

OBJECTIVE ASSESSMENT AND COMMUNICATION OF THE PHYSIOLOGIC STATUS OF THE SICK INFANT L'ÉVALUATION OBJECTIVE ET LA COMMUNICATION DE L'ÉTAT PHYSIOLOGIQUE D'UN NOUVEAU-NÉ MALADE

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INTRODUCTION

The practice of midwifery involves the initial and ongoing assessment of newborn infants in terms of their maturity, transition to extrauterine life, completeness of resuscitation and ongoing health status. The universally familiar Apgar score is an essential tool for initial neonatal assessment for midwives as for other medical professionals.¹ The score was developed by Virginia Apgar as an objective measure of the physiologic status of the infant after birth, and to quantify the progress through, and adequacy of, resuscitation and adaptation to extra-uterine life.

While elements of the Apgar score are relevant for assessing and describing the status of the infant after 10 minutes of age, the score as a whole is not used routinely beyond this time. The Pediatric Assessment Triangle (PAT) is a newly developed tool for ongoing, objective assessment of an infant's (or child's) physical appearance.^{2,3} The PAT can be used to describe the presence of abnormal physiology, define whether an infant is in distress or actually experiencing system failure, and assess the infant's response to intervention by observing the resolution or progression of the clinical problem. The PAT has the potential to be a valuable tool for midwives, both for ongoing assessment, and as a means of describing the status of an infant to other health care professionals using objective terminology.

The use of objective criteria and precise terminology can strengthen the impact and relevance of communication and contribute to logical decision-making about immediate care and long-term disposition. A consistent framework is also valuable when providing follow-up, particularly where a treatment or intervention has been suggested and it is important to communicate whether the infant has responded.

The purpose of this paper is to describe the Pediatric Assessment Triangle, explain how it is applied and to suggest the use of this tool by midwives in practice.

INTRODUCTION

La pratique sage-femme exige l'évaluation initiale et le suivi des nouveaux-nés, en ce qui a trait à leur maturité, la transition à la vie extra-utérine, la réanimation complète et l'état de santé en cours. Le score d'Apgar, universellement reconnu, est un outil essentiel pour l'évaluation initiale néonatale pour les sages-femmes ainsi que pour d'autres professionnels de la santé.¹ Le score fut développé par Virginia Apgar en tant que mesure objective de l'état physiologique de l'enfant après la naissance, et pour quantifier le progrès et la compétence à travers la réanimation et l'adaptation à la vie extra-utérine.

Bien que les éléments du score d'Apgar sont pertinents pour évaluer et décrire l'état du nouveau-né 10 minutes après sa naissance, le score dans l'ensemble n'est pas couramment utilisé passé ce moment-là. Le Pediatric Assessment Triangle (PAT) "*Triangle d'Évaluation Pédiatrique*" est un outil récemment développé pour l'évaluation continue et objective de l'apparence physique du bébé (ou de l'enfant).^{2,3} Le PAT peut être utilisé pour décrire la présence d'une physiologie anormale, pour déterminer si un nouveau-né est en détresse ou s'il est en train de subir une décompression, et pour

évaluer la réaction du bébé à l'intervention en observant la résolution ou la progression du problème clinique. Le PAT a le potentiel d'être un outil très utile pour les sages-femmes, pour l'évaluation continue et aussi en tant que moyen pour décrire l'état du nouveau-né aux autres professionnels de la santé en utilisant une terminologie objective.

L'usage de critères objectifs et de terminologies précises peut augmenter l'impact et la pertinence de la communication et peut contribuer aux prises de décisions logiques en ce qui a trait aux soins immédiats et aux dispositions à long terme. Un encadrement consistant est aussi très utile lors du suivi, particulièrement lorsqu'un traitement ou une intervention ont été suggérés et qu'il est important de communiquer si le nouveau-né a bien réagi ou non.

Le but de ce travail est de décrire le PAT "*Triangle d'Évaluation Pédiatrique*" et d'expliquer comment il peut être appliqué et aussi de suggérer l'utilisation de cet outil par les sages-femmes en pratique.

