have been subjected either to blunt force or to penetrating injury, and their care poses specific challenges for the anesthetic provider, including the unstable hemodynamics, challenging airway management, extensive resuscitation needs in the setting of hemorrhage or coagulopathy and ever-evolving intraoperative course, with the full extent of injuries often not determined until surgical exploration has been performed (Rhee, Joseph, Pandit, Aziz, Vercruysse, Kulvatunyou et al., 2014).

The trauma anesthesiologist has multiple competing concerns when supporting the patient with major trauma, but the priority must be focused on adequate resuscitation to facilitate surgical hemostasis. A broad, evidence-informed knowledge of airway management, resuscitation, physiology, pharmacology, and critical care is required to address the unique pathophysiological processes encountered in trauma. Judicious selection of anesthetic agents is crucial to ensure optimal outcomes (Sikorski, Koerner, Fouche-Weber, et al., 2014).

The trauma anesthesiologist has multiple competing concerns when supporting the patient with trauma, but first and foremost, adequate resuscitation must be assured to enable surgical hemostasis. Judicious selection of anesthetic agents is crucial when supporting the physiology of the severely injured trauma patient. Future studies are warranted to evaluate the effect of different anesthetic regimens on physiological endpoints and clinical outcomes (Bassett & Smith, 2012).

Checklists are common in some medical fields, including surgery, intensive care and emergency medicine. They can be an effective tool to improve care processes and reduce mortality and morbidity. Despite the seemingly rapid acceptance and dissemination of the checklist, there are few studies describing the actual process of developing and implementing such tools in health care. (Thomassen, Espeland, Softeland, Lossius, Heltne & Brattebo, 2011).

Implementing checklists involves many conflicting interests, including the organisational culture and workflow, which are often affected. Oversimplification of potential challenges could easily lead to conflicts between fractions of adopters and opponents. There are several reports of low compliance when checklists are introduced in health care (Thomassen, Brattebo, Softeland, Lossius & Heltne, 2010).

1.2 Problem statement

The anesthesiologist plays a critical role in stabilizing the patient and maintaining safe conditions during this dynamic period and frequently will find it necessary to shift management strategies as the case evolves.

In trauma cases, unlike many scheduled and urgent anesthesia cases, the patient commonly presents to the OR with an unknown past medical history and is already involved in an evolving spectrum of care that may have been initiated in the prehospital setting or in the emergency department (ED).

In the face of the special challenges posed by trauma, it is imperative that the anesthesiologist be able to call upon his or her training in a well-equipped environment and act quickly to induce and/or maintain anesthesia without having a detrimental effect on blood pressure (BP), to obtain appropriate vascular access for monitoring and resuscitation, and to maintain communication with the operative team regarding the patient's ongoing needs.

A rapid sequence induction is required for trauma patients presenting to OR with an unsecured airway. As noted, induction of anesthesia is particularly challenging in the setting of trauma, both because the extent of the patient's injuries is often undetermined or underappreciated (as when there is significant blood loss in closed compartments such as the retroperitoneal space or the lower extremities) and because comorbid conditions frequently are unknown and un optimized (Sikorski, Koerner, Fouche-Weber, et al., 2014).

Therefore, the problem of this study is analyze the followed checklist upon the arrival of trauma patients and the using of the emergency anesthesia procedures. The problem of the study also lies in the attempt to justify the use of medical checklists, and following up the checklists' protocols, especially in the field of emergency anesthesia procedures for trauma patients by analyzing the most used checklists worldwide, and demonstrates the importance of adherence to regulations in the checklists for trauma patients.

1.3 Importance of the study

The importance of this study stems out of its role in justifying the use of medical checklists, and following up the checklists' protocols. In the field of emergency anesthesia procedures for trauma patients this study analyzes the most used checklists worldwide, and demonstrates the importance of adherence to regulations in the checklists for trauma patients.

