Literature Review in Critical Care Transport Medicine:

Recent Articles That May Affect Your Practice

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Prehospital Intravenous Fluid Administration Is Associated With Higher Mortality in Trauma Patients: A National Trauma Data Bank Analysis

Elliott R. Haut, MD, Brian T. Kalish, BA*, Bryan A. Cotton, MD, MPH†, David T. Efron, MD*, Adil H. Haider, MD, MPH*‡, Kent A. Stevens, MD, MPH*‡, Alicia N. Kieninger, MD§, Edward E. Cornwell, III, MD¶, and David C. Chang, MBA, MPH, PhD‖*

Objective: Prehospital intravenous (IV) fluid administration is common in trauma patients, although little evidence supports this practice. We hypothesized that trauma patients who received prehospital IV fluids have higher mortality than trauma patients who did not receive IV fluids in the prehospital setting.

Methods: We performed a retrospective cohort study of patients from the National Trauma Data Bank. Multiple logistic regression was used with mortality as the primary outcome measure. We compared patients with versus without prehospital IV fluid administration, using patient demographics, mechanism, physiologic and anatomic injury severity, and other prehospital procedures as covariates. Subset analysis was performed based on mechanism (blunt/penetrating), hypotension, immediate surgery, severe head injury, and injury severity score.

Results: A total of 776,734 patients were studied. Approximately half (49.3%) received prehospital IV. Overall mortality was 4.6%. Unadjusted mortality was significantly higher in patients receiving prehospital IV fluids (4.8% vs. 4.5%, $P < 0.001$). Multivariable analysis demonstrated that patients receiving IV fluids were significantly more likely to die (odds ratio [OR] 1.11, 95%

vital organ perfusion.[1] Since its inception, the American College of Surgeons Advanced Trauma Life Support course has emphasized immediate treatment of trauma patients with IV fluids, although in the newest eighth edition, the course now emphasizes a more "balanced" approach.[2] The routine practice of IV fluid administration in the prehospital arena is touted with great enthusiasm but little data exist to support its use.[3,4]

An increasing body of evidence has demonstrated that IV fluid administration does not improve survival in trauma and may actually be of harm in certain subsets of trauma patients.[5–9] One theory for the possibility of harm is based upon the delay of transport to definitive care. Scene placement of venous access is not only associated with increased scene time but also increased overall time to hospital, in some cases the time to place an IV exceeds that of the actual transport itself.[10] In hypotensive patients and those with primary torso injuries, scene placement times exceed that of en route IV line placement.[11,12] Many trauma providers believe that the "scoop and run" approach, which minimizes prehospital procedures in favor of rapid transport

(Ann Surg 2011;253:371–378)

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Prehospital Fluids

- 776,334 patients looked at in the National Trauma Data Bank
- 49% received prehospital IV fluids
- Unadjusted mortality was significantly higher in patients receiving prehospital IV fluids (4.8% vs. 4.5%, *P <0.001).*

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Prehospital Fluids

- *Multivariable analysis demonstrated that patients receiving* **IV fluids were significantly more likely to die (odds ratio [OR] 1.11, 95% confidence interval [CI] 1.05–1.17).**

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Prehospital Fluids

- **The association was identified in nearly all subsets of trauma patients: especially marked in patients with penetrating mechanism (OR 1.25, 95% CI 1.08–1.45), hypotension (OR 1.44, 95% CI 1.29–1.59), severe head injury (OR 1.34, 95% CI 1.17–1.54), and patients undergoing immediate surgery (OR 1.35, 95% CI 1.22–1.50).**

Prehospital Fluids
What is the Lesson Here?

- **The harm associated with prehospital IV fluid (crystalloid) administration is significant for victims of trauma. The routine use of prehospital IV fluid administration for all trauma patients should be discouraged.**

Special Commentary

State of the Art of Fluid Resuscitation 2010: Prehospital and Immediate Transition to the Hospital

Norman E. McSwain, MD, Howard R. Champion, MD, Timothy C. Fabian, MD, David B. Hoyt, MD, Charles E. Wade, PhD, Brian J. Eastridge, MD, Todd E. Rasmussen, MD, Robert R. Roussel, PhD, Frank K. Butler, MD, John B. Holcomb, MD, Martin A. Schreiber, MD, Steven R. Shackford, MD, and Lorne H. Blackbourne, MD

The Prehospital Fluid Conference was sponsored by the US Army Institute of Surgical Research and Combat Casualty Care Research, US Army Medical Research and Materiel Command. Some 65 conferees were invited in January 2010 to review the contemporary guidelines on the use of fluid resuscitation in treating combat casualties, discuss the state of the art of fluid resuscitation for combat casualties, and answer the following questions:

tations, will be used throughout this document to indicate a level of care facility (see Table 1).

Although discussions focused on military needs, it was understood and accepted by the consensus group that many, if not all, of the recommendations could and would be used for civilian prehospital providers with appropriate situational modifications.

The conferees explored the state of the science in three sessions:

J Trauma 2011 (May Supp); 70:S2-S10

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Recommendations

- The primary recommendation was that fluid resuscitation should be instituted for a systolic blood pressure of 80 mm Hg to 85 mm Hg, a falling blood pressure, or decreasing ability to mentate without evidence of head injury.

Recommendations

- No fluids should be instituted in the presence of a strong radial pulse and normal mentation
- Fluids should be initiated for weak or absent radial pulse or decreasing level of consciousness in the absence of head injury.

Recommendations

- 1:1 resuscitation should be used as much as conditions and resources permit.
- 1:1:1 resuscitation should be the goal until hemorrhage is controlled. (This goal is based on retrospective studies.)
- Use low-volume resuscitation as appropriate in hospital.
- Management of the initial coagulopathy of severe blood loss is best achieved by early plasma infusion.

Fluid Resuscitation
What is the Lesson Here?

- Extensive volume resuscitation with crystalloids is detrimental
- Plasma and packed cells should be started ASAP (and platelets, if feasible)

ORIGINAL ARTICLE

Accounting for differences in transfusion volume: Are all massive transfusions created equal?

John P. Sharpe, MD, Jordan A. Weinberg, MD, Louis J. Magnotti, MD, Paul A. MacLennan, PhD, Thomas J. Schroeppel, MD, Timothy C. Fabian, MD, *and* **Martin A. Croce, MD,** *Memphis, Tennessee*

BACKGROUND: Among patients subjected to massive transfusion (MT), some will require considerably more blood than others, depending on the rate and quantity of hemorrhage. In analyses concerning plasma to red blood cell (RBC) ratios and platelet to RBC ratios, this has yet to be examined. We sought to evaluate the effect of the number of RBC units transfused on both plasma:RBC and platelet:RBC and their association with mortality in MT patients.

METHODS: Prospective data were collected on trauma patients taken directly to surgery from the resuscitation room who received ≥10 RBC units by completion of operation. MT protocol was in place for all patients. To account for survival bias, intra-operative deaths were excluded. Patients were stratified by plasma:RBC and platelet:RBC (HIGH > 0.5, MID 0.33-0.5, LOW < 0.33). Crude and adjusted risk ratios (RRs) for hospital mortality were determined, using the HIGH ratio as the reference group.

RESULTS: One hundred thirty-five patients met inclusion criteria. There were no significant differences with respect to demographics, injury characteristics, or shock severity. However, the mean number of intra-operative RBC units transfused was significantly different between plasma:RBC groups (HIGH: 16.2, MID: 19.7, LOW: 25.1; $p < 0.001$). The crude risk for mortality was significantly higher for the LOW group relative to the HIGH group (RR 1.99, 95% confidence interval [CI] 1.02–3.89). However, after adjustment for the number of RBCs transfused, the risk was not significantly different (RR 1.54, 95% CI 0.75–3.15). The adjusted mortality risk for the LOW versus HIGH platelet:RBC groups was also not statistically different (RR 1.92, 95% CI 0.99–3.71).

CONCLUSIONS: Among patients subjected to MT, those who receive relatively higher quantities of RBCs are both more likely to receive a lower plasma:RBC and are more likely to die. Any analysis concerning transfusion ratios should take the potential confounding of this heterogeneity among MT patients into account. (*J Trauma Acute Care Surg*. 2012;72: 1536–1540. Copyright © 2012 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Prognostic study, level III.

KEY WORDS: Massive transfusion; trauma; mortality.

J Trauma Acute Care Surg. 2012; 72:1536-1540

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Massive Transfusion

Sharpe, et al.

