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Adaptive Collaboration Between the Emergency Department and Neonatal Intensive Care to Treat a 16-Month-Old with Sepsis-Related Hemolytic Anemia with a Hemoglobin of 1.7 g/dL

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NO DISCLOSURES

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Objectives

- Describe a **rare** case of resuscitation with **massive transfusion, ventilatory support** by an emergency physician, and **collaboration with a neonatal intensivist** of a 16 month old infant with hemolysis induced **hemoglobin of 1.7 g/dL**
- Discuss **Autoimmune Hemolytic Anemia** (AIHA)
- Describe the **interdisciplinary collaboration** between emergency medicine, neonatal intensive care, pharmacy, laboratory/blood banking, nursing, and respiratory therapy

Introduction

- **Autoimmune Hemolytic Anemia (AIHA)** can cause transient and **intense hemolysis and severe anemia**, especially among children under 10 years of age. Extreme cases of anemia necessitate urgent blood transfusion resuscitation.
- Massive transfusion (MT) and MT protocols (MTPs) pose significant complications, and are **poorly defined in pediatric and neonatal settings**
- **Pediatric intensive care** specialists are **not present in most non-academic centers**, placing children at risk in emergency situations

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Case Presentation

Patient:

- 16-months-old
- Chief complaints of **whining, restlessness, and lack of appetite.**
- **Born prematurely** at 30 weeks

Recent History:

- presented to the ED three times in the previous month with symptoms of **upper respiratory tract infection**
- In the last two days, patient was unable to keep food down, had diarrhea, and became lethargic

Admission to ED:

- **Physical exam** revealed a temperature of **95.5 °F (hypothermic), heart rate of 152, respiratory rate of 30**, blood pressure of 87/60, and SPO2 94%
- Patient skin and conjunctiva were pale and appeared toxic
  - Patient was crying, made eye contact, and withdrew from attempts to put on high-flow O2

Laboratory Analysis

Septic Child

- Blood sugar: 22 mg/dL
- Total CO2: 6 mmol/L ($HCO3^-$: 7 mEq/L)
- Anion Gap: 36
- Arterial pH: 7.09
- **Hemoglobin: 1.7 g/dL**
- **Hematocrit: 4.7%**
- WBC: 59,700 per µL left shift

Blood Smear: Hemolysis

- **Macrocytes** with anisopoikilocytosis, **polychromasia**, **nucleated RBCs**, **WBCs with myeloid left shift and toxic change**, atypical and activated lymphoid cells, **plasmacytoid**, and **smudge cells**

Laboratory Value	Day 1 14:37	Day 1 15:51	Day 1 20:00	Day 4 4:28
White Blood Cells	59.7	56.5	19.9	7.4
Red Blood Cells	0.32	0.89	1.74	2.28
Hematocrit	4.7	11.6	20.9	26
Hemoglobin	1.7	3.9	7.7	9.5
Mean Corpuscular Volume	147.3	130.6	119.8	114
Mean Platelet Volume	7.3	6.7	6.4	7.9
Platelets	463	341	258	155
Anion Gap	36	35	16	8
Total Bilirubin	1.4	0.8	0.7	1.5
CO2	6	4	15	29
Glucose	22	112	146	71
Potassium	4.8	5	2.8	4.4
pH, Arterial	7.09		7.35	
O2 Partial Pressure, Arterial	144		108	
CO2 Partial Pressure, Arterial	13		28	
Reticulocyte Count		9.3	7.4	

