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QUARTERLY NEWS
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Improved Heroin Detection Using Umbilical Cord Tissue

By Joseph Salerno, Science Writer, USDTL

In the years 2011-2012, nearly 6% of pregnant women between 15-44 years of age used illicit drugs, including heroin, while pregnant.[1] Heroin use in the United States has increased 65% over the past decade.[1] Experts attribute the sharp rise to tighter controls on the distribution of prescription painkillers. Decreased access has driven up the cost of opioids such as oxycontin and hydrocodone, driving painkiller addicts to cheaper alternatives, primarily heroin.

The Child Abuse Prevention and Treatment Act requires States to establish policies and procedures for reporting cases of newborns exposed to illegal substances to child protective services agencies, and to establish plans of safe care for these newborns.[2] Forensic drug testing of newborn samples such as umbilical cord tissue provides a tool for health practitioners to objectively identify when newborns have been exposed to maternal substance abuse. Unfortunately, prenatal heroin exposure is difficult to discern from morphine or codeine given to the mother during delivery. Recent research from USDTL demonstrates an improved ability to distinguish between heroin exposure and administration of codeine or morphine.

The Difficulty of Heroin Detection

After ingestion, heroin is rapidly converted to its metabolite, 6-monoacetylmorphine (6-MAM), which is then quickly converted to morphine. To identify prenatal heroin exposure, umbilical cord tissue is typically tested for both 6-MAM and morphine. Due to its swift conversion to morphine, 6-MAM may not be present in the umbilical tissue at detectable levels, causing a positive drug test for morphine only. Morphine is also a metabolite of the medication codeine, and a stand-alone drug as well. As a result, prenatal heroin exposure may go unidentified in an umbilical cord that tests positive only for morphine, especially if the mother has been given codeine or morphine during delivery.

Improved Testing for Newborn Heroin Exposure

Heroin is produced by chemically modifying the morphine molecule. During the process, other contaminating compounds are produced in the heroin product, including a substance called noscapine, which is not found in codeine or morphine. While heroin is being metabolized to 6-MAM and morphine, noscapine is converted by the body into a compound called meconin. The presence of meconin in an umbilical cord sample helps to distinguish between newborn heroin exposure from administration of codeine or morphine during delivery.

Researchers at USDTL seized upon this knowledge to work to improve their ability to detect heroin exposure. They took a two-fold approach. First, they improved their method for detecting 6-MAM in umbilical cord tissue. The lowest concentration of a substance that can be reliably measured in a drug testing sample is called the limit of quantification (LOQ). USDTL's R&D scientists were able to lower the LOQ for 6-MAM from 0.8 ng/g down to 0.2 ng/g. Second, they were able to develop the science to detect meconin in umbilical cord tissue, which had previously only been reported in urine samples.[3]

USDTL researchers then retested 46 authentic umbilical cord specimens using the lower 6-MAM LOQ. When previously tested using the LOQ of 0.8ng/g, only two of the specimens tested positive for heroin exposure. Using the new LOQ, that number improved to five positive specimens, a 150% increase in the detection rate.

Additionally, USDTL added the detection of meconin to their opiate drug class testing, at an LOQ of 0.2 ng/g. (The opiate drug class screen also includes the detection of 6-MAM, meconin, morphine, codeine, hydrocodone, and hydromorphone.) In the year following the addition of meconin to the opiate screen, 97 umbilical cord specimens tested positive for heroin exposure. Of those, 11 were identified solely by the detection of meconin and did not contain measurable amounts of 6-MAM. The result is a 13% increase in the detection of newborn heroin exposure over the previous test.

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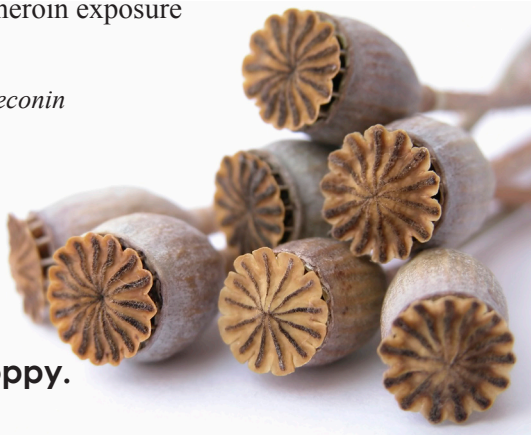

Heroin and morphine are both produced from the seeds of the opium poppy.

