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Changes In Lung Function Parameters After Total Intravenous Anaesthesia and Balanced Anaesthesia with Sevoflurane in Covid-19 Recovered Patients Undergoing Elective Surgery: A Prospective Randomised Controlled Study

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ABSTRACT

Background: The preference for a type of anaesthesia procedure depends mainly on the personal experience and expertise of the anaesthetist with respect to a particular procedure. The majority of COVID-19 patients develop pulmonary consequences. We aimed to investigate the possible differential effects of total intravenous anesthesia (TIVA) with propofol and balanced anesthesia (BAL) with sevoflurane on various postoperative lung function parameters in COVID-19-recovered patients undergoing general anesthesia for elective surgery.

Materials and Methods: This prospective randomized controlled study was conducted for a period of 01 years after obtaining approval from the Institutional Ethical Committee and was registered in Clinical Trial Registry (CTRI) – India with reference No. CTRI/2022/12/048056. 60 COVID-19-recovered patients undergoing elective surgery were randomly allocated to one of the two study groups of 30 patients each: Group B (patients undergoing balanced anesthesia with sevoflurane) and Group T (patients undergoing TIVA with propofol). Pulmonary function parameters, including FVC, FEV1, MEF, and PEF, were recorded both pre-operatively and post-operatively using a portable desktop spirometer.

Results: The mean age of study patients was 34.73±9.85 years in Group B and 32.57±7.78 years in Group T. Overall, 73.33% of patients were female and 26.66% were male. Significant reductions in the values of FVC, FEV1, MEF, and PEF were observed post-operatively in both the TIVA and BAL groups. There was no significant difference in the pre-operative and post-operative values of FVC, FEV1, MEF, and PEF between the two study groups.
Conclusion: There was no significant effect of the type of anesthesia on pulmonary functions in COVID-19-recovered patients undergoing elective surgery.

Keywords: Balanced anaesthesia, COVID-19, Propofol, Sevoflurane, Total intravenous anaesthesia

Introduction

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection, commonly referred to as COVID-19, affects the nasopharynx and lungs, leading to a variety of clinical symptoms ranging from being asymptomatic to patients with symptoms of upper respiratory tract infections, taste and smell disorders. The clinical presentation of COVID-19 includes cough, fever, pneumonia, dyspnea and acute respiratory distress syndrome (ARDS) in some cases.[1] Respiratory complications post-operatively may result in increased mortality and morbidity. Although both regional and general anaesthesia are known to cause a reduction in the post-operative respiratory parameters, the reduction in these parameters is significantly lower after spinal anaesthesia as compared to general anaesthesia. [2,3] One of the most widely used and popular general anaesthesia technique is Balanced anaesthesia (BAL) with halogenated anaesthetics. Emergence from BAL with halogenated anaesthetic agents has been reported to be associated with significantly higher incidences of coughing when compared to the total intravenous anaesthesia (TIVA). [3] In recent times, TIVA has grabbed more attention owing to its ability to provide enhanced quality of emergence from anaesthesia, reduction in the incidence of post-operative nausea and vomiting (PONV), quick onset of action (independent of alveolar ventilation), and prevention of occupational encounter as seen with inhalational anaesthetic agents. [3,4] Propofol is regarded as a vital drug in TIVA owing to its rapid onset and offset properties accompanied with lesser side effects. [5] Previously reported animal studies have shown that inhalational anaesthetics impairs the hypoxic lung vasoconstriction and increases shunt fraction. However, propofol does not have any effect on the hypoxic lung vasoconstriction. [6-9] Thus, inhalational anaesthetics and propofol are anticipated to exhibit different effects on pulmonary functions. There is paucity of data regarding whether the known negative effects of a general anaesthesia on lung function affect all parameters to the same extent, or whether various parameters are affected differently by BAL and TIVA in COVID 19 recovered patients posted for elective surgery. Thus, the present study was undertaken to investigate the possible differential effects of TIVA with propofol and BAL with sevoflurane on various postoperative lung function parameters in COVID 19 recovered patients undergoing general anaesthesia for elective surgery.

