



ISSUE ANALYSIS

Fetal Pain

Arina O. Grossu

A growing body of science reveals an undisputable fact: unborn babies can feel pain by 20 weeks post-fertilization,¹ and most likely even earlier. As the medical community continues to increase its understanding of fetal pain, there have also been growing legislative efforts to protect the unborn child from barbaric and cruel suffering.

Pain (nociception) is an aversive response to a physically harmful or destructive stimulus. The National Institutes of Health define pain as, "a basic bodily sensation that is induced by a noxious stimulus, is received by naked nerve endings, is characterized by physical discomfort (as pricking, throbbing, or aching), and typically leads to evasive action."²

Unborn babies 20 weeks post-fertilization not only have the anatomy in place to process pain, but also the neurobiology to transmit painful sensations to the brain and perceive pain. Dr. Jean A. Wright, testifying at a Congressional subcommittee hearing summarized it best:

After 20 weeks of gestation [18 weeks post-fertilization], an unborn child has all the prerequisite anatomy, physiology, hormones, neurotransmitters, and electrical current to "close the loop" and create the conditions needed to perceive pain... The development of the perception of pain begins at the sixth week of life. By 20 weeks [18 weeks post-fertilization], and perhaps even earlier, all the essential components of anatomy, physiology, and neurobiology exist to transmit painful sensations from the skin to the spinal cord and to the brain.³

Embryology textbooks have precisely described the fetal and neurological development of the unborn child and peer-reviewed scientific studies have shown that unborn children 20 weeks post-fertilization and younger can experience pain. The following are some of the findings.⁴

Fetal Brain Development

- The basic organization of the nervous system is established by 28 days (four weeks) post-fertilization.⁵
- The earliest neurons are formed at four weeks post-fertilization in the neocortex, which is the region of the brain responsible for thinking, memory, and other higher functions.⁶ The earliest function of the neocortex as a network begins in the seventh week post-fertilization.⁷
- Pain receptors appear around the mouth 4 to 5 weeks post-fertilization, followed by the development of nerve fibers, which carry stimuli to the brain. Around 6 weeks post-fertilization, the unborn child first responds to touch. By 18 weeks post-fertilization, pain receptors have appeared throughout the body.⁸

FAMILY RESEARCH COUNCIL

801 G STREET NW, WASHINGTON, D.C. 20001
202-393-2100 • fax 202-393-2134 • (800) 225-4008 order line
www.frc.org

May 2014
Issue Analysis IS14E04

- The cerebral cortex, the center of pain consciousness, starts developing at 6 weeks and has a complement of neurons by 18 weeks post-fertilization.⁹
- The thalamus, which translates neural impulses going from the spinal cord to the cortex into appropriate sensations (including pain), develops between 8 and 16 weeks post-fertilization.¹⁰

By 18 weeks post-fertilization, nerve tracts connecting the spinal cord and the thalamus are in place, and nerves from the thalamus first connect with the cortex at week 20 post-fertilization.¹¹

Fetal Development of Pain Perception

The neuro-anatomical structures underlying pain perception are present in the unborn child well before the twentieth week post-fertilization.

