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Intraoperative HFJV support during bronchoplasty

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ABSTRACT : High frequency jet ventilation (HFTV) was experimentally studied to ensure intraoperative respiratory support at tracheo-bronchoplasty.

On the condition of driving pressure of 5 to 15 PSI and frequency of 100 to 400 during bronch-plastic procedure, HFJV is of great help to shorter the operation time and to secure the anastomosis. And the arterial Po_2 and Pco_2, and pulmonary hemodynamics were kept satisfactory in the circumstances of intraoperative respiratory support.

INTRODUCTION

Bronchoplasty of choice for surgical treatment of central type of lung cancer has become widely accepted to preserve pulmonary function as much as possible. This procedure has been developed with safety and wide indication in consideration of high quality of life. The reasons for wide spread of the indication are based on advances in proper preoperative preparation, sound surgical technique and postoperative intensive care. In particular, the development of absorbable suture material and intraoperative respiratory care by high frequency jet ventilation (HFJV) was of great value to improve surgical outcome.

However, an ideal condition of HFJV is not yet made clear when HFJV is applied for tracheo-bronchoplasty.

The aim of this study is to clarify a proper condition of HFJV in applying for tracheo-bronchoplasty.

MATERIAL AND METHOD

Mongrel dogs weighed 12 to 15kg, supplied from the animal center of Nagasaki University School of Medicine were prepared and underwent left thoracotomy at the 5th ICS. The left main bronchus was exposed and isolated from the surrounding tissues. The cannulation was made into the left atrium and the femoral artery to measure each pressure respectively, and also Swan-Ganzcatheter was introduced into the pulmonary artery to measure cardiac output (CO) and the pressure of the pulmonary artery (PAP). Regional pulmonary blood flow (RPF) was measured by electromagnetic flow meter with the probe placing on the wall of peripheral pulmonary artery which was ventilated by HFJV, after performance of a 3cm segment resection of the left main bronchus, a smallsized catheter was introduced into the separated distal bronchus via endotracheal tube used for anesthesia. On the condition of the open bronchus, the driving pressures from 5 to 15

PSI and frequencies from 100 to 400 were ranged to seek a proper setting condition of HFJV.

Hemodynamic study at each condition of HFJV was performed in comparison with arterial Po_2 and Pco_2, CO and pulmonary blood flow (RPF).

The values were obtained at the steady states which indicated constant values during at least 15 minutes and these were shown as a mean.

RESULTS

On the setting condition of HFJV, driving pressures ranged 5 to 15 PSI and frequency from 100 to 400 during performing bronchoplasty, the arterial Po_2 and Pco_2 were compared as shown in Fig. 1 and 2. The Po_2 values varied from 420 to 520 torr and the Pco_2 fluctuated from 10 to 20 torr.

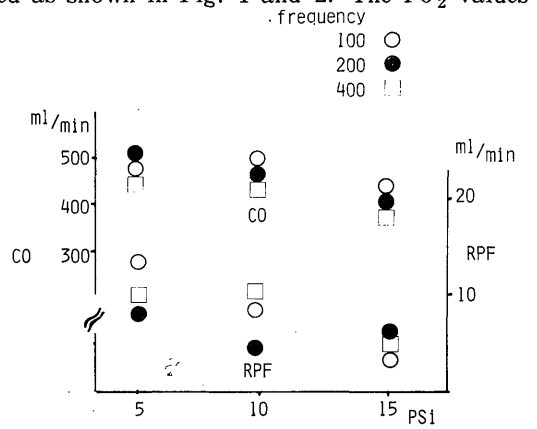

Fig. 1. Changes in cardiac output (CO) and regional pulmonary blood flow (RPF) employed HFV via opening bronchus on dogs

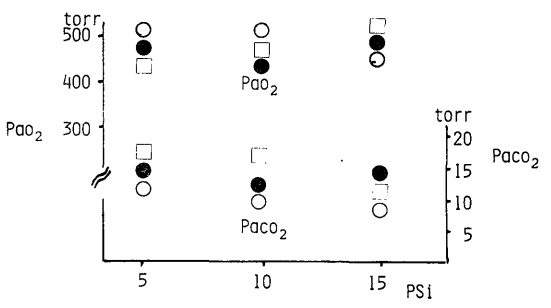

Fig. 2. Changes in Po_2 and Pco_2 in the pulmonary vein employed HFV via opening bronchus

There were no remarkable differences in the arterial Po_2 and Pco_2 levels between the ranges of 5 and 15 PSI in driving pressures and 100 and 400 in frequency. Under such a working condition of HFJV, CO and RPF values were kept almost similar as shown in Fig. 2. However, the higher the driving presure, the greater reduction of CO and PBF has become. Furthermore, when the frequency were increased to 400, CO and RPF levels were disproportionally reduced.

A satisfactory hemodynamic state was obtained on the condition of driving pressure of 10 PSI and frequency of 200.

DISCUSSION

High frequency ventilation is divided into 3 categories, high frequency positive pressure ventilation (HFPPV)[1], high frequency jet ventilation (HFJV)[2] and high frequency oscillation (HFO)[3] according to the historical background. However, HFJV is widely accepted in the clinical use because of the simple instrument. It is characteristic that HFJV is available through a small-sized catheter, less movement of the thoracic wall and less inflation of the lung.

At the time of bronchoplasty, HFJV is of great value to make bronchial anastomosis satisfactory and to reduce the consuming time required for anastomosis because an operation field is ensured by using a small-sized catheter and disappearance of pulmonary ventilation movement[4]. The advantages of HFJV is now applied for plastic procedures of the trachea[5] and its bifurcation[6].

Surgeons should be aware of a decrease in CO and an increase in PVR by using HFJV. This study aims at clarifying a critical point of reduction of CO caused by an increase in PVR. HOFF [7] reported a condition of 100 PSI of driving pressure, 300-2400/min of cycle by Emerson's high frequency ventilator. It is known that the working condition of 28.4 PSI presents detrimental effect of reduction of CO although that of 14.2 PSI causes no harm.

However, SCHUSTER[8] cited that the cycle in a

range of 100 to 150 does not cause a decrease in CO. It is generally accepted that driving pressures of 10-15 PSI are effective in maintaining normal CO during HFJV support. We must bear in mind that the factors affecting a reduction of CO depends on the kinds of the instrument used and also relates to the situation as to whether the bronchus was opened or closed and ventilation was applied for one or both lungs. There is many research work that respiratory support is feasible with one or both lungs ventilated by HFJV. Nowadays, HFJV enables tracheo-bronchoplaty to facilitate its application without any trouble about intraoperative respiratory support.

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