Circulation

ETAT Module 3

Adapted from Emergency Triage Assessment and Treatment (ETAT): Manual for Participants, World Health Organization, 2005
Learning objectives

- Accurately assess circulation in a child.
- Reliably identify signs of shock in a child.
- Manage a well-nourished child in shock with appropriate fluids and volumes.
- Recognize severe acute malnutrition
- Understand the significance of severe acute malnutrition for the management of shock.
- Manage a malnourished child in shock with appropriate fluids and volumes.
- Demonstrate where and how to achieve vascular access in a child.
- Achieve intraosseous vascular access.
Target audience

• Healthcare providers in any facility who are likely to manage sick patients, including physicians, nurses, and assistants.
• Teachers and trainers for healthcare professionals
Circulation: overview of assessment and management

Circulation

Any positive signs
- Cool hands
- Capillary refill >3 seconds
- Weak pulses
- Bleeding

Manage
- Stop bleeding
- Give oxygen
- Keep patient warm
- Restore volume
Assessment of circulation

- Does the child have warm hands?
- Is capillary refill longer than 3 seconds?
- Is the pulse weak and/or fast?
Prolonged Capillary Refill

• Press an area on the patient’s extremity (bottom of the foot, toe, finger, or nailbed) with your finger until it is pale

• Color should return to the skin within 3 seconds after you remove your finger

PALS: Rapid Cardiopulmonary Assessment, American Heart Association 2001
Check pulse

- Check quality and rate of distal pulse (radial, foot).
- Compare to central pulse (femoral, carotid).

PALS: Rapid Cardiopulmonary Assessment, American Heart Association 2001
Shock

- Definition: inadequate tissue perfusion
- Diagnosis: signs of poor peripheral perfusion
  - Cool extremities
  - Capillary refill $> 3$ seconds
  - Weak, fast pulse
  - Altered mental status
Causes of shock

- Hypovolemia (severe diarrhea, bleeding)
- Sepsis

 Courtesy Rehydration Project, WHO
Treatment of shock

- Stop any bleeding
- Give oxygen
- Keep child warm
- Restore volume
  - IV fluids
  - Oral fluids
Management of shock: well-nourished

- Establish vascular access.
- Give isotonic fluid (Ringer’s lactate or normal saline).
- Rapidly infuse 20 mL/kg (push-pull).
- Re-evaluate extremity temperature, cap refill, pulses, and mental status.
- If there is no improvement, repeat 20 mL/kg bolus and re-evaluate. If there is no improvement, may give a third 20 mL/kg bolus.
- May consider giving blood if no improvement after 60 mL/kg of isotonic fluid.
Well-nourished child, signs of shock (Cool hands, cap refill >3 sec, weak pulse, altered mental status)

Establish vascular access

Give 20 mL/kg Ringer’s lactate or normal saline

Re-evaluate (extremity temperature, cap refill, pulses, and mental status)

No improvement

Give 20 mL/kg Ringer’s lactate or normal saline

Re-evaluate (extremity temperature, cap refill, pulses, and mental status)

No improvement

Give 20 mL/kg Ringer’s lactate or normal saline

Improved

Maintenance IV fluid (as for severe dehydration)
Estimating IV fluid bolus volume for shock by age or weight (well-nourished)

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight</th>
<th>Volume of isotonic fluid to infuse (20 mL/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 months</td>
<td>&lt;4kg</td>
<td>75 mL</td>
</tr>
<tr>
<td>2- &lt;4 months</td>
<td>4- &lt;6kg</td>
<td>100 mL</td>
</tr>
<tr>
<td>4- &lt;12 months</td>
<td>6- &lt;10kg</td>
<td>150 mL</td>
</tr>
<tr>
<td>1- &lt;3 years</td>
<td>10- &lt;14kg</td>
<td>250 mL</td>
</tr>
<tr>
<td>3-5 years</td>
<td>14-19kg</td>
<td>350 mL</td>
</tr>
</tbody>
</table>

Adapted from ETAT manual for participants, Chart 7, page 73
Maintenance IV fluid: well-nourished shock (after resuscitation)

- Continue isotonic fluid (Ringer’s lactate or normal saline), consider adding glucose into solution (D5LR, D5NS).
- For children <12 months, give 70 mL/kg over 5 hours.
- For children >12 months, give 70 mL/kg over 2 ½ hours.
Maintenance IV fluid (well-nourished): total volume (volume per hour)

<table>
<thead>
<tr>
<th>Weight</th>
<th>Age &lt;12 mo (over 5 hours)</th>
<th>Age 12 mo-5yr (over 2 ½ hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4 kg</td>
<td>200mL (40mL/hr)</td>
<td></td>
</tr>
<tr>
<td>4 - &lt;6 kg</td>
<td>350mL (70mL/hr)</td>
<td></td>
</tr>
<tr>
<td>6- &lt;10 kg</td>
<td>550mL (110mL/hr)</td>
<td>550mL (220mL/hr)</td>
</tr>
<tr>
<td>10 - &lt;14 kg</td>
<td>850mL (170mL/hr)</td>
<td>850mL (340mL/hr)</td>
</tr>
<tr>
<td>14-19 kg</td>
<td>1200mL (240mL/hr)</td>
<td>1200mL (480mL/hr)</td>
</tr>
</tbody>
</table>

Adapted from ETAT manual for participants, Chart 11, page 77
Shock and severe acute malnutrition (SAM)

- It is very dangerous to give unnecessary fluid to children with SAM. Patients may develop heart failure and die.
- Use signs of inadequate circulation (cool extremities, prolonged capillary refill, weak pulse, altered mental status).
- Signs of severe dehydration (sunken eyes, slow skin pinch, absence of tears) are unreliable with severe acute malnutrition.
Signs of severe acute malnutrition (SAM)

- Severe wasting
  - Weight for height Z scores
- Decreased upper arm circumference
- Oedema
Severe wasting

www.unicef.org/french/health/togo

www.unicef.org/har08/index liberia feature.html
Decreased upper arm circumference
Severe malnutrition with oedema
Management of shock: SAM

- Confirm diagnosis of shock. Should be a history of volume loss, cap refill $\geq 3$ sec, cool extremities, weak pulses, and altered mental status.

