Controlled Ventilation

A personal reflection of an era in the development of respiratory medicine.

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My professional career in respiratory diseases was forged in the early 1960's as chest medicine was just beginning the transition from its long time focus in tuberculosis to the many other medical chest conditions. The reason for this dynamic was due to the effectiveness of drug treatment for pulmonary tuberculosis and a parallel increase in the interest of other medical disorders of the chest as chronic bronchitis, emphysema, asthma or other diffuse lung entities.

I was born into the world of tuberculosis. As an intern at Kings County Hospital in Brooklyn, New York, I opted for a two week elective in chest medicine located in the 'E' building. I do not recall the exact number, but there were perhaps 8 stories of large wards, seven of which were devoted to the inpatient care of tuberculosis patients. One top floor was reserved for the care of patients with other non-tuberculous medical lung disorders. The service chief was a well known Harold Lyons, a sort of tough, and gruff character, but a very knowledgeable mentor. Treatment for chronic obstructive lung diseases in those days consisted of oxygen, intravenous hydration, antibiotics, bronchodilator medications and forms of physical therapy. Aerosol bronchodilators delivered by a positive pressure device called an IPPB (intermittent positive pressure breathing) machine was the mainstay of mechanical devices. It could deliver an aerosol medication from a side arm nebulizer with a gas pulse under positive pressure of either air or oxygen mixtures. Many patients apparently benefited from the air pulse delivery as it and the nebulized medications eased their terrible sense of suffocation.

I yet recall being called on numerous instances to the ward in the midst of the night hours to adjudicate 'theft'. There were not enough IPPB devices for all of the patients so it was a not uncommon practice for the afflicted to temporarily 'borrow' another patients IPPB unit- no matter what medication happened to be in the IPPB nebulizer - just for the sake of relieving the agony of dyspnea..

A year later I was a resident at Boston City Hospital. The following clinical story dwells in my minds eye after 50 years as if had occurred last evening. It is the middle of the early morning darkness. I have an elderly, frail white man patient in extreme respiratory distress ... suffocating to death from some flare-up superimposed upon an advanced case of underlying pulmonary emphysema: 'pink puffer' was the terminology employed then for such patients whose primary disease was emphysema. The latter was a gradual destruction of lung tissue, piece by piece, such that the amount of area for gas exchange, or transfer of oxygen into the blood, was slowly and inexorably impaired. Eventually these patients became totally crippled from the failure of the lung system to provide oxygen (and to eliminate waste carbon dioxide gas) such that total physical activity was limited and continuous oxygen therapy mandatory just to survive. Any time a superimposed problem ensued, as for example an infection in their bronchial airways which was termed acute bronchitis, an impairment in the ability to breathe and exchange oxygen would occur. At this point the situation was disabling for the patient and could in fact become totally life threatening. Unless the physician could both reverse the new, acute bronchitis process

while simultaneously maintaining the patient's life despite the underlying and devastating lung disease condition of emphysema, well, the outcome was often inevitable ... death.

To return to my patient. It is in the early hours of the morning on 3-Medical. The large ward is dark and silent. There were no beeping monitors in those days. An ancient mechanical clock marks the passage of hours. One nurse is on duty in a small, dimly illuminated work station in the long central corridor that connects large wards with as many as 20 -30 beds. A few private rooms arise from the central axis. I am in one such small, dank room, sufficient for one bed only, a small white enameled night table and scattered medical paraphernalia. The bedded patient is bolt upright, both hands grasping the edge of the bedding as he struggles for air. With an oxygen cannula in his nostrils, he labors with a typical gasping, raising his chest with any available muscles to afford some inspiratory air flow ... sweat flows profusely over his face, he purses his purplish lips tightly as he exhales, and then quickly gasps another breath. His pupils are widely dilated as aweful fear and anxiety dominate his face. In his hand a tube with a nebulizer of bronchodilator drug connected to an IPPB device. Puff, puff, puff ... stop. It is too fatiguing. Begin anew. Puff ... still no relief. Cough is feeble. I try to help him cough and expectorate. Not much results. As a physician I cannot increase the oxygen delivery beyond a certain safe limit- and that had been challenged! Besides in those days I could not even get a measurement of the oxygen level in his blood at 2 AM in the night hours neither the technology nor the services for same did not exist. I am at full therapy, I am at full compassion. I am facing certain death and that too – as a young physician – was totally unacceptable**.**

"Nurse, can we call Dr. Cxxxx from the lung station." There really was no pulmonary physician on call as it were, but I took a chance that I could get help. He answered the phone call fairly quickly. I explained in detail the situation ... I was not totally green as I had some chest disease experience at Kings County. When I finished Dr. Cxxxx replied, "Earle, you have done it all, there is nothing else to do. You might try Coramine, but that is illogical and would worsen the situation. I am sorry. I wish I could have been of some assistance. You have done everything possible. Good night."

My man died. He died an awful death, gasping for air, puffing on his IPPB machine, gasping and puffing as I stood helplessly by. But it was not me, alone, standing there. This scene was repeating itself all over the medical world, as this situation was the state of the art, science and technology in1962 for the care of this not uncommon, devastating situation.

