Drugs in Labor
an Overview • by Sarah J. Buckley, MD

Labor is, as the term implies, hard work, and throughout history, women and their caregivers have developed an array of resources to ease the passage for mother and baby. In some cultures, this has included herbs and other medicinal substances.

For example, traditional midwives in Zimbabwe use donkey’s placenta, either chewed or made into an infusion, to strengthen a woman’s contractions during labor and to treat bleeding after birth (Blythe 1998). Some Native American women are reported to have consumed rattlesnake tails to ensure a fast and easy birth, and European midwives in the Middle Ages discovered the medicinal properties of ergot—a fungal infection of rye—and used it to treat postpartum haemorrhage (Inch 1984).

Papal Christianity, however, forbade the use of any medicine to assist birth, claiming that any difficulty that women might experience in birth reflected God’s punishment of Eve, recorded in the Biblical passage Genesis 3:16: “In pain you will bring forth children.” As Dick-Read (1963) highlighted, this prohibition hinged on the translation of a Hebrew word, “etzev,” which is translated elsewhere in the Bible as meaning labor or work, rather than as pain or sorrow.

The so-called curse of Eve continued to be influential in Christian societies until 1853, when Queen Victoria used a new drug—inhaled chloroform (discovered by James Simpson in 1847) for the birth of her eighth child, Prince Leopold. Although not without controversy, the Queen’s choice became instantly acceptable for other women, and medicalized pain relief entered the birth room for the first time (Ellis 1994).

One hundred and fifty years later, laboring women are routinely administered a staggering array of drugs. This includes not only drugs for pain relief (analgesics), but also drugs to induce and augment labor, to anesthetize and sedate and drugs to prevent or treat problems such as hemorrhage, which may, ironically, result from the use of other drugs (Gilbert 1987, Philip et al 2004). Women who give birth by cesarean are also exposed to higher doses of analgesics (if they have a spinal or epidural) or the more powerful drugs used for general anesthetics.

All of these drugs pass from the mother’s bloodstream to her unborn baby in measurable levels, with documented short-term effects. There have been very few studies of the long-term sequelae for babies, but we do know that the newborn baby is in a critical state, especially in relation to brain development, and that effects may reach far beyond childhood.

We must also realize that all of these drugs interfere with the natural process of birth and, as Suzanne Arms reminds us, “We do not yet know the subtle but long-term effects of depriving the baby of the full processes of labor” (Arms 1996).

The mother’s condition also varies with her birth experience. If she has labored under her own steam, she is replete with an ecstatic hormonal cocktail during the first hour or so after birth (Buckley 2004), and her brain and hormones are altered (Nissen et al 1996), perhaps permanently. We are, as a culture, witnessing the effects of the loss of birthing ecstasy, and it is my belief that many of our current difficulties with parenting, as well as with our offspring’s behavior, may result from this unprecedented shift in birth experience.

The drugs I discuss in this paper include opiate drugs, inhaled analgesics, epidural and sedative drugs and oxytocin used for induction and acceleration of labor.

Opiate Drugs

Ancient Chinese writings describe the use of opium for pain relief in labor, but it wasn’t until the invention of the hypodermic syringe, in 1853, that morphine was used parenterally in labor. It was soon abandoned because of early concerns about its effects on the neonate but was reintroduced in 1902 as a component of twilight sleep, along with the muscle relaxant drug scopolamine or suxamethonium, derived from belladonna (Bricker and Lavender 2002).

Twilight sleep was invented by Bertha van Hoosen, a Chicago surgeon, and became popular, apparently because it was more natural than prevailing methods such as routine use of chloroform (which can paralyze a woman’s uterine muscles), forceps and episiotomy. Women anesthetized under twilight sleep often had to be restrained because they thrashed around, but the drugs also gave them amnesia for the events. Unfortunately, the muscle relaxant effects could severely depress the baby’s nervous system and increased the risks of uterine atony and postpartum hemorrhage, which in 1915 lead to the death of Mrs F.X. Carmody, who had campaigned strongly for the method in the U.S. (Fissell 1999).

