GADGETS

Mechanical Ventilation of the Infant

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Supporting the ventilation of the neonate and infant has presented problems in the past because of: (1) the small tidal volumes involved, (2) the rapid respiratory rate required, (3) the difficulty in providing rapid flow rates instantaneously, and (4) the inherent powerful respiratory drive often seen in infants requiring ventilatory assistance. Conventional ventilators have failed to provide the requisites properly to assist the spontaneous respirations of the small infant. Controlled respirations have been possible only at the expense of marked depression of the infant or pronounced hyperventilation. What was needed was a mechanical ventilator sensitive enough to assist respirations with minimal inspiratory effort, or control ventilation with virtually no lag in response, so that tidal volumes of 15 to 30 ml. could be moved in and out of the lungs at rates of 60 to 80 per minute. Such a mechanical ventilator for ventilating the lungs of the newborn and especially the premature infant would be of particular value in hyaline membrane disease, with its essentially self-limiting nature and probable lack of residual pathologic change.

To meet this need, a standard Mark 8 Bird respirator (fig. 1) has been modified in a relatively simple manner with micro-controls, vernier sensitivity magnet control (no. 1) and a fine expiratory valve control (no. 2). Attached to the respirator is a double jet, bi-directional venturi valve which is incorporated into a “U” configuration head piece (Jackson-Rees type). The respirator (fig. 2) has a twin parallel booster (no. 4) with an inspiratory parallel flow booster (no. 3) for giving adequate humidification and a booster mixer (no. 5) with its oxygen supply (no. 6) to control oxygen concentration delivered to the patient. The system utilizes an in-line, long term nebulizer (no. 12) which is connected to the twin parallel booster mixer.

The double jet, bi-directional venturi valve (fig. 3) is designed with an inspiratory jet (no. 17) on one side and an expiratory jet (no. 18) on the other side. Also, this valve has a passive gate (no. 19) to allow any spontaneous effort to be transmitted to the respirator. This valve, which has no mechanical components, permits rapid changes in direction of the air flow. The exhalation jet can be adjusted by the fine expiratory valve control (no. 2) to a very low negative phase (0.5 to 1.0 cm. of water) to just overcome the resistance of the small endotracheal tube which is attached to the “U” configuration head piece at the endotracheal tube connection (no. 15). The “U” configuration head piece with its endotracheal tube connection has a removable plug (no. 16) for easy access for suctioning down the endotracheal tube. This arrangement allows for easy endotracheal tube attachment to the ventilator and for firm anchoring of the tube complex to the infant’s

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head with adhesive tape; thus, permitting manipulation and turning of the baby without dislodgment of the nasotracheal tube.

The inspiratory parallel flow booster, which permits the patient to receive a high humidity atmosphere, is placed above the respirator on the main 50 p.s.i. line and is triggered with each inspiratory cycle of the respirator by the inspiratory power line (no. 8). There is a flow adjustment which can regulate the amount
of flow to the jet of the nebulizer by the inspiratory parallel air flow line (no. 9). For cases requiring more oxygen, the booster mixer is the answer. It is mounted to the side of the inspiratory flow booster and releases the oxygen during inspiratory phase into the system through one of the inlets on top of the in-line nebulizer.

Adaptation to an infant is very simple. Before the nasotracheal tube is inserted, it is attached to the entire set-up and with the respirator in the "off" position. The fine expiratory valve control is adjusted to 0.5 cm. of water, which is read off the respirator aneroid dial. The tube is then inserted, taped securely, and attached to the "U" configuration with a small plastic connector. Inspiratory pressure is regulated according to the ventilation required. Inspiratory flow rate is adjusted to the requirements of the inspiratory cycle and is balanced against the additional flow through the nebulizer jet. The sensitivity is adjusted to avoid pressure cycling and to follow the inspiratory efforts without delay from initiation to triggering of the respirator.

General management of the respirator is relatively easy with minimal adjustment required after initial adjustment. Additionally, the automatic timer for controlled respiration can be adjusted to take over when the respiratory rate of the patient falls below any predetermined level.

This respirator has been used at Duke University Medical Center for ventilation of infants with congenital heart disease postoperatively, and in prematures with hyaline membrane disease. Early results have been encouraging and it is believed that this modified ventilator supports the respiratory exchange of the premature, newborn, and older infant in a satisfactory and physiologic manner. Clinical impressions have been substantiated by blood gas measurements, as will be reported in a future publication.

Infant respirator kit to modify standard Mark 8 Bird respirator available from Bird Corporation, Palm Springs, California.

Aid During Tonsillectomy

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The Davis-Crowe mouth gag is commonly employed to good advantage during tonsillectomy. Its use, however, requires that some individual (surgical assistant, anesthesiologist) or some mechanical device maintain the tip of the handle in an elevated position; a circumstance which often proves distressing to both the anesthesiologist and the surgeon.

For several years I have employed a gadget in the solution of this problem which relieves this assistant from this chore. It further provides stable fixation for the mouth gag and yet allows for changing position or height of the table at any time without disturbing the position of the mouth gag. The pertinent piece of apparatus is an ordinary, inexpensive clothes line tightener which can be purchased in any hardware store. This is assembled, using clothesline for the attachments (fig. 1), with appropriate rope loops superiorly and inferiorly and a single strand of rope for the tightening adjustment. Raising the tightener, and therefore anything that is attached to it, is easily accomplished by grasping it with thumb and fingers of the right hand, while the left hand makes taut the strand of rope which passes through it. The device will then maintain itself at any level by the unidirectional gripping action of the housing through which the rope passes. Any downward force on the lower loop serves only to make the device more secure at that level. Release of this locking action is easily affected by the maneuver shown in figure 2. With the right thumb placed on the metal loop from which the lower rope loop