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HYPOXEMIA AND LUNG MECHANICS DURING FIBEROPTIC BRONCHOSCOPY

Respiratory Medicine

Dr. Pardeep Kumar Senior Resident, Department of Respiratory Medicine, Kalpana Chawla Govt. Med. College, Karnal.

Dr. Rekha Consultant Radiologist, Oscar Superspeciality Hospital and Trauma Centre, Sonepat, Haryana.

Dr. Gopal Purohit Sr. Prof, Department of Respiratory Medicine, Dr. S.N Medical college, Shastri Nagar, Jodhpur.

ABSTRACT

Background: Arterial hypoxaemia is the common complication, since respiratory depressant drugs are used for premedication, and the airway is also partially occluded by the bronchoscope. The study is therefore designed to find out the changes in arterial oxygen tension and PFTduring FOB.
Objectives: To find out the changes in arterial oxygen tension and pulmonary function tests during FOB.
Methods: One hundred patients aged 20 years above undergoing FOB were evaluated for the arterial oxygen tension and pulmonary function tests changes at KNCH, Jodhpur.
Results: All patients developed a fall in PaO2 following FOB but hypoxemia was noted only in 18 cases. Bronchial washing, punch biopsy and brush biopsy did contribute to hypoxemia significantly. The pulmonary functions which include change in V.C, FVC, FEV1 and PEFR after FOB, no statistical difference could be observed on statistically comparison.
Conclusion: All patients showed a decline in arterial PaO2 after FOB which was highly significant. FOB itself does not cause any significant or serious complications.

KEYWORDS

hypoxemia, fiberopticbronchoscopy, pulmonary function test

INTRODUCTION:

Bronchoscopy was established by Jackson in 1907 for the investigation of pulmonary diseases. Flexible bronchoscope was introduced by Ikeda[1] in 1964 for the early diagnosis of bronchial carcinoma and fiberscopes became available commercially in 1967. Flexible bronchoscopy (FB) is a safe and frequently performed procedure for the assessment, diagnosis, and treatment of patients with respiratory diseases. FB is now established as an essential diagnostic and therapeutic tool in respiratory medicine. The transnasal approach is most often used. Bronchofiberscopy is preferred over straight bronchoscopy as it eliminates heavy sedation to the patient and when performed in sitting position there is less hypoxaemia. Arterial hypoxaemia is the commonest complication of FOB.When bronchoscopy is performed under conscious sedation without supplemental oxygen, oxygen desaturation will occur rapidly giving a good indication of ventilatory status. The British Thoracic Society (BTS)[2] guidelines recommend that oxygen supplementation should be used to achieve an oxygen saturation (SpO2) of at least 90% to reduce the risk of significant arrhythmias during the procedure and also in the post-operative recovery period. The mechanisms responsible for the arterial PaO_2 decline during FOB were not defined by this investigation. It appears that the procedure includes both a mode of intrapulmonary shunt and zones of low ventilation-perfusion ratio. It seems likely that loss of lavage fluid and induction of bronchospasm by tracheal stimulation during the procedure.

Objectives

To find out the changes in arterial oxygen tension and pulmonary function tests during FOB.

MATERIALS AND METHODS:

Type of study- observational study**.**

Study Place: This study was done in 100 patients above 20 years of age irrespective of their sex and occupation at K.N.C.H, Jodhpur.

Selection Criteria :

Inclusion Criteria: All patients were above 20 years of age, having PaO2>60mm Hg.

Exclusion Criteria:

Uncooperative patients,
Hemodynamically unstable patients,
Any severe acute illness and those who refused to consent, Insufficient platelet number (<50,000 cells/μL) and coagulation disorders.

The patients were thoroughly evaluated by a clinical history and physical examination along with an informed valid consent.

Local anaesthetic effect of the pharynx, nasal mucosa, and larynx were achieved by 2-3 puffs of 10% xylocaine spray and its effect was checked by gag reflex.

PROCEDURE:

A fiberoptic bronchoscope (OLYMPUS MODEL TH 190) was used in the study. Arterial blood samples were taken from femoral artery both before and after flexible fiiberopticbronchoscopy.

For arterial blood samples, 2 ml. disposable syringe with needle was used which was heparinised by pushing heparin solution (5000 I.U.).

Samples were immediately subjected on blood gas analyzer for examination within half an hour after withdrawal. Patients after bronchoscopy were kept in the observation room for 2 hours and complications if any occurred after the procedure were recorded and managed accordingly.

