FOOTPRINTS

Pediatric Trauma Program Newsletter

EDITION 08 ● A Season of Change ● November 2024

Welcome to the Fall edition of our trauma program newsletter! In this issue, we highlight an interesting case study that highlights the challenges and quick response of our team in managing a complex trauma patient. We will discuss and review recent literature on the use of TXA in pediatric trauma patients, exploring its potential benefits and implications to practice. Additionally, we're excited to introduce a new section in the newsletter. "Greeno's Corner" will include updates from our Trauma Program Director, Amber Greeno. This newsletter aims to enhance your understanding and improve the care we provide to our patients. Thank you for your continued dedication to pediatric trauma!

THE COMMITTEE ON TRAUMA VERIFIED TRAUMA CENTER

DATES TO REMEBER

Video Review:
Dec 11 ● Jan 8 ● Feb 12
@ 8am via Teams

PACC Adv. Trauma Lecture:
Feb 19
@11:30 via Teams Register in LMS

WELCOME

Victoriana Kelley, MSN, APRN, CPNP-PC, CPN

Trauma Program Coordinator

Hey trauma team, I'm Tori Kelley! Originally from New Orleans, I've got a passion for good food and recently made the move from North Alabama with my husband and toddler. I've been a pediatric nurse for eight years, specializing in pediatric ER and trauma care. I'm excited to meet everyone, so if you see me around the hospital, don't hesitate to say hello!

Trauma Program Website

CASE STUDY

A 4 year old girl experienced a life-threatening incident when she fell from a second-story window, which lacked a safety screen. She unfortunately, landed on a metal lawn chair on the patio below, resulting in a devasting impalement injury to her right axilla. 911 was called immediately, and she was transported to the local Trauma Center.

Upon arrival to the ED, she was responsive to verbal stimuli, airway was patent, breathing was spontaneous but labored, and she had weak peripheral pulses. Her pupils were equally round and reactive to light. A quick penetrating survey revealed one impalement injury to the right axilla with no uncontrolled external hemorrhage. A full set of vitals reveal HR 152, RR 40, BP 80/56, SpO2 92% on room air, Temp 36.8C.

One unit of trauma blood was ordered and initiated. The secondary survey was completed noting no other obvious signs of trauma. The patient was transported to radiology for a full traumagram. CT revealed a significant vascular injury with active extravasation of the right subclavian artery. The child was subsequently taken as a level 1 to the OR for surgical intervention. To control the bleeding, TXA (tranexamic acid) was administered and MTP was activated.

The child was admitted to the PICU post-op for close monitoring. Her vital signs stabilized and the fluid resuscitation via MTP was shown to be effective. Pain management was maintained with analgesics, ensuring her comfort. She was transferred to the floor on post op day 3 and discharged on hospital day 6 with scheduled follow-up appointments. Education included instructions on wound care, signs of infection, and activities to avoid during recovery as well as injury prevention.

This case study highlights the need for rapid assessment and surgical intervention as well as the effective use of TXA and MTP in managing pediatric trauma patients. This patient had a positive outcome as a direct result of the teamwork and quick response of all teams involved in her care.

LITERATURE REVIEW

Trauma is the leading cause of death among children in the United States, accounting for over 12,000 fatalities annually, which exceeds all other causes of pediatric mortality combined. Hemorrhage is the most preventable cause of death in traumatic injuries, often complicated by coagulopathy, which can worsen outcomes. Despite the critical role of timely intervention, there is a significant lack of proven therapeutic strategies to improve survival rates in pediatric trauma patients. Tranexamic acid (TXA), an antifibrinolytic agent, has been investigated for its potential to manage bleeding and improve outcomes through the inhibition of plasmin formation and modulation of the inflammatory response. However, the evidence supporting its effectiveness specifically in pediatric trauma remains unclear.

A recent systematic review and meta-analysis sought to address this knowledge gap by examining the effectiveness and safety of TXA in pediatric trauma patients. Given that pediatric patients often experience different injury patterns and physiologic responses than adults, TXA's ability to control bleeding could play a role in improving outcomes. While more rigorous randomized control trials are necessary to fully understand TXA's benefits, the existing literature indicates that TXA can be a valuable tool in the management of pediatric trauma, potentially saving lives in a population that is particularly vulnerable to the effects of hemorrhage. As trauma care continues to advance, integrating TXA into treatment protocols could significantly enhance survival rates for injured children, addressing a critical need in current trauma management strategies.