Twilight sleep was also promoted in Australia, apparently to convince women to procreate after World War II. A film of the procedure, which I have seen, shows the mother draped and unconscious, with two gloved and masked accoucheurs performing complicated maneuvers to extract the baby (including, it seems, maneuvers through the woman’s rectum). The baby is eventually pulled out limp and unresponsive. My father, who trained as an obstetrician in New Zealand in the 1940s and 50s, also recounts that a woman could awake from twilight sleep 24 or more hours after giving birth and ask when she was going to have her baby (Buckley 2004). Twilight sleep continued to be used in some places until the 1960s.

A number of opiate drugs are in current use. These include the classic opiates morphine and pethidine/meperidine (Demerol), the short-acting synthetic opiate fentanyl (Sublimaze) and the agonist-antagonist opiates meptazinol (Meptid), nalbuphine (Nubain) and butorphanol (Stadol), which occupy the opiate receptor sites, partly activating and partly blocking them.

In the U.S., between 39 and 56% of laboring women use an opiate drug, the
lower figures reflecting use in smaller hospitals (Hawkins et al 1999). In the UK, 37% of women are estimated to use opiates in labor (Chamberlain 1993). The most commonly used opiate in most labor wards is pethidine/meperidine.

Opiates are popular partly because of their ease of use, however their efficacy has been questioned. For example, a study from Sweden in 1996, involving 20 laboring women, has suggested that, even after repeated doses up to 1.5 mg/kg of pethidine/meperidine, a woman's pain score can remain high—between 70 and 80 points out of 100 on visual analogue scale (VAS). Although, in this study, the women's VAS pain scores did not decrease significantly after repeated doses, the VAS sedative score increased progressively up to 70–90/100 after the third dose. The authors conclude, “These drugs only cause heavy sedation” (Olofsson et al 1996).

Subsequent research has confirmed that the analgesic effect is modest. For example, Tsui et al (2004) found a decrease of 17 points out of 100 in VAS for Hong Kong women using 100mg pethidine compared to placebo, but concluded that pethidine is worthwhile. As Twycross (1997) highlights, a decrease from unbearable to severe pain may be welcomed, and an estimated pain score of 70 out of 100, reported by women who used no analgesia in the Queen Charlotte 1000 mother survey (Morgan et al 1982), was associated with high rates of satisfaction, both short- and long-term. In one large survey, 40% of women who had used pethidine said they would opt for it again in a subsequent labor (Chamberlain 1993).

Research by Zanardo and colleagues has suggested that labor pain may increase the levels of beta-endorphin in colostrum milk, which assists the baby in transition from the mother's womb (Zanardo et al 2001). In this case, drugs that do not eliminate pain completely may be physiologically advantageous. (See also the hazards of epidurals, as below.)

Although pooled analyses have not shown definite effects on labor and delivery—partly because these outcomes are not sought (Bricker and Lavender 2002)—there is some evidence that pethidine may slow labor. Thomson and Hillier (1994) followed up this unexpected research finding with a search of the literature and concluded: “There is a strong suggestion in the literature that the use of this drug is associated with a lengthening of labor and this association is dose-related. Studies in animals support this view” (p. 448).

Large doses of opiates are needed to relieve labor pain, and such doses can have side effects that range from unpleasant to serious. As nervous system depressants they can lead to excessive sedation and respiratory depression in both mother and baby. Other maternal side effects include nausea, vomiting, pruritus (itchiness), decreased gut motility (and increased risk of aspiration if a general anesthetic is subsequently needed), hypotension (low blood pressure) and loss of airway protective reflexes (ACOG 1996). Opiate drugs are lipid-soluble and pass easily to the baby in utero, and fetal levels can build up, especially when the mother receives repeated doses. After birth, when the mother no longer metabolize the drug for her baby, the half-life can be very prolonged due to the immature neonatal liver and excretory systems. For example, the half-life of pethidine is three to six hours in the mother, but is 15 to 23 hours in the neonate (Caldwell 1978). Norpethidine (norperidine), the major metabolite of pethidine, has a half-life of 14 to 21 hours in the mother and 63 hours in the neonate (Hale 1997). The baby will have the highest opiate levels when drugs are administered between one-and-one-half and four hours before birth (Hale 1998). Babies whose mothers received repeated doses of pethidine/meperidine will continue to be exposed to the drug via its long-acting metabolite norpethidine, which will be excreted in the mother's milk for the first 24 hours or so.