- The neural circuits responsible for the first basic response to pain are established by 8 weeks post-fertilization. This is the earliest point at which the fetus experiences pain and can respond by withdrawing from painful stimuli.¹²
- “The earliest reactions to painful stimuli motor reflexes can be detected at 7.5 weeks of gestation [5.5 weeks post-fertilization].”¹³
- “Sensory receptors... develop in the perioral area [around the mouth] at approximately 7 weeks gestation [5 weeks post-fertilization] and are diffusely located throughout the body by 14 weeks [12 weeks post-fertilization].”¹⁴
- “The first essential requirement for nociception is the presence of sensory receptors, which develop first in the perioral area at around 7 weeks gestation [5 weeks post-fertilization]. From here, they develop in the rest of the face and in the palmar surfaces of the hands and soles of the feet from 11 weeks [9 weeks post-fertilization]. By 20 weeks [18 weeks post-fertilization], they are present throughout all of the skin and mucosal surfaces.”¹⁵
- “If pain is conceived...then it becomes possible to talk of foetal pain anytime between 10 and 17 weeks GA [gestational age i.e. 8-15 weeks post-fertilization] when nociceptors develop and mature, and there is evidence of behavioural responses to touch.”¹⁶
- “Immature skin nociceptors are probably present by 10 weeks [8 weeks post-fertilization] and definitely present by 17 weeks [15 weeks post-fertilization].”¹⁷
- “The connection between the spinal cord and the thalamus (an obligatory station through which nearly all sensory information must pass before reaching the cortex) starts to develop from 14 weeks onwards and is finished at 20 weeks.”¹⁸
- “Multiple lines of scientific evidence converge to support the conclusion that the human fetus can experience pain from 20 weeks of gestation [18 weeks post-fertilization], and possibly as early as 16 weeks of gestation [14 weeks post-fertilization].”¹⁹
- “Connections between the spinal cord and the thalamus, the region of the brain that is largely responsible for pain perception in both the fetus and the adult, begin to form around 12 weeks [post-fertilization] and are completed by 18 weeks [post-fertilization].”²⁰

The Unborn Child's Reaction to Painful Stimuli

In the unborn child, application of painful stimuli is associated with significant increases in stress hormones resulting in a stress response and elevated heart rate. An unborn child will also avoid tissue injury from pain-causing stimuli during an invasive procedure. However, unborn patients who receive fetal anesthesia do not show increases in stress hormones during the in-utero surgery. Further, between 20 and 30 weeks post-fertilization, the unborn baby has more pain receptors per square inch of skin than at any other time and the mechanisms that inhibit pain have not been established. Therefore, an unborn baby between 20 and 30 weeks post-fertilization will feel pain more intensely.

Numerous studies show hormonal stress responses and pain perception early in human development:

- "Invasive fetal procedures clearly elicit a stress response..."²¹
- "Human fetal endocrine responses to stress have been demonstrated from as early as 18 weeks gestation [16 weeks post-fertilization]."²²
- "Fetuses have been observed to exhibit hormonal stress responses to painful stimuli from as early as 16 weeks of gestation [14 weeks post-fertilization]."²³
- "Another stage of advancing neural development takes place at 18 weeks, when it has been demonstrated that the fetus will launch a hormonal stress response to direct noxious stimulation."²⁴
- "Fetal stress in response to painful stimuli is shown by increased cortisol and β -endorphin concentrations, and vigorous movements and breathing efforts... This independent stress response in the fetus occurs from 18 weeks gestation [16 weeks post-fertilization]."²⁵
- "Fetuses at 20 weeks post fertilization have an increase in stress hormones in response to painful experiences."²⁶
- "Multiple studies show that 'the human fetus from 18-20 weeks elaborates pituitary-adrenal, sympatho-adrenal, and circulatory stress responses to physical insults.'"²⁷
- "Fetuses undergoing intrauterine invasive procedures, definitely illustrative of pain signaling, were reported to show coordinated responses signaling the avoidance of tissue injury."²⁸
- "Premature infants, delivered as early as 23 weeks show clear pain-related behaviors."²⁹
- "Of note, the earlier infants are delivered, the stronger their response to pain."³⁰
- Mechanisms that inhibit or moderate the experience of pain do not begin to develop until 32 to 34 weeks post-fertilization. Any pain the unborn child experiences before these pain inhibitors are in place is likely more intense than the pain an older infant or adult experiences when subjected to similar types of injury.³¹
- Between 20 and 30 weeks post-fertilization, an unborn child has more pain receptors per square inch of skin than at any other time in his or her life, with only a very thin layer of skin for protection, leaving nerve fibers closer to the surface.³²
- As early as 18 weeks, stress hormones are released by the unborn child injected by a needle, just as they are released when adults feel pain. Hormone levels in those babies decrease as pain-relievers are supplied.³³

Not only does the unborn child elicit a direct stress response after subjection to painful stimuli, but such stimuli are associated with long-term harmful neuro-developmental effects. These effects range from altered pain sensitivity to the possibility of emotional, behavioral, and learning disabilities later in life.