I suppose it was this ember that led me to a career in respiratory disease – was I that altruistic and motivated**?**

Fast forward 5 years. I have finished my medical residency at Boston City Hospital and two years of a pulmonary disease fellowship. The situation of salvaging patients with chronic obstructive pulmonary disease (COPD) including asthma who are suffering particularly when in the midst of an acute, superimposed respiratory process that is threatening their lives persists.

At the center of the issue is the IPPB device. Used primarily to deliver aerosol therapy it also is being used with greater frequency to mechanically support and assist the labored breathing generally with a mouthpiece when patients are in so called acute respiratory distress or acute respiratory failure. Blood oxygen and carbon dioxide levels are now more

routinely available, such that the state of these critical gas levels in their blood could be determined. Similarly the benefits of therapy could be determined and the gravity of the clinical situation could be more easily quantified.

But, no significant advance was made in supporting the lungs of such patients during the flare up of their disease or more precisely when a complication as bronchitis, pneumonia, allergic reaction, or heart failure had supervened for example, .

“You did what!” Mauricio said. “I changed the setting on the IPPB unit to 100% oxygen, the patient got sleepy, I had him intubated. I set the IPPB such that it was on an automatic mode so that I am totally breathing for him while suctioning his secretions as well from the underlying pneumonia. There is a nurse and an inhalation therapist with him at all times and I will be on call all night to watch him….he looks a lot better under this situation,” And that is sort of how the notion of controlled mechanical ventilation nurtured in our minds set the seeds for studies that demonstrated that such an approach could be both safe and effective in supporting the breathing of patients struck down by a superimposed acute respiratory process upon their chronic respiratory condition. Seemed simple enough: Take the ineffective and exhausting ventilatory/chest bellows apparatus out of the picture, support the basic need for ventilation and oxygen with a simple medical pneumatic device (IPPB device), treat the precipitating events and wait while the underlying processes healed sufficiently that the patient was self-supporting.

At this time the concepts in supportive mechanical ventilation were changing rapidly. Physicians were employing masks or frankly intubating such patients, intervening with the use of IPPB units to achieve temporizing but adequate ventilation. Such attempts were inherently difficult as patients were invariably awake often exhibiting great difficult assisting their native dysfunctional ventilatory patterns with the commercially available positive pressure mechanical devices. A few centers owned expensive so-called volume cycled ventilators. These were generally in use in anesthesia departments and not readily available for the widespread demand mandated by the sheer greater numbers of patients with COPD and asthma on medical or even surgical services. who required interventional ventilatory support. As a caveat, this story does not include the vast past history of mechanical ventilation by so-called iron lungs which had been in use for decades with great success for poliomyelitis. That chapter of polio had greatrelevance,patients could be supported in breathing for prolonged periods. Yet there was no direct extrapolation to the newly understood need for mechanical ventilation in reversing acute respiratory failure associated with chronic respiratory disorders that was now becoming more clearly understood.

Pioneers in the field of respiratory therapy such as Alvin Barach (1) and Maurice Segal (2) in their texts of inhalation therapy never mention the need assume control of breathing in patients with a diverse background of pulmonary disorders where the respiratory apparatus has failed. IPPB was merely a device to deliver medication and in some cases relieve some of the breathing discomfort of an acute deterioration. The monumental textbook of the 1960 era by Mushin et al (second edition), “Automatic Ventilation of the Lungs”, Vintage 1969, (3) where intermittent positive pressure ventilation and even notions of controlled ventilation are extensively detailed particularly in the anesthesia setting do not cite the need nor any approach for patients with COPD who are in respiratory failure and unable to interface with the most common device available on medical units in that era, namely IPPB units.

The details of assuming total control of breathing in patients with acute respiratory failure upon the background of a variety of chronic obstructive lung diseases including asthma, chronic bronchitis and pulmonary emphysema are reviewed in the definitive paper by Weiss and Dulfano (4). Here the background, approach and outcomes are specifically detailed. Following the publication of this paper other reports quickly validated the usefulness of controlled ventilation with IPPB in negotiating the acute deterioration phase of those disorders where significant underlying lung dysfunction required more aggressive intervention for survival. The widespread use of IPPB for supportive ventilation changed the face of respiratory intervention and respiratory care by establishing this principle and set the stage for greater precision and universal application of ventilation in the field of respiratory medicine.

(1) Barach, A.L., Principles And Practices Of Inhalational Therapy. J.B. Lippencott Co., Philadelphia.1944

(2) Segal, M., Inhalation Therapy.

(3) Mushin, W., et al., Automatic Ventilation Of The Lungs. 2nd Edition, F.A.Davis Company, Philadelphia, Pa. 1969

(4) Weiss, E.B. and Dulfano, M.J., Controlled Ventilation With Intermittent Positive Pressure Breathing in the Management of Acute Ventilatory Failure Associated With Chronic Obstructive Pulmonary Disease. Ann Int Med. 67: 556-567, 1967.

The End 5/2009
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