

## An Undying Optimist



Bert Bunnell's interest in medicine began at the University of Utah where he was introduced to medical devices such as the artificial kidney at age 20. As a senior majoring in chemical engineering in 1968, he developed malignant melanoma, which exempted him from military service and provided him the opportunity to apply to graduate schools.

Accepted by the chemical engineering department of Massachusetts Institute of Technology, Bert's interest in medicine intensified when his melanoma metastasized, tracking his lymph system from the back of his neck towards his lungs. After enduring his second radical surgery within a year, he passed the rigorous exams qualifying him for entrance into the doctorate program where, as luck would have it, a thesis topic related to treatment of respiratory distress syndrome of premature infants with aerosolized artificial surfactant was available. Having recently developed a very personal interest in lungs, Bert dove into the field of pulmonary physiology.

Radiation and chemotherapy were not advised for melanoma in the early 1970s, so Bert's survival depended entirely on successful surgery. He never asked anyone about his chances for survival. He used graduate school and the challenge of trying to improve the lot of preterm babies to keep his mind occupied with more productive thoughts.

In 1974, Bert stumbled across a shocking statistic in the journal *Chest* while researching papers on forced oscillations at the Countway Library of Harvard Medical School. The paper stated that only 10% of patients were alive one year after being diagnosed with metastatic malignant melanoma. It was five years after his second radical neck resection, and he was totally weaned from the medicines he took to ease the aches and pains of losing the muscles he used to use to hold up his right shoulder. He felt good, his cancer was obviously in remission, and he was excited about an idea he and his mentor, Dr. Daniel Shannon, were pondering: high frequency ventilation.

Two papers led Bert into development of a high frequency ventilator: one describing the diagnostic technique called *forced oscillations*, and the other describing some unintentional effects of *infrasound*.

Forced oscillations is a diagnostic technique for measuring airway resistance in a person who holds a large bore tube in his mouth and allows small volumes of gas to be oscillated in and out of his lungs by a large loudspeaker. The frequency of oscillations produced by the speaker is varied from  $\sim 1$  Hz to 50 Hz while the pressure amplitudes and flow rates of the gas passing through the mouthpiece are measured. A minimum in the pressure vs. frequency waveform appears at the point where the energy to overcome lung compliance is supplied by loudspeaker and the *inertance* of the gas is overcome by the elastic recoil of the

lungs so that the only element of impedance to gas passing in and out of the lungs is airway resistance. One can then take that minimum pressure amplitude and divide it by the flow rate of the gas at that point to calculate airway resistance.

Intrigued by the concept that one could effectively eliminate lung compliance by using the inertia of gas being forced into the lungs at high frequency, Bert was further entranced by this idea when he discovered the work of Daniel Johnson, a US Air Force scientist at Wright Patterson Air Force Base in Dayton, OH.

Dr. Johnson discovered that he could hyperventilate anesthetized animals in an airtight box when he subjected them to amplified sound in frequency range of 1-10 Hz. In a telephone conversation with Dr. Johnson, Bert determined that the tidal volumes developed in these experiments were in the range of 1 mL/kg body mass, less than the anatomic dead space of the animal's lungs!

In a series of animal studies in basement laboratories at the Massachusetts General Hospital where Bert worked as a Research Fellow in Pediatrics after graduating from MIT with a Doctor of Science degree in 1972, Bert proved that he could ventilate animals at frequencies up to 600 breaths/minute (10Hz) using his prototype high frequency ventilator.

Dr. Bunnell left academia in 1975 to pursue commercial development of his ventilator. After two unsatisfactory experiences with large corporations, he founded Bunnell Incorporated in 1980. It became the first company to receive FDA approval to market a high frequency ventilator in 1988.



Bert's success was fraught with failures in academia and business as well as his health. He was once nearly arrested for defying a government order to close down his business. His favorite leisure time activities of rock climbing and skiing have produced numerous broken bones and contusions. Perhaps Bert's near death experience at age 20 made him a little cavalier, but it also helped him persevere in the face of adversity.

An undying optimist, Bert has maintained a healthy sense of humor and a passion for helping others. He considers himself lucky, having learned at an early age how to create opportunity from misfortune, and he enjoys sharing how he learned to do that every chance he gets.