- **165 patients received massive transfusion (MT); 135 entered study (30 died)**
- **Divided into HIGH, MEDIUM and LOW ratio groups**
- **Those patients who received the most PRBCs were less likely to receive high ratios of blood products**

TABLE 1. Plasma:RBC Groups by Demographic, Injury, Shock Severity, and Transfusion Characteristics

	Plasma Ratio Group			
Characteristics	LOW (<0.33)	MID (0.33–0.5)	HIGH (>0.5)	p
N	26	40	69	
Age (yr)	34.6 (15.8)	36.9 (15.5)	35.7 (13.5)	0.8638
Male (%)	80.8	72.5	72.5	0.6867
Mechanism (%)				
Blunt	42.3	60.0	49.3	0.3389
Penetrating	57.3	40.0	40.7	
Mortality (%)	57.7	40.0	29.0	0.0344
ISS	35.1 (13.5)	30.0 (16.6)	32.1 (16.3)	0.6077
Base excess	−12.0 (7.2)	−8.9 (7.1)	−8.5 (7.3)	0.0636
SBP	91.0 (44.8)	104.2 (40.6)	99.8 (43.6)	0.5236
Hemorrhage control time	240.4 (221)	131.5 (72.2)	200.2 (134.2)	0.2469
RBC units	25.1 (13.0)	19.7 (12.1)	16.2 (6.9)	0.0001

Continuous variables presented as mean values (standard deviation) and tested with ANOVA. Categorical variables tested using χ^2. SBP, systolic blood pressure.

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Massive Transfusion

Sharpe, et al.

- **PROPPR (Prospective Randomized Optimum Platelet and Plasma Ratios) will soon begin in North America to look at various ratios of blood products during MT**

J Trauma Acute Care Surg
2012; 73:27-32

REVIEW ARTICLE

Base excess: A review

Jeremy Juern, MD, Vikram Khatri, MBBS, *and* **John Weigelt, MD, DVM,** *Milwaukee, Wisconsin*

The measurement of pH, carbon dioxide, and oxygen in blood goes back hundreds of years. This scientific history involves distinguished names such as Boyle, Dalton, Avogadro, Arrhenius, Henderson, and Hasselbach.[1] Following in the footsteps of these luminaries, Siggaard-Andersen[2] and Astrup[3] developed the term *base excess* (BE) to describe the metabolic component of an alkalosis or acidosis. Ever since then, physicians and physicians-in-training have been trying to understand BE. There is a paucity of literature, even in critical care textbooks, to explain BE to the eager learner. This review article will explain what BE is, groups of patients where it has been studied, and finally explore the pitfalls and limitations of its use. The goal is to understand BE without having to be a clinical chemist.

BASE EXCESS QUALITATIVELY

All living cells of the human body need oxygen for cellular respiration. Oxygen is the terminal electron acceptor in the oxidative phosphorylation portion of aerobic metabolism. Hemoglobin (Hb) delivers oxygen to the cells via the bloodstream. When the flow of blood, and thus oxygen delivery, is insufficient to meet the demand of the cells, the cells switch over to anaerobic metabolism. The products of anaerobic metabolism include lactic acid and other organic acids. As acids build up, a metabolic acidosis occurs resulting in a relative "acid excess" (or "deficiency of base") in the blood.

The body's buffering system mitigates the buildup of acids. The buffering system of the human body comprises bicarbonate, Hb, and albumin. Other body proteins do not have a sig-

are more concerned about a negative BE than a positive one. Using the term *base deficit* implies that the BE is a negative number; however, the BD might be expressed as the absolute value. The terms *base deficit* and *base excess* are often used interchangeably in conversation and writing. Caution is advised because all of the following practically mean the same thing: "the BD is 5," "the BE is −5," and "the BD is −5." We will use the term BE preferentially.

How the numbers are described and written can be confusing from a mathematical standpoint. The symbols greater than (>), less than (<), greater than or equal to (≥), and less than or equal to (≤) should be used as they would be on a number line, although in practice they are not always used that way. For example, the statement, "the BE is less than −5" would be written mathematically as $BE < -5$. Using a number line, this should mean a BE of −6, −7, and so on. However, the speaker might have meant that the BE is −4, −3, and so on. To avoid confusion when speaking, it may be better to use terms such as more negative, more positive, better, worse, or improved. We will use either descriptive words or standard mathematical number line convention as we explore the use of BE in clinical medicine.

To summarize, the purpose of the BE is to reflect the pure metabolic component of an acidosis or an alkalosis. It is not affected by short-term changes in P_{CO_2}, which is the respiratory component. Figure 1 is a number line representation of BE along with common causes of metabolic acidosis and alkalosis.

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Base Excess

- "There is a paucity of literature, even in critical care textbooks, to explain BE to the eager learner…The goal is to understand BE without having to be a clinical chemist."

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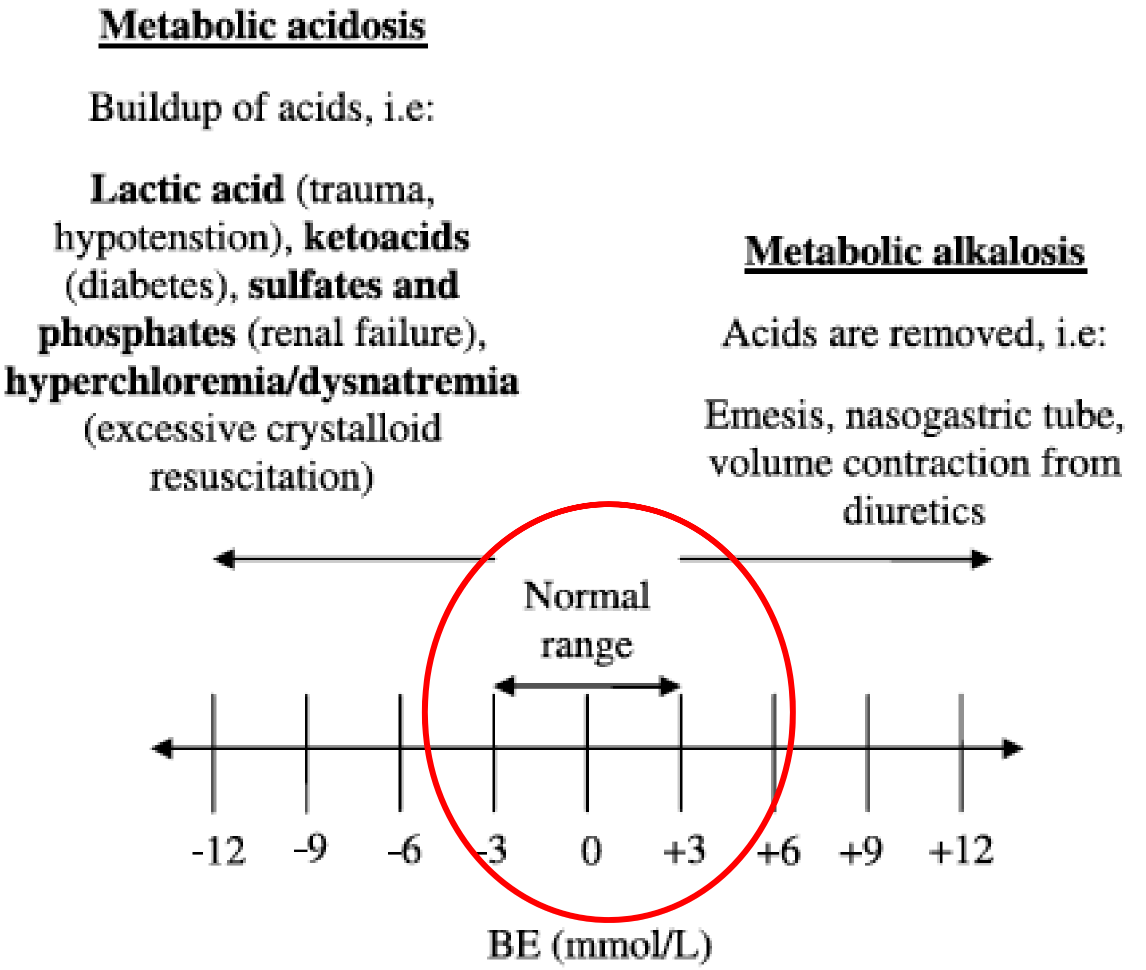

Figure 1. BE represented on a number line with common causes for metabolic acidosis and alkalosis.

Base Excess

- BE is the metabolic component of acid-base disorders
- Base excess is useful in trauma, burns and the ICU for shock states
- In trauma, a more negative BE and longer time to correct it correlates with severity of injury and higher mortality

Base Excess

- In the ICU, useful for determining success of resuscitation of shock
- With the increasing presence of Point of Care testing, BE is an important piece of the puzzle in your resuscitation
- Article discusses correlation (or lack of correlation) with lactate, anion gap, bicarb

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Base Excess

- We are now using BE as one of several criteria for plasma and packed cell administration on the helicopter

ORIGINAL ARTICLE

Just One Drop: The Significance of a Single Hypotensive Blood Pressure Reading During Trauma Resuscitations

Mark J. Seamon, MD, Cristina Feather, MD, Brian P. Smith, MD, Heather Kulp, MPH, John P. Gaughan, PhD, and Amy J. Goldberg, MD

Background: Single, isolated hypotensive blood pressure (BP) measurements frequently are ignored or considered "erroneous." Although their clinical significance remains unknown, we hypothesized that single, isolated hypotensive BP readings during trauma resuscitations signify the presence of severe injuries that often warrant immediate intervention.

