



## New reasons and new ways to study birth physiology

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### Abstract

The age of cesarean sections on request, epidurals and drips of oxytocin is a turning point in the history of childbirth. Until recently women could not give birth without releasing a complex cocktail of 'love hormones'. Today, in many countries, most women have babies without releasing these specific hormones. The questions must be raised in terms of civilization. This turning point occurs at the very time when several scientific disciplines suggest that the way human beings are born has long-term consequences, particularly in terms of sociability, aggressiveness or, in other words, 'capacity to love'. I find it relevant to combine data provided by perspectives as diverse as ethology, animal experiments, studies of the behavioral effects of hormones that fluctuate in the perinatal period, and a branch of epidemiology I call 'Primal Health Research'. This combination of data offers new reasons to disturb the physiological processes as little as possible. We are also at a time when a physiological approach can help to rediscover the basic needs of women in labor. These women firstly need to be protected against any sort of neocortical stimulation. We must keep in mind what the main stimuli of neocortical activity are: language, bright lights, the 'feeling of being observed' and situations associated with a release of catecholamines. © 2001 International Federation of Gynecology and Obstetrics. All rights reserved.

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### 1. Introduction

One can easily interpret the current lack of motivation for studying the environmental factors that influence the physiological processes in the perinatal period. We are entering the age of

elective cesarean section on request. This new phenomenon was developed originally in Italy [1] and in the largest Latin American cities. It is found today all over the world. Certain obstetricians are indirectly participating in its rapid development. For example, 31% of London female obstetricians with an uncomplicated singleton pregnancy at term claimed that they would choose an elective cesarean delivery for themselves [2]. Similar preferences have been expressed among

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female and male North American obstetricians. It has been argued that the human brain size represents the main challenge to the birth process and that cesarean section is a technological solution to 'the conflict between the need to think and the need to run' [3].

Furthermore, a great proportion of women who give birth vaginally do not rely on the release of their own hormones, insofar as drips of oxytocin and epidural anesthesia are commonly used. In such circumstances the birth process is not highly dependent either on environmental factors.

## **2. New reasons**

At the very time when there is an understandable lack of interest in birth physiology, several scientific disciplines that are not directly related to obstetrics offer new reasons to rediscover the basic needs of women in labor.

One of these disciplines is the developing branch of epidemiology we call 'Primal Health Research'. This includes all studies exploring correlations between the 'primal period' and health and behavior later on in life. According to the vocabulary we proposed when anticipating the development of this new generation of research [4], the primal period includes fetal life, perinatal period and the year following birth. Such studies do not fit into the current classifications and therefore they are difficult to find in the scientific and medical literature. This is the reason for creating the 'Primal Health Research data bank', which includes hundreds of references with abstracts ([www.birthworks.org/primalhealth](http://www.birthworks.org/primalhealth))).

From an overview of the data bank it appears that there are published studies detecting correlations between events during fetal life and health conditions in adulthood, adolescence and childhood in all fields of medicine: today it is possible to claim that our health is 'shaped in the womb'.

There are also studies detecting links with the perinatal period: it is noticeable that when such links are detected, it is not usually in the health field but, rather, in the field of sociability, aggressiveness or, in other terms, capacity to love. After bringing such studies together it appears that

when a condition can be interpreted as an 'impaired capacity to love' (to love others or to love oneself), researchers are in a position to detect risk factors in the perinatal period. Furthermore, all these conditions are highly topical and tend to be more frequent than in the past.

Juvenile criminality is highly topical and can be interpreted as an 'impaired capacity to love' others. Raine and colleagues found that the main risk factor for being a violent criminal at age 18 was the association of birth complications, together with early separation from or rejection by the mother. Early separation-rejection by itself was not a risk factor [5].

All sorts of self destructive behavior can be interpreted as 'impaired capacities to love' oneself, such as suicide, drug abuse and anorexia nervosa. Teenage suicide, previously almost unknown, is an important issue specific to our time. Salk et al. found risk factors in the perinatal period for adolescent suicide victims who died before their 20th birthday [6]. One of the most significant ones was the fact of being resuscitated at birth. Jacobson studied in particular how people commit suicide. He found that suicides involving asphyxiation were closely associated with asphyxiation at birth; suicides by violent mechanical means were associated with mechanical birth trauma. In his last study, Jacobson confirmed that men (but not women) who had traumatic births are five times more at risk of committing suicide by violent means than others [7]. Jacobson compared the background of 242 adults who committed suicide by using a firearm, or by jumping from a height, or by jumping in front of a train, or by hanging, or by laceration, etc., with 403 siblings born during the same period and at the same group of hospitals. Many possible confounding factors were considered. The differences between men and women disappeared if their mothers had used pain killers of the opiate family when in labor. It seems that the long-term side effects of pain killers such as morphine or different sorts of synthetic morphine are different. They include drug addiction.

