

## Pain in the Neonate

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**Abstract:** None available.

**Full Text:** Headnote ABSTRACT: While pain control in children has been poor in the past, pain control in neonates has been virtually neglected. In this review, I examine the rationalizations for not treating pain in neonates, then discuss three areas where pain control needs improvement, specifically, in surgical anesthesia, in analgesia for circumcision, and in analgesia following surgery. Suggestions are made for improving care in all three spheres. One might suspect that in our current state of development of medical technology that children and babies could be spared needless suffering from pain, but this is not the case. Pain in children is often neglected in the clinical setting, and pain in the neonate is barely even mentioned in most textbooks or in the medical literature. This lack of guidance for the practitioner is often rationalized by stating that neonates either do not consciously perceive pain or, if they perceive pain, they do not remember it because of the immaturity of their brain. Recently, however, it has become clear that neonates do sense pain, that physiologic changes occur when neonates suffer pain, and that these physiologic changes can impede healing in small babies. This new information, plus an awakening of concerns about humanitarian treatment of patients, has led to interest in better management of pain in neonates. I will first examine the rationalizations for not treating pain adequately in the neonate. The first is that neonates do not consciously perceive pain. Recently an editorial has reviewed the evidence that neonates respond to painful stimuli in a way that is consistent with conscious perception.<sup>1</sup> The following lines of evidence are presented: (1) The cerebral cortex and other nervous system parts necessary for conscious perception are present. (2) Infants respond to painful stimuli with crying, movement, and facial grimacing. The facial expressions that they make are identifiable as those consistently associated with discrete emotions-evidence of higher nervous system input. (3) Behavior is disturbed after circumcision-more evidence of higher nervous system input. Thus, after examining these arguments, one must conclude that there is evidence that higher centers are functioning, indicating that infants may very well perceive pain. The second rationalization for inadequate pain therapy is that even if infants feel pain, they do not remember it. It is clear that many early experiences are repressed, but in spite of not being remembered they can influence later behavior. An example of the presence of "memory" in neonates is the fact they they can undergo learning processes, such as habituation, classical conditioning, and operant conditioning.<sup>2</sup> There is also the suggestion that circumcision may result in later behavioral differences between males and females.<sup>3</sup> Thus we are forced to conclude that infants may have "memory" for painful events. If the perception of pain can influence later behavior, then we must be concerned with treating it effectively. In evaluating the neonate's behavioral response to pain, one must remember the limited behavioral repertoire of the neonate. It is possible that the neonate does not respond as an adult does to painful stimuli not because of limited sensory or perceptual processes, but because of limited motor capabilities. I will now emphasize three areas of neonatal pain management where great improvements need to be made, specifically neonatal and premature neonatal surgical anesthesia, neonatal circumcision, and postoperative pain control. Part of the problem of managing pain in these situations is that we lack full understanding of the physiology of pain in the neonate and we lack age appropriate forms of treatment. This lack of knowledge is in contrast to the situation in adult pain management. When dealing with an adult, appropriate methods of treatment are available for all of these three causes of pain, but pain is often inadequately treated because the methods are not universally applied. In neonates, however, in addition to the problem of lack of application, there is also a problem in understanding appropriate and safe techniques for managing pain. Fortunately, we are approaching a state of knowledge in

the field of anesthesia where the first two situations (that is, surgical anesthesia and circumcision) can be, by and large, dealt with in a nonpainful way, but postoperative pain management in neonates remains a problem.

**SURGICAL ANESTHESIA** In the past 20 years great advances have occurred in the treatment of severe and life-threatening illnesses in infants, both term and pre-term infants. Astounding survival rates are now being achieved in even the smallest of babies, and many "now survive long enough to develop surgical problems for which they require an anesthetic. Many of these problems result from a premature birth, and the problems are often of such significance that surgery is required during the neonatal period, at a time when the baby is still critically ill. Anesthetizing these babies has been, and remains, a challenge for the anesthesiologist. One method of providing "anesthesia" is to continue life support while adding a neuromuscular blocking agent. These sorts of drugs prevent transmission of impulses from nerve to muscle; thus muscles are paralyzed and do not move. Use of these agents provides adequate operating conditions for the surgeon, but these drugs do not alter perception of pain, thus no alteration of the painful effects of the surgical procedure is provided to these helpless infants. This anesthetic technique has been, by and large, abandoned because of ethical reasons, but may persist in some institutions. An alternative anesthetic procedure is the so called "Liverpool technique," which consists of the use of oxygen, nitrous oxide and neuro-muscular blocking agents. Nitrous oxide is an anesthetic which provides excellent analgesia, but at atmospheric pressure at sea level cannot provide complete anesthesia. When adults are subjected to such an anesthetic technique, there is an incidence of recall of approximately 50%, that is, patients have conscious recollection of intraoperative events (conversations, etc.). This "Liverpool technique" has been a standard anesthetic technique for neonates for some time, and is a very safe technique in terms of immediate short term outcome. In the past many anesthesiologists have avoided the addition of more potent anesthetic agents out of concern that such small and frail babies would not tolerate deeper anesthesia with more potent agents. In fact, it has been shown that more potent agents, such as halothane, cause exaggerated depression of heart function in newborns and preterm infants.<sup>4</sup> Recently the "Liverpool technique" has been subjected to scientific study by Anand et al.,<sup>5</sup> who studied pre-term infants undergoing surgery. The patients were anesthetized with the "Liverpool technique," and in half of the babies, supplemental fentanyl (a short-acting, very potent narcotic) was added in doses sufficient to provide adequate anesthesia, sufficient to abolish recall in most adults. The investigators measured blood levels of a number of hormones thought to be chemical indicators of stress, and they followed the patients and evaluated their outcome. The investigators found that in the group of babies anesthetized with the "Liverpool technique" without added fentanyl, there was a prolonged catabolic response to surgery, that is, following surgery these babies demonstrated the normal response of utilizing body tissues for energy supply, and that this response was prolonged in the babies not given fentanyl. This catabolic response is important because adequate healing does not occur in the face of catabolism. In addition, in the group treated with the "Liverpool technique" alone, there were more postoperative complications. Following this study, there was a good deal of discussion. A parliamentary investigation in Great Britain was begun because of the allegation that the investigators were experimenting on helpless infants. Several letters to the editor suggested that the authors were studying an inadequate anesthetic technique,<sup>6-7</sup> but the authors of the study replied that in fact they were merely studying a well accepted technique, and comparing it to an improvement on this technique.<sup>8</sup> In the United States, as a result of information unrelated to Anand's study, concern has arisen about the appropriate anesthetic technique to use for small premature infants. Sufficient concern has been generated that the American Academy of Pediatrics appointed a committee to develop a statement about appropriate anesthesia for pre-term neonates. This statement has been published and is available for review<sup>9</sup> and a recent editorial in the journal, *Anesthesiology*, emphasizes the need for anesthesia in premature infants.<sup>10</sup> It appears, then, that in addition to ethical considerations, there are sound physiologic reasons to provide adequate anesthesia for pre-term newborns, just as there are similar reasons to provide such anesthesia for older children and adults. In addition, there are now techniques which are available that allow anesthesia to be provided to these very sick infants in a