Methods: A prospective observational study was performed on all trauma patients admitted from June 2008 to January 2009. Patients with a single systolic blood pressure (SBP) reading <110 mm Hg during their trauma resuscitation were evaluated, and demographics, hemodynamics, resuscitation (fluids, blood products, and duration), injuries, and operative or endovascular management were analyzed. Single and multiple variable logistic regression analyses were performed. Cutpoint analysis of the entire range of lowest single SBP measurements determined which SBP value best predicted the need for immediate therapeutic intervention.

Results: Patients (n = 145) were predominantly male (77.2%) but age

Advanced Trauma Life Support teaches that hemorrhagic shock is not clinically evident until tachycardia and narrowed pulse pressure develops during a 15% to 30% blood volume, class II hemorrhage.[1] Hypotension becomes clinically apparent during class III hemorrhage when >1,500 mL of blood, or 30% of circulating blood volume, is lost.[1] Despite this well-established classification scheme, tachycardia in trauma patients may be an unreliable indicator of injury,[2–9] and persistent hypotension is often a late manifestation of shock that becomes evident once end-organ damage has already begun in the decompensated shock state.[10–13]

However, brief episodes of hypotension may be an early indication of impending shock. Transient hypotension during prehospital care or in the surgical intensive care unit (ICU) has been reported and determined to be predictive of

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(J Trauma. 2010;68: 1289–1295)

Just One Drop

- Prospective observational study of 145 trauma patients
- Patients with a single systolic blood pressure (SBP) reading <110 mm Hg during their trauma resuscitation were evaluated
- Demographics, hemodynamics, resuscitation (fluids, blood products, and duration), injuries, and operative or endovascular management were analyzed.

Just One Drop

- Single, isolated hypotensive BP measurements during trauma resuscitations should not be ignored or dismissed
- Results suggest that a single SBP reading <105 mm Hg is associated with severe injuries that often require immediate operative or endovascular treatment and surgical intensive care unit admission

Just One Drop

- Pre-hospital provider report to our trauma surgeons include the lowest systolic BP and the highest pulse determined during transport

ORIGINAL ARTICLE

ONLINE FIRST

Military Application of Tranexamic Acid in Trauma Emergency Resuscitation (MATTERs) Study

Jonathan J. Morrison, MB ChB, MRCS; Joseph J. Dubose, MD; Todd E. Rasmussen, MD; Mark J. Midwinter, BMedSci, MD, FRCS

Objectives: To characterize contemporary use of tranexamic acid (TXA) in combat injury and to assess the effect of its administration on total blood product use, thromboembolic complications, and mortality.

Design: Retrospective observational study comparing TXA administration with no TXA in patients receiving at least 1 unit of packed red blood cells. A subgroup of patients receiving massive transfusion (≥10 units of packed red blood cells) was also examined. Univariate and multivariate regression analyses were used to identify parameters associated with survival. Kaplan-Meier life tables were used to report survival.

Setting: A Role 3 Echelon surgical hospital in southern Afghanistan.

Patients: A total of 896 consecutive admissions with combat injury, of which 293 received TXA, were identified from prospectively collected UK and US trauma reg-

ministration on postoperative coagulopathy and the rate of thromboembolic complications.

Results: The TXA group had lower unadjusted mortality than the no-TXA group (17.4% vs 23.9%, respectively; $P = .03$) despite being more severely injured (mean [SD] Injury Severity Score, 25.2 [16.6] vs 22.5 [18.5], respectively; $P < .001$). This benefit was greatest in the group of patients who received massive transfusion (14.4% vs 28.1%, respectively; $P = .004$), where TXA was also independently associated with survival (odds ratio = 7.228; 95% CI, 3.016-17.322) and less coagulopathy ($P = .003$).

Conclusions: The use of TXA with blood component–based resuscitation following combat injury results in improved measures of coagulopathy and survival, a benefit that is most prominent in patients requiring massive transfusion. Treatment with TXA should be implemented into clinical practice as part of a resuscitation strat-

Arch Surg 2012; 147:113-119

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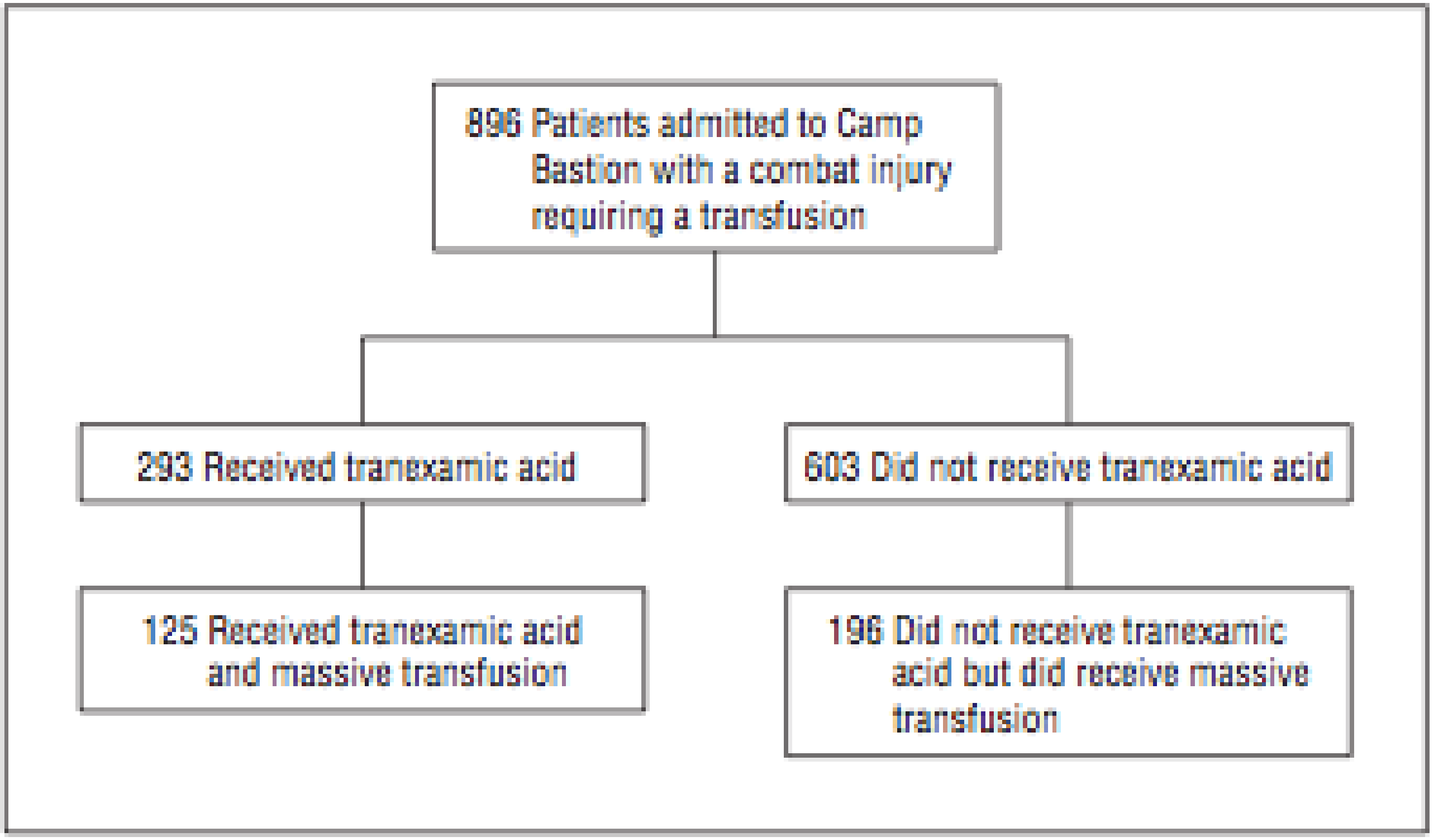

Figure 1. Study profile illustrating the overall cohort and study groups.

