

## **MINIMIZING PAIN IN THE NICU**

My primary goal is to arm parents with some medical knowledge about pain in the NICU so they can be better advocates for their babies.

### **BABIES AND PAIN**

Unfortunately, not long ago many doctors believed that babies could not feel pain. However, all lines of evidence suggest that babies, even very premature babies, do indeed feel pain. Babies behave as though they experience pain, (both in their movements and in their heart rate, blood pressure, breathing, etc.). They have the nerves in place that send pain messages from the body to the brain, and they have all of the chemical and hormonal changes in blood tests that people of other ages have when they are in pain. They just can't tell us about it in words, and they can't recall it when they are older. They can't show us they are in pain, either, if they are paralyzed with drugs for an operation, a frightening situation that happened too often in the past.

There is evidence that babies do carry a memory of painful experiences with them, at least for awhile. In one study, for example, boys who had been circumcised showed more distress with their two month baby shots than did boys who had not been circumcised. While much progress has been made since the "babies can't feel pain" days, babies still tend to be treated less than older children and adults for painful procedures. This points to one important way parents can help their babies in the NICU, by simply insisting that the NICU staff to use pain relief appropriately.

### **ASSESSING PAIN IN THE NEWBORN**

Accurately assessing pain in adults is difficult enough, but the problems are much greater in the newborn.

Pain is much more than nerves sending messages of tissue injury to the brain. Our interpretation of pain is a very personal thing, highly influenced by our past experiences and by our state of mind. These additional factors make pain assessment difficult even in adults, because we must rely on their verbal reports of what their personal interpretation of their pain. Add on the lack of language and later recall of newborns, and you have a problem with no complete solution. Even sophisticated tests like the measurement of adrenaline levels in the blood fail as "gold standards".

Knowing that there is no perfect solution does not mean that partial solutions are not possible and useful, however. Many attempts have been made to construct scoring systems to evaluate pain in newborns. These various systems look primarily at behavioural (crying, body movements, etc.) and physiologic (heart rate, blood pressure, etc.) cues.

Even these more objective scoring systems can easily fail us, however. Common experience tells us that not all crying babies are in pain. Conversely, a chronically ill and chronically stressed baby in the NICU may "shut down" and react little or not at all to things we know must be painful.

## **PREMATURE BABIES AND PAIN**

Although premature babies usually have weaker and less consistent reactions to pain, they may actually be more sensitive to pain than full term babies.

After a painful event, premature babies will often react to non-painful events as though they were indeed painful. This makes the general rule of "staying ahead of the pain" (that is, giving pain killers before pain occurs, rather than after) all the more important in preemies.

### **WHY RELIEVE PAIN?**

Besides the obvious effect on comfort, there are other good reasons to relieve pain. Pain leads to a stress response, which includes an outpouring of stress hormones by the body, which can make it harder for a sick baby to recover.

In a pilot study for a currently ongoing larger study, sick premature babies given morphine (which gives both pain relief and sedation) were more likely to survive without severe brain injury (such as severe intraventricular hemorrhage) than were babies who were given sedation only or no medications at all.

In carefully done medical experiments, babies who received deeper anesthesia during and after surgery had fewer serious complications (such as infections) than did comparison babies who received more standard (at that time) anesthesia.

So pain relief is more than "just" a matter of comfort, it can decrease complications, too.

### **SYSTEMIC PAIN MEDICATIONS**

The most commonly used pain medications are morphine and fentanyl, which are both members of the opiate group of drugs. Both are potent pain killers, especially in high doses, and are also fairly good sedatives. This is a good combination for the NICU setting, because both pain relief and sedation are often needed.

Morphine's advantages are less difficulty upon withdrawal, somewhat better sedation, and no problems with the "rigid chest" issue (which interferes with breathing) that sometimes occurs with fentanyl.

Fentanyl's advantages are less trouble with lowered blood pressure and a more rapid onset of pain relief.

Standard doses exist for these potent medications, but the standard dose may not be enough for an individual baby. Premature babies may need higher doses of opiates than full term babies to get the same effect. This is especially true if the baby has been on opiate medications in the recent past, because babies (both premature and full term) can become "tolerant" of opiates, and therefore need a greater dose to achieve the same effect.

Both doctors and parents worry about babies having difficulty withdrawing from these opiate drugs. Some care must be taken, but this can be accomplished with far less discomfort than would occur if these medications were not used.

Acetaminophen (Tylenol) is also sometimes useful. It can be used alone for mild pain, or combined with morphine or fentanyl to lower the amount of opiate needed, (and therefore lessening side effects).

Sucrose (ordinary table sugar) appears to have some pain-relieving properties, for reasons not well understood.