1. 4 Induction of anesthesia

The following (Box 1) represents the checklist before the induction of anesthesia.

Box (1): Checklist before the induction of anesthesia

Is an experienced and trained assistant available to help you with induction?
- □ **Yes**
- □ **Not applicable**

Has the patient had no food or drink for the appropriate time period?
- □ **Yes**
- □ **Not applicable**

Is there intravenous access that is functional?
- □ **Yes**

Is the patient on a table that can be rapidly tilted into a head-down position in case of sudden hypotension or vomiting?
- □ **Yes**

Equipment check:
- □ **If compressed gas will be used, is there enough gas?**
- □ **Anesthetic vaporizers are connected?**
- □ **Breathing system is securely and correctly assembled?**
- □ **Breathing circuits are clean?**
- □ **Resuscitation equipment is present and working?**
- □ **Laryngoscope, tracheal tubes and suction apparatus are ready and clean?**
- □ **Needles and syringes are sterile?**
- □ **Drugs are drawn up into labelled syringes?**
- □ **Emergency drugs are present in the room, if needed?**

Accordingly, careful selection of induction and maintenance agents is critical. Commonly the used agents include the following:

1.4.1 Propofol

Propofol, (see figure 1), a lipid-soluble GABA agonist, is one of the most widely used induction agents in the United States; consequently, most US anesthesia providers are familiar with it and have expertise in using it. However, Propofol, though ideal for hemodynamically stable patients by virtue of its quick onset of action and deep levels of amnesia, causes a significant reduction in systemic vascular tone and has mild myocardial depressant effects, which make it potentially dangerous in the trauma setting. Nonetheless, this agent can still play a role in trauma anesthesia if administered in reduced doses, in conjunction with other induction agents, or with vasoactive support.

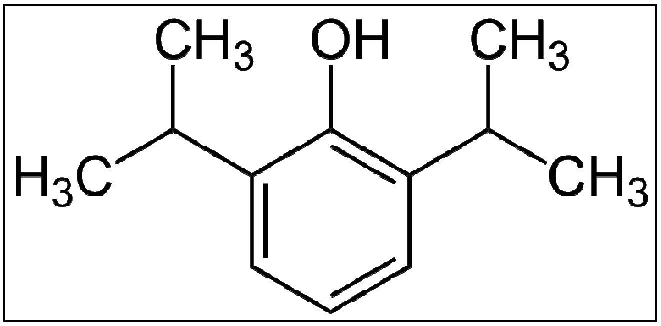

Figure (1): Chemical formula of Propofol

1.4.2 Etomidate

Etomidate, (see figure 2), a gamma-aminobutyric acid (GABA) agonist, offers a stable hemodynamic profile with minimal disruption of vascular tone. Furthermore, its ability to decrease cerebral blood flow, cerebral metabolic requirements, and intracranial pressure (ICP) make it particularly useful in unstable trauma patients with known intracranial injury. On the other hand, etomidate has its disadvantages. It has been associated with increased mortality in septic patients on the basis of its known adrenal suppression; it has also been shown to increase trauma patients' susceptibility to pneumonia, which potentially limits its utility (Asehnoune, Mahe, Seguin, Jaber, Jung, Guitton, et al., 2012).