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Treatment

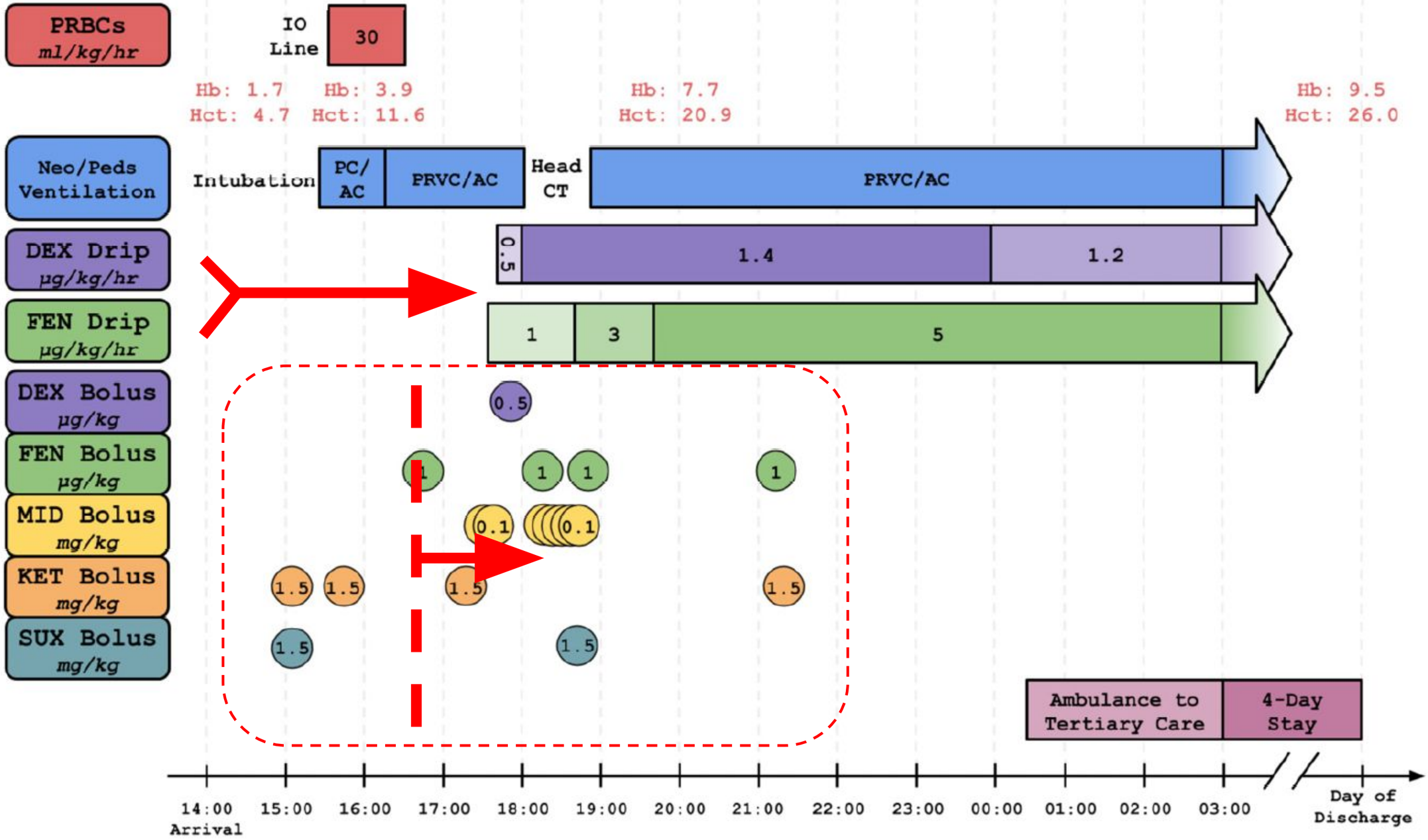
1. **IV line** secured immediately after the blood draw + a **20 mL/kg saline bolus**
2. After glucose test results, 25% dextrose bolus
   a. **vancomycin** and **ceftriaxone**
3. Endotracheal intubation with intravenous **12 mg ketamine** and **12 mg succinylcholine** after child became obtunded with hypoventilation
   a. Patient placed on a Neonatal/Pediatric (Neo/Peds) ventilator on **pressure control/assist control** (PC/AC)
4. **30 mL/kg O negative packed red blood cells (PRBCs) MT over 1h** ordered, because of hemoglobin of 1.7 and hematocrit of 4.9
   a. Through an 45 mm, yellow, adult, EZIO line placed in the distal right femur, proximal to the femoral diaphysis.

Treatment

1. Ventilator mode switched to **pressure-regulated volume control** (PRVC)
    a. achieved target tidal volume using lowest pressure
2. Repetitive doses of **fentanyl**, **midazolam**, **ketamine**, and **succinylcholine** given due to **increased alertness following transfusion** completion.
    a. Fentanyl drip of 1 µg/kg/h started following acceleration of agitation while intubated
        i. **Increased gradually to a maximum of 5 µg/kg/h together with a dexmedetomidine bolus of 0.5 µg/kg, followed by a drip at 1.4 µg/kg/h max**
3. **End-tidal CO2 was attached to the sideport** of the endotracheal tube extensor to enable **respiratory therapy** titrated ventilator settings based on both the patient's response and on the **end-tidal CO2**