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BACKGROUND

The Pediatric Assessment Triangle is shown in Figure 1.^{2,3} The PAT was developed by the American Academy of Pediatrics as an assessment tool for their Pediatric Emergencies for Prehospital Professionals (PEPP) training course. The components of the PAT are shown on the three arms of the triangle. They are:

- The appearance of the infant (or child).
- The work of breathing.
- The status of circulation to the skin.

You can gather the information required for the PAT entirely through observation. The PAT describes in objective terms what experienced caregivers determine almost instinctively when they first see a sick or injured infant. For those less experienced, the PAT provides a simple and easy-to-remember framework for formulating this first general impression. The PAT does not take the place of physical examination or the recording of vital signs, nor is it intended to replace the ABCDE's of resuscitation in an emergency situation. However, using the triangle can help you decide whether an infant is sick and if so, whether the infant is relatively stable and compensating, or very sick with a system (or systems) that has decompensated and is in failure.

The information gathered for each arm of the triangle is first considered alone, and an assessment made whether the observations are within normal parameters. The information from all three arms is then considered in combination to obtain an indication of the infant's physiologic status.

APPEARANCE

The infant's appearance is the most important thing to consider when determining how severely he or she is affected by an illness or injury. The appearance arm of the triangle reflects how well the brain is being supplied with oxygen and perfused with blood, and whether normal central nervous system function is continuing in the presence of compromise in other systems.

In essence, when an infant's appearance (which reflects brain function) becomes compromised, this translates into a significant degree of physiological dysfunction. In the first stages of an illness, evidence of this dysfunction is absent or minimal due to the infant's ability to compensate by various mechanisms. Compensatory mechanisms include an increased work of breathing to improve oxygenation, and vasoconstriction in the skin and elsewhere to

FIGURE 1: THE PEDIATRIC ASSESSMENT TRIANGLE



redistribute blood flow preferentially to the more important organs. An infant with normal appearance and compensatory tachypnea and vasoconstriction is thus sick and physiologically distressed, but while in need of intervention, is usually sufficiently stable for treatment not to be required urgently.

In contrast, the infant with tachypnea and vasoconstriction who also has an abnormal appearance is no longer able to compensate effectively because an organ system(s) is actively failing. There may still be physical signs suggesting an attempt to compensate, but in the sickest infants such signs (e.g. increased work of breathing and/or increased heart rate) are less evident or even absent due to a reduction of brain-mediated central drive. Consequently, treatment of the underlying system failure is now urgent.

Over time, changes in the infant's appearance reflect either the natural progression or resolution of the disease process, and whether and to what degree the infant has responded to an intervention.

To describe an infant's appearance appropriately, you should be familiar with age appropriate behaviours. For those looking after children from birth through childhood and into adolescence, this requires familiarity with the whole range of physical, behavioral and emotional development that passage through these ages involves. However, in the context of midwifery it is sufficient to be familiar with the progression that occurs from birth through the first six weeks of life.

While the changes that occur even during this short time span are significant, they are not within the scope of this paper. However, obvious examples are that transitional behaviour of many organ systems and instability of some physiological functions (e.g. transient tachypnea, periodic breathing, uneven skin color or a degree of jaundice) are to be expected during the first hours or days of life, but are deemed abnormal later. In addition, developmental signs such as a social smile, while reassuring at six weeks of age, would not be expected or its absence considered troublesome in the first few weeks of life.

Consequently, to label aspects of an infant's appearance as normal or abnormal, you need to know more than just what to expect of any healthy infant of that particular age and maturity. You also have to factor

in the infant's gestational maturity, age, birth history, and care and progress to date to determine any relevant variations from normal that would indicate that the infant is unwell.

When assessing an infant's appearance, the five areas to look for are:

- tone
- interactiveness
- consolability
- look/gaze
- speech/cry

The mnemonic TICLS (“tickles”) from the PEPP course can be used as a reminder of these five components (Table 1).²

You may be familiar with the significance of abnormal tone from your experience with infants born following birth asphyxia. Similarly, infants demonstrate interactiveness particularly when offered the breast. Healthy infants show obvious vigor in contrast to the muted or absent response seen in a seriously ill infant. The information gained from observing the eyes and the quality of the infant's gaze is of sufficient importance that it has been used as an objective measure in a research tool for quantifying recovery from sedation.⁴

An infant with normal appearance will have good muscle tone, make eye contact with you, interact at least to the extent of reacting when disturbed, have a normal cry, be easily consoled, have bright eyes which look at you rather than through you, and have a good skin color. In contrast, you should be worried when you see an infant who is limp, inactive, listless, allows intervention without complaint, looks glassy eyed or distant, has a weak cry and/or is pale.