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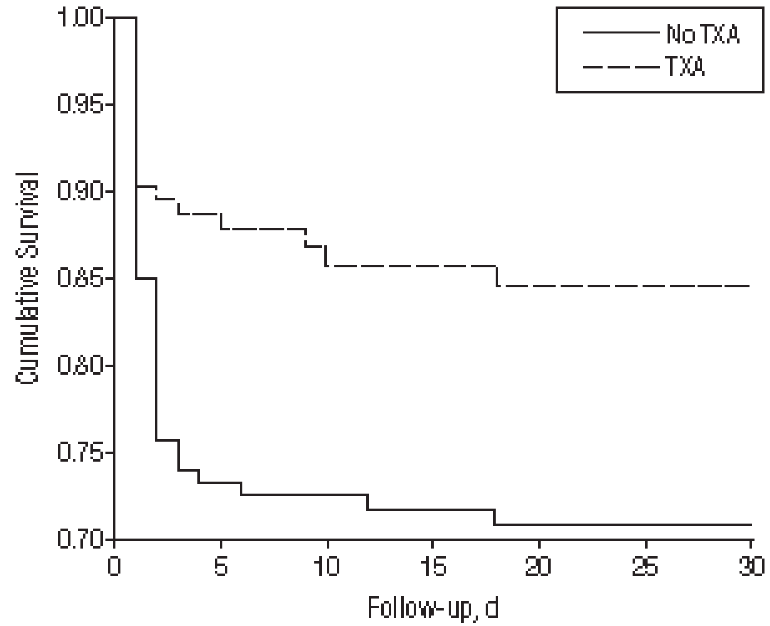

No. at risk

TXA:	125	100	78	74	72	72	71
No TXA:	169	106	87	78	74	74	71

Figure 4. Kaplan-Meier survival curve of the massive transfusion group receiving tranexamic acid (TXA) or no TXA. *P* = .004, Mantel-Cox log-rank test.

Figure 4 illustrates survival curves for both groups from the MT cohort. The TXA^{MT} group had superior 30-day survival compared with the no-TXA^{MT} group (*P* = .004).

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TXA

- Our guidelines now include giving TXA to any patient that we start transfusion of plasma and packed cells on
- It is an inexpensive and easy to administer intervention

Mayo One use

- **Inclusion criteria:**
  - Any acutely injured patient who meets our criteria for pre-hospital plasma and PRBC administration per the Blood Administration Guideline. Give blood products if 2 of the following criteria are met:
    - Hypotension (single BP ≤ 90)
    - Tachycardia (single HR ≥ 120)
    - Penetrating mechanism
    - Lactate ≥ 5
    - INR ≥ 1.5
  - Trauma patients only
  - ≥ 18 years of age

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Drug Administration: TXA

- Loading dose:
  - 1 Gm (mixed 50 mL saline) over 10 minutes
- Infusion:
  - 1 Gm (mixed in 250 mL saline) over 8 hours
  - We will only start the infusion if time permits
- Do not administer more rapidly than 1 ml/min to avoid hypotension

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ORIGINAL CONTRIBUTION

ONLINE FIRST

Out-of-Hospital Administration of Intravenous Glucose-Insulin-Potassium in Patients With Suspected Acute Coronary Syndromes

The IMMEDIATE Randomized Controlled Trial

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Delanor D. Doyle, MD

Context Laboratory studies suggest that in the setting of cardiac ischemia, immediate intravenous glucose-insulin-potassium (GIK) reduces ischemia-related arrhythmias and myocardial injury. Clinical trials have not consistently shown these benefits, possibly due to delayed administration.

Objective To test out-of hospital emergency medical service (EMS) administration of GIK in the first hours of suspected acute coronary syndromes (ACS).

Design, Setting, and Participants Randomized, placebo-controlled, double-blind effectiveness trial in 13 US cities (36 EMS agencies), from December 2006 through July 31, 2011, in which paramedics, aided by electrocardiograph (ECG)-based decision support, randomized 911 (871 enrolled) patients (mean age, 63.6 years; 71.0% men) with high probability of ACS.

Intervention Intravenous GIK solution (n=411) or identical-appearing 5% glucose placebo (n=460) administered by paramedics in the out-of-hospital setting and continued for 12 hours.

Main Outcome Measures The prespecified primary end point was progression of ACS to myocardial infarction (MI) within 24 hours, as assessed by biomarkers and ECG evidence. Prespecified secondary end points included survival at 30 days and a composite of prehospital or in-hospital cardiac arrest or in-hospital mortality, analyzed by intent-to-treat and by presentation with ST-segment elevation.

JAMA. 2012; 307:1925-1933

The Premise of IMMEDIATE

- There has been some indication in lab research that an IV cocktail of glucose-insulin-potassium (GIK) may reduce ischemia related arrhythmias and myocardial injury in patients with ACS
- Randomized, prospective, double blind study of the GIK cocktail vs. placebo

IMMEDIATE

- 411 patients received GIK and 460 patients received placebo
- There was no difference between the 2 groups in progression of unstable angina to a STEMI
- GIK not associated with improved 30 day survival (This was primary endpoint)

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IMMEDIATE

- Was associated with lower rates of the composite outcome of cardiac arrest or in-hospital mortality

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IMMEDIATE

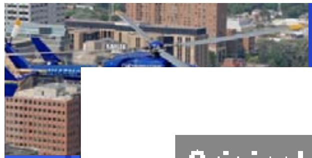
Table 2. Hospital and 30-Day Outcomes by Group (N = 871)

	No. of Events (%) GIK	No. of Events (%) Placebo	Risk Ratio for GIK vs Placebo (95% CI)	*P* Value
Outcome for all participants	n = 411	n = 460		
Progression to MI	200 (48.7)	242 (52.6)	OR, 0.88 (0.66-1.13)	.28
30-d mortality	18 (4.4)	28 (6.1)	HR, 0.72 (0.40-1.29)	.27
Cardiac arrest[a] or in-hospital mortality	18 (4.4)	40 (8.7)	OR, 0.48 (0.27-0.85)	.01
Cardiac arrest[a]	15 (3.6)	29 (6.3)	OR, 0.56 (0.30-1.07)	.08
In-hospital mortality	13 (3.2)	23 (5.0)	OR, 0.62 (0.31-1.24)	.18
30-d mortality or heart failure[b]	23 (5.6)	35 (7.6)	HR, 0.73 (0.43-1.23)	.24
30-d heart failure[b]	6 (1.5)	10 (2.2)	HR, 0.67 (0.24-1.82)	.43
Outcome for participants presenting with ST-segment elevation[c]	n = 163	n = 194		
Progression to MI	139 (85.3)	172 (88.7)	OR, 0.74 (0.40-1.38)	.34
30-d mortality	8 (4.9)	15 (7.7)	HR, 0.63 (0.27-1.49)	.29
Cardiac arrest[a] or in-hospital mortality	10 (6.1)	28 (14.4)	OR, 0.39 (0.18-0.82)	.01
Cardiac arrest[a]	9 (5.5)	21 (10.8)	OR, 0.49 (0.23-1.03)	.06
In-hospital mortality	6 (3.7)	14 (7.2)	OR, 0.49 (0.18-1.31)	.16
30-d mortality or heart failure[b]	9 (5.5)	19 (9.8)	HR, 0.56 (0.25-1.23)	.15
30-d heart failure[b]	1 (0.6)	6 (3.1)	HR, 0.20 (0.02-1.61)	.13

Abbreviation: MI, myocardial infarction.
[a] Defined as prehospital or in-hospital cardiac arrest.
[b] Defined as hospitalization for heart failure within 30 d.
[c] Analysis done only on participants presenting with ST-segment elevation on out-of-hospital electrocardiogram.

IMMEDIATE

- It is not yet clear if we will be using GIK in the future, but there is no compelling reason to do so yet
- Further study needs to be done to look at these other secondary endpoints



Original article

Trauma patients with the 'triad of death'

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ABSTRACT

Introduction Injured patients presenting with hypothermia, acidosis and coagulopathy have been identified at high risk of death. This study aimed to describe the presentation, management and outcome of major trauma patients presenting with the 'triad of death' and identify ways to improve survival.

Methods A retrospective, explicit chart review was undertaken on patients presenting to a level I adult major trauma centre with the 'triad of death'. These patients presented directly from the scene, were coagulopathic (international normalised ratio (INR) >1.5), hypothermic (temperature <35°C) and acidotic (pH <7.2) on arrival.

Results There were 90 patients over an 8 year period, with an overall mortality of 47.8%. No significant differences were observed among demographics and injury severity scores between survivors and non survivors. Extremes of systolic blood pressure and heart rate, a high activated partial thromboplastin time activated partial thromboplastin time, low fibrinogen counts, pH, bicarbonate, base excess and haemoglobin were present among survivors. There were no survivors in our cohort with an initial INR greater than 3.2. Survivors received significantly lower volumes of packed red blood cells.

hypothermia, acidosis and coagulopathy remains unknown. This study aimed to review the presentation, management and outcome of patients presenting with the trauma 'triad of death'. This was undertaken to outline any change in outcome of such patients over time and examine potential strategies for improvement.

METHODS

Setting

The state of Victoria, Australia, has one paediatric and two adult major trauma services (MTS) located within metropolitan Melbourne. Ambulance Victoria triages adult major trauma patients directly to an adult MTS when the travel time is less than 30 min. There are no current provisions for the administration of blood products during transit. The Alfred Hospital, Melbourne, Victoria, is the largest adult MTS in Australasia. There are more than 1930 trauma team activations per year. In 2008, 1007 patients had an injury severity score (ISS) of greater than 15 (unpublished data, The Alfred Trauma Registry).