Recognised effects on the baby include neonatal respiratory depression (Schneider and Moya, 1964), decreased neonatal alertness (Belsey et al, 1981), inhibition of sucking (Richard and Alade 1990, Nissen et al, 1995), lower neurobehavior scores (Hodgkinson et al, 1977) and a delay in effective feeding (Matthews 1989, Crowell et al, 1994). Ranjan (1994) found that, apart from general anesthesia, pethidine was the drug most inhibiting to breastfeeding.

Although some argue for the benefits of particular opiates, according to ACOG (1996), “All opiates have similar effects on the fetus and neonate when administered to the mother in equipotent doses” (p. 2). Bricker and Lavender (2002) conclude, “No strong preference for any of the opioids... can be recommended” (p. S106).

Longer-term studies on neonates exposed to opiates in labor are concerning. Belsey and colleagues (1981) followed such babies to six weeks and found that neurobehaviour was affected in a dose-response way for the entire follow-up period. They found that: “Higher cord blood levels of pethidine were associated with babies who were more prone to respiratory difficulties, drowsy and unresponsive immediately after delivery. Throughout the six weeks in which the assessments were made, depressed attention and social responsiveness were found in infants with high drug levels” (p. 398). Consolability was also decreased with increasing levels of pethidine exposure. The authors conclude, “Greater exposure to pethidine results in neonatal behaviour that is significantly depressed in areas of functioning which might affect the ability of the mother to adjust to her baby in the first few weeks of his life.”

This study used the more comprehensive Brazelton Neonatal Behavioural Assessment Scale (BNBAS), as opposed to the more recent Neurologic and Adaptive Capacity Score (NACS) or Early Neonatal Neurobehavior Score (ENNS), which both pool data to obtain an aggregate score. As one researcher noted, a baby could be drowsy enough to be unable to breastfeed, yet still score as normal on NACS or ENNS (Walker 1997).

Of even greater concern is a study that looked at the birth records of 200 opiate...
addicts born in Stockholm from 1945 to 1966 and compared them with the birth records of their non-addicted siblings. When the mothers had received opiates, barbiturates and/or nitrous oxide gas during labor, especially in multiple doses, the offspring were more likely to become drug addicted. For example, when a mother received three doses of opiates, her child was 4.7 times more likely to become addicted to opiate drugs in adulthood (Jacobson 1990). This study was recently replicated with a U.S. population, with very similar results (Nyberg 2000).

**Inhaled Analgesics**

Various anesthetic gases have historically been used, in low doses, in childbirth, but their use has been restricted by various factors including their relaxant effect on the laboring mother's uterus, putting her at risk of postpartum hemorrhage; their propensity to cause drowsiness and amnesia; concerns about toxicity; and difficulties with their administration (Wongprasart et al. 2004).

Currently nitrous oxide (N₂O) is the only inhaled agent with general use in the labor ward. Nitrous oxide is an analgesic but not anesthetic gas—that is, it reduces sensation without producing unconsciousness. It was introduced by Polish-Russian physician Stanislav Casmirovicz Klikovicz over 100 years ago and became more usable after Dr. R.J. Minnitt, in 1933, introduced his self-named gas and air apparatus, allowing an adjustable concentration of N₂O to be administered by midwives in labor (Wongprasart et al. 2004). Currently it is usually used as a 50:50 N₂O-oxygen mixture known as Entonox. Entonox is usually self-administered via a facemask with a one-way valve that opens with inhalation.

