COMMENTARY  This commentary provides editorial perspectives on the report which follows

A priori and A posteriori Knowledge in Medicine

The article, “Intermittent Mandatory Ventilation Is Synchronization Important?” (see page 598) is welcome and long overdue. Since its introduction as a form of mechanical ventilatory support, IMV has generated controversy, much of which has been based on the a priori concept of what “must” happen when the technique is used rather than the observation of what actually does happen.

Criticism of a new therapeutic technique is desirable if it leads to careful testing in an attempt to ascertain the validity of the criticism. Often, however, such criticism is accepted at face value (a priori) without appropriate confirmation (a posteriori). As a result, a potentially useful form of therapy may be delayed or never see the light of day. One does not have to search extensively to illustrate pertinent examples of this problem. Reservations which were based upon an incomplete evaluation of the physiologic events transpiring hindered the introduction of PEEP/CPAP into clinical medicine for over 20 years because it was “obvious” that cardiovascular function would be impaired by increased airway and intrapleural pressure. Although the observations which led to this conclusion had been made in normal subjects rather than those with diffuse pulmonary parenchymal disease, this fact was overlooked completely. Only when a few investigators finally challenged the established viewpoint was it possible to ascertain the potentially life-saving affects of PEEP/CPAP.

An excellent contemporary example of such controversy involves the theoretical advantages of synchronized intermittent mandatory ventilation (SIMV) compared to IMV. Heenan et al examined the effects of the two with and without CPAP in normal and near-drowned dogs. They found no differences in measured or calculated cardiopulmonary function, except for a slight (but statistically significant) increase in peak and mean airway pressure when IMV was employed. Of particular interest were their findings that intrapleural pressure was not increased with IMV compared to SIMV and that cardiac output was not adversely affected with IMV, despite “stacking” of the mechanical breath upon a preceding spontaneous one.

This information is important for several reasons. It demonstrates again that theoretical objections may be at odds with clinical observation. Example: A mechanical breath which is stacked on a spontaneous breath results in a larger overall tidal volume (true) and hence must increase intrapleural pressure (false). This assumption results from a failure to recognize that the mechanism by which changes in transpulmonary pressure are generated during mechanical and spontaneous breathing is different. The predicted increase of intrapleural pressure does not occur during IMV because the lower intrapleural pressure resulting from the spontaneous breath partially offsets the higher pressure which would otherwise be anticipated from the combined spontaneous and mechanical tidal volumes.

The distinction between a priori and a posteriori concepts is often muddled. Empiricists have held that the a priori concept can express only the relationship of ideas and is therefore restricted to logic and mathematics. If one accepts this proposition, it is doubtful that a priori concepts or propositions can exist in medicine, which surely ranks among the least exact of the sciences. This is not to say that conceptualization is unimportant, but rather that rigorous testing of the concepts is mandatory before they are accepted or rejected as medical “knowledge.”

The practical impact of Heenan’s study must also be emphasized. Theoretical objections to IMV have persuaded several manufacturers to develop methods which synchronize the spontaneous and mechanical breaths. These include SIMV (Bourns Bear 1, Bennett MA 2, Monaghan 225, Gill 1, Servo 900 B, McGaw CV 200 and CV 200, Ohio CCV-2), intermittent assisted ventilation—IAV (Healthdyne), and intermittent demand ventilation IDV (Searle). Such innovations are based upon no documented or published evidence in patients with pulmonary disease as to either the need for or efficacy of the modes in question. Instead they represent a solution to a problem which has not yet been demonstrated to
exist, and increase the cost of individual ventilators from several hundred to perhaps a thousand dollars. Such costs added to the baseline price, which has become almost prohibitively expensive in some instances, cannot be justified on the basis of available information.

The present study involves laboratory animals and experimental conditions which do not fully approximate the ICU setting. Confirmation of the observed findings in patients will be welcome. Nevertheless, there is no reason to doubt the clinical applicability of the reported observations. Critics may question whether or not IMV is as useful as proponents claim, but a decision not to employ it as a means of ventilatory support should not be based upon the alleged danger of a lack of synchronization between spontaneous and mechanical breaths.

Heenan et al are to be congratulated, both for presenting data which are of practical value and for pointing out some of the misconceptions which have governed the selection of IMV as a technique of mechanical ventilatory support.

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Reference

Intermittent Mandatory Ventilation
Is Synchronization Important?*


Intermittent mandatory ventilation (IMV) allows patients to breathe spontaneously between mechanically supported breaths. Recently, several manufacturers have implied that nonsynchronous application of the mechanical breath may depress cardiovascular function and increase pulmonary barotrauma. Because it is technically difficult and expensive to synchronize mechanical ventilation to spontaneous breathing, we sought to determine whether there is any significant difference in cardiopulmonary function during synchronous and nonsynchronous mandatory ventilation. Our investigation failed to support the hypothesis that synchronization of spontaneous and mechanically mediated breathing is physiologically beneficial.

Intermittent mandatory ventilation (IMV) was originally developed as a way to discontinue mechanical ventilatory support. By allowing unassisted and unrestricted spontaneous respiration between mechanically mediated breaths, mechanical support may be withdrawn gradually as spontaneous respiration improves. This is accomplished by increasing the length of the respiratory cycle of a time-cycled ventilator and, thus, decreasing the mechanical respiratory rate.1 With such a system, mechanical inspiration may be independent of, or nonsynchronous to, respiratory efforts by the patient. Recently, there has been concern that dysynchrony between spontaneous and mechanically mediated respiration might have detrimental cardiovascular effects. Synchronization so that the mechanical breath is delivered just as spontaneous inspiration begins would insure that the increase in lung volume would not exceed the preset tidal volume.2 Thus, peak and mean airway pressure would be lower and possibly less detrimental to cardiopulmonary function. This study was designed to determine if there is any difference between the cardiopulmonary effects of nonsynchronized IMV and synchronized IMV (SIMV).

MATERIALS AND METHODS

Ten mongrel dogs weighing 13 to 20 kg were anesthetized by an intravenous injection of sodium pentobarbital (25 mg/kg) and placed supine. Their tracheas were intubated with cuffed endotracheal tubes and light general anesthesia was maintained with intermittent intravenous injections of sodium pentobarbital. The endotracheal tube was attached to the breathing circuit of a mechanical ventilator (MA-1, Puritan-Bennett) modified to permit both spontaneous and