Critical (Intensive) Care Medicine and CPR

A Personal History By
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ABSTRACT
I perceive that the most consistent pursuits of successful innovators and leaders in medicine, as in all endeavors, come from aspirations generated by dreams rather than hope or by fate alone; from the excitement with which the dreamer attracts collaborators who have prepared minds and skilful hands; they join talents and destinies to convert the dream to expert plans. Contingent on the vigor, the persistence and on the attention to detail with which they commit to the execution of their plans, the secure the advances that contribute to the social goods and bring ultimate success to all who have jioned destinies to seriously pursue those dreams.

Key words: cardiopulmonary resuscitation, critical care medicine, intensive care medicine, history, progress, future

More than fifty years ago when the late Dr. Herbert Shubin and I began what became critical care medicine, monitoring and life support interventions which we now accept as routine were at best experimental. The routines of hemodynamic and blood gas monitoring, and even mechanical ventilation outside of the operating theater were controversial. Transvenous cardiac pacing had just started. This was still in the area of oxygen tents, the iron lung, and the intermittent positive pressure (IPP) devices. The segregation of critically ill patients into discrete units was limited to very special services like Shock Units that began under our auspices at USC in 1958 and in 1961, Coronary Care Units. In 1960, the remarkable report by Kouwenhoven, Jude and Knickerbocker ushered in the area of closed chest cardiac resuscitation.

The following decades have extended critical care monitoring and interventions from medical and surgical Intensive Care Units to neurology and neurosurgery, neonatology, pediatrics, obstetrics and gynecology, trauma surgery, and emergency medicine.

With astounding speed, the monitoring of cardiovascular function and especially the early detection and competent management of major cardiac arrhythmias in coronary care units followed by acute coronary interventions, led to remarkable increases in survival after acute myocardial infarction. Hemodynamic monitoring, initially with central venous catheters was followed in the early 1970s by the introduction of flow directed, balloon-tipped Swan-Ganz catheters. Multi-purpose, multi-lumen catheters became available for percutaneous peripheral and central venous, pulmonary artery, and arterial cannulation. Together with disposable pressure transducers and microprocessor-controlled amplified display and recording systems, the routines of pressure measurement were greatly facilitated. However, both the value and the risks of vascular invasion have been reassessed and increasingly more competent non-invasive options are rapidly gaining dominance. Transcutaneous pulse oximetry, expiratory capnography, ultrasound, including echocardiography, Doppler for pressure monitoring and both pulse wave based and impedance based techniques for estimating cardiac output have evolved. Within the most recent five years, we are witnessing a de-emphasis on the macrocirculation, more concern with the delivery of vital substrates to tissues, and a clear call for better understanding of the microcirculation and cell viability.

The availability of orthogonal polarization spectral imaging of the sublingual mucosa opened a new era of microcirculatory measurement on acutely ill patients. There were giant advances in airway
management, volume assisted, pressure supported and controlled ventilation, airway pressure controls, elective hypercarbia and recognition of the problem of respiratory muscle fatigue. Extracorporeal oxygenation was initially disappointing but re-emerged for transitional management of life-threatening lung failure especially for newborn and pediatric patients but more recently more selectively also for adult patients. Digital processors, initially used in our unit in 1962, have revolutionized both data acquisition and data management in support of computerized medical recording. Sophisticated interventions with fluid challenge, vasoactive drugs, and vasodilator agents to moderate preload and afterload are widely used. In some instances, vasoconstrictor drugs and adrenergic inotropes are still unproven therapeutic options for management of life-threatening circulatory shock and heart failure. More specific coronary interventions evolved, including acute administration of anti-platelet and thrombolytic drugs, angioplasty and stents. Mechanical support of the failing circulation was initially facilitated by balloon counterpulsation techniques and mechanical hearts are in increasing use, both for transition to cardiac transplantation and very recently, for permanent implantation.

New techniques for diagnosis came to the fore, applicable to pediatric, obstetrical and neonatal patients, including arrhythmia detection and in-utero measurements, computerized axial tomography, radionuclear including PET scanning and both magnetic resonance and sonographic imaging. Impaired immuno-responsiveness due to HIV but also in critically ill and injured patients more generally, is well recognized. The understanding of mechanisms of cardiac arrest and options for cardio-pulmonary resuscitation have changed substantially, witness the major changes in the International Guidelines and the newly recognized de-emphasis on routine ventilation. In our Institute, our laboratory and engineering research has had a special emphasis on CPR after the sudden death, while hiking, of our colleague and co-leader, Dr. Herbert Shubin in 1975. With respect to CPR including defibrillation, mechanical chest compression, together with early definitive intervention, especially for the majority of coronary artery based caused of cardiac arrest, we see opportunity for increasing resuscitation and meaningful survival. Most, importantly, the most impressive outcomes result from very well organized and exercised programs starting with bystander initiated CPR followed by out-of-hospital diagnosis and management, including automated chest compression, in-hospital triage for coronary interventions, and intensive post-resuscitation management, including hypothermia. In part based on our research, pharmacological interventions for CPR were reassessed and especially the potentially harmful effects of sodium bicarbonate, lidocaine and calcium salts. Even epinephrine is undergoing reassessment. The overriding benefits of precordial compression to improve forward blood flow have led to new mechanical chest compressors. Hypothermia for post-resuscitation management is now a routine practice. External defibrillators are increasingly more sophisticated for prompting CPR interventions, recognizing both the need and the optimal timing of shock delivery. Such verbal and visually direct “Resuscitation Sequences” such as to serve as comprehensive “Resuscitation Boxes”. Advances in the treatment of infectious diseases were spurred on by the availability of a continuing stream of new antibiotic, antifungal and antiviral formulations. Risks to health care workers after exposure to hepatitis, HIV and the tubercle bacillus during patient management, and the imminent threat of pandemics, witness the emergence of swine and H1N1 influenza viruses. Newer options for prevention of iatrogenic malnutrition and the roles of micronutrients were recognized together with the value of early enteral alimentation with less enthusiasm for parenteral nutrition. For better understanding of multi-organ failure, the roles of infecti-
complex and threatening. Health care delivery systems in the United States impose complex and consuming rules on physicians. Outcome measures and evidence based protocols are unquestionably important so that there may be a more objective basis for the use of costly resources. Technologically formidable and costly diagnostic and therapeutic interventions in the United States are often utilized to avoid legal liabilities even though conscientious clinicians may be secure that there is often greater likelihood of adverse effect than benefit. The professional roles of physicians, nurses, pharmacists, physician assistants, and other allied medical personnel specializing in the care of the critically ill are continually changing. Critical care specialists are now recognized on par with other medical and surgical subspecialists in industrialized countries. The shortage of such specialist has requested that some of the skills are extended to nurse practitioners, physician’s assistants and especially physicians with short-term training in the specialty. In the United States, the reality is that the modern hospital is becoming one large Intensive Care Unit or groupings of specialized Intensive Care Units. Other patients are directed to out-patient services. Full time intensivists assume responsibility on a 24-hour basis for a larger number of patients. The model of “shift” presence in the United States was pioneered by emergency physicians and also by trauma surgeons who themselves are some of the best intensivists. We also recognize the increasingly greater need of specialists in critical care nursing, hospital pharmacy, clinical engineering and bedside technology as well as clinical ethicists who share in the decision-making process for management of the critically ill. We are increasingly altered to the risks of medical and nursing errors in the complex settings of critical care and their high human and economic costs.