Nitrous oxide, when offered, is a popular choice, being used by 60% of laboring women in the UK (Chamberlain 1993) and 37% in Canada (Levitt et al. 1995), although it is less available in the U.S. It is a simple and inexpensive option, and women rate its efficacy as higher than TENS (Chamberlain 1993), although other studies have questioned its efficacy. For example, Carstiu et al. (1994) found that, in a blinded randomised controlled trial, women in early labor reported no reduction in pain score for N₂O compared to air. Rosen (2002) has critiqued this rather flawed study, and other studies, of N₂O and concluded, "It appears to provide analgesia at a level comparable with paracervical block and probably better than that provided by opioids" (quoted in Caton et al. 2002, p. S10).

Nitrous oxide has low solubility in the blood, which gives it a rapid onset (around 50 seconds) and offset (Paech 1996). It is most often used discontinuously—that is, during contractions (most effective if begun at the very start of a contraction)—and set aside in between. Side effects include dizziness, excessive sedation and drowsiness, especially if used continuously. The advantage of self-administration is that excessive drowsiness will render a woman unable to get the mask to her face.

Although N₂O has a reputation as an innocuous form of analgesia, it is well known to lower blood oxygen levels. Pure inhaled N₂O, which was used extensively as an analgesic in my father's day, induces cyanosis in a relatively short time (Buckley 2004). In obstetrics, Paech (1996) notes, "Entonox has been associated with longer and more severe episodes of oxygen desaturation than epidural analgesia, although overall maternal hypoxemia (during hypoventilation between contractions) is not increased" (Paech 1996, p. 26). Paech also warns that the combination of N₂O with an opioid, which is not uncommon, may lead to episodes of marked maternal, and hence fetal, oxygen desaturation, especially, he says, in obese women. He recommends maternal pulse oximetry when women use this combination in a high-risk situation. There are...
l'llie popularity of epidurals for pain relief, as well as a profound effect on the process of labor. As WHO notes, “Epidural analgesia is one of the most striking examples of the medicalization of normal birth, transforming a physiological event into a medical procedure” (WHO 1996, p. 16).

Epidurals involve an injection of one of several types of local anesthetic (all of which are cocaine derivatives) into the “epidural space” around the spinal cord, which blocks sensation from the nerves supplying the lower half of the body, including a woman’s pubis and uterus. As below, an added opiate drug is commonly used. Although an epidural does not usually block the motor nerves, few women are steady or safe enough on their feet to walk after an epidural, and the need for fetal monitoring also keeps most women bed-bound after this procedure (Mayberry et al. 2002).

Side effects of epidurals are common. A drop in blood pressure occurs for up to 50% of women (Mayberry et al. 2002), although this possibility is usually pre-empted by the use of intravenous fluids to “preload” the laboring woman. Occasionally, treatment with ephedrine/adrenaline may be necessary to maintain circulation to the woman’s uterus and baby, which will be compromised to some extent by a drop in blood pressure. Sedation occurs in around 21% of women, averaged from multiple studies (Mayberry et al. 2002), and is highest when sufentanil is used in the epidural. A woman’s bladder function is likely to be affected by the nerve blocks, and a catheter may be needed to pass urine—this occurs for up to two-thirds of women with epidurals (Mayberry et al. 2002).

When opiate drugs are included in the procedure, a woman may experience pruritus (generalised itching); this occurs mainly in women who have received fentanyl or sufentanil, when almost two-thirds of women experience this side effect. Epidurals can also cause nausea and vomiting, again more likely with the use of opiates, and the risk overall can be as high as 30%. Shivering is also not uncommon and seems to be a direct effect of the epidural drugs on a woman’s thermal regulation (see below). Inadvertent puncture of the spinal cord covering (dura mater) occurs in about 3% of epidural procedures and can give a severe headache that lasts several days (Eitzschig et al 2003).

Less common side effects for a woman having an epidural include ongoing numb patches, which usually clear after three months (1 in 550, MIDIRS 1999), and weakness and loss of sensation in the areas affected by the epidural (1 in 10,000), also usually resolving by three months (MIDIRS 1999). Potentially life-threatening complications, such as inadvertent injection into the woman’s blood stream, occur in about 1 in 4000 cases (MIDIRS 1999). Here in Australia, the much-publicized death of a new mother who developed an undiagnosed epidural abscess after a cesarean under epidural reminds us that caregivers must also be alert to this possibility.

