NORMAL NEWBORN AND THERMAL CARE
TERMINOLOGY

• Neonatal – perinatal period
• Weight related
• Gestation related
Neonatal period

Refers to the period of less than 28 days after birth.

Perinatal period

Commences from 22 weeks (154 days) of gestation (the time when the birth weight is 500 g), and ends at 7 completed days after birth.
Still birth

Death of a fetus having birth weight > 500 g (or gestation > 22 weeks or crown - heel length >25 cm) or more.
WEIGHT

Low birth weight (LBW)

Birth weight of less than 2500 gm.

Very low birth weight (VLBW)

Birth weight of less than 1500 gm.

Extremely low birth weight (ELBW)

Birth weight of less than 1000 gm.
GESTATION

Preterm
Gestational age of less than 37 completed weeks (i.e. less than 259 days)

Term
Gestational age of 37 to less than 42 completed weeks (i.e. 259 to 293 days)

Post term
Gestational age of 42 completed weeks or more (i.e. 294 days or
AGA

Weight 10-90th percentile for gestation

SGA

Weight < 10th percentile for gestation

LGA

Weight > 90th percentile for gestation
NEWBORN HEALTH IN INDIA

• 25 million (2.5 crores) births per year
  - Accounts for 20% of global births.

• 0.9 million (9 lakhs) die in neonatal period
  - Accounts for about 25% of global deaths.

India accounts for highest births & neonatal deaths globally
FACTS

• Preterm baby has 9-20 times more chance of dying compared to term baby.

• IUGR baby has 3 times more chance of dying than term baby.

• 70 % of neonatal deaths are preventable.
VULNERABLE NEWBORN

Newborn Mortality is the world’s most neglected health problem
**NEONATAL MORTALITY**

- Neonatal Tetanus: 11%
- Pneumonia: 19%
- Asphyxia: 21%
- Injuries: 11%
- Congenital abnormalities: 11%
- Prematurity: 10%
- Sepsis: 7%
- Diarrhea: 2%
- Other: 5%
- Diarrhea: 2%
THERMAL CARE
BASIC CONCEPTS

• Basal Metabolism constantly produces heat.
• Newborn thermoregulation is poorly developed.
• Heat loss is the main detrimental factor.
• Essentially a balance between thermogenesis & thermolysis.
• Basic foundation on which the neonatal care is based.
HANDICAPS IN NEWBORN

• Larger surface area to body mass ratio
• Less of subcutaneous fat
• Increased insensible losses : Thin skin
• Lack of behavioral mechanisms
• Predisposition for sepsis, hypoglycemia
• Limited non shivering thermogenesis
• Narrow thermal neutral zone
PRETERM VS. TERM

• Less subcutaneous tissue
• Thin skin: Evaporative losses
• Less brown fat
• Lack of sweating
• Larger body surface area
• No behavioral mechanisms
• Behave like poikilothermic
• Less oral intake
THERMAL COMPARTMENTS

Core
• Hypothalamus.
• Precisely controlled.
• Heat production –
• Distribution: uniform
• Rectal temperature.

Periphery
• Influenced by environmental temp.
• Variable.
THERMOREGULATION

Thermogenesis = Thermolysis

**Thermogenesis:**
- Voluntary muscle activity.
- Shivering.
- Non shivering thermogenesis.

**Thermolysis:**
- Core to periphery.
- From periphery to environment.
RESPONSE TO HEAT

Increase heat loss:

• Cutaneous vasodilation
• Sweating
• Increased respiration

Decrease heat production:

• Apathy and inertia
RESPONSE TO COLD

Increase heat production:

• Shivering
• Increased voluntary activity
• Increased secretion of sympathomimetics.

Decrease heat loss:

• Cutaneous vasoconstriction
• Curling up
• Horripilation
Cold exposure

Hypothalamus

Brown Adipose tissue

Glycerol + FFA

Increased $O_2$ demand

Metabolic rate

$O_2$ to thermogenic organs

$O_2$ to other organs

FFA in circulation

Anaerobic metabolism/
lactic acidosis

complete with bilirubin

for albumin

Metabolic acidosis

Diffusion of bilirubin

in brain

Kernicterus

Pulmonary Constriction

Surfactant deficiency

Rt to Lt shunt
NON SHIVERING THERMOGENESIS

Posterior Hypothalamus

temperature sensors

Pituitary

↓

Thyroid

(Thyroxine-
T4)

↓

Adrenal Glands

(norepinephrine)

↑

Breakdown of brown fat

CNS

↓
BROWN FAT

Major site of heat production

Sites: Kidneys, adrenal

Stimulus: Catecholamine release

Response dependence: Thyroid

Unique structure: Vascular. Mitochondria.

Cord cutting, neonatal cooling, augmented T4 to T3 conversion mediate & condition.
NEUTRAL THERMAL ZONE
NEUTRAL THERMAL ZONE

• Depends upon resting heat production & insulation.

  Clothing & wrapping widen and lower the NTZ.

• Nursing in NTZ optimizes somatic and brain growth.