Materials and Methods

The present prospective randomized controlled study was done in the department on Anaesthesia for a period of 01 years after obtaining approval from the Institutional Ethical Committee and was registered in Clinical Trial Registry (CTRI) – India with reference No. CTRI/2022/12/048056. Study included 60 COVID-19 recovered patients who were scheduled for elective surgery under general anaesthesia aged 18 years and above, and ASA grade I/II. Patients with significant cardio-pulmonary, neurological or

psychiatric disease, morbid obesity with BMI >35 and those with history of cardiothoracic surgery were excluded from the study. Written informed consent was obtained from each patient prior to their enrolment in the study. Patients were randomly allocated in to one of the following two study groups as:

Group B: Patients undergoing BAL with sevoflurane

Group T: Patients undergoing TIVA with propofol

On arrival in the operating area before surgery, a baseline spirometry measurement was performed using a portable desktop spirometer with patient in a 30° head up position. Forced vital capacity (FVC), forced expiratory volume in 1s (FEV1), mid expiratory flow (MEF 25-75) and peak expiratory flow (PEF) were recorded in predesigned proforma. Following surgery, in the post anaesthesia care unit (PACU), when the patient was alert and fully cooperative with VAS pain score <3, postoperative spirometry was carried out to measure the same parameters as outlined for preoperative spirometry. All the data obtained was entered into excel sheet and was subjected to statistical analysis.

Statistical Analysis

Statistical Analysis was performed with help of Epi Info (TM) 7.2.2.2. EPI INFO is a trademark of the Centers for Disease Control and Prevention (CDC). Test of proportion was used to find the Standard Normal Deviate (Z) to compare the difference proportions and Chi-square (χ^2) test was performed to find the associations. t-test was used to compare the means of the two groups. Fisher Exact test was used where Chi-square (χ^2) test was not applicable. $p<0.05$ was taken to be statistically significant.

Results

Mean age of study patients in Group B was 34.73±9.85 years and in Group T was 32.57±7.78 years, with age ranging from 20 to 52 years. Majority of patients were between 20 and 40 years and were female, with a male: female ratio of 1:2.8. 66.7% of patients in Group B and 73.3% of patients in Group T had ASA Grade I, while 33.3% in Group B and 26.7% in Group T had ASA Grade II. Patients in both the study groups were comparable in terms of age, gender, ASA Grade, height, weight and BMI. (Table 1)

Table 1: Characteristics of Patients in both the Study Groups

Parameters		**Group B**	**Group T**	**p-value**
Age (years)	**20 - 29**	11 (36.7%)	11 (36.7%)	p=0.35
	30 - 39	9 (30%)	14 (46.7%)	
	40 - 49	6 (20%)	3 (10%)	
	50 - 59	4 (13.3%)	2 (6.7%)	
	Mean±s.d.	34.73±9.85	32.57±7.78	
	Median	32.5	30.5	
	Range	20 - 52	23 - 52	
Gender	**Male**	9 (30%)	7 (23.3%)	0.55
	Female	21 (70%)	23 (76.7%)	
	M:F	1:2.8		
ASA grade	**I**	20 (66.7%)	22 (73.3%)	0.57
	II	10 (33.3%)	8 (26.7%)	

Mean Height (cm)	164.87±7.88	163.10±8.07	0.40
Mean Weight (kg)	65.87±8.58	64.87±8.43	0.65
Mean BMI	24.24±2.75	24.37±2.53	0.85

Co-morbidities observed in study patients included hypothyroidism (11.7%), anaemia (8.3%), carcinoma breast (5%), hypertension (1.7%), paracetamol allergy (1.7%), and obesity (1.7%). Co-morbidities were comparable between the two study groups. (Figure 1)