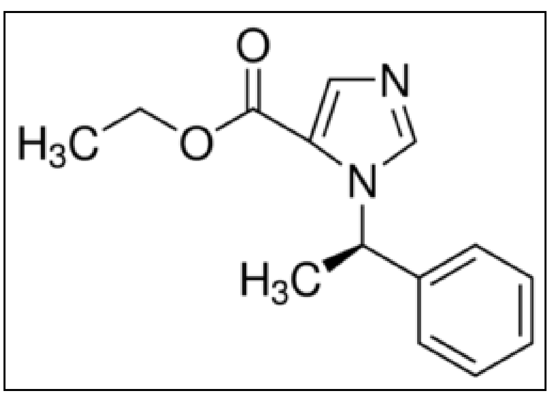

Figure (2): Chemical formula of Etomidate

1.4.3 Ketamine

Ketamine, (see figure 3), a noncompetitive *N*-methyl-d-aspartic acid (NMDA) inhibitor, is another induction and maintenance agent that is commonly used in trauma patients. Through its ability to raise sympathetic tone and release endogenous catecholamine's, ketamine can actually increase cardiovascular tone; this makes it particularly appealing in the hypovolemic, hypotensive trauma patient. In addition, because ketamine's lipophilicity and formulation permit intramuscular (IM) injection, this agent can be administered to combative patients without vascular access.

However, ketamine is not without its own disadvantages. Despite its ability to increase cardiovascular tone, it is also a direct myocardial depressant, and its use can lead to significant hypotension in the catecholamine-depleted patient. Ketamine is also known to raise ICP, an effect that raises questions about its applicability in patients with traumatic intracranial injuries; however, some studies have suggested that it may in fact have a neuroprotective effect (Stollings, Diedrich & Oyen, 2014).

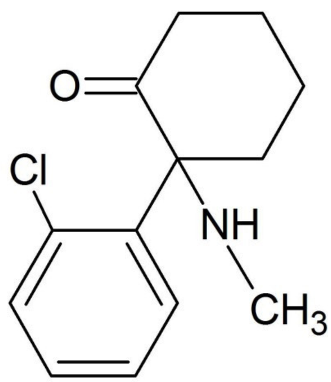

Figure (3): Chemical formula of Ketamine

1.4.4 Benzodiazepines

Benzodiazepines, (see figure 4), are a class of medications that work in the central nervous system and are used for a variety of medical conditions. As a class, benzodiazepines are similar in how they work in the brain but have different potencies, durations of actions, and receptor site affinities. Because of this, some benzodiazepines work better than others in the treatment of particular conditions.

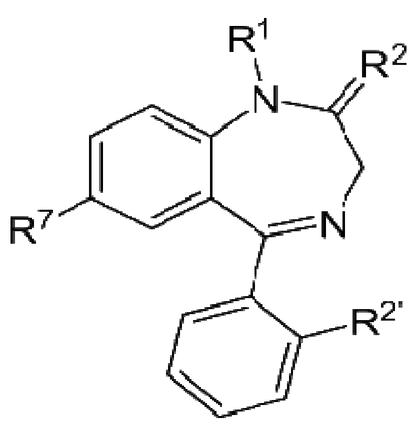

Figure (4): Chemical formula of Benzodiazepines

1.4.5 Opioids

Opioids are by far the oldest known analgesics, and their versatility in the practice of anesthesia and pain management remains unchallenged. It behooves any physician dealing with acute pain situations to have a working knowledge of the mechanisms through which opioids produce analgesia and the locations in the body where opioids work. Knowledge of the physical properties of the various opioids can help the practitioner predict how a given opioid will function when administered by a particular route, eg, epidural versus intravenous. In this article, the actions and properties of opioids will be reviewed with emphasis placed on their use in clinical practice.

1. 5 Trauma and Emergency Anesthesia Checklist

Anesthesiologists will be involved in the management of patients who have sustained traumatic injuries. Because residency may impart limited training in management of trauma, we propose that anesthesiologists use a standardized "trauma and emergency checklist" to facilitate the care they provide these patients and (hopefully) improve outcomes. Checklists have been shown to decrease patient morbidity and mortality by assuring that the health care provider does not overlook some important aspect of care. Checklists are used when preparing an anesthetic workstation at the beginning of the day. The algorithms promulgated by the Advanced Trauma Life Support and Advanced Cardiac Life Support courses are checklists. The checklist assures that critical steps are not missed. Checklists are easy. Missing critical steps can be deadly. Checklists have been shown to decrease inpatient complications and death.1 Standardized checklists can be especially useful during emergencies (Walker & Reshamwalla, 2012, Hunter & Finney, 2011).