Inclusion criteria

All major trauma (ISS >15) patients who presented

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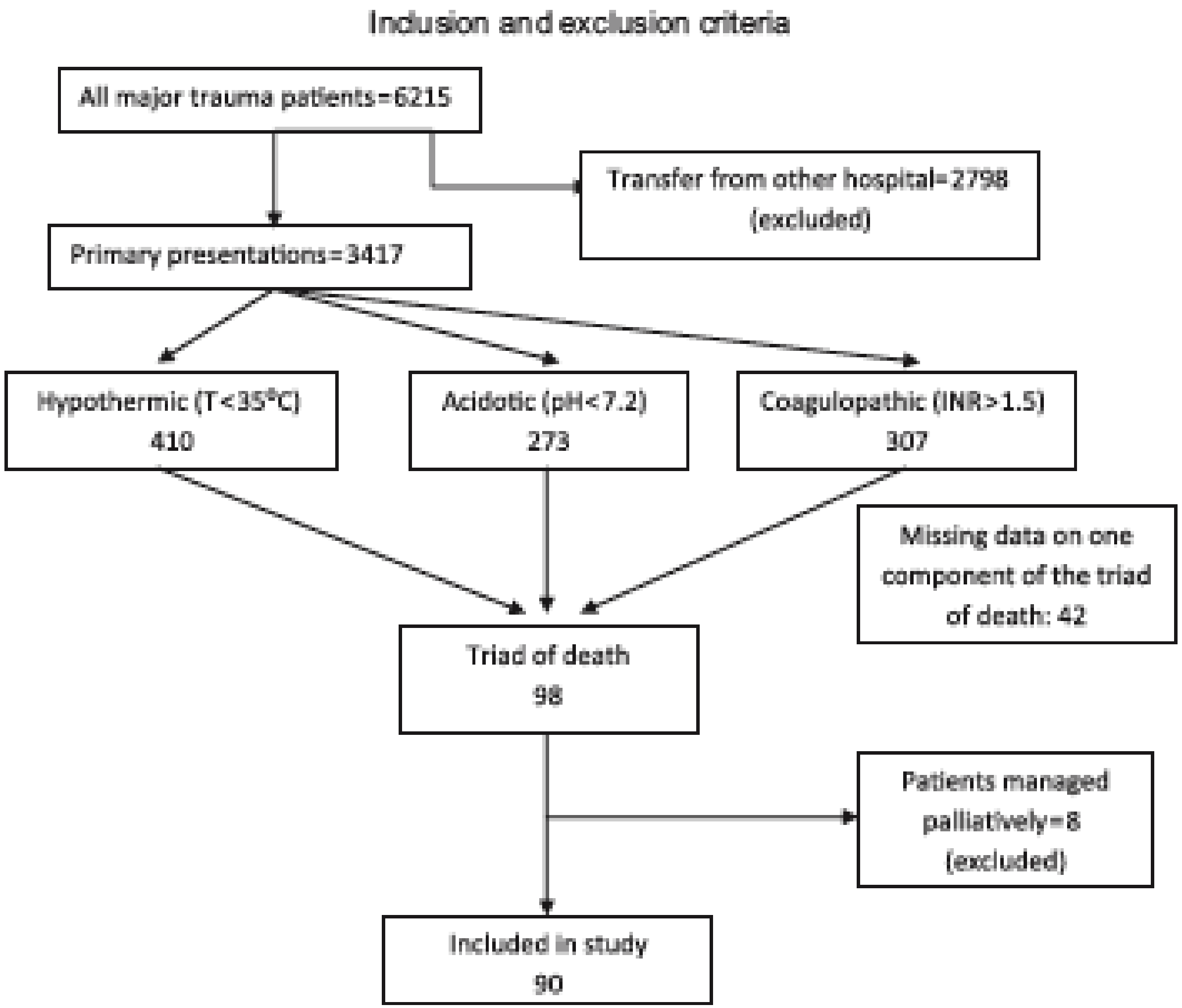

Figure 1 Inclusion and exclusion criteria.

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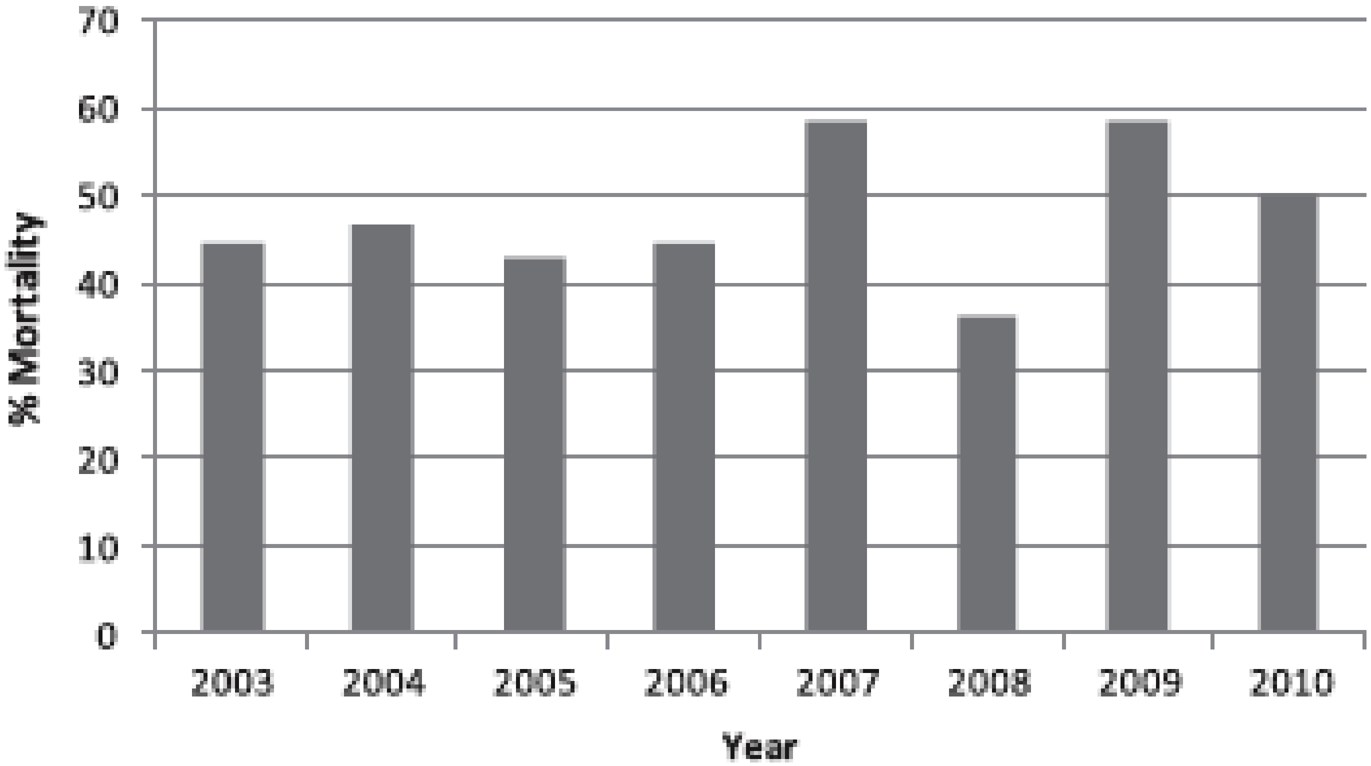

Figure 2 Mortality among trauma patients presenting with the 'triad of death'.

Triad of Death

- There were no survivors among patients presenting with an INR of greater than 3.2 with concurrent acidosis and hypothermia
- POCT testing allows transport personnel to determine BE, INR
- Our guidelines begin resuscitation for hypovolemic shock from trauma with thawed plasma alternating with PRBCs

Triad of Death

- Lessons learned:
  - Keep them warm
  - Treat hypovolemia induced acidosis
  - Determine PT and treat accordingly

Official Journal of the Society for Academic Emergency Medicine

SPECIAL CONTRIBUTION

Theoretical Analysis of the Effect of Positioning on Hemodynamic Stability During Pregnancy

Richard L. Summers, MD, James M. Harrison, MD, James R. Thompson, MD, John Porter, MD, and Thomas G. Coleman, PhD

Abstract

Objectives: A left lateral tilt of 15° has been advocated during trauma resuscitation of near-term pregnant patients to avoid the potential for hemodynamic compromise caused by aortocaval compression in the supine position. This recommendation is supported by limited objective evidence, and an experimental determination of the optimal tilt required would be very difficult to accomplish logistically. A derivation of the Guyton/Coleman/Summers computer model of cardiovascular physiology was used to analyze the theoretically expected hemodynamic responses to varying degrees of lateral tilt for a normal pregnancy and during a simulated hemorrhagic shock.