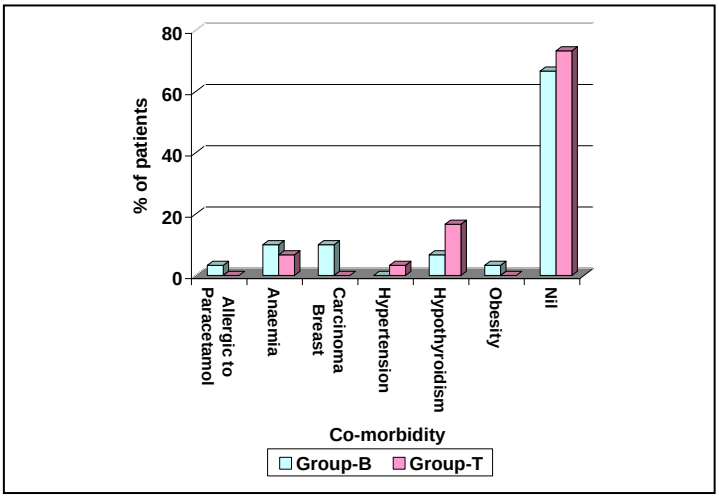

Figure 1: Co-morbidity of the patients in Study Groups

Mean and median VAS score in Group B was 1.70±0.79 and 1.5, while in Group T it was 1.80±0.61 and 2, respectively. Most of the patients in Group B had a VAS score of 1 (50%) while in Group T, most of the patients had a VAS score of 2 (60%). The mean VAS score in Group-T was higher than that of Group-B but it was not statistically significant (p=0.59). (Figure 2)

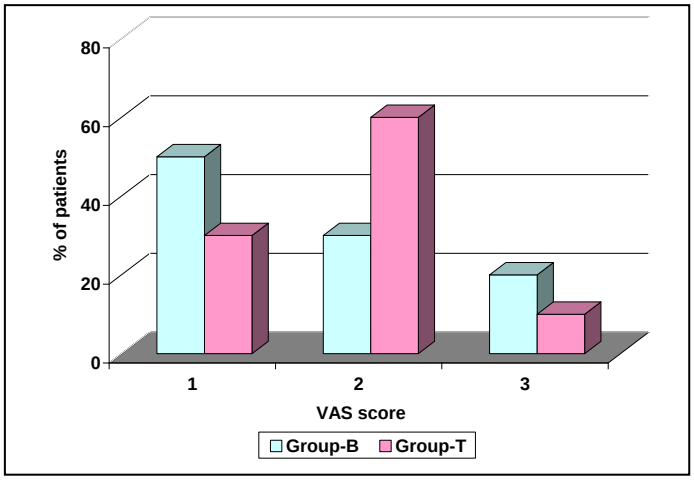

Figure 2: VAS score among patients of both the Study Groups

In both the study groups, mean FVC reduced significantly after surgery as compared to the pre-operative values ($p<0.0001$). However, there were no significant differences in mean pre-operative and post-operative FVC values of the patients between the two study groups ($p>0.05$). (Table 2)

Table 2: Comparison of FVC between the Patients of two study groups

Descriptive statistics	Pre-OP FVC (L)	Post-OP FVC (L)	t-value	p-value
Group-B				
Mean±sd	3.82±0.43	2.97±0.47	7.26	<0.001 S
Median	3.895	2.985		
Range	2.98 - 4.51	2.16 - 3.88		
Group-T				
Mean±sd	3.72±0.59	2.87±0.54	5.79	<0.001 S
Median	3.76	2.885		
Range	2.89 - 4.74	2.09 - 3.92		
t-value	0.80	0.77		
p-value	0.43 NS	0.45 NS		

Mean FEV1 reduced significantly post-operatively when compared to pre-operative values in both the study groups ($p<0.0001$). But there were no significant differences in mean FEV1 of the patients of the two groups before and after surgery ($p>0.05$). (Table 3)

Table 3: Comparison of FEV1 between the Patients of two study groups

Descriptive statistics	Pre-OP FEV1 (L)	Post-OP FEV1 (L)	t-value	p-value
Group-B				
Mean±sd	2.80±0.26	2.21±0.25	8.92	<0.001 S
Median	2.89	2.265		
Range	2.26 - 3.12	1.70 - 2.72		
Group-T				
Mean±sd	2.70±0.29	2.09±0.30	8.04	<0.001 S
Median	2.705	2.135		
Range	2.22 - 3.11	1.52 - 2.69		
t-value	1.47	1.66		
p-value	0.15 NS	0.10 NS		