Despite mixed results regarding the clinical utility of checklists, the anesthesia community is increasingly interested in advancing research around this important topic. Although several checklists have been developed to address routine perioperative care, few checklists in the anesthesia literature specifically target the management of trauma patients.

A trauma and emergency anesthesia checklist can serve as a template of care for the initial phase of operative anesthesia, as well as resuscitation. The goal of this manuscript is not to provide a definitive checklist. The definitive checklist, if it ever exists, should be created, and vetted, by a learned society within the trauma anesthesiology community. Our goal for this manuscript is to initiate a discussion about what should be on a trauma anesthesia checklist, providing a nidus for a definitive document (see Box 2).

Checklists have been shown to decrease patient morbidity and mortality by assuring that the health care provider does not overlook some important aspect of care. Checklists are used when preparing an anesthetic workstation at the beginning of the day. The algorithms promulgated by the Advanced Trauma Life Support and Advanced Cardiac Life Support courses are checklists. Even trauma surgeons in the military, who have a great deal of experience in managing patients who sustain blast injury, use checklists. Military surgeons use checklists to manage trauma for the same reason that anesthesiologists use checklists when checking an anesthesia workstation, or that an airline pilot uses a checklist before every takeoff and landing. The checklist assures that critical steps are not missed. Checklists are easy. Missing critical steps can be deadly.

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A trauma and emergency anesthesia checklist can serve as a template of care for the initial phase of operative anesthesia, as well as resuscitation. The goal of this manuscript is not to provide a definitive checklist. The definitive checklist, if it ever exists, should be created, and vetted, by a learned society within the trauma anesthesiology community (Stephens, Kahntroff & Dutton, 2009).

Box (2): Trauma and Emergency Anesthesia Checklist

BEFORE PATIENT ARRIVAL
- ☐ Room temperature 25C or higher
- ☐ Warm IV Line
- ☐ Machine Check
- ☐ Airway Equipment
- ☐ Emergency Medications
- ☐ **BLOOD BANK: "6U O Neg PRBC, 6U AB FFP, 5-6 Units of random donor plat (1 standard adult dose) available"**

PATIENT ARRIVAL
- ☐ Patient identified for trauma / emergency surgery?
- ☐ **BLOOD BANK: "Send blood for T&C and initiate MTP now!"**
- ☐ IV Access
- ☐ Monitors (SaO2, BP, ECG)
- ☐ **SURGEON: "PREP & DRAPE!"**
- ☐ Pre-oxygenation

INDUCTION
- ☐ Sedative hypnotic (ketamine v. propofol v. etomidate)
- ☐ Neuromuscular Blockade (succ v. roc)

INTUBATION
- ☐ **(+) $ETCO_2$ → SURGEON: "GO!"**
- ☐ Place Orogastric Tube

ANESTHETIC
- ☐ (Volatile Anesthetic and/or Benzodiazepine) + Narcotic
- ☐ Consider TIVA
- ☐ Insert additional IV access if needed and an arterial line

RESUSCITATION
- ☐ Send baseline labs
- ☐ Follow MAP trend
- ☐ Goal FFP:PRBC controversial, but consider early FFP
- ☐ Goal Urine Output 0.5-1 mL/kg/hr
- ☐ Consider tranexamic acid if <3 hr after injury; 1 gm over 10 min x1, then 1gm over 8 hrs
- ☐ Consider calcium chloride 1 gm
- ☐ Consider hydrocortisone 100 mg
- ☐ Consider vasopressin 5-10 IU
- ☐ Administer appropriate antibiotics
- ☐ Special Considerations for TBI (SBP > 90-100 mmHg, SaO2>90%, pCO2 35-45mmHg)

CLOSING / POST-OP
- ☐ **ICU: "Do you have a bed?"**
- ☐ Initiate low lung volume ventilation (TV = 6mL/kg ideal body weight)

