No. 355-Physiologic Basis of Pain in Labour and Delivery: An Evidence-Based Approach to its Management

Abstract

Objective: To review the evidence relating to nonpharmacological approaches in the management of pain during labour and delivery. To formulate recommendations for the usage of nonpharmacological approaches to pain management.

Options: Nonpharmacological methods available for pain management during labour and delivery exist. These should be included in the counselling and care of women.


Validation methods: The quality of the evidence is rated using the criteria described in the Report of the Canadian Task Force on Preventive Health Care. Recommendations for practice are ranked according to the method described in this report.

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Women have the right and responsibility to make informed decisions about their care in partnership with their health care providers. To facilitate informed choice women should be provided with information and support that is evidence based, culturally appropriate and tailored to their needs. The values, beliefs, and individual needs of each woman and her family should be sought and the final decision about the care and treatment options chosen by the woman should be respected.
Benefits, risks, and cost: The nonpharmacological method encourages an incremental approach to pain management that contributes to reduced interventions through optimal use of the woman’s neurophysiologic and endocrine resources and a better understanding of the physiology of stress and pain during labour.

Guideline update: The guideline will be reviewed 5 years after publication to decide whether all of part of the guideline should be updated. However, if important new evidence is published prior to the 5-year cycles, the review process may be accelerated for a more rapid update of some recommendations.

Sponsors: This guideline was developed with resources funded by the Society of Obstetricians and Gynaecologists of Canada.

Summary Statements:
1. It is important that all health care professionals have a good understanding of pain in childbirth including its physiological and psychological management whether or not a person in labour also chooses pharmacological relief (III).
2. A growing body of scientific literature supports the use of nonpharmacological approaches to pain management during childbirth due to their numerous benefits for the mother and child, including a reduction in the need for obstetrical interventions, labour augmentation, or Caesarean section (I).
3. Suffering, as opposed to pain, occurs when a woman is unable to activate her own mechanisms for coping with pain, or when her own mechanisms are insufficient to deal with the situation (III).
4. The Gate Control Theory mechanism, which consists of creating pleasant stimulations in the painful area between or during contractions is best achieved through ambulation, gentle massage, stroking, water, or vibrations (I).
5. The Diffuse Noxious Inhibitory Control (which consists of applying painful stimulations at any site on the body for the duration of each painful contraction) is best achieved through acupressure, sterile water injections, or deep massage (I).
6. The Central Nervous System Control mechanism, which consists of deviating or focusing the woman’s attention is best activated through labour support and the practice of yoga, relaxation, visualization, breathing, auto-hypnosis and cognitive restructuring (I).
7. Continuous labour support, as part of nonpharmacological approaches to pain management during childbirth, reduces stress, fear, and anxiety, which in turn decreases the frequency of obstetrical interventions (I).
8. Natural oxytocin is not only important for uterine contractions; it enhances a sense of calmness and reduces pain. Because synthetic oxytocin does not cross the blood-brain barrier in a significant manner, the analgesic and psychological effects on the mother of calmness and well-being are lost (II).
9. Elevated endorphins in labour help reduce maternal stress and pain and may assist in newborn adaptations (II).
10. Health care providers and the birthing environment can have a major impact on labour progress and experience by paying attention to and reducing a woman’s stress level (I).
11. Prolactin not only promotes breast milk production, it optimizes the mother’s physiologic and behavioural responses in adapting to her role (II).
12. Creating a calm, stress-free environment, encouraging women, and having a positive attitude where possible play an important role to stimulate the endogenous hormone production that promotes and supports the physiologic progress of labour (II).
13. Neurophysiologic and hormonal mechanisms contribute to help women cope with the intensity of labour (I).

Recommendations:
1. Health care providers should be familiar with the neurophysiologic and hormonal mechanisms and related methods in physiological labour and birth (III-A).
2. To help women cope with normal labour, nonpharmacological approaches are recommended as a safe first-line method for pain relief and should be continued throughout labour whether or not pharmacologic methods are used (I-A).
3. To prevent suffering, health professionals should address the emotional component of pain (pain unpleasantness). This is most effectively achieved through support and nonpharmacological approaches to pain management.
4. To develop support measures consistent with the wishes of women, health professionals should work with women and listen to their needs (III-A).
5. To further reduce the need for obstetric interventions and avoid associated risks and side-effects, health professionals should provide continuous labour support with the addition of at least one other nonpharmacological pain modulating mechanism (I-A).
6. Health professionals should, where possible, promote and support the physiological progress of labour, delivery, and the postpartum period trusting the woman’s ability to work with her pain and encouraging her to rely on her ability to give birth (III-A).
7. To enhance the endogenous hormone production that promotes and supports the physiologic process of labour, health care providers should reduce a woman’s stress level by encouraging her and having a positive attitude where possible and by creating a calm, stress-free environment (I-A).
8. Continuous labour support, as part of nonpharmacological approaches to pain management during childbirth for women should be promoted and provided for all women in labour (I-A).
9. Health professionals should encourage parents and the people assisting them to prepare for the birth by learning about birth physiology and gaining skills in working with pain (III-A).
INTRODUCTION

Physiological birth is defined as an approach to labour and birth that maximizes the inherent strength and normal physiology of the woman and fetus and refrains from outside interventions unless the well-being or safety of the pair are jeopardized. This clinical guideline follows the SOGC Joint Policy Statement on Normal Childbirth No. 221, published in December 2008, and the SOGC Guideline on the Management of Spontaneous Labour at Term in Healthy Women, which promote, protect, and support normal birth. In response to concerns among many professional associations about the rise in medical interventions during labour and delivery, the statement of principle recommends developing national clinical directives in support of nonpharmacological approaches to pain management based on scientific data.

The purpose of this guideline is to recommend a frame of reference, for health professionals, that promotes physiological birth while providing physical and emotional relief to women to promote health and well-being for mother and baby, mother-infant attachment, and breastfeeding.