In both the groups mean MEF reduced significantly after surgery as compared to the pre-operative values ($p<0.0001$). However, there were no significant differences in mean pre-operative and post-operative MEF values of the patients between the two study groups ($p>0.05$). (Table 4)

Table 4: Comparison of MEF between the Patients of two study groups

Descriptive statistics	Pre-OP MEF (L/sec)	Post-OP MEF (L/sec)	t-value	p-value
Group-B				
Mean±sd	3.02±0.54	2.58±0.54	3.11	0.003 S
Median	2.93	2.52		
Range	2.24 - 3.89	1.74 - 3.51		
Group-T				

Mean±sd	3.01±0.51	2.56±0.52	3.39	<0.001 S
Median	2.915	2.465		
Range	2.25 - 3.86	1.79 - 3.40		
t-value	0.04	0.16		
p-value	0.97 NS	0.87 NS		

Mean PEF reduced significantly post-operatively when compared to pre-operative values in both the groups. ($p<0.0001$). But there were no significant differences in mean PEF of the patients of the two groups before and after surgery ($p>0.05$). (Table 5)

Table 5: Comparison of PEF between the Patients of two study groups

Descriptive statistics	Pre-OP PEF (L/sec)	Post-OP PEF (L/sec)	t-value	p-value
Group-B				
Mean±sd	4.50±0.23	4.12±0.24	6.23	<0.001 S
Median	4.505	4.1		
Range	4.11 - 4.82	3.70 - 4.47		
Group-T				
Mean±sd	4.45±0.22	4.09±0.21	6.37	<0.001 S
Median	4.49	4.135		
Range	4.09 - 4.79	3.71 - 4.41		
t-value	0.85	0.53		
p-value	0.40 NS	0.60 NS		

Discussion

The extent of postoperative pulmonary dysfunction may be influenced by the type of anaesthesia. General anaesthesia administration causes alterations in the respiratory system in terms of decreased FEV1, tidal volume (TV) and functional residual capacity (FRC). [10,11] In addition to this, it also reduces the respiratory parameters following emergence from general anaesthesia, particularly in patients who underwent intra-abdominal surgeries.[2] The preference of the type of anaesthesia procedure depends mainly on the personal experience and expertise of the anaesthetist with respect to a particular procedure. BAL techniques with halogenated anaesthetics exhibits bronchodilatory effects and carries lower risk of awareness, and hence it is preferred by majority of the anaesthetists. On the other hand, TIVA procedure has the upper edge in providing ease of control and brief recovery times. [2,12] Propofol exhibits both anti-inflammatory and anti-oxidant effects, and is a commonly preferred drug in TIVA. [10,13] No study has been done till date to compare the effects of TIVA and BAL on pulmonary function in COVID-19 recovered patients. Thus, this study was conducted to investigate the possible differential effects of TIVA with propofol and BAL with sevoflurane on various postoperative lung function parameters in COVID 19 recovered patients undergoing general anaesthesia for elective surgery.

In our study, the overall mean age of patients was 33.65±8.62 years and median age was 32 years, with age range of 20-52 years. In BAL group, mean age was 34.73±9.85 years and in TIVA group, mean age was 32.57±7.78 years. (Table 1) Both the study groups were comparable in terms of age of the patients. Hajijafari M et al [10], in a similar study, have observed that the mean age of patients was 41.84±11.31 years in BAL group and 43.75±8.57 years in TIVA group. Similar observations were made by Sharma S

et al [3] and Oguz A et al [6]. In our study majority of patients were females, with a male: female ratio of 1:2.8. (Table 1) Patients were comparable gender-wise between the two study groups. Similar observations were made in a Turkish study, wherein 52.43% of patients were females and 47.56% patients were males.[6] However, most of other studies evaluating the effects of TIVA and BAL have observed that most of their study patients were male. [2,3,10,14]