Use of Fetal Anesthesia

It is common practice for doctors to administer fetal anesthesia routinely before performing *in-utero* surgeries. When administered, fetal anesthesia decreases stress hormones when compared to their level when painful stimuli are applied without anesthesia. Observations of fetal behavior and physiology have resulted in a “clear consensus among professional anesthesiologists” for the use of anesthesia in prenatal surgery.³⁴

- “It has also been shown that fetuses feel pain from week 18. This has given rise to the practice of using fetal anesthesia for surgery or invasive diagnostic procedures in utero.”³⁵
- “Therefore, it has been suggested that pain relief has to be provided during *in utero* interventions on the fetus from mid-gestation (20 weeks) on.”³⁶
- “As with any procedure, the provision of analgesia depends on the likely severity of pain associated with the intervention. However, analgesia is recommended for: (i) endoscopic, intrauterine surgery on placenta, cord, and membranes; (ii) late termination of pregnancy; (iii) direct surgical trauma to the fetus.”³⁷
- “Anaesthetized patients do not show increases in stress hormones during surgery.”³⁸
- “Despite ongoing debate regarding fetal capacity for pain perception, fetal anesthesia and analgesia are warranted for fetal surgical procedures.”³⁹

A Mature Cerebral Cortex is Not Necessary to Feel Pain, Only the Thalamus

Some scientists argue that a mature cerebral cortex is necessary to perceive pain. However, substantial evidence shows that children born missing most of the cerebral cortex, a condition known as hydranencephaly, do in fact perceive pain. Further, in adults, stimulation or removal of the cerebral cortex does not alter pain perception, while stimulation or removal of the thalamus does. If cortical activity is not a necessary criterion for pain perception in children or adults, neither should it be one for unborn babies.

- “As such, it would seem these children [with hydranencephaly] demonstrate that anatomic development or functional activity of the cortex may not be required for conscious sensory perception. They may, and do in fact, respond to painful or pleasurable stimuli in what may easily be argued to be a conscious, coordinated manner, similar to intact children.”⁴⁰
- “My impression from this first-hand exposure to children with hydranencephaly confirms... These children are not only awake and often alert, but show responsiveness to their surroundings in the form of emotions or orienting reactions to environmental events... They express pleasure by smiling and laughter, and aversion by ‘fussing,’ arching of the back and crying (in many gradations), their faces being animated by these emotional states.”⁴¹

- “Indeed, there is evidence that hydranencephalic children respond to painful and pleasurable stimuli in a coordinated manner similar to other children.”⁴²
- “Clinical data show that ablation or stimulation of the thalamus *alone* is sufficient to alter pain perception in adults.”⁴³
- “In keeping with this evidence, we should consider that if cortical activity is not a prerequisite for pain perception in adults, then by analogy neither would it be a necessary criterion for fetuses.”⁴⁴

Fetal Structures of Pain Perception Differ From Adult Structures

Further, it is not enough to compare adult structures of pain perception and impose them on fetal structures of pain perception. The unborn child’s ability to feel pain depends on complex pain processing mechanisms and neural pathways that transform with each stage of development.