Nonpharmacological methods of pain management, including support during labour, have the potential to reduce obstetrical interventions, increase breastfeeding rates, and improve the mother's satisfaction without increasing morbidity. To facilitate the endogenous physiological mechanisms activated during labour and delivery, health professionals, women giving birth, and their birth supporters should have a good understanding of the neurophysiologic and hormonal activity and relevant techniques. A recent meta-analysis (57 randomized studies of a total 34,000 women) assessed the effects of nonpharmacologic approaches organized by mechanism of action rather than by technique, on obstetrical interventions, labour, maternal, and perinatal outcomes. This study addressed the lack of systematic reviews assessing the impact of nonpharmacologic approaches on obstetric interventions and outcomes. In this meta-analysis, techniques were divided in three neurophysiologic pain modulating mechanisms: (1) light stimulation of the painful area (Gate Control Theory), (2) second painful stimulation anywhere on the body during a contraction (DNIC), and (3) CNSC activated through continuous labour support and other psychological mechanisms. A sub-group analysis included in this meta-analysis showed a first-line approach that involved continuous support and at least one other nonpharmacological method, and a pharmacological method as needed or requested by the women produced optimal clinical outcomes. These approaches provide benefit by reducing interventions. Usual care compared to these combined nonpharmacological approaches had increased odds of Caesarean delivery (11 studies, 10,338 patients, OR 2.17), instrumental delivery (6 studies, 2281 women, OR 1.78), epidural analgesia (6 studies, 2207 women, OR 1.42), and the need of synthetic oxytocin (6 studies, 2207 patients, OR 1.57). The total duration of labour was reduced compared to usual care (4 studies, 1254 women, average reduction 73.8 minutes).

Nonpharmacological approaches can also benefit women and babies by reducing exposure to the potential risks and side-effects of pharmacological pain management.

It is noteworthy that “The degree to which a woman is satisfied with the birth experience is not solely associated with the pain felt.” A systematic review found that the four most important factors for women’s birth satisfaction: personal expectations, the amount of support from caregivers, the quality of the caregiver-patient relationship, and involvement in decision-making, overrode all other influences, including self-reported pain and analgesic efficacy. In addition, the presence of pain does not necessarily imply a negative birth experience—women can have pain coexisting with satisfaction, enjoyment, and empowerment.

ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CNS</td>
<td>central nervous system</td>
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<tr>
<td>CNSC</td>
<td>control of the higher centres of the CNS</td>
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<tr>
<td>DNIC</td>
<td>diffuse noxious inhibitory control</td>
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<tr>
<td>OR</td>
<td>odds ratio</td>
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<td>RCT</td>
<td>randomized controlled trial</td>
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<td>SOGC</td>
<td>Society of Obstetricians and Gynaecologists of Canada</td>
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<td>TENS</td>
<td>transcutaneous electrical nerve stimulation</td>
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Summary Statements

1. It is important that all health care professionals have a good understanding of pain in childbirth including its physiological and psychological management whether or not a person in labour also chooses pharmacological relief (III).
2. A growing body of scientific literature supports the use of nonpharmacological approaches to pain management during childbirth due to their numerous benefits for the mother and child, including a reduction in the need for obstetrical interventions, labour augmentation, or Caesarean section (I).

Recommendation

1. Health care providers should be familiar with the neurophysiological and hormonal mechanisms and related methods in physiological labour and birth (III-A).
2. To help women cope with normal labour, nonpharmacological approaches are recommended as
a safe first-line method for pain relief and should be continued throughout labour whether or not pharmacologic methods are used (I-A).

These clinical findings and a better understanding of the neurophysiologic and endocrine mechanisms involved in labour and delivery suggest a need to replace the paradigm of “pain relief” with that of “working with pain.”

In fact, the paradigm of pain relief is based on a set of assumptions that labour pain is “abnormal” and unnecessary, that the benefits of analgesia will always exceed the risks, and that efficient pain relief is systematically correlated with women’s satisfaction with the childbirth experience. In terms of satisfaction, studies suggest that factors including the amount of support from caregivers and involvement in decision-making are more important to women than pain relief.

The “working with pain” paradigm is based on the assumption that pain has a physiologic role in childbirth. When women are properly prepared and supported, they produce endogenous analgesic substances that support them to work with the pain of childbirth. Through working with pain in labour, women can experience a deep sense of satisfaction that enhances their feelings of competency and confidence in rising to the challenges of parenthood. With appropriate support, and through a complex hormonal physiology and regulating neurophysiological mechanisms, most women have the resources they need to give birth.

**I. UNDERSTANDING PAIN**

The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage.” Under normal circumstances, pain plays an essential role in protecting us from danger. Unlike other types of pain, however, the strong sensations experienced by women in labour are not usually a sign of danger, pathology, or dystocia. During labour, pain performs an important function in the physiologic process by producing hormones like endorphins and oxytocin that provide comfort. They signal the start of labour and tell the woman that the time has come to find a safe place to give birth and to surround herself with supporters. When a woman can make sounds and move freely, these sensations provide her with information about the progress of her labour. They help her find the body positions that soothe her, and they guide her expulsion efforts.

**The dimensions of pain**

Pain, especially during childbirth, is a complex phenomenon. According to Marchand et al., pain has at least four dimensions: nociceptive (noxious stimuli), sensory-discriminative (intensity), affective-motivational (the unpleasant, emotional aspect), and cognitive-behavioural (behaviour).

The circular pain model illustrates each of these dimensions and their interrelations (Figure 1). It shows that pain can include any or all of these dimensions and be experienced differently from one person to the next. This model helps professionals adjust their actions to ensure that responses to pain are not based only on what they perceive in the behaviour of labouring women (dimension 4), but also on other dimensions affecting the woman’s experience of her pain. This also helps distinguish pain from suffering.
1. The nociceptive dimension

This dimension involves real or potential injury. In the first phase of labour, nociception results from stretching of the cervix, ligaments, muscles, structures, and adjacent tissue. It is typically referred pain that projects sensations to the lower abdomen and back.