Overall, 70% patients were ASA grade I, while 30% were ASA grade II in our study. (Table 1) There was no significant association between ASA grade and patients of two study groups in our study. Similarly, Hajijafari M et al [10], in their study, have observed that most of their study patients were ASA grade I in both BAL group (71.4%) and TIVA group (65.5%), however, Oguz A et al [6] have observed that majority of their study patients were ASA grade II. Mean height of our study patients in BAL group was 164.87±7.88 cm and in TIVA group was 163.10±8.07 cm. Mean weight of study patients in BAL group was 65.87±8.58 kg and in TIVA group was 64.87±8.43 kg. (Table 1) There was no significant association of height and weight with patients of two study groups in our study. These results are in accordance with previous studies. [3,6,10,14] In our study, BMI of the study patients ranged from 18 to 30, with a mean BMI of 24.24±2.75 in BAL group and 24.37±2.53 in TIVA group. (Table 1) These results are in accordance with the results of study by Sharma S et al [3] and Hajijafari M et al [10].

In our study, no comorbidity was observed in 70% of patients, while hypothyroidism was the most common co-morbidity observed in 11.7% of patients. (Figure 1) In our study, pain was evaluated using VAS score. Mean VAS score ranged between 1 and 3 in both the study groups, with a median score of 1.5 and 2 in BAL and TIVA groups, respectively. (Figure 2) Mean VAS score of TIVA group was higher than that of BAL group, but it was not statistically significant ($p>0.001$). In a similar study from Iran, mean pain score in BAL group was 2.70±0.87 and in TIVA group was 2.71±0.81.[10]

In our study, mean pre-operative FVC was 3.82±0.43 L and mean post-operative FVC was 2.97±0.47 L in BAL group, whereas in TIVA group, mean pre-operative and post-operative FVC were 3.72±0.59 L and 2.87±0.54 L, respectively. (Table 2) There was no statistically significant difference in pre-operative and post-operative FVC values between the two study groups ($p>0.05$). Hajijafari M et al [10] have observed less decrease in pulmonary function in TIVA group as compared to BAL group, whereas Tiefenthalaer W et al [2] have observed that post-operative decrease in FVC was lower in BAL group when compared to TIVA group. Similar observations were made by Sharma S et al [3] and Oguz A et al [6] in their studies who found that decrease in FVC was lower in BAL group when compared to TIVA group. Mean pre-operative FEV1 in our study was 2.80±0.26 L and mean post-operative FEV1 was 2.21±0.25 L in BAL group, while in TIVA group, mean pre-operative FEV1 was 2.70±0.29 L and mean post-operative FEV1 was 2.09±0.30 L. (Table 3) No significant difference was observed in mean pre-operative and mean post-operative FEV1 between BAL and TIVA groups in our study ($p>0.05$), though mean FEV1 reduced more in TIVA group post-operatively when compared to BAL group. Sharma S et al [3], have observed increased reduction in FEV1 values post-operatively in TIVA group as compared to BAL group ($p>0.001$). Similar observations were made by other studies. [6,10]

In our study, mean pre-operative MEF was 3.02±0.54 L/sec and mean post-operative MEF was 2.58±0.54 L/sec in BAL group, while in TIVA group, mean pre-operative and post-operative MEF were 3.01±0.51 L/sec and 2.56±0.52 L/sec, respectively. (Table 4) There was significant reduction in mean MEP values post-operatively in both the study groups ($p<0.0001$). Although, the reduction in mean MEF was higher in TIVA group as compared to BAL group, this difference was not statistically significant ($p>0.05$). Similar observations were made by Tiefenthaler W et al [2] and Sharma S et al [3]. The mean pre-operative and

post-operative PEF was 4.50±0.23 L/sec and 4.12±0.24 L/sec, respectively in BAL group, and it was 4.45±0.22 L/sec and 4.09±0.21 L/sec in TIVA group. (Table 5) There was no significant difference in mean pre-operative and post-operative PEF between the two study groups ($p>0.05$). These results are in accordance with a similar study from Austria.[2] However, mean FVC significantly decreased post-operatively in both the study groups ($p<0.001$).

Conclusion

Mean VAS score of TIVA group was higher than that of BAL group, but it was not statistically significant. This study concludes that there was no significant effect of type of anaesthesia (either propofol- based TIVA or BAL with sevoflurane) on pulmonary functions (FVC, FEV1, MEF and PEF) in COVID-19 recovered patients undergoing elective surgery.

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