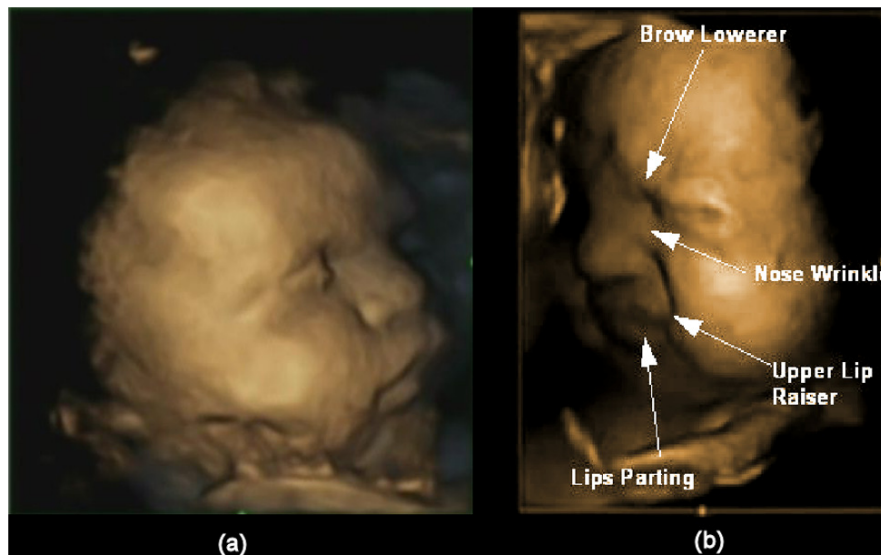
- “Clinical and animal research shows that the fetus or neonate is not a ‘little adult,’ that the structures used for pain processing in early development are unique and different from those of adults, and that many of these fetal structures and mechanisms are not maintained beyond specific periods of early development. The immature pain system thus uses the neural elements available during each stage of development to carry out its signaling role.”⁴⁵
- “[P]ain perception during fetal and neonatal development does not necessarily involve the same structures involved in pain processing as those in adults, meaning that the lack of development of certain connections is not sufficient to support the argument that fetuses cannot feel pain until late gestation. Some say even that the structures used for pain processing in the fetus are completely different from those used by adults and that many of these structures are not maintained beyond specific periods of early development.”⁴⁶
- “Newborn infants show strong pain behaviour, but the study of the development of nociceptive pathways shows that their pain involves functional signaling pathways that are not found in the mature nervous system in healthy individuals.”⁴⁷

Observation of Fetal Facial Expressions of Pain and Distress

A 2013 study used 4-D ultrasound scans to measure facial movements in healthy unborn children 24 to 36 weeks gestation [22 to 34 weeks post-fertilization].⁴⁸ Its aim was to examine whether complex fetal facial movements formed recognizable facial expressions of pain and distress. The unborn children showed various co-occurring facial movements that expressed pain and/or distress, although the study’s authors shied away from attributing facial *expressions* of pain with the perception of pain. It is impossible for any person to know what any other human being experiences, but using scientific observation and our common human experience we can attribute similar reactions to pain to a similar perception of pain.

Although 12 and 20 week gestation [10 and 18 week post-fertilization] scans of these unborn children were also taken, another shortcoming of this study is that the authors did not publish information encompassing the earlier gestational scans. They should consider releasing or others should consider doing further studies examining fetal facial movements in 4-D scans of

unborn children 20 weeks post-fertilization and younger. Nevertheless, this study does provide a scientifically-observable visual of the pain an unborn child experiences as early as 22 weeks post-fertilization.



Typical unborn children at 32 weeks gestation [30 weeks post-fertilization]. (a) Showing an example of neutral face, and (b) a “pain/distress” facial expression with complex combinations of facial movements.

The Pain-Capable Unborn Child Protection Act

In light of this information, the Family Research Council (FRC) supports state and federal efforts to pass laws such as the Pain-Capable Unborn Child Protection Act (H.R. 1797, S.1670), a bill that protects the lives of unborn babies who can perceive pain.

The majority of Americans are, by far, in favor of restricting abortion to the first trimester. A January 2014 Marist poll found that 84% of Americans believe abortion should be restricted (within the first three months of pregnancy, in cases of rape, incest, or to save the life of the mother) or never allowed at all.⁴⁹

Despite this overwhelming support for abortion restrictions, abortion at any stage of development and for any reason is still legal in many states. Some doctors in many states even perform late abortion using methods such as “Dilation and Evacuation (D &E),” in which the baby is ripped apart having its body parts removed before crushing the skull to remove it, or through other means. An abortion of an unborn child can be excruciatingly painful, be it via suction, dilation and curettage, dilation and evacuation or any abortion procedure. Late abortion should not be a legally sanctioned procedure.