During the second phase of labour, nociception can result from traction on the pelvis caused by the stretching of the pelvic floor, perineum, perineal muscles, and pelvic cavity and strong pressure on the roots of the sacral nerves. Nociception is transmitted by the pudendal nerve and is felt more keenly in the perineum and anus regions, the lower part of the sacrum, the thighs, and the lower portion of the legs.

In addition, the fetal position (occiput posterior, transverse, or asynclitic positioning) plays a role in nociception by placing greater pressure on the pelvis and the sacroiliac joint and possibly by prolonging the length of labour. Encouraging women to move freely to ease their pain can help to modify this dimension.

Although the scientific literature describing women’s experience following the artificial rupture of membranes is limited, research suggests that women report more pain following this intervention. This heightened nociceptive signal may result from the absence of amniotic fluid, which acts like a shock absorber between the baby and the mother’s uterus. Leaving membranes intact may reduce pain experienced in labour.

One study reported that women find it extremely stressful to be prevented from ambulating as they would like. According to the women, ambulation and avoiding interventions that restrict mobility (intermittent auscultation rather than continuous electronic fetal monitoring (EFM) and eating/drinking rather than a continuous drip therapy) may diminish perceived pain.

2. Sensory-discriminative dimension (physical)

This dimension makes it possible to identify the intensity and threshold of pain. Among other things, pain can be modulated by pleasant sensations in the affected area (Gate Control Theory), by providing another painful stimulus (DNIC), and through pharmacological approaches (narcotics and epidural).

3. Affective-motivational dimension (psychological and emotional)

This dimension is used to gauge the unpleasantness of pain. It is affected by emotions, values, and experience. It is the element that expresses “suffering.” Interventions to modulate this component include approaches that call on the higher centres of the brain such as support (feeling safe and protected), cognitive restructuring, emotional care, environmental ambience, and relationship with health care staff.

4. Cognitive-behavioural dimension

This refers to the way a person expresses her experience of pain. This dimension is heavily influenced by cultural, emotional, motivational, social, and cognitive factors. Everyone externalizes pain differently. Others cannot make assumptions about pain: pain is a perception and there may be no correlation between what the woman is experiencing and what others are perceiving.

The circular pain model shows that a woman in labour can exhibit any one or all dimensions of pain. Intensity (dimension 2) and unpleasantness (dimension 3) are supported by two separate and therefore mutually independent neurophysiological pathways. A positive event, like birth, can be perceived as more intense than unpleasant. The experience is individual; some women can experience an intense labour (dimension 2) without suffering (dimension 3), whereas others may feel no intensity (dimension 2) after an epidural, for example, and yet may still suffer (dimension 3). This would apply to a woman who may not have wanted an epidural and sees it as a failure. Conversely, an epidural can create physical relaxation and lowered pain intensity (dimension 2). This in turn can lead to emotional relaxation and a reduction in pain unpleasantness (dimension 3).

Distinguishing between pain and suffering

The purpose of interventions for relieving pain in labour must be to prevent suffering with consideration for potential effects on mother and baby and on the progress
of labour. Suffering is defined by a woman’s inability to activate her own pain relief mechanisms or the inadequacy of her mechanisms to confront the situation. This is the unpleasant dimension of pain (dimension 3). To prevent suffering, professionals must address the various dimensions of pain. Special attention must focus on the motivational affective dimension (dimension 3) because emotional stress creates catecholamine, which may slow labour and potentially increase the use of obstetrical interventions.

Making sounds, ambulating, and deep breathing are not necessarily signs of maternal suffering. It is often a mother’s way of working with pain, and it is largely conditioned by culture (dimension 4). Unless the woman is specifically requesting otherwise, when labour is advancing normally, offer nonpharmacological approaches as a first approach. Slowing of labour may indicate that the labouring woman is experiencing excessive stress and possibly suffering. In this circumstance, addressing the affective dimension of pain (emotions) may be effective, noting that it is always important to check the labouring woman’s needs and experience before making this assumption. Pharmacological approaches, in addition to continuing nonpharmacological approaches, should be available and provided if she is suffering and/or requesting them.

**Summary Statement**

3. Suffering, as opposed to pain, occurs when a woman is unable to activate her own mechanisms for coping with pain, or when her own mechanisms are insufficient to deal with the situation (III).

**Recommendations**

3. To prevent suffering, health professionals should address the emotional component of pain (pain unpleasantness). This is most effectively achieved through support and nonpharmacological approaches to pain management (I-A).

4. To develop support measures consistent with the wishes of women, health professionals should work with women and listen to their needs (III-A).

**The neurophysiology of pain during labour and delivery**

Mechanisms that modulate the pain dimensions discussed above can be used to alter the perception of pain by reducing nociceptive stimuli. These mechanisms affect both the sensory-discriminative and motivational-affective dimensions (dimensions 2 and 3), enabling women to better cope with their sensations during labour.

Neurophysiologic modulating mechanisms are divided into three categories: (1) The Gate Control Theory, (2) DNIC, and (3) CNSC. These mechanisms act on the nervous system to modulate potentially painful (nociceptive) signals before the brain decodes them as pain.

**The three endogenous mechanisms**

1. **Gate Control Theory**

The Gate Control Theory, or specific inhibitory control via non-nociceptive stimuli mechanism, is at work during non-painful, gentle massaging of the painful area. It activates large afferent fibres that block the smaller fibres transmitting the pain message. Through this action, the perceived intensity of the pain (dimension 2) is modulated. This mechanism includes techniques like conventional non-painful TENS, gentle massage, vibration, baths, warm towels, and body positioning with movement.