Other unintended effects of epidurals include longer labors (average increase of around 42 minutes for first stage and 14 minutes for second stage, in one meta-analysis of epidural vs. injected opiate drugs, Halpern et al 1998); lower rates of spontaneous delivery; increased rates of instrumental deliveries; higher rates of intrapartum fever; and increased risks of neonatal sepsis evaluation, when compared to non-epidural forms of pain relief.

Lieberman and O’Donoghue (2002), in their systematic review, estimate that women who have an epidural are 1.5 times as likely to have a cesarean delivery, and Halpern et al (1998) estimate from their pooled data that instrumental delivery is 2.2 times more likely when women have been administered an epidural. Because of the delay in labor, women who use an epidural are also more likely to be administered oxytocin to accelerate their labor, and there is an increased risk of severe (third- and fourth-degree)
perineal lacerations after an epidural, due to the increase in forceps and vacuum deliveries (Lieberman and O'Donoghue 2002). One small study showed that, when mothers who had received epidurals subsequently had a forceps delivery, the peak force applied to their babies' heads was almost doubled (7.72 vs. 3.88 lb), as measured by a tactile sensing device (Poggi et al 2003).

Responses to these well-documented problems include trials of "low dose" or walking epidurals (although, as above, the chance of women actually walking is low), as well as the addition of opiate drugs, which also allow lower doses of anesthetics to be used. Combined spinal-epidurals (CSE) have also been developed, which combine an initial injection (usually an opiate drug, sometimes with a local anesthetic) into the spinal space, which provides good but short-lived pain relief, with placement of an epidural needle for ongoing dosage. One large study has linked CSE (using the synthetic opioid sufentanil) with severe bradycardia necessitating emergency cesarean in 1.5% of women using this method (Gambling et al 1998). Lieberman and O'Donoghue conclude that CSE does not seem to offer any advantages over conventional epidural techniques (2002).

The effect of epidurals on maternal temperature is well documented but still not well understood. A gradual increase in temperature of around 0.07°F per hour has been documented (Vinson et al 1993), and other research has suggested that around 15% of women with epidurals develop fever > 100.4°F (Lieberman et al 1997). Various explanations, which may overlap, have been proposed, including vasodilation; a direct thermoregulatory effect; chorioamnionitis; and an anti-pyretic effect of opiates, which are the usual control group in epidural studies (Gaiser 2002). Lieberman et al (2000), in a large study, found that babies born to feverish mothers (97% of whom had received epidurals) were more likely to have low Apgars at one minute and to be hypotonic. They also needed resuscitation more often (11.5% vs. 3%) and had a higher rate of neonatal seizures (3.3% vs 2%).

The authors note, "In primate studies, hyperthermia in the absence of infection has been associated directly with the development of fetal hypoxia, metabolic acidosis and hypotension. Other animal studies have demonstrated that an increase in brain temperature of even 1°C or 2°C increases the degree of brain damage resulting from an ischemic insult" (p. 8). Impey et al (2001) also note a substantially increased risk of encephalopathy in babies born to febrile mothers.

Whether or not this elevation in maternal temperature directly causes neonatal morbidity, it is likely to lead to a sepsis evaluation in the neonate, which involves separation from the mother, special care nursery admission, invasive diagnostic procedures and possibly antibiotic treatment until test results are available. Lieberman et al (1997) found that 34% of babies born to epidural mothers had a sepsis evaluation, compared to 9.8% of non-epidural babies.

There has been a noticeable lack of research and information about the effects of epidurals on babies (Howell 1992), with still many unanswered questions. Drugs used in epidurals can reach levels at least as high as those in the mother (Fernando et al 1995), and, as with opiates, these drugs take a long time to be cleared from the baby's body, because of the baby's immature excretory systems. For example, the half-life of bupivacaine, the most popular local anesthetic used in epidurals, is 8.1 hours in the neonate, as compared to 2.7 hours in the mother (Hale 1998). Although findings are not consistent, possible problems, such as rapid breathing in the first few hours...
highest pain ratings) are the most satisfied guarantee satisfaction after childbirth. In fact, contrary to the expectation that pain.

