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Obtaining Newborn Infant Vital Signs
--Manuscript Draft--

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Clinical Skills Education Title: Obtaining Newborn Infant Vital Signs

Overview

Vital signs include the accurate and routine measurements of temperature, heart rate (HR), respiratory rate (RR), and blood pressure (BP). They are utilized to assess the physiological status of infants and children in many clinical settings. The interpretation of vital signs is widely used as the basis for clinical decision-making. Vital signs inform initial triage screenings, routine clinical care, acute intensive care, and clinical status during cardiopulmonary resuscitation, and they can also provide critical early warning signs of clinical deterioration. Therefore, being able to accurately obtain vital signs in an infant or child is essential to providing informed health care.

Normal ranges for the vital signs in an infant are: temperature, 36.5-37.5 °C; HR, 120-160 beats per minute (bpm); RR, 40-60 bpm; and as a general guideline, normal mean BP approximates gestational age plus 2-5 millimeters of mercury (mmHg).

Procedure

1. General considerations for obtaining the vital signs.

1.1. Wash hands with soap and water or use an alcohol-based sanitizer directly prior to patient contact. Alcohol-based sanitizers are not appropriate to use when hands are grossly soiled; washing hands with soap and water is required, in such a case.

1.2. Approach the infant from their right side.

1.3. Record the measurements on a vital sign sheet or within an electronic medical record.

2. Temperature.

According to the American Academy of Pediatrics (AAP) and the American Congress of Obstetrician and Gynecologists (ACOG), infant axillary temperature should be within the range of 36.5 °C and 37.5 °C. Both hypothermia and hyperthermia can have adverse effects for newborns. Additionally, regular temperature monitoring can help identify elevated body temperatures and potential infection. AAP and ACOG also recommend obtaining temperatures in newborn infants via the axilla. The Handbook in Neonatal Intensive Care informs that an axillary temperature provides an early warning of hypo- or hyperthermia. However, controversy exists about whether or not axillary or rectal temperatures should be routinely obtained. Although rectal temperature measurement is one of the oldest methods of measuring core body temperature in an infant, it can pose a risk of injury to the infant. Additionally, core temperatures can lag and won't always indicate an accurate change in body temperature.

2.1. Axillary Temperature.

2.1.1. Obtain an electronic or digital thermometer.

2.1.2. With an electronic thermometer, place the covered tip of the electronic probe under the arm in the center of the axilla.

2.1.3. Hold the patient's arm firmly against their side to keep close contact to the skin.

2.1.4. Record the temperature on paper or electronic medical records.

2.2. Rectal temperature.

Rectal temperature measurements should be taken with the patient lying on their side in a supine or prone position with the legs slightly flexed at the hips and knees. An infant or small child may be placed prone on the parent's lap.

2.2.1. Lubricate the thermometer tip by submerging the tip in an opened packet of lubricating jelly.

2.2.2. Direct the thermometer position anteriorly and approximately 20 degrees to the surface of the examination table or bed.

2.2.3. Place the well-lubricated thermometer tip no more than 2.5 cm (1 in) into the rectum.

2.2.4. Do not attempt to take a rectal temperature if contraindications are suspected, such as neutropenic conditions and/or status post-rectal surgery.

3. Heart Rate.

Heart rate is a key vital sign used to assess the physiological status of infants in all clinical settings and is used as one of the initial measurements in acutely ill infants. Heart rates and deviations from baseline measurements can act as part of an early warning marker of clinical change, can reflect an underlying clinical diagnosis, and can determine responsiveness to interventions, such as cardiopulmonary resuscitation or cardiac-focused medications. Sustained heart rates above or below the normal range for age, whether a sinus rhythm or an arrhythmia, can act as clinical indicators of infection or specific cardiac and non-cardiac disease processes. Some examples of sustained heart rates above or below the normal range are sustained tachycardia, which can be a marker of hypovolemia, pain, or the initial response to compensated shock, and bradycardia, which can indicate heart block, over-sedation, or uncompensated shock. Heart rates are measured in bpm. The normal range for the heart rate is age-dependent. The average heart rate of infants is from 120 to 160 bpm.

