

As regularly supplied the catheter measures 35 cm.; when fitted with a glass adapter the effective length is reduced to 33 cm. This length may be insufficient to reach secretions in the main stem bronchi when the catheter is inserted through an endotracheal tube which may measure up to 27 cm. (fig. 1). Furthermore, there is a definite danger that short catheters which are inserted up to their maximal length may completely occlude the endotracheal tube, since the outside diameter of the proximal end of the aspirating catheter, expanded by the connecting glass tube, may exceed the internal diameter of the endotracheal tube or its adapter. Occlusion of the endotracheal tube not only interferes with pulmonary ventilation but the lungs may rapidly be deflated by suction applied through an airtight connection.

We have found it necessary to warn anesthetists in training repeatedly of the danger of producing atelectasis when the conventional catheter is inserted its entire length through an endotracheal tube. The funnel-like expansion of the proximal portion of the catheter is capable of effecting an airtight connection between the suction machine and the patient's lungs when an endotracheal tube provided with a cuff is in place. Actual measurements have revealed that it is possible to evacuate air through the size 14 French aspirating catheter at a rate of 1 liter in approxi-

mately four seconds. Ideally, endotracheal aspiration through an endotracheal tube should be performed with a catheter whose diameter is small enough to permit the passage of air around the aspirating catheter with each respiratory movement in order to prevent deflation of the lungs.

By increasing the length of the Friend type aspirating catheter to 60 cm., the above objections may be eliminated. It is also helpful to have the catheters marked off in 10 cm. segments similar to tubes used for gastric suction. These improved catheters have been manufactured for us in the two sizes most commonly used, 12 and 14 French.*

These lengthened catheters may readily be passed through the nose to perform tracheobronchial aspiration and to stimulate cough for the prevention and treatment of postoperative atelectasis; their added length is a decided advantage in accomplishing this maneuver.

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* Manufactured by Davol Rubber Company, Providence, Rhode Island.

RESISTANCE STUDY WITH THE CARLEN-STILLE DOUBLE LUMEN ENDOTRACHEAL CATHETER *

There has been some question as to whether the Carlen-Stille catheter permits adequate, unobstructed respiratory exchange. Because of our experiences, we share in the belief that respiratory obstruction occurs in some situations when this catheter is used. Preoperatively, occlusion of one pulmonary artery and the bronchus to the corresponding lung was used on candidates for pneumonectomy to predict post-pneumonectomy pulmonary competence (1).

* This study was supported by Wilson C. Laucks Memorial Research Foundation, the A. Atwater Kent Fund and The National Institutes of Health.

A special balloon tipped, cardiac catheter placed in one pulmonary artery arrested the blood flow to an entire lung when the balloon was inflated. A 39 French Carlen-Stille, double lumen, bronchospirometry catheter, inserted in the tracheobronchial tree, permitted selective occlusion of either bronchus (2). Ideally, with the pulmonary artery and bronchus of the same lung occluded, a "physiologic pneumonectomy" would be accomplished (3).

The majority of the patients studied showed little change with pulmonary arterial occlusion. However, bronchial occlusion produced respiratory distress and

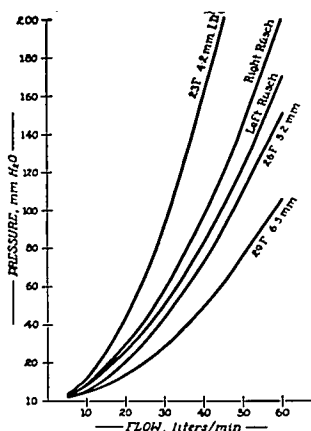


FIG. 1. Pressure opposing the gas flow in millimeters of water (resistance) at various flow rates in liters per minute for the following tubes: (1) 23 French endotracheal tube with 4.2 mm. inside diameter, (2) right side of the large 39 French adult male, Carlen-Stille catheter manufactured by Rüsch with an approximate inside diameter of 7 mm., (3) left side of the Carlen-Stille catheter of the same inside diameter, (4) 26 French endotracheal tube with a 5.2 mm. inside diameter and (5) 29 French endotracheal tube with a 6.5 mm. inside diameter.

clinical signs of obstruction along with decreased arterial oxygen saturation (1). In an attempt to explain these changes the actual aerodynamic properties of the Carlen-Stille catheter were studied, using established techniques (4, 5).