Several studies have found subtle but definite changes in the behaviour of newborn babies after epidurals (Scanlon et al. 1974; Morikawa et al. 1990; Lester et al. 1982), with one study showing that behavioural abnormalities persisted for at least six weeks (Rosenblatt et al. 1981). Other studies have shown that, after an epidural, mothers spent less time with their newborn babies (Sépkowski et al. 1992) and described their babies at one month as more difficult to care for (Murray et al., 1981).

The hormonal effects of epidurals may explain some of these findings. Women who use epidurals in labor have diminished release of labor hormones, including catecholamines, which catalyse the final powerful contractions of labor (Jones et al. 1985); oxytocin (Goodfellow 1983); and beta-endorphin (Brismed 1985). Such changes may disrupt early maternal and/or neonatal hormones, as well as the subtle interaction between new mother and baby. Buckley (2004) offers a fuller account of the hormonal effects of epidurals.

Although there is scant research about the effects of epidurals on breastfeeding, there is evidence that babies born after an epidural have diminished suckling reflexes and capacity (Riordan et al., 2000), consistent with drug-related neurobehavioral deficits as above. A recent study showed that, for healthy full-term babies born vaginally, exposure to an epidural reduced their chances of being fully and successfully breastfed before hospital discharge (Baumgarten et al. 2003).

In light of the studies by Jacobson (1990) and Nyberg (2000) mentioned above, which link use of drugs in labor with increased risk of addiction in adult offspring, it is interesting to note that an upsurge in cocaine addiction began around 20 years after the introduction of epidural drugs, all of which contain cocaine derivatives.

The popularity of epidurals reflects their strong analgesic efficacy, but this does not guarantee satisfaction after childbirth. In fact, contrary to the expectation that a pain-free birth is best, many studies show that women who use no analgesia (and have the highest pain ratings) are the most satisfied long-term (Green 1990, Morgan et al 1982). Further, as Hodnett (2002) comments, "Pain relief and satisfaction with pain relief are not the same" (p. S165). Epidurals also increase the number of obstetric interventions, which is associated with lower overall satisfaction ratings in large surveys (Hodnett 2002). Note also that many surveys of satisfaction with childbirth are done while the women are captive, in hospital, within a few days of birth. These studies are likely to be colored by either a halo effect or the "what is, must be best" effect, as well as by the relationship between researcher and participant (Hodnett 2002).

Oxytocin

The pituitary hormone oxytocin was first synthesised in 1955 by the American biochemist Vincent du Vigneaud, who received a Nobel Prize for his work (den Hertog 1994). Now Syntocinon/Pitocin is one of the most widely used (and, I believe, abused) drugs in obstetrics.

Synthetic oxytocin (Syntocinon, Pitocin) is used to induce and to augment (or accelerate) labor, as well as for prevention and treatment of postpartum hemorrhage. Currently, almost all women giving birth under obstetric care will receive oxytocin for one of these indications. In some circumstances, oxytocin can be a life-saving drug, but its administration in labor can also put both mother and baby at serious risk.

When used for induction and/or augmentation, oxytocin is administered to the pregnant women via a drip, with the dose usually being doubled every 30 minutes until adequate contractions are produced. Theobald (1974) has estimated that oxytocin levels in a woman receiving an oxytocin drip at 32 mU/minute, with a half-life for oxytocin of 3–5 minutes (which may be actually longer), will have blood levels of 40,000 mU/ml. This is between 130 and 570 times greater than oxytocin levels in a natural labor (70–300 mU/ml).

The risks of these abnormally high levels are well documented. A woman's oxytocin-induced contractions will be longer, stronger and closer together than her body would normally produce, and the resting tone of her uterus will be higher. All of these factors reduce her baby's blood supply during contractions and give less of a break in between to recover. Haire (2001) comments, "The situation is analogous to holding an infant under the surface of the water, allowing the infant to come to the water to gasp for air, but not to breathe." With this loss of blood and oxygen, the baby will be at risk, as the Pitocin package insert warns, of fetal heart abnormalities (bradycardia, premature ventricular contractions and other arrhythmias); low 5-minute Apgar scores; neonatal jaundice; neonatal retinal hemorrhage; permanent central nervous system or brain damage and fetal death (Haire 2001). It is ironic that babies induced because of concerns about their health will be exposed to further risks through the process of induction.