3.1. Obtain a stethoscope and a watch/clock with a second hand or a digital display.

3.2. Measure the heart rate by direct auscultation, palpation of the heart, or palpation of the peripheral arteries including (carotid, femoral, brachial, or radial).

3.2.1. For infants and small children, auscultate the apical pulse (the point of maximal intensity) at the fourth to fifth intercostal space at the mid-clavicular line for a full 60 sec on the initial assessment or if any irregularity is suspected.

3.2.2. Alternatively, measure the heart rate of infants by palpating the pulse at the brachial arterial site for a full 60 sec.

3.2.3. For older children, palpate the pulse at the radial arteries.

3.3. For repeated measurements, count the heart rate for 15 to 30 sec.

4. Respiratory Rate.

Sustained respiratory rates above or below the normal range for an age can act as clinical indicators for respiratory infections or specific disease processes. Respiratory rates are measured in bpm. The normal range for the respiratory rate is age-dependent with average respiratory rates of infants ranging from 30 to 60 bpm. Accurate measurements of respiratory rates are best determined when attempted while the infant or child is calm, at rest, or sleeping.

4.1. Obtain respiratory rates through auscultation, palpation, or direct observation. Observe and/or auscultate the rate of breathing for a full 60 sec on the initial infant assessment. With infants and small children, abdominal movements with each breath can be observed.

4.2. For repeated measurements, count the respiratory rate for 15-30 sec.

5. Blood Pressure.

Blood pressure is a measurement of the pressure exerted by the circulating systemic blood flow on the arterial blood vessels. It is expressed in terms of the systolic pressure over diastolic pressure and is measured in millimeters of mercury (mmHg). The systolic pressure (SBP) is the measurement reflective of the pressure as the heart beats, forcing blood into the arterial system. The diastolic pressure (DBP) is the measurement reflective of the pressure as the heart relaxes between beats. Mean arterial blood pressures (MAP), the pressure average throughout the cardiac cycle, are also measured in infants. A blood pressure measurement can vary depending on the patient's circulatory status, hydration status, underlying cardiovascular or renal disease, or if infection is present. Sustained hypertensive and hypotensive states can ultimately lead to organ impairment. Studies have identified that target organ impairment can

be ameliorated, and the risk for future cardiovascular disease, stroke, and premature death can be decreased by early and effective blood pressure control. Therefore, accurate measurements and early detection of abnormal blood pressure is critical in preventing potential long-term negative effects. Both hypertension and hypotension can indicate an underlying pathological process and always warrant further investigation.

Hypertension is defined as the SBP and/or DBP that is, on repeated measurement, at or above the 95th percentile. In infants in the inpatient setting, there is a general rule of thumb: if the MAP is measured at 10 mmHg higher than the gestational age, it is considered hypertension; if a MAP is less than the gestational age, it is considered hypotension. Utilization of this rule of thumb, in addition to physical exam findings and clinical judgment, should be done prior to administration of medical therapy.

Accurate blood pressure measurement requires a properly-sized cuff. A small cuff may cause a falsely elevated reading, and a large cuff may result in a lower reading. The cuff size refers only to the inner inflatable bladder, not the cloth or plastic covering. The width of the cuff bladder should cover about 40% of the mid-upper arm or mid-low leg circumference. The length of the blood pressure bladder cuff should extend and encircle 80-100% of the length of the upper arm and 80% of the lower leg. Multiple size-specific infant blood pressure cuffs are available, including premature-sized cuffs (**Figure 1**), to ensure appropriately-sized cuffs are utilized to obtain accurate blood pressure measurements.

5.1 Auscultatory method.

5.1.1. Obtain a stethoscope and a manual blood pressure setup including sphygmomanometer with an appropriately-sized cuff for the patient.

5.1.2. With infants, place the cuff on either an upper or lower extremity.

5.1.3. Place the stethoscope on the limb associated with the arterial site, either brachial, radial, popliteal, or posterior tibial.