- **STOP** IV fluid immediately if child’s condition deteriorates at any time during treatment (heart rate increases by 15 beats/min and/or respiratory rate increases by 5 breaths/min.)
Management of shock: SAM (2)

- Give 15 mL/kg of D5 Ringer’s lactate, D5 ½ Strength Darrow’s solution, or D5 ½ normal saline over 1 hour.
- Monitor heart rate and respiratory rate every 5 minutes.
- Discontinue IV if heart rate increases by 15 beats/min and/or respiratory rate increases by 5 breaths/min.
- For oral fluid resuscitation, give 5 mL/kg of ReSoMal orally or NG every 30 minutes for 2 hours
- Switch to oral fluids as soon as the child can tolerate them.
**Malnourished child, signs of shock** (Cool hands, cap refill >3 sec, weak pulse, decreased mental status)

- Establish vascular access
- Give 15 mL/kg D5 Ringer’s lactate, D5 ½ normal saline, or D5 ½ Darrow’s over 1 hour
- Monitor heart rate and respiratory rate every 5 minutes

  - HR and respiratory rate unchanged or decreasing → Continue infusion
  - HR increases by 15 beats/min and/or respiratory rate increases by 5 breaths/min (heart failure likely) → Stop IV infusion

As soon as child can tolerate liquids orally, switch to ReSoMal

- 5mL/kg ReSoMal every 30 min for 2 hours, NG or oral
### Estimating IV fluid bolus volume by weight (severe malnutrition)

<table>
<thead>
<tr>
<th>Weight</th>
<th>Volume of isotonic fluid to infuse (15 mL/kg over 1 hour)</th>
<th>Weight</th>
<th>Volume of isotonic fluid to infuse (15 mL/kg over 1 hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kg</td>
<td>60 mL</td>
<td>12 kg</td>
<td>180 mL</td>
</tr>
<tr>
<td>6 kg</td>
<td>90 mL</td>
<td>14 kg</td>
<td>210 mL</td>
</tr>
<tr>
<td>8 kg</td>
<td>120 mL</td>
<td>16 kg</td>
<td>240 mL</td>
</tr>
<tr>
<td>10 kg</td>
<td>150 mL</td>
<td>18 kg</td>
<td>270 mL</td>
</tr>
</tbody>
</table>

Adapted from ETAT manual for participants, Chart 8 page 74
Maintenance fluids for SAM (after resuscitation)

- Oral or NG ReSoMal at 10 mL/kg/hour for up to 10 hours.
- Initiate re-feeding with F-75.
When management resources are limited

- Use guidelines from Integrated Management of Childhood Illness (IMCI).
- IMCI chartbook uses the same assessment and classification principles as ETAT.
- Management recommendations emphasize recognizing patients that should be stabilized and transferred.
Circulation: IMCI under 2months

**Circulation**

- Poorly responsive
- Cool hands
- Capillary refill >3 seconds
- Weak pulses

**Any positive signs**

**Manage**

- Keep patient warm (skin to skin)
- Give fluids (IV, IO, or NG) or continue breast feeding
- Give antibiotics
- Refer urgently to hospital
Circulation: IMCI 2 months to 5 years

Circulation

Any positive signs
- Cool hands
- Capillary refill >3 seconds
- Weak pulses
- Bleeding

Manage
- Stop bleeding
- Keep patient warm
- Give fluids (IV, IO, or NG)
- Give antibiotics
- Refer urgently to hospital
Treatment Skills: Vascular Access

- Peripheral intravenous
- Central intravenous
- Intraosseous
The landmarks for the cannulation of the femoral vein are identified. The patient is placed in a frog-leg position with the hip externally rotated and abducted. The femoral vein is located by feeling for the femoral pulse. The vein is found medial to the pulse. In the patient without a pulse, the vein can be approximately located midway between the pubic symphysis and the anterior superior iliac spine, distal to the inguinal ligament.
A) Insert the needle in the proximal tibia on the flat surface located distal and medial to the tibial tuberosity. Direct the needle caudad (away from growth plate) at a 10 to 15 degree angle. Use downward pressure from the heel of the hand, and a twisting motion until resistance decreases. See text for details. B) Marrow can sometimes be aspirated. C) The needle will flush easily when it is in the marrow cavity. D) Immobilize the leg and secure the needle.
Cool hands
Capillary refill ≥ 3 seconds
Fast, weak pulse

Well-nourished
- Stop bleeding
- Give oxygen
- Keep child warm
- Rapidly give IV fluid

Severe malnutrition
- Stop bleeding
- Give oxygen
- Keep child warm
- Will child drink or tolerate NG fluids?
- If not, carefully give IV fluid