Jacobson and Nyberg found that if a mother had been given analgesic or sedative medication during labor (opiates, barbiturates or nitrous ox-

ide), her child was statistically at increased risk of becoming drug-addicted in adolescence [8]. Nyberg et al. [9] found that adolescents who have been exposed in the perinatal period to three doses (or more) of opiates or barbiturates had a risk of becoming drug addicted multiplied by 4.7 (95% C.I. = 1.00–44.1).

Anorexia nervosa is also a sort of self-destructive behavior. It is topical. Yet the one study of anorexia nervosa included in our data bank detected correlations with the birth itself [10]. A team of researchers had access to the birth records of all girls born in Sweden from 1973 to 1984. They also had access to the files of the 781 girls who had stayed in a Swedish hospital due to having anorexia nervosa between age 10 and age 21. For each anorexic girl five non-anorexics born in the same hospital during the same year were selected for comparison. The most significant risk factor for anorexia nervosa in this study was a cephalhematoma at birth. A cephalhematoma indicates traumatic birth from a mechanical point of view. A forceps delivery or a ventouse were also risk factors.

Autism and other aspects of the ‘autistic spectrum’ can also be presented as the expression of an ‘impaired capacity to love’. Autistic children and autistic adults do not socialize. When teenagers they cannot manage dating. When adults they do not have children.

Tinbergen, one of the founders of ethology (who shared the Nobel prize with Konrad Lorenz and Karl Von Frisch in 1973), found that ‘deep forceps’ delivery, birth under anesthesia, resuscitation at birth and induction of labor were factors which predispose to autism or which can exaggerate the symptoms [11]. The work of Tinbergen and co-workers represents the first attempt to explore autism from a ‘primal health research’ perspective. Later on, Hattori evaluated the risks of becoming autistic according to the place of birth. She found that children born in a certain hospital were significantly more at risk of becoming autistic. In that particular hospital, the routine was to induce labor a week before the expected date of delivery and to use a complex mixture of sedative and analgesics agents during labor [12].

I used some of these studies as examples in order to explain the term ‘cul-de-sac epidemiology’ [13], that is the opposite of what L.H. Kuller calls ‘circular epidemiology’. ‘Circular epidemiology’ can be defined as the continuation of specific types of epidemiological studies beyond the point of reasonable doubt of the true existence of an important association or the absence of such association. Muller regrets that, for epidemiologists, research support is biased toward the continued study of already proven hypotheses. ‘Cul-de-sac epidemiological studies’, however, are not replicated, even by the original investigators and they are rarely quoted after publication. This framework includes research about topical issues. Despite publication in authoritative medical or scientific journals, the findings are shunned by the medical community and the media.

The data offered by the ‘Primal Health research perspective’ complement the findings of a great variety of disciplines that participate in what I call ‘The Scientification of Love’ [14]. Until recently love was the realm of poets, artists and philosophers. In the closing decades of the twentieth century, it has been studied by scientific methods. It is easy to miss the importance of the phenomenon because there is a multitude of specialized approaches to explore the nature of love and how the capacity to love develops.

The emergence of modern ‘ethology’ represents the advent of the ‘Scientification of Love’. It is worth recalling the famous experiment by Konrad Lorenz, who had interposed himself between newly hatched ducklings and their mother and then imitated the mother duck’s quacking sounds. These ducklings became attached to Lorenz for the rest of their lives, following him when he walked in the garden. This is how the concept of a sensitive period in the process of forming attachment was introduced, and it shows that there is a short yet crucial period immediately after birth which will never be repeated. This is how many ethologists came to study the process of attachment between mother and child. They all confirmed that in a great variety of species of birds and mammals there is a sensitive period just after birth. Such studies include the work of Harlow with primates. Harlow followed rhesus

monkeys until adulthood and demonstrated the effects of early mother–newborn separation on adult genital sexuality.

The scientification of love entered a new phase in 1968 when Terkel and Rosenblatt injected virgin rats with blood taken from mother rats within 48 h of parturition [15]. The virgin rats expressed a maternal behavior. This historical experiment was followed in the 1970s by a great number of other experimental studies exploring the behavioral effects of hormones whose levels fluctuate in the perinatal period (estrogens, prolactin, progesterone).

A new era of research started in 1979 when Prange and Pedersen found that oxytocin can induce a maternal behavior in mammals on the condition that it is injected in the cerebral ventricles [16]. The explosion of research triggered by such an experiment is illustrated by the publication by the New York Academy of Sciences, in 1992, of a 500-page book including 53 articles on the behavioral effects of oxytocin [17]. It appears that oxytocin is the typical altruistic hormone. Whatever the facet of love one considers, oxytocin is involved. At the very time when the behavioral effects of oxytocin were confirmed by a multitude of studies, Swedish investigators found that the peak levels of oxytocin just after birth can be still higher than during labor [18].