Methods: Computer simulation studies were used to predict the degree of left lateral tilt required to restore hemodynamic normalcy during the final 20 weeks of gestation. The analytic procedure involved recreating the clinical conditions for a virtual subject through a simulated reenactment of the clinical transfer of a pregnant patient from a lateral to a supine positioning. An analysis of model validity in the context of this particular clinical condition found the model predictions to be within 5% to 12% of experimental results.

Results: During the simulated lateral to supine position transfer, the virtual patient with Class I hemorrhage had a 7% greater fall in cardiac output and a 17% greater fall in mean arterial pressure (MAP) than the corresponding nonhemorrhagic patient. The model suggests that 15° of tilt will result in hemodynamic normalization only up to 26 weeks of gestation. In addition, 13% greater tilt is required to achieve hemodynamic normalcy in the hemorrhaged term pregnant patient.

Conclusions: Current trauma guidelines suggest that the pregnant trauma patient be placed in a 15° left lateral tilt position to prevent aortocaval compression. A computer simulation study suggests that this tilt may be inadequate to offload the vena cava and normalize the circulation.

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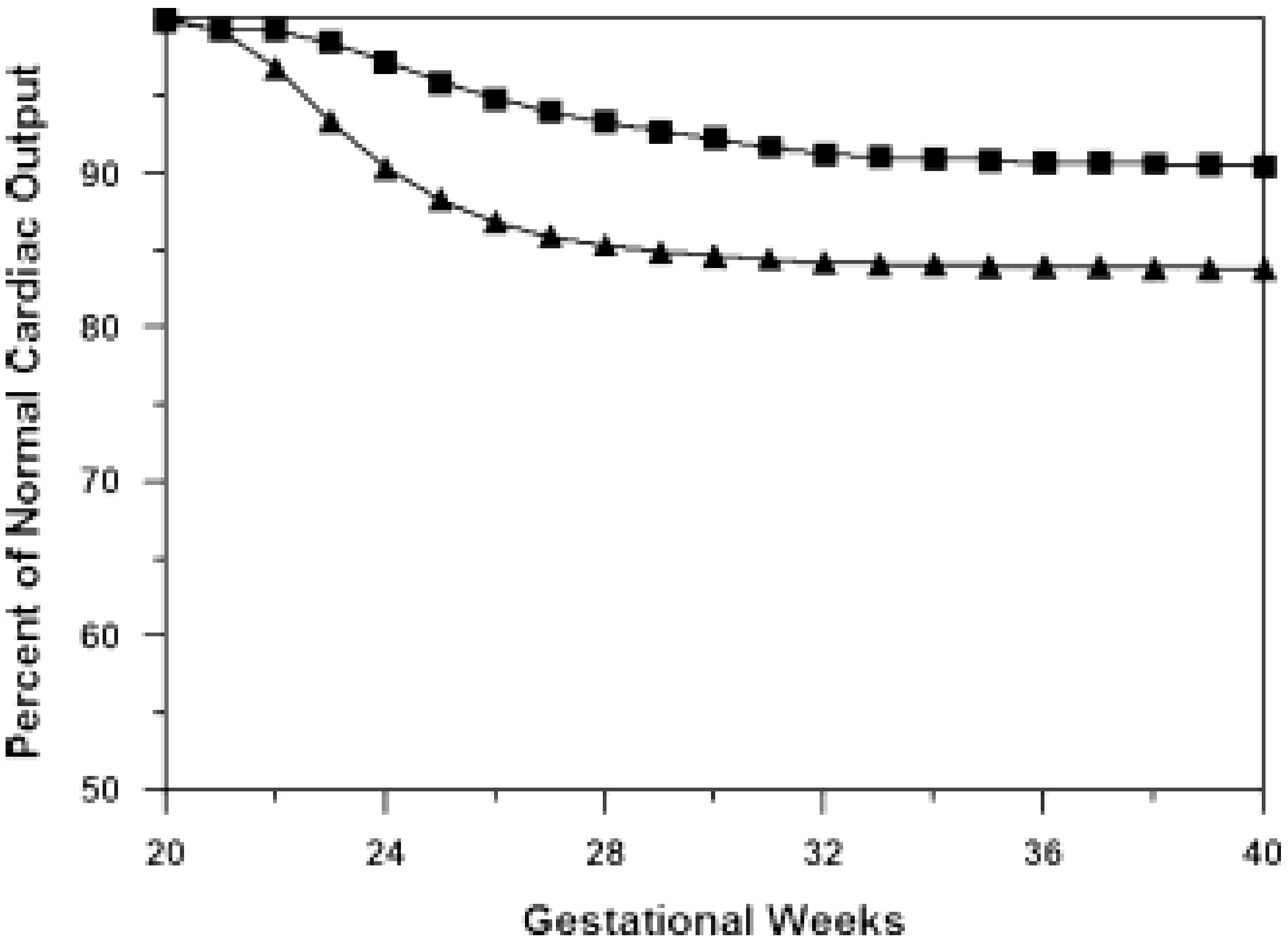
Acad Emerg Med 2012; 18:1094-1098


Percent of Normal Cardiac Output
90
80
70
60
50
20
24
28
32
36
40
Gestational Weeks

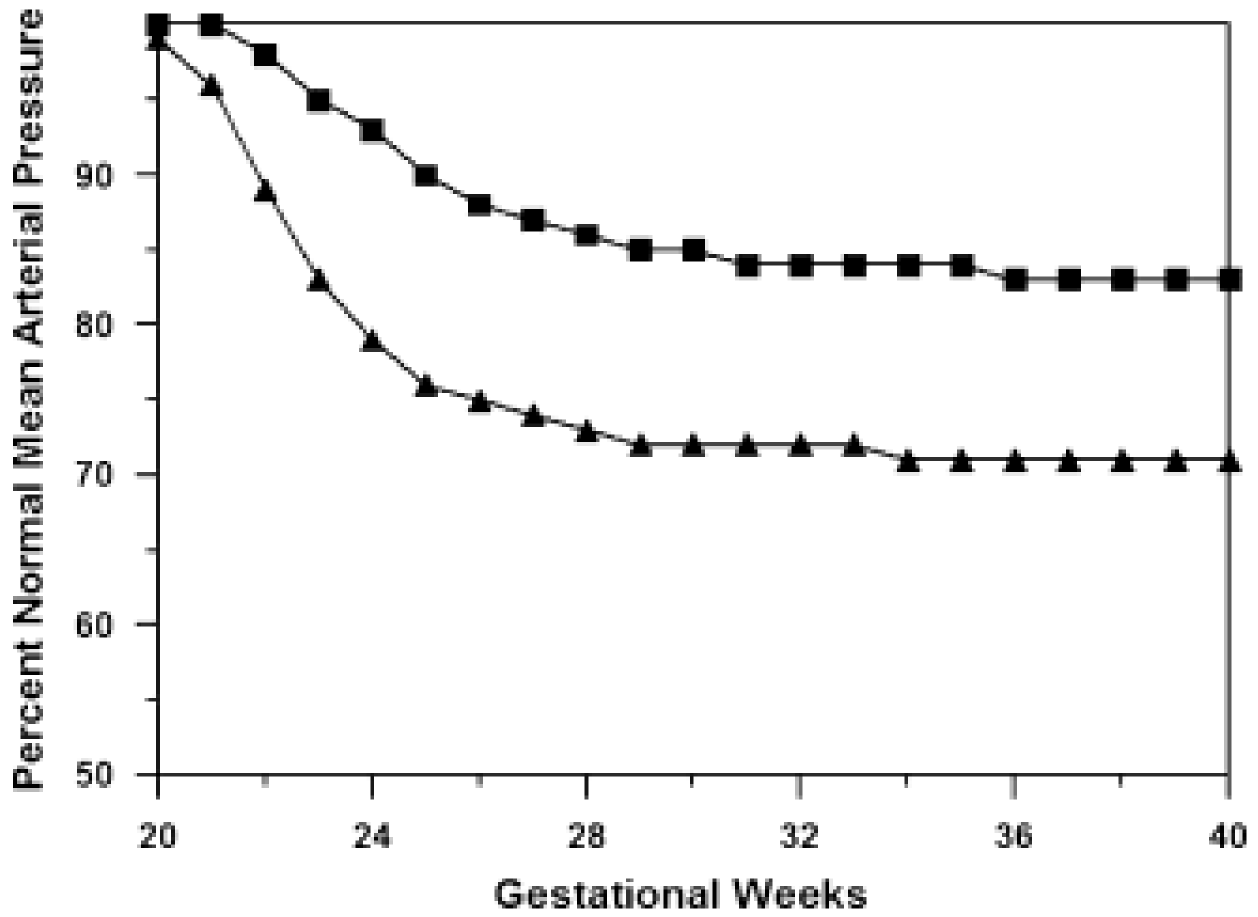


Figure 2. Supine decrease in MAP with gestational age, normal versus hemorrhage (Class I). MAP = mean arterial pressure.