Situational Treatment

1. **Manual ventilation** for a computerized tomography (CT) scan of the head, which required additional doses of **midazolam**, **fentanyl**, and **succinylcholine**
2. CT scan of the head was considered unnecessary by the emergency physician but was demanded by the accepting academic pediatric intensivist at the tertiary center despite no focal findings and the child was thrashing about until the child was adequately sedated. In retrospect, the emergency physician was correct in not wanting to do the CT scan because it required manual ventilation and repeated doses of sedation analgesia and paralysis as the patient was transported to and from the CT scan unit. Exposing the child to possible extubation



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Timeline

- **10 hour period of critical care** by the emergency physician with the collaboration of the respiratory therapists and neonatal intensivist
- Arrival at the **tertiary care center ~13 hrs** after initial ED presentation

Etiology

- **Streptococcus pneumoniae + Haemophilus influenzae** tracheal culture
- **Negative aspirate methicillin-resistant Staphylococcus aureus** antibody test
  - Additional growth of Enterobacter cloacae and Kluyvera ascorbata
- Rhinovirus/enterovirus and adenovirus nasal swabs

Evolution Laboratory Data Days 1-4

Day 1: 1 hr 14 min

Labs

- WBC Count: 56.5
- **Hematocrit: 11.6**
- **Hemoglobin: 3.9**
- Reticulocyte Count: 9.3
- **TCO2: 4** mmol/L
- Glucose: 112

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Day 1: 5 hrs 23 min

Labs

- ABC Count: 19.9
- **Hematocrit: 20.9**
- **Hemoglobin: 7.7**
- Reticulocyte Count: 7.4
- **TCO2: 15** mmol/L
- Glucose: 146

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Day 4: Tertiary Center

Labs

- WBC Count: 7.4
- **Hematocrit: 26**
- **Hemoglobin: 9.5**
- Reticulocyte Count: N/A
- **TCO2: 29** mmol/L
- Glucose: 71

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Follow-through

- **Cefepime and vancomycin** until blood cultures were negative (36 hours)
- **Amoxicillin/clavulanate** at discharge (4 days after tertiary care center admission)
- **Steroids or immunotherapy** foregone

Post-treatment Testing:

- Immunologic abnormalities (IGA, IGG, & IGM): Negative
- Indirect and direct Coombs tests: Negative
- Whole-genome sequencing: No positive mutations
  - rules out the inherited causes of hemolysis
    - G6PD deficiency or hemoglobinopathy.
- Presumed secondary AIHA diagnosis: probable > definitive

Five months after discharge:

- Hct/Hb stabilized at 12.1 g/dL and 36.9%

Discussion

Interprofessional collaboration overcame inefficiencies of the "**silo effect**" commonly inherent with communication and between hospital departments in 5 key areas:

1. Placement of an **EZIO** line with a **45-mm yellow adult needle**
2. Administration of **MT**
3. Management of the airway and ventilator to avoid barotrauma by three RTs
4. **Repetitive** doses of sedation, paralysis, and analgesia, with boluses of **ketamine, succinylcholine, midazolam, fentanyl and dexmedetomidine** boluses and drips
5. **Constant communication** between **emergency physician** and other specialty, including **pathology**, with whom the slides were reviewed.

1. *Intraossues transfusion and MT administration*

- Final transfusion volume (30cc/kg)
  240 mL PRBCs
  - Did not develop Transfusion Associated Circulatory Overload (**TACO**)

Adult, 45-mm IO needle (not pediatric) in the distal femur proximal to the femoral diaphysis** used due to higher likelihood of achieving **high-flow IO access