reasonably safe manner. While some improvement in the techniques can be expected, the biggest problem in ensuring that neonates get adequate anesthesia is ensuring that they are anesthetized by individuals familiar with these techniques and who are comfortable in dealing with small, sick, premature infants.

### ANALGESIA FOR CIRCUMCISION

Another area where an improvement in care can easily be effected with current knowledge is in the management of analgesia during circumcision. While many have questioned the necessity of routine neonatal circumcision, others have suggested that there are valid medical reasons for continuing this procedure.<sup>11</sup> The debate continues, but it is clear that circumcision will continue to be done for the foreseeable future. Distraction is the standard anesthetic practice for newborns undergoing circumcision in the newborn nursery. Usually no local, regional, or general anesthetic technique is applied. If these same infants, however, go home and come back to the hospital for an operative circumcision, they will almost always have an anesthetic done in the operating room. It has been shown that infants do respond to the pain associated with circumcision. They respond with an increased heart rate, movement, crying and a decreased amount of oxygen in the blood,<sup>12-13</sup> and an increase in Cortisol and cortisone levels in the blood.<sup>14</sup> Following the procedure, there is a change in sleep and behavior patterns.<sup>15-16-17</sup> Thus, it is evident that newborn infants can perceive and do respond to the painful stimulus of the circumcision. The long term effects of routine circumcision without anesthesia are unknown, although it has been suggested that this procedure may alter personality development.<sup>3</sup>

### Analgesic techniques are readily available for circumcision.

Analgesia can be applied by the use of either local infiltration or a nerve block of the penis,<sup>12-18</sup> or standard operating room anesthetic techniques can be used. The major need in circumcision is for these techniques to be taught to those who are doing routine circumcision.

### POSTOPERATIVE ANALGESIA

The third area where an improvement in pain management for neonates needs to occur is in the management of pain after surgery. This is a neglected topic, and, even in adults, postoperative analgesia is often poorly managed. Generally, for adults, intramuscular narcotics are prescribed on a 4 hourly basis, with fixed dose for all patients. Unfortunately, the variability of patient's pain requires more precise tailoring of the prescription. As a result of prescribing the same pain medication for all patients, some may suffer from inadequate pain management. In neonates, the situation is more complex. We lack validated methods of pain assessment in infants, and determining that a baby is in pain relies to a large extent on the nurse's intuition and clinical experience. In addition, the standard pain management techniques that can be applied in adults are felt to be dangerous in babies. Many advise against using narcotics for pain relief in newborns because of infants' propensity to develop respiratory complications from the narcotics. These complications probably result from the fact that narcotic clearance is prolonged in newborns,<sup>19</sup> that is, newborn livers and kidneys do not rid the body of the narcotic as rapidly as is seen in adults, and blood levels of drug accumulate. Secondly, in neonatal rats there is a more rapid transfer of narcotic from blood to brain,<sup>20</sup> and the brain concentration is increased for a given dose. If a similar rapid transfer to brain occurs in humans, this concentration may increase the risk of complications, particularly respiratory complications. Because of these problems with pain assessment and with safe pain management, infants are frequently undertreated for pain. They may receive drugs (e.g., acetaminophen), but the effectiveness of these nonnarcotic agents for the treatment of postoperative pain in neonates has not been established. Thus, the situation with respect to improving postoperative pain management in neonates is quite difficult. We need much more research into methods of pain assessment, and considerably more information about safe methods of pain management in newborn infants. In conclusion, pain management in newborn infants has been neglected. In the areas of operative anesthesia and analgesia for circumcision, techniques are becoming available which can be applied to most newborns in a safe and efficacious manner with a resulting reduction in pain. With respect to postoperative pain, however, techniques need to be developed which can be applied to newborns to allow these patients to recover from their surgery without suffering unneeded pain that is often inflicted upon them.

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