

Original Articles

Trans-Endotracheal Tube Suction in the Simulated Breathing Patient

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Serious impedance to air flow in the upper respiratory tract may be a complication of disease and of the means employed to improve the patency of an airway, as with endotracheal tubes and suction. A great degree of subatmospheric pressure may be developed during inspiration, in the presence of an endotracheal tube and use of the suction catheter and suction. The extent of change caused by each of these factors, separately and in combination, was measured on a lung model simulating a spontaneously breathing patient. Suction catheters with side arms designed to minimize unwanted suction during catheter manipulation were evaluated and compared with a laboratory standard. The studies revealed that subatmospheric pressures developed in the upper airway may be severe and that the side arms in suction catheters are not nearly as effective as they should be.

ENCROACHMENT upon the airway may occur during anesthesia, as a result of operation and during respiratory care in general. The insertion of a catheter into an airway already narrowed by an endotracheal or a tracheostomy tube in a spontaneously breathing patient presents an added obstruction to air flow. Suction via a catheter imposes a further burden on the patient's efforts at ventilatory exchange.

It was the purpose of this investigation to determine the effect of the endotracheal tube, the endotracheal tube plus suction catheter, and, finally, the added influence of suction on airway resistance and pressure produced in a lung model during simulated inspiration. Sev-

eral commercial suction catheters with side arm adapters especially designed to minimize the extent of subatmospheric pressure developed were studied. The findings were compared with a side arm adapter designed in the laboratory.

Methods

Figure 1 represents the lung model employed. It consisted of a chamber with a compliance of 0.069 liter/cm. of water. A tidal volume was created by means of a negative pressure chamber with a capacity of 3.387 liters. Negative pressure within this small chamber was controlled at -119 cm. of water, equivalent to a volume deficit of 400 ml. When the partially evacuated chamber was brought into communication with the larger chamber by opening a solenoid valve, and with simultaneous closure of the solenoid valve to the suction line, a tidal volume of 400 ml. was created. This tidal volume could be produced on a nonrepetitive basis; or by means of a timing mechanism ° a "respiratory" rate of 20 per minute may be maintained.

Air flows were determined by means of a no. 2 Fleisch pneumotachometer (PN) in line. Differential pressures were led to a differential transducer (T1), and with amplification were recorded on a Sanborn Polybeam Optical Recorder. A second pressure tap from the airway led to a transducer (T2); from here the pressure signal led to an optical recorder. Paper speed was 25 mm. per second.

The Influence of the Endotracheal Tube. Cuffed endotracheal tubes of various sizes were introduced into the "airway." With each, 400 ml. tidal volumes were generated and flow and pressure tracing obtained (table 1).

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° Flexopulse Timer, manufactured by Eagle Signal Co., Moline, Illinois.