These stronger, oxytocin-induced, contractions can be hazardous to women, as well as their babies. Uterine rupture may occur, which may result in emergency hysterectomy (Stubbs 2000) or even maternal death. In addition, the induction may fail, as oxytocin is more effective at causing a woman's uterus to contract than causing her cervix to dilate (Stubbs 2000). It is also highly likely that women who have an induction with oxytocin will have a more painful labor, necessitating drugs for pain relief, as well as beginning the "cascade of intervention" that can end with a cesarean or instrumental delivery.

The second important aspect of oxytocin administration relates to its hormonal effects. Oxytocin has been called the hormone of love because of its connection with sexual activity, orgasm, birth and breastfeeding. In addition, oxytocin is produced in social situations, such as sharing a meal (Verbalis et al, 1986), making it a hormone of altruism, or, as Michel Odent (1994) suggests, of "forgetting oneself.

Oxytocin is naturally secreted from a laboring woman's posterior pituitary, being distributed first to local areas in her brain and then in her general circulation, and so reaching her uterus, where it causes her uterus to contract. In labor, oxytocin levels are relatively constant until close to the time of birth (Steer 1990), but the uterotonic effect strengthens, because the woman's uterus becomes increasingly responsive to oxytocin as labor progresses. In her brain, oxytocin helps to prepare her for motherhood, as well as continuing, as in pregnancy, to keep her feeling relaxed and loving (Russell et al 2001, Uvnäs-Moberg 1998).
When oxytocin is administered into a laboring woman's blood stream, however, it cannot cross from her body back to her brain through the blood-brain barrier. This means that Syntocinon/Pitocin cannot act as the hormone of love, nor of maternity. However, it does provide the hormonal system with negative feedback—that is, oxytocin receptors in the laboring woman's body detect high levels of oxytocin and signal the brain to reduce production. We know that women with Syntocinon infusions are at higher risk of bleeding after the birth, because their own oxytocin production has been shut down (Gilbert 1987, Phillip et al 2004). However, we have not yet researched the subtler, but equally important effects of a reduction in oxytocin levels on brain, emotions and mothering behaviours.

Other risks of oxytocin relate to induction of labor. These include iatrogenic prematurity (because of mistakes in dates); increased risk of cesarean (around twice overall for first-time labors compared to non-induced labors and even more when the woman's cervix is unripe, Johnson et al 2003); increased risk of uterine rupture after previous cesarean (Lyndon-Rochelle et al 2001); and umbilical cord prolapse, if the membranes are artificially ruptured as well.

### Barbiturates

Barbiturates are powerful nervous system depressants and were widely used as sleeping pills until the 1970s, when benzodiazepines became available. The first barbiturate to be used clinically was phenobarbitone in 1912 (Burt 1971), and barbiturates were subsequently given to women in childbirth to relax and sedate them. Like twilight sleep, which barbiturates largely replaced, moderate doses of barbiturates induce a retrospective amnesia. As Eastman (1970) enthuses, "The results are usually very satisfactory, the patient knows nothing about her labor, and awakening several hours after the baby has been born" (Quoted in Arms 1996, p. 79).

Barbiturates readily cross the placenta and accumulate in the fetal brain and liver. Large doses may cause a drop in blood pressure and pulse rate as well as respiratory depression in mother and/or baby (Burt 1971). Burt notes further, "Euphoria and impairment of fine judgement may persist for many hours after the drowsiness and sedation has worn off." For the baby, barbiturates cause neurobehavioral depression that lasts several days (Kron et al 1966, Hodgkinson 1977). A 1988 study noted that barbiturates were still being used in obstetrics to prevent epileptic seizures and hyperbilirubinemia and to placate "the stressful effects of labor." These researchers found that administration of phenobarbitone for three days before birth altered brain development in rats (Jacobson 1988).