A recent meta-analysis on labour pain relief showed that when compared with nonpharmacological approaches based on this Gate Control mechanism, usual care increases the odds of epidural analgesia (OR = 1.22, 95% CI 1.04–1.43, RCTs, 3369 women). This analysis also found that women who used Gate Control Theory techniques based on ambulation experienced a reduction in Caesarean deliveries and use of synthetic oxytocin during labour, and had lowered maternal anxiety when compared to standard care. No significant difference was observed in other obstetrical interventions or neonatal and maternal morbidity (I-A).

**Summary Statement**

4. The Gate Control Theory mechanism, which consists of creating pleasant stimulations in the painful area between or during contractions is best achieved through ambulation, gentle massage, stroking, water or vibrations (I).

2. **DNIC**

This mechanism is activated by painful stimulation, sometimes at a site far removed from the painful area. As endorphins are released, the body inhibits pain at all painful areas except the one subjected to the painful stimuli. This mechanism is activated with all peripheral stimulation techniques such as acupuncture, TENS (high-intensity), deep tissue massage (acupressure), ice massage, and sterile water injections.

A recent meta-analysis on labour pain relief showed that when compared with nonpharmacological approaches based on the DNIC mechanism, standard care is associated with an increase of epidural analgesia (OR = 1.62, 95% CI 1.18–2.21, 6 RCTs, 920 women). The findings also showed an
increase in the dystocia rate in the second stage of labour, increased pain felt by women, and lower maternal satisfaction with childbirth. No significant difference was detected in other obstetrical interventions or perinatal and maternal morbidity (I-A).

**Summary Statement**

5. The Diffuse Noxious Inhibitory Control (which consists of applying painful stimulations at any site on the body for the duration of each painful contraction) is best achieved through acupressure, sterile water injections, or deep massage (I).

3. CNSC

Deviation of attention plays a major role in managing pain by modifying the message and triggering the pain inhibition centre (endorphin secretion). In the higher centres of the brain, pain messages create direct and indirect links with other regions of the brain. These regions are closely associated with memory and emotion. All behavioural or cognitive approaches used to modulate the perception of pain, such as relaxation, hypnosis, attention deviation, yoga, breathing, meditation, aromatherapy, music, support, or placebos are included in this mechanism.

A recent meta-analysis on labour pain relief showed that when compared with nonpharmacological approaches based on the higher centres of the CNS, standard care is associated with a significant augmentation of epidural analgesia (OR 1.13, 95% CI 1.05–1.23, 11 RCTs, 11 957 women), Caesarean deliveries (OR 1.60, 95% CI 1.18–2.18, 27 RCTs, 23 860 women), instrumental delivery (OR 1.21, 95% CI 1.03–1.44, 21 RCTs, 15 591 women), use of synthetic oxytocin (OR 1.20, 95% CI 1.01–1.43, 19 RCTs, 14 293 women), duration of labour (29.7 min, 95% CI 4.5–54.8, 13 RCTs, 4276 women), and lesser maternal satisfaction with childbirth (I-A).

**Summary Statement**

6. The Central Nervous System Control mechanism, which consists of deviating or focussing the woman’s attention, is best activated through labour support and the practice of yoga, relaxation, visualization, breathing, auto-hypnosis, and cognitive restructuring (I).

**Combined approaches**

The meta-analysis by Chaillet et al. also showed that a combined approach to pain relief based on continuous intrapartum support along with at least one other endogenous method (Gate Control Theory or DNIC) significantly lowered Caesarean rates (OR = 2.17, 95% CI 1.30–3.61, 11 RCTs, 10 338 women), instrumental deliveries (OR = 1.78, 95% CI 1.06–2.98, 6 RCTs, 2281 women), epidural analgesia (OR = 1.42, 95% CI 1.15–1.76, 5 RCTs, 2207 women), and the average length of labour by 73.8 minutes (95% CI 42.6–105.0), 4 RCTs, 1254 women) (I-A).

These results suggest that labour support (CNSC) associated with one or more techniques that enlist other endogenous mechanisms (a combined approach) is the most effective method for helping women work with pain.

**Summary Statement**

7. Continuous labour support, as part of non-pharmacological approaches to pain management during childbirth, reduces stress, fear, and anxiety, which in turn decreases the frequency of obstetrical interventions (I).

**Summary of the hormonal physiology of labour and birth**

During labour and birth, a series of hormones are released for mother and baby that regulate labour, reduce pain, and prepare the mother to welcome her child, among other effects. These hormones also promote mother and child safety and well-being and support the initiation of maternal-infant attachment and breastfeeding.

**Oxytocin**

Oxytocin is well known for its role in producing uterine contractions during labour. Oxytocin also creates feelings of love and connection and is released during social and sexual contact, female and male orgasm, and childbirth and breastfeeding, among other situations. Oxytocin is produced in the limbic system and released both locally in the brain and into the bloodstream. Its effects are both psychological and physical. In addition to fostering love, attachment, and calmness, it also alleviates pain.
Oxytocin is also responsible for the ejection reflexes that expel the fetus (Ferguson reflex) and the placenta after birth and the milk-ejection (‘let-down’) reflex.\textsuperscript{35}

Maternal oxytocin levels increase in labour and peak at birth.\textsuperscript{39,40} Even higher levels postpartum, stimulated by maternal-newborn contact, ensure effective uterine contractions and prevent postpartum haemorrhage (Figure 2).\textsuperscript{12,41}

Skin-to-skin contact, eye contact, touch, and nipple stimulation by the baby help release this hormone.\textsuperscript{35,40}

Stress and disturbance can disrupt labour progress via several possible hormonal mechanisms. When a labouring woman perceives her environment as stressful (e.g., transport in labour, bright lights, noise, etc.), supra-physiological levels of catecholamines (adrenaline and noradrenaline) and/or endorphins,\textsuperscript{42} which are also increased in response to excessive stress, may inhibit labour by direct and indirect mechanisms.\textsuperscript{12}

