Oxygen saturation after bronchography under general anaesthesia

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Summary

Thirty-six patients undergoing bronchography or bronchoscopy under general anaesthesia were continuously monitored by pulse oximetry for 5 hours after these procedures. Significant falls in oxygen saturation were observed in the first hour and were of most clinical relevance in patients with pre-existing pulmonary dysfunction who underwent bronchography. These results support the recommendation that supplementary oxygen should be provided for all patients undergoing this investigation.

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Although there has been a general decline in the use of bronchography for the investigation of pulmonary disease,[1] the prevalence of tuberculosis combined with the destructive pneumonias resulting in bronchiectasis, has provided a continued call for this procedure in our population. Conventional bilateral bronchography requires the introduction of contrast medium via a tracheal catheter utilising topical analgesia.[2] Recently the use of the fibre-optic bronchoscope has become more popular.[1,3,4] However, for more than 10 000 bronchograms performed in the thoracic surgical unit of the University of Natal over the past 20 years (604 in 1987) examination under general anaesthesia has been the method of choice.[5]

Continuous monitoring of arterial oxygen saturation (SaO_2) during bronchoscopy has shown that patients may be at risk of hypoxaemia.[6] Conventional bronchography[7] and bronchography via the fibre-optic bronchoscope[8] both cause falls in SaO_2 of up to 35%. A study was undertaken to monitor SaO_2 continuously after bronchography performed under general anaesthesia.

Patients and methods

Eighteen adult patients undergoing bilateral bronchography with oily propyliodone under general anaesthesia, using a technique[5] similar to that described for bronchography in children,[9] were studied. They were divided into two age-matched groups on the basis of pre-operative spirometry values. Nine patients were considered to have impaired function (forced expiratory volume in 1 second (FEV_1) < 70% predicted — group 1) and 9 to have essentially normal pulmonary function (FEV_1 > 70% predicted — group 2). Two similar groups undergoing rigid bronchoscopy with the same general anaesthetic technique, but without the instillation of contrast material, were used as controls (groups 3 and 4). Demographic data are shown in Table I.

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The anaesthetic technique employs 100% oxygen (fractional inspired oxygen concentration (FiO_2) 1,0) and in a preliminary study no desaturation occurred during bronchography. SaO_2 was measured continuously with an Ohmeda Biox 3700 pulse oximeter and finger probe from the time the patients returned to the recovery area. Recordings were taken pre-operatively and at 5, 15, 30, 45, 60, 90, 120, 180, 240 and 300 minutes after bronchography with the patients breathing room air (FiO_2 0,21).

In the event of the SaO_2 having fallen to 90% or less at any of these time intervals, patients were provided with supplementary oxygen (FiO_2 0,4) through a face mask until 5 minutes before the next recording was due when they were once again allowed to breathe room air.

Mean saturations at each time interval for the four groups were calculated and the *t*-test for paired data was used to determine significant deviation from pre-bronchographic baseline values; the chi-square test compared the number of episodes of desaturation in each group. Significance was accepted at $P < 0,05$.

Results

There was no significant difference in baseline values between the groups although saturations were lower in patients in whom spirometry showed impaired function. Both the bronchography groups showed an immediate and sustained fall in mean SaO_2 ($P < 0,01$-$0,05$) (Fig. 1), never returning to baseline throughout the study period. The patients with poor lung function (group 1) had a fall in mean SaO_2 from 93% to 86% at 5 minutes, returning to 90% at 15 minutes and never falling below this figure thereafter. In only 1 patient was a saturation of less than 80% recorded (73% at 5 minutes). The mean SaO_2 of those patients with normal lungs (group 2) never fell below 90%.

