Chapter I

Introduction and history

INTRODUCTION AND HISTORY

In healthy individuals tissue oxygenation and carbon dioxide elimination is achieved by regular spontaneous breathing. Artificial ventilation enables maintenance of the vital processes e.g. helps to keep the body internal environment normal in case of respiratory insufficiency or failure. Proper artificial ventilation will provide maintenance of these vital processes, blood gases, tissue oxygenation and metabolism and will allow stability of the patient's general condition to treat the original cause of this respiratory imbalance. ***(Robert and Robert, 1994).***

For centuries it has been realized that failure to breath not necessarily lead to death. In the Second book of kings there is a vivid description of successful mouth-to-mouth resuscitation which the Prophet Elisha performed on a child who appeared to be dead. **In 1543,** Andreas Wesele Vesalius was the first to give a report about tracheostomy and the basics of modern resuscitation. He ventilated a dog's lungs with bellows connected to the trachea by a hollow reed. Vesalius technique of resuscitation was the simplest form of intermittent positive pressure breathing (IPPB), a form of support which has proven to be the most efficient mean of artificial breathing for the last 400 years. **In 1667**, Robert Hook of London repeated Vesalius experiment and ventilated a dog by fixing bellows tightly into the cut trachea of the dog, keeping it alive by regular intermittent inflations. Towards the end of the 18th century there developed a great interest in resuscitating people rescued from drowning. Medals and prizes were offered for new ideas and new apparatus for resuscitation. Many designs based on pumps, bellows and

tubes were introduced, developing the suggestions that Vesalius had put two hundred years previously.*(Baker, 1963)*.

In 1743 Elisha's mouth-to-mouth resuscitation was rediscovered by Tossach. Although the method was later condemned as unhygienic by the newly founded Royal Human Society, expired air resuscitation is now regarded as the method of choice when equipment is not available. **In 1754**, Benjamin Pugh described an air pipe for the resuscitation of the newborn. One end of the pipe was placed next to the baby's larynx and the lungs could be inflated by mouth or bellows. **In 1802**,E-Coleman from Ayreslin, Scotland, later veterinary professor in London, recommended tracheal intubation and used silver catheter much wider than those previously employed. He also recommended that an electric current be passed through the heart by means of electrodes placed over the apex will be beneficial. **During the period 1840-1940**, most of the mechanical aides to artificial ventilation depended on applying a subatmospheric pressure to the outside of the thorax. Dr. Alfred F. Jones of Lexington, Kentucky, patented the first american tank ventilator in 1864. he claimed cures for "paralysis, neuralgia, rheumatism, and many other diseases, the inventors of subsequent tank and cuirass ventilators only claimed successful treatment of respiratory diseases.*(Woolam, 1976)*

Alexander Graham Bell invented a vacuum jacket for resuscitation of the newborn and in 1889, Dr. Egon Braun described a small tank ventilator for the same purpose. *(Seely,1984).*

In 1887, Fell and O'Dwyer introduced a foot bellows ventilator for postoperative ventilatory support. **In 1890**, Tuffier and Hallion were the first to apply intra-operative artificial ventilation by insufflation in an intubated patient to solve the pneumothorax problem in thoracic surgery. **In 1910**, Lawen and Sievers in Friederch Trendelburg's department in

Lipzig, reported a piston ventilator which applied positive and negative pressure with supplemental oxygen through an endotracheal tube. *(Manrh. 1985).*

In 1913, Henrry H.Janeway of New York described a machine for anesthesia and artificial ventilation with cuffed endotracheal tube exactly the shape of the one used today. Janeway also appreciated the potentially adverse effects of positive pressure on circulation. **In 1916**, K-Giertz showed that artificial ventilation obtained through positive pressure rhythmic insufflation was superior to every form of constant differential breathing. He recommended rhythmic inflation rates of 12-16 breaths/m, for better ventilation. *(Mushin et al., 1980).*