Source: (Tobin, Grabinsky, McCunn, Pittet, Smith, Murray & Varon, 2013)

1.6 Fundamentals of trauma and emergency anesthesia checklist

1.6.1 Before patient arrival

Hypothermia impairs antibody and cell-mediated immune defense, increases perioperative infection rates, and contributes to coagulopathy. The cycle of hypothermia, coagulopathy, and metabolic acidosis is well described. In one retrospective review, patients with a temperature <35 C°, an International Normalized Ratio >1.5 and a pH <7.2 had a mortality of 47%. Active fluid warming with fluids heated to 40 C through 45 C° can mitigate heat loss in the surgical patient, helping abort the trauma triad of hypothermia, coagulopathy, and acidosis. Thus, the specific steps related to hypothermia are:

1- The operating room (OR) temperature should be warm (25 C° or higher). Maintaining a warm OR on patient arrival helps keep patients warm, reducing the effects of hypothermia.
2- Have additional warming devices available, including a forced air device system, fluid warmers on the IV line, warm IV solutions, and warm blankets.
3- Have a system to warm all solutions that are to be used in the surgical field.
4- Verify that a warm IV line is available.

A routine anesthesia machine check and verification that airway equipment, including a difficult airway cart, are immediately available are a standard part of OR preparation and should not be overlooked (Tobin, Grabinsky, McCunn, Pittet, Smith, Murray & Varon, 2013).

It takes time for the blood bank to prepare blood to treat massive hemorrhage. Before arrival:

1- Verify that 6 units "O Negative" packed red blood cells (PRBCs), 6 units "AB" fresh frozen plasma (FFP), and 5 to 6 units of random donor platelets (1 standard adult dose) are available.
2- Activate the massive transfusion protocol. In one study using an historical control, mortality improved from 45% to 19% after institution of a massive transfusion protocol.10 Although there was no significant difference in the ratio of red blood cells to FFP administered, a decreased mean time to administration of first blood product was noted. This illustrates the role that timely and effective communication with the blood bank can play in management of the trauma patient.

1.6.2 Patient arrival

1- As soon as a patient is identified as an emergency and/or trauma patient, the OR staff and anesthesiologist should be notified. Ideally, the anesthesiologist should be involved in the initial evaluation and management in the trauma bay and communicate with the blood bank immediately to free up prearranged assets in a timely fashion.
2- Obtain large bore vascular access. A 14-gauge IV (flow rate over 300 mL/min) is ideal but may be challenging to place in a cold patient who has suffered significant blood loss. A 16-gauge IV (flow rate 200 mL/min) offers flow rates double that of an 18-gauge IV (flow rate 100 mL/min) and can be easier to place. While a large bore central line (8.5 Fr × 3.5 in) offers significantly higher flow rates under pressure at 300 mm Hg, operative management of a trauma patient in extremis should not be delayed for placement of central venous access. Consider replacing small bore IVs with rapid infusion catheters, available in 7 and 8.5 Fr sizes. Also consider having an ultrasound machine available to assist with placement of central venous access. Consider placement of an intraosseous line if vascular access is otherwise not possible.
3- Connect the patient to monitoring. At a minimum, an oxygen saturation probe can record a heart rate and serve as a surrogate for peripheral perfusion. Poor peripheral perfusion is demonstrated in a low quality, "dampened" oxygen saturation waveform, as well as low end-tidal carbon dioxide (McNeer & Varon, 2012).
4- Place an arterial line when possible to establish reliable arterial blood pressure monitoring and to facilitate ease of blood draws. Do not, however, delay surgery for placement of an arterial line.

5- Consider having a transesophageal echocardiography machine available for personnel skilled in its use.

6- Instruct the surgical/interventional radiologic team to prepare and drape the patient immediately upon arrival in the OR. Recognition of hemodynamic/ metabolic instability is a responsibility of the anesthesiologist and should be discussed during the decision-making process.

