

# TUFTS UNIVERSITY

## Schools of Medicine and Dental Medicine

# SCIENTIFIC NEWS

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WINTER  
1968

Published at Tufts—New England Medical Center, Boston

Vol. 5, No. 1

## Tufts Clinician Advocates Wider Use of Controlled Mechanical Ventilation

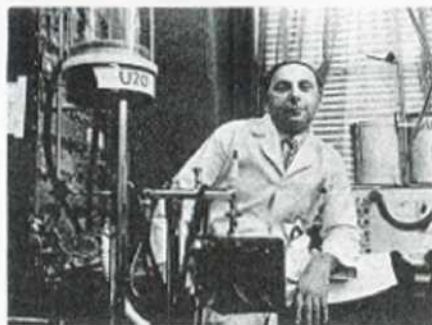
CONTROLLED mechanical ventilation in patients near death from chronic obstructive lung disease with acute ventilatory failure can prove lifesaving to a significant number of patients if instituted promptly and properly when conventional assisted respiration techniques fail. This finding is reported by two Research Fellows at the prototype Lung Station-Tufts, a clinical unit of Tufts University School of Medicine located at the Boston City Hospital. Dr. Earle B. Weiss, Tufts Instructor in Medicine and director of BCH's Pulmonary Physiology section predicts that half and perhaps more of the patients failing to respond to assisted ventilation can be salvaged by utilizing the inexpensive IPPR respirator at times in conjunction with morphine and similar drugs to override the uncooperative patient's respiratory control. The clinicians also developed sequential guidelines for establishing control ventilation during acute ventilatory collapse. Their protocol stresses the need for proper machine-patient synchronization, an essential factor in establishing effective ventilation.

Coinvestigating respiratory problems with Dr. Weiss, who also directs the Blood-Gas Laboratories at Boston City Hospital and is Research Associate at the Lung Station-Tufts is Dr. Mauricio J. Dulfano. Dr. Dulfano, a former Tufts Associate Professor of Medicine, also served as a Lung-Station Research Associate during his tenure at BCH. Dr. Dulfano is now Assistant Professor of Medicine at Downstate University (N. Y.).

Twenty-one bedside studies providing case material were performed on 19 patients afflicted with a variety of respiratory ailments. Specific disorders treated by Drs. Weiss and Dulfano are asthmatic bronchitis, chronic bronchitis, cor pulmonale, obstructive emphysema, and tuberculosis. Aggravating and complicating these respiratory disorders in the present study were pneumonia, cerebrovascular problems, cardiac disease, obesity, superinfection, gastrointestinal dysfunctions, and shock. With few exceptions, all patients were gravely ill; nearly 40% were comatose or obtunded, declare the investigators.

Controlled ventilation is the mechanical adjunct of choice when conventional assisted ventilation fails, according to the two physicians. They emphasize that in 19 selected patients with advanced acute ventilatory failure treated on the First and Third Medical Services (Tufts) at the hospital, assisted ventilation maneuvers were successful only four times. Controlled machine synchronization without drugs proved feasible in seven (41%) trials. "In the remaining 10 cases," Dr. Weiss states, "where oxygen control was attempted, only three (18%) suppressed to the point where machine cycle could be employed." The seven remaining patients resisted machine cycling and proved refractory to oxygen suppression. Morphine and succinylcholine, alone and together, are required to achieve optimal coordinated respirator effect in uncooperative or non-responding patients, report the investigators.

Drs. Weiss and Dulfano maintain that over-all ventilatory improvement is best achieved by



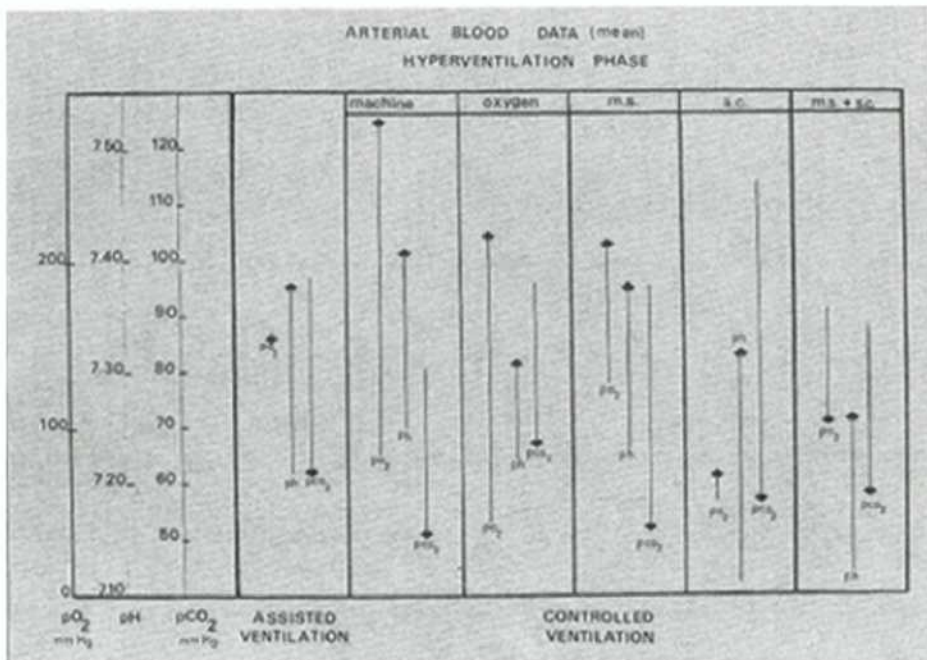
LUNG STATION physician, Earle B. Weiss, M.D.

reducing respiratory rates after a short period of initial hyperventilation and increasing the patient's normal physiologic volume of air inspired and expired. Reduction of respiratory rate and careful hyperventilation seem preferable to gross increases in the minute ventilation, in their opinion.