5.1.4. Pump the cuff up at least 20 mmHg above the estimated systolic number or until the pulse disappears.

5.1.5. While stabilizing the limb, allow a slow release of pressure from the cuff bladder.

5.1.6. Record the systolic value at the onset of the first Korotkoff sound (often described as a tapping sound).

5.1.7. Record the diastolic value at the fourth Korotkoff sound (low-pitched muffled sound) for children up to 12 years old.

5.2. Non-invasive automatic blood pressure measurement.

5.2.1. Obtain the appropriately-sized blood pressure cuff and automated measuring device.

5.2.2. With infants, place the cuff on an upper or lower extremity.

5.2.3. Follow the manufacturer's instructions for use.

Summary

Accurately obtaining vital signs in an infant is a critical component to providing safe and effective health care management. Vital signs, along with physical examination findings and clinical judgment, direct decision-making pathways and patient interventions in all clinical settings. Obtaining temperatures, heart rates, respiratory rates, and blood pressures in infants are skills repeatedly employed when providing care at all levels of the health care continuum. Therefore, these are essential clinical skills and tools that must be practiced and mastered by all direct patient caregivers.

Figures and legends

Figure 1: Blood pressure cuffs.

A photograph showing several different sizes of blood pressure cuffs.



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Comment [JS1]: The first sentence is already listed in the Overview section. The rest of the information is relevant, as well, but better suited in the Overview.

Comment [AS2]: Strictly speaking, we like to stick to a certain amount of content for the Overview section, and we add more detailed info in the appropriate Procedure sections. Therefore, we highlight the necessary info to be included in the video, while leaving it up to the production team to decide if it's possible to include all non-highlighted background information, as well.

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Comment [JS3]: Better suited in the overview.

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Comment [JS4]: overview

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Comment [AS5]: Again, we like to think of the Overview as a brief summary, so we didn't think adding in this much text to that section would be appropriate. It doesn't have to be in the video, just in the manuscript; hence, it is not highlighted here.

be ameliorated, and the risk for future cardiovascular disease, stroke, and premature death can be decreased by early and effective blood pressure control. Therefore, accurate measurements and early detection of abnormal blood pressure is critical in preventing potential long-term negative effects. Both hypertension and hypotension can indicate an underlying pathological process and always warrant further investigation.

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Comment [JS6]: Again, large amounts of text that should not be included in the procedure section.

5.1 Auscultatory method.

5.1.1. Obtain a stethoscope and a manual blood pressure setup including sphygmomanometer with an appropriately-sized cuff for the patient.

Comment [AS7]: This is described in the paragraph above: by arm circumference and length.

5.1.2. With infants, place the cuff on either an upper or lower extremity.

Comment [JS8]: How are the sizes appropriately determined?

5.1.3. Place the stethoscope on the limb associated with the arterial site, either brachial, radial, popliteal, or posterior tibial.

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5.2.2. With infants, place the cuff on an upper or lower extremity.

5.2.3. Follow the manufacturer's instructions for use.

Comment [JS9]: Will this method also be demonstrated? If so, 5.2.3 would need to reflect what steps would be shown.

Comment [AS10]: We envisioned to have a narrative sentence and a short demonstration, as all the devices are different from one another.

Summary

Accurately obtaining vital signs in an infant is a critical component to providing safe and effective health care management. Vital signs, along with physical examination findings and clinical judgment, direct decision-making pathways and patient interventions in all clinical settings. Obtaining temperatures, heart rates, respiratory rates, and blood pressures in infants are skills repeatedly employed when providing care at all levels of the health care continuum. Therefore, these are essential clinical skills and tools that must be practiced and mastered by all direct patient caregivers.

Figures and legends

Figure 1: Blood pressure cuffs.

A photograph showing several different sizes of blood pressure cuffs.

Comment [JS11]: Should the image be labeled with some sort of classification?

Comment [AS12]: This is just an illustration for the statement that different sizes are available, even for tiny little preemies...