This bill would, therefore, prevent late abortion nationwide at 20 weeks post-fertilization. It contains an exception to save the life of the mother, as well as a rape and incest exception. The bill prescribes criminal fines of up to five years in jail for an abortion doctor who performs an

abortion after 20 weeks post-fertilization, yet it protects a woman who has an abortion from prosecution.

Current Fetal Pain Laws

Currently, commercial livestock in a slaughterhouse and animals in a laboratory have more legal protection from pain than do unborn children.⁵⁰

Fetal Pain Laws: 11 States

- States that protect pain-capable unborn children: Alabama, Arkansas, Georgia*, Idaho,*⁵¹ Kansas, Louisiana, Mississippi,⁵² Nebraska, North Dakota, Oklahoma, Texas.⁵³

Informed Consent Laws Regarding Fetal Pain⁵⁴

- 7 states require women to receive information about fetal pain and/or the option of anesthesia for the unborn child: Arkansas, Georgia, Louisiana, Minnesota, Missouri, Oklahoma, and Utah.
- 1 state law requiring information about fetal pain is in litigation: Indiana

Conclusion

The abundance of peer-reviewed scientific studies shows that the early brain and neurological development of the unborn child is sufficient for the perception of pain by 20 weeks post-fertilization. By 18 weeks post-fertilization when the connection between the spinal cord and the thalamus is complete, painful stimuli elicit a stress response in the unborn child and the child can perceive severe pain.

It is barbaric and cruel to expose humans to a procedure that causes pain: “based on evidence suggesting that the types of stimulation that will occur during abortion procedures, very likely most fetuses at 20 weeks after conception will be able to perceive that as painful, unpleasant, noxious stimulation.”⁵⁵

FRC urges the passage of laws such as the Pain-Capable Unborn Child Protection Act that protect the lives of unborn children who can perceive pain.

Arina O. Grossu M.A. is the Director for the Center for Human Dignity where she focuses on sanctity of human life issues, ranging from conception to end of life care.

¹ Fetal age can be given as age "post-fertilization" meaning the time from conception, or gestational age meaning the time since the last menstrual period (LMP), which is usually easier to determine and occurs approximately two weeks before ovulation and fertilization. Thus gestational age will be 2 weeks older than post-fertilization age, *i.e.*, 22 weeks gestation = 20 weeks post-fertilization.

² See definition "b" at: Medical Dictionary, accessed on May 12, 2014, <http://www.merriam-webster.com/medlineplus/pain>.

³ Dr. Jean A. Wright, professor and chair of Pediatrics at Mercer School of Medicine said in a testimony at a Congressional subcommittee hearing, who testified before Congress said, U.S. Congress. House of Representatives. Committee on the Judiciary. Pain of the Unborn: Hearing Before the Subcommittee on the Constitution. 109th Cong., 1st Sess., 2005,

⁴ For more scientific documentation on fetal pain, see “Fetal Pain: The Evidence,” Doctors on Fetal Pain, accessed on May 12, 2014, <http://www.doctorsonfetalpain.com/>.

⁵ Thomas W. Sadler, *Langman’s Medical Embryology, 11th Edition*. (Baltimore: Lippincott Williams and Wilkins, 2009), Chapters 5 and 6.

⁶ “Testimony of Maureen L. Condic, Ph.D.,” Priests for Life, May 23, 2013, accessed on May 12, 2014, <http://www.priestsforlife.org/legislation/hr-1797-condic.pdf>.