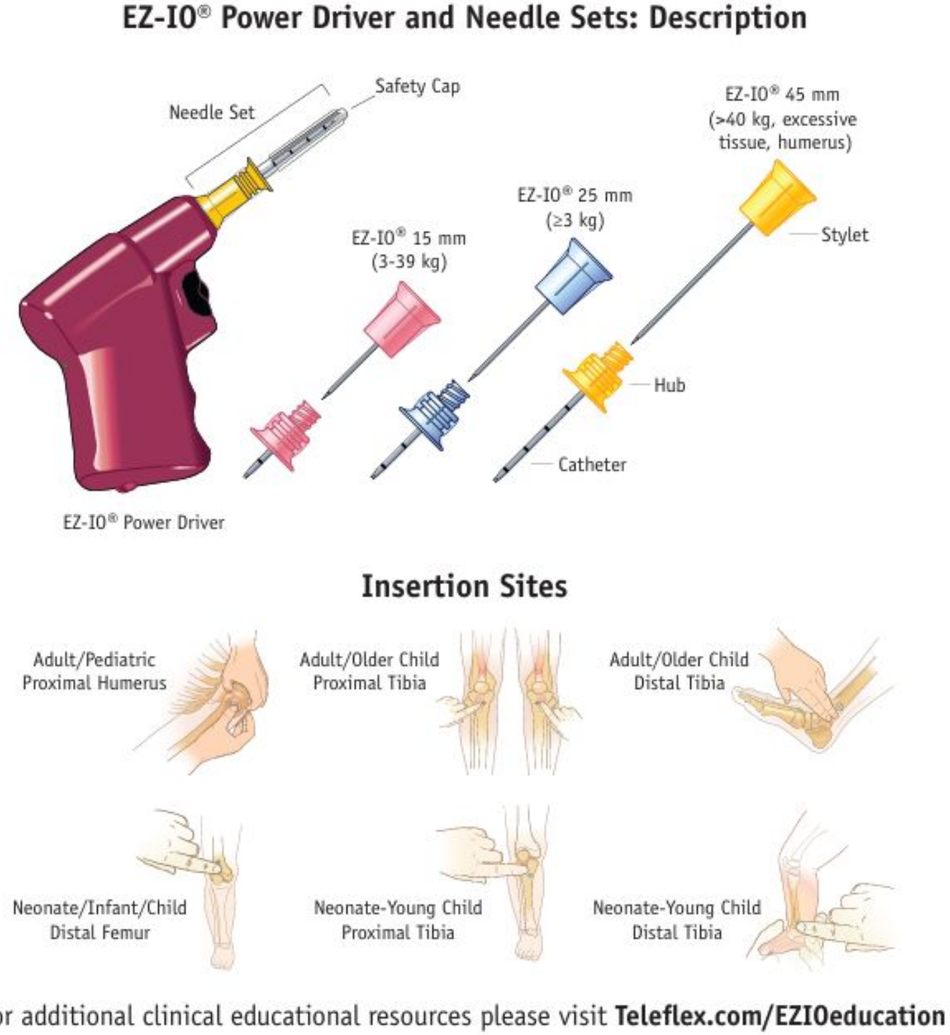


Image Sourced from EZ-IO User Manual

Neonatal Intensive Care

Guidance on Massive Transfusion
Guidance on Sedation and Analgetics
Guidance on Potassium Bolus

Laboratory/Pathology

Provision of Interpretational Labs

Emergency Medicine

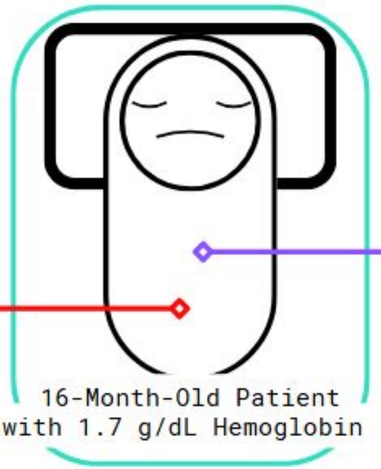
Rapid Medication Preparation

Pharmacy

Communication on Ventilation Preparation

Respiratory Therapy

1. Administration of Massive Transfusion
2. Administration of Fentanyl, Midazolam, Ketamine, Succinylcholine, and Dexmedetomidine Boluses and Drips
3. Administration of Potassium Bolus
4. Monitoring of Intravenous Pump Function and Physiologic Parameters Reflecting Success of Recussitation



Communication on Ventilation Preparation

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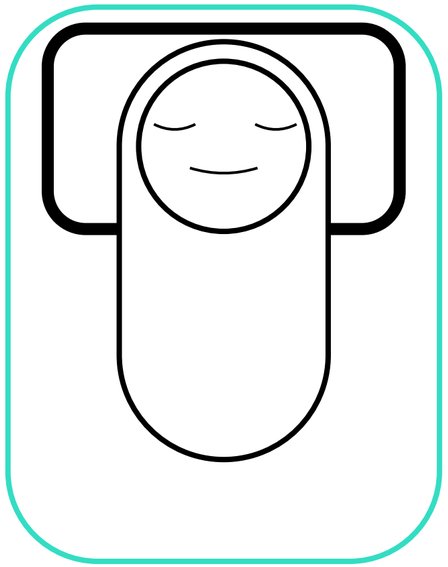
Conclusion

This case highlights the challenges of managing profound anemia (**Hb 1.7 g/dL**) and severe sepsis in a young child within the **ED of a community hospital without** the assistance of a pediatric intensivist. Survival depended not just on a single intervention but on **sustained collaboration** between and within departments, adaptive use of available resources, and continuity of critical care.



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Thank you!

Questions?