In the control patients undergoing bronchoscopy there was a transient fall in mean SaO_2 up to 45 minutes after the procedure ($P < 0,05$) but after 1 hour values had returned to prebronchoscopic levels and did not deviate significantly thereafter (Fig. 2). Mean SaO_2 did not fall below 90% in either

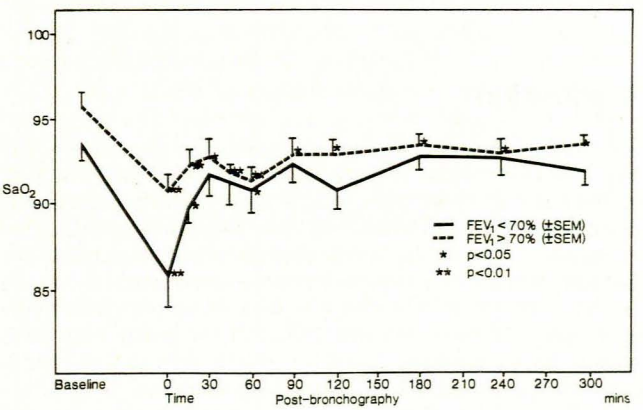

Fig. 1. Groups 1 and 2 — mean values of SaO_2 after bronchography under general anaesthesia.

TABLE I. PATIENT CHARACTERISTICS

	Bronchography (study)		Bronchoscopy (control)	
	Group 1 $FEV_1 < 70\%$	Group 2 $FEV_1 > 70\%$	Group 3 $FEV_1 < 70\%$	Group 4 $FEV_1 > 70\%$
No. of patients	9	9	9	9
Mean age (yrs)	45,4 ± 11,9	42,9 ± 12,0	53,3 ± 7,8	52,1 ± 13,2
Mean FEV_1 (SD)	46,9 ± 9,1	87,0 ± 14,2	40,1 ± 12,9	87,0 ± 11,4
M:F	8:1	9:0	6:3	4:5

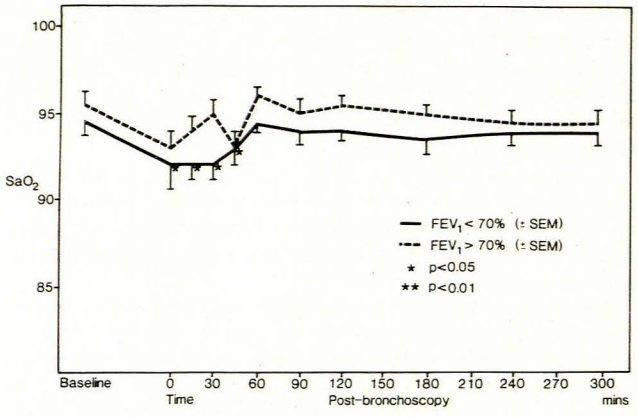

Fig. 2. Groups 3 and 4 — mean values of Sao_2 after bronchoscopy under general anaesthesia.

bronchoscopy group; the lowest saturation recorded in these patients was 86%.

The number of episodes of desaturation — SaO_2 of 90% or less — was significantly greater in group 1 (35 episodes) than in group 2 (16), control group 3 (13) and control 4 (7) ($P < 0,01$) (Table II).

TABLE II. EPISODES OF DESATURATION ($Sao_2 < 90\%$)

	Time (min)											
	Base	5	15	30	45	60	90	120	180	240	300	Total
Group 1	1	7	5	4	3	4	3	3	2	1	2	35*
Group 2	0	3	2	2	1	2	2	1	2	1	0	16
Group 3	0	3	3	4	2	0	0	0	0	1	0	13
Group 4	0	2	1	1	1	0	1	0	0	1	0	7

* $P < 0,01$.

Discussion

The introduction of contrast medium into the tracheobronchial tree can be expected to cause deterioration in SaO_2 owing to obstruction of small airways. In patients with pre-existing obstruction and low SaO_2, the study method of recording subsequent SaO_2 levels 5 minutes after discontinuing oxygen supplementation (FiO_2 0,4) may lead to underestimation of the extent of the insult. The time constants for equilibration to the new inspired oxygen tension (FiO_2 0,21) of certain lung units may exceed 5 minutes; however, we felt we could not allow patients' SaO_2 to fall lower without intervention.