Studies of drug addiction in adult offspring exposed to drugs in labor (Jacobson et al. 1990, Nyberg et al. 2000) also implicate barbiturates. When barbiturates and/or opiates were administered between 0.5 and 1.5 hours before birth, offspring had 3.5 times the risk of becoming addicted to opiates in adulthood. Single doses increased the risk by 1.6 for opiates and 1.7 for barbiturates (Jacobson 1990). Barbiturates continue to be used for the treatment of epilepsy, but the only barbiturate still commonly used in childbirth is the short-acting thiopentone (Pentothal), used for induction of general anesthetics.

### Benzodiazepines

Benzodiazepines were first synthesised in 1933 and became popular substitutes for barbiturates because it was erroneously believed that, unlike barbiturates, these new drugs had no addictive potential. Benzodiazepines include the long-acting drug diazepam (Valium), used as a sedative and muscle relaxant and shorter-acting compounds such as midazolam (Hypnovel, Versed), used to induce sedation and amnesia before
general anesthetic and other medical procedures. Like the barbiturates, benzodiazepines were used to sedate laboring women, with little analgesic effect.

Benzodiazepines can cause a drop in maternal blood pressure and respiratory depression; the latter can be severe when these drugs are given with opiates. Diazepam is slowly metabolised and crosses the placenta. Because of the long action of its active metabolite, demethyl-diazepam, diazepam has a half-life of 43 hours in the adult, 20 to 50 hours in the full-term neonate and up to 400 hours in a premature baby (Hale 1997). Diazepam can cause side effects in the neonate ranging from mild sedation, hypotonia and reluctance to suck, to severe hypotonia ('floppy baby syndrome'), apnoea spells, cyanosis, and impaired thermoregulation (McElhatton 1994). Because of these effects, diazepam is not generally used in the labor ward today.

**Conclusion**

This review has touched upon some of the known aspects of several drugs used in labor, but there is much that we do not know. Firstly, we are dangerously ignorant of the effects that obstetric drugs may have on the developing brains of our babies. Haire (1997, 2001) notes, "In no other time in an individual's life is his or her brain more vulnerable to alteration, trauma and permanent injury than during the hours which surround that individual's birth" (Haire 1997, p. 2). She believes that "our embarrassingly high rate of learning disabled children" may well be due to the toxic effects of drugs used during labor (Haire 1997, p.1).

Secondly, the effects of our widespread interference in the natural processes of labor and birth go well beyond drug side effects and toxicity and include, as I have documented elsewhere (Buckley 2004), disruption of the delicate and complex hormonal orchestration of birth that has served our species for millions of years. Again, the long-term sequelae of this interference are not known.

The current situation is analogous, in my view, to our understanding and beliefs about infant feeding 50 years ago. I believe that the damage being caused by current birth practices (especially our very liberal use of obstetric drugs) is at least equal to the damage caused to generations of babies raised on human milk substitutes.

I hope the information I have provided will raise awareness of the hazards of obstetric drugs and encourage us to protect mothers and babies from the unnecessary use of drugs during this unique and crucial time. Protecting mothers and babies involves prioritising systems and models of care that value drug-free labour and birth and that support laboring women in achieving this. Birth without drugs and medical intervention is, I believe, the best birth day gift possible for all mothers and babies, and one we all deserve.

Sarah J. Buckley, GP (family MD), has been writing and lecturing on pregnancy, birth and parenting since 1997. Born in 1969 in New Zealand, Sarah inherited her interest in medicine and birth from her father and grandfather, who both worked as small-town GP-obstetricians, and her passion has been fuelled by her experiences with her own children. Sarah has deepened her understanding of birth and mothering as a journey of transformation through her participation, ongoing since 1997, in women's circles with Shivam Rachana and the Melbourne-based International College of Spiritual Midwifery, of which she is a founding member. Sarah lives in Brisbane, Australia, with Nicholas, the love of her life, and their children Emma, Zoe, Jacob and Maia Rose, all born gently at home, 1990 to 2000. Sarah is currently writing a book about ecstatic birth, due for publication in late 2005.

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