

An evaluation of flow rates in different size bronchial blockers at various vacuum pressures

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Introduction: With advances thoracoscopic surgery there has been a significant increase in the need for lung isolation and single-lung ventilation in adult and pediatric surgical patients. In 1999, Hammer et. al. published a brief communication explaining the techniques available for single-lung ventilation in pediatric patients.(1) Double lumen tubes (DLT) are often used. However, in many smaller pediatric patients (< 8 years old) the airway is often too small to allow placement of a DLT.(1) Bronchial blockers specifically designed for lung isolation have recently been introduced and have been shown to be relatively straight forward to position.(2) In order to facilitate lung deflation some practitioners apply suction to the bronchial blocker (Arndt and Peters personal communication). The purpose of this study was to measure the flow rate through several sizes of bronchial blockers at several vacuum pressures and hopefully provide practitioners with useful information when using this technique.

Methods: This study examined 5, 7, 9 French Arndt Endobronchial Blockers (CAEB) (Cook Inc., Bloomington, IN) and Univent 6.0 mm ID endotracheal tube (ETT) with an integrated bronchial blocker (Fuji Systems Corp., Tokyo, Japan). Pressure and flow measurements were made using a Biotek VT Plus Gas Flow Analyzer (Model VT Plus, Korr Medical, Salt Lake City, UT). The wall vacuum device used was an Ohmeda “Intermittent Suction Device” (Ohmeda Medical, Columbia, MD) set in the “continuous suction” mode. Flow rates were measured at 20, 40, 60, 80 and 100 mmHg vacuum pressure for the 5 French CAEB and 10, 20, 30, 40 and 50 mmHg for the 7 and 9 French CAEB and the integrated bronchial blocker on the Univent 6.0 mm ID ETT. Two blockers of each size were studied with thirteen measurements made at each specified vacuum pressure.

Results:

Bronchial Blocker Size O.D. = Fr or mm ID = Inches or mm Length = cm	Average Vacuum Pressure +/- SD (mmHg)	Average Aspiration Flow Rate +/- SD (ml/min)
CAEB 5 French Blocker OD: 5 Fr ID: 0.028 in Length: 50 cm	20.1 +/- 1.3 39.7 +/- 1.5 58.5 +/- 1.4 81.0 +/- 1.6 99.0 +/- 1.9	154.0 +/- 8.7 267.0 +/- 10.1 352.2 +/- 7.3 449.8 +/- 7.9 517.8 +/- 5.3
CAEB 7 French Blocker OD: 7 Fr ID: 0.044 in Length: 65 cm	10.0 +/- 0.9 20.3 +/- 0.9 30.5 +/- 1.2 39.7 +/- 1.5 51.0 +/- 1.5	323.6 +/- 24.1 583.5 +/- 23.1 812.5 +/- 25.6 993.8 +/- 27.9 1182.0 +/- 24.5
CAEB 9 French Blocker OD: 9 Fr ID: 0.068 in Length: 78 cm	10.2 +/- 0.6 21.0 +/- 0.9 31.1 +/- 0.9 40.0 +/- 1.2 50.6 +/- 0.9	1101.6 +/- 48.6 1859.7 +/- 44.1 2424.0 +/- 43.8 2873.9 +/- 47.6 3371.6 +/- 40.7
Univent 6.0 mm ID ETT w/ blocker OD: 3.0 mm ID: 2.0 x 1.4 mm Length: 52.5 cm	10.5 +/- 0.5 20.5 +/- 0.6 31.5 +/- 0.7 39.0 +/- 0.9 49.6 +/- 1.3	1189.1 +/- 41.4 1928.3 +/- 40.8 2607.1 +/- 37.7 3004.5 +/- 43.7 3499.0 +/- 52.3

OD=outside diameter, ID=inside diameter

Discussion: This laboratory model predicts, that when using constant vacuum pressure, flow will occur through the bronchial blocker proportional to the pressure applied. With the thorax open, this enhanced flow should facilitate quicker lung deflation than occurs with absorption atelectasis alone. Practitioner should be cautious, as the data points out, rapid flow occurs at relatively modest vacuum pressure and if applied too long could possibly pose a hazard to the lung. Further, clinical studies in patients using the methods described above would be helpful to refine this technique.

References:

- 1) Anesth Analg, 1999;89:1426-9
- 2) Arndt Endobronchial Blocker, Suggested Instructions for Use, (C-T-AEBS501) Cook Inc., 2001