Although endogenous oxytocin reduces stress and pain by release within the brain, synthetic oxytocin administered intravenously does not cross the blood-brain barrier in significant amounts\textsuperscript{43,44} and so does not produce these central effects.\textsuperscript{12} In addition, prolonged exposure to synthetic oxytocin during labour reduces the sensitivity of uterine oxytocin receptors,\textsuperscript{45} which can heighten the risk of postpartum bleeding.\textsuperscript{36-48} Long-term effects of perinatal exposure to synthetic oxytocin for mother and offspring are biologically plausible, but poorly studied. One Canadian study showed a positive correlation between the synthetic oxytocin dose administered during labour and symptoms of maternal depression, anxiety, or somatization two months after childbirth.\textsuperscript{49}

In addition to augmenting pain by triggering stronger, more frequent and longer contractions than physiologic contractions,\textsuperscript{30} recent studies suggest that synthetic oxytocin exposure in labour may interfere with the release of natural oxytocin during early breastfeeding.\textsuperscript{51} Although poorly studied, some research suggests lowered success with breastfeeding.\textsuperscript{49,52-54}

Epidural administration reduces endogenous oxytocin release\textsuperscript{55-58} and can slow the progress of labour and also increase the risk of instrumental delivery\textsuperscript{3,59} by inhibiting the Ferguson reflex.\textsuperscript{4,60} Evidence on the clinical impact of epidural is inconsistent and conflicting,\textsuperscript{61} but some studies have shown epidural effects on the success of newborn breastfeeding\textsuperscript{54,62-65} and the duration of breastfeeding.\textsuperscript{4,66,67}

Summary Statements

8. Natural oxytocin is not only important for uterine contractions; it enhances a sense of calmness and reduces pain. Because synthetic oxytocin does not cross the blood-brain barrier in a significant manner; the analgesic and psychological effects on the mother of calmness and wellbeing are lost (II).

Recommendations

6. Health professionals should, where possible, promote and support the physiological progress of labour, delivery, and the postpartum period trusting the woman’s ability to work with her pain and encouraging her to rely on her ability to give birth (see Appendix 1) (III-A).
labour, health care providers should reduce a woman’s stress level by encouraging her and having a positive attitude where possible and by creating a calm, stress-free environment (see Appendix 2) (I-A).

**Endorphins**

Endorphins are analgesic substances produced in the brain during sexual activity, pregnancy, birth, and breastfeeding. Endorphin levels, as measured in the blood, are elevated during pregnancy, increase during labour and birth, and decline within 20 minutes after birth (Figure 3). Through central release, endorphins ease pain and alter the mother’s state of consciousness. After the delivery, they can trigger a sense of pleasure and euphoria and may play an important role in mother-child attachment, as they do in other mammals.

Endorphins foster the release of prolactin, which prepares the breasts for breastfeeding and is also present in breast milk. Endorphins activate central reward and pleasure circuits that create a sense of wellbeing in mother and child. Their release during maternal-infant interactions, including breastfeeding, may be important in motivating and rewarding infant contact and breastfeeding.

Physiologic birth produces high levels of endorphins in early breastmilk which may assist with newborn adaptations. The amount of endorphins in colostrum at postpartum day 4 was found to be significantly higher among women following physiologic birth than after a pre-labour Caesarean delivery.

**Adrenalin and noradrenalin**

Adrenalin (epinephrine) and noradrenalin (norepinephrine) belong to the catecholamine group of “fight-or-flight” stress hormones that reach their maximum physiological levels at the end of labour, and diminish quickly after birth (Figure 4). At the end of labour, physiologic catecholamine elevations heighten the mother’s attention and energy level, equipping her with the resources to give birth to her baby. For the fetus, a late-labour catecholamine surge protects from low oxygen levels and prepares for life outside the uterus by optimizing respiratory function, metabolic function, and heat production. After delivery, maternal catecholamine levels drop significantly. Supra-physiological levels during labour can inhibit contractions, both directly and possibly via effects on oxytocin. Excessive catecholamine levels after birth may inhibit, uterine contractility, and increase the risks of postpartum hemorrhage. A negative emotional or physiological state in labouring women, including subjective stress, fear, anxiety, hunger, thirst, or the feeling of being watched or disturbed could slow labour by increasing catecholamines and/or via other hormonal stress responses. This response, clearly seen in animal studies, is likely an evolutionary adaptation to ensure that labour and birth occur in the safest possible environment.
Health care providers and the birthing environment may have a significant effect on labour progress and experience by modifying a woman’s stress level. Several meta-analyses show a diminished need for analgesics when women are continuously supported whether in the hospital setting, with midwives, in birthing centres, or at home.

Summary Statement
10. Health care providers and the birthing environment can have a major impact on labour progress and experience by paying attention to and reducing a woman’s stress level (I).

Prolactin

Prolactin fosters the production of breast milk and ensures successful breastfeeding. As the “mothering” hormone, it optimizes the mother’s physiologic and behavioural responses to adapt to her maternal role.

To a degree, prolactin may increase anxiety and vigilance, keeping breastfeeding mothers alert to their infant’s needs. Prolactin may contribute to the beneficial effects of breastfeeding on maternal sleep. Prolactin is also the “fathering” hormone, and appears in higher levels in fathers involved with their infant. Prolactin reduces stress and sexual desire.

Prolactin levels increase gradually during pregnancy, but the production of breast milk is inhibited hormonally until delivery of the placenta. At the start of labour, prolactin levels diminish only to rise again at the end of labour, reaching a peak at birth and remaining high for several hours thereafter (Figure 5). This prolonged elevation, which may be disrupted by epidural analgesia, may support long-term breastfeeding success by promoting prolactin receptor formation.

Summary Statement
11. Prolactin not only promotes breast milk production, it optimizes the mother’s physiologic and behavioural responses in adapting to her role (II).

Oxytocin, endorphins, catecholamines, prolactin, and other hormones help to regulate the progress of labour and promote essential adaptations after birth for mother and baby. This hormonal physiology also fosters maternal-newborn attachment and breastfeeding. Hormonal effects are optimized when the mother feels safe and protected and when her need for privacy is met.