In 1929, Drinker and his colleagues introduced their tank ventilator for prolonged artificial respiration which subsequently became known as the "iron lung". Poliomyelitis was the main cause of respiratory failure in children and young adults during the first half of the 20th century, and the first patient to be treated by the " iron lung" was a victim of paralytic poliomyelitis. *(Seely, 1984).*

During the 1930's, the technique of "controlled respiration", was introduced. Artificial ventilation was carried out by rhythmically squeezing the reservoir bag of a circle and absorber system. The combination of hyperinflation and general anesthesia suppressed the patient's spontaneous respiration. Guedel and Treweek used ether and called the technique "ether apnoea". A little later, Waters used cyclopropane and first suggested the term "controlled respiration". This method of artificial ventilation was used when curare was introduced into anesthesia in the early 1940's *(Churchil, 1993).*

After the Second World War, there were two stimuli to the development of mechanical ventilators for IPPV. The first was the

introduction of curare into anesthesia. The second was the fear of health authorities that if another poliomyelitis epidemic occurred, large numbers of patients might require artificial ventilation. **In 1952**, Denmark was struck by a particularly severe epidemic of paralytic poliomyelitis. At Blegdam Hospital in Copenhagen, the apparatus available consisted of tank and six cuirass ventilators and these facilities were rapidly overwhelmed by the number of patients and these facilities were rapidly overwhelmed by the number of patients requiring respiratory assistance. By this time "controlled respiration" was well established in anesthesia and almost as a last resort the technique was extended to patients needing long-term ventilation. At one time, 70 patients were receiving respiratory assistance from "ventilators" which consisted of medical students squeezing the bag of a to-and-fro system with carbon dioxide absorption. The medical students were paid for each eight-hour shift. Lassen and Ibsen established the basic principles of long-term ventilation : careful air way control and protection, humidification avoidance of high inspired oxygen concentrations and meticulous physiotherapy. Once the acute phase of the disease was over, weaning was accomplished by intermittent mandatory ventilation (IMV). Adequacy of ventilation was assessed by oximetry and by end-tidal carbon dioxide concentration measurements. A dramatic fall in mortality occurred after the new technique had been introduced, and this ensured that intermittent positive-pressure ventilation (IPPV) was to become the standard method of artificial ventilation. The superiority of IPPV was confirmed during the Stockholm epidemic in the following year and during the New England epidemic of 1955. After the introduction of the Salk and Sabin vaccines the incidence of poliomyelitis fell sharply. During the 1960's the indications for IPPV were broadened further and the cardiovascular effects were investigated. Improvements in

the immediate management of the injured showed that a group of patients who had been successfully resuscitated went on to develop a lung condition characterized by certain radiological changes and severe impairment of gas exchange. Shock lung and adult respiratory distress syndrome (ARDS) were two of the many names for this condition which proved to be particularly serious in septic patients. ***(Churchil, 1993).***

In the 1960's the term "respirator lung" was introduced to describe radiological and pathological changes in the lungs of some patients who had received artificial ventilation. In retrospect pulmonary oxygen toxicity was probably responsible for many cases of "respirator lung". The toxic effects on the lung of pure oxygen at standard atmospheric pressure had been recognized for over 50 years and an inspired oxygen concentration of 50 percent or less was considered safe. After 1955, most ventilators in use in North America were powered by compressed oxygen and employed a venturi device to entrain air. Several years later it was shown that the venturi device was not performing as expected: as a result, oxygen concentrations in the toxic range were being delivered to patients. Subsequent animal experiments using carefully controlled oxygen concentrations freed the respirator from blame. This evidence together with the experience already gained with polio patients established that IPPV with modest levels of oxygen in the inspired gas may be continued indefinitely without adverse effect on the lung. ***(Churchil, 1993)***.

Several modes of ventilation are now available which allows adjustment of artificial ventilation according to the patient's requirement. These modes progressed recently to give the maximum benefits with minimal complications. ***(Stusky, 1993)***.