Kornelsen, E., Kuppermann, N., Nishijima, D. K., Ren, L. Y., Rumantir, M., Gill, P. J., & Finkelstein, Y. (2022). Effectiveness and safety of tranexamic acid in pediatric trauma: A systematic review and meta-analysis. *The American journal of emergency medicine*, *55*, 103–110. https://doi.org/10.1016/j.ajem.2022.01.069

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GREENO'S CORNER

MTP Standard Operating Procedure Updates:

- Condensed Adult, Pediatric, and OB into 1 SOP.

- Added activation considerations:
  - >2 units of blood products in the ED.
  - Assessment of Blood Component (ABC) Score of 2 or more.
    - 1 point each for HR>120, BP<90, +FAST exam, penetrating thoracoabdominal injury.

- Ordered through eSTAR instead of calling the Blood Bank.
  - Verbal MTP activation is allowable only when electronic MTP order entry is impossible due to patient condition or eSTAR downtime.

Pediatric Vital Signs Thresholds Indicating Hypovolemic Shock

AGE (KG)	HR min – max	SBP min 70+(age in years x 2)
Premie (1-2)	90-180	70
Newborn (3.5)	90-180	70
6 month (7)	85-180	70
1 year (10)	80-160	72
3 year (15)	80-160	76
6 year (20)	70-140	82
8 year (25)	70-140	86
10 year (30)	65-140	90
12 year (40)	60-130	90
15 year (50)	55-130	90
18 year (65)	50-130	90

- Calcium repletion
  - With each MTP cooler administration.
  - Ionized calcium of <1 mmol/l per the laboratory or <4mg/dL per POC VBG.

- When MTP cooler #5 is delivered, the designated team member receiving the cooler announces its arrival, prompting a multidisciplinary discussion on clinical futility.

- Attendings will then lead a discussion on the patient's overall clinical status, salvageability, and status of hemorrhage control.

- Based on these factors, the attending physician(s) will decide whether to continue MTP or consider cessation of efforts based on futility.

- The physician or designee notifies the Blood Bank immediately when the MTP has been discontinued by completing the order in eSTAR (preferred) or calling the Blood Bank (downtime only).

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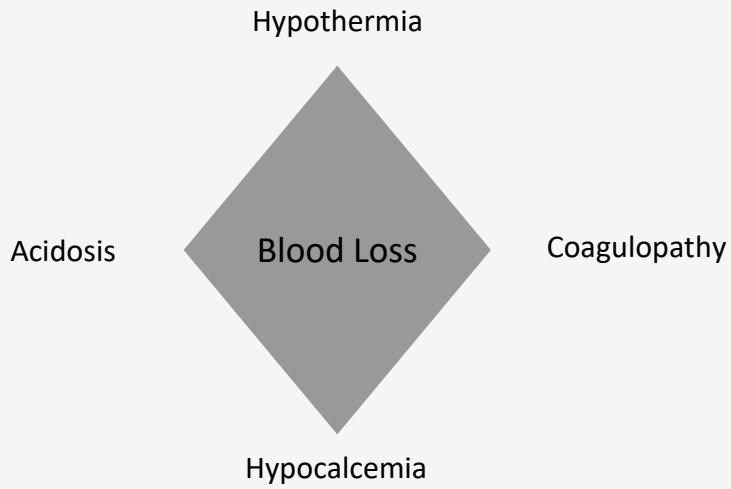
Diamond of Death:



Recent data have introduced a fourth component, hypocalcemia, in this grouping of critical trauma resuscitation factors. It has been found to be linked to each component of the lethal triad and plays a key role in the outcomes of multisystem trauma patients.

Cardiac contractility

Hypocalcemia -> heart experiences both electrical and mechanical dysfunction.

Hypocalcemia prolongs the QT interval, increasing likelihood of dysrhythmias. Hypocalcemia suppresses cardiac contractility and can contribute to acute cardiovascular decompensation.

Smooth muscle contraction and relaxation in vasculature

Hypocalcemia -> hypotension.

Multiple studies have found that patients with hypocalcemia require vasopressor support compared to those with normocalcemia.

Hemostasis and coagulation

Hypocalcemia -> coagulopathy.

Ca assists in attachment of clotting factors to the platelet membrane. Formation of fibrin from fibrinogen requires Ca with low levels in platelet function.

Serum pH

Hypocalcemia -> low serum Ca has been tied to worsening acidosis.