Data Analysis

A database was created in SPSS statistical software, version 24.0 for Windows. Continuous data were summarized with means (M) and standard deviations (SD). Absolute numbers and percentages were used for categorical data. Comparison of quantitative variables among groups, when these followed a normal distribution, was done with the Student t test for independent samples; if distribution was not normal, the non-parametric Kruskal-Wallis/ Mann–Whitney U test was used. The non-parametric Pearson chi square test and where applicable Fischer exact test was used. For all statistical tests, a significance threshold of $p = 0.05$ was applied.

Statistical Analysis:

The changes in arterial oxygen tension during FOB were assessed and their effects on pulmonary function tests were found. The results were considered statistically significant if p value was <0.05.

OBSERVATIONS AND RESULTS

The study was undertaken in one hundred patients of various chest pathologies. To evaluate its safety and complications like hypoxia, following points were assessed:

To evaluate decrease in arterial oxygen tension in blood after the procedure, if present,
To evaluate the pulmonary function abnormality after bronchoscopy, if any,

Table 1: Patient Characteristics

Variable		Values
No. of patients		100
Age	Years	22-84
	Mean±S.D	59.3±11.83
Sex	Males	89%
	Females	11%
Height		60.00-69.00
	Mean±S.D	65.05±2.6

Table 2 : Distribution Of Cases According To PaO_2 (mmHg)

	Mean PaO_2 mmHg	Range of PaO_2	Mean fall in PaO_2	Range of fall in PaO_2
Before Bronchoscopy	80.73±11.37	61-100	10.96	7.82-14.09
After Bronchoscopy	69.77±11.07	50.9-99.4		

SE=0.94 T=1.1 P value=0.001 (S)

In our study, all 100 patients, showed a decline in arterial PaO_2 after fiberoptic bronchoscopy ranging from 7.82-14.09 mmHg. In the 100 patients studied during room air breathing, the decline in arterial PaO_2 from 80.73 (SD ± 11.37) to 69.77 (SD ± 11.07) mm Hg was highly significant ('p'<0.05).

Table-3: Effect Of Bronchoscopy On Vital Capacity

Vital capacity	Mean V.C%	Range of V.C%	Mean rise in V.C%	Range of rise in V.C%
Before Bronchoscopy	72.94±13.206	51-100	2.68	-0.41-5.77
After Bronchoscopy	70.26±13.45	45-98		

SE=1.55 T=1.71 P value=0.08

The % change in vital capacity before bronchoscopy ranged from 51-100% with a mean value of 72.94. After bronchoscopy change in vital capacity ranged from 45-98% with a mean value of 70.26. The % change in vital capacity after bronchoscopy was not statistically significant ('p'>0.05, non significant).

Table 4: Effect Of Bronchoscopy On Forced Vital Capacity

Forced vital capacity	Mean FVC%	Range of FVC%	Mean rise in FVC%	Range of rise in FVC
Before Bronchoscopy	69.36±10.81	47-90	0.87	0.14-2.15
After Bronchoscopy	68.49±11.54	40-91		

SE=0.64 T=1.34 P value=0.18

The % change in forced vital capacity before bronchoscopy ranged from 47-90% with a mean value of 69.36. After bronchoscopy % change in forced vital capacity ranged from 40-91% with a mean value of 68.49. The % change in forced vital capacity after bronchoscopy was not statistically significant ('p'>0.05).

Table 5: Effect Of Bronchoscopy On FEV1

FEV_1	Mean FEV_1%	Range of FEV_1 %	Mean rise in FEV_1 %	Range of rise in FEV_1 %
Before Bronchoscopy	64.36±11.96	44-94	1.34	0.25-2.93
After bronchoscopy	63.02±12.41	42-96		

The % change in FEV_1 before bronchoscopy ranged from 44-94% with a mean value of 64.36 and standard deviation +/- 11.96. After bronchoscopy % change in FEV_1 ranged from 42-96% with a mean value of 63.02 and standard deviation +/-12.41. The % change in FEV_1 after bronchoscopy was not statistically significant ('p'>0.05).

Table 6: Effect Of Bronchoscopy On PEFR

	Mean PEFR%	Range of PEFR%	Mean rise in PEFR%	Range of rise in PEFR%
Before Bronchoscopy	71.95±12.58	51-100	1.81	1.01-2.607
After Bronchoscopy	69.78±12.71	50-99		

SE=1.49 T=5.64 P value=0.57

The % change in PEFR before bronchoscopy ranged from 51-100% with a mean value of 71.95 with standard deviation +/-12.58. After bronchoscopy % change in PEFR ranged from 50-99% with a mean value of 69.78 with standard deviation +/-12.71. The% change in PEFR after bronchoscopy was not statistically significant ('p'>0.05).