## **SEDATIVES**

There are other drugs that provide no pain relief, but will calm a baby upset by something other than pain. The best known member of the benzodiazepine group is Valium, but Valium is rarely used in newborns. Two other drugs from that group, midazolam (Versed) and lorazepam (Ativan) are more commonly used.

These benzodiazepine drugs appear to be quite safe for full term babies, but have been reported to cause seizures in some premature babies. This is an interesting paradox, because the same drugs are sometimes used to stop seizures, and the explanation for this is not clear at this time, although theories exist. Some neonatologists believe that these drugs are less likely to cause seizures if they are given slowly and if they are used sparingly. Seizures caused by these drugs in premature babies are over within a few minutes. It is not clear if this is harmful or not in the long run, but certainly at least the potential for long term harm exists.

Chloral hydrate can be used to induce sleep, and is sometimes used for painless procedures like CAT scans.

Sedation should not always be used when a baby is uncomfortable. If the cause of the discomfort can be eliminated, then no sedation should be needed. For example, it is silly to sedate a baby who is upset because her diaper is wet.

## **LOCAL ANESTHETICS**

By far the most commonly used local anesthetic in the NICU is lidocaine. Lidocaine comes in different forms, however.

Lidocaine can be used with or without added epinephrine (adrenaline). Epinephrine causes blood vessels to constrict, which can help local anesthesia in a couple of ways.

First, it keeps the lidocaine in the painful area longer, because there is less blood flow to carry the lidocaine away. In so doing, it also lessens the chance of toxicity, because the body as a whole is exposed to it more slowly. There are certain parts of the body, however, where epinephrine cannot be used. (There may be no better example of the latter point than that of circumcision.)

Lidocaine stings when it is injected, beyond the sting caused by the needle used to inject it. The sting of lidocaine injection can be decreased by adding some sodium bicarbonate to the lidocaine. This allows the lidocaine to be absorbed into the nerves more quickly.

Lidocaine can also be used as a cream that is simply placed on the skin rather than injected, as in the EMLA patch. This sounds great in theory, but there are some practical problems. It takes an hour or so to optimally numb an area, and there may not be that much notice when a painful procedure is to be done. If an IV is being placed or blood is being drawn from a vein, the attempt at the numbed spot may fail. Last, another ingredient

in the EMLA patch can alter the baby's hemoglobin into a nonfunctioning form called methemoglobin, although the levels of this methemoglobin appear to be acceptable after a single use of the EMLA patch. A recent study showed that EMLA patches lessened indications of pain in premature babies who were having long-term IVs placed.

There is growing experience with another injectable local anesthetic, bupivacaine, which has the advantage of keeping the area numb longer than lidocaine does. The same points about epinephrine and bicarbonate noted above for lidocaine are true with bupivacaine, too.

## **POSITIONING**

Keeping a baby comfortably positioned can also decrease signs of distress during a painful procedure. Most babies are more comfortable with their bodies and legs flexed, and their hands under their chins, but each baby has his or her own preferences.

## **IVs AND BLOOD DRAWING**

Many of the more unpleasant things we do to babies in the NICU are related to obtaining blood samples and maintaining IV access for IV nutrition and medications.

A recent experiment suggests that drawing blood from babies with a needle into a vein, as is usually done for adults, is less painful than a heel stick. If a stick must be done, another recent experiment suggests that it is less painful to intentionally pop a small vein with a needle than to lance a heel.

If a baby has no long-term lines, needle pokes for blood tests can be minimized by grouping tests into single pokes. Again, some forethought can often save a baby from some pain.

When babies need frequent blood tests, however, the most comfortable way to get blood is from a long-term line in an artery or a large central vein.

## **UMBILICAL LINES**

Fortunately, babies are born with quick and easy access to their bloodstream via the blood vessels of the umbilical cord. The umbilical cord has no sensation, so there is no pain with the placement of umbilical lines other than the baby's objection to being held relatively still.

For most sick babies, a line can be placed in both the umbilical vein and an umbilical artery.

Where I work, the umbilical vein line is usually a double line, so it can function as two separate IVs. One of them carries the main IV fluid and any continuously infused medications, such as dopamine for blood pressure support. The other is used for medications and blood transfusions. The line in the artery is used for blood sampling and blood pressure monitoring. With this combination, babies rarely need any additional IVs or needle pokes for blood samples.

Also, where I work, we used to remove umbilical venous lines fairly early, fearing that a line in the umbilical cord would get infected more easily than a line placed somewhere else.

Experience in large medical studies has not shown that assumption to be true, so we now leave our double umbilical venous lines in for extended periods.

## **OTHER LONG-TERM LINES**

Babies in the NICU often need long-term lines other than umbilical lines.