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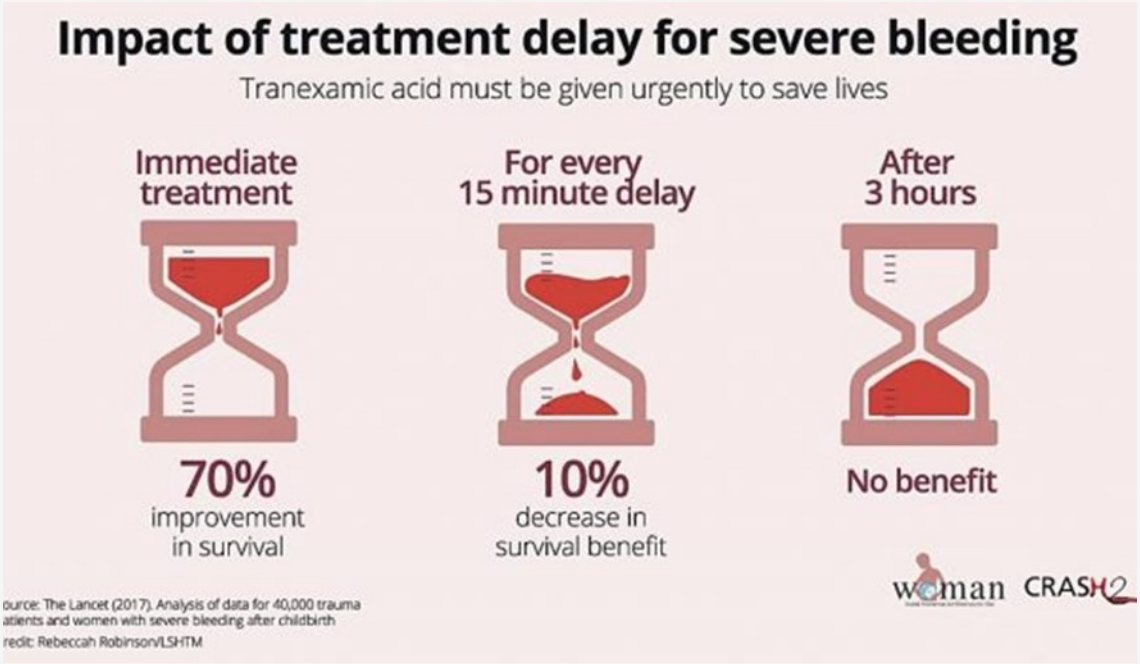
Calcium and Blood Products:

Recent data have demonstrated that most trauma patients (~56%) are Ca deficient prior to transfusion of blood products. Suspected reasons include calcium binding by lactate with the presence of lactic acidosis in trauma patients, impaired parathyroid gland and hormone function, and intracellular influx in the setting of ischemia and reperfusion.

Hypocalcemia on admission was predictive of the need for multiple transfusions and massive transfusion. Blood products, including both PRBCs and WB, are stored with the anticoagulant citrate, which is one of the many serum proteins that bind Ca. PRBCs -> 3g/unit, WB -> 1.66g/unit, FFP -> 20mmol/L -> Platelets 15mmol/L. Under normal physiology, the liver can metabolize up to 3 g of citrate every 5 min. Massive transfusion of either component therapy or whole blood results in a large influx of citrate, amplified by an impairment in citrate metabolism due to hypothermia, hypoperfusion and liver dysfunction. The increasing levels of citrate bind ionized calcium in the blood and generate hypocalcemia in patients undergoing transfusion. The additional citrate burden from FFP and platelets with that of pRBCs exacerbate hypocalcemia from blood component transfusion. This suggests a potential benefit of whole blood.

Benefit of TXA:



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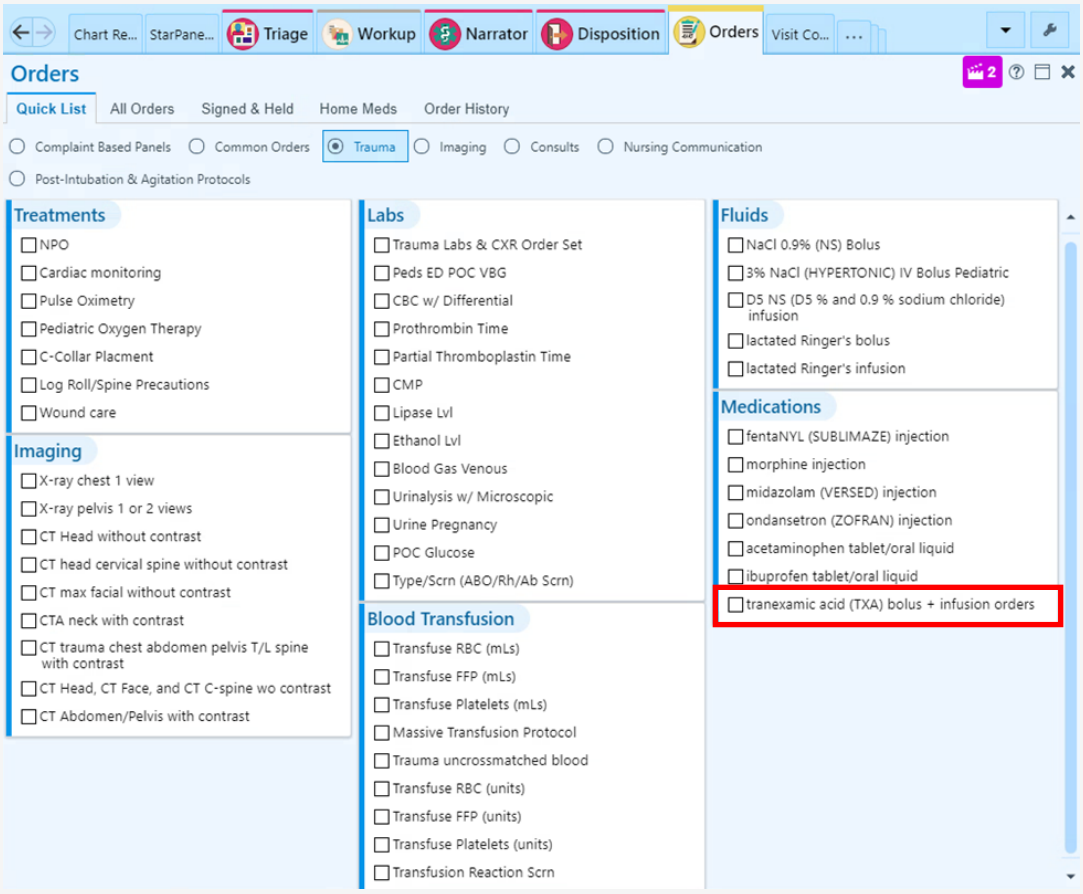
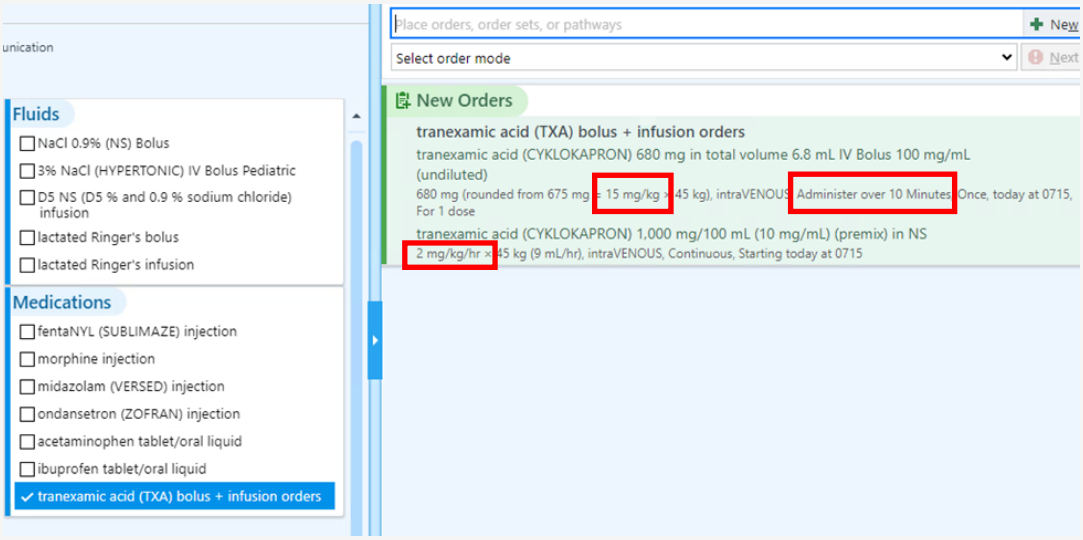
Ordering TXA in the PED:





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