The Transfer of Drugs and Alcohol Through Breast Milk

By Joseph Salerno, Science Writer, USDTL

The benefits of breast feeding for both mother and child are numerous. Research suggests the hormones and antibodies in breast milk help to reduce the incidence of certain conditions such as asthma, lower respiratory infections, and type-2 diabetes in breast fed babies. For mothers, breast feeding has been shown to reduce the risk of post-partum depression, breast and ovarian cancer, and type-2 diabetes.[1] Since 2007, the Centers for Disease Control and Prevention's (CDC) Division of Nutrition, Physical Activity, and Obesity has made great efforts to promote breast feeding of newborns in the United States to help improve the overall health of mothers and babies.[2]

Breast feeding may be a challenge for mothers who are using legal or illicit substances while lactating (producing breast milk). Studies have shown that drugs and alcohol can pass from mother to baby in varying degrees, depending on the substance ingested. The potential for adverse effects on the newborn exists when drugs or alcohol pass from mother to baby. Controlled studies to investigate the harm to newborns associated with drug transfer through breast milk are ethically impossible to conduct. Data available on this subject comes from random sampling trials, and it is important to keep this in mind when considering this information. All potential harms to the newborn resulting from drugs and alcohol in breast milk may not yet be known. The toxicology of drugs and alcohol in breast milk conveyed here come from research reported and referenced in LactMed, the Drugs and Lactation Database within the U.S. National Library of Medicine's Toxicology Data Network.[3]

Narcotic Pain Killers

Prescription narcotic use by breast feeding mothers has potentially serious consequences reported for newborns, including drowsiness, central nervous system depression, and possibly infant death. Drugs such as codeine, hydrocodone, oxycodone, and others of the same drug class are transferred in small, though easily measured, amounts. Although the amounts measured in breast milk are small percentages of the total maternal dose, they represent larger dosages to infants who are much lower body weight than their parents. Infants seem to be especially sensitive even to small doses of narcotic pain medicines. Data for prescription narcotics comes from numerous random samplings of lactating mothers receiving pain medications during hospital stays following birth. As such, research demonstrating the effects of narcotic analgesics on newborns is more abundant than for most substances.

Cocaine

Measured levels of cocaine transfer from mother to baby have varied widely and may involve several unknown variables, including maternal dosage and metabolism. Cocaine transfer to newborns is especially risky, because infants have not yet developed the enzyme that metabolizes the cocaine molecule. Without the ability to metabolize the drug, serious adverse effects on the newborn may be possible, depending on how much was transferred to the child. Observed effects on infants from cocaine exposure in breast milk have included tremors, irritability, dilated pupils, vomiting, and diarrhea.

Benzodiazepines

Benzodiazepines pass easily from mother to infant through breast milk. Benzodiazepines have long half-lives and are able to accumulate in the newborn if prolonged transfer occurs during breast feeding. Sedation, lethargy, and depressed breathing have been observed in newborns exposed to benzodiazepines in breast milk. It has been hypothesized that some benzodiazepines, such as nordiazepam, may compete with the liver enzyme bilirubin during certain, essential liver functions.

Amphetamines and Methamphetamines

Both amphetamine and methamphetamine are transferrable in breast milk, but studies examining the effects on newborns as a result of this transfer are scant. Product labels for therapeutic amphetamines list hypertension, tachycardia, and seizures as potential effects on newborns, based on animal studies. Little is known about the effects of methamphetamines on newborns when the drugs are transferred through breast milk. One case study involving criminal prosecution suggests that methamphetamine transfer through breast milk may be fatal for newborns, but this has not been conclusively demonstrated. What is known is that amphetamines and methamphetamines may persist in breast milk as long as 24-48 hours after maternal use.