Tangential networks of precocious neurons and early axonal outgrowth in the embryonic human forebrain. Bystron I, Molnár Z, Otellin V, Blakemore C. *J Neurosci*. 2005;25:2781-92.; ApoER2 and VLDLR in the developing human telencephalon. Cheng L, Tian Z, Sun R, Wang Z, Shen J, Shan Z, Jin L, Lei L. *Eur J Paediatr Neurol*. 2011;15:361-7.; The first neurons of the human cerebral cortex. Bystron I, Rakic P, Molnár Z, Blakemore C. *Nat Neurosci*. 2006;9:880-6. Epub 2006 Jun 18.; Development of the human cerebral cortex: Boulder Committee revisited. Bystron I, Blakemore C, Rakic P. *Nat Rev Neurosci*. 2008;9:110-22

⁷ Ibid.

⁸ Susan Tucker Blackburn, *Maternal, Fetal, & Neonatal Physiology: A Clinical Perspective 2nd Edition* (Philadelphia: Elsevier Inc., 2003).

⁹ Sampsa Vanhatalo and Onno van Nieuwenhuizen, “Fetal Pain?,” *Brain & Development* 22, no. 3 (2000): 145-50.

¹⁰ Blackburn, *Maternal, Fetal, and Neonatal Physiology*.

¹¹ Vanhatalo and van Nieuwenhuizen, “Fetal Pain?,” 145-50., “Expert Report of Kanwaljeet S. Anand, MBBS, D.Phil.” Northern District of the US District Court in California. 15 Jan 2004

¹² “Testimony of Maureen L. Condic, Ph.D.”

Synaptogenesis in the cervical cord of the human embryo: sequence of synapse formation in a spinal reflex pathway. Okado N, Kakimi S, Kojima T. *J Comp Neurol*. 1979;184:491-518.; Onset of synapse formation in the human spinal cord. Okado N. *J Comp Neurol*. 1981;201:211-9.; The fine structure of the spinal cord in human embryos and early fetuses. Wozniak W, O’Rahilly R, Olszewska B. *J Hirnforsch*. 1980;21:101-24.; Early synaptogenesis in the spinal cord of human embryos. Milokhin AA. *Acta Biol Hung*. 1983;34:231-45.; Development of pain mechanisms. Fitzgerald M. *Br Med Bull*. 1991;47:667-75.

¹³ Aida Salihagić Kadić, Maja Predojević, “Fetal neurophysiology according to gestational age,” *Seminars in Fetal & Neonatal Medicine* 17, no. 5 (2012): 256-260.

¹⁴ Laura B. Myers and Linda A. Bulich, “Fetal endoscopic surgery: indications and anaesthetic management,” *Best Practice & Research Clinical Anaesthesiology* 18, no. 2 (2004): 231-258, 241.

¹⁵ Roland Brusseau, “Developmental Perspectives: Is the Fetus Conscious?,” *International Anesthesiology Clinics* 46, no. 3 (2008): 11-23, 14.

¹⁶ Stuart W. Derbyshire, “Foetal pain?,” *Best Practice & Research Clinical Obstetrics and Gynaecology* 24, no. 5 (2010) 647-655.

¹⁷ Mark D. Rollins and Mark A. Rosen, “Anesthesia for Fetal Intervention and Surgery,” *Gregory’s Pediatric Anesthesia, ed. 5*, Edited by George A. Gregory and Dean B. Adropoulos, (West Sussex: Wiley-Blackwell, 2012), 444-474, 465.

¹⁸ PNA Van Scheltema, S. Bakker, FPHA Vandebussche, and D. Oepkes, “Fetal Pain,” *Fetal and Maternal Medicine Review* 19, no. 4 (2008): 311-324, 313.

¹⁹ “Expert Report of Kanwaljeet S. Anand, MBBS, D.Phil.,” National Right to Life Committee, January 15, 2004, accessed on May 13, 2014, <http://www.nrlc.org/uploads/fetalpain/AnandPainReport.pdf>.

²⁰ “Testimony of Maureen L. Condic, Ph.D.”

Kostovic I, Goldman-Rakic PS: Transient cholinesterase staining in the mediodorsal nucleus of the thalamus and its connections in the developing human and monkey brain. *J Comp Neurol* 219:431-447, 1983.