Obstetrical interventions, though sometimes necessary, can disturb hormonal physiology, producing a gap between expected and actual hormonal experiences for mother and infant. Practices that optimize hormonal physiology such as skin-to-skin maternal-newborn contact and support for breastfeeding can help to restore hormonal physiology, with ongoing benefits to breastfeeding and attachment. See Appendix 1 on obstetrical practices that support the endogenous abilities of women.

The birth supporter’s role

The continuous support and empathy of the father or other partner, a birth supporter, doula, and/or a health care professional is an important priority in maternity care. Labouring women may need emotional support (a continuous, reassuring, encouraging presence), physical support (massage, help to change position, adequate fluid and solid intake), information support (about the progress of labour, interventions, tools for working with pain), and/or advocacy (to help the woman voice her wishes).
Appendix 2 for practical actions that support and help women in labour.

Summary Statements

12. Creating a calm, stress-free environment, encouraging women, and having a positive attitude where possible play an important role to stimulate the endogenous hormone production that promotes and supports the physiologic progress of labour (II).

13. Neurophysiologic and hormonal mechanisms contribute to help women cope with the intensity of labour (I).

Recommendation

8. Continuous labour support, as part of nonpharmacological approaches to pain management during childbirth for women should be promoted and provided for all women in labour (I-A).

II. NONPHARMACOLOGICAL PAIN RELIEF METHODS

Gate Control Theory Techniques: Non-Painful Stimulation of the Painful Site

1. Water immersion

Water immersion or showering during labour promotes the release of oxytocin and endorphin hormones and reduces the nociceptive message via pleasant stimuli applied to painful areas. It reduces pain, accelerates labour, promotes physiologic birth, and gives women a greater sense of satisfaction. A Cochrane systematic review did not find an increased infection risk, whether the membranes are intact or not. Although the findings of a few studies did not find any increased risk with water births, there are currently insufficient data to offer a recommendation concerning the birth stage. Women can be encouraged to shower and take baths during labour and delivery.

2. Warm/cold packs

Non-painful applications of warm or cold packs at the pain site blocks part of the message in the spine, as described in the Gate Control Theory. Cold in particular reduces pain in various clinical trials and can alleviate muscle spasms and reduce tissue swelling and bruising when it occurs.

During or between contractions, warm or cold packs can be applied to the back, neck, chest, face, or any other painful area as best suits the woman’s comfort.

3. Gentle massage

Gentle massage is an easy, nonpharmacological method for increasing the release of analgesic hormones while blocking some of the nociceptive signals in the spine. It can alleviate pain and the frequency of epidurals and their associated consequences (when performed by a professional massage therapist). It loosens and relaxes the woman’s body, calms her anxiety by creating a sense of safety, and improves maternal satisfaction and mood.

During or between contractions, stroking or gentle massage can be performed in areas determined by the woman’s preference (abdomen, shoulders, back, legs, and sacrum).

Partners can be shown gentle massage techniques during the prenatal period or at the start of labour.
4. Mobility and positions

Moving around during labour and vertical positioning ease pain, produce better fetal-maternal circulation, improve fetal oxygenation, and produce more effective uterine contractions. They also reduce the length of labour, facilitate fetal descent, and diminish perineal trauma. Women request epidural analgesia less often when they use a vertical position.

During delivery, women perceive less severe pain when they are in a vertical or lateral position. Interventions that significantly limit mobility may therefore increase pain, including labour induction, continuous electronic fetal monitoring, and intravenous drip.

Standing, sitting, squatting, or any other comfortable position chosen by the mother can be effective and have no negative impact on mothers or infants. Women can be encouraged to follow and work with their sensations.

Women can be offered accessories such as birth balls, birth stools, trapeze bars, or bars to hang from.

DNIC Techniques: Painful Stimulation during a Contraction

1. Acupuncture, electro-acupuncture, acupressure

Acupuncture involves inserting fine needles at specific points on the body. It can be used to facilitate labour (cervical dilation, descent of baby, perineal relaxation, soothing of mother, etc.) and/or to ease pain. Electro-acupuncture involves administering a mild electrical current between the needles, and acupressure involves the acupuncture points being stimulated by painful deep tissue massage rather than needle insertion. Painful stimulation of acupuncture points during the painful contraction activates the DNIC mechanism. Most commonly used acupuncture reflex zones are Bladder 31–34 (BL-31-34), Large Intestine 4 (L.I.-4-Hegu), Gall Bladder 30 (G.B.-30-Huantiao), Liver 3 (LIV-3-Taichong), Spleen Pancreas 6 (S.P.-6-Sanyinjiao), and Heart 7 (H-7-Shenmen) (Figure 6).

RCTs show that women who use acupuncture are less likely to use other types of analgesic, experience less pain, have fewer instrumental deliveries, are more relaxed, and have a greater sense of control. Other studies have found that electro-acupuncture during labour diminishes the intensity of pain and increases beta-endorphin levels. Acupressure also reduces the intensity of pain during labour.

2. Sterile water injections

Painful intradermal injections of sterile water in the lower back (near lumbosacral area) can diminish the pain of women in labour by activating endorphin-producing DNIC. It is effective for all types of pain, especially lumbar pain, and its effects last from 45 to 120 minutes. One meta-analysis showed that this method reduces Caesarean rates, whereas two Cochrane systematic reviews reported insufficient data to establish the method’s effectiveness.

During a contraction, intradermal sterile water injections may be administered in the lower back or another area to create a sharp pain. Although the location of the second pain is relatively unimportant for the purposes of the DNIC mechanism, studies suggest the water injections should be administered in the lower back, especially for women experiencing strong back pain (Figure 7). Repeat the injection as needed.

Figure 6. Acupuncture Reflex points. Used with permission from Les Éditions de l’Homme.

Figure 7. Location of intradermal injections. Used with permission from Les Éditions de l’Homme.
3. Ice

Creating a second pain anywhere else on the body with the application of ice cubes causes the release of endorphins (DNIC). Pressure point massage using ice cubes has been examined in several studies\(^\text{119,120}\) and was found effective in alleviating pain during labour.