• Clinically body maintains core temperature between 36.7 – 37.3 C
Axillary temperature recording for 3 minutes is recommended for routine monitoring
## COLD STRESS / HYPOTHERMIA

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>Normal range</td>
<td></td>
</tr>
<tr>
<td>36.5</td>
<td>Cold stress</td>
<td>Cause for concern</td>
</tr>
<tr>
<td>36.0</td>
<td>Moderate hypothermia</td>
<td>Danger, warm baby</td>
</tr>
<tr>
<td>32.0</td>
<td>Severe hypothermia</td>
<td>Outlook grave, skilled care urgently needed</td>
</tr>
</tbody>
</table>

**Body temperature in the newborn infant (°C)**
MECHANISM OF HEAT LOSS

Convection
Evaporation
Radiation

Conduction
## Diagnosis of Hypothermia by Human Touch

<table>
<thead>
<tr>
<th>Trunk</th>
<th>Extremities</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>Warm</td>
<td>Normal</td>
</tr>
<tr>
<td>Warm</td>
<td>Cold</td>
<td>Cold stress</td>
</tr>
<tr>
<td>Cold</td>
<td>Cold</td>
<td>Hypothermia</td>
</tr>
</tbody>
</table>
MEASURES IN DELIVERY ROOM

Thermoregulation

- Draft free area
- Pre-warmed linen
- Heat source
- Room temp: 28-30 degrees C
- Remove wet linen
- Dry thoroughly & Wrap
- Promote skin to skin contact
THERMAL CARE (PNC WARD)

• Ensure warmth
• Cover the head
• Promote rooming in
• Avoid baby bath in hospital
• Do not remove vernix caseosa
• Early & Exclusive breast feeding
KANGAROO CARE

• Assists in maintaining temperature
• Facilitates breastfeeding
• Increases duration of breastfeeding
• Improves mother-baby bonding
**TEN COMMANDANT’S WARM CHAIN**

<table>
<thead>
<tr>
<th>Warm delivery room</th>
<th>Postpone bath</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm resuscitation</td>
<td>Appropriate clothing</td>
</tr>
<tr>
<td>Immediate drying</td>
<td>Rooming in</td>
</tr>
<tr>
<td>Kangaroo Care</td>
<td>Warm transportation</td>
</tr>
<tr>
<td>Breast feeding</td>
<td>Awareness</td>
</tr>
</tbody>
</table>
HYPERTHERMIA

- Elevated set point
  - Endogenous / Exogenous pyrogens
  - Prostaglandin / cytokine mediated
  - Behavioral mechanism

- Hyperthermia no change in set point:
  - Overrides the ability to lose heat
  - Hyperpyrexia: > 41.5°C
HYPERTHERMIA

OVER HEATED
1. High rectal temp.
2. Warm hands / feet.
3. Pink skin.
4. Extended posture.
5. Healthy.
6. Core – axillary mismatch < 2 degrees C.

FEBRILE
1. High rectal temp
2. Cold hands / feet.
3. Pale skin.
4. Flexed posture.
5. Sick.
6. Core – axillary mismatch > 3 degrees C.
MANAGEMENT OF HYPERTHERMIA

• Place the baby in a normal temperature environment (25 - 28 degrees C), away from any source of heat.

• Undress the baby partially or fully, if necessary.

• Give frequent breast feeds; give breast milk by cup if unable to suck.

• If temperature >39 degrees C, sponge the baby with tap water; DO NOT use cold / ice water for sponge.

• Measure the temperature hourly till it becomes normal.
HYPOTHERMIA

• More due to lack of knowledge than to lack of equipment.

• No single environmental temperature that is appropriate for all sizes, gestational ages and conditions of newborn babies

• Early marker of thermal stress
MANAGEMENT OF COLD STRESS

• Cover adequately - remove cold clothes and replace with warm clothes
• Warm room/bed
• Take measures to reduce heat loss
• Ensure skin-to-skin contact with mother; if not possible, keep next to mother after fully covering the baby
• Breast feeding
• Monitor axillary temperature every \( \frac{1}{2} \) hour until it reaches 36.5\(^0\) C, then hourly for next 4 hours, 2 hourly for 12 hours thereafter.
MANAGEMENT OF MODERATE HYPOTHERMIA

- Skin to skin contact
- Warm room/bed
- Take measures to reduce heat loss
- Provide extra heat
  - Room heater
  - Radiant warmer, incubator
  - Apply warm towels
MANAGEMENT OF SEVERE HYPOTHERMIA

• Provide extra heat preferably under radiant warmer or air heated incubator.
  • rapidly warm till 34 degrees C, then slow re-warming
• Take measures to reduce heat loss.
• IV fluids: 60 - 80 ml/kg of 10% Dextrose.
• Oxygen.
• Inj. vitamin K 1 mg in term & 0.5 mg in preterm
• If still hypothermic, consider antibiotics assuming sepsis.
• Monitor HR, BP, Glucose (if available).
CONCLUSIONS

• Hypothermia is a major contributory factor in neonatal morbidity / mortality.

• It is the most neglected aspect of neonatal management.

• Essentially preventable.

• Early detection and prompt simple interventions will prevent both hypo & hyperthermia.
THANK YOU