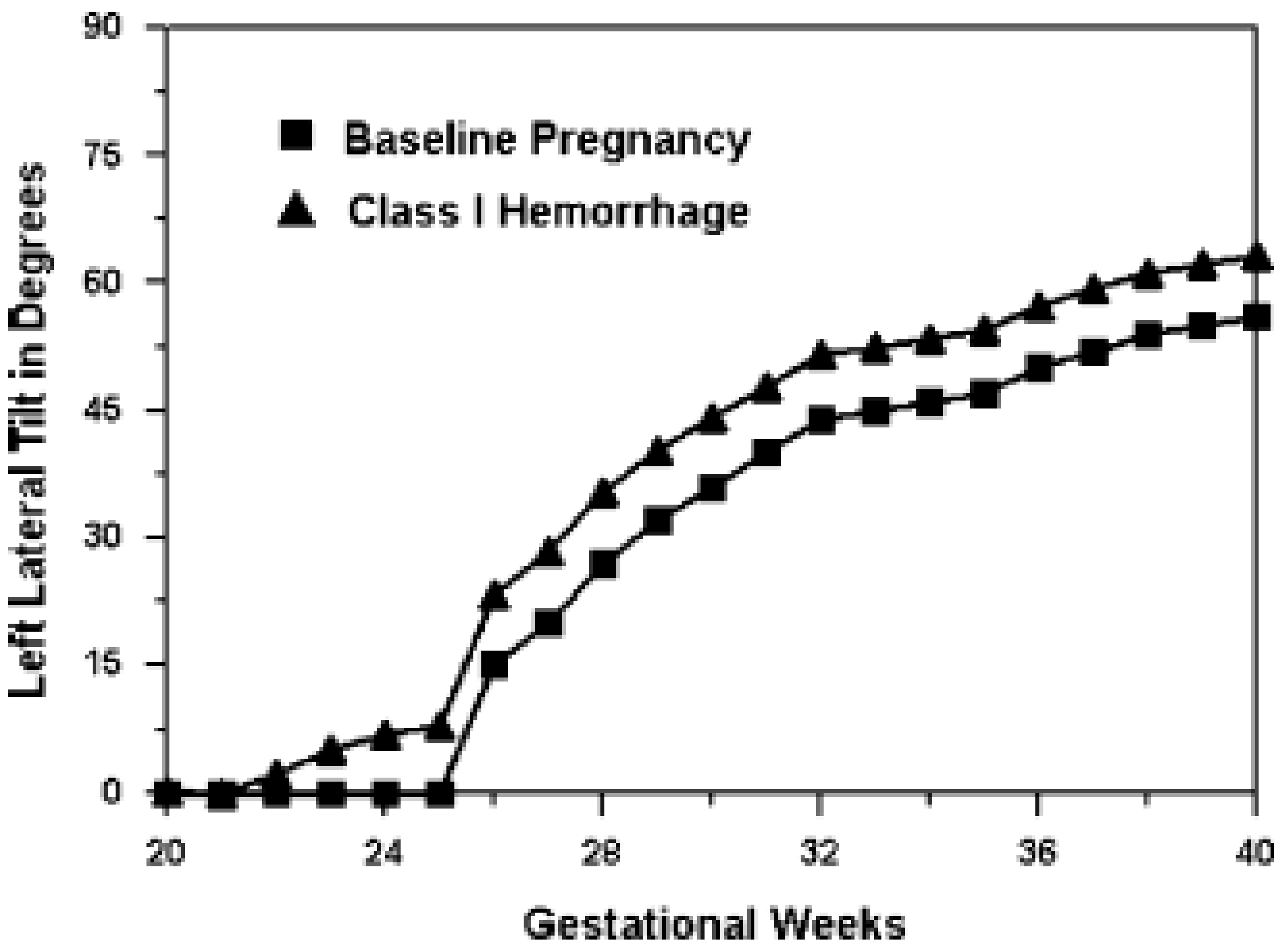


Figure 3. Relationship between gestational weeks and lateral tilt required for hemodynamic normalcy.

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Pregnancy Tilt

- Current trauma guidelines suggest that late term pregnant trauma patients be placed at a 15º tilt
- This computer simulation suggests that this may not be enough to take the pressure off of the IVC to increase venous return
- This needs more in-depth clinical study, obviously

Pregnancy Tilt

- Lesson learned:
  - ✦If your pregnant trauma patient is not doing well, perhaps you need to increase the tilt

Cerebrovascular Diseases

Original Paper

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Transcranial Ultrasound from Diagnosis to Early Stroke Treatment – Part 2: Prehospital Neurosonography in Patients with Acute Stroke – The Regensburg Stroke Mobile Project

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Cerebrovascul Dis 2012; 33:262-271

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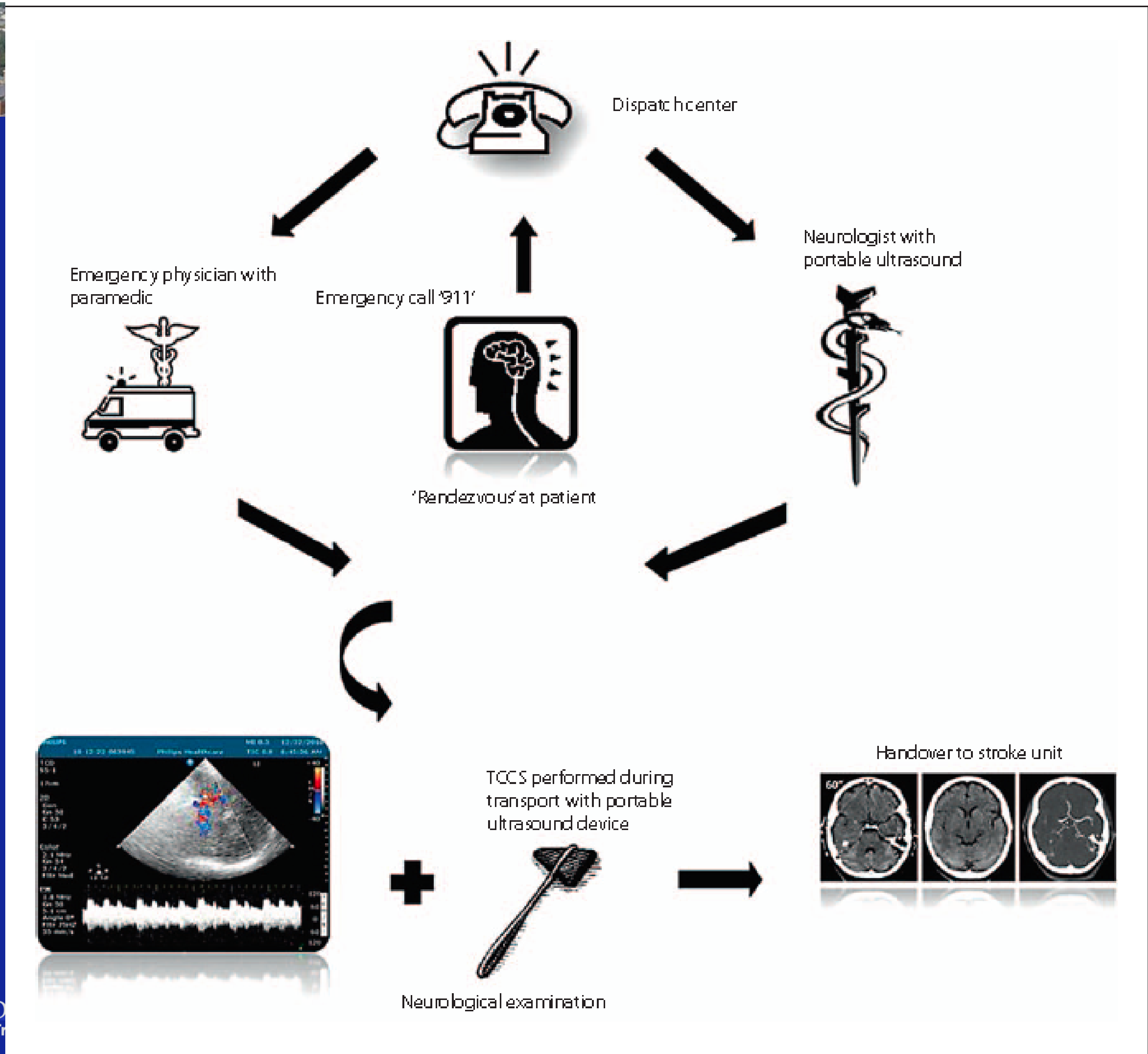
Dispatch center
Emergency physician with paramedic
Emergency call '911'
Neurologist with portable ultrasound
'Rendezvous' at patient
Handover to stroke unit
TCCS performed during transport with portable ultrasound device
Neurological examination

