




Pain in Neonates: A Concept Analysis

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Abstract

Context: The term pain in neonates is emerged in recent decades. However, studies on pain in neonates are still limited and have various indicators. In addition, the term pain still often overlaps with stress in various studies and clinical circumstances. The concepts of pain and stress in the neonates need to be clarified to be better understood and then applied to improve neonates' quality of life. Therefore, the current study aimed at clarifying the concept of pain in neonates.

Evidence Acquisition: The current study employed the concept analysis approach developed by Walker and Avant. The authors reviewed articles from JSTOR, ScienceDirect, Proquest, Sage, Cochrane, and Springer databases from 1980 to 2016 using keywords pain, stress, neonatal, neonates, and quality of life.

Results: Pain had attributes such as tissue damage, physiological changes, metabolic changes, and behavioral changes. Stress had attributes such as physiological changes, metabolic changes, and behavioral changes.

Conclusions: Attributes of pain and stress have similarities and differences. The main difference is the stimulus that induces a response. Pain has an attribute of tissue damage, whereas stress is not always due to tissue damage. The attributes of physical, metabolic, and behavioral changes between pain and stress are similar.

Keywords: Neonatal, Pain, Stress

1. Context

The neonatal health care is advanced compared to the previous periods; now neonates' mortality rate is relatively decreased. However, the surviving infants have poor quality of life (QoL) by the time they enter childhood (pre-school age, school, and adolescence) compared with the ones that were never hospitalized, especially in the intensive care units (1, 2). It is correlated with the impact of neurodevelopmental changes resulting from experience of pain and stress during hospitalization. Stressors in inpatient care, particularly intensive care, are generally related to the impact of vital signs equipment and intensive care environment, such as noise, lighting, and medical procedures that can cause neonatal pain (3).

In the past three decades, the term pain in neonates was not popular. And for the first time mentioned in his study that neonates are not given analgesics in any invasive procedure thus far. Then, it was concluded that neonates can perceive pain, although not subjectively (4).

Furthermore, pain in the neonates is debated in the last three decades, after it was believed that neonates may experience it. Some argue that neonates do not feel pain, while others state that they may feel it. This disagreement

is related to the immaturity of neonatal nervous system. However, as more studies identify the pain response in neonates, recent reviews show that neonates may perceive pain (5, 6). Physiological indicators of pain such as neurotransmitters and other metabolic systems such as transmitter of pain are developed in infancy.

Physiological and metabolic indicators of neonatal pain also occur when the baby is said to be stressed. Therefore, even today stress is often associated with pain in neonates. Pain and stress in neonates are thought to affect the QoL in infancy and adulthood. Pain and stress from the hospital environment affect the physical, metabolic, and behavioral aspects of the neonates, which is a factor that leads to a lower QoL at later ages (7). Acute pain or injury in neonates is a risk factor of permanent neurological damage. The experience of acute pain and recurrent mild pain can lead to long-term adverse effects on neurological aspects (8).

Aspects of pain and stress in neonates are still not considered by health workers, given the assumption that neonates do not experience pain and stress. This assumption has long been existed in various countries. It is not easy to convince the health workers that neonates also

have a perception of pain and stress response. Therefore, it is not surprising if the terms pain and stress in practice are still debated, some people assume they are the same, and some others assume they are different. It is required to distinguish between pain and stress. In an analysis of the concept of pain (9), pain was discussed in general, and looked at from psychological, sociological, and cultural aspects other than the physical aspect. In neonates, according to Piaget, cognitive development is still in the early stages of the motor sensory phase and also is not able to perceive an event. In addition, neonatal verbal aspects are not developed yet; hence, the pain in neonates cannot involve psychological, social, and cultural aspects. Therefore, it is necessary to clarify the concept of pain experienced by neonates and its difference with stress. The current study aimed at discussing the pain in neonates.

2. Evidence Acquisition

The concept analysis approach was used in the current study (10). Stages of concept analysis include:

- Selection of concepts
- Determination of the purpose of the analysis
- Identification of all the concepts referred to in various literatures
- Definition of the attributes
- Identification of a case model
- Identification of cases in different contexts
- Identification of the antecedents and consequences
- Definition of empirical references

Inclusion criteria of the current study were: the studies focusing on neonatal age as well as pain and stress.

Exclusion criterion was the studies published in a language other than English.

3. Results

3.1. Selection of Concept

According to Walker and Avant, the concept selection phase, which is indispensable, should be relied on the field of interest (10). Based on the above description, the concept selected in the current study was stress-related pain in neonates.

3.2. Determination of the Purpose of the Analysis

The second phase of the concept analysis is an attempt to focus the interest on the selected concept; it is important to guide further discussion, and assess the results of the analysis. The purpose of the analysis in the current study was to analyze the concept of pain in the neonate.