Generally you would assess an alert and interactive infant as not being seriously ill. However it is important to remember that in some emergencies, particularly those involving ingestion of poisons or trauma, an infant when first seen may be able to interact appropriately and have a normal appearance.

When appearance is abnormal, the other arms of the triangle, which assess work of breathing and circulation of the skin, provide additional information about the physiologic problem that is disturbing brain function sufficiently to affect appearance.

TABLE 1: "TICKLES"

Physical Characteristics	Features to Look For
<u>T</u> one	Is she moving or resisting examination vigorously? Does she have good muscle tone? Or is she limp, listless or flaccid?
<u>I</u> nteractiveness	How alert is she? How readily does a person, object or sound distract her or draw her attention? Or is she uninterested in, or unable to interact with, you or her caregiver?
<u>C</u> onsolability	Can she be consoled or comforted by the caregiver or is her crying/agitation unrelieved by gentle reassurance?
<u>L</u> ook/ <u>G</u> aze	Does she fix her gaze on your face, or is there a glassy-eyed stare?
<u>S</u> peech/ <u>C</u> ry	Is her speech or cry strong and spontaneous? Or is it weak, muffled or hoarse?

further on inspiration when the work of breathing increases.

Other signs that indicate that the infant has to make increased physical efforts to breathe include the use of accessory muscles of ventilation, evidenced in infants as nasal flaring, and the presence of retractions of the chest wall. Retractions are usually observed as indrawing of the soft tissues in the supraclavicular, intercostal or substernal areas. Retractions occur when an increased effort to inhale is not matched by inflow of air into the chest sufficiently rapid to maintain the functional residual capacity of the lung. Each diaphragmatic tug then results in the lower rib cage and soft tissues of the neck being pulled in.

WORK OF BREATHING

Assessment of an infant's work of breathing is a better way of estimating adequacy of oxygenation and ventilation than counting respiratory rate or listening to the chest. The harder an infant is working to breathe, the more he or she is attempting to make up for a deficit or difficulty with ventilation. Assessing work of breathing involves looking at the way the infant is breathing, noting whether he or she is breathing faster or slower than normal, and listening carefully for abnormal sounds during inspiration and expiration. Abnormal sounds include snoring, stridor, grunting or wheezing.

The sounds an infant makes during respiration also give an anatomical indication of the location in the airway of the infant's problem. For instance, snoring and stridor indicate problems in the upper airway. Stridor is a high pitched inspiratory sound caused when air flow occurs through a partially obstructed upper airway. Grunting is heard when an infant is exhaling against a partially closed glottis. Physiologically this helps to hold the alveolar air sacs open for maximum gas exchange. Grunting is often present when there is moderate or severe oxygen lack caused by conditions such as pneumonia or pulmonary edema. Wheezing occurs when there is partial blockage or narrowing in the small airways. Generally it is heard first as the infant breathes out, but is heard

To perform a comprehensive assessment of work of breathing, it is necessary to have the caregiver uncover the infant's chest. The mother may also volunteer relevant history, such as her observation that the infant becomes breathless during feeding or shows signs of increased breathing difficulty when she lays the infant down.

By combining the infant's appearance with your assessment of work of breathing, you can assess the adequacy of respiratory function:

- increased work of breathing and a normal appearance indicates respiratory distress
- increased work of breathing associated with an abnormal appearance, with or without pale or cyanosed skin, indicates respiratory failure

Depression of brain function in the second scenario tells you that this infant is more seriously ill and more in need of emergent intervention than is the one in respiratory distress.

CIRCULATION TO THE SKIN

The assessment of this component of the triangle is intended to determine the adequacy of cardiac output and perfusion of vital organs with blood. When circulating volume is decreased in dehydration, or cardiac output is impaired in cardiac failure, the body

preferentially circulates blood to the most essential organs. Decreased blood flow to anatomic areas such as the skin and mucous membranes becomes evident. Thus, if the infant is pale or mottled, or actually blue (cyanosed), the status of the circulation is abnormal.

