Perioperative Care of the Neonate

By Lilian Budden, R.N.

The neonatal period is the first 28 days of life and presents the greatest risk to the newborn. It is a period full of physiological transitions and adoptions, and to the surgical neonate are added the pathophysiological changes which accompany the surgical condition.

The two major adjustments from intrauterine to extrauterine life are with the respiratory and the cardiovascular systems.

The Respiratory System:

There are several stimuli that promote spontaneous respirations:

1. Rebound of the thoracic cage following vaginal birth. Descent through the vaginal canal also squeezes fluid from the lungs.
2. Chemical changes: With the clamping of the umbilical cord there follows a low blood $P0_2$ a high $PC0_2$ and a low pH which excites the respiratory center in the medulla.
3. Thermal changes: As the neonate leaves the warm aquatic environment for the cooler air, sensory impulses in the skin are excited and these are also transmitted to the respiratory center.
4. Tactile stimulation: This is now questionable with only gentle, if any, tactile stimulation used.[1]

When respirations are established the normal neonatal rate is between 30/40 breaths per minute.

Abstract

The neonate is a unique individual with his\her own needs. This article deals with the adjustments the neonate has to make to extrauterine life; some of the differences between neonates and older children and adults, and the special needs of the neonate who needs surgery.

Cardiovascular System:

As the lungs expand, the pulmonary blood flow increases; the pressure in the right atrium, right ventricle and pulmonary vessels decrease, the pressure in the left side of the heart increases and as blood flows from a higher to lower pressure the circulation through the fetal shunts are reversed. The high $P0_2$ level of the blood causes the duct walls to constrict and the foramen ovale and ductus arteriosis functionally close soon after birth.[2] This transition may take from minutes, hours, to weeks and during this time the neonate's circulation can be thought of as an unstable, transitional system.[3]

All systems undergo change and most are immature at birth, however, neonates can see, smell, hear, taste and feel pain.

Some other changes will be incorporated as we follow the neonate through surgery.

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Some Neonatal Conditions Requiring Surgery

- Omphalocele
- Gastroschisis
- Diaphragmatic hernia
- Tracheoesophageal Fistual
- Mecomium Ileus
- Imperforate Anus
- Total Anomalous Pulmonary Venus Return
- Hypoplastic Left Heart
- Laryngotrachealesophageal Cleft
- Tracheomalasia
- Myelomeningocele
- Hydrocephalus

When a neonate is booked for surgery, one of the major concerns is for thermoregulation. In preparation for this surgery: the heat in the operating room should be increased, a well-padded warming blanket placed on the OR bed and drapes and prep solutions placed in a warmer.

Neonates have a proportionately larger surface area in relation to body weight which provides more exposure to the environment and greater heat loss per unit of body weight.[4] They also have a very thin insulation or subcutaneous fat layer.

Heat is lost in four ways:

1. **Evaporation**- heat lost through moisture. Wet newborns lose five times as much heat as dry babies.
2. **Radiation** - heat lost to cooler solid objects in the environment that are not in contact with the neonate.
3. **Conduction** - heat lost from the body through direct contact of the skin with a cooler solid object.
4. **Convection** - heat lost due to warm air rising and being replaced by cooler air.[5] This is accentuated by doors opening, and anything that creates a draft.

Man is homeothermic; that is heat production increases when exposed to a cold environment to maintain body temperature.[6] The central nervous system receives multiple sensory inputs concerning thermal balance within the body, it interprets the data and activates the mechanisms to adjust the balance of heat loss/heat gain. In other words, man shivers! Neonates do not shiver. He/she can only maintain a constant body temperature within a narrow range of environmental conditions and if the neonate is cold stressed then non shivering thermogenesis occurs. The oxygen consumption and metabolic activity increases which breaks down brown fat located between the scapulae, neck, behind the sternum and around the kidneys and adrenals. The heat generated by the breakdown of the brown fat is distributed around the body by blood which is warmed as it flows through the fat. In this non-shivering thermogenesis as much as 20% of the cardiac output may be diverted through the fat and this causes pulmonary and peripheral vasoconstriction. This gives the neonate its mottled appearance. The consequences of this can be hypoxia, metabolic acidosis and hypoglycemia.[7]

For the neonate we have to try and provide a neutral thermal environment, that is one that permits the neonate to maintain a normal body temperature with minimal oxygen consumption and caloric expenditure. A skin temperature of 36.5°C will indicate a neutral thermal environment for most neonates.[8] With a neonate > 2.5Kg a room temperature of 26° is fine, < 2.5Kg the room should be 29°, but if the neonate is uncovered the room heat may need to be increased to 32.5°C.[9] If the neonate becomes too hot the same reaction will occur as during cold stress.

If the axilla is being used to measure the temperature it should be the axilla without the IV as IV fluids can produce a false temperature reading.[10]

Most neonates who need surgery will be nursed in a neonatal intensive care unit and a pre-operative visit should be done. The neonate should be assessed for needs in transporting to the operating room and for needs in the operating room. Some considerations are: premature or full term, weight, co-existing anomalies, etc. Check that a type and cross-match have been done and when the blood will be available. The blood reports are also checked keeping in mind that in a neonate the haemoglobin, haematocrit and white blood counts are higher than an adult's.

Hgb- 16-18 9/100 ml blood
Hct - 45-50%/100 ml blood
WBC - 20,000 mm^3[11] for the first 24 hours decreasing to 12,000 mm^3 by the end of the first week.[12]

It should also be verified that Vitamin K was given post delivery. Vit K catalysis the synthesis of prothrombin in the liver. It is produced by intestinal bacteria but as a neonate's gastrointestinal tract is sterile there is no vit K available for prothrombin formation for about four days.[13]

The consent for surgery is also checked. At our hospital we accept a telephone consent witnessed by two people. The mother may still be a patient in another hospital and the father may not be able to be with the baby. If the parents are present when the baby is taken to the operating room they will be emotionally upset, so allowing them to touch, kiss or say goodbye to their baby may help.