A dry gas, oxygen, was directed in turn through each side of the 39 French adult male, Carlen-Stille catheter and through several common sizes of rubber endotracheal tubes, all equal in length with the Carlen-Stille catheter. At various flow rates, the pressure opposing the flow (resistance) through each tube was measured and curves were plotted (fig. 1). In the physiological range of flow rates, the 26 French tube has more resistance than the 29 French tube, as expected; the 23 French tube has even more. The curves of the 39

French Carlen-Stille catheter lie between those of the 23 French and the 26 French tubes. The resistance of the right side exceeds that of the left because of the angulation of the air stream at the bronchial orifice, compared with a gradual curve on the left.

Occlusion of one side of the catheter results in more resistance to ventilation for the normal adult male than the use of a 26 French endotracheal tube, an uncommonly small size for an adult. The high instantaneous flow rates that accompany the anxiety and discomfort of the procedure, together with further diminution of the airway size by secretions, accentuate this resistance. The substitution of a single, large bore, double cuffed endobronchial tube for the Carlen-Stille catheter resulted in free, unobstructed breathing in all cases.

In the bronchspirometric application of the Carlen-Stille catheter, where simple static lung volume is measured, flow rates are of little importance. Use of the catheter for endobronchial anesthesia is possible when the low flow rates of "controlled respiration" are used (6). At low rates, resistance to air passage is minimized. If, however, spontaneous respirations are allowed to occur, the correspondingly higher instantaneous flow rates result in turbulent flow and relative respiratory obstruction. Such obstruction might be expected if the equivalent of a small endotracheal tube in the adult patient were used.

Thus, we found that many of the objections to the Carlen-Stille catheter arise from its high resistance to spontaneous ventilation. This is strikingly noticeable when an individual breathes through only one side of the catheter.

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SUBARACHNOID HEMORRHAGE FOLLOWING TRACHEOBRONCHIAL SUCTION AND THE "STIR-UP" REGIMEN: A CASE REPORT

A well-developed, well-nourished, 32 year old man underwent a gastric resection for duodenal ulcer which had previously ruptured and been closed by an operative procedure. The ulcer crater was visible by roentgen examination. The history revealed no significant findings other than those associated with the ulcer. The blood pressure before operation was 134 mm. systolic and 78 mm. diastolic. Subtotal gastric resection with vagotomy was performed under intercostal-celiac plexus block on September 20. Intubation was performed while the patient was awake and after the oral pharynx and larynx were sprayed with a solution of 2 per cent pontocaine® hydrochloride. Following this procedure nitrous oxide-oxygen (1:1) and 450 mg. of a 0.2 per cent solution of pentothal® were employed to keep the patient from reacting to the endotracheal tube or the surgical manipulation, or both. The anesthesia time was four hours, and nothing unusual occurred during administration of the anesthetics. There were no episodes of hypertension before, during, or in the immediate postanesthetic period. During operation the blood pressure remained in the vicinity of 120 mm. systolic and 60 mm. diastolic. The operation was deemed successful and uneventful.

On the afternoon of the first postoperative day, that is, September 21, the temperature rose to 102 F., the pulse increased from 80 to 120, and respirations from 20 to 26. On auscultatory examination partial or

total collapse of the lower left lobe of the lung was thought to be present. A roentgenogram of the chest showed multiple areas of increased density in line with the left cardiac shadow and extending laterally. The roentgenologist concluded that this appearance might be attributable to "parenchymal involvement" or "multiple areas of atelectasia." He also noted that there was partial collapse of the left lower lobe, as suspected on physical examination. The Anesthesia Department was notified and a bilateral intercostal block from the sixth through the twelfth thoracic segment was performed, using a 0.15 per cent solution of pontocaine which contained 0.2 cc. of epinephrine in a concentration of 1:1,000. One half hour was allowed to elapse so that anesthesia might become established. After this period of time the patient was completely free from abdominal pain, and a tracheobronchial toilet was performed using a number 16 French urethral catheter. The patient coughed vigorously and an estimated 20 cc. of secretion was obtained. The intercostal block was effective for approximately three and a half hours, and five hours after the block the patient voluntarily stated that he felt much better. On physical examination at that time, no signs of a collapsed lung were found, and it was thought that the lower lobe of the left lung was aerated.

On September 22, the second postoperative day, the temperature was 100.5 F., pulse was 96 and respirations were 20. The