Skin becomes pale when blood flow is reduced. Mottling occurs where there is vasoconstriction, and cyanosis develops where there is an increase in the concentration of unoxygenated hemoglobin in the circulation. Therefore, an infant who is pale and mottled but has a normal appearance and normal work of breathing is showing signs of circulatory impairment and is clearly unwell, providing you are not just looking at a newly born baby or one that has become cold. When pallor and mottling are associated with increased work of breathing, the infant is working to compensate for the circulatory dysfunction, and if his or her appearance is also abnormal you must assume that physiologic efforts to compensate have been inadequate and circulatory failure is now present.

COMBINING INFORMATION FROM ALL THREE ARMS

By combining information from all three arms of the PAT, you will be able to decide whether and how the infant's appearance (brain function), is being adversely affected by a clinical problem. For example, where there is an obvious problem with the work of breathing but the infant's appearance is normal, physiological respiratory distress, rather than respiratory failure, is present. In contrast, increased work of breathing and an altered appearance indicates respiratory failure, as the respiratory system is unable to compensate adequately to meet the brain's requirements for oxygen.

Similarly, if the infant is pale and mottled with increased work of breathing, but is alert, active and normal in appearance, a circulatory problem is present but is being compensated for. The circulatory problem is uncompensated (i.e., shock) when there is evidence in the infant's appearance of a neurological effect in addition to the abnormalities in circulation and work of breathing.

REEVALUATION

Ongoing observation and reevaluation while you are developing a treatment plan and deciding an infant's disposition allows you to determine whether the infant

is stable or his or her condition is worsening. If, for instance, the work of breathing increases further or is associated with a gradual and then obvious impairment in the infant's appearance, a progressive situation has developed. If the clinical problem was due to fluid loss, deterioration in the PAT indicates that shock has progressed from being partially compensated to being uncompensated and the situation is emergent.

Repeating the PAT assessment can also be used to observe the efficacy of an intervention such as giving oxygen or reestablishing the infant's circulating volume. For example, when an infant in uncompensated shock receives effective treatment with oxygen and intravenous fluids, you would expect to see progressive improvement, with normalization of the infant's appearance, gradual return of interest and responsiveness to the surroundings, a progressive decrease in the work of breathing until the respiration became normal, a return of skin colour, and resolution of mottling.

COMMUNICATION

It has been shown that midwives have good clinical examination skills.⁵ One of the practical problems faced by midwives is how to communicate effectively with other health care professionals when questions arise about the physical or emotional well-being of an infant in their care. However, the efficacy of communication between health professionals is recognized to affect the quality of care.⁶ In a review of the literature, Rowe et al found that skills training in communication improved information transfer by midwives and physicians.⁷ One of the most valuable components of effective interprofessional communication is a clear and factual description of the overall impression of the infant's well-being when first seen. The information gained from the three arms of the PAT give clear and useful information that provides an immediate and factual picture of the patient's status. This is always preferable to the temptation to fall back on generalities such as "he does not seem to be himself", "the mother says he has been out of sorts", or "I don't like the look of this infant", as these are vague, imprecise, and open to differences in interpretation.

When communication leads to a suggested intervention or treatment plan, the infant's response can also be evaluated with greater objectivity when the

review is made using the same descriptors as the initial report. Familiarity with and routine use of the assessment triangle will provide midwives with a reliable framework for effective assessment, objective description to other professionals, and reevaluation over time or during treatment.

IMPLICATIONS FOR PRACTICE

When you, as a practicing midwife, use the PAT to assess an infant, you will be able to address two critical questions:

- Is the infant well, sick yet stable, or sick and potentially unstable?
- Which system or systems are physiologically involved?

The answers to the questions in turn will assist you in determining what immediate and specific treatments are needed, how fast intervention is required and whether transfer to a higher level of care is required.

Using the PAT to assess all infants in your care has four advantages:

- you will rapidly come to appreciate when an infant has an abnormal appearance, work of breathing or circulation to her skin
- you will learn to formulate valuable objective information about the infant's physiologic status from your first visual impression
- the information you gain from the use of the triangle will help you set priorities for the remainder of your physical examination and assess the efficacy of your interventions
- you will have a means of clearly communicating the infant's status to another health care professional whenever you need to obtain advice or direction

ACKNOWLEDGMENTS

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