For the duration of the painful contraction, second pain can be created by applying ice anywhere on the woman’s body or at acupressure points.

4. Painful TENS

Using a low-frequency electrical current transmitted via electrodes placed on the skin, TENS produces transcutaneous electrical neurostimulation that creates a second source of pain to diminish the pain of a contraction (DNIC). The woman controls the low-frequency/high-intensity (painful) stimulation emitted by a portable device.

TENS helps reduce the use of analgesics\(^\text{8,121}\) and its application at specific acupuncture points has proven to be a non-invasive means of easing pain in the first stage of labour.\(^\text{122}\) However, a Cochrane meta-analysis\(^\text{123}\) showed that women generally reported little difference in the intensity of perceived pain with TENS, except those using it on acupressure points. Nevertheless, several women said they would be interested in using this method again in a future labour.

During the contraction, the woman can increase the intensity of the electrical stimulation to create a second pain, which releases endorphins.

**CNSC Techniques**

1. Yoga

Yoga combines flexibility and strength exercises with breathing, relaxation and meditation.\(^\text{124}\) It prepares women for childbirth and fosters the release of endorphins\(^\text{125}\) by CNSC. It helps increase a sense of competency and enables faster recovery from stress.\(^\text{126}\) Two meta-analyses show that yoga during pregnancy and labour has a positive impact on controlling anxiety\(^\text{127}\) and reducing the intensity of pain.\(^\text{128}\) Women also report greater satisfaction with their labour and greater pain relief. The length of labour diminishes along with the use of pharmacological analgesia.\(^\text{128}\) These findings are promising, although more detailed studies would be helpful.\(^\text{129}\)

Where available and accessible, women may be encouraged to prepare for childbirth by practising yoga poses, and becoming familiar with using breathing, relaxation, and meditation throughout their pregnancy.

2. Relaxation and visualization

Relaxation and visualization are helpful techniques for physically and mentally preparing for labour and birth. Relaxation may include an awareness of body tensions with deliberate relaxation of the affected areas. Visualization helps the woman deal with stress through positive thoughts, either by imagining herself in pleasant surroundings or using labour-associated metaphors (the cervix as a blossoming flower, waves for contractions, etc.).

When the woman relaxes and uses positive imagery, she produces endorphins that lower the intensity and, most importantly, the unpleasantness of her pain.\(^\text{19}\) This effect is achieved through the attention deviation mechanism or CNSC of the brain.

This technique improves mental and physical well-being,\(^\text{130}\) and reduces anxiety during pregnancy\(^\text{127}\) and labour.\(^\text{131}\) It also reduces pain intensity, lowers the rate of assisted vaginal delivery, and improves maternal satisfaction.\(^\text{128}\)

During labour, women can be encouraged to relax through loosened muscle tension in targeted areas (buttocks, mouth, shoulders, hands, etc.) while engaging in positive visualization.

3. Breathing

Breathing techniques are used to alleviate pain and create a sense of calmness and confidence. Breathing is one of the most effective tools available to women in labour.\(^\text{132}\) It is often encouraged to increase relaxation and to distract attention away from the pain.\(^\text{8,132}\)

Focused breathing can also increase a woman’s confidence and ability to cope with contractions.\(^\text{8}\) When a woman is conscious of her breathing rhythm, how she inhales and exhales, she is able to adjust her breathing to the intensity of her labour.\(^\text{133}\) Furthermore, slow, rhythmic breathing combined with massage has a “hypnotic” effect.\(^\text{134}\) A recent, quasi-experimental study showed that breathing techniques are an effective means of significantly reducing pain in primiparous women during the first stage of labour.\(^\text{135}\)

During each contraction, the labouring woman can be encouraged to be aware of her breathing and to fully exhale. She can also be encouraged to make sounds, depending on her own needs.

4. Hypnosis, self-hypnosis, and hypnobirthing

Hypnosis, self-hypnosis, and hypnobirthing are techniques used for overcoming the fear of labour. Based on deep relaxation, breathing, and visualization techniques, women are...
taught to trust their bodies, regain the belief in their ability to give birth, and free themselves from tension and pain. Using these tools, the labouring woman can reach a state of deep relaxation without losing touch with reality. In this state, the woman produces endorphins that reduce the unpleasantness and intensity of the pain along with the need for analgesics, while shortening the stages of labour.\footnote{136–139}

Hypnosis is an effective means of reducing stress during the prenatal period and also during childbirth.\footnote{137} In one study, higher vaginal delivery rates were achieved among nulliparous women who used hypnotherapy.\footnote{138} In another study women who engaged in self-hypnosis during labour were less likely to use pharmacological analgesic methods, including epidural analgesia, and were more satisfied with their pain management.\footnote{140} However, further research is needed to confirm these studies.\footnote{140,141}

As with other techniques involved in CNSC, these work best when health care professionals avoid disturbing the woman in labour. It is ideal to create a space of trust and privacy with dimmed lighting, silence, calmness, and serenity to protect the woman’s well-being and hormonal physiology.\footnote{12}

5. Aromatherapy and odour

Aromatherapy refers to the use of aromatic plant extracts (essences or essential oils) for medicinal purposes. The extracts can be applied to the skin, infused on a cloth, or diffused in a bath or in the room, although the latter method is not recommended at birth, as it may overstimulate the newborn’s sensitive olfactory system and interfere with scent free hospital policies. Odour modulates pain by deviating the woman’s attention.

Although systematic reviews have not proven aromatherapy’s effectiveness,\footnote{118,128} this method does not have known side-effects. Women can be encouraged to smell a pleasant odour, such as aromatic plant extracts, or a reassuring odour, such as that of her partner or a familiar object (e.g., their own pillow), if they desire.

