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The Advance of Rescue Technologies and the Border of Viability

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This past month (April 2017) a pediatric surgery group at Children’s Hospital of Philadelphia published a report of their development of a pumpless oxygenator circuit connected to a lamb fetus via an umbilical cord interface, allowing the fetal lamb to be maintained within a closed ‘amniotic fluid’ circuit closely reproducing the environment of the womb. Fetal lambs equivalent in gestational age to extremely premature human infants were able to be physiologically supported (and continue to develop) in this extra-uterine device for up to 4 weeks (Partridge 2017). While many potential therapeutic advances do not succeed in transition from animal models to care of humans, the continued pursuit of ideas that could become life sustaining and those that become successful present an additional consideration to the arguments put forward by Rieder in his target article. Prognosis is not static. It is dynamic with the dominant trend (at least for the past century) being the extension of the number of infants who can live to have healthy lives. The development of exogenously administered surfactant and continuous positive airway pressure (CPAP) dramatically improved care of premature infants (Avery 1986, Gregory 1971). New ideas, like this pumpless umbilical oxygenator allowing a premature infant to be maintained in an extra-uterine amniotic environment, particularly if it can be shown that the infant could continue to developmentally mature as if it were still in utero, may similarly allow the healthy survival of additional children. Blanket statements about patient cohorts or philosophies built on prognoses must consider that outcomes change. Medicine at its’ best is not “taking over creation” (Rieder), it is partnering with nature to allow normal development or healing to occur. Placing someone with respiratory failure on extracorporeal oxygenation (ECMO) is not taking over creation of their lungs, it is giving their lungs time to heal themselves. The disease being treated in prematurity is, premature birth. The best medicine would be a therapy that allows continued development to a healthy childhood.

In 1975, the ethicist Al Jonsen convened a panel to address “Critical Issues in Newborn Intensive Care,” using clinical case examples from the care of individual 32 week gestational age premature infants to raise discussion of the ethical challenges arising from “clinical decisions regarding resuscitation and maintenance of small, severely asphyxiated preterm infants, especially those with respiratory distress who require prolonged assisted ventilation” (Jonsen 1975). The questions asked by the panel underlie the debate raised by Rieder: “Is it ever right not to resuscitate an infant at birth? Is it ever right to withdraw life support from a clearly diagnosed, poor-prognosis infant?” And the thoughts Jonsen put forward are equally fundamental to Rieder’s arguments: “Parents bear the principal moral responsibility for the

well-being of their newborn infant;” “Physicians have the duty to take measures conducive to the well-being of the baby in proportion to their fiduciary relationships to the parents;” “Life-preserving intervention should be understood as doing harm to an infant who cannot survive infancy, or will live in intractable pain, or cannot participate even minimally in human experience.” The panel recognized the responsibility of bringing a premature infant to birth and the moral accountability for the burdens of its nurture (Jonsen 1975). What is interesting, reading Jonsen 40 years later is that, in addition to the sagacity of the arguments, for the clinical example Jonsen used advances in medical therapeutics have largely resolved the debate. From 2013 data, survival of 32 week gestational age infants is now greater than 98%, possibly higher if stillbirths and genetic disorders are not considered (Mathews 2015).

Similarly, changes in clinical outcomes of extremely premature infants have been significantly influenced by changes in medical care and technologies. Following Gregory’s application of continuous positive airway pressure (CPAP), many centers in the United States and Europe began aggressive programs to develop intensive care programs to support the smallest premature infants and develop tracking programs (follow up clinics, databases) to evaluate the success of these efforts (Gregory 1971, Glass 2015). Following the implementation of CPAP and mechanical ventilation strategies in the 1980s, exogenous surfactant was introduced in the early 1990s, antenatal steroids in the late 1990s, recognition of avoidance of postnatal steroids in the 2000s, recent studies examining targeted oxygen therapies and ongoing examinations of systematic care delivery, each with a demonstrable improvement in outcomes (Glass 2015). In fact Glass pooled large population based cohort studies conducted from 1986 to 2004, including almost 15,000 extremely premature infants from North America, Western Europe, Australia and Japan, and analyzed them in reference to these different technological advances in care. Each gestational age (22 weeks through 26 weeks) shows improvement in survival rates over time. Using the 50% survival rate standard viability improved from approximately 25–26 weeks in the 1990s to approximately 23–24 weeks by the mid-2000s (Glass 2015).

The optimism from the improvement in survival has to be tempered by the concern for an increase in the number of children who experience severe acute and chronic morbidities (intraventricular hemorrhage, necrotizing enterocolitis, bronchopulmonary dysplasia, chronic lung disease, severe visual impairment, hearing impairment, cerebral palsy, and cognitive developmental delay) and the suffering experienced by these children and their families. However, data from the 2000s suggest that morbidity may be declining (Vaucher 2012). Ethics scholarship during these periods of medical advances in neonatal intensive care assert that it is among the most cost efficient of acute medical interventions, with the costs per quality adjusted life year saved being about 1/100 of the cost of acute adult coronary care, that the majority of even the surviving extremely low birth weight infants achieve functional outcomes and economically productive lives and that major improvements in newborn survival have not resulted in proportionate increases in severe morbidity (Janvier 2007). However, that outcomes are analyzed in cohort, over time, makes individual prognosis challenging, limiting a clinician’s ability to protect a family from needless suffering by being able to easily predict which children will do better than others. It is difficult at bedside, in the moment of resuscitation, to predict an individual outcome. Only the decision to not resuscitate and allow death is prognostically certain.

None of these therapeutic advances are “taking over creation” of the child. Underlying Western allopathic medicine is *vis medicatrix naturae*—a trust, from Hippocrates to William Harvey, in the healing power of nature. Modern medical interventions, even surgical interventions, rely on removing or ameliorating the disease causing problem and partnering with nature to allow the patient’s body to heal itself. In premature birth, the disease being treated is prematurity. All of the advances in neonatal care have been in service of protecting the infant so they can develop into a healthy child.

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