²¹ Kha M. Tran, “Anesthesia for fetal surgery,” *Seminars in Fetal & Neonatal Medicine* 15 (2010): 40-45, 44.

²² Myers et al, “Fetal endoscopic surgery,” *Clinical Anaesthesiology*, 242.

²³ “Expert Report of Kanwaljeet S. Anand.”

²⁴ Stuart W. Derbyshire, “Fetal Pain: Do We Know Enough to Do the Right Thing?,” *Reproductive Health Matters* 16, no. 31 Supp. (2008): 117-126.

²⁵ Rita Gupta, Mark Kilby, and Griselda Cooper, “Fetal surgery and anaesthetic implications,” *Continuing Education in Anaesthesia, Critical Care & Pain* 8, no. 2 (2008): 71-75, 74.

²⁶ Nicholas M. Fisk, Rachel Gitau, Jeronima M. Teixeira, Xenophon Giannakouloupoulos, Alan D. Cameron, and Vivette A. Glover, “Effect of direct fetal opioid analgesia on fetal hormonal and hemodynamic stress response to intrauterine needling,” *Anesthesiology* 95, no. 4 (2001): 828-35.

²⁷ “Testimony of Maureen L. Condic, Ph.D.”

²⁸ Curtis L. Lowery, Mary P. Hardman, Nirvana Manning, Barbara Clancy, R. Whit Hall, and K.J.S. Anand, “Neurodevelopmental Changes of Fetal Pain,” *Seminars in Perinatology* 31, no. 5 (2007): 275-282, 276.