1.6.3 Resuscitation

1. Send baseline labs as soon as feasible. Follow base excess/deficit, coagulation prolife, and arterial blood gas to guide the resuscitation. Base deficit is the amount of base required to bring a sample of blood at body temperature to a pH of 7.4, assuming a carbon dioxide tension of 40 mm Hg. Ideally, this allows one to evaluate the metabolic status of the patient independently from any respiratory contribution. The base deficit is often available rapidly in the OR and offers the ability to guide the resuscitation more immediately than other laboratory values. While rapid clearance of lactate during an emergency portends improved survival, the value of a lactate level during the acute resuscitative phase is less clear.
2. Follow trends in MAP. During the initial phase of resuscitation, titrate fluid administration to restore consciousness and radial pulse. Following trends in blood pressure is a more sensitive measure of the adequacy of resuscitation and is superior to reliance on any single number. The concept of hypotensive resuscitation is hotly debated. Any advantage of hypotensive resuscitation is limited to penetrating trauma, and administration of medication to decrease the blood pressure is probably ill advised. Similarly, "chasing a blood pressure" to achieve a "normal" blood pressure in the trauma patient may also be poorly advised (Morrison, Carrick, Norman, Scott, Welsh, Tsai, Liscum, Wall & Mattox, 2011).
3. While the ideal FFP to PRBC ratio is subject to debate and continuing research, it is reasonable to consider the early use of FFP. Avoid excessive crystalloid resuscitation and consider early transfusion of blood products as needed, particularly if a large crystalloid infusion has been required.
4. Tranexamic acid is a synthetic lysine derivative that binds lysine sites and is an effective anti-fibrinolytic. Tranexamic acid has been demonstrated to confer a mortality benefit to severely injured patients in both the civilian and military settings.43,44 The greatest benefit is obtained if the patient is bleeding and tranexamic acid is administered within 3 hours of injury. If these criteria are met, consider administration of tranexamic acid 1 g in 100 mL 0.9% saline IV over 10 minutes once, followed by 1 g in 100 mL 0.9% saline IV infusion over 8 hours.
5. If the patient has received a significant blood transfusion, then consider administration of calcium chloride 1 g. The citrate preservative in blood products can lower calcium levels and contribute to hypotension. Furthermore, hypocalcemia in patients requiring massive transfusion can increase mortality (Ho & Leonard, 2011).
6. Consider administration of hydrocortisone 100 mg during unremitting hypotension. Adrenal suppression is a well-described phenomenon in critical illness. Hydrocortisone can benefit trauma patients as well. Twenty-three trauma patients treated with hydrocortisone were more sensitive to α-1 adrenoceptor stimulation; and another group of 16 trauma patients, who were cosyntropin stimulation

test non-responders, were more likely to have prolonged vasopressor dependency (Hoen, Mazoit, Asehnoune, Brailly-Tabard, Benhamou, Moine & Edouard, 2005).

7. Administer appropriate antibiotics. First generation cephalosporin's will treat Gram-positive organisms found on the skin. If gastrointestinal contamination is a concern, then consider a second generation cephalosporin for broad Gram-negative coverage. Allergic cross reactivity between penicillin's and cephalosporin's has an incidence of approximately 5% to 10%. Cephalosporin's should therefore be used with caution in penicillin-allergic patients.

1.7 Conclusion

The trauma and emergency anesthesia checklist can improve communication in the care of critically ill patients requiring an anesthetic. The challenges of producing strong prospective data in the trauma population make definitive suggestions difficult; however, a well-referenced guide to the emergent induction and operative resuscitation of these critically ill patients can serve as a tool to evaluate benchmarks for care (e.g., time from OR arrival to induction of anesthesia, appropriateness of blood product administration, etc.). the researchers believe that a checklist such as this can serve as a starting point for that discussion.

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