There is no contradiction between our current understanding of oxytocin as the hormone of love and the observations of those who studied the effects of other sexual hormones, in particular estrogens and progesterone. Today it is well understood that estrogens activate the oxytocin and prolactin sensitive receptors. We must always think in terms of hormonal balance. For example, immediately after birth, oxytocin — an altruistic hormone — and prolactin — a mothering hormone — complement each other.

It was also in 1979 that the maternal release of beta-endorphins during labor and delivery was demonstrated. In the early 1980s we learnt that the fetus releases its own endorphins in the birth process and today, there is no doubt that, for a certain time following birth, both mother and neonate are impregnated with opiates. The property of opiates to induce states of depen-

dency is well known, so it is easy to anticipate how the beginning of a ‘dependency’ — an attachment — will be likely to develop.

Catecholamines also have a role to play in the interaction between mother and neonate immediately after birth. During the very last contractions before birth the maternal levels peak: as soon as the ‘fetus ejection reflex’ starts, women tend to be upright, full of energy, with a sudden need to grasp something or someone; they often need to drink a glass of water, just as a speaker may do in front of a large audience. One of the effects of such a release of catecholamines is that the mother is alert when the baby is born [19]. There is an evolutionary advantage that the mother has enough energy — and aggressiveness — to protect her newborn baby if need be. It is also well known that the fetus has its own survival mechanisms during the last strong, expulsive contractions, and releases its own catecholamines. The visible effect of this release of noradrenaline is that the baby is alert at birth, with eyes wide open and dilated pupils.

Human mothers are fascinated and delighted by the gaze of their newborn babies. It is as if the baby was giving a signal, and it certainly seems that this eye-to-eye contact is an important feature of the beginning of the mother and baby relationship among humans.

The highly complex role of catecholamines in the interaction between mother and baby has not been studied for a long time. A small number of animal experiments open the way to further research. Mice who lack a gene responsible for the production of noradrenaline leave their pups scattered, unclean and unfed — except if they are injected with a noradrenaline-producing drug when giving birth [20].

Our current knowledge about the behavioral effects of different hormones involved in the birth process helps us to interpret the concept of a sensitive period introduced by ethologists. It is clear that all the different hormones released by the mother and by the fetus during labor and delivery are not eliminated immediately. It is also clear that all of them have a specific role to play in the later interactions between mother and baby.

It is noticeable that at all stages of the history

of the scientification of love there have been convincing animal experiments. This is a reason to clarify what we can learn from non-human mammals and also the limits of what we can learn from them. Let us take as an example the experiment by Krehbiel and Poindron, who studied the link between the birth process and maternal behavior. They found that after giving birth with epidural anesthesia, ewes do not take care of their lambs [21]. It is obvious that the effects of an epidural anesthesia during labor among humans are much more complex than among sheep. It is easy to interpret such differences. Human beings use elaborated forms of communication and create cultures; this implies that our behaviors are less directly under the effects of the hormonal balances and more directly under the effects of the cultural milieu. This does not mean that we have nothing to learn from the sheep. Animal experiments indicate which question we should raise where human beings are concerned. If ewes do not take care of their lambs after giving birth with an epidural anesthesia, this implies that where human beings are concerned the right question is: what is the future of a civilization born under epidural anesthesia?

Genuine scientific advances always lead to raise new questions or to formulate old questions in a different way. This is the case of the scientification of love. This new awareness develops at the very time when the evidence points to the importance of early experiences in the development of the capacity to love. In the current scientific context there are new and imperative reasons to improve our understanding of the physiological processes in the perinatal period and to disturb them as little as possible.

### 3. New ways

We are also at a time when it is becoming easy to offer a simplified overview of birth physiology. This leads to list in a concise way the basic needs of women in labor.

The different hormones released during the birth process (oxytocin, endorphins, prolactin, ACTH, catecholamines, etc.) originate in archaic

brain structures such as the hypothalamus and the pituitary gland. In other words, the most active component of the body of a woman in labor is the primitive part of the brain. It is also well accepted that during parturition — or any episode of sexual life — the possible inhibitions originate in the neocortex. These facts are essential to interpret the particular state of consciousness that characterizes women in labor. During parturition many women tend to become less rational, behaving in a way which would be unacceptable in the daily social life, daring to scream or to swear. This particular state of consciousness is associated with a reduction of neocortical activity. Hence, it becomes easy to explain that a woman in labor needs first to be protected against any sort of useless neocortical stimulation.

Some of the main factors that can stimulate the neocortex of human beings are language, bright lights, the feeling of being observed and the release of catecholamines associated with certain situations. Language is processed by neocortical structures, meaning that language, particularly rational language, should be used with caution by birth attendants. In many modern hospitals, however, the midwives and other health professionals ask precise questions to laboring women, just to fill in forms.