3.3. Identification of the Use of Concepts

Pain and stress have different meanings, but have a close connection. Both terms are often overlapping in various literatures. The followings may define each of these terms independently. According to the International Association for the Study of Pain (IASP), pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (11), while stress is a physical, chemical, or emotional tension that can cause illness (12). The stress in neonates has a variety of forms, and it is difficult for neonates to distinguish it from other aspects (13). Pain is a continuum of stressors ranging from holding up to a skin-damaging procedure (14). There is a considerable overlap between what is referred to as pain and what causes stress in the neonates (15). The stress response can occur due to specific and non-specific aspects (16). The pain is always stressful, but stress is not necessarily painful (17).

Pain is a perception, not a sensation (8). Pain perception includes chemical changes, and interpretation of the change is dangerous. There are emotional consequences and behavioral responses to the cognitive, emotional, and physiological aspects. Pain is also a language to describe a wide variety of experiences and responses. Pain is also an abstract representation of information that occurred over and over in the past through a whole somesthetic system. The physiological mechanism involved in pain phenomenon is known as nociceptive. The term nociception demonstrates the ability of nerve cells to detect the noxious stimuli (stimuli that cause harm) and convey the related information to brain in order to be interpreted. Unlike the pain phenomenon, nociception does not require self-reporting. Therefore, the term nociception is an accurate picture of the infant's response to a noxious stimulus. In some literature, the term pain and nociception are also used interchangeably (8).

In the literature review, the term pain often overlaps with stress. Stress and pain in neonates have the same sign of increased heart rate and blood pressure, decreased oxygen saturation (SPO₂), muscle tension, and facial expression change (18). Furthermore, a scale of pain and stress is developed in the same measuring instrument, meaning that pain and stress are considered to have the same phenomenon (19). Based on the above description, what distinguishes pain from stress is the aspect of tissue damage. Pain occurs due to tissue damage, whereas stress is not, and stress can occur after pain.

Pain has the following signs in neonates (20):

- Crying
- Postural change and movement of the body
- Facial expressions

Meanwhile, pain can be observed through two main factors (16):

- Physiological measurements
- Behavior indicator

Other theories reveal that pain includes attributes of physiological and behavioral changes (21). Physiological changes include heart rate and blood pressure. Behavioral changes include facial expressions, crying, gross motoric movements, and behavioral and functional changes.

Furthermore, components of pain include (4):

- Physiological changes (i.e., changes in cardiorespiratory, hormonal, and metabolic systems)
- Behavior changes (i.e., simple motoric response, facial expression, crying, and complex behavioral responses)

Loeser and Melzack describe the concept of pain with the Onion Theory of Pain that they developed (22). According to them, the Onion Theory of Pain is a pain theory associated with a layer of onion. Pain is described as a five-layer phenomenon; this is identical to a layer of onion. The 1st layer, or the core layer, is nerve damage or face the stimulus (physiology of pain). The 2nd layer is the perspective of pain, described as cognition in the brain. The 3rd layer is a complaint; an assessment of the experience of pain. The 4th layer is the behavior of pain, which is the result of pain and complaints or perceived suffering. The 5th layer is the interaction with the environment; it requires social contact.

3.4. Specifying Attributes

Walker and Avant (10) mentioned that the phase of determining this attribute is the core of a concept analysis. Definition of attribute begins with grouping the majority of attributes that appear related to the concept. Based on the previous description, the main attributes of pain in neonates are: tissue damage (nerve damage), physiological changes, changes in metabolic measure, and behavioral changes. In contrast to stress, pain begins with a stimulus of tissue damage that results in nerve damage perceived as pain. While in stress the attributes are the same, except that the tissue damage stimulus does not exist. Therefore, the difference between pain and stress is on a different stimulus.

3.5. Case Model

The case model is an example of using the concept under analysis, encompassing all its definitions and attributes (10). Here is an example of case model:

Baby H (two day-old) birth weight 1750 g, treated in NICU due to low birth weight and asphyxia. Currently, infusion is being given to her. The response shown by Baby H when infusion was set was crying, heart rate change from

134 bpm to 144 bpm, SPO₂ change from 96% to 92%, and movement of extremities and grinning facial expressions.

All of the attributes were noted in this case. This case showed that the baby feels pain since the event of noxious stimuli exists by pressing and damaging the tissue. The observed pain responses included physiological (heart rate and oxygen saturation) and behavioral aspects (changes of facial expressions).

3.6. Identification of Cases in Different Contexts

3.6.1. Borderline Case

This borderline case is a case that mostly contains the attributes of the concept, but not all include the concept. For example:

Baby B (two-day-old) is a male newborn with 34 weeks' gestational age and birth weight 1600 g. A nurse took a blood sample by heel prick procedure. The nurse gave sucrose to the baby to reduce pain before the procedure. When the heel prick was performed, the baby showed the following responses: no crying, eye squeeze, brow bulge, heart rate change from 144 to 145 bpm, and no changes in SPO₂.

Most of the attributes were in the case, but physiological attributes were not clearly indicated. There was no change in SPO₂ and heart rate increase was only 1 point. Based on the Premature Infant Pain Profile-Revised (PIPP-R), change of heart rate is scored more than 0 if it is increased more than 4 points. In the PIPP-R, bigger scores show increase according to the pain intensity (23, 24).