6. Music

Music during labour, perceived in the right hemisphere of the brain, can stimulate the pituitary gland to release endorphins.\footnote{142} It can also alter the perception of pain through affect (ameliorating mood, increasing relaxation and lowering anxiety) and cognitive effects (increasing control and distraction).\footnote{143,144}

Studies show considerable heterogeneity and currently provide insufficient evidence to support the effectiveness of this technique.\footnote{128} However, music remains a simple method free of side effects that can be used along with other methods during labour to help women work with pain. While some suggest calm music, others support women to choose the music they prefer.\footnote{145}

During pregnancy, women can be encouraged to prepare their own playlist of music they enjoy. Using earphones during labour can help a woman stay in her calm zone of wellbeing.

7. Prenatal education

Birth preparation courses are intended to help parents develop tools for a better childbirth experience and may also promote parenting skills. The content covered aims to provide mental, physical, and emotional preparation.

Studies looking at possible benefits from childbirth preparation show conflicting and inconsistent results, which may reflect the wide variety of programs and lack of high-quality studies.\footnote{146}

Prenatal education courses that have shown the most significant benefits feature physiology-based education and offer a variety of tools for working with pain, while giving participants opportunities to practice during classes.\footnote{147–149}

During pregnancy, encourage women (and their partner or labour support person) to take birth preparation classes, where available and appropriate, that promote physiology and strengthen their skills in working with pain.

**Recommendation**

9. Health professionals should encourage parents and the people assisting them to prepare for the birth by learning about birth physiology and gaining skills in working with pain (III-A).

**CONCLUSION**

Pain management and the prevention of suffering during labour are complex processes that may not be effectively addressed by administering the best available analgesic. As far as safely possible, health care professionals are encouraged to focus on the needs of the labouring woman and to limit interventions that increase her stress and anxiety or disturb her natural hormonal physiology.\footnote{8} Health care professionals can promote and support an environment that values and recognizes the ability of the labouring women, their partners, and their newborns.

An undisturbed environment that supports hormonal physiology for the labouring woman will foster the processes of labour and birth, help women to work with their pain, and
provide an ideal postpartum situation for the initiation of breastfeeding and mother-child attachment.

A good understanding of neurophysiological mechanisms will assist health professionals to work with labouring women to modulate pain stimuli. When labouring women have continuous support and ready access to a variety of nonpharmacological approaches, obstetrical interventions and intervention-related risks and side effects can be reduced and maternal satisfaction improved.3

APPENDIX 1

Obstetrical practices that support endogenous abilities

1. Allow labour to start physiologically to optimize hormonal activity that soothes and protects the mother-child pair.
2. Increase the effectiveness of labour by encouraging actions that support natural oxytocin release. Protect the privacy of the woman and her partner and make them feel safe. Alleviate stress, which can interfere with labour progress.
3. Maintain intact membranes, except when medically contraindicated, to avoid increasing nociceptive signals.
4. Encourage women to hydrate and eat as they require: stress related to hunger and thirst increases catecholamine, which blocks natural oxytocin.
5. Allow the women to experience the pre-labour, labour, expulsion, and postpartum phases in the same location; changing surroundings can create stress, which can interfere with labour progress.
6. Allow women to move about and position themselves as they prefer throughout labour and delivery. Avoid obstetrical interventions that limit women’s mobility. In the absence of medical contra-indications, intermittent auscultation should be favoured to continuous electronic monitoring. Solid food and liquids are preferable to intravenous perfusion. In case of an anticipated need for a rapid intravenous access, the use of a saline lock or stopper is to be considered. Ambulation can reduce the perception of pain by blocking some of the nociceptive fibres in the spine (Gate Control Theory).
7. Encourage continuous, one-on-one support with the woman to create the sense of trust and safety that supports hormonal physiology and helps the woman work with pain and thus assists the physiological progress of labour.
8. Various nonpharmacological methods to comfort the women should be considered as primary methods of pain management. Before offering pharmacological methods, wait until the woman asks.
9. At full dilation, wait until the baby passively descends to the vulva to allow the Ferguson reflex to activate. The baby’s descent activates oxytocin receptors and the pelvic nerve which release high doses of oxytocin that create contractions causing the baby to descend into the vagina.
10. At the time of birth, support undisturbed early contact between mother and newborn and delay cord clamping.150 Immediate and uninterrupted skin-to-skin contact, tactile stimulation, and sucking stimulates release of maternal oxytocin which contributes to uterine contractility inhibiting haemorrhaging.151 It also improves newborn stability and favours the success of breastfeeding.
11. During the postpartum period, offer unrestricted maternal-newborn contact and especially support liberal skin-to-skin contact and breastfeeding to encourage optimal hormonal release.

APPENDIX 2

Practical ways to support and assist women in labour

1. When the mother arrives, review and discuss her objectives and wishes for the birth to identify her preferences.
2. Find out what kind of support she wants from staff.
3. Find out what methods she would like to use to help her work with her labour pain.
4. Prioritize emotional support, and positively support the woman and her partner throughout labour and delivery.
5. Suggest and apply various nonpharmacological techniques with her, even if she has had no preparation or methods for dealing with pain (ball, positions, massage, breathing, presence, etc.).
6. Instruct and support the partner with nonpharmacological methods for easing the woman’s pain.
7. Ask open-ended questions to understand the woman’s experience rather than closed-ended questions (“How do you feel?” rather than “Are you suffering?”).
8. Trust in the physiological process of birth, in the woman, and in her baby.
9. Encourage women to stay inside their “bubble,” avoiding any sensory or mental stimulation from questions, clocks, continuous electronic fetal monitoring, noise, etc. This will help the woman let go and flow with her involuntary sensations.25
10. Create a stress-free environment to make the woman feel safe, protected and supported. A calm environment with dimmed lights reduces the amount of intervention during labour, increases spontaneous vaginal deliveries and creates greater satisfaction in the women.
11. Encourage women to participate in decisions by explaining the risks and benefits of suggested interventions as well as alternatives.

REFERENCES