In this study the SaO_2 falls were greater than those observed after bronchoscopy without contrast medium instillation employing the same anaesthetic technique. Reductions in SaO_2 of a similar magnitude were seen by Motley and Tomashefski[7] who, in a series of 25 patients with 'fibrosis and emphysema', found an 8% reduction in SaO_2 after iodised oil instillation via nasotracheal catheter. In contrast Goldman *et al.*[8] found a mean fall in SaO_2 of 20,5% (range 8-35%) in 8 patients who all had pre-operative spirometric values > 70% predicted, and who were given aqueous propyliodone via the fibre-optic bronchoscope.

Goldman *et al.*[8] suggest that the fall in SaO_2 observed in their study represents a reduction in oxygen tension from 12,2 kPa to 5,4 kPa. This is much more severe than that found by Motley and Tomashefski[7] (10-7,4 kPa), Kokkola[10] in 14 patients (11,2 - 9,5 kPa) or our own unpublished observations in 19 patients with $FEV_1 < 50\%$ predicted (10,5 - 9,0 kPa).

On only one occasion was a saturation of < 80% recorded in any of the study patients while Goldman *et al.*[8] found such levels in 5 of 8 patients who had essentially normal lung function, and 2 had falls to 61% and 64%. This poses serious questions as to the safety of performing bronchography without the benefit of supplemental oxygen.

The recommendation by Goldman *et al.*[8] that arterial blood gas tension be measured before bronchography and that if hypoxaemia is demonstrated then a limited approach should be considered cannot be supported. None of their patients would have demonstrated pre-bronchographic hypoxaemia and yet all suffered significant desaturation. We recommend that not only those who have pre-operative hypoxaemia but *all* patients undergoing bronchography should be provided with supplementary oxygen during the procedure and into the post-bronchographic period to prevent episodes of desaturation.

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REFERENCES

1. Flower CDR, Shneerson JM. Bronchography via the fibre-optic bronchoscope. *Thorax* 1984; **39:** 260-263.
2. Olsen AM, O'Neil JJ. Bronchography: a report of the Committee on Broncho-esophagology. *Dis Chest* 1967; **51:** 663-668.
3. Currie DC, Goldman JM, Cole PJ, Strickland B. Comparison of bronchograms after instillation of contrast medium via fibre-optic bronchoscope and nasal catheter. *Thorax* 1987; **42:** 903-904.
4. Simpson FG, Arnold AG, Purvis A, Belfield PW, Muers MF, Cooke NJ. Postal survey of bronchoscopic practice by physicians in the United Kingdom. *Thorax* 1986; **41:** 311-317.
5. Le Roux BT, Mohlala ML, Odell JA, Whitton ID. Suppurative diseases of the lung and pleural space: Part II. Bronchiectasis. *Curr Probl Surg* 1986; **22:** 97-159.
6. Katz AS, Michelson EL, Stawicki J, Holford FD. Cardiac arrhythmias, frequency during fiberoptic bronchoscopy and correlation with hypoxemia. *Arch Intern Med* 1981; **141:** 603-606.
7. Motley HL,Tomashefski JF. Acute effects of lipiodol instillation on respiratory gas exchange. *Am J Physiol* 1951; **167:** 812.
8. Goldman JM, Currie DC, Morgan A, Collins JV. Arterial oxygen saturation during bronchography via the fibre-optic bronchoscope. *Thorax* 1987; **42:** 694-695.
9. Le Roux BT, Mason AHB. Bronchography and general anaesthesia. *Br J Anaesth* 1962; **34:** 200-202.
10. Kokkola K. Respiratory gas exchange after bronchography. *Scand J Respir Dis* 1972; **53:** 114-119.