EEG shows that bright lights tend to stimulate the neocortex. This means that dim light should be better than a bright light in a birthing place, a question that obstetric and midwifery textbooks do not even approach. Such an issue should be seriously studied and discussed.

The feeling of being observed is a situation associated with an increased neocortical activity, which underscores the importance of privacy during birth. It implies also that any device that can be perceived as a way to observe should be used with caution, as it is the case of the camera often introduced today by a companion. This is also the case of the electronic fetal monitor: the neocortex of a laboring woman tends to be stimulated when she knows that her body functions are continuously monitored; this can interfere with the physiological processes and explain the increased risk of intervention. The cultural misunderstanding of

birth physiology can also be detected in books about ‘natural childbirth’, which often show the photographs of a laboring woman surrounded by two or three people who are watching her.

It is noticeable that non-human mammals have a strategy not to feel observed when giving birth. For example nocturnal mammals (e.g. rats) tend to give birth during the day, while diurnal mammals (e.g. horses) tend to give birth at night. Our relative the chimpanzees separate from the group to give birth.

It can be said that any situation associated with an increased release of catecholamines tends to simulate the cortex. When there is a possible danger the role of catecholamines is to make the individual more attentive, watchful and ready for emergency. This implies the need to feel secure. It is noticeable that in many cultures women have a tendency to give birth close to their mother, or close to a substitute for their mother, such as an experienced mother or grandmother. This is the root of midwifery. A midwife is originally a mother-figure. The vocabulary often used when referring to the birth attendant translates and contributes to transmit the widespread misunderstanding of the physiological processes. Laboring women do not need a ‘coach’.

A similar overview of the basic needs of mother and newborn baby during the first hour following birth is also possible in the current scientific context. Once more the point is the antagonism between the release of catecholamines and the neocortical activity on the one hand, and the release of oxytocin on the other hand. This suggests the importance of such environmental factors as privacy, the temperature of the birthing place and the mother–newborn eye-to-eye and skin-to-skin contacts [22]. In general any event associated with oxytocin release is highly dependent on environmental factors (copulation, parturition, lactation, etc.). At that stage oxytocin should be seen both as the hormone necessary for a safe delivery of the placenta and as the typical ‘hormone of love’. The so-called third stage of labor represents also the initiation of breastfeeding.

Certain connections between birth physiology

and the physiology of lactation are easy to explain in the current scientific context. Here are some examples: Beta-endorphins levels increase during labor and induce the release of prolactin. Women who gave birth vaginally release oxytocin in a pulsatile way during breastfeeding, 2 days after birth, while women who gave birth by emergency cesarean section do not. The ‘pulsatility’ of oxytocin release is associated with the duration of exclusive breastfeeding and with the amount of milk transferred from mother to baby [23]. Women who delivered by cesarean section lacked a significant rise in prolactin levels at 20–30 min after the onset of breastfeeding [23]. In addition, colostrum milk beta-endorphin concentrations of mothers who delivered vaginally are significantly higher in the fourth post-partum day than colostrum levels of mothers who underwent cesarean section [24]. One of the effects of milk opiates is probably to induce a sort of addiction to mother’s milk.

It can be concluded that at the time when the human neonate is able to find the breast for the first time, the behaviors of mother and baby are influenced by the numerous hormones they released during labor and delivery.

Today we have at our disposal effective and not too invasive ways to improve our understanding of the physiological processes in the perinatal period. Not only is it possible to evaluate how oxytocin is released, but there are also non invasive ways to evaluate the fluctuations of catecholamines release. One of them is based on the correlations between plasma catecholamines and skin microvibration patterns. In spite of practical and ethical difficulties, one can imagine in the future the use of new functional imaging techniques of the brain during labor and even delivery. Orgasmic states have already been explored that way. It is worth noticing that, according to a Finnish study with single photon emission computed tomography [25], orgasmic states are associated with a decreased cerebral blood flow in all cortical areas (except the right prefrontal cortex). Let us underline that the hormonal releases are pretty similar during an orgasm and during a ‘fetus ejection reflex’. Furthermore, a certain

number of women who had unguided and undisturbed deliveries compare their experience with an orgasm.

One of the objectives of our simplified overview of birth physiology is to offer a framework for further research. The main obstacles for improving our understanding of the physiological processes in relation to environment factors are not technical. The point is to overcome a widespread lack of interest in such issues.

This lack of interest is linked to an unprecedented crisis point in the history of childbirth. Until recently women could not deliver babies and placentas without releasing a complex cocktail of 'love hormones'. Today, in many countries, most women have babies without releasing these specific hormones. Obstetricians and obstetric teams must be aware of their enormous responsibilities, which go far beyond the perinatal period. Questions must be raised in terms of civilization.

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