Cannabinoids

Research on marijuana use and breast feeding is limited, but it has been demonstrated that both native THC (delta-9-tetrahydrocannabinol) and its metabolite, carboxy-THC, from cannabis use can pass into breast milk in small quantities. The effects on the newborn are not well examined, but some long-term studies have demonstrated impairment of motor development.

Alcohol

Alcohol easily passes from mother to newborn through breast milk. Alcohol levels in breast milk have been shown to parallel maternal blood alcohol levels. The production of breast milk can be reduced as much as 20% following ingestion of 1-2 standard drinks. Peak alcohol levels occur in breast milk approximately 30-60 minutes after ingestion. Infants exposed to alcohol in breast milk may become agitated and experience poor sleep. Long-term effects resulting from daily maternal drinking during lactation are poorly understood, but some research suggests just 1 drink a day may impair infant growth and motor function.

Other Substances

Many other substances not described here have been measured in breast milk including, though not limited to, heroin, ecstasy (MDMA), phencyclidine, methadone, buprenorphine, barbiturates, propoxyphene, and tramadol. Due to the obvious ethical concerns surrounding controlled studies involving maternal drug usage and transfer to infants through breast milk, it is difficult to say with certainty what effects a particular drug may have on any individual newborn. What is known is that these substances are detectable in breast milk using modern toxicological instrumentation and have been shown to be transferrable to newborn infants.

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Meconin, continued from page 1

Lack of 6-MAM and Meconin Does Not Rule Out Heroin Use in All Cases

USDTL researchers caution that, although they have been able to greatly improve the detection of *in utero* heroin exposure, care must be taken when interpreting some opiate testing results. In the case of a morphine positive umbilical cord, the absence of 6-MAM or meconin does not necessarily rule out heroin use. If codeine or morphine was not administered during delivery, an unexplained morphine positive in an umbilical cord sample may require further investigation. The 6-MAM metabolite accumulates in human nails and hair as well or better than morphine. The window of detection for nail and hair testing is approximately 3 months. Further testing of maternal nail or hair samples may shed light on whether or not heroin was ingested during pregnancy.

Although the improvements in heroin exposure testing have increased the detection rate, it may be possible that some umbilical cord specimens do not accumulate measurable levels of 6-MAM or meconin. The very short half-life of 6-MAM (38 minutes) makes its detection in umbilical cord specimens challenging. It has not been scientifically determined how much 6-MAM might be trapped in umbilical cord tissue or for how long. As well, the half-life of meconin and its metabolism in the human body have not been determined. As such, 6-MAM and meconin accumulation in u-cord may depend on how much and how often a mother uses heroin while pregnant, and her personal metabolism.

The Forensic Importance of Heroin Detection

For the healthcare professional under Federal mandate to report cases of newborn substance exposure, the importance of improved heroin detection cannot be overstated. The ability to distinguish heroin use from the background of morphine only positives allows more confidence in reporting. The detection of heroin exposure using umbilical cord samples provides the forensic evidence needed. Child custody or placement may be at stake in these situations, and improvements in objective testing for prenatal drug exposure add confidence to reporting policies and procedures.

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Quarterly Perinatal Newsletter

Upcoming Events:

- August 21-22 – 24th Annual Arizona Perinatal Trust Conference – Flagstaff, AZ
- September 3-6 – 14th Annual National Neonatal Nurses Conference – New Orleans, LA
- September 7-9 – Innovations in Neonatal Care 2014 – San Antonio, TX
- September 10-13 – National Association of Neonatal Nurses 30th Annual Educational Conference – Phoenix, AZ
- September 11-12 – 2014 AWHONN Ohio Section – Perrysburg, OH
- September 19-22 – Society for Developmental & Behavioral Pediatrics 2014 Annual Meeting – Nashville, TN
- September 22 – Cooperative Caregiving Maternal Child Conference – Des Moines, IA
- October 2 – 2nd Annual Substance Exposed Pregnancy Symposium – Louisville, KY
- October 14-18 – 2014 Florida Association of Neonatal Nurse Practitioners Conference – Clearwater Beach, FL
- October 16-17 – 9th annual Professional Outreach Education Conference – Spokane Valley, WA
- October 16-17 – National Perinatal Association 35th Annual Conference – Saint Louis, MO

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