-
- ²⁹ Sharyn Gibbins, Bonnie Stevens, Joseph Beyene, P.C. Chan, Marie Bagg, and Elizabeth Asztalos, "Pain behaviours in Extremely Low Gestational Age infants," *Early Human Development* 84, no. 7 (2008): 451-8.
- ³⁰ Lina Kurdahi Badr, Bahia Abdallah, Mirvat Hawari, Saadieh Sidani, May Kassar, Pascale Nakad, and Julianna Breidi. "Determinants of Premature Infant Pain Responses to Heel Sticks," *Pediatric Nursing*, 36, no. 3 (2010): 129-36.
- ³¹ "Expert Report of Kanwaljeet S. Anand."
- ³² "Expert Report of Kanwaljeet S. Anand."
- ³³ Adnan T. Bhutta, Sarita Garg, and Cynthia Rovnaghi, "Fetal Response to Intra-Uterine Needling: Is It Pain? Does It Matter?," *Pediatric Research* 51, no. 1, (2002).
- ³⁴ "Testimony of Maureen L. Condic, Ph.D."
Use of fetal analgesia during prenatal surgery. Bellieni CV, Tei M, Stazzoni G, Bertrando S, Cornacchione S, Buonocore G.J *Matern Fetal Neonatal Med.* 2013;26:90-5.; Towards state-of-the-art anesthesia for fetal surgery: obstacles and opportunities. Kuczkowski KM. *Rev Esp Anestesiol Reanim.* 2013 Jan;60(1):3-6.; Fetal and maternal analgesia/anesthesia for fetal procedures. Van de Velde M, De Buck F. *Fetal Diagn Ther.* 2012;31:201-9.
- ³⁵ L. Giuntini and G. Amato, "Analgesic Procedures in Newborns," *Neonatal Pain* 73 (Giuseppe Buonocore & Carlo V. Bellieni ed.), 2007
- ³⁶ Marc Van de Velde, Dominique Van Schoubroeck, Liesbeth E. Lewi, Marco A.E. Marcus, Jacques C. Jani, Carlo Missant, An Teunkens, and Jan A. Deprest, "Remifentanyl for Fetal Immobilization and Maternal Sedation During Fetoscopic Surgery: A Randomized, Double-Blind Comparison with Diazepam," *Anesthesia & Analgesia* 101, no. 1 (2005): 251-258, 256.
- ³⁷ Gupta, Kilby, and Cooper, "Fetal surgery and anaesthetic implications," *Continuing Education in Anaesthesia*, 74.
- ³⁸ Carlo V. Bellieni and Giuseppe Buonocore, "Is fetal pain a real evidence?," *The Journal of Maternal-Fetal and Neonatal Medicine* 25, no. 8 (2012): 1-6.
- ³⁹ Rollins and Rosen, "Anesthesia for Fetal Intervention and Surgery," *Gregory's Pediatric Anesthesia*, 466.
- ⁴⁰ Brusseau, "Developmental Perspectives: Is the Fetus Conscious?," *International Anesthesiology Clinics*, 17.
- ⁴¹ Björn Merker, "Consciousness without a cerebral cortex: A challenge for neuroscience and medicine," *The Behavioral and Brain Sciences* 30, no. 1 (2007): 63-81, 79.
- ⁴² Roland Brusseau and Laura Myers, "Developing consciousness: fetal anesthesia and analgesia," *Seminars in Anesthesia, Perioperative Medicine and Pain* 25, no. 4 (2006): 189-195, 191.
- ⁴³ P.N.A Van Scheltema, S. Bakker, F.P.H.A. Vandenbussche, and D. Oepkes, "Fetal Pain," *Fetal and Maternal Medicine Review* 19, no. 4 (2008): 311-324, 313.
- ⁴⁴ Brusseau, "Developmental Perspectives: Is the Fetus Conscious?," *International Anesthesiology Clinics*, 17.
- ⁴⁵ Kanwaljeet S. Anand, "Fetal Pain?," *Pain: Clinical Updates* 14, no. 2 (2006): 1-4, 3.
- ⁴⁶ Van Scheltema et. all, "Fetal Pain," *Fetal and Maternal Medicine Review*, , 313.
- ⁴⁷ Maria Fitzgerald, "The Development of Nociceptive Circuits," *Nature Reviews: Neuroscience*, 6 (2005): 507-520, 507.
- ⁴⁸ Nadja Reissland, Brian Francis, and James Mason, "Can Healthy Fetuses Show Facial Expressions of 'Pain' or 'Distress'?" *Public Library of Science One* 8, no. 6 (2013), accessed May 13, 2014, <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0065530>.
- ⁴⁹ "Marist Poll: Abortion in America," Knights of Columbus, January 2014, accessed May 13, 2014, <http://www.kofc.org/un/en/resources/communications/marist-poll-abortion-restrictions2014.pdf>.
- ⁵⁰ Human Slaughter Act, 7 U.S.C. 1902, accessed April 16, 2014, <http://www.law.cornell.edu/uscode/text/7/1902>.
- ⁵¹ Georgia and Idaho are enjoined, pending litigation. "Pain-Capable Unborn Child Protection Act," National Right to Life Committee, May 12, 2014, accessed May 13, 2014, <http://www.nrlc.org/uploads/stateleg/PCUCPAfactsheet.pdf>.
- ⁵² Eric M. Johnson, "Mississippi sets 20-week limit on abortions," *Reuters*, April 24, 2014, accessed May 13, 2014, <http://www.reuters.com/article/2014/04/24/us-usa-abortion-mississippi-idUSBREA3N0LN20140424>.
- ⁵³ "The State of Abortion in the United States," National Right to Life Committee, January 2014, accessed May 13, 2014, <http://www.nrlc.org/uploads/communications/stateofabortion2014.pdf>.
- ⁵⁴ *Defending Life 2013*, Americans United for Life, February 20, 2013, accessed May 13, 2014, <http://www.aul.org/2013/02/the-defending-life-report/>.
- ⁵⁵ From the testimony of Dr. Sunny Anand, Director, Pain Neurobiology Laboratory, Arkansas Children's Hospital Research Institute, and Professor of Pediatrics, Anesthesiology, Pharmacology, and Neurobiology, University of Arkansas College of Medicine. U.S. Congress. House of Representatives. Committee on the Judiciary. Pain of the Unborn: Hearing Before the Subcommittee on the Constitution. 109th Cong., 1st Sess., 2005, p. 38.