

Transoperational induced pulmonary atelectasis

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During the performance of intrathoracic operations the presence of rhythmically aerating lung tissue can be a source of inconvenience, and in most cases continuous compression of the lung by lung retractors and swabs on forceps is required to provide a clear operative field. If atelectasis of the ipsilateral lung is induced the volume occupied by the collapsed pulmonary tissue within the hemithorax is small, and the exposure of other intrathoracic structures or of the constituents of the hilum is simplified.

Unilateral pulmonary atelectasis can be produced by the use of a double-barrelled intratracheal tube of the Carlens type or with intra-bronchial balloons or blockers. These were originally designed, in the main, to deal with the problem of transoperational secretion control, and the satisfactory positioning of such tubes and blockers calls for a considerable degree of technical skill and manipulation in the early stages of an operation. The use of these appliances is not free from incident, and if slipping of a blocker or rupture of a cuff takes place during the course of the operation, difficulty may be encountered in restoring satisfactory anaesthetic and operative conditions. They have long been abandoned in our practice in patients with hypersecretion in favour of a head-down tilt in the early stages of the operation and clamping of the appropriate branches when the hilum has been exposed.

It was apparent that during the performance of a routine pneumonectomy under modern anaes-

thetic conditions with the use of nitrous oxide and oxygen and moderate hyperventilation, if the main bronchus had been clamped as the first stage in the hilar dissection and the pulmonary artery left open, the patients did not develop the degree of oxygen desaturation that might be expected in these circumstances.

A series of systemic blood oxygen saturation, PO_2 , PCO_2 , and pH levels was performed in adults and children after clamping of the bronchus during various types of intrathoracic operations; this showed that the oxygen saturation usually fell to 90% but never below 85%. The ventilatory rate and volume were maintained at a constant level throughout, thus during the period of bronchial occlusion ventilation of the opposite lung was doubled. The PCO_2 level remained at or below normal, as is usual with the hyperventilation technique, and the PO_2 frequently rose above normal. The pH remained within normal limits. When the pulmonary artery was ligated or the bronchial clamp removed, the oxygen saturation of the blood returned to normal and there was no major alteration in the PCO_2 or pH levels.

A selected series of blood gas analyses from aortic samples is shown in the Table.

It seemed clear that with the almost complete atelectasis of the lung which occurs with the open chest and the associated immediate and marked reduction in the blood flow through the lung, a satisfactory respiratory exchange without the development of any significant respiratory acidosis

TABLE
BLOOD-GAS ANALYSES

Operation	Age	Sex	Pre-ligation			Period of Ligation			Time (min.)	Post-ligation		
			PO_2 (mm. Hg)	PCO_2 (mm. Hg)	pH	PO_2 (mm. Hg)	PCO_2 (mm. Hg)	pH		PO_2 (mm. Hg)	PCO_2 (mm. Hg)	pH
Oesophago-gastrectomy	70	M	100	35	7.3	120	30	7.3	80	100	35	7.2
"	75	F	95	38	7.3	100	35	7.2	90	90	40	7.3
Left pneumonectomy ..	63	M	95	42	7.2	100	40	7.3	—	—	—	—
Right " ..	60	M	90	36	7.2	105	38	7.25	—	—	—	—
Coarctation ..	12	M	100	40	7.25	140	35	7.25	105	90	38	7.25
" ..	9	F	95	30	7.2	130	30	7.25	80	100	35	7.2

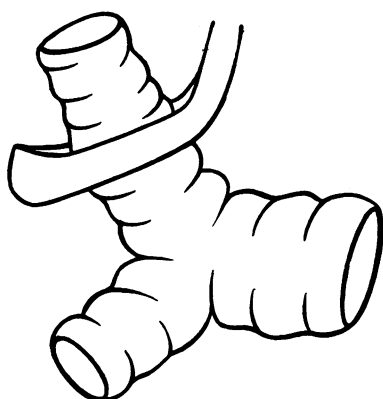


FIG. 1. *Bronchial occlusion by light clamp.*

could be maintained by the increased ventilation of the opposite lung.

Following these observations it has now become routine to occlude the main bronchus of the ipsilateral lung at an early stage in the operation for pulmonary resection, oesophageal resection, and other intrathoracic procedures such as removal of tumours, resections of coarctations, etc., where a long period of lung retraction might be called for and when the constant readjustment of retractors may induce some lung damage. Frequently the services of a second assistant, whose occupation in most thoracic operations is that of a lung retractor, can be dispensed with.

Coincidental taping of the pulmonary artery has been found helpful in cases where haemorrhage might occur, such as a difficult lobectomy or resection of an arteriovenous fistula, and should disaster supervene the tightening of the pulmonary artery tourniquet combined with the induced atelectasis renders recovery of the situation relatively easy.

In patients with lobar bronchiectasis or abscess this technique is not used for fear of flooding with secretion the lung tissue to be retained. In such cases, wherever possible, the lobar bronchus is clamped after the arteries have been divided and before the lobe itself is mobilized.



FIG. 2. *Bronchial occlusion by temporary ligation over a rubber tube.*

TECHNIQUE

Two methods of bronchial occlusion are used. If a pneumonectomy is to be performed, about 2 cm. of the main bronchus is dissected out as the first stage in the procedure, and a Price Thomas clamp is applied tightly to the bronchus distal to the line of proposed bronchial section. If a lesser lung resection is to be performed, the Price Thomas clamp is applied only to the first notch on the ratchet so that the bronchus is air-tight, but the ciliary and bronchial vascular damage is minimized (Fig. 1).

For non-pulmonary operations a piece of strong no. 5 braided nylon is passed double around the bronchus and tied over a 2–3 cm. long piece of 6–8 mm. diameter rubber tubing lying on the membranous portion of the bronchus (Fig. 2).

CONCLUSION

Transoperative induced pulmonary atelectasis has been found to facilitate many types of intrathoracic operations, and its use over some years does not appear to have been responsible for any specific post-operative complication. Most thoracic surgeons will have used the above technique to get them out of difficulties, but its use as a routine procedure is here recommended.