Table 1. Study demographics

Total patients, n	113
Stayed at home (no stroke, ultrasound examination unremarkable), n	11
Clinic admission, n	102
Mean age in years, SD	80.6 ± 13.52
Sex, w/m	63/50
Site of ultrasound examination	
Patient's home	56 (50%)
Ambulance during patient transport	49 (43%)
Private office practice	4 (4%)
Public space	2 (2%)
Senior citizen home	2 (2%)
Stroke neurologist examinations, n	
S.B.	61
F.S.	49
M.E.	3
Time from dispatch to arrival at patient in min, SD	12.3 ± 7.09
Time from arrival at patient to handover of patient to hospital, mean ± SD, min	53 ± 18
Ultrasound examination time, mean ± SD, min	5.6 ± 2.2
Contrast-enhanced TCCS, n	41 (36%)
Stroke[1] diagnosis at hospital discharge, n	73
Intravenous thrombolysis, n	
Yes	9
No due to exclusion criteria	72
Thrombectomy	1
M1-MCA occlusion, n	10 (9%)

SD = Standard deviation; S.B. = Sandra Boy; F.S. = Felix Schlachetzki; M.E. = Michael Ertl.
[1] Stroke = TIA, ischemic stroke, or hemorrhagic stroke.

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Stroke US

- First large study on prehospital neurosonography demonstrated high sensitivity and specificity in detecting thrombotic conditions: especially MCA occlusions
- The exam needs to be performed by an experienced provider in the context of the neuro exam

Stroke US

- “Prehospital neurological as well as transcranial vascular assessments during patient transport can be performed by a trained neurologist with high sensitivity and specificity, perhaps opening an additional therapeutic window for sonothrombolysis or neuroprotective strategies.”

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Stroke US
Lessons Learned?

- As US technology improves and machines are more prevalent in prehospital vehicles around the world, strokes may be diagnosed earlier and therapy instituted earlier
- Better triage
- Better outcomes

Early Administration of Systemic Corticosteroids Reduces Hospital Admission Rates for Children With Moderate and Severe Asthma Exacerbation

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From the Department of Epidemiology, Biostatistics and Occupational Health, Faculty of Medicine (Bhogal, Bourbeau, Benedetti, Ducharme), and the Department of Medicine (Benedetti, Bartlett), McGill University, Montreal, Quebec, Canada; the Department of Pediatrics, Montreal Children's Hospital of the McGill University Hospital Centre, Montreal, Quebec, Canada (McGillivray); the Respiratory Epidemiology and Clinical Research Unit, Montreal Chest Institute of the McGill University Health Centre, Montreal, Quebec, Canada (Bourbeau, Benedetti, Bartlett); and the Research Centre, CHU Sainte-Justine and Department of Pediatrics, University of Montreal, Montreal, Quebec, Canada (Ducharme).

Study objective: The variable effectiveness of clinical asthma pathways to reduce hospital admissions may be explained in part by the timing of systemic corticosteroid administration. We examine the effect of early (within 60 minutes [SD 15 minutes] of triage) versus delayed (>75 minutes) administration of systemic corticosteroids on health outcomes.

Methods: We conducted a prospective observational cohort of children aged 2 to 17 years presenting to the emergency department with moderate or severe asthma, defined as a Pediatric Respiratory Assessment Measure (PRAM) score of 5 to 12. The outcomes were hospital admission, relapse, and length of active treatment; they were analyzed with multivariate logistic and linear regressions adjusted for covariates and potential confounders.

Results: Among the 406 eligible children, 88% had moderate asthma; 22%, severe asthma. The median age was 4 years (interquartile range 3 to 8 years); 64% were male patients. Fifty percent of patients received systemic corticosteroids early; in 33%, it was delayed; 17% of children failed to receive any. Overall, 36% of patients were admitted to the hospital. Compared with delayed administration, early administration reduced the odds of admission by 0.4 (95% confidence interval 0.2 to 0.7) and the length of active treatment by 0.7 hours (95% confidence interval −1.3 to −0.8 hours), with no significant effect on relapse. Delayed administration was positively associated with triage priority and negatively with PRAM score.

Conclusion: In this study of children with moderate or severe asthma, administration of systemic corticosteroids within 75 minutes of triage decreased hospital admission rate and length of active treatment, suggesting that early administration of systemic corticosteroids may allow for optimal effectiveness. [Ann Emerg Med. 2012;60:84-91.]

Please see page 85 for the Editor's Capsule Summary of this article.

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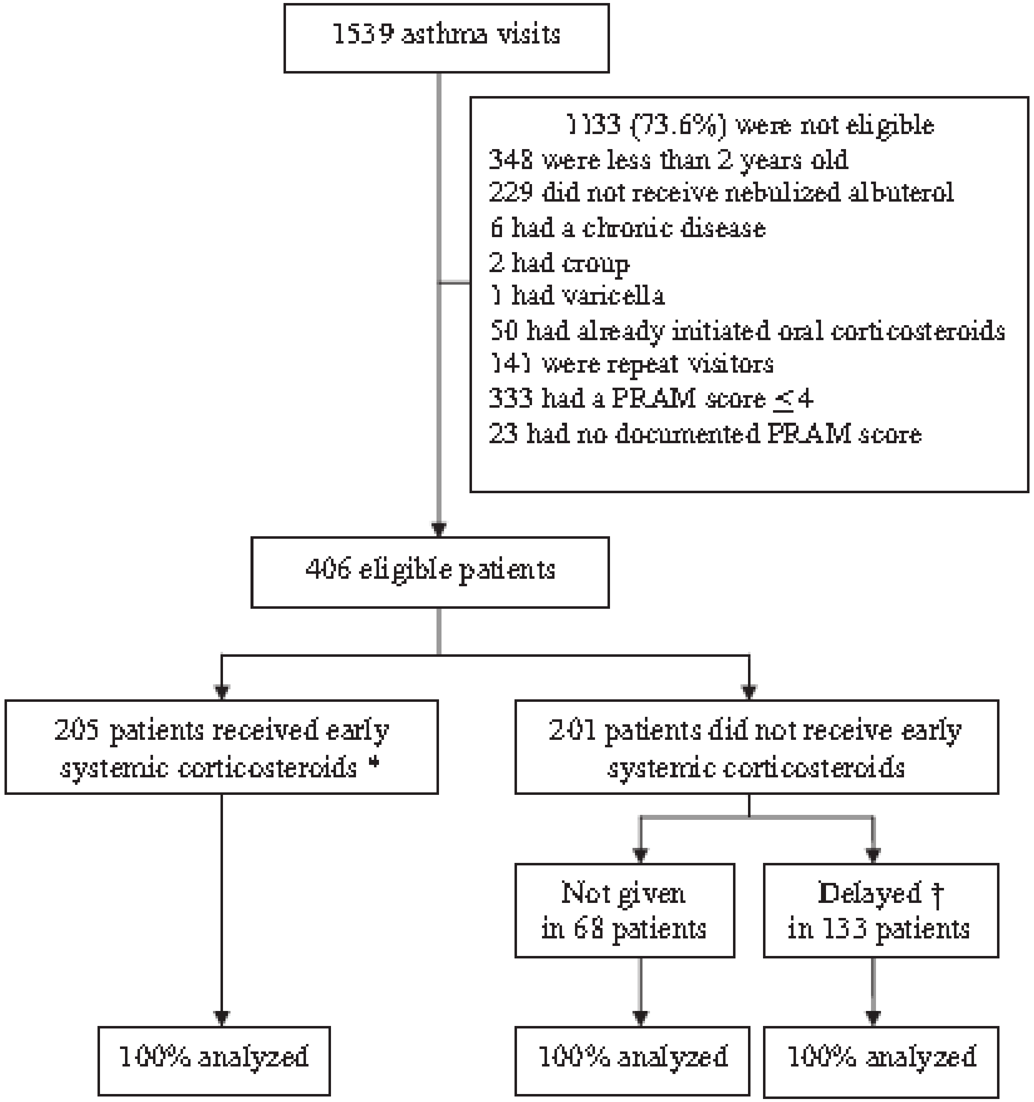
Ann Emerg Med 2012; 60:84-91



* Administered within 60 (± 15) minutes of triage

† Administered beyond 75 minutes of triage

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Peds Asthma Steroids

- **Early administration of steroids (within 60 minutes of ED presentation) significantly reduced the rate of hospital admission and the length of active treatment**
- **Despite a clinical pathway specifically recommending systemic corticosteroids within 60 minutes of triage, optimal timing was met in only half of children**

Peds Asthma Steroids
Lessons Learned

- **This study begs the question about moving the administration of steroids to the out-of-hospital arena**
- **Our crews carry dexamethasone to use as part of our asthma guidelines**

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