Table 7: Correlation Between PaO2 With PFT Parameters Before And After FOB

PFT Parameters		PaO_2 [mmHg]		
		>90 mmHg [Normal]	75-89 mmHg [Mild]	<75 mmHg [Severe]
VC%	Before	70.84±11.76	75.97±13.16	70.97±13.90
	After	69.55±15.02	73.08±13.05	73.05±12.98
P value		0.785	0.463	0.727
FVC%	Before	67.36±12.91	76.02±7.72	69.37±10.85
	After	70.88±10.90	71.95±13.37	70.67±12.07
P value		0.284	0.226	0.661
FEV1%	Before	63.32±11.53	70.45±13.44	68.25±12.39
	After	69.00±15.46	66.04±12.48	64.66±12.57
P value		0.442	0.144	0.323
PEFR%	Before	70.40±12.27	71.07±12.31	74.05±13.18
	After	74.44±8.26	72.34±11.81	71.38±13.30
P value		0.078	0.895	0.419

Table 8: Correlation Between PaCO2 With PFT Parameters Before And After FOB

PFT Parameters		$PaCO_2$ [mmHg]		
		35 -45 [Normal]	<35 mmHg [Alkalosis]	>45 [Acidosis]
VC%	Before	72.91±13.85	73.91±11.59	70.66±13.08
	After	72.08±13.82	72.65±11.87	75.31±12.63
P value		0.647	0.961	0.396
FVC%	Before	72.05±10.93	69.08±11.14	73.77±9.92
	After	69.91±12.58	73.69±11.60	70.50±11.63
P value		0.213	0.234	0.471
FEV1%	Before	68.08±13.46	67.47±11.99	67.55±10.85
	After	65.39±13.36	64.53±12.28	66.62±11.87
P value		0.442	0.419	0.967
PEFR%	Before	72.48±13.40	70.00±11.21	72.88±9.76
	After	71.98±12.71	71.03±11.95	72.87±13.49
P value		0.669	0.406	0.999

Table 9 : Correlation Between pH With PFT Parameters Before And After FOB

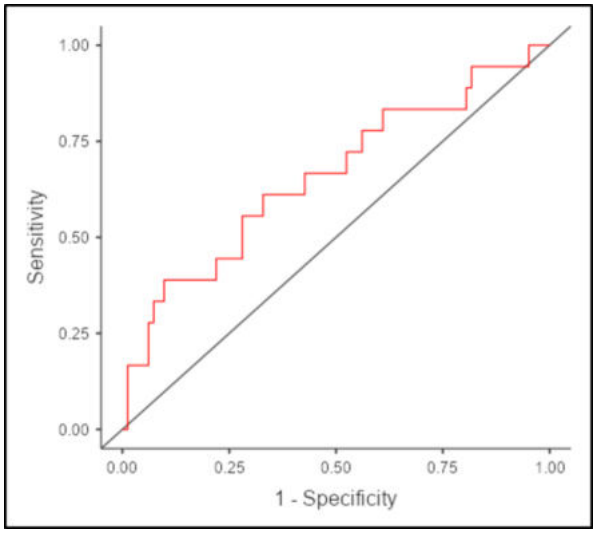
PFT Parameters		pH		
		7.35-7.45 [Normal]	<7.35 [Acidemia]	>7.45 [Alkalemia]
VC%	Before	74.35±12.47	78.66±1.15	71.00±14.23
	After	72.13±12.95	75.33±12.54	73.14±13.56
P value		0.460	0.072	0.415
FVC%	Before	72.03±10.75	77.00±12.76	70.60±11.04
	After	70.98±12.27	62.16±13.13	72.26±11.68
P value		0.564	0.707	0.212
FEV1%	Before	67.35±11.48	62.66±11.67	68.84±14.34
	After	63.76±11.77	69.33±13.33	66.78±13.82
P value		0.078	0.477	0.513
PEFR%	Before	72.37±13.57	71.33±11.59	71.52±11.72
	After	73.40±13.28	72.33±11.75	69.92±11.66
P value		0.803	0.355	0.522

DISCUSSION:

The patients studied were distributed mainly in the age group of 20 to 70 years, out of which 89 were males and 11 were females. Bronchoscopic procedures like punch biopsy, bronchial washing and brush biopsy were performed.

In our study all hundred patients showed a decline in arterial PaO_2 after fiberoptic bronchoscopy ranging from 7.82-14.09 mmHg. All patients

studied during room air breathing, the decline in arterial PaO_2 from 80.73 (SD ± 11.37) to 69.77 (SD ± 11.07) mm Hg was highly significant ('p'<0.05). The mean fall in PaO_2 levels in this study was 10.96 mmHg.