When other arterial access is needed for frequent blood sampling or continuous blood pressure monitoring, many arteries can be used. The radial artery, the one where you can feel your pulse in your wrist, is the one most often used, but there are others. A bright light which shines through the wrist usually gives a good view of the artery while the line is being put in. Pain relief with sedation and, if possible, brief paralysis can make the insertion procedure easier for everyone. Atracurium is a paralyzing drug that lasts for about 15-20 minutes, and I use it often for placing such arterial lines in babies who are intubated. (The ventilator may have to be adjusted while the baby's breathing efforts are stopped by the paralysis.)

When other long-term vein access is needed, it is generally best to place another sort of central venous line. A venous line is considered "central" when its tip is in a large vein somewhere within the chest or abdomen, usually just outside the heart. These lines can last for a long time, because the larger veins have thicker walls, and the large amount of blood flow quickly carries away any irritating IV fluid. The main risks of these lines are infection and clot formation. Simple "peripheral" IVs, such as those placed in the hands, can also get infected and can cause local tissue injury when they wear out. Central venous lines may carry a little more risk than peripheral IVs in terms of infection, but they mean a lot less pain and stress for the baby. Central lines go by many other names. They can be called long lines, deep lines, PICC (percutaneously inserted central catheter) lines, or other names.

I like to place central venous lines by cutdown, rather than through a needle punched through the skin, for four reasons. I feel I can give better local anesthesia if I don't have to worry about obscuring the vein from view. I can also get a larger size line in by cutdown, which can usually be used for blood sampling, saving the baby some needle pokes later on. I can tunnel the catheter under the skin for a fair distance between the vein insertion and skin insertion sites, which makes the line easier to secure while giving the baby more freedom to move, and may decrease the chance of infection caused by skin germs reaching the bloodstream. Last, the cutdown procedure is less likely to end in failure (no IV placed) than is the needle approach.

## **GETTING "EXTRA" WORK OUT OF A LINE**

Additional IVs can sometimes be avoided by knowing details of drug incompatibilities. We have also found that peripheral arterial lines can be used for a very limited group of medications, which can often preclude the need for another IV.

Before removing a line, we should think carefully about any last uses for the line before it is removed. It is unfortunate when a line is removed, and it is realized too late that some blood tests or a transfusion are needed.

When drawing blood samples from any long term line, we always use a rig of our own design which minimizes the number of "breaks" into the line, which should (but is not proven to) decrease the chance of infection.

## **SKIN CARE**

Skin that has been injured can be particularly painful. This is primarily a nursing issue, and is most important for the immature skin of the micropreemie. Potential trouble spots can often be found before skin injury occurs. Tape should be used minimally. Tape does not always have to be taken off the skin to remove a device it is holding in place. Peripheral IVs should always be watched carefully, to minimize nasty sores that sometimes result from IVs left in a little too long.

Studies are going on now about the use of a skin cream called Aquaphor, which certainly seems to help the skin of premature babies stay healthier. It leaves the skin rather greasy, though, which causes some practical problems with taping things to the skin. There is also the ever-present concern that harmful chemicals from the Aquaphor could be absorbed through the skin, and this has kept some NICUs from using this treatment.

## **THE BREATHING PROBLEM**

One of the fundamental problems with keeping babies comfortable with medications is that these medications also tend to suppress breathing. For short-term sedation and pain relief, this is less of a problem, especially if the baby is still intubated. Even when a baby is not intubated, morphine can be given for sedation and pain relief during a procedure. At the end of the procedure, the morphine's effect can often be stopped with a drug called naloxone (Narcan). Naloxone might not be used, however if the baby is also getting long term sedation.

It is this long-term sedation/pain relief that is often the biggest problem. On one hand, we want the babies to be as comfortable and unstressed as possible. On the other hand, we want the babies as awake as possible, so they can breathe well, be taken off the ventilator, and breathe on their own. This problem most commonly comes up in the smaller premature babies, who are often intubated for many weeks and often have their lungs injured (bronchopulmonary dysplasia or BPD) as a result.

Where I work, we feel we have found a good way around this problem that works well for most babies, especially for the "micropreemies". We keep the tiny preemies heavily sedated for the first three days, when the risk of brain bleeding is highest and the babies are usually the sickest. At that point, we take an unorthodox step. We reverse their sedation (by giving a drug, called naloxone or Narcan, that is an "antidote" to morphine) and extubate them to nasal CPAP at three or four days of age. This seems to be a good compromise. The babies are heavily sedated when they are the sickest, and yet get off the ventilator quickly, which probably accounts for our very low rate of BPD in our tiny babies. It may be that the well-rested baby who has been well sedated is (paradoxically) easier to extubate than a more stressed baby who has been kept more awake to encourage more spontaneous breathing.

## **CONCLUSION**

We will probably never eliminate all discomfort in the NICU. By using developmentally appropriate care, providing care in such a way as to minimize painful procedures, and using appropriate sedation and pain relief, we can make the best of a difficult situation.

Resources: <http://hometown.aol.com/dderleth/minpain.html>