3.6.2. Related Case

Related cases are the examples of the ones similar to those being analyzed, but not containing all of the set attributes.

For example:

Baby A (four-day-old) treated at NICU. Every day there was an alarm sound from the ventilator and very bright lighting day and night. In a lab examination, Baby A turned out to show increased cortisol values, often grinning facial expression and irritation, heart rate change from 138 to 144 bpm, and SPO₂ decrease from 94% to 92%.

This case showed one of the defining attributes, excluding skin or tissue damage. In this case, there were similar attributes, but the appeared phenomenon was not triggered by the tissue or skin damage. It was a stress condition in the newborn that was related to pain.

3.6.3. Contradictory Case

A contradictory case is a case that does not describe the concept.

For instance:

Baby N (three-day-old) treated in the perinatology care. During treatment, Baby N used cloth diapers. Every time the diaper was wet, Baby N cried with a rough motoric movement and a grinning facial expression.

However, none of the defining attributes was included in this case. This was in contrast with the model case, where all of the defining attributes are included. A contradictory case helped to understand how the importance of defining attributes in this concept is related to pain management.

3.7. Antecedent and Consequences

Antecedent is an event or factor that should exist for the occurrence of the concept in question. Based on this definition, the antecedent of the concept of pain is (i) age, neonates who are small for their gestational age (premature) are more sensitive to pain; (ii) maturity, mature neonates show more varied pain responses (25); (iii) sleep and awake status; (iv) severity of illness; (v) duration and previous pain experience; and (vi) invasive procedures, pain may occur when the neonate encounters an invasive procedure.

Consequences are events or factors that occur as a result of the concept analysis, which are called outcomes (10). The consequences in this concept mean that with the pain, neonates experience both short- and long-term effects. These effects include changes in physiological function such as increased heart rate and oxygen saturation; it aggravates the illness that is going through. In addition, repeated physiological effects affect the function of neurons, while the neonate is in a critical period of neuronal development. If SPO₂ decreases, the developmental aspects of the nervous system can be affected and cause later symptoms in life.

3.8. Determination of References or Empirical References (Empirical Referents)

This stage is the final stage of concept analysis by Walker and Avant (10). Empirical referent is a category of actual phenomenon that its existence can reveal the concept itself. In some cases, attributes and empirical referents can be identical. Sometimes the analyzed concepts as well as the attributes are very abstract; then this condition, called empirical referent, is very important. Empirical referents are very useful to develop an instrument, since it is very closely related to the discussed concept. Empirical referent in the concept of pain in neonates is identical to its attributes including (i) physiological changes: heart rate and oxygen saturation; (ii) behavior change: crying, facial expression, and gross motoric movement; (iii) metabolic change: cortisol.

Of the three components of empirical referents, currently based on various studies, there are at least six tools to measure pain in neonates, namely:

1- CRIES: crying, requiring oxygen for SPO₂ above 95%, increased vital signs, facial expression, and sleeplessness

2- NIPS (neonatal infant pain scale): facial expression, crying, breathing pattern, and arms and legs in state of arousal

3- PIPP-R: gestational age, behavioral state, heart rate, oxygen saturation, brow bulge, eye squeeze, nasolabial furrow

4- COMFORT scale (pain assessment for ventilated children): alertness, calmness/agitation, respiratory response, crying, physical movement, muscle tone, facial tension

5- COVERS neonatal pain scale (crying, requiring oxygen, vital signs change, facial expression, restlessness, and signaling distress): six physiological and behavioral measures for scoring were nearly equal to other scales, but added stress sign.

6- NFCS: The neonatal facial coding system: a unidimensional measure that includes multiple indicators of facial expression that was developed for use in pain research.

The six neonatal pain measurements are not clearly associated with metabolic aspects due to painful stimuli such as cortisol. Therefore, the measuring instrument should be reevaluated by correlating the physiological and behavioral aspects with the metabolic aspects.

4. Conclusions

The occurrence of pain and stress in neonates involves neural and endocrine circuits; therefore, the responses arising from both are the same. What distinguishes between the two is the stimulus that triggers (antecedent). Pain is always caused by tissue damage and other noxious stimuli, whereas stress is not due to tissue damage, but situations that threaten the balance (homeostasis), which is non-invasive. In spite of the stimulus that triggers, the attributes of pain and stress are the same.

The consequences of conditions due to pain and stress in neonates in the short- and long-term both lead to changes in neurobiology and behavior, which in turn affects the deterioration of QoL. It is therefore important to anticipate, prevent, and deal with pain and stress on neonates in order to create a high quality generation in the future.

Footnotes

Authors' Contribution: Study concept and design: Siti Yuyun Rahayu Fitri and Lely Lusmilasari; critical revision

of the manuscript: Mohammad Juffrie; writing of the manuscript: Windy Rakhmawati and Siti Yuyun Rahayu Fitri.

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