When everything is ready in the operating room and with the neonate, he/she is transported to the OR. This is usually accomplished as a joint effort with the anaesthetist, maybe a respiratory technologist and the OR nurses. The baby is transported in either an isolette or an Ohio bed with the radiant heaters. Even if the baby is not intubated O_2 and a pulse oximeter are used for transport and a warm blanket is placed over the baby. If the baby is not being nursed in the NICU then then he/she will be transported to the OR by the nursery nurses and the chart is checked in the OR admission area.

In the operating room the baby is carefully transferred from the isolette/Ohio bed to the warm operating room bed and preparation for induction begins. The isolette should be plugged into an outlet in another area to keep it warm for when surgery is finished.

EKG leads have to be placed for good surgical access but also so they won't cause any pressure on the skin when the baby is positioned. This is not a problem if you use the flat preattached wire electrodes. The two layers of a neonate's skin, the dermis and epidermis, are loosely bound to each other and are very thin. Slight friction can cause separation of these layers and blister formation.[14] Care should be taken when repositioning leads and removing tape.

The precordial stethoscope, the temperature probe, B/P cuff and pulse oximeter probe are applied.

If possible, at the first opportunity a hat should be placed on the neonate's head for "heat loss from an uncovered head may represent 60% of the total heat loss in the OR".[15]

If there is an existing IV and it is functioning even though it may be a butterfly, the anaesthetist may opt to use this to induce the baby. Getting an IV can be a time consuming process (sick baby, every vein used prior to coming to the OR etc.)

The intubation of a neonate is an extremely stressful time for everyone. The differences in a neonate's airway and why they can be more difficult to intubate than an adult are:

1. The tongue is relatively larger and more easily obstructs the airway.
2. The larynx is higher in the neck.
3. The epiglottis is narrower, shorter and angled away from the trachea and more difficult to lift with the blade.
4. Tip of the endotracheal tube catches in the vocal folds.
5. The larynx is funnel-shaped so the ET tube may pass through the vocal folds but not the subglottis." [16]

Neonates also desaturate very rapidly. They consume O_2 twice as fast (premies 3 times)[17] as an adult and they have very little lung reserve so until the ET tube is securely taped in place, tension is high. (34% of infants under one year (1) of age experienced critical incidents under anaesthesia and 22% of these occurred during induction.)[18]

After the intubation, better IVs, arterial lines, central venous lines, etc. are obtained. The baby's eyes are protected with lubricating drops, eye pads and tape. Urinary catheters may be needed and for this very small Foleys or even feeding tubes may be used. During this phase, team work is very essential as the baby is only so big and many people try to have a piece of the action. Prevention of heat loss must be remembered.

After the anaesthetist gives the O.K. the neonate can be positioned for surgery. We make donuts from combine pads and cling to support the head. We also use combine pads and/or foam to make rolls and bolsters to support the baby in the lateral and prone position and to protect the pressure areas. The smaller size electrosurgical dispersive pad is placed under the baby - the back and buttocks for supine and flank for the lateral position.

The prep should be done with warm solution and the sponges not too wet. There should be no pooling of solution under the baby to prevent chemical burns and heat loss from evaporation and conduction. Ideally the prep should be done when the surgeon is in the room and ready to drape for, as I said earlier, a wet baby looses heat five times faster than a dry one[19] and there is usually a lot of the body exposed. (in one instance the preprep temperature was 36.8°C but decreased to 34.9°C by the time the surgeon came in the room.

Sponges are weighed as soon as they are discarded from the setup so an accurate blood loss can be determined. A neonate has a blood volume of 80-90 ml/Kg [20], so a 10% loss in a 3Kg baby is only 24-27 ml of blood. A small suction receptacle which gives a more accurate measurement of blood loss can be used. Irrigating solutions must be warm and, as they cool quickly and have to be replaced, accurate records of volume must be maintained. We use a marking board visible to the anaesthetist to keep a running tally of blood loss and volume of fluid on the setup.

Instruments used for neonatal surgery can be small and more delicate than those used for larger children and adults and must be handled and processed with care. Surgical team members must take care not to rest on, or put pressure on, the neonate's body or limbs.

Record keeping and care of any specimens is the same as for any surgery - accurate and complete.

Following closure the incision is dressed or not dressed as per the surgeon's instructions. If drainage is expected it would be good perioperative nursing care to use Montgomery straps to keep the neonate's dressing in place. The electrosurgical dispersive pad is gently removed and the site checked for burns. Warm, dry blankets should be placed over and under the baby.

A nurse should stay with the neonate ready to assist the anaesthetist with extubation if it is planned, or to help with the transfer of the intubated baby to the ICU and PARR. There are probably more lines and tubes postoperatively, and it is important that they do not get dislodged.

Some studies suggest that too much environmental stimulation, e.g., loud noises, jarring of the isolette, too much handling etc., are stressful for the sick neonate and can cause decreased PO_2 and increased heart rate, respiration and intracranial pressure[21], so neonates should be handled gently, especially in transport. The baby is then handed over to the ICU or PARR nurses and a report is given.

The neonate is a unique individual with unique needs, and we have to be aware of these to give the optimum care for his/her stay with us in the O.R.

Notes

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A **95th reunion** of the School of Nursing of the **Toronto Western Hospital** is planned for **September 18, 1993.**
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