Graph 1: Graph Showing ROC To Show The Sensitivity And Specificity

In 45 patients where bronchoscopy was performed along with bronchial washings, changes of fall in PaO_2 before and after bronchoscopy procedure were noted with minimum 0.2 mm Hg, maximum 35.7 mm of Hg with the mean value 10.56 mm of Hg (SD ± 8.88), statistically it was found significant (p<0.05). In 20 patients the brush biopsy was performed along with bronchoscopy. The changes of fall in PaO_2 were noted with minimum 2.2 mm Hg, maximum 23.1 mm of Hg, mean values of 12.75 mm of Hg (SD ± 6.35) and it was statistically significant (p<0.05). In 35 cases where punch biopsy was performed with fiberoptic bronchoscopy, the change in PaO_2 level after bronchoscopy procedure were noted with minimum value of 0.7, maximum value of 32 and mean value 10.73 mm Hg (SD ± 7.98), statistically it was found significant (p<0.05).

M.S.Hendy et al[5] 1984, observed in 26 patients during fiberoptic bronchoscopy that hypoxemia was seen in patients having lung biopsy during routine fiberoptic bronchoscopy.

Sharma et al[6] 1993, selected twenty one patients for arterial blood gas during bronchoscopic study . They concluded that arterial hypoxemia during fiberoptic bronchoscopy can be of substantial degree and persists for a variable period of time after completion of the procedure. Bronchoalveolar lavage has also been associated with hypoemia which can be distressing to the patient.

Sharma et al[7] 1999, studied 50 patients in whom a significant fall in PaO2 was seen (mean fall 8 +/- 2.45 mm Hg). The lowest values were recorded at the completion of the procedure. In all patients studied during room air breathing, the decline in arterial PaO_2 from 63.69+/- 6.43 to 56.65+/- 5.47 was highly significant (p<0.05) The mechanisms responsible for the arterial PaO_2 decline during fiberoptic bronchoscopy were not defined by this procedure but may be due to intrapulmonary shunt and zones of low ventilation-perfusion ratio, obstruction of the trachea and large bronchi, laryngospasm and bronchospasm.

Jones and O'Driscoll June[7] 2001, studied forty-four patients in whom oxygen saturation was monitored during the procedure with pulse oximetry (PO) and arterial blood gas levels .No difference in saturation values was found between arterial blood gas levels and PO analysis both before and after FOB. Saturation values (mean +/- SD) were significantly decreased after FOB (from 96.5 +/- 1.0% to 91.6 +/- 3.6%, p < 0.05), and desaturation (arterial oxygen saturation <90%) was detected in 22 of the patients (50%) during the procedure.

G. Hassan et al[13] 2005, observed that during bronchoscopy done on 56 hospitalized patients, statistically highly significant (p < 0.001) fall of SaO_2 was observed progressively while bronchial tree was being examined and various procedures like forceps biopsy, brush biopsy and bronchoalveolar lavage were performed.

The pulmonary functions which include change in vital capacity, forced vital capacity, forced expiratory volume in one second and peak expiratory flow rate were performed before and after bronchoscopic procedure. no statistical difference could be observed on statistically comparison. Similar findings were observed by **Chiug-Chi lin, Jen Liang Wu[9] 1989,** that there was no significant change in FEV_1, PEF, FEV_1 / FVC, vital capacity except for a decreased PaO_2 level after bronchoscopic examination.

Y. Matsushima et al[10] 1984, measured pulmonary functions in patients who were undergoing routine diagnostic flexible fiberoptic bronchoscopy either through an 8 mm endotracheal tube or transnasally. In these patients with moderate airway obstruction, after inserting the endotracheal tube, functional residual capacity increased significantly. Removal of flexible fiberoptic bronchoscopy and endotracheal tube caused functional residual capacity to return toward the normal value.

Limitations:
Our study had some limitations. We did not measure the total volume of local anaesthesia given to all patients.

RESULTS:
No patient had hypoxemia before the procedure. All patients developed a fall in PaO_2 but hypoxemia was noted in 18 cases. Bronchial washing, punch biopsy and brush biopsy did contribute to hypoxemia significantly.

Pulmonary function tests were done prior to and after bronchoscopy. In pulmonary functions tests, forced expiratory volume in one second, vital capacity, peak expiratory flow rate and forced vital capacity were measured. It was seen that there was no significant difference in pulmonary function test results before and after bronchoscopic examination. Although there was decrease in FEV1, FVC, V.C and PEFR, but these changes were of no statistical significance by 'paired t' test.

CONCLUSION:
All patients showed a decline in arterial PaO_2 after FOB which was highly significant. FOB does not cause any significant or serious complications.

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Conflict Of Interest: None declared

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