The hyperventilation phase requires from two to six hours for maximum effectiveness. Directed at rectifying subnormal arterial blood oxygen levels and acidosis, hyperventilation is later replaced by maintenance ventilation. This maintenance stage, according to the Tufts and BCH clinicians, "permits full medical therapy to correct the precipitating factors." When and if underlying and/or complicating factors can be sufficiently relieved, the treatment regimen developed at Boston City Hospital permits replacement of controlled ventilation with conventional assisted intermittent positive-pressure breathing and later by non-mechanical breathing.

But, regardless of whether ventilation maneuvers take place at the patient's bedside or in an intensive care facility, Dr. Weiss strongly urges constant physiological monitoring of candidates for controlled ventilation. Monitoring techniques at the Lung Station-Tufts and on the wards of the

*continued on page thirteen*



Boston City Hospital include serial arterial blood gas measurements ( $P_{aCO_2}$ ,  $P_{aO_2}$ ), determination at the exhalation port of tidal and minute volumes with a ventilation meter, blood pH values, and oxygen saturation levels.

"Every attempt was made to improve conventional assisted respiration," Dr. Weiss says, outlining initial treatment protocol. But when blood pH dropped below 7.25, accompanied by rising arterial carbon dioxide concentrations ( $>55$  mm Hg) and decreasing blood oxygen levels ( $<60$  mm Hg), Dr. Weiss' diagnostic criteria for acute respiratory insufficiency were satisfied and the patient immediately received assisted improved ventilation in every instance.

All patients in this early stage were ventilated through tracheostomy or endotracheal tubes using IPPR. But even with respirator oxygen concentration set at a minimum of 40%—and occasionally as high as 100%—conventional assisted respiration with the IPPB unit proved inadequate in 80% of the ventilatory studies.

Major medical detriments contributing to assisted IPPB failure in the first stage, according to the two clinicians, are:

- progressive clinical obtundation;
- inability of IPPB to counter rising arterial carbon dioxide concentrations;
- refusal of uncooperative and agitated patients to accept or phase with the respirators;
- persistent very rapid breathing compounded by physical exhaustion from obviously excessive energy deficits due to increased work in breathing;
- patient obtundation from oxygen therapy.

Dr. Weiss recommends for patients in whom improved assisted circulation proves of little or no avail, treatment with controlled ventilation in four sequential steps: First, he institutes automatic machine ventilation set at 10-15 cycles per minute. If, after seven minutes, patient synchronization with the machine doesn't occur, the second step is taken; 100% oxygen suppression with the machine on automatic cycle. This proved adequate and successful in 50% of the trials. If these two simple maneuvers fail, he advises either morphine (3-5 mg intravenously, total dose not to exceed 20 mg) or succinylcholine. Twenty to 40 milligrams of the latter suppressive drug is intravenously injected as a stat dose by the Tufts and BCH physicians. The choice between morphine

or succinylcholine is arbitrary, says Dr. Weiss. Administration of one is, however, mandatory when it becomes necessary to reduce patient agitation or produce muscle relaxation. Drug injection in all cases should be immediately followed by a machine cycle. As an added precaution, he insists that a manual bag respirator be kept by the bedside in anticipation of mechanical failure.

Once synchronization is established, the hyperventilation period cited earlier is begun, followed by a maintenance period once patient improvement warrants it. Drs. Weiss and Dulfano interpret the following signs to indicate proper patient control:

- improved blood-gas parameters;
- disappearance or drastic decrease in patient agitation and uncooperativeness to the point where he can cycle with the machine;
- appearance of adequate tidal volume on the respirator, even with oxygen administration;
- significant reduction in energy expenditures of patients who earlier presented gross ventilatory effort because of severe obstruction, etc.;
- disappearance of cyanosis.

The goal of the maintenance period is to support adequate alveolar ventilation. Hopefully, associated medical therapy alleviating the need for ventilatory therapy can be continued to fruition during this period.

"Of the 16 patients on controlled ventilation, five died during the procedure, leaving 11 (69%) who were transferred to assisted ventilation and were maintained thereafter," state Dr. Weiss and his colleague. "From this latter group three died at later dates, while on a continuous or intermittent assisted schedule, leaving eight (50%) survivors, who were entirely weaned off the respirator." The over-all mortality experienced by the 19 patients was 41%.

Although complications attributable to controlled IPPR therapy present a problem, the clinicians aver that the magnitude of IPPR-induced difficulty is hard to evaluate because of the overlap of associated diseases and therapy.

The program, originating in the Lung Station-Tufts (a unit directed by Tufts Clinical Professor of Medicine Maurice S. Segal) was underwritten in part by the Pittsfield Anti-Tuberculosis Association and the Council for Tobacco Research.

*Annals of Internal Medicine*, Vol. 67 (3):556-567