MAY YOU LIVE IN INTERESTING TIMES

by John Salyer RRT-NPS, MBA, FAARC

It is said that we cannot possibly interpret the present without a deep understanding of the past. This is certainly true when considering the broad topic of the care of critically ill infants and children. Those of us who have worked in the field in one capacity or another are well aware of the problems that continue to vex us. A solution to premature birth still eludes us. We are still searching for the optimal way to ventilate infants. Our technology is imperfect, as is our wisdom in how best to use it. We still have heartbreaking morbidities.

And yet, there has been so much innovation and improvement that it kind of boggles my addled brain. It is always instructive and usually fun to review where we have been, so we can understand how far we have come. Consider this. In 1862, M.A. Baines submitted a paper to the British National Social Science Association entitled, "Excessive Infant-Mortality: How Can It Be Stayed?" In this paper he quotes the following statistics, "Of the deaths in England in 1859, no less than 184,264 -- two in every five of the deaths of the year -- were of children under five years of age; and above half of these -- 105,629 -- had scarcely seen the light, and never saw one return of their birthday." He goes on to point out that, "……. from 43 to 45 infant deaths take place in every 100 births -- 45 per cent! Almost half of the children who are born, die -- perish miserably! And this is far from representing the whole mass of pain and suffering, which it is the calamity of children to endure."

World wide infant mortality rates in the first year of life are now about 8 per 1000 live births. To compare these statistics lets make sure they are in the same units. Baines reports 45 infant deaths per 100 live births, or in modern metrics, 435 per 1000 live births. Contrast this with our current rate of 8 per 1000 live births.

In the 1960's infants < 1000 grams had a survival rate ≈ 5%. Now, survival among infants in the 901–1000 gram range is ≈ 95%. In 1960, infants who were born at < 28 weeks gestation were considered "pre-viable." Now, 50% of infants who are born at 24 wk gestation survive.

So, how did all this happen? Below I list some interesting milestones in the advancement of neonatal care. It is only a sampling of the many important developments in this field.

The first really practical human incubator was introduced in 1880 by a French physician. About this time incubators and premature infants became part of carnival side shows in Europe and the U.S. The Germans called these shows kinderbrutanstalt, "the child hatchery". This persisted until the 1940's in the United States. It turns out that someone named Archibald Leach worked as a barker outside one of these exhibits. He later changed his name to Cary Grant.

Oxygen in the treatment of premature or sick infants was described as early as 1889 by French physicians. One method described oxygen tubing being connected to inverted funnels held closely above the infants face. Eventually babies were treated by filling the atmosphere of incubators with high concentrations of oxygen. Beginning in about 1940, this contributed to a world wide epidemic in developed countries of retinopathy of prematurity (then called retrolental fibroplasia) in which 12,000 babies eventually had their vision impaired (Stevie Wonder being one of the most famous victims). As understanding of the role of oxygen in this disease increased, a company eventually marketed an incubator that had a red lever with two positions, one for 100% oxygen and the other for 40% oxygen. Thus was the epidemic abated.

It is believed the Dr. Virginia Apgar inserted the first umbilical artery catheter for the purpose of measuring arterial blood gases in a neonate, sometime in the early 1960's. Speaking of blood gases, this assay became possible for infants when the size of the samples required decreased to an amount suitable to withdraw from babies. I remember running old blood gas instruments that required 2 mL of blood. I am not going to say when. By the 1960's and 70's, advanced blood gas technology was becoming available that allowed sample sizes as low as 0.5 mL.

As early as 1800, doctors in Europe were reporting nasotracheal intubation and mechanical ventilation. One of the earliest reports I have found in the "modern" era describing ventilating babies was a paper out of Cape Town South Africa in 1958 describing the ventilation of a series of babies with neonatal tetanus. In the 1960's physicians began using positive pressure to treat what was then called hyaline membrane disease, but the devices used were mostly modified adult ventilators. Research into premature lung disease got a boost by the tragic death from respiratory failure of the premature baby of President and Mrs. Kennedy in 1963. Intermittent mandatory ventilation and continuous positive airway pressure, both of which became important tools in the treatment of adults, were first developed for neonates in the early 1970's. Inverse ratio ventilation, also first invented for use in neonates, came along about this time. In

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my own travels I have used the Bourns LS-104, Bourns BP-200, Bear Cub, and the Sechrist IV -100B, all of which were early neonatal/pediatric ventilators introduced in the 1970's. Oh yeah, I almost forgot the famous Baby Bird, introduced in 1970. One is currently available on EBay; the bid is at $20 if you are interested. One of the most remarkable devices I ever encountered was fabricated by a gifted respiratory therapist I knew in San Diego named Guillermo. It was an incubator that had been modified to create a continuous negative pressure inside the device. The baby's body was inside, but the head stuck out through a purse-string style plastic sleeve at the end of the incubator, which was cinched up tight enough around the infant's neck to allow negative pressure to be developed inside the incubator. The infant was intubated and ventilated with a time-cycled pressure limited neonatal ventilator, while continuous negative external chest wall pressure was being developed inside the incubator (with something akin to a vacuum cleaner motor). The thought was that risk of lung injury and air leak could be minimized by decreasing PIP. When you increased the negative pressure inside the incubator you could concomitantly decrease the PIP while achieving acceptable blood gases. Of course this was before we fully understood that lung injury is not really caused by pressure but by volumetric over-distention of the lung. While ingenious, this device did not really change trans-respiratory pressure, nor the tidal volume being used to ventilate the patient. But the innovation and commitment of the RT's and physicians to have created this technique is emblematic of the creativity and passion in the neonatal community.

The first neonatal intensive care unit was started in 1968 in Connecticut. "Neonatology" was initially coined in 1960 and approved as a sub-specialty by the American Academy of Pediatrics in 1975. Regionalization of care followed, with infants needing special care being transported to centers with neonatal and pediatric subspecialty care. To help understand what it was like before the development of these systems of regionalization and transport, consider this story from C. Everett (Chick) Koop's autobiography. When he was a young surgeon in the then nascent field of pediatric surgery in Philadelphia he would get called to hospital in the city to attend a newborn needing advanced surgical care. He reports wrapping them in blankets, putting them in a box and putting them on the passenger side front floorboard of his car, right under where the heater vent blew warm air to help keep them from cooling. He would then drive the kid to the children's hospital.

I can remember ventilating many neonates whose only continuous monitoring was of heart rate and chest wall motion (apnea). Then, in the late 1970's along came transcutaneous oxygen monitors, soon followed in the 80's by transcutaneous carbon dioxide monitoring and pulse oximetry. Early on we may have misunderstood some of the limitations of this technology, but we have recently learned that careful monitoring and a systematic way to manage oxygenation can substantially improve outcomes.

So much has changed that we can lose site of it all. So the next time you are tired or discouraged or emotionally drained from your work in the NICU please remember that we have met the future, and it is you. You are part of a continuum